

## **The Relationship of the C-514T Polymorphism of the Human Hepatic Lipase Gene Promoter with Plasma HDL -C Concentrations in Koreans**

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**B**ackground and Objectives: Hepatic lipase is a key enzyme in high density lipoprotein-cholesterol (HDL -C) metabolism and may therefore influence the susceptibility to coronary artery disease (CAD). Furthermore, there seems to be genetic variation in the -514T allele frequency among different races. Subjects and Methods : To assess the -514T allele frequency in Koreans, 99 subjects (54 patients with coronary artery disease & 45 normal controls) were examined by polymerase chain reaction (PCR) and restriction enzyme digestion. The lipid profiles of the subjects were also obtained. Results : The -514T allele frequency was 0.33 in the CAD group and 0.41 in the normal controls, results which are higher than the equivalent reported for Caucasians. The plasma lipid profiles did not differ significantly between genotypes. Conclusion : These data indicate that the Koreans in this study have a higher -514T allele frequency than that reported for Caucasians. This elevation may be partly responsible for the higher HDL -C level in Koreans, although such polymorphism does not seem to significantly influence plasma HDL -C levels or CAD susceptibility.

## **Apolipoprotein E Polymorphism in Patients with Myocardial Infarction**

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**B**ackground and Objectives : In this study we investigated the association between the polymorphism of apolipoprotein E and the development of myocardial infarction, and assessed whether this polymorphism produces any changes of plasma lipid level. Subjects and Methods : A total of 182 patients participated in this study and were divided into two groups; 91 patients with myocardial infarction (MI group) and 91 patients with no known heart disease (control group). For both groups we analyzed the clinical parameters, the changes of plasma lipid level and the degree of polymorphism of apolipoprotein E. Results: Total cholesterol, triglyceride and LDL cholesterol levels were significantly higher in the MI group, while the HDL cholesterol level was significantly lower. Compared with the control group, the frequency of 2 allele was significantly lower while that of 3 allele was significantly higher in the MI group. As for the control group, the triglyceride level was significantly higher in the patients with 2 allele than in those without 2 allele, and the total cholesterol level was significantly higher in the patients with 4 allele than in those without 4 allele. In the MI group, the plasma lipid levels were not significantly different from those in the control group. Conclusion : We suggested that apolipoprotein E polymorphism could affect the lipid metabolism as well as the development of myocardial infarction. However further study is needed in patients with myocardial infarction.

## **Subject Functional Severity of Coronary Stenosis in Relation to Luminologic Severity in AMI ; Comparison with Angina**

**Eui Soo Hong, MD; Jeong Kee Seo, MD; Ki Hoon Lee, MD; Dae Hyeok Kim, MD; Hyo Jung Lee, MD; Hoon Gi Park, MD; Jun Kwan, MD; Keum Soo Park, MD; and Woo Hyung Lee, MD**

**B**ackground and Objectives: Positive correlations between quantitative coronary angiography and functional indexes of coronary stenosis are well known in angina pectoris. However, there is little data concerning correlations with acute myocardial infarction (AMI). The objective of this study was to evaluate the differences in correlation of functional severity and luminologic severity between patients with angina and acute myocardial infarction. Subjects and Methods : The study population consisted of 23 patients with AMI and 25 patients with angina pectoris. We performed intravascular ultrasound (IVUS) and intracoronary pressure measurement following diagnostic coronary angiography, and measured angiographic diameter stenosis (DST), minimal luminal diameter (MLD), minimal luminal area (MLA), and reference area stenosis (r-AST). Additionally, the fractional flow reserve (FFR) was defined by the ratio of the distal mean coronary pressure (Pd) to the aortic mean pressure (Pa). Results : The IVUS parameters and DST in patients with AMI showed more severe stenosis than seen in patients with angina ; MLD ( $1.37\pm 0.30$  mm vs  $1.73\pm 0.63$  mm,  $p<0.05$ ), MLA ( $1.99\pm 0.80$  mm<sup>2</sup> vs  $3.20\pm 2.25$  mm<sup>2</sup>,  $p<0.05$ ), r-AST ( $79\pm 9\%$  vs  $64\pm 24\%$ ,  $p<0.05$ ), DST ( $78\pm 14\%$  vs  $68\pm 21\%$ ,  $p<0.05$ ) respectively. FFR showed no significant difference between the patients with AMI and angina ( $0.733\pm 0.14$  vs  $0.729\pm 0.14$ ,  $p>0.05$ ). FFR was correlated less with r-AST in patients with myocardial infarction than angina ( $-0.55$  vs  $-0.84$ ). The r-AST in patients with AMI, in order to be the best cut-off values that fit with a  $FFR<0.75$ , was higher than seen in patients with angina (83% vs 67%). Conclusion : FFR in AMI was not significantly different from that seen in angina despite the presence of a significant difference of IVUS parameters between the two patient groups. The functional severity of stenosis in relation to its luminologic severity may be lessened following acute myocardial infarction.

## **Clinical Outcome and ECG Change in Patients with Acute Myocardial Infarction and Prodromal Angina**

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**B**ackground and Objectives : Ischemic preconditioning reduces the size of myocardial infarct in animal models, however its role in humans remains unclear. Clinical data suggests that episodes of angina immediately before acute myocardial infarction may be associated with a protective effect on the human myocardium. We performed an analysis on the effect of prodromal angina on infarct size, in-hospital outcome and newly developed Q-wave in patients with acute myocardial infarction. Subjects and Methods : 65 patients who had received thrombolytic therapy were enrolled in the study. Eleven patients (17%) had experienced previous angina within 24 hours prior to acute myocardial infarction (group I), and the remaining 54 patients (83%) did not have a history of previous angina (group II). Killip class, cardiac enzyme, ECG findings, echocardiographic data and in-hospital outcomes were compared between the two groups. Results : Group I tended to have lower peak creatine kinase (CK) and CK-MB levels, although the difference between the two groups in regards to the level of cardiac enzyme was statistically insignificant. Despite similar patient characteristics, Group I showed a lower incidence of heart failure during hospitalization than group II. 6/11 patients (55%) in group I and 47/54 (87%) in group II had a Q-wave at discharge ECG. Group I showed better left ventricular systolic function during admission. None of the DM patients (14 patients) had prodromal angina and 13 of 14 patients (93%) demonstrated Q-wave infarction. Conclusion : Prodromal angina prior to acute myocardial infarction as a marker of ischemic preconditioning may also confer beneficial effects in terms of in-hospital outcomes. Further studies concerning the long term outcomes of such cases are needed.

## **Subject Effect of Steroid on Impaired Vascular Function Induced by Irradiation**

**Woo-Seung Lee, MD, Seok-Yeon Kim, MD, Seong-Wook Park, MD, Byung-Hee Oh, MD.**

**B**ackground and Objectives : Intracoronary irradiation has been proven to reduce restenosis following percutaneous transluminal coronary angioplasty, however late thrombosis is another recurring problem. We evaluated the sequential changes of vascular dysfunction and morphological changes according to the radiation dosage in rats. The effects of dexamethasone on these changes were also evaluated. Materials and Methods : Female Sprague-Dawley rats were randomized into 4 groups ( n=20, each group ), and were irradiated with 0, 5, 10, 20 Gray ( Gy ). The rats were sacrificed at 1 hour, 1, 3 and 7 days after irradiation. The physiographic responses and morphologic changes of the arterial rings were evaluated. After the time- and dose-response relationship was determined, an additional 40 rats were pretreated with dexamethasone for 3 days and irradiated with 10 or 20 Gy to evaluate the effects of the dexamethasone. Results : 5 Gy irradiation did not induce endothelial dysfunction. 10 Gy irradiation induced an impairment of endothelium dependent relaxation ( EDR ) only 7days after irradiation. 20 Gy caused an impairment of EDR from the very time of irradiation, although endothelium independent relaxation ( EIDR ) was not affected irrespective of dose or time. On immuno-histochemistry of vWF, all irradiated arteries showed mild de-endothelialization in acute phase and subsequent re-endothelialization. However, after 20 Gy irradiation, re-endothelialization did not occur. With dexamethasone treatment, all of these vascular dysfunctions were prevented, and re-endothelialization was promoted. Conclusion : Irradiation induced the impairment of EDR as well as de-endothelialization, in a time- and dose-response relationship in rats. Pretreatment with dexamethasone may partly prevent radiation-induced vascular dysfunction and de-endothelialization.

## **The Risk Factors of Vasospastic Angina**

**Han Cheol Lee, MD, Sung Ro Hong, MD, Hyo Sang Kim, MD, Kyoung Chan Kim, MD.**

**B**ackground and Objectives : The causes of vasospastic angina are not well known. We attempted to elucidate the risk profiles of Korean patients with vasospastic angina. Subjects and Methods : The risk profiles were analyzed in 181 patients with vasospastic angina ( VA ), 1533 patients with obstructive coronary artery disease ( CAD ) who underwent coronary angiography at Samsung Seoul Hospital, and 455 normal control subjects, sex and age matched to the VA group and selected from the Health Promotion Center of Samsung Seoul Hospital. Results : The male to female ratio was significantly higher in the VA group ( 4.6 : 1 ) than the obstructive CAD group ( 2.7 : 1 ) . The mean age of the VA group ( 52.2±10.7 years ) was significantly younger than the mean age of the obstructive CAD group ( 59.0±10.6 years ) (  $p<0.01$  ) . Additionally, the smoking rate was significantly higher in the VA group ( 49.2% ) as compared with the obstructive CAD group ( 43.1% ) (  $p<0.01$  ) . Other major risk factors such as hyperlipidemia, hypertension and diabetes mellitus were significantly more prevalent in the obstructive CAD group than the VA group. Among the obstructive CAD group, a subgroup of Q-wave myocardial infarction ( MI ) showed a significantly higher smoking rate ( 59.3% ) as compared with VA group ( 49.2% ) (  $p<0.01$  ) . Conclusion : The VA group showed a higher prevalence in males and younger subjects as compared with the obstructive CAD group, and smoking appeared to be the most important risk factor for VA.

## **Vessel Size and Long-Term Clinical and Angiographic Outcome after Primary Stenting in Acute Myocardial Infarction**

**Jeong Cheon Ahn, MD, Sang Weon Park, MD, Seung Hwan Han, MD, Sung Hee Shin, MD**

**B**ackground and Objectives : The role of coronary stenting in the treatment of patients with small vessels (<3.0 mm) in AMI is not well defined. The purpose of this study was to investigate the influence of vessel size on the long-term clinical and angiographic outcome following primary stenting in AMI. Subjects and Methods : The study comprised 130 AMI patients with successful primary stent implantation within 12 hours of chest pain onset. Patients were divided into two groups according to the vessel size of the infarct related artery, with the respective ranges of the groups being <3.0 and 3.0 mm. The primary end points were the major adverse cardiac events including death, recurrent myocardial infarction, or target vessel revascularization at follow-up. The incidence of angiographic restenosis ( 50% of diameter stenosis ) was assessed as a secondary end point. Results : Event-free survival in the small vessel group ( less than 3mm of reference vessel diameter ) was 62.5% at 23.7±13.0 months and 76% in the large vessel group ( p<0.001 ) at 23.5±12.0 months. The follow-up angiographic restenosis rate was significantly higher in the small vessel group ( 61% vs. 32% in the small and large vessel groups, respectively, p = 0.026 ) . Conclusion : Acute myocardial infarction patients with small vessels present a higher risk for an adverse outcome following primary stenting.

## **A Case of Three Major Coronary Arteries to Left Ventricular Fistulae via Common Channel**

**Chang Kyun Lee, MD, Won Jea Jeong, MD, Nam Hoon Kim, MD**

**M**ultiple coronary arteries to communicating with the left ventricular fistulae is a very rare congenital anomaly in adults. This anomaly involves three major coronary arteries that have a direct communication between these arteries and the left ventricle. Hemodynamically, it induces myocardial ischemia due to coronary steal syndrome and diastolic volume overload from a left-to-left shunt. A 70-year-old woman with essential hypertension was admitted to our clinic to evaluate complaints of exertional dyspnea. Clinical examination revealed a diastolic murmur at the apex. A coronary angiogram showed a common fistular channel connecting the right coronary artery, the left circumflex coronary artery, and the first large diagonal branch of the left anterior descending coronary artery with the left ventricular chamber. The patient's symptoms were relieved by the administration of calcium channel blocker and angiotensin II receptor blocker. We report a very rare case of three major coronary arteries communicating to the left ventricular fistulae via a common channel.



## **A Case of Moyamoya Disease with Total Occlusion of Left Main Coronary Artery**

**Seong Hwan Kim, MD, Chang Gyu Park, MD, Seung Hwan Han, MD, Sang Won Park, MD**

**M**oyamoya disease is an occlusive intracranial arteriopathy with an abnormal cerebral vascular collateral network at the base of brain. Despite strict diagnostic guidelines for moyamoya disease, the etiology and pathogenesis remains unknown. There are several reports that moyamoya disease should be regarded as a systemic vascular disorder. However, Moyamoya and coronary artery disease may have common etiologic factors. We describe here a 35-year-old female with moyamoya disease that was diagnosed as severe coronary artery disease. Coronary angiography showed a left main ostial total obstruction with TIMI grade III collateral blood supply from the normal right coronary artery. We report the first clinical case of moyamoya disease with left main ostial total obstruction in a Korean patient and recommend that an evaluation of the extracranial (especially coronary artery) vascular system should be considered if there is some evidence of coronary artery disease.

## **Clinical Significance of Slow Flow Velocity in the Distal Left Anterior Descending Coronary Artery Detected by Transthoracic Doppler Echocardiography**

**Ho-Joong Youn, MD, Chul-Soo Park, MD, Eun-Ju Cho, MD, Hae-Ok Chung, MD**

**B**ackground and Objectives : The aim of this study was to test whether flow velocity in the distal left anterior descending coronary artery (LAD) measured using transthoracic Doppler echocardiography (TTE) can predict pathologic coronary flow dynamics. Subjects and Methods : We prospectively examined 222 subjects (mean age  $57\pm 9$  yrs, M : F = 132 : 90) including 55 subjects with myocardial infarction (MI group, mean age =  $57\pm 9$ , M : F = 45 : 10), 68 with typical angina (Angina group, mean age =  $62\pm 8$ , M : F = 44 : 24) and 99 with atypical chest pain and normal coronary angiogram (Control group, mean age =  $54\pm 10$ , M : F = 43 : 56). After obtaining tubular color flow signals of the distal LAD using TTE with a special preset program for a low velocity range, the peak (PDV) and mean (MDV) diastolic velocity as well as velocity time integral (VTI) were measured. The echocardiographic parameters of distal LAD flow were compared with the coronary angiographic findings including lesion classification according to ACC/AHA guidelines and the percent diameter stenosis. Results : The average PDV was  $20.3\pm 9.7$  cm/sec in patients with atypical chest pain and normal coronary angiogram,  $16.8\pm 8.5$  cm/sec in patients with typical angina without myocardial infarction and  $15.0\pm 7.5$  cm/sec in those with myocardial infarction ( $p < 0.01$  versus the MI group and Angina group, respectively). The PDV was found to be significantly related to the percent diameter stenosis ( $r = -0.292$ ,  $p = 0.002$ ). The PDV in the group with complex lesion was significantly lower than that of the group with simple lesion. A value of  $PDV < 14$  cm/sec had a sensitivity of 76.6% and a specificity of 91.5% for predicting complex lesion of the LAD in groups including myocardial infarction and angina. Conclusion : Slow flow velocity in the distal LAD as demonstrated by TTE strongly predicts complex lesions. Baseline coronary flow velocity using TTE provides valuable information about the pathologic condition.

## **Six-Month Angiographic Follow-up after Intravascular Ultrasound Guided Stenting of Infarct Related Artery**

**Si-Wan Choi, MD, Myeong-Ki Hong, MD, Seong-Wook Park, MD, Cheol Whan Lee, MD**

**B**ackground and Objectives : Intracoronary Stenting has been established as an effective treatment modality for the reduction of restenosis in patients with acute myocardial infarction. This study was performed in order to evaluate the long-term outcomes of stenting for infarct-related artery (IRA) lesions using intravascular ultrasound (IVUS) and compare these results with the stenting of non infarct-related artery (non-IRA) lesions. Subjects and Methods : IVUS-guided coronary stenting was successfully performed in 510 native coronary lesions (105 IRA vs. 405 non-IRA). A six-month angiography was performed in 419 lesions (82.2%) : 87 IRA lesions (82.9%) and 332 non-IRA lesions (82.0%). The results were evaluated using clinical, angiographic and IVUS methods. Results : There were no significant differences in the clinical and angiographic variables between the two groups. IVUS variables including reference vessel area and minimal stent area were also similar between the two groups. There was no significant difference in the angiographic restenosis rate between the two groups in cases of minimal stent area  $\geq 7$  mm<sup>2</sup> : 12.8% (6/47) in IRA vs. 19.1% (33/173) in non-IRA lesions ( $p = 0.315$ ). However, the angiographic restenosis rate in cases of minimal stent area  $< 7$  mm<sup>2</sup> was 50% (20/40) in IRA lesions vs. 31.5% (50/159) in non-IRA lesions ( $p = 0.028$ ). Conclusion : The rate of angiographic restenosis is significantly higher in stenting for IRA lesions as compared with that for non-IRA lesions in cases of minimal stent area  $< 7$  mm<sup>2</sup>.

## **Clinical Experience of Cutting Balloon Angioplasty for in Stent Restenosis**

**Gi Soo Park, MD, Tae Hoon Ahn, MD, Min Soo Son, MD.**

**B**ackground and Objectives : A cutting balloon (CB) is a balloon catheter with 3 or 4 metal blades on its surface used for making controlled endovascular surgical incisions and promising minimal intimal injury. Some reports suggest advantages of the use of CB in the treatment of in-stent restenosis (ISR). The purpose of this study was to report the clinical experience of the use of CB for ISR. Subjects and Methods : 28 patients were enrolled in this study. Angiographic success (defined by 40% residual stenosis), in-hospital, 30 days and 6 months clinical outcomes were evaluated. Results : Angiographic success was 92.9% (26/28). The number of inflations and maximal inflation pressure were  $2.8 \pm 0.9$  and  $10.1 \pm 1.3$  ATM, respectively. The balloon/artery (B/A) ratio was  $1.1 \pm 0.2$ . There was a case of stent insertion for treating type D dissection and a case of rotational atherectomy for suboptimal result after CB angioplasty. 25 cases underwent analysis through 6 months of clinical follow-up. During the 6-month clinical follow-up, 4 cases of re-PTCA were documented, while MACE during in-hospital time and the subsequent 30 days was 0%. Conclusion : Our experience demonstrated that CB can be performed safely and effectively in coronary ISR. Further clinical and angiographic effectiveness are warranted in a large-scale clinical trial.

## **Comparison between Pattern of ST Change during Exercise Treadmill Test and Coronary Flow Reserve in Patients with Chest Pain and Normal Coronary Angiogram**

**Chul-Soo Park, MD, Ho-Joong Youn, MD, Eun-Joo Cho, MD, Hae-Ok Jung, MD,**

**B**ackground and Objectives : The validity of an exercise test in microvascular angina has not yet been elucidated. Therefore, in order to evaluate the usefulness of the exercise treadmill test in determining the true microvasculature induced ischemia, we compared patterns of ST depression with coronary flow reserve (CFR) using transthoracic Doppler echocardiography in patients with chest pain and normal coronary angiogram. Subjects and Methods : Fifty-nine subjects (M : F = 21 : 38, mean age  $55 \pm 9$  yrs) with chest pain and normal coronary angiogram underwent maximal symptom-limited treadmill exercise according to the Bruce protocol. Coronary flow reserve (CFR) was estimated using transthoracic Doppler echocardiography and dipyridamole. Patients with a history of acute myocardial infarction, regional wall motion abnormalities, hypertrophic cardiomyopathy, an ejection fraction of less than 50% or primary valvular heart disease were excluded in this study. The patterns of ST segment depression were compared with CFR. Results : No ST change was observed in 20 of 59 (34%), upslope depression in 20 (34%), flat depression in 13 (22%) and downslope depression in 6 (10%). Eleven of 39 (28%) exercise positive patients demonstrated decreased  $CFR < 2.1$ . CFR was  $3.1 \pm 0.6$  in the group with no ST change,  $3.1 \pm 0.6$  in the group with upslope depression,  $2.1 \pm 0.6$  in the group with flat depression ( $p < 0.05$  versus the group with no change and the upslope depression group, respectively) and  $2.0 \pm 0.4$  in the group with downslope depression ( $p < 0.05$  versus the group with no change and the upslope depression group, respectively). Flat to downslope depression of ST change during exercise treadmill test had a sensitivity of 58% and a specificity of 95% for predicting  $CFR < 2.1$ . Conclusion : Flat and downslope depression of the ST segment during an exercise stress test may increase the sensitivity and specificity to detect the true microvasculature-induced ischemia that is defined as CFR less than 2.1.

## **The Clinical Effects of a Combined Agent Including Losartan and Hydrochlorthiazide, Hyzaar(r), in Patients with Ischemic Heart Failure**

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**B**ackground and Objectives : Angiotensin converting enzyme inhibitor is known to be effective in the prevention of left ventricular remodeling following myocardial infarction. However, little data is available concerning the clinical effects of angiotensin (AT) receptor blocker in ischemic cardiomyopathy. This study evaluated the clinical effects of the concomitant use of losartan with low doses of hydrochlorthiazide in cases of ischemic cardiomyopathy. Subjects and Methods : A combined agent of 50 mg of losartan potassium with 12.5 mg of hydrochlorthiazide (HCTZ) was administered once daily over a 12-week period to 29 patients (M : F = 26 : 3, 61.4±8.7 years) who were diagnosed with ischemic heart failure (ejection fraction lower than 50% by echocardiography) at Chonnam National University Hospital. Results : Clinical symptoms of dyspnea in the 29 patients improved from 2.08±0.49 to 1.15±0.38 as measured by New York Heart Association class. The systolic and diastolic blood pressure did not change significantly following treatment (116.5±18.0/77.0±11.9 mmHg vs. 118.7±15.1/78.1±11.1 mmHg). The ejection fraction following administration of Losartan/HCTZ increased from 40.3±8.1% to 46.7±10.8% (p=0.001). Losartan/HCTZ was well tolerated in all patients without significant adverse effects or laboratory changes. Conclusion : A fixed combination of losartan and low dose hydrochlorthiazide is effective in patients with ischemic heart failure.

**Comparison of the cost-effectiveness of stress myocardial SPECT and stress echocardiography in suspected coronary artery disease considering the prognostic value of false-negative results.**

Lee DS, Jang MJ, Cheon GJ, Chung JK, Lee MC.

**B**ACKGROUND: The prognoses of patients with false-negative test results by myocardial single photon emission computed tomography (SPECT) and by stress echocardiography are known to be different; the prognosis with false-negative SPECT is better in suspected and proven coronary artery disease (CAD). METHODS AND RESULTS: Three strategies by which to diagnose CAD were compared for their cost-effectiveness when considering the prognostic value of false-negative results: (1) stress myocardial SPECT by dipyridamole or adenosine followed by coronary angiography (CAG), (2) exercise stress echocardiography followed by CAG, and (3) dobutamine stress echocardiography followed by CAG. Delta quality-adjusted life-year (QALY) was calculated for the three strategies separately when annual mortality and infarction rates were 0.5% and 0.5% for myocardial SPECT and 2% and 2% for stress echocardiography, respectively. Costs were estimated and costs per DeltaQALY were calculated according to the pretest likelihood of CAD (pCAD). The myocardial SPECT followed by CAG strategy was the most cost-effective in the patients with a pCAD of 0.3 or greater, and the dobutamine echocardiography followed by CAG strategy was the most cost-effective in patients with a pCAD of 0.2 or lower. This was the case when we assumed that the nondiagnostic test rate of dobutamine echocardiography was 9% (in contrast to 0% by myocardial SPECT and 18% by exercise echocardiography). Sensitivity analysis showed that the cost-effectiveness of dobutamine echocardiography followed by CAG was best only if the prognosis of false-negative results of dobutamine echocardiography was better. The cost-effectiveness of exercise echocardiography was dubious because of the high nondiagnostic rate with inadequate exercise. CONCLUSIONS: When the lower event rates of (false) negative SPECT were considered, the relatively expensive myocardial SPECT strategy was more cost-effective than the cheaper stress echocardiography strategy in patients with a pCAD of 0.3 or greater. According to sensitivity analysis, the prognostic value of false-negative results and the nondiagnostic test rate were important determinants of stress myocardial study cost-effectiveness.

## **Coronary artery calcification and dietary cholesterol intake in Korean men.**

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**O**BJECTIVE: This study was performed to examine the relationship between dietary cholesterol intake and coronary artery calcification (CAC) score in healthy men. **METHODS:** Electron beam computed tomography (EBCT) was used to examine the CAC score in 135 Korean men aged 40-81 years who did not have clinical illness. Dietary cholesterol intake was assessed by a nutritionist using a semiquantitative food frequency method. Body mass index (BMI), serum lipid levels, cigarette use, alcohol intake, exercise, and a past history of cardiovascular disease were determined during interview and examination. **RESULTS:** The resultant median CAC score among those who experienced CAC was 22.5 (1-697) and average intakes of total fat and cholesterol were 22.4% (13.8-40.7) of total energy intake and 306.0 mg/day (84-1191). When the participants were classified into high ( $\geq$  75 percentile) and low ( $<$  75 percentile) CAC score groups, multiple logistic analysis showed that the cholesterol intake (per 10 mg/1000 kcal of energy) was significantly related to a high CAC score (OR 1.12: 95% CI 1.02-1.24), after adjustment for age, BMI, serum triglyceride level, past history of hypertension, past history of hyperlipidaemia, and energy intake. Also, when participants were classified into 2 groups (CAC score  $\geq$  100 vs.  $<$  100), cholesterol intake was found to be significantly related to CAC score. However, fatty acid intakes were not significantly related to the CAC score. **CONCLUSION:** These results suggest that in a population with a relatively low risk of coronary heart disease, higher cholesterol intake may increase the level of CAC.



**The haplotype analyses using multiple markers of the apolipoprotein B gene in patients with coronary artery disease.**

**Hong SH, Song J, Kim JQ.**

**T**he high level of low density lipoprotein (LDL) is a risk factor for cardiovascular disease. Apolipoprotein (apo) B is a major protein component of LDL and plays an important role in the maintenance of cholesterol homeostasis. In this study, six polymorphic sites of the apoB gene were analysed in 235 patients with coronary artery disease (CAD) and 216 normal control subjects. There were no significant differences in the allele frequencies of apoB polymorphisms between the control and patient groups. However, haplotype frequencies were significantly different between the CAD patients and control ( $p < 0.05$ ). In addition, the allelic distributions of both EcoRI and MspI polymorphisms in Koreans were similar to those in Chinese but significantly different from those in Caucasians. ApoB polymorphisms showed no association with plasma lipid levels. In conclusion, haplotype analysis of the apoB gene using multiple diallelic markers might be a useful marker for Korean CAD patients.

## **The Changes of Fractional Flow Reserve after Intracoronary Nitrate and Nicorandil Injection in Coronary Artery Ectasia**

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**B**ackground and Objectives : Little data exist relating to the mechanism of myocardial ischemia in patients with coronary artery ectasia (CAE). The purpose of this study was to evaluate the fractional flow reserve (FFR), as an index of myocardial ischemia, in patients with CAE. Subjects and Methods : Ten patients (7 males, 54.0±12.6 years) who diagnosed as CAE, by coronary angiographies, between March 2002 and July 2002, were analyzed. The clinical diagnosis of all the patients was unstable angina. FFR were performed using a pressure wire on the patients diagnosed with slow flow CAE from their coronary angiograms. After measurement of the baseline FFR using adenosine 20 µg for the right coronary artery, and 24 µg for the left anterior descending artery, the changes in the FFR with 500 µg of intracoronary nitrate and 2 mg of Nicorandil were observed. Results : Smoking was the most frequently associated risk factor. Type I CAE, according to Markis' classification, was the most prevalent at 60.0%. The values of the baseline FFR in the left anterior descending artery and right coronary artery, following the intracoronary injection of adenosine were both normal, and there were no significant changes in the FFR following the intracoronary injections of nitrate and Nicoronadil. Conclusion : The value of the FFR with CAE was normal, and an intracoronary injection of vasodilators did not change the FFR in patients with CAE. Therefore, vasodilator therapy might be beneficial for patients with symptomatic CAE.

## **Predictive Factors of Survival for Intra-aortic Balloon Pump in Acute Myocardial Infarction Treated with Angioplasty**

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**B**ackground and Objectives : Intra-aortic balloon pumps (IABP) are useful tools for hemodynamic support in patients with hemodynamic instability or cardiogenic shock due to acute myocardial infarction (AMI). The purpose of this study was to examine the clinical characteristics and outcomes in patients with AMI who underwent IABP support, and to identify predictors of in-hospital mortality. Subjects and Methods : We retrospectively analyzed 46 consecutive patients with an acute myocardial infarction, who underwent primary or rescue percutaneous coronary intervention, with IABP support, between March 1997 and June 2002. The patients were divided into survivors and non-survivors. We compared the clinical characteristics, hemodynamic parameters and therapeutic outcomes between the two groups, and assessed the clinical and angiographic predictors of in-hospital mortality. Results : The overall survival rate was 39%. The indications of IABP support were cardiogenic shock (50%), unstable hemodynamics during coronary angioplasty (13%) and high risk intervention (35%). There were no significant differences in clinical diagnosis, infarct location, Killips classification, risk factors, ejection fraction, pain to balloon time, clinical indications for IABP, extents of coronary artery disease and left ventricular end diastolic pressure between the two groups. The survival group was younger than the non-survival group ( $p=0.04$ ), and the TIMI III flow after PCI was more frequent in the survival group ( $p=0.01$ ). The TIMI III flow was a predictor of in-hospital mortality ( $p=0.01$ ). Conclusion : The predictive factor of survival following IABP was the TIMI III flow in patients with AMI who underwent primary or rescue PCI.

## **The Clinical Outcome of Acute Myocardial Infarction with Normal Coronary Angiogram**

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**B**ackground and Objectives : Little data exist concerning the clinical outcome of patients with acute myocardial infarction (AMI) and angiographically normal coronary arteries (NCA). The purpose of this study was to evaluate the clinical outcome, the etiological factors and prognosis of these patients. Subjects and Methods : The subjects were divided into two groups according to findings from coronary angiograms performed between January 1999 and December 2001, Group 1 : comprised of 46 patients, 34 males and 12 females, with a mean age of  $50.4 \pm 11.9$  years, had AMI with NCA ; Group II : 181 patients, 143 males and 38 females, with a mean age of  $59.0 \pm 10.3$  years, with AMI and total occlusion of the coronary arteries. Results : The percentages of smoking and hypertension were similar between the two groups ; a higher prevalence rates of hyperlipidemia and diabetes were observed in group II compared to group I ( $p=0.03, 0.01$ ). In group I, coronary spasm, combined inflammatory diseases and embolization were demonstrated in 32.6, 6.5 and 4.3% of subjects, respectively. The left ventricular ejection fraction was higher in group I than group II ( $51.5 \pm 11.3\%$  vs.  $46.2 \pm 10.5\%$ ,  $p=0.006$ ). In-hospital outcomes, with the combined end-point defined as death, re-infarction and stroke was 0% in group I vs. 7.7% in group II ( $p=0.07$ ). The mean long-term survival rate during the 26.5-month clinical follow-up were 100 and 92.2% in groups I and II ( $p=0.04$ ), respectively. Conclusion : A coronary spasm is the most common cause of AMI with NCA, but these patients had the higher long-term clinical event-free survival.

## **Early Diagnosis of Acute Coronary Syndrome Using Myocardial Contrast Echocardiography**

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**B**ackground and Objectives : Without typical electrocardiographic (ECG) changes, and the elevation of cardiac enzymes, the early identification of high risk chest pain patients remains a major challenge. We hypothesized that myocardial contrast echocardiography (MCE) was more sensitive than conventional echocardiography (Echo) for the identification of high risk patients. Subjects and Methods : We prospectively enrolled 75 consecutive patients (age ;  $62\pm 11$  yrs, 34 men), presenting to the emergency room, with suspected cardiac chest pain at rest. The exclusion criteria for enrolment were : age <40 yrs, the presence of a Q wave or ST segment elevation, an initial troponin I level >1.5 ng/mL and a poor Echo window. Echo and MCE were performed to evaluate regional wall motion abnormalities (RWMA), and assess myocardial perfusion defects (PD), using a continuous infusion of PESA during intermittent power Doppler harmonic imaging. The Echo and MCE studies were interpreted by different reviewers, blinded to the clinical data. We defined major adverse cardiac events (MACE) as mortality, myocardial infarction (MI) and severe ischemia requiring revascularization. Results : There were 35 MACE, including 12 MI, during hospitalization. No significant differences were found in the clinical characteristics between patients with, or without, MACE. A RWMA or a PD were seen in 18 (24%) and 27 (36%) of patients, respectively, and the sensitivity, specificity of RWMA were 46 and 95% for a MACE, and 59 and 86% for a MI. The sensitivity and specificity of a PD were 69 and 93% for MACE, and 88 and 79% for MI, respectively. Conclusion : The assessment of a PD by MCE is clinically feasible, and a MCE can improve the sensitivity of Echo in identifying high risk chest pain patients.

## **The Role of Extracellular Matrix within the Neointima in A Porcine Coronary Stent Restenosis Model**

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**B**ackground and Objectives : Coronary stent restenosis remains a major limitation to percutaneous coronary intervention. The most important mechanism of coronary stent restenosis is neointimal hyperplasia (NIH). In addition to neointimal cell proliferation, extracellular matrix (ECM) synthesis may be important in the induction of NIH. We sought to observe the degree of this in a porcine model. Subjects and Methods : Twenty-one coronary stents were placed in 15 pigs, and the pigs were sacrificed at 14 (Group I), 28 (Group II) and 56 (Group III) days following stenting. The twenty-one coronary stents were classified into three groups, followed by histopathological analyses of 7 stented arteries. Each specimen was analyzed by H&E, modified Movat and Masson-Trichrome staining methods. Immunocytochemistry was performed for type I collagen, smooth muscle  $\alpha$ -actin and proliferating cell nuclear antigen (PCNA). A Visus 2000 Visual Image Analysis System was used. Results : There were no differences in the injury scores of the stented porcine coronary arteries between the three groups. The areas of neointima in Groups I, II and III were  $0.75 \pm 0.32$ ,  $1.45 \pm 0.78$  and  $1.62 \pm 0.51$  mm<sup>2</sup>, respectively (Group I vs. II and Group I vs. III ;  $p=0.08$ ,  $p=0.03$ ). The pathological area stenoses were  $18.8 \pm 7.4$ ,  $34.2 \pm 0.2$  and  $43.1 \pm 28.4\%$  in Groups I, II and III, respectively (Group I vs. II and Group I vs. III ;  $p=0.35$ ,  $p=0.02$ ). The PCNA indices of neointima were  $16.5 \pm 14.4$ ,  $0.5 \pm 0.74$  and  $0.83 \pm 0.68\%$  in Groups I, II and III, respectively (Group I vs. II and Group I vs. III ;  $p=0.01$ ). The collagen content ratios within the neointima were  $23.5 \pm 4.7$ ,  $27.7 \pm 5.0$  and  $36.6 \pm 10.5\%$  in Groups I, II and III, respectively (Group I vs. II and Group I vs. III ;  $p=0.52$ ,  $p=0.01$ ). Proteoglycans were abundant in Groups I and II, and  $\alpha$ -actin was positive in the neointima cells. Conclusion : The role of cell proliferation and proteoglycans are important in the early period, but collagen plays a major role in the late period, following coronary stenting, in a porcine model.

## **Age and Gender Distribution of Patients with Acute Myocardial Infarction Admitted to University Hospitals during the Period of 1990 - 1999**

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**B**ackground and Objectives : The prevalence of coronary disease in Korea, with the consequent morbidity and mortality, has rapidly risen during the last two decades. This study aimed to describe the changing pattern in the demographic composition during the 1990s of patients presenting with acute myocardial infarction (AMI) in Korean metropolitan cities. Subjects and Methods : Data from the medical record of patients with AMI, admitted to five University Hospitals in Busan and Daegu between January 1990 and December 1999, were sorted according to their age (<30, 30-44, 45-59, 60-74, >75 years) and gender. Results : During the last decade, the number of cases of AMI increased from 283 in 1990, to 988 by 1999 (ratio of AMI/medical patients admitted; 1.68% in 1990 to 2.52% in 1999). The most prevalent age group was 60-74 yrs (46.1%), followed by 45-59 yrs (34.2%). Generally, the male cases were twice as prevalent as female (68.2% : 31.8%), but the gender ratio was reversed in the highest age group (>75 yrs) (44.6% : 55.4%). During the period in question, the gender ratio and age distribution remained reasonably constant throughout. The proportion of younger AMI patients (<45 yrs) did not increase. Conclusion : Admissions due to AMI increased substantially during the 1990s. Almost half the cases were from the 60-74 yrs age group, and two third were male. There were little changes in the compositions of age and gender of the AMI cases during this period.

## **Sex Differences in Early Management of Patients with Acute Myocardial Infarction (AMI) in the 1990s**

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**B**ackground and Objectives : Previous studies have suggested that women with AMI are less aggressively managed than men. The aim of this study was to assess the differences between the sexes, in terms of the medical and invasive coronary procedures, in AMI patients during the 1990s, and the association to in-hospital mortality. Subjects and Methods : In 1758 AMI patients, the baseline clinical characteristics, initial management and in-hospital outcomes, were studied. Results : The women, on average, were older than men ( $68.8 \pm 10.6$  versus  $59.2 \pm 12.3$ ,  $p < 0.01$ ), with a higher prevalence of diabetes and hypertension. Women received heparin and b-blockers less often than men. The unadjusted rates of thrombolysis, angiography and PTCA use were lower in women than men, but not after covariate adjustment. The in-hospital mortality was higher in women than men (11.7% versus 8.1%, odd ratio (OR) 1.51, 95% CI 1.09 to 2.11,  $p < 0.05$ ), but this difference was not significant after adjustment for age (adjusted OR 0.98, 95% CI 0.69 to 1.40,  $p = \text{NS}$ ). Conclusion : Women with AMI are less aggressively managed than men, and have higher in-hospital mortalities. The difference in outcome seems to be associated with increased age, with a greater co-morbidity of women.



## **Risk Assessment with Duke Treadmill Score in Patients with Coronary Artery Disease : Comparison with Scintigraphic and Angiographic Findings**

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**B**ackground and Objectives : The Duke treadmill exercise score (DTS) has been used to stratify patients with coronary artery disease into low-, moderate-, and high-risk groups. To determine the coronary angiographic and myocardial scintigraphic correlates of these scores, we have compared the degree of risk assessed by the DTS and with those obtained by angiography and SPECT. Subjects and Methods : The subjects were classified into low risk ( $DTS \geq 5$ ), moderate risk ( $4 > DTS \geq -11$ ) and high risk ( $DTS < -11$ ) groups according to their DTS. To evaluate the agreement in the risk assessment, 102 patients with angiographically proven coronary artery disease, were assessed for the extent of their coronary artery disease by the number of stenotic vessels, and from their exercise Tc-99m MIBI myocardial SPECT findings. Results : Of the 102 subjects, 52 (51%) had one-vessel, 25 (24.5%) had two-vessel, and 25 had three-vessel disease. With the results of the coronary angiography and SPECT, the patients were re-classified into three groups ; group 1 (n=20) had three-vessel disease and/or >10 abnormal segments, group 3 (n=41) had one vessel disease and less than 5 abnormal segments, and group 2 (n=41) included the remaining subjects. Based on the DTS, 37 (36%) were in the low-risk, 44 (43%) in the moderate risk, and 21 (21%) in the high risk groups. In the low-risk DTS patients, 32.4% were in group 1, 35.2% in group 2 and 32.4% in group 3. In relation to the subjects with moderate risk DTS, there were 9, 16 and 55% in groups 1, 2 and 3, respectively. Whereas, there were 19, 24 and 57% in groups 1, 2 and 3 with high risk DTS subjects, respectively. Conclusion : Although considerable overlap exists, the degree of risk assessed from the angiography and SPECT findings were different from those by DTS. We suggest that patients classified into the low-risk DTS group may have extensive coronary artery disease, or myocardial perfusion SPECT abnormalities, whereas patients in the high-risk DTS group may be normal, or have mild coronary artery disease or mild SPECT abnormalities.

## **Role of Inflammation on Coronary Artery Disease in Koreans**

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**B**ackground and Objectives : The prevalence of coronary artery disease is lower in Korea compared to most western countries. The increasing prevalence of the traditional atherosclerotic risk factors has been documented but the impact of inflammatory activity on coronary artery disease remains unclear. In this study, the role of inflammatory activity on coronary artery disease in Koreans was investigated. Subjects and Methods : This study included a consecutive cohort of 1057 patients who underwent coronary angiography. Patients with conditions that might change the CRP levels were excluded and 227 patients were finally enrolled. The CRP was measured using a highly sensitive Behring nephelometer BN II. Results : The mean CRP value of the enrolled patients was  $1.06 \pm 0.51$  mg/L ( median : 0.95 mg/L ). There were no differences in the CRP levels (  $1.17 \pm 0.57$  vs.  $0.92 \pm 0.42$  mg/L,  $p = 0.11$  ) between patients with and without coronary artery disease. In logistic regression analysis, only the traditional risk factors ( age, being male, hyperlipidemia, and diabetes ) were independently associated with coronary artery disease. In patients with coronary artery disease, those with unstable angina had significantly higher CRP levels than those with stable angina (  $1.85 \pm 0.94$  vs.  $0.97 \pm 0.45$  mg/L,  $p = 0.02$  ). However, the CRP levels were not correlated with the angiographic severity. 16.7% ( 15/89 ) of coronary artery disease patients without hyperlipidemia had a CRP level  $> 3$  mg/L. Conclusion : The CRP level is not an independent risk factor for coronary artery disease in Koreans. However, the CRP level was higher in patients with unstable angina than in those with stable clinical conditions.

## **The Change of Cholesterol Level and IL-6, CRP in Unstable Angina Patients with Hypercholesterolemia after Low Dose Simvastatin Therapy**

**Su-Jin Chung, MD, Ki-Sun Bae, MD and Si-Hoon Park, MD**

**B**ackground and Objectives : Cardiovascular mortality in patients with atherosclerosis can be reduced by treatment with 3-hydroxy-3-methylglutaryl coenzyme A ( HMG-CoA ) reductase inhibitors. This proven effect is probably due, not only to the cholesterol lowering effect, but also to the non-lipid-lowering mechanisms elicited by the action of statins. These results, however, were achieved with high or usual doses of statin therapy, whereas similar results with low dose statins are rare. The aims of this study were to investigate the changes of cholesterol level and the inflammatory markers, Interleukin-6 ( IL-6 ) , and C-Reactive protein ( CRP ) , in unstable angina patients with hypercholesterolemia, using low dose simvastatin therapy. Subjects and Methods : Eighteen unstable angina patients ( 55±6 years, M : F = 10 : 8, Braunwald class IIIb ) with hypercholesterolemia ( a LDL -cholesterol level over 100 mg/dL ) were evaluated. A low dose of simvastatin ( 5 mg ) was administered for 4 weeks. The changes of total cholesterol, LDL-cholesterol, triglyceride, HDL-cholesterol and the inflammatory markers, IL-6, and CRP, were all elevated from the baseline following 4 weeks of treatment. Results : The baseline mean values of total cholesterol, LDL-cholesterol, triglyceride, and HDL-cholesterol were 237.1±56.9 mg/dL, 131.9±39.0 mg/dL, 168.3±20.4 mg/dL, and 50.0±3.8 mg/dL, respectively. The baseline mean values of IL-6 and hs CRP were 6.842±6.661 pg/mL, and 0.866±1.083 mg/dL, respectively. Following the 4 weeks of simvastatin treatment, the levels of total cholesterol, LDL-cholesterol, triglyceride, and HDL-cholesterol were 200.8±47.5 mg/dL, 101.6±35.4 mg/dL, 155.8±18.6 mg/dL, and 47.0±2.3 mg/dL, respectively, giving percentage changes of 17.6% ( p<0.01 ) , 24.7% ( p<0.01 ) , 1.3% ( p>0.05 ) , and 2.1% ( p>0.05 ) , respectively. Following the 4 weeks of treatment, the levels of IL-6 and hs CRP were 6.955±5.555 pg/mL, and 0.753±0.571 mg/dL, respectively, giving percentage changes of 51.8 ( p>0.05 ) , and 36.5% ( p>0.05 ) , respectively. There was no significant correlation between the level of LDL-cholesterol and the levels of IL-6, or hs CRP at the baseline, or post-treatment. There was also no significant correlation between the change of LDL-cholesterol and the changes of IL-6 or hs CRP levels during the simvastatin therapy. There was no significant correlation between the levels of IL-6 and hs CRP at the baseline or post-treatment. Conclusion : Our data showed that in patients with unstable angina patients with coupled with hypercholesterolemia, low dose statin therapy has a cholesterol lowering effect, but no effect on inflammation.

## **The Comparison of Reasons for not Receiving Reperfusion Therapy on Acute Myocardial Infarction for the Recent 10 Years**

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**B**ackground and Objectives : This study was performed to evaluate the changing aspects of the reasons why patients with an acute myocardial infarction were not given the adequate reperfusion therapy over the last 10 years. Subjects and Methods : All patients were divided into a reperfusion group ( phase I = 55, phase II = 289 ) who received reperfusion therapy such as a thrombolytic trial or direct PCI, and a conservative group who had not received reperfusion therapy ( phase I = 83, phase II = 81 ) . We analyzed the clinical characteristics and the various time delays from chest pain onset, the first hospital arrival time, the transfer time, the ER arrival time, and the door to reperfusion time in 138 patients with acute myocardial infarction admitted to Wonju Christian Hospital from Jan. 1991 to Oct. 1993 and 370 patients from Jan. 1997 to Jun. 2002. Results : 55 cases ( 39.9% ) received an adequate reperfusion therapy during phase I and 289 cases ( 78.1% ) received an adequate reperfusion therapy on phase II. 213 cases ( 78.1% ) received direct PTCA on phase II and 12 cases on phase I. The patient time delay was  $305.0 \pm 346.8$  min and  $253.7 \pm 233.4$  min, the first hospital time delay,  $237.2 \pm 320.7$  min and  $183.0 \pm 243.6$  min in phase I and phase II. Only 4.8% of patients were transferred from the first hospital after reperfusion therapy in phase I, but 43.1% of patients were transferred in phase II. The Patient time delay was the most common reason for not receiving reperfusion therapy in phase I , and II, and the time delay and lack of adequate reperfusion therapy at the first hospital despite the early arrival were the second most common reason. Other reasons included a contraindication to lytic therapy, a subsidence of pain or a ST segment elevation, no initial change in the ST segment on EKG and a delay in therapy. Conclusion : The most common reason of not receiving reperfusion therapy was patient delay and the time delay at the first hospital. In addition, reperfusion therapy in the first hospital has increased over the last 10 years. To maximize the effectiveness of reperfusion therapy, it is important to shorten the hospital arrival time delay and to use reperfusion therapy at the first hospital.

## Long-term Clinical Outcomes of Single Long Coronary Stent

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**B**ackground and Objectives : The aim of this study was to evaluate clinical outcomes following single long coronary stenting. Subjects and Methods : We evaluated the short- and long-term clinical outcomes in 935 consecutive patients with single long ( $\geq 18$  mm) coronary stents. The patients were divided into three groups according to the stent length : ( 1 ) Group A, 445 patients,  $18 \text{ mm} \leq \text{length} < 25 \text{ mm}$ , ( 2 ) Group B, 322 patients,  $25 \text{ mm} \leq \text{length} < 30 \text{ mm}$ , ( 3 ) Group C, 168 patients,  $\text{length} \geq 30 \text{ mm}$ . Results : There were no significant differences in the baseline clinical characteristics between the 3 groups. Group A had larger reference vessel sizes ( $3.33 \pm 0.40 \text{ mm}$  vs.  $3.18 \pm 0.50 \text{ mm}$  in the other groups,  $p < 0.001$ ) and stent diameters ( $3.46 \pm 0.40 \text{ mm}$  vs.  $3.27 \pm 0.42 \text{ mm}$  in the other groups,  $p < 0.001$ ). One-year clinical follow-up and 6-month angiographic follow-up were possible in all patients, and for 578 of the lesions (62%), respectively. The longer the stent, the higher the in-stent restenosis (A : B : C = 20.3% : 27.1% : 35.7%, respectively,  $p = 0.008$ ). For the cases where the stent diameter was  $\geq 3.5 \text{ mm}$ , the in-stent restenosis rates were similar between the 3 groups (16.2% : 23.0% : 21.1%, respectively,  $p = 0.43$ ). There were no significant differences in the 1-year cumulative TLR ( $8.3 \pm 1.4\%$  :  $11.1 \pm 1.9\%$  :  $12.8 \pm 2.8\%$ , respectively,  $p = 0.22$ ) and the overall cardiac event (death, myocardial infarction, and TLR) -free survivals ( $89.9 \pm 1.5\%$  :  $88.1 \pm 1.9\%$  :  $85.3 \pm 2.9\%$ , respectively,  $p = 0.31$ ) between the 3 groups. Conclusion : The long-term clinical outcomes following single long coronary stenting are acceptable. The single long coronary stents of  $\geq 3.5 \text{ mm}$  could be a useful therapeutic option for diffuse coronary lesions.

## **Factors Affecting Coronary Flow Reserve ( Measured by Transthoracic Doppler Echocardiography )**

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**B**ackground and Objectives : Coronary flow reserve ( CFR ) is considered an important index of the functional significance of coronary artery stenosis, but is influenced by several factors, such as left ventricle hypertrophy ( LVH ) , diabetes mellitus ( DM ) , hyperlipidemia and smoking. Measurement of the coronary flow velocity of the left anterior descending coronary artery ( LAD ) by transthoracic Doppler echocardiography ( TTDE ) is feasible, and provides reliable information. The purpose of this study was to investigate the relationship between CFR and LVH, DM, hyperlipidemia and hypertension in patients with or without coronary artery disease, and to assess the prominent factors influencing CFR. Subjects and Methods : Coronary angiographies were performed in 38 patients to evaluate chest pain. The distal LAD flow velocity was measured by TTDE, and the CFR calculated as a ratio of the hyperemic and baseline mean diastolic velocities. The CFR was compared with clinical, echocardiographic and angiographic parameters. Results : The CFR was similar in patients both with and without hypertension, DM, high LDL-cholesterol levels and low ejection fraction ( <40% ) . The mean CFR was lower in patients with ( 50% LAD stenosis than in patients with no significant stenosis. The CFR of patients with a left ventricle wall thickness of ( 12mm was lower than in those without LVH. The multivariate analysis of the aforementioned factors showed that LVH was the factor most influencing to the CFR (  $p < 0.05$  ) . Conclusion : When using CFR as a functional parameter of LAD stenosis, one should consider LVH as one of the factors attributed to CFR modification.

## **The Effect of Gender on Short- and Long-term Clinical Outcomes of Percutaneous Coronary Intervention in Korean Octogenarians**

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**B**ackground and Objectives : Previous studies examining the gender differences in patients undergoing percutaneous coronary intervention (PCI) have reported that women have a higher in-hospital mortality rate, and are at an increased risk for adverse outcomes compared to men. The aim of this study was to determine whether or not Korean women undergoing contemporary PCI have a higher risk than men. Subjects and Methods : Seventy eight elderly patients with 105 lesions, including 33 women (47 lesions, 81.9±1.97 year-old) and 45 men (58 lesions, 81.6±1.74 year-old) who underwent PCI from Jan 1996 to Apr 2001 were enrolled in this study. The demographics, angiographic findings and the clinical outcomes of each gender were compared. Results : Clinical diagnosis and risk factors for atherosclerosis for males and females were similar with the exception of their smoking status (36.7% vs. 14.8%,  $p=0.002$ ) and stroke history (9.1% vs. 0%,  $p=0.038$ ). There were no differences in the major in-hospital complications including cardiac death (12.1% vs 15.6%,  $p=0.75$ ), acute myocardial infarction (AMI : 3% vs. 0%,  $p=0.42$ ), rescue PCI (3% vs. 0%,  $p=0.42$ ) and emergent coronary artery bypass grafts (CABG : 6.1% vs. 11.1%.  $p=0.44$ ) between the two groups. A twelve-month clinical follow-up showed that the major adverse cardiac events including cardiac death (17.8% vs 28.9%,  $p=0.27$ ), AMI (0% vs. 5.3%,  $p=0.5$ ) and repeated revascularization (20.7% vs. 15.8%,  $p=0.6$ ) in males and females were also similar. Conclusion : PCI in Korean female patients older than 80 years can be performed with a comparable procedural success rate and clinical outcomes to those of elderly male patients.

## **Clinical Usefulness of Noninvasive Measurement of Coronary Flow Velocity Reserve with Transthoracic Doppler Echocardiography for Detection of Restenosis after Revascularization of Left Anterior Descending Coronary Artery**

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**B**ackground and Objectives : The measurement of the coronary flow velocity reserve (CFR) using transthoracic Doppler echocardiography (TTDE) has been reported to be useful for assessing the physiological significance of left anterior descending coronary artery (LAD) stenosis. This study was performed to evaluate the usefulness of CFR by TTDE for diagnosis of restenosis following revascularization procedures. Subjects and Methods : Patients who were scheduled for follow-up coronary angiography following percutaneous intervention, or coronary bypass, surgery for a LAD lesion were enrolled. Prior to the follow-up coronary angiography, flow velocities in the distal LAD were measured by TTDE, both at rest and during the intravenous infusion of adenosine. CFR was defined as the ratio of the hyperemic to the basal peak diastolic velocities. Angiographic restenosis was defined as a diameter stenosis of more than 50% of the normal value by a quantitative coronary angiography. Of 142 consecutive patients, measurement of the CFR was possible in 95% (n = 135), with 39 patients having a myocardial infarction in the LAD territory. The remaining 96 patients were used as the subjects of this study. Results : The diameter stenosis was  $41 \pm 26\%$ , with angiographic restenosis found in 33 patients (34%). The mean CFR by TTDE was  $2.5 \pm 1.1$ . CFR  $< 2.0$  was used to diagnose restenosis, with a sensitivity and specificity of 79% (26/33) and 89% (56/63), respectively. Conclusion : The noninvasive measurement of the CFR with TTDE is highly feasible, and can be a useful diagnostic modality for restenosis of a LAD following a revascularization procedure.



## **The Study of Coronary Spasm by Follow-up Coronary Angiography in Variant Angina**

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**B**ackground and Objectives : The therapeutic duration of variant angina is controversial. This study sought to determine the remission rates for coronary artery spasms, the factors associated with remission and the changes in spasm sites. Subjects and Methods : Fifty-eight patients were enrolled in the study. Initial, and follow-up, coronary angiographies (CAG), with ergonovine stimulation tests, were performed. Paired CAG were performed at a mean interval of  $27\pm 17$  months. Medication was stopped 3 days prior to the follow-up CAG, and the occurrence of chest pain during these 3 days was studied. Coronary spasms were confirmed by follow-up CAG. Any changes, and the diameters, of spasm sites were analyzed on each paired CAG. Results : The remission rate of coronary spasms was 24% (14 patients), when the smoking group (49 patients) stopped smoking (31 patients), the remission rate was 29% (9 patients). In the current smoking group (18 patients), the remission rate was 6% (1 patient,  $p = 0.05$ ). 31 patients had chest pains after stopping medication prior to their follow-up CAG. Of those patients, 1 patient had a remission (3%). Among another 27 patients with no chest pain, 13 patients had a remission (48%,  $p < 0.001$ ). In 28 out of 44 patients (64%, non-remission), fluctuations in spastic locations were observed at the follow-up CAG. The interval changes in the diameter of the spasm sites were not significant. Conclusion : The non-chest pain group showed higher remission rates, but lack of chest pain did not identify the loss of coronary spasm. Atherosclerosis at spasm sites did not progress, as confirmed by the paired CAG in our study.

## **The Long - Term Clinical Effects of Heparin - Coated Coronary Stent**

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**B**ackground and Objectives : A heparin-coated stent has been reported to be effective in the prevention of restenosis in a porcine model. The aim of this study was to compare the long term effects of heparin-coated and bare stents in patients who underwent percutaneous coronary intervention (PCI), with regard to the clinical and angiographic outcomes. Subjects and Methods : Thirty patients who underwent PCI at Chonnam National University Hospital between July 1999 and December 2000 were randomly assigned into two groups ; Group I had control bare stents (n = 15, 15 lesions, 59±12 years, 13 males) and Group II heparin coated stents (n = 15, 15 lesions, 59±11 years, 14 males). Six months following stenting, follow-up coronary angiograms were performed in 24 (80%) patients. The average follow-up period was 22±6 months. Results : The initial clinical and angiographic characteristics were no different between the two groups. The reference diameters (Group I ; 2.84±0.57 mm, II ; 3.34±0.57 mm), minimal luminal (Group I ; 2.37±0.60 mm, II ; 2.60±0.59 mm) and diameter stenosis (Group I ; 16.8±8.8%, II ; 22.6±8.6%) following stenting, were no different between the two groups. Subacute stent thrombosis was observed in 1 patient (6.7%) of Group I. On follow-up coronary angiograms, the reference (group I ; 2.46±0.34 mm, group II ; 2.70±0.43 mm), minimal luminal diameters (group I ; 1.47±0.59 mm, group II ; 1.64±0.80 mm) and diameter stenosis (group I ; 39.4±25.1%, group II ; 40.8±26.1%) diameters were also no different, and restenosis was observed in 3 (25%) patients of each group. One cardiac death and 3 target vessel revascularizations were observed in each group during follow-up. Conclusion : The heparin-coated coronary stents were not effective in the prevention of coronary stent restenosis.

## **Predictive Value of C-Reactive Protein for Cardiac Events after Coronary Stenting**

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**B**ackground and Objectives : Recent studies have implicated inflammation in the pathogenesis of coronary artery disease. The aim of this study was to determine whether C-reactive protein (CRP) levels are predictive of major adverse cardiac events (MACE) following stenting. Subjects and Methods : The study comprised 193 patients (90 men, 152 unstable angina, mean age 63 years) between October 1999 and March 2001. The patients were classified into 2 groups according to their MACE, [group A ; MACE (+), n = 46 and group B ; MACE (-), n = 147]. Results : During clinical follow-up at a mean duration of 15 months, there was 1 death, 7 myocardial infarctions, 25 cases of revascularization therapy, and 13 recurrent anginas. At 24 hours after stenting, the CRP levels were significantly higher in group A compared to group B (5.4, 0.615.2 vs. 3.1, 0.19.8 mg/L, respectively,  $p < 0.01$ ), with the elevation of the CRP level ( $> 8.0$  mg/L) occurring more commonly in group A than group B (24% vs. 9%,  $p < 0.05$ ). The differences in the CRP levels between the baseline and 24 hours following stenting (CRP 24h-base) were also significantly higher in group A than in group B. After adjustment for age, sex, and cardiovascular risk factor, multi-variate analysis using logistic regression revealed the CRP levels 24 hours after stenting were predictive of MACE, with an odd ratio of 1.6 (95% CI 1.12.2,  $p = 0.01$ ). Conclusion : CRP levels, 24 hours following intervention, are powerful predictor of cardiac events in patients with stable or unstable angina undergoing coronary stenting. These results suggest that the inflammatory responsiveness to coronary intervention can play an important role in predicting cardiac events.

## **Effects of Ramipril on Vascular Response in Patients with Coronary Artery Disease**

**Bong - Kee Cho, MD1, Ki-Rack Park, MD2, Ki-Young Kim, MD2 and Jang - Ho Bae, MD2**

**B**ackground and Objectives : Angiotensin-converting enzyme ( ACE ) inhibitors have been shown to improve the endothelial dysfunction and prevent the development of atherosclerosis in animal models. We performed this study to investigate the effects of the ACE inhibitor, ramipril, on carotid atherosclerosis and endothelial dysfunction of the brachial artery in patients with coronary artery disease ( CAD ) . Subjects and Methods : We studied 69 subjects with a mean age of 59yrs, and divided them into two groups according to ramipril use ( 39 patients with ramipril and 30 without ) . Using a double-blind, randomized, prospective design, we measured the flow-mediated vasodilatation ( FMD ) of the brachial artery and intima-media thickness ( IMT ) of the carotid artery, prior to, and 1, 3 and 6 months following coronary angiograms in CAD patients. Results : The FMD was significantly increased in the ramipril group from  $4.6\pm 2.2\%$  baseline to  $5.3\pm 2.5\%$  at the 1 month follow-up (  $p<0.05$  ) , but at the 3 and 6 month follow-ups no significant changes were found. There were no significant differences in the FMD between the two groups at any of the follow-up periods, and no changes in the IMT were found in relation to time for either group. Conclusion : Ramipril improved the endothelial dysfunction in patients with CAD for the first month ; however this effect did not persist 3 or 6 months after taking ramipril. Ramipril had no effect on the atherosclerotic vascular changes to the IMT of carotid arteries.

## **Optimal Stent Expansion by Nominal Pressure Balloon Inflation : an Intravascular Ultrasound Study**

**Ki-Young Kim, MD1, Seung-Ho Hur, MD2 and Yong-Won Cho, MD3**

**B**ackground and Objectives : Intravascular ultrasound ( IVUS ) , following stent implantation, demonstrated a significant degree of underexpansion, despite the initial appearance of an angiographically successful deployment, in first-generation stents. With improvements in stent designs and delivery systems, the current-generation of stents appear to achieve optimal stent expansion. The purpose of this study was to evaluate optimal stent expansion, by nominal pressure balloon inflation, in the current generation of stents. Subjects and Methods : We evaluated 30 patients having had Nir-Sox, Tristar, S670 or Bx Velocity stents successfully deployed at nominal pressure ( 710 atm ) with delivery balloon system, between March and September 2001, using IVUS. IVUS criterion for optimal stent expansion was defined as a minimal stent area ( MSA ) ratio of  $\geq 0.8$  of the average reference lumen area. Results : The mean nominal balloon pressure was  $8.87 \pm 0.9$  atmospheres and the mean stent size was  $3.38 \pm 0.45$  mm. In reference segments, the minimal lumen diameter and average lumen area, found from the IVUS, were  $3.18 \pm 0.51$  mm and  $8.88 \pm 2.92$  mm<sup>2</sup> , respectively. In stented segments, the minimal stent diameter and MSA were  $2.55 \pm 0.46$  mm and  $6.10 \pm 2.08$  mm<sup>2</sup> , respectively. In only 11 of the 30 patients ( 36.7% ) was the optimal stent expansion, by IVUS, achieved. Conclusion : Despite the development of a balloon delivery system for the current generation of stents, 63.3% of our study patients did not achieve optimal stent expansion, by IVUS, following nominal balloon inflation. Therefore, additional procedure will be required for optimal stent expansion in the current generation of stents.

## **Predictors of Side Branch Occlusion Immediately after Coronary Stenting : an Intravascular Ultrasound Study**

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**B**ackground and Objectives : Previous studies have indicated that side branch occlusion ( SBO ) remains a significant problem in coronary bifurcation lesions during percutaneous intervention. Subjects and Methods : To evaluate the predictors of SBO by intravascular ultrasound ( IVUS ), 35 patients ( 28 males, mean age  $56\pm 11$  years ) were studied at their left anterior descending artery ( LAD ) -diagonal branch ( DB ) bifurcation lesions, prior to coronary intervention for the measurement of the following plaque characteristics : total plaque area ( PA ), PA of the branch-side semicircle, % area stenosis ( %AS ) of the LAD, the presence of bull's eye in the DB, the diameter of the vessel and the ostial lumen of the DB, and the LAD-DB angle. SBO was defined as a persistent reduction in the TIMI flow to  $\leq 1$  by the end of the procedure. Results : The PA of the branch-side semicircle, the vessel diameter and the ostial lumen diameter of the DB all significantly affected the SBO. The total PA and the %AS of the LAD were not related to the SBO. Multivariate analysis identified that the PA of the branch-side semicircle was the only predictor of SBO ( odds ratio 3.2, 95% confidence interval 1.3 to 8.6,  $p=0.015$  ). Conclusion : It appears that the plaque distribution of LAD is a major determinant of SBO. These findings support the theory that the plaque shift ( "snow plow effect" ) may be the mechanism of the SBO following stenting.

## **Comparison of Tissue Perfusion Measured by ST Segment Resolution between Thrombolysis and Primary Stenting in Acute ST Elevation Myocardial Infarction**

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**B**ackground and Objectives : The primary objective of reperfusion therapy in the acute ST elevation myocardial infarction (STEMI) is the recovery of myocardial perfusion in infarct tissue, as well as the restoration of epicardial blood flow. ST segment resolution on the ECG is an index, which represents adequate myocardial tissue perfusion following treatment. Subjects and Methods : Patients with acute STEMI, arriving within 12 hours of the onset of symptom underwent either thrombolysis (n = 40) or primary stenting (n = 51) were used for this study. ST segments on the ECG were measured with hand-held electronic callipers and the results were analysed by a single observer. Results : Thrombolysis therapy was started earlier than primary stenting, although this was not statistically significant (311±171 minutes vs 399±251 minutes, p = 0.61). After treatment, thrombolysis achieved a higher rate of complete ST segment resolution ( $\geq 70\%$ ) compared to primary stenting (20/40 ; 50.0% vs 13/51 ; 25.4%, p = 0.016). However, when the data was corrected for time, the difference between the two modalities was not significant (p = 0.119). ST segment resolution varied significantly (p = 0.026) according to treatment time, regardless of treatment modality. At the 6 month follow up, patients with complete ST segment resolution had a lower rate of major cardiac event (2.1% vs 13.8% p = 0.094). Conclusion : In this study, thrombolysis achieved a higher rate of complete ST resolution compared with primary stenting in acute STEMI. By ad hoc analysis, this result was attributed to the difference in treatment time between the two groups, suggesting successful tissue reperfusion in acute STEMI is determined primarily by the rapidity, rather than the type, of treatment.

## **Serum C-Reactive Protein Level and its Association with H. Pylori Infection and Other Risk Factors in Apparently Healthy Korean**

**Ki Chul Sung, MD and Jin Ho Kang, MD**

**B**ackground and Objectives : Recent studies have demonstrated a direct relationship between C-reactive protein (CRP) levels and the risk factors associated with cardiovascular disease. Some previous studies demonstrated a link between chronic bacterial infections, a persistent cause of inflammation, and raised concentrations of CRP and inflammatory mediators within conventional normal ranges. The aim of this study was to show the association between serum CRP levels with H. pylori infection and cardiovascular risk factors in apparently healthy Koreans. Subjects and Methods : We evaluated the relationship of high sensitivity CRP with H. pylori infection and several cardiovascular risk factors, in a cross sectional survey of 8,347, apparently healthy persons. The study was conducted on 4,813 men and 3,534 women aged 20 years and over. Results : The mean ( $\pm$ SD) age and CRP levels of the population were 47.1 ( $\pm$ 11.5) and 1.12 ( $\pm$ 1.72) mg/L. The seropositive rate of H. pylori infection in our study was 74%. The distribution of CRP was highly skewed toward a lower level than that of previous studies. There were significant positive associations between CRP levels and age, fasting blood sugar, total cholesterol, triglyceride, low density lipoprotein, apolipoprotein B, uric acid, body mass index, waisthip ratio and systolic, and diastolic blood pressures. High density lipoprotein and apolipoprotein A were inversely related to CRP level ( $p < 0.0001$ ). The association between CRP and cardiovascular risk factor was more prominent in women. Age, fasting blood sugar, low density lipoprotein, apolipoprotein B, uric acid and body mass index were significant independent variable following adjustment for dependent variable. H. pylori infection was not associated with raised concentration of CRP levels. Conclusion : The CRP levels among the apparently healthy Koreans were relatively lower than among Westerners. CRP levels were correlated with some cardiovascular risk factors, but H. pylori infection was not associated with serum CRP levels. The role of CRP and H. pylori infection in the prediction of cardiovascular disease should be confirmed in prospective cohort studies.



## **Insulin Sensitivity is Associated with the Presence and Extent of Coronary Artery Disease**

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**B**ackground and Objectives : Insulin resistance has been suggested to be an important risk factor in the development of arteriosclerosis. The correlation between insulin sensitivity and the degree of coronary atherosclerosis in patients with angina pectoris was investigated. Subjects and Methods : The study population consisted of 74 subjects with angina (54 men, 20 women), aged from 31 to 73 years. Coronary angiograms were evaluated by 3 semiquantitative scoring systems (vessel score, stenosis score and extent score) to estimate the extent of focal and diffuse coronary artery disease (CAD). Insulin sensitivity (K ITT) was determined by an insulin tolerance test. Results : There were significant correlations between K ITT and all 3 coronary scores. Multivariate analysis revealed significant and independent correlations between all 3 coronary scores and K ITT , even in patients without diabetes mellitus. Both HDL cholesterol level and K ITT were significantly lower in patients with CAD than in those without. Conclusion : Decreased insulin sensitivity was significantly associated with the presence and extent of CAD. These results suggest the potential benefits of insulin-sensitizing treatment strategies for patients with decreased insulin sensitivity.

## **Apolipoprotein B-100/Apolipoprotein A-I Ratio is on Useful Indicator for Coronary Artery Disease in Koreans**

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**B**ackground and Objectives : Little is known about the relationship between the apolipoprotein (apo) B-100, or the apo B-100/apo A-I ratio, and coronary artery disease (CAD). The aim of this study was to investigate this association. Subjects and Methods : Our study was carried out on 194 patients who had undergone elective coronary angiography (CAG), but had received no lipid-lowering medication. Patients with acute myocardial infarction were excluded. Stenosis of  $\geq 50\%$  in 1 or more coronary arteries was classified as CAD (+). Results : HDL-C and apo A-I were significantly higher in females than in males ( $p = 0.009$  and  $0.036$ ). In our population we found that the apo A-I, HDL-C and the apo B-100/apo A-I ratio were significantly related to CAD ( $p = 0.001$ ,  $0.006$ , and  $0.007$  respectively). In the male group ( $n = 111$ ), the apo B-100/apo A-I ratio was the only parameter statistically significant to CAD after correcting for age, diabetes mellitus and hypertension. Whereas, in the female group ( $n = 83$ ), the apo B/apo A-I ratio, apo B-100/apo A-I ratio, apo B-100, nonHDL-C, triglyceride, apo B, total cholesterol and low-density lipoprotein cholesterol were all significantly related to CAD ( $p = 0.002$ ,  $0.003$ ,  $0.003$ ,  $0.007$ ,  $0.007$ ,  $0.009$ ,  $0.012$  and  $0.012$  respectively). Of these parameters only the apo B-100/apo A-I ratio was significantly related to CAD in both female and male group. Conclusion : The apo B-100/apo A-I ratio is an useful indicator for discriminating between CAD (+) and CAD ().

## **The Effects of <sup>166</sup>Ho - Loaded Radioactive Stent in a Porcine Model**

**Dong Chea Lee, MD3, Myung Ho Jeong, MD1 Kun Hyung Kim, MD3, Han Sle Lee, MD3**

**B**ackground and Objectives : Vascular brachytherapy known to be an effective method in the prevention of restenosis following percutaneous coronary intervention ( PCI ) . In this study we observed the effects of a radioisotope-loaded stent in a porcine model. Materials and Methods : Holmium-166 ( <sup>166</sup>Ho ) was loaded onto the stent surface using impregnated polyurethane, and placed the stents into 7 porcine coronary arteries. Four weeks after stent overdilation injury, histopathological examination was performed. Results : The absorbed dose of <sup>166</sup>Ho to the coronary artery, from the  $158.5 \pm 140.9$   $\mu$ Ci <sup>166</sup>Ho stent, was about 141 Gy at a depth of 0.5 mm, which was calculated by Monte Carlo EGS 4 Code. The mean external, and internal elastic lamina areas, the luminal and neointimal areas and the histopathological area stenosis in the 7 porcine coronary arteries were  $7.6 \pm 2.8$  mm<sup>2</sup>,  $4.7 \pm 1.6$  mm<sup>2</sup>,  $2.4 \pm 1.4$  mm<sup>2</sup>,  $2.3 \pm 1.6$  mm<sup>2</sup> and  $49.4 \pm 24.9\%$ , respectively. The histopathological findings revealed remarkable inflammatory reactions and thrombosis in two of the porcine coronary arteries. Conclusion : <sup>166</sup>Ho radioactive loaded stents, using impregnated polyurethane, may inhibit neointimal hyperplasia, but the problems of stent thrombosis and inflammation should be solved.

## **Effect of Adjuvant Balloon Inflation on Infarct Artery Flow after Primary Stenting**

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**B**ackground and Objectives : Slow flow or no-reflow during the primary angioplasty is associated with a poor prognosis. The impact of adjuvant balloon inflation on infarct artery flow after successful primary stenting has not yet been studied. Therefore, we investigated the effect of adjuvant balloon inflation on infarct related artery flow after successful stenting in patients with acute myocardial infarction. Subjects and Methods : The changes in infarct artery flow before and after adjuvant balloon inflation were assessed in 46 patients with a first episode of acute myocardial infarction ( pain duration  $\leq 12$  hr ) who underwent adjuvant balloon inflation after successful primary stenting. Infarct artery flow was evaluated by corrected TIMI frame count ( CTFC ) . Results : After adjuvant balloon inflation, 20 patients ( 43% ) showed a slower flow. The minimal lumen diameter became greater (  $3.0 \pm 0.5$  mm vs.  $3.2 \pm 0.5$  mm,  $p = 0.002$  ) and the residual stenosis lessened (  $12.2 \pm 9.6\%$  vs.  $6.4 \pm 8.1\%$ ,  $p < 0.001$  ) . There was no change in reference vessel diameter. CTFC was significantly increased after adjuvant balloon inflation (  $21.6 \pm 11.5$  frames vs.  $26.9 \pm 20.5$  frames,  $p = 0.005$  ) . On multivariate analysis, only pre-adjuvant balloon CTFC was a predictor of a slower flow after adjuvant balloon inflation ( odds ratio 1.148, 95% CI : 1.014-1.301 ) . Conclusion : Adjuvant balloon inflation after successful primary stenting reduced residual stenosis but deteriorated the infarct artery flow. Further studies are required to define the clinical impact of the positive and negative effects of adjuvant balloon inflation.

## **The Usefulness of Cardiac Troponin as a Marker for the Detection of Minor Myocardial Injury Following Percutaneous Coronary Intervention**

**Ju Han Kim, MD1, Myung Ho Jeong, MD2, Du Sun Sim, MD1, Seng Hyun Lee, MD1,**

**B**ackground and Objectives : The purpose of the study was to evaluate the usefulness of cardiac troponin as a marker for the detection of minor myocardial injury following percutaneous coronary intervention (PCI). Subjects and Methods : In 79 patients who underwent successful PCI under the diagnosis of stable angina, serum creatinine kinase MB isoenzyme (CK-MB), cardiac troponin T (cTnT), and cardiac troponin I (cTnI) were measured before and at 6, 12 and 24 hours after PCI, and the angiographic findings and procedural characteristics of PCI were compared between the elevated and the normal enzyme groups. Results : Abnormal values of one or more markers following PCI were observed in 17 patients (22%) ; 11 after stenting and 6 after balloon angioplasty alone. The frequency of abnormal cTnI levels was 19% and was significantly higher than that of CK-MB (6%,  $p < 0.01$ ). No significant differences in target vessel number, target artery, ACC/AHA type, TIMI flow, stenting, time and number of ballooning, maximal inflation pressure or balloon diameter and length were observed between the two groups. Small side branch occlusions developed in 23% of the elevated enzyme group and in 3% of the normal enzyme group. Conclusion : Minor myocardial injury can be detected by cTnI and is observed frequently in patients with stable angina following PCI. A small side branch occlusion is related with elevated cTnI.

## **The Effects of Beta-Radiation Using a Holmium-166 Coated Balloon on Neointimal Hyperplasia in a Porcine Coronary Stent Restenosis Model**

**Weon Kim, MD1, Myung Ho Jeong, MD3, Sang Rok Lee, MD1, Ok Young Park, MD1,**

**B**ackground and Objectives : Brachytherapy is a promising method in the prevention and treatment of coronary stent restenosis. We sought to observe the therapeutic effects of a radioactive balloon loaded with Holmium-166 ( $^{166}\text{Ho}$ ) in a porcine coronary stent restenosis model. Materials and Methods : A radioisotope of  $^{166}\text{Ho}$  was coated on the balloon surface using a polyurethane coating (20 Gy in 0.5 mm depth). Stent overdilation injuries were performed in two coronary arteries in 8 pigs. Four weeks after the stent overdilation injury, radiation therapies were performed using a control balloon dilation in one coronary artery (Group I : n=8) and a  $^{166}\text{Ho}$ -coated balloon in the other coronary artery in each pig (Group II : n=8). Follow-up coronary angiogram and histopathologic assessment were performed at 4 weeks after the therapy was administered. Results : Laboratory findings did not differ significantly between the pre-treatment baseline and the measurements taken after radiation. On quantitative coronary angiogram, the coronary artery diameters were not significantly different between the two groups before stenting or at 4 and 8 weeks after stenting. On histopathologic analysis, injury score, internal elastic lamina area and lumen area did not differ significantly between the two groups. The neointimal area was  $1.78\pm 0.11\text{ mm}^2$  in group I and  $1.36\pm 0.12\text{ mm}^2$  in group II ( $p=0.017$ ), and the histopathologic area of stenosis was  $35.1\pm 1.6\%$  in Group I,  $27.6\pm 1.9\%$  in Group II ( $p=0.005$ ). Conclusion : A treatment of beta-radiation in a stented porcine coronary artery using radioactive Ho-166 coated balloon inhibits stent restenosis without any side effects.

## **A Prospective, Randomized Comparison of Clinical Outcomes of the CrossFlex and NIR Stents in Coronary Intervention**

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**B**ackground and Objectives : This prospective single-center randomized clinical study was designed to evaluate the long-term angiographic and clinical outcomes of elective treatment using the Crossflex (coil stent) as compared with the NIR (tubular stent) in patients with native coronary artery disease. Subjects and Methods : 104 patients with 107 de novo discrete coronary stenoses were randomly assigned to the NIR stent (54 coronary stenoses) or the Crossflex stent (53 coronary stenoses). Six-month follow-up angiograms were obtained in 83 patients with 86 lesions (80%). Clinical follow up was available in all patients and the period averaged  $23.1 \pm 5.3$  months in the Crossflex group and  $23.1 \pm 6.2$  months in the NIR group. Results : Procedural success was measured at 100% in both groups. There were no cases of stent thrombosis in either group. Although a higher loss index and more severe follow-up diameter stenosis occurred in the crossflex group, the angiographic restenosis rate was not significantly different in between the groups (35.0% for the Crossflex group versus 19.6% for the NIR group,  $p = 0.11$ ). The target lesion revascularization rate was also similar in both groups (13.5% for the Crossflex versus 14.8% for the NIR group,  $p = 0.55$ ). The two-year event free survival rate was not significantly different =between the groups ( $70.8 \pm 8.3\%$  in Crossflex group and  $78.1 \pm 6.6\%$  in NIR group,  $p = 0.36$ ). Conclusion : In terms of the treatment of discrete native coronary artery disease, the angiographic and long-term clinical results of the Crossflex stent were not significantly different from those obtained with the NIR stent.





## **The long - term clinical outcomes of low molecular weight heparin in patients with unstable angina underwent percutaneous coronary intervention**

**B**ackground: Antithrombotic therapy with heparin reduces the rate of ischemic events in patients with acute coronary syndrome. Low-molecular-weight heparin (LMWH), given subcutaneously twice daily, has a more predictable anticoagulant effect than standard unfractionated heparin, is easier to administer and does not require monitoring. Methods: We prospectively analyzed 180 patients with unstable angina who underwent percutaneous coronary intervention (PCI) between 1999 and 2001 at Chonnam National University Hospital to receive either 120 U/kg of Dalteparin (Fragmin), administered subcutaneously twice daily (group I; n=90, 61.8±8.9 years, male 67.8%), or continuous intravenous unfractionated heparin (group II; n=90, 62.6±9.7 years, male 70.0%). During hospitalization and at 6 month after PCI, major adverse cardiac events such as acute myocardial infarction, target vessel revascularization, death, or restenosis were examined. Results: During hospitalization, the incidence of acute myocardial infarction, target vessel revascularization and death were not different between two groups. At follow-up coronary angiography at 6 month after PCI, the incidence of restenosis was lower in group I than in group II (Group I; 26/90, 28.8% vs. Group II; 32/90, 35.6%, p=0.041) and the incidence of target vessel revascularization was lower in group I than in group II (Group I; 21/90, 23.3% vs Group II; 27/90, 30.0%, p=0.039). There was no difference in the rate of major and minor hemorrhage, ischemic stroke and thrombocytopenia between two groups. In the multivariate analysis, factors relating to restenosis were lesion length, postprocedural minimal luminal diameter, CRP on admission, diabetes mellitus, type of heparin, stent use. Conclusion: Dalteparin, a LMWH, is superior to standard unfractionated heparin for reducing restenosis rate and target vessel revascularization without increasing bleeding complications.

## **An elevated value of C - reactive protein is the only predictive factor of restenosis after percutaneous coronary intervention**

**B**ackground: Current techniques of percutaneous coronary interventions (PCI) remain limited by the restenosis. Recent studies provide evidence that inflammation plays a role in the pathogenesis of cardiovascular disease. Methods: We prospectively tested whether inflammatory markers are predictors of subsequent restenosis in 272 consecutive patients with angiographically proved coronary artery disease. The patients who underwent PCI at Chonnam National University Hospital between Sep. 1999 and Mar. 2001 were divided into two groups according to the occurrence of restenosis on follow-up coronary angiogram: patients with restenosis (Group I: n=99, 59.5×10.8 years, M:F=77:22) and patients without restenosis (Group II: n=173, 58.8×10.2 years, M:F=131:42). IgG seropositivity and titer of CMV, C. pneumoniae, H. pylori, levels of C-reactive protein (CRP) were compared between two groups. Results: There were no statistical differences in the seropositivity of CMV IgG, C. pneumoniae IgG, H. pylori IgG between two groups (Group I vs. II: 100% vs. 100%, 24.7% vs. 25.7%, 62.2% vs. 63.7% in group I vs. II respectively). Among angiographic parameters, low TIMI flow (TIMI 0 or I) was more common in Group I than in Group II (p=0.038). The patients with elevated CRP (>0.5 mg/dL) were more common in Group I than those in Group II (57.6% vs. 36.4%, p=0.001) and the value of CRP was higher in Group I than in Group II (3.3±5.8 mg/dL vs. 1.3±2.6 mg/dL, p=0.001). According to multiple logistic regression analysis, CRP was the only predictor of restenosis with odd ratio of 2.1169 (95% C.I. 1.2062-3.7154, p=0.009). Conclusion: The value of CRP is the most important predictor of restenosis after PCI.

## **Long - term clinical benefit of a platelet glycoprotein IIb / IIIa receptor blocker ( Abciximab ; ReoPro ) in diabetic patients undergoing high - risk percutaneous coronary intervention**

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**B**ackground: High-risk percutaneous coronary interventions (PCI) are associated with high complication rate, low procedural success rate and high restenosis rate, especially in diabetics. We sought to observe whether diabetes affects long-term clinical outcomes after Abciximab (ReoPro) therapy in Korean patients undergoing high-risk PCI. Methods: One hundred nineteen patients with 152 lesion sites were administered ReoPro out of 2,231 patients who underwent PCI at Chonnam National University Hospital from Mar 1999 to Feb 2001. They were divided into two groups, 30 in diabetic group (Group I, 57.7±8.2 years, 22 male) and 89 in non-diabetic group (Group II, 59.6±10.8 years, 68 male). Early and long-term clinical outcomes after PCI were analyzed. Results: In clinical diagnosis the number of acute myocardial infarction was 25 in Group I (83.3%) and 76 in Group II (85.4%). As for risk factors and target lesion artery, ACC/AHA types, there were no differences between the two groups. The number of patients with total occlusion was 21 (55.3%) and 62 (53.9%) and thrombus-containing lesion 28 (93.3%) and 88 (98.9%) in Group I and II respectively. Procedure was successful in 27 (90.0%) in Group I and 80 (89.9%) in Group II and there were no differences in bleeding complications. No major adverse cardiac events (MACE), including myocardial infarction, repeat revascularization or cardiac death were observed in Group I, but there were 8 cases of MACE in Group II during hospitalization. Clinical follow-up was performed in 116 patients (97.5%) during 18.5±6.7 (5-28) months. The number of overall MACEs were 10 (3.3%) in Group I and 14 (15.7%) in Group II (p=0.038). Conclusion: ReoPro used in high-risk PCI in diabetics was effective in early clinical outcome, but long-term clinical benefits were not warranted.

## The inhibitory effect of Platelet glycoprotein 2b / 3a receptor blocker - coated stent on porcine coronary stent restenosis

Background: The problems of coronary stent thrombosis and restenosis still remain to be solved. The glycoprotein lib/IIIa receptor blocker, Abciximab (ReoPro), plays important roles in the treatment of high-risk patient with acute platelet-rich thrombus and in the inhibition of smooth muscle cell proliferation. The aim of this study was to determine whether the use of ReoPro-coated stents could reduce the neointimal formation in a porcine coronary stent restenosis model. Methods: ReoPro was coated on the surface of stent by means of plasma polymerization followed by chemical grafting. Stent overdilation injury was performed with control bare stent (Group I, n=13), and ReoPro-coated stents (Group II, n=14). Follow-up quantitative coronary angiogram was performed at 4 weeks after stenting and histopathologic assessment were compared in both groups. Results: The diameter stenosis by QCA between two groups was significantly higher in Group I ( $23\pm 5\%$  vs.  $15\pm 7\%$ ,  $p=0.003$ ). On histopathologic examination, no in-stent thrombus was observed. The percent area stenosis was significantly higher in Group I than in Group II ( $48\pm 17\%$  vs.  $30\pm 16\%$ ,  $p=0.01$ ). The area of neoinima was larger in Group I than in Group II ( $3.2\pm 1.2$  mm vs.  $2.0\pm 1.0$  mm,  $p=0.01$ ). By immunocytochemistry, proliferation cell nuclear antigen indices were higher in Group I ( $4.2\pm 2.1\%$ , vs  $2.4\pm 1.8\%$   $p=0.03$ ). Conclusion: The ReoPro-coated stent is safe and effective in the prevention of in-stent thrombus and restenosis, which may be related with the inhibition of platelet thrombus and neointimal cell proliferation.

## KOREAN PAPER

1. The Relationship of the C-514T Polymorphism of the Human Hepatic Lipase Gene Promoter with Plasma HDL-C Concentrations in Koreans

Kyung-Woo Park, MD; In-Ho Chae, MD; Jin-Ho Choi, MD; Jae-Ran Ju, MS ; Seil Oh, MD; Cheol-Ho Kim, MD; Dae-Won Sohn, MD; Byung-Hee Oh, MD; Myoung-Mook Lee, MD; Young-Bae Park, MD; and Yun-Shik Choi, MD

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2. Apolipoprotein E Polymorphism in Patients with Myocardial Infarction

Ho Seuk Jeong, MD; Sung Koo Kim, MD; Sang Cheol Lee, MD; Duk Won Bang, MD; Won Yong Shin, MD; Young Keun On, MD; Sung Choon Choe, MD; Chul Hyun Kim, MD; Tae Myoung Choi, MD; Min Su Hyun, MD; Eun Seuk Jeon, MD; and Young Joo Kwon, MD

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3. Subject Functional Severity of Coronary Stenosis in Relation to Luminologic Severity in AMI ; Comparison with Angina

Eui Soo Hong, MD; Jeong Kee Seo, MD; Ki Hoon Lee, MD; Dae Hyeok Kim, MD; Hyo Jung Lee, MD; Hoon Gi Park, MD; Jun Kwan, MD; Keum Soo Park, MD; and Woo Hyung Lee, MD

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4. Clinical Outcome and ECG Change in Patients with Acute Myocardial Infarction and Prodromal Angina

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**The Korean Society of Circulation 2001 Jan;31(6):**

**Association of Neutrophil Adhesion Molecules Expression and Change of sICAM-1 Concentration after Coronary Artery Stenting with Later Restenosis**

**Jin-Su Hwang, Jei-Keon Chae, Bang-Ju La, Byung-Hyun Rhee, Won-Ho Kim, Jae-Ki Ko**

**Background :Neointimal hyperplasia, as the most important mechanism of restenosis after intracoronary artery stenting, its severity is closely correlated with the degree of local inflammatory reaction initiated by vascular**

injury during stenting procedure. So, we proceeded this study to determine whether inflammatory markers such as CD11b/CD18 (Mac-1) adhesion molecules of neutrophils, sICAM-1 (soluble intercellular adhesion molecule-1), ESR, and CRP increase or not in the peripheral circulation after coronary artery stenting, and whether there is any association between these findings and the degree of later restenosis.

**Method :** 32 patients (chronic stable angina 4, unstable angina 17, acute myocardial infarction 11) underwent single vessel coronary artery stenting were enrolled in our study. Blood samples were obtained from peripheral vein just before coronary artery stenting and 48 hours thereafter. The degrees of CD11b/CD18 expression on the surface of neutrophils were analyzed by flow cytometry with monoclonal antibodies, and sICAM-1 by ELISA method. At each times, ESR and CRP were also measured. Follow-up coronary artery angiography was performed with QCA analysis at least 6 months later. We compared the each 48 hours values with the baseline (just before procedure) values. Percentage increments (as a ratio 48 hours values to baseline) of CD11b/CD18 expression, sICAM-1, ESR, and CRP levels were also compared with the results of follow-up QCA analysis.

**Results :** Restenosis (diameter stenosis  $\geq 50\%$ ) occurred in 6 patients (19%) at follow up angiography. 48 hours values of CD11b/CD18 expression, sICAM-1, ESR, and CRP were significantly elevated from the baseline values (each p values, CD11b :  $< 0.0001$ , CD18 :  $0.01$ , sICAM-1 :  $< 0.0001$ , ESR :  $0.005$ , and CRP :  $0.001$ ). The percentage increments of CD11b/CD18 expression were more elevated in restenosis group than nonrestenosis group (CD11b :  $341 \pm 215\%/74 \pm 95\%$ , CD18 :  $84 \pm 60\%/17 \pm 37\%$ , each  $p < 0.001$ ,  $0.001$ ). There was some positive correlation between the percentage increments in the expression of CD11b and the late loss index at the follow up angiography ( $r=0.43$ ,  $p<0.05$ ).

**Conclusions :** Through this study, we found that the activation of neutrophils was occurred, and that sICAM-1 level was increased after coronary artery stenting in the peripheral blood. There was some correlations between the degree of CD11b expression on the surface of neutrophils and the severity of late lumen loss of inserted stents. The measurements of increased neutrophil adhesion molecules of CD11b/CD18 levels at 48hrs after coronary stenting may have a value as the predictor of subsequent late restenosis

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Predictive Factors for the Restenosis after Long Coronary Stent Implantation

Yun Ah Kim, Myung Ho Jeong, Jang Hyung Cho, Jong Cheol Park, Sang Hyun Lee, Kyung Tae Kang, Jay Young Rhew, Nam Ho Kim, Kun Hyung Kim, Seung Uk Lee, Young Keun Ahn, Jeong Gwan Cho, Jong Chun Park, Sang Ki Cho, Sang Hyung Kim, Jung Chae Kang

**Background and Objectives** :In-stent coronary restenosis remains one of major clinical problems in percutaneous coronary intervention. Long stent has been known to be associated with high restenosis rate. Predictive clinical and angiographic factors were analyzed after long coronary stenting.

**Methods** :One hundred four patients (57.2±9.6 year-old, 105 male) who underwent long coronary stent implantation and follow-up coronary angiogram, out of 237 patients implanted long coronary stents between June 1996 and January 1999 at Chonnam National University Hospital.

**Results** :Primary success rate was 100%. Lesion length was 18.5 ± 9.2 mm and the length of stent was 27.3 ± 6.1 mm. Mean duration of clinical follow-up and follow-up coronary angiogram was 20.1±6.8 months and 6.3±2.7 months respectively. Restenosis rate according to follow-up coronary angiogram was 42.5% (57/134). Clinical variables of age, sex, clinical diagnosis, risk factors, and angiographic variables of target artery and lesion types, indications for stenting, stent types, reference diameter, lesion length, minimal luminal diameter, and acute gain were not related with late stent restenosis. Diameter stenosis before stenting was higher in the group with restenosis (81.9±16.9 %) than in group without restenosis (71.1±18.5%; p<0.05), and lower lower in the group with restenosis (-7.6±15.7%) and in the group without restenosis (5.6±22.4%; p<0.05) after stenting.

**Conclusions** :

Primary success rate was comparable. Severe luminal stenosis before stenting and overdilation after stenting are associated with restenosis after long coronary stenting.

The Korean Society of Circulation 2001 Jan;31(4):

Early outcome and Restenosis rate after Coronary Artery Stenting in the Elderly

Sang Hyun Lee, Myung Ho Jeong, Ok Young Park, Weon Kim, Kye Hun Kim, Kyung Tae Kang, Jay Young Rhew, Jong Cheol Park, Young Keun Ahn, Jeong Gwan Cho, Jong Chun Park, Jung Chae Kang,

**Background and Objectives**

With the prolonged life expectancy and changes in dietary habits in Korea, the number and percentage of elderly patients with ischemic heart disease(IHD) has been increased. Primary success rate and long-term clinical outcomes of elderly patients were compared with younger patients, who underwent coronary artery stent(CAS).

**Materials and Method**

A retrospective analysis of 379 patients, who underwent CAS at Chonnam National University Hospital from January 1993 to June 1998, was performed. Clinical characteristics, lipid profiles, coronary angiographic findings, success rates and in-hospital mortality rates and follow-up coronary angiographic findings of elderly patients older than 70 years (Group I; n=91, 73±4 years) were compared with the patients under the age of 70 years (Group II; n=288, 56±11 years).

#### Results

Female was more prevalent in Group I than Group II (41/91, 45.1% vs. 57/288, 19.9%, P<0.001). Ejection fraction was lower in Group I than in Group II (56.9±6.4 vs. 63.8±15.3 %, P<0.05) and left ventricular end-diastolic pressure was higher in Group I (17.9±7.9 vs. 14.0±7.7 mmHg, respectively P<0.05) than in Group II. There were no significant differences in the distribution of the risk factor except for smoking (Group I; 26/91, 28.6% vs Group II; 130/288, 45.3%, P<0.05). Lesion and procedural characteristics were not different between two groups. Primary success rate of Group I was 94.5%(86/91) and 96.5%(278/288), which were not different between two groups. On follow-up coronary angiogram, restenosis rate was not different between two groups (Group I: 9/37, 24.37% vs. Group II 50/154, 32.5%, P=NS).

#### Conclusion

The initial success rate and restenosis rate of coronary stenting in the elderly patients are not different from those of younger group. Thus coronary stent can be performed effectively in elderly patients.

The Korean Society of Circulation 2001 Jan;31(3):

#### Long-term Clinical and Angiographic Results of Coronary Stenting in Diabetic Patients

Weon Kim, Myung Ho Jeong, Kye Hun Kim, Jong Cheol Park, Sang Hyun Lee, Jae Young Rue, Kyung Tae Kang, Young Keun Ahn, Jeong Gwan Cho, Jong Chun Park, Jung Chae Kang

**Background :**Diabetes is a major risk factor for restenosis and high mortality after percutaneous coronary intervention. The impact of coronary stenting on the clinical outcome of diabetic patients remains controversial. **Method :**The in-hospital and long-term clinical outcomes of 104 consecutive diabetic (60±8 year-old, 74 male) and age-matched 193 control (57±10 year-old, 162 male) patents underwent coronary stenting between January 1998 and March 1999 at Chonnam National University Hospital were compared.

**Results :**1) Coronary stenting was successful in 98% of diabetic patients and 97% of non-diabetic patients. Post-

procedural minimal luminal diameter (MLD) was not different between two groups ( $2.89 \pm 0.42$  vs.  $2.95 \pm 0.62$  mm), but follow-up MLD was lower in diabetics than that in non-diabetics ( $1.70 \pm 0.96$  vs.  $2.05 \pm 0.72$  mm,  $P < 0.05$ ). 2) Restenosis rate on follow-up coronary angiography was not different between two groups (40.7% in diabetics and 32.0% in non-diabetics). 3) In-hospital outcome was not different between two groups. Long-term clinical follow-up ( $16 \pm 11$  months) revealed higher overall major adverse cardiac events in diabetics than in non-diabetics (38.7 vs. 30.7 %,  $P < 0.05$ ).

Conclusion :Coronary stenting in diabetics can be performed with acceptable short-term results. However, long-term clinical outcome in diabetic patients was worse than in non-diabetics.

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#### The Long-term Clinical Outcomes after Rescue Percutaneous Coronary Intervention in Patients with Acute Myocardial Infarction

Young Joon Hong, Myung Ho Jeong, Seung Hyun Lee, Ok Young Park, Jung Woo Kon, Sang Rok Lee, Woen Kim, Kye Hun Kim, Kyung Tae Kim, Jay Young Rhew, Sang Hyun Lee, Jong Cheol Park, Jeong Gwan Cho, Jong Chun Park, Jung Chae Kang

**Background and Objectives:** A rescue percutaneous coronary intervention (PCI) has been used to treat the patients after failed thrombolysis in acute myocardial infarction. However, short- and long-term benefits of rescue PCI has not been known exactly. The goal of this study was to examine the clinical and angiographic outcomes, success rate of the procedure, and long-term survival rate after rescue PCI.

**Materials and Methods:** Clinical and angiographic outcomes of 31 patients (Group I;  $59.7 \pm 11.4$  years, 80.6% male), who underwent rescue PCI were compared with those of 177 patients (Group II;  $59.7 \pm 9.7$  years, 79.7% male), primary PCI at Chonnam National University Hospital between January 1997 and December 1999.

**Results:** There were no significant differences in the risk factors for coronary artery diseases except for smoking (Group I; 24/31, 77.4% vs. Group II; 76/177, 42.9%,  $P < 0.05$ ). The incidence of cardiogenic shock was higher in Group I than in Group II (Group I; 7/31, 22.6% vs. Group II; 11/177, 6.2%,  $P < 0.05$ ). The coronary angiographic findings were not different between two groups. Thrombolysis in Myocardial Infarction flow of Group I was lower than in Group II (Group I;  $1.14 \pm 0.93$  vs. Group II;  $1.61 \pm 1.14$ ,  $P < 0.05$ ). Primary success rate was 93.6% (29/31) in Group I and 94.9% (168/177) in Group II ( $P < 0.05$ ). Baseline ejection fraction was lower in Group I than in Group II (Group I;  $44.2 \pm 8.9\%$  vs. Group II;  $50.8 \pm 11.7\%$ ,  $P < 0.05$ ), which improved in both groups (Group I; 51.7

$\pm 7.9\%$  vs. Group II;  $60.7 \pm 13.4\%$ ,  $P < 0.05$ ) at six months after the procedures. The survival rate of Group I was 93.5%, 93.5% and 90.3% and that of Group II was 94.5%, 93.7% and 91% at 1 month, 6 and 12 months, respectively.

**Conclusion:** Rescue PCI was associated with the risk factor of smoking and the high incidence of cardiogenic shock. The success rate of rescue PCI was comparable with primary PCI and left ventricular function was improved after rescue PCI on long-term clinical follow-up with relatively high survival rate.

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#### Long-term Outcome of Minor Plaque Prolapsed within Stents Documented with Intravascular Ultrasound

June Hong Kim, Myeong-Ki Hong, Sung-Tae Cho, Kyoung-Seok Rhee, Jong-Min Song, Cheol Whan Lee, Duk-Hyun Kang, Jae-Kwan Song, Jae-Joong Kim, Seong-Wook Park, Seung-Jung Park

**Background:** The direct relationship between minor plaque prolapsed within stents and late in-stent restenosis is unknown. Therefore, we evaluated the impact of minor plaque prolapse on late angiographic in-stent restenosis.

**Materials and methods:** Intravascular ultrasound (IVUS) guided single-coronary stenting was successfully performed in 384 consecutive patients with 407 native coronary lesions. Six-month follow-up angiogram was performed in 315 patients (82.0%) with 334 lesions (82.1%). Minor plaque prolapsed within stent occurred in 75 of 334 lesions (22.5%). Results were evaluated using angiographic and IVUS methodology.

**Results:** The development of minor plaque prolapse was significantly associated with infarct-related artery ( $p = 0.000$ ) and smaller pre-intervention minimal lumen diameter ( $p = 0.001$ ). The overall angiographic restenosis rate was 23.1% (77/334); 21.3% (16/75) in the lesions with plaque prolapse vs. 23.6% (61/259) in the lesions without plaque prolapse ( $p = 0.806$ ).

**Conclusion:** Minor plaque prolapsed within stents might not be associated with late angiographic in-stent restenosis.

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## Long-term Outcomes of Minor Dissection at the Edge of Coronary Stents Detected with Intravascular Ultrasound

June Hong Kim, Myeong-Ki Hong, Sung-Tae Cho, Kyoung-Seok Rhee, Jong-Min Song, Cheol Whan Lee, Duk-Hyun Kang, Jae-Kwan Song, Jae-Joong Kim, Seong-Wook Park, Seung-Jung Park

**Background :** The impacts of minor non-flow limiting dissections at the edge of stents on the late clinical outcomes are unknown. Therefore, we evaluated the influences of minor edge dissections on late angiographic in-stent restenosis.

**Subjects & methods :** Intravascular ultrasound (IVUS) guided single coronary stenting was successfully performed in 390 consecutive patients with 420 native coronary lesions. Six-month follow-up angiogram was performed in 327 patients (83.9%) with 348 lesions (82.9%). **Results:** Proximal or distal minor edge dissections were observed in 67 of 348 lesions (19.3%) (proximal in 26 lesions, distal in 37 and both in 4). In distal reference segments, lumen areas and diameters were significantly smaller in the lesions with minor edge dissection ( $p=0.037$  and  $0.025$ , respectively). The overall angiographic restenosis rate was 26.2% (91/348); 29.9% (20/67) in the lesions with minor edge dissections vs. 25.3% (71/281) in the lesions without minor edge dissections ( $p=0.540$ ). All minor dissections disappeared and were completely healed at follow-up IVUS study.

**Conclusion :** Minor non-flow limiting dissections at the edge of stents might not be associated with the development of late angiographic in-stent restenosis.

The Korean Society of Circulation 2001 Feb;31(3):

### Intravascular Ultrasonic Predictors of Intimal Hyperplasia after Coronary Stenting

Joe YH, Hong MK, Park SU, Lee CH, Choin SW, Jo ST, Lee KS, Kang HD, Song JK, Kim JJ, Park SJ

**Background :** Several studies using intravascular ultrasound (IVUS) suggested several factors to predict angiographic restenosis or intimal hyperplasia (IH) after stenting. However, independent factors to predict IH have not been reported. Therefore, we evaluated the independent predictors of IH after stenting.

**Methods:**The serial (pre- and post-intervention, and follow-up) IVUS images were obtained in 77 patients with single stent implantation (GFX in 46 patients and NIR in 31). The matching IVUS image slices at 4 different sites within the same stent (follow-up lesion site, center of the stent and within 2 mm of proximal and distal margin of stent) were selected for serial comparisons. Total 308 matching images were obtained. A number of pre- and post-intervention IVUS variables including remodeling index = (lesion / proximal reference segment) pre-intervention vessel area were entered into multivariate linear regression analysis model to predict percent IH.

**Results:**The independent IVUS predictors of percent IH were pre-intervention plaque burden at follow-up lesion site ( $r=0.252$ ,  $p=0.027$ ) and proximal margin of the stent ( $r=0.245$ ,  $p=0.034$ ), and pre-intervention plaque burden ( $r=0.334$ ,  $p=0.003$ ) and remodeling index ( $r=-0.353$ ,  $p=0.002$ ) at the center of stent, and remodeling index at distal margin of the stent ( $r=-0.230$ ,  $p=0.046$ ). The percent IH positively correlated with pre-intervention plaque burden and inversely with remodeling index.

**Conclusions:**The independent IVUS predictors of greater percent IH are larger pre-intervention plaque burden and smaller remodeling index.

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Meaning of serum antibody to Chlamydia pneumoniae in patients with restenosis after coronary balloon angioplasty or stent insertion

Seong IH, Jeon ES, Choi SJ

**Background:**The relationship between infection of Chlamydia pneumoniae and atherosclerotic disease such as coronary artery disease has been studied because many epidemiologic studies using antibody detection reported positive correlation between them. But there are controversies in the role of Chlamydia pneumoniae to restenosis after angioplasty or stent insertion. This study was purposed on the prevalence of Chlamydia infection in the patients with restenosis after percutaneous coronary intervention (PCI) and the possible role of Chlamydia to restenosis in Korea.

**Methods:**Total 110 subjects were enrolled and age and sex adjusted subjects were divided into 4 groups, angioplasty-no restenosis group ( $n=32$ ), angioplasty-restenosis group ( $n=20$ ), stent-no restenosis group ( $n=32$ ), stent-restenosis group ( $n=26$ ). Serum total cholesterol (TC), triglyceride (TG), HDL-cholesterol (HDL-C) were measured, LDL-cholesterol (LDL-C) was calculated. Serum anti-Chlamydia pneumoniae IgG were measured by ELISA method.

**Results:**There was no significant differences in clinical and lipid profiles between restenosis and non-restenosis groups regardless of balloon angioplasty or stenting. There was no statistical significance in positivity of anti-Chlamydia pneumoniae IgG between restenosis and non-restenosis groups after any PCI.

**Conclusion:**This study could not demonstrate the relationship between Chlamydia infection and restenosis after angioplasty or stent insertion in Korea.

**Key word:** Chlamydia pneumoniae antibody, angioplasty, stent, restenosis

The Korean Society of Circulation 2001 Apr;31(2):

Long-term clinical outcomes in patients with angina and insignificant coronary artery stenosis

Ki Rack Park, Jang Ho Bae Kee Sik Kim, Yoon Nyun Kim Kwon Bae Kim

**Background :**We performed this study to evaluate the long-term clinical prognosis, the effects of anti-anginal medicines on angina, and the factors on recurrence of angina in patients with angina and insignificant coronary artery stenosis (CAS).

**Methods:**The study population was consisted of 372 patients with angina and normal or minimal (less than 50 % stenosed) CAS out of 2475 consecutive patients who were performed coronary angiogram for 3.5 years. We reviewed the medical record of the study population.

**Results:**Myocardial infarction was developed in 2 cases (0.5%), recurrence of angina 59 cases (16%), and no death during mean 19 months follow-up period out of 372 patients. Patients with normal coronary artery (n=266) were younger (mean 54 yrs vs 59 yrs,  $p<0.001$ ), had less incidence of diabetes (5% vs 13%,  $p<0.01$ ), hypertension (19% vs 29%,  $p<0.05$ ), recurrent angina (15% vs 18%, not significant), and myocardial infarction (0.4% vs 0.9%, not significant) than patients with minimal lesion (n=106). Anti-anginal medicine did not show benefits in relieving recurrent angina. Furthermore, in case of taking nitrates in patients with normal coronary artery, there was more frequent recurrence of angina (23% vs 13%,  $p<0.01$ ) than not taking nitrates. There were no affecting factors to the recurrent angina among age, sex, ischemic changes on electrocardiogram, smoking, hypertension, diabetes, and hyperlipidemia.

**Conclusion:**The long-term clinical outcomes in patients with insignificant CAS were good. Although there were no definite factors for recurrence of chest pain, administration of nitrates may cause more frequent angina in patients with normal coronary angiography.

The Korean Society of Circulation 2001 May;31(5):

The Rescue Use of A Platelet Glycoprotein IIb/IIIa Receptor Blocker (Abciximab; Reo-Pro ) in High-Risk Patients with Acute Myocardial Infarction Underwent Percutaneous Coronary Intervention

Weon Kim, Myung Ho Jeong, Kye Hun Kim, Jong Cheol Park, Sang Hyun Lee, Jae Young Rhew, Kyung Tae Kang, Nam Ho Kim, Kun Hyung Kim, Young Keun Ahn, Jeong Gwan Cho, Jong Chun Park, ung Chae Kang

**Background :**Platelets are known to play a major role in the ischemic complications of percutaneous coronary intervention (PCI). Accordingly, we evaluated the effect of rescue use of a platelet glycoprotein IIb/IIIa receptor blocker (Abciximab; Reo-Pro ) in Korean patients with acute myocardial infarction (AMI) at high risk for the ischemic complications who underwent PCI.

**Method:**Sixty eight patients (54 male,  $59.1 \pm 9.96$  years) treated by the rescue use of Reo-Pro out of 1,117 patients underwent PCI at Chonnam National University Hospital from Mar 1999 to Feb 2000. All of target lesions were thrombus-containing lesions in patients with AMI. The primary end points consisted of any of the followings : cardiac death, nonfatal MI, repeated revascularization. The number of end-point events were tabulated at 6 months after PCI.

**Results :**The primary success rate was 92.6% (63/68). At primary end points, there were 5 cases (7.3%), composed of 2 deaths (2.9%), 1 MI, 2 repeated revascularization (2.9%). There was no major bleeding complication after PCI. At secondary end point, there were 23 cases (34.9%) including primary end point, composed of 3 deaths (4.4%), 1 MI and 19 revascularization (28.0%)

**Conclusion :**The rescue Reo-Pro can be used safely and effectively in high-risk Korean patients with AMI

The Korean Society of Circulation 2001 May;31(3):

The Effects of Lipoprotein(a) on Coronary Stent Restenosis

Jay Young Rhew, Myung Ho Jeong, Young Joon Hong, Weon Kim, Kyung Tae Kang, Sang Hyun Lee, Jong Cheol Park, Nam Ho Kim, Kun Hyung Kim, Sung Hwa Kim, Young Keun Ahn, Jeong Gwan Cho, Byoung Hee Ahn, Soon Pal Suh, Jong Chun Park, Sang Hyung Kim, Jung Chae Kang

**Background:**Lipoprotein (a) [Lp(a)] contains apolipoprotein(a), which is a structural homologue of

plasminogen and competes with it for binding sites. It also acts by increasing plasminogen activator inhibitor-1 expression. The objective of this study was to evaluate the relationship between Lp(a) levels and restenosis rate after successful coronary stent placement.

**Methods:**The study included 306 patients who underwent coronary stent placement and follow-up coronary angiogram at Chonnam National University Hospital from August 1996 to June 2000. Restenosis rate was analyzed according to the level of Lp(a); Group I with high Lp(a) (n=77, Lp(a)  $\geq$  36 mg/dL, 58.98.8 years, female: 35.1%) and Group II with low Lp(a) (n=229, Lp(a) < 36 mg/dL, 57.79.8 years, female: 18.8%).

**Results:**1) There was no significant differences in risk factors of atherosclerosis, clinical diagnosis, the number of involved coronary artery, left ventricular function, angiographic lesion characteristics by American College of Cardiology/American Heart Association classification and Thrombolysis In Myocardial Infarction flow in two groups. 2) Angiographic restenosis rates were not different between two groups (group I : 33.8%, group II : 35.4%).

**Conclusion:**Plasma Lp(a) levels are not related with the angiographic restenosis rate after coronary stent placement.

The Korean Society of Circulation 2001 May;31(2):

Treatment of Diffuse In-stent Restenosis with Rotational Atherectomy Followed by Radiation Therapy with a <sup>188</sup>Re-MAG3-Filled Balloon

Seong-Wook Park, June Hong Kim, Siwan Choi, Myeong-Ki Hong, Dae Hyuk Moon, Seung Jun Oh, Cheol Whan Lee, Jae-Joong Kim, Seung-Jung Park

**Background:**Rotational atherectomy has been shown to be safe and efficient for the treatment of ISR, but the recurrence rate is still high. Intracoronary -irradiation after rotational atherectomy may be a reasonable approach to prevent recurrent ISR.

**Subjects & methods:**Fifty consecutive patients with diffuse ISR (length > 10 mm) in native coronary arteries underwent rotational atherectomy and adjunctive balloon angioplasty followed by -irradiation using a <sup>188</sup>Re-MAG3-filled balloon catheter. The radiation dose was 15 Gy at 1.0 mm deep into vessel wall.

**Results:**Mean length of the lesion and irradiated segment was 25.6 12.7 mm and 37.6 11.2 mm, respectively. The radiation was delivered successfully to all patients, with a mean irradiation time of 201.8 61.7 seconds. No adverse event including myocardial infarction, death, or stent thrombosis occurred during the follow-up

period (mean 10.3 3.7 months) and non-target vessel revascularization was needed in one patient. Six-month binary angiographic restenosis rate was 10.4 % and loss index was 0.17 0.31.

Conclusions:-irradiation using 188Re-MAG3-filled balloon following rotational atherectomy is safe and feasible for patients with diffuse ISR, and it may improve the clinical and angiographic outcomes. Further prospective randomized trials are warranted to evaluate the synergistic effect of debulking and irradiation in patients with diffuse ISR.

The Korean Society of Circulation 2001 May;31(1):

### Coronary Brachytherapy

Park SW

(percutaneous trans luminal coronary balloon angioplasty: PTCA) 1978 (restenosis)

stent (1,2). stent 20% PTCA (in-stent restenosis) stent PTCA 40-60% (3).

Stent 가 (FDA) 가 stent stent

DNA 가

Stent

SCRIPPS 55 192Ir placebo , 6 (target vessel revascularization rate: TVR) placebo 44.8%, 11.5% (p=0.01) TVR 74% . 3 가 placebo TVR 48.3%, 192Ir 15.4% (p<0.01) TVR 68% (4). r-WRIST 6 , TVR placebo 58%, 67.7%,

192Ir 19%(p=0.001), 26.2%(p=0.0001) SCRIPPS (5).  
 GAMMA-1 252 stent 192Ir placebo  
 9 event-free survival 28.2%, 43.8%(p=0.12)  
 (6). - START (32P)  
 stent 가 , -WRIST (90Y) 6 22%,  
 TVR 34% -WRIST (7).

(de novo lesion)

Stent 가  
 . Verin - (90Y) 9, 12, 15, 18Gy  
 stent PTCA 28%, 17%, 16%,  
 4% , 18Gy 4% (8). 32P stent  
 (9), BetaCath (90Sr/90Y)  
 (10).

(Edge restenosis, ERS)

ERS 32P stent stent  
 (11), catheter (12). ERS

(geographic miss) (13).

stent  
 가 stent  
 stent 30 , 1 ,  
 30 .  
 stent  
 . -WRIST 가 7.7%, GAMMA-1 5.3% (  
 0.8%) stent (5,6). stent stent  
 (6). ticlopidine clopidogrel  
 가 stent

1.

'stent'

가

2.

가

stent

aspirin ticlopidine

clopidogrel, ( cilostazol) 6

3.

?

<sup>192</sup>Ir

, 90Y

<sup>32</sup>P

<sup>32</sup>P-

, <sup>188</sup>Re-

<sup>188</sup>Re-MAG3

<sup>188</sup>Re-DTPA-

가

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가

가

stent

The Korean society of circulation 2001 Jul;31(7):

Comparison of Core stent and Palmaz-Schatz stent in a Porcine Stent Restenosis Model

Donghoon Choi, Seung-Hyuk Choi, Duk Kyu Cho, Hee Doo Kyung, Jung Rae Cho, Jung Sun Kim, Sung Jin Oh, Seung Hyun Kwon, Yangsoo Jang, Seung Yun Cho

Background and Objectives: The purpose of this study is to compare new Core stent and Palmaz-Schatz (PS)stent in a porcine coronary stent restenosis model.



**Methods:** Twelve pigs underwent balloon injury and followed by implantation of oversized, tubular types of Core and PS stents (stent/artery ratio 1.2:1) in twenty-four coronary arteries. Quantitative analyses of initial and follow-up coronary angiograms at 4 weeks after stenting were performed. By morphometric analysis, the extents of injury and neointimal area were compared between two stented groups. The stent flexibility and longitudinal straightening effect were compared between two groups by the bending test and measurement of the angle changes.

**Results:** 1) Reference vessel diameter, stented artery diameter, and diameter stenosis were not different between two groups. 2) The neointimal area was significantly smaller in the Core stent group than in the PS stent group (1.81 0.67 mm<sup>2</sup> vs 2.93 0.94 mm<sup>2</sup>, p=0.006). 3) Core stent had more flexible property than PS stent. 4) The angle changes after stent implantation were not different between two groups (13.29.0, 14.411.1, p=0.88).

**Conclusion:** Core stent is effective in the inhibition of neointimal formation in a porcine coronary stent restenosis model. And this results may be due to more improved flexibility of the Core stent and further clinical trials may be needed.

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The Role of Fibrinogen, Lipoprotein (a) and C-Reactive Protein in Acute Thrombotic Occlusion after Percutaneous Coronary Intervention

Woo Kon Jeong, Myung Ho Jeong, Sang Rok Lee, Ok Young Park, Ju Hyup Yum, Won Kim, Jae Young Rhew, Nam Ho Kim, Kun Hyung Kim, Young Keun Ahn, Sung Hwa Kim, Jeong Gwan Cho, Soon Pal Suh, Byoung Hee Ahn, Jong Chun Park, Sang Hyung Kim, Jung Chae Kang

**Background:** Acute thrombotic occlusion after percutaneous coronary intervention (PCI) is a serious complication that provokes acute myocardial infarction, cardiac death or emergent bypass surgery. The role of fibrinogen, C-reactive protein (CRP) and lipoprotein (a) [Lp(a)] in the patients who developed acute thrombotic occlusion after PCI was investigated.

**Methods:** The patients with acute coronary syndrome who underwent PCI at Chonnam National University Hospital between Jan. 1999 and Jun. 2000 were divided into two groups according to the occurrence of acute thrombotic occlusion: patients with thrombotic occlusion after PCI (Group I; 62.3 8.8 years, M:F=19:8) and patients without thrombotic occlusion after PCI (Group II; 59.6 10.6 years, M:F=271:95). Clinical and angiographic characteristics, levels of fibrinogen, CRP and Lp(a) were compared between two groups.

**Results:** There were no significant differences in the level of fibrinogen between two groups. The patients with elevated CRP (>0.5mg/dL) were more common in Group I than those in Group II (88.9% vs. 42.3%, p=0.0001)

and the value of CRP was higher in Group I than in Group II (4.97 5.18 mg/dL vs. 2.27 4.23 mg/dL,  $p=0.002$ ). The patients with high Lp(a) ( $>30\text{mg/dL}$ ) were more prevalent in Group I than those in Group II (44.4% vs 18.6%,  $p=0.001$ ). There were no significant differences in the risk factors for coronary artery disease, except for diabetes mellitus (Group I : Group II, 40.7% : 16.9%,  $p=0.002$ ). Thrombolysis in Myocardial Infarction (TIMI) flow of Group I was lower than in Group II ( $p=0.0001$ ). Multiple regression analysis after the adjustment for age, sex and other cardiovascular risk factors, diabetes mellitus, low TIMI flow, high CRP and Lp(a) were independently associated with the occurrence of acute thrombotic occlusion ( $p=0.008$ , 0.0001, 0.031, 0.035, respectively).

Conclusion: The elevated values of CRP and Lp(a), diabetes mellitus, and low TIMI flow are significant predictive factors for the acute thrombotic occlusion in patients with acute coronary syndrome after PCI.

The Korean Society of Circulation 2001 Aug;31(8):

A Randomized Comparison of Cilostazol Versus Ticlopidine Therapy After Elective Coronary Stent Implantation

Jin Ho Song, Chul Yoon, IL Rhee, Jun Yong Jung, Kil Hyun JO, Doo Il Kim, Dong Soo Kim

Background :Percutaneous transluminal coronary angioplasty(PTCA) is a widely acceptable treatment for ischemic heart disease. Restenosis after successful PTCA, which develops in 20 - 30% of all patients, remains a serious late complication. This study was to evaluate the efficacy of cilostazol for the prevention of stent restenosis compared with ticlopidine.

Materials and Methods : Fifty three patients underwent coronary stent implantation were divided in to as group A( $n=25$ ) receiving 100mg aspirin and 200mg cilostazol and group B( $n=28$ ) receiving 100mg aspirin and 500mg ticlopidine from Sep 1998 and Feb 1999 at Pusan Paik Hospital, Inje University. Clinical and laboratory evaluations were performed at regular interval.

Results : There were no differences in baseline characteristics between the two groups. Coronary artery restenosis was observed in 5(20.8%) in group A and 8(26%) in group B respectively, which were not statistically significant ( $p=NS$ ). Minimal luminal diameter was  $2.10\pm 0.89\text{mm}$  in group A and  $1.93\pm 0.65\text{mm}$  in group B ( $p=NS$ ). Two patients in group A had headache, while 6(21.4%) patients of group B developed side effects including thrombocytopenia in 2 patients, skin rash in 2 patients . There was no cardiac death during the follow-up period.

Conclusion : Aspirin plus cilostazol may be safer and equally antithrombotic regimen compared results to aspirin plus ticlopidine after elective coronary stent implantation.

The Korean Society of Circulation 2001 Aug;31(8):

The Level of Interleukin-6 in Coronary sinus and peripheral blood in patients with unstable angina after coronary intervention

Seong-Eun Kim, Soeng Hee Jeon, Si-Hoon Park

Background : It has not been completely understood whether acute phase responses of unstable angina were from the disruption of coronary plaques or from the instability & hypersensitivity of the plaque itself. Meanwhile, plasma IL-6 can be affected by several systemic factors, so it is difficult to conclude that IL-6 level in peripheral blood always reflects that of the coronary sinus blood.

Methods : We measured the IL-6 level in coronary sinus blood and peripheral blood of 14 patients (11 men, 3 women, mean age  $55 \pm 6$  years, range 43 to 65 years) with unstable angina before, and 4, 8, 16, 24, 36 hours after undergoing percutaneous coronary intervention(PCI), respectively.

Results : A statistically significant increase of all IL-6 levels in both coronary sinus blood and peripheral blood after PCI was noted. There was correlation between IL-6 levels in coronary sinus blood and peripheral blood after PTCA(correlation coefficient  $r=0.416$ ,  $p=0.01$ ), but the difference of the concentration of IL-6 between coronary sinus blood and peripheral blood after PCI was increased as time passed. There was no statistically significant relationship between the number of coronary lesions treated with PCI and the amount of elevation of plasma IL-6 level.

Conclusion : It is difficult to infer that IL-6 level in peripheral blood exactly reflect that of the coronary sinus blood, and that plaque rupture induced by PCI is the main cause of elevated plasma IL-6.

The Korean Society of Circulation 2001 Aug;31(8):

Long-term Outcomes of Primary Stenting in Acute Myocardial Infarction

Min Soo Son, Ji Won Son, Gi Soo Park, Dong Kyu Jin, Tae Hoon Ahn, Kwang Kon Koh, In Suck Choi, Eak Kyun Shin, Se Jin Oh

**Background and Objectives:** Primary coronary stenting has been shown to be an effective reperfusion therapy for acute myocardial infarction(AMI). However, few data exist regarding long-term follow-up. We examine the long-term clinical and angiographic outcomes after primary coronary stenting in the early setting of AMI.

**Methods:** Between September 1995 to October 1999, coronary stenting was attempted in 181 consecutive patients admitted with the diagnosis of AMI within 6 hours from the onset of the chest pain. Clinical events, including death, MI, coronary bypass surgery and repeat angioplasty, were recorded for 1 year. Angiogram were obtained at baseline, after stent, at 2 weeks and 6 months.

**Results:** 168 patients(92.8%) of all patients had complete 1 year clinical follow-up. In-hospital deaths occurred in 5 patients(3%). One hundred five patients(62.5%) had follow-up angiography at  $6.4 \pm 2.1$  months after stent implantation and restenosis occurred in 21.9%. Clinical events after 1 year included death in 6.5%, myocardial infarction in 1.2%, bypass surgery in 1.8% and repeat angioplasty in 7.7%. Freedom from any adverse cardiac event at 1 year was 82.2%.

**Conclusion:** Primary stenting is safe and feasible in patients of AMI, even in large thrombus containing lesion and results in excellent long-term outcomes.

The Korean Society of Circulation 2001 Sep;31(9):

**Stromelysin Gene Promoter 5A/6A Polymorphism and Risk of Restenosis after Coronary Angioplasty**

Kee-Hyoung Lee, In-Ho Chae, Hyun-Jai Cho, Soo-Yeon Choi, Jae-Ran Ju, Seong Hoon Park, Dae-Won Sohn, Byung-Hee Oh, Myoung-Mook Lee, Young-Bae Park, Yun-Shik Choi, Young-Woo Lee

**Background:** Remodeling of extracellular matrix is one of the main mechanism of restenosis that is the major limitation of percutaneous coronary angioplasty. Stromelysin is one of the matrix metalloproteinase, which catalyze extracellular matrix of the diseased vessels. We studied the effect of 5A/6A stromelysin promotor gene polymorphism on the restenosis after coronary angioplasty.

**Materials and method:** A total of 64 patients who underwent coronary angioplasty and 6-month follow-up angiogram were enrolled into 4 groups classified by the presence of intracoronary stenting during angioplasty and restenosis in the follow-up angiogram. We analyzed basic clinical data and risk factors for coronary artery disease of all patients. The 5A/6A stromelysin promotor gene polymorphism was analyzed by direct sequencing of polymerase chain reaction products from patient? DNA.

**Results:** We studied clinical data and stromelysin genotype of 51 feasible patients. We found no significant differences of clinical risk factors between the patients with or without restenosis. The allele frequencies of 5A and 6A were 17% and 83% in total study population, 26% and 74% in patient group without restenosis, 6% and 94% in patients with restenosis, respectively. The frequencies of non6A/6A containing 5A allele(5A/5A and 5A/6A) and 6A/6A was 41% and 59% in non-restenotic group and 12.5% and 87.5% in restenotic group. So the relative risk of restenosis for 6A/6A compared to non6A/6A was 4.83(95% CI: 1.15 20.17, p=0.03).

**Conclusion:** Our study for stromelysin 5A/6A polymorphism reveals predominance of 6A allele in Korean patients with coronary artery disease. We conclude that 6A/6A homozygote is the possible genetic risk factor for restenosis after percutaneous coronary angioplasty.

The Korean Society of Circulation 2001 Oct;31(10):

#### Safety of transradial coronary intervention with early discharge in selected patients

Seong Hee Jeon, Young Sook Lee, Ji Eun Chang, Hong Keun Cho, Ick Mo Chung, Seong Hoon Park, Gil Ja Shin, Si-Hoon Park

**Background and Objectives :** Transradial percutaneous coronary intervention enables early ambulation and caused less complications at the puncture site. This study was performed to evaluate the safety of transradial coronary intervention with early discharge in selected patients.

**Materials and Method :** Thirty patients were studied retrospectively. Twenty five patients had transradial percutaneous coronary intervention with next morning discharge and 5 patients had transradial percutaneous coronary intervention on an outpatient basis. Each patient was checked for cardiovascular complication and any other problems at the puncture site immediately after, 2 weeks after and 1 month after the procedure.

**Results :** This study group consisted of 30 patients with a mean age of  $60 \pm 10$  years. The indication for intervention were unstable angina (63.3%), stable angina (20.0%), and restenosis at 6-month follow-up after intervention. A total of 21 stents were implanted at 40 lesions. No major cardiovascular complication nor puncture site complication was reported at 1 month follow-up.

**Conclusion :** Early discharge is supposed to be safe for those with optimal angiographic results and no clinical problems for at least 5 hours after intervention.

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### Acute and Long-term Clinical Outcomes after Coronary Stenting of CrossFlex, GFX and NIR Stents

Sang Hyun Lee, Myung Ho Jeong, Weon Kim, Kye Hun Kim, Kyung Tae Kang, Jay Young Rhew, Jong Cheol Park, Young Keun Ahn, Jeong Gwan Cho, Byoung Hee Ahn, Jong Chun Park, Sang Hyung Kim, Jung Chae Kang

**Background and Objectives:** New coronary stents are displacing for the broader array of lesions, but disagreement remains which device is more advantageous and whether design determines outcomes. The present study investigates the impact of stent design on early and one year outcomes.

**Materials and Method:** A retrospective analysis of 350 patients with 378 lesions ( $60 \pm 10$  years, 265 male), that underwent 181 CrossFlex, 95 GFX, 102 NIR coronary stentings at Chonnam National University Hospital from January 1996 to December 1999, was performed. Early procedural success rates, major adverse cardiac event (MACE) within one year and follow-up angiographic findings in 227 patients (240 lesions, follow-up duration= $8.1 \pm 5.9$  months) were compared among three groups.

**Results:** 1) There were no significant differences in the baseline clinical and angiographic characteristics except the lesion length (CrossFlex: GFX: NIR= $11.5 \pm 5.2$ :  $14.5 \pm 6.7$ :  $13.9 \pm 5.7$  mm,  $p < 0.05$ ). 2) There were no significant differences in early angiographic success rates among three groups (CrossFlex: 98.9%, GFX: 100.0%, NIR: 99.0%). 3) There were no significant differences in late luminal loss (CrossFlex: GFX: NIR= $1.03 \pm 0.69$ :  $1.11 \pm 0.75$ :  $1.09 \pm 0.70$  mm,  $p = \text{NS}$ ), restenosis rates (CrossFlex: 30.6%, GFX: 30.8%, NIR: 28.4%,  $p = \text{NS}$ ) and MACE (CrossFlex: GFX: NIR= $27.6\%$ :  $29.5\%$ :  $27.5\%$ ,  $p = \text{NS}$ ) among three groups.

**Conclusion:** Despite different lesions length, the early and late angiographic outcomes, and MACE within one year were not different among three different types of coronary stents

The Korean Society of Circulation 2001 Oct;31(10):

### Characteristics of Coronary Artery Stenting in the Elderly over 70 Years Old: Short-Term Outcome and Long-Term Angiographic and Clinical Follow-Up

Wook Sung Chung, Chong Jin Kim, Ki Bae Seung, Eun Joo Cho, Keon Woong Moon, Jong Min Lee, Young Suk Oh, Ho Joong Youn, Jang Seong Chae, Ihn Soo Park, Jae Hyung Kim, Kyu Bo Choi, Soon Jo Hong

**Background and Objectives:** The elderly is the fast growing segment of the population in Korea. Elderly patients undergoing coronary revascularization are considered a high-risk group. Few data exist that relate the results of stenting in treating coronary artery disease in the elderly population. This study sought to compare the short- and long-term outcomes of elderly patients undergoing coronary artery stenting with those of younger patients.

**Methods:** All elderly patients 70 years of age who underwent coronary artery stenting between January 1997 and July 1999 (n = 106) at our centers were compared to the patients <70 who underwent coronary artery stenting during the same time period (n = 597).

**Results:** Elderly patients presented with lower ejection fraction (52.9% vs. 57.4%, p = 0.001), more unstable angina (47% vs. 31%, p = 0.003), and more multivessel disease (67% vs. 51%, p = 0.005) than younger patients. Major in-hospital complications including death (0.9% vs. 0.5%, p = NS), procedural acute Q-wave myocardial infarction (0.9% vs. 0.3%, p = NS), and emergency CABG (0% vs. 0.3%, p = NS) did not differ between two groups. And also vascular complication rate was similar between two groups (1.9% vs. 1.0%, p = NS). Angiographic follow-up, obtained in both groups, demonstrated similar restenosis rates (26.5% vs. 24.9%, p = NS). Long-term clinical follow-up at 12 months showed major adverse cardiac events including death, acute myocardial infarction, and repeat revascularization were significantly higher in elderly patients than in younger patients (18.3% vs. 12.6%, p = 0.04).

**Conclusions:** Elderly patients with higher risk factors who underwent coronary artery stenting had similar rates of in-hospital procedural complications and similar rates of 6 months angiographic restenosis, compared to younger patients. Overall rates of major adverse cardiac events in the elderly population at 12 months postcoronary artery stenting were significantly higher than those of younger patients.

The Korean Society of Circulation 2001 Oct;31(10):

The Relationship of Infection and Inflammation with Coronary Restenosis after Percutaneous Coronary

## Interventions

Shin Bae Joo, Myung Ho Jeong, Woo Kon Jeong, Ok Young Park, Sang Rok Lee, Won Kim, Kye Hun Kim, Kun Hyung Kim, Joo Hyup Yum, Jae Young Rhew, Nam Ho Kim, Young Keun Ahn, Jong Hee Shin, Jeong Gwan Cho, Jong Chun Park, Jung Chae Kang

**Background and Objectives:** Possible correlations between the serologic status concerning Cytomegalovirus(CMV), Chlamydia pneumoniae (CP), Helicobacter pylori(HP), their related markers of C-reactive protein(CRP), erythrocyte sedimentation rate(ESR), and the restenosis(RS) in patients underwent percutaneous coronary intervention(PCI) were analyzed. Materials and

**Methods:** The 142 patients(58.0±10.9 year-old, M:F=116:26) with 189 coronary lesions, who underwent follow-up angiography after PCI, were evaluated.

**Result:** The overall RS rate was 47.1%(89/189), and the RS rate according to clinical diagnosis was 50.6% in acute myocardial infarction(MI), 41.8% in unstable angina(UA), 6.3% in stable angina(SA), and 1.3% in old MI. The values of RS rate in acute MI and UA were higher than those of old MI and SA(p=0.02). Thrombolysis In Myocardial Infarction(TIMI) flow was significantly lower in group with RS than without RS(p=0.039). Seropositivities of CMV, CP, HP were not different between groups with and without RS. Titers of CMV and HP were not different between two groups. Positivity of CRP was 56.3% in group with RS and 30.2% in group without RS(p=0.005). Titers of ESR and CRP were higher in group with RS than without RS(20.3±22.4 mm/hr, 2.2±4.5 mg/dL vs. 11.8±11.6 mm/hr, 0.7±0.8 mg/dL, p=0.007, p=0.010 respectively).

**Conclusion:** RS rate after PCI is higher in patients with acute coronary syndrome and low TIMI flow. Inflammatory markers, such as CRP and ESR, might be associated with the RS after PCI.

The Korean society of circulation 2001 Nov;31(11):

Types of In-Stent Restenosis and Predictive Factors for Diffuse Type In-Stent Restenosis

Jong Seon Park, Jun Ho Seok, Gue Ru Hong, Dong Gu Shin, Young Jo Kim, and Bong Sup Shim

**Background and Objectives :** Coronary stents have been used increasingly in the field of coronary intervention.



However, in-stent restenosis (ISR) remains a therapeutic challenge. The subsequent response to repeat intervention in the restenotic lesion may be predicted by the angiographic pattern of ISR. In particular, the restenosis rate following re-intervention in this lesion is higher. This study evaluated the incidence of restenosis types and the predictors for diffuse type ISR.

**Subjects and Methods :** The study population included 66 patients with in-stent restenotic lesions after stent implantation. Angiographic restenosis was defined as a diameter stenosis of  $\geq 50\%$  at follow-up coronary angiography. Patterns of ISR were defined as focal type ( $<10$  mm in length) and diffuse type ( $\geq 10$  mm in length). The patients were divided into two groups according to the angiographic patterns of ISR. Clinical characteristics, pre-stenting angiographic features, and stenting procedure related factors were analyzed. A multivariate logistic regression analysis was performed in order to identify the independent predictors for diffuse-type ISR.

**Results :** Angiographic analysis of 66 restenotic lesions showed diffuse type in 29 lesions (44%) and focal type in 37 (56%). Most of the focal in-stent restenoses occurred in the proximal and mid portions of the stents. The reference diameter ( $3.02 \pm 0.37$  mm vs  $3.25 \pm 0.46$  mm,  $p = 0.046$ ) and post-stenting minimal luminal diameter ( $2.89 \pm 0.36$  vs  $3.19 \pm 0.39$  mm,  $p = 0.002$ ) were significantly smaller in the diffuse type as compared to the focal type, whereas other parameters were significantly different. Using multivariate logistic regression analysis, the only predictive factor for diffuse type ISR was post-stenting MLD (OR = 4.74,  $p = 0.025$ ).

**Conclusion :** Small post-stenting MLD ( $<3$  mm) has a high risk for diffuse type ISR. Therefore, new therapeutic strategies are required for these lesions.

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A Comparison of Clinical Outcomes and Risks for Major Adverse Cardiac Events between the Pre- and Post-Stent Period

Byoung Keuk Kim, Dong Hoon Choi, Dong Ki Kim, Hyun Jin Kim, Yangsoo Jang, Won-Heum Shim, and Seung Yun Cho

**Background and Objectives :** Several studies have demonstrated improved outcomes achieved with stents vice balloon angioplasty. The purpose of this study was to compare the clinical outcomes and risk factors for major adverse cardiac events (MACE) between the pre- and post-stent period.

**Subjects and Methods :** Clinical outcomes for 294 patients who had undergone balloon angioplasty alone in

1991 and 1992, were compared with those for of 320 patients who underwent stent implantation in 1998. The duration of follow-up was 12 months.

Results : There were more patients with diabetes and hyperlipidemia in the stent group ( $p < 0.05$ ). The stent group had significantly more 3-vessel diseases and complex lesion morphology ( $p < 0.05$ ). Cardiac event-free survival rates in the stent group at 1, 6, and 12 months were significantly higher than those in the balloon group (1, 6, 12 month : 97.0 vs 93.9%, 89.6 vs 82.3%, 83.7 vs 77.2%,  $p = 0.03$ ). MACE rates were highly associated with lesion morphology (OR = 2.6, 95% CI 1.4-4.9) and angiotensin converting enzyme (ACE) inhibitors (OR = 2.4, 95% CI 1.3-5.4) in the balloon group, and hypertension in the stent group (OR = 2.7, 95% CI 1.3-5.6). Excluding acute myocardial infarction in the stent group, risk factors included diabetes (OR = 4.8, 95% CI 1.6-14.2) and hypertension (OR = 4.4, 95% CI 1.2-15.7). The stent group had significantly higher event-free survival rates in the complex lesions ( $p = 0.002$ ), but showed no difference in simple lesions.

Conclusion : Compared with balloon angioplasty in the early 1990s, stent implantation in 1998 was associated with higher early and late cardiac event-free survival rates. Risk factors included complex lesion morphology and the use of ACE inhibitors in balloon angioplasty, and hypertension and diabetes in the stent group.

The Korean Society of Circulation 2001 Nov;31(11):

#### The Clinical Effects of Tranilast on Restenosis after Percutaneous Transluminal Coronary Angioplasty

Woo Kon Jeong, Myung Ho Jeong, Kye Hun Kim, Im Kwan Jhu, Sang Rok Lee, Ok Young Park, Ju Hyup Yum, Won Kim, Ju Han Kim, Jae Young Rhew, Young Keun Ahn, Young Chull Kim, Jeong Gwan Cho, Jong Chun Park,

Background and Objectives : Tranilast is an anti-allergic drug that suppresses the release of cytokines, such as platelet-derived growth factor, transforming growth factor- and interleukin-1 . It has recently become known to be effective in the prevention of restenosis following PTCA (percutaneous transluminal coronary angioplasty).

Subjects and Methods : One hundred forty two consecutive patients with angina who underwent PTCA between Jan 1999 and Jul 2000 at Chonnam National University Hospital were analyzed prospectively. Thirty patients (Tranilast group :  $60.8 \pm 7.7$  years, M : F = 22 : 8, 41 lesions) out of 48 who received 300 mg tranilast for 3 months following PTCA and who underwent follow-up CAG (coronary angiogram), were compared with 61 patients (Control group :  $58.1 \pm 11.0$  years, M : F = 52 : 9, 82 lesions) out of 94, 94 who did not receive tranilast

but did undergo follow-up CAG.

Results : The restenosis rate per lesion was significantly lower in the Tranilast group than in the Control group on the 6-month follow-up CAG (Tranilast vs. Control group : 19.5% vs. 40.2%,  $p = 0.021$ ). The minimal luminal diameter was significantly larger in the Tranilast group as compared to the Control group ( $1.99 \pm 0.76$  vs.  $1.50 \pm 0.83$  mm  $p = 0.002$ ). One patient of the Tranilast group suffered from liver dysfunction and stopped medication.

Conclusion : The oral administration of tranilast is safe and effective in the prevention of restenosis following PTCA in patients with angina.

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Immediate and follow-up results after long stent implantation in diffuse long coronary lesions.

Dae Jin Joen, Gu Roo Hong, Jin Ho Bae, Jong Seon Park, Dong Gu Shin, Young Jo Kim, Bong Sub Shim

Background : The results and restenosis after long stent implantation for diffuse long coronary lesion has not been fully evaluated. We evaluated immediate and follow-up results of single long coronary stenting for long coronary disease. Methods : This study report on the use of follow-up examination is possible 48 patients with 50 lesions after stenting in total 70 patients with 72 lesions with long lesion. Diffuse long coronary lesion was defined as a lesion length longer than 20mm. Mean follow-up duration was  $8.7 \pm 2.9$  months and mean patients age was  $58 \pm 10$  years. Total patients was infused 8000-10000IU heparin and added bolus 3000-5000IU heparin for activating clotting time(ACT) was over 250 seconds during procedure. Restenosis was defined over 50% diameter stenosis in 6 months follow-up angiographic study. Results : Angiographic success was achieved 68/70 patients(97.1%) in this study. Mean reference diameter was  $3.14 \pm 0.1$ mm and baseline, final, follow-up minimal luminal diameter(MLD) was  $0.6 \pm 0.4$ mm,  $3.0 \pm 0.4$ mm,  $1.6 \pm 0.3$ mm on each occasion and each % diameter stenosis(% DS) was  $78.7 \pm 0.4\%$ ,  $4.9 \pm 0.4\%$ ,  $47.4\% \pm 0.5\%$  present. The overall restenosis rate was 42%(21/50). Procedure associated complication included 1 myocardial infarction and 1 death. The restenosis rate was significantly increased in diabetics patients(7/21 vs 3/29  $p=0.04$ ) and in long lesion length patients( $33.9 \pm 4$ mm vs  $30.4 \pm 0.4$ mm  $p=0.02$ ) but, clinical diagnosis and indication of stenting, lesional location, stent length, stent size, reference diameter size were not associated with restenosis rate. Conclusion : Single long stent implantation for diffuse long coronary lesion shown excellent success rate but high restenosis rate present. The restenosis rate was significantly associated with diabetics and lesion length Some further study for improving

restenosis rate is needed.

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Effect of angiotensin converting enzyme and nitric oxide synthase polymorphisms and the effect of interaction between the polymorphisms on the restenosis after coronary angioplasty in Korean

Jin Sik Park, Young Jin Choi, Soo Yeon Choi, Ji Dong Seong, In Ho Chae, Hyo Soo Kim, Byung Hee Oh, Myung Mook Lee, Young Bae Park, Yun Shik Choi, Young Woo Lee

**Background :** Intimal hyperplasia and vascular remodeling are major mechanisms of restenosis after coronary artery angioplasty. Angiotensin II causes restenosis by stimulating cell proliferation and vascular constriction and nitric oxide prevents restenosis by inhibiting cell proliferation and stimulating vascular dilatation. Angiotensin converting enzyme (ACE) and nitric oxide synthase (NOS) are the main determinants of the activity of the angiotensin II and the nitric oxide. In this study, we tested whether the genetic polymorphisms of the ACE and the NOS gene are the risk factors of restenosis and whether the effect of the genetic polymorphisms in stent group is different from that in balloon angioplasty group. We also tested whether there are interactions among the polymorphisms. **Methods :** We determined ACE I/D polymorphism and NOS A/B and G/T polymorphism in 219 patients (77 patients (81 lesions) in stent group and 142 patients (181 lesions) in balloon angioplasty group) who underwent PTCA and follow up coronary angiography in Seoul national university hospital from January 1996 to May 1999. **Results :** Restenosis (50% of reference diameter) was observed in 78/262(30%) lesions (18/81(22%) lesions in stent group, 60/181(33%) lesions in balloon angioplasty group). ACE DD genotype is the significant risk factor for increment of late luminal loss and loss index in stent group. In stent group, means of the late luminal loss and loss index of the lesions of the DD genotype are  $1.12 \pm 0.61$ mm and  $74.7 \pm 38.3\%$  and those of the non-DD genotype are  $0.72 \pm 0.77$ mm and  $44.9 \pm 67.5\%$  but DD genotype is not the risk factor for restenosis after balloon angioplasty. The restenosis rate, late luminal loss and loss index are not significantly different according to NOS polymorphisms. No significant interaction among the polymorphisms is observed. **Conclusion :** ACE DD genotype is a significant risk factor for restenosis after stent insertion but is not a risk factor for restenosis after balloon angioplasty in Korean. This result reflects the different mechanism of restenosis after stent insertion and balloon angioplasty. NOS polymorphisms are not associated with restenosis and no interaction between the polymorphisms is observed

Korean J Med 2000;59(6):402-410

Safety and cost-effectiveness of early discharge after primary coronary stenting in acute myocardial infarction

Eun Mi Lee, Dong Joo Oh, Young Sun Kang, Jeong Cheon Ahn, Young Hoon Kim, Hong Seog Seo, Wan Joo Shim, Young Moo Ro

**Background :** Primary coronary stenting results in reduced rates of reinfarction, recurrent ischemia, stroke and in-hospital mortality and may allow earlier hospital discharge compared with primary angioplasty for acute myocardial infarction(AMI). This study evaluated the hypothesis that primary coronary stenting, with subsequent discharge within 4 days after admission, is safe and cost-effective in low risk patients for AMI, prospectively. **Methods :** The study group consisted of low risk patients after successful primary stenting with conventional transfemoral intervention for AMI. Low risk status required be met all the following criteria : age  $\leq 75$  years, no persistent arrhythmias, no recurrent ischemia and no symptomatic heart failure signs during admission after successful reperfusion. The total 41 patients were randomized into 2 groups{early discharge group(ED, hospital stay  $\leq 4$  days), N=25//conventional discharge group(CD, hospital stay  $\leq 5$  days), N=16}. Their demographic and angiographic characteristics, the rate of major adverse cardiac events, ejection fraction during 3 months, and total medical costs were analyzed. **Results :** The 25 patients(61%) were discharged on day 3 or 4. The peak level of CK-MB were not significantly lower in early discharge group than conventional discharge group(ED/CD;  $112.4 \pm 67.3 / 153.3 \pm 76.9$  U/L,  $p=0.089$ ). Comparing to conventional discharge group, in-hospital costs were significantly lower in patients of early discharge group(ED/CD;  $7,109,118 \pm 1,068,861 / 8,766,336 \pm 1,688,707$  ₩,  $p=0.001$ ). Major adverse cardiac events were similar in both group(ED/CD; 16/25%,  $p=0.329$ ). **Conclusion :** Early identification of low risk patients after successful primary stenting by transfemoral intervention for AMI allowed safe omission of the intensive care phase and noninvasive testing, and early hospital discharge, resulting in substantial costs savings

Korean J Med 2001; 60(1):51-60

Relationship between T-wave normalization on exercise ECG and myocardial functional recovery in patients with acute myocardial infarction

Kyung Jin Kim,Wan Joo Shim,Seong Won Jung,Hui Nam Pak,Soo Jin Lee,Woo Hyuk Song,Young Hoon Kim,Hong Seog Seo,Dong Joo Oh,Young Moo Ro

**Background :** Several studies has been reported that T-wave normalization(TWN) in exercise ECG indicates the presence of viable myocardium. But the clinical implication of this phenomenon in patients with acute myocardial infarction who received proper revascularization therapy was not determined. The aim of this study was to investigate the relationship between TWN in exercise ECG and myocardial functional recovery after acute myocardial infarction. **Methods :** We studied 30 acute myocardial infarction patients with negative T waves in infarct related electrocardiographic leads and who received successful revascularization therapy. All patients performed exercise ECG, 10-14days after infarct onset using Naughton protocol. Patients were divided into 2 groups, according to presence (group I; n=14) or not (group II; n=16) of TWN in exercise ECG. Exercise parameters, coronary angiographic findings were compared between groups. Baseline and follow up (mean 11 months) regional and global left ventricular function was analyzed by echocardiography. **Results :** Exercise parameters was similar between groups. There were no difference in baseline ejection fraction and regional wall motion between group I and II (EF;  $56 \pm 12\%$  vs  $52 \pm 11\%$ , p=ns. WMS;  $21 \pm 3$  vs  $23 \pm 4$ , p=ns) and it was improved at the tenth month by similar magnitude. (group I/group II, EF % change =  $12 \pm 12\%$  vs  $7 \pm 6\%$ , p=ns, WMS % change =  $6 \pm 6\%$  vs  $7 \pm 5\%$ , p=ns) The findings of no relation between TWN and functional recovery was observed also when the patients were analysed according to infarct location and presence of Q-waves. **Conclusion :** As the exercise induced TWN in patients with acute myocardial infarction was not related with better functional recovery of dysfunctional regional wall motion, TWN dose not appears to be a sign of myocardial viability

Korean J Med 2001;60(5):456-462

The percutaneous coronary intervention in elderly women over 70 years of age

Yun Ah Kim,Myung Ho Jeong,Shin Bae Joo,Myung Ja Choi,In Soo Kim,Nam Ho Kim,Kun Hyung Kim,Seung Uk Lee,Jang Hyun Cho,Young Keun Ahn,Sang Ki Cho,Jeong Gwan Cho,Jung Chae Kang

**Background :** Previous reports have mentioned the increased mortality of percutaneous coronary intervention (PCI) in elderly female patients compared with elderly male. The purpose of this study was to evaluate the clinical characteristics, coronary lesion, characteristics and differences of success rate of PCI between male and female elderly patients. **Methods :** Three hundred sixty six elderly patients (454 lesions), including 210 male (255 cases,  $73.4 \pm 2.45$  year-old) and 156 female (199 cases,  $73.5 \pm 2.55$  year-old) who underwent PCI at Chonnam National University Hospital between Jan '96 and Dec '98 (out of 3,030 patients during same period). We compared clinical characteristic, coronary artery lesion morphology, success and complication rates of PCI in elderly male and female patients. **Result :** Clinical diagnosis and risk factors for atherosclerosis were not different between two groups. Right coronary lesions were more common in female and left circumflex artery lesion less common in female patients. The success rate of balloon angioplasty was 93.2% (110/118) in male and 93.3% in (98/105) in female patients, and the success rates of stenting were 99.2% (136/137) in male and 100% (94/94) in female. Success rates of PCI were not different between two groups. Procedure-related mortality was one cardiac death (1/255, 0.39%) in male group only. Complications of elderly male were two occlusive dissection (OD: 2/255, 0.8%), three thrombotic occlusion (TO: 3/255, 1.2%) and two ventricular arrhythmia (VA) with shock (2/255, 0.8%). In 199 female patients, three OD (3/199, 1.5%), three TO (3/199, 1.5%) and two VA (2/199, 1.0%) developed. The complications rates were not different two groups. **Conclusion :** PCI in female patients older than 70 years can be performed with comparable success and complication rates to those of elderly male patients

Korean J Med 2001;60(6):529-536

A long stent is the only predictive factor for coronary stent restenosis

Myung Ho Jeong, Jeong Gwan Cho, Jung Chae Kang, Seung Hyun Lee, Young Joon Hong, Ok Young Park, Woo Kon Jung, Sang Rok Lee, Woen Kim, Kye Hun Kim, Kyung Tae Kang, Jay Young Rhew, Sang Hyun Lee, Jong Cheol Park, Jong Chun Park, Jung chaea Kang

**Background :** Coronary stenting is one of the most effective methods of percutaneous coronary interventions (PCI) in the treatment of intimal dissection and prevention of restenosis after balloon angioplasty. However, coronary stent restenosis still remains a major clinical limitation. **Methods :** Three hundreds seventy three patients who underwent coronary stent implantations and follow-up coronary anigrams at Chonnam National University Hospital between June 1996 and December 1999, were divided into two groups: 123

patients with restenosis (Group A: 98 male, 25 female, 58.5±9.4 year-old) and 240 patients without restenosis (Group B: 193 male, 47 female). Results : The prevalence of clinical diagnosis and risk factors for the atherosclerosis were not different between two groups. The indications for stenting and stent types, reference vessel diameter and minimal luminal diameter before stenting were not different. However, stent length was 23.4±7.57 mm in Group A and 20.8±6.58 mm in Group B, which were longer in Group A than in Group B (p=001). By multiple logistic regression analysis for the independent predictive factors for stent restenosis, the long stent more than 25mm in length was the only significant predictive factor after correction according to age, sex, risk factor, lipid profiles (OR=2.590, 95% C.I.=1.40-4.78). Conclusion : The long coronary stent more than 25 mm in length is a predictive factor of restenosis after coronary stenting

#### Interventional Articles from Korea

1999. 12. 11

#### A Case of Giant Aneurysm of Coronary Arteriovenous Fistula Treated by Percutaneous Deployment of Embolization Coil

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Communication between coronary arteries and cardiac chambers or large vessels is unusual type of congenital malformation. Aneurysmal formation of a coronary arteriovenous fistula is even rare. We report a case of 83-year-old women with giant aneurysm of the coronary arteriovenous fistula from the left anterior descending coronary artery treated by percutaneous deployment of embolization coil.

Key words: Coronary arteriovenous fistula, Coronary artery aneurysm, Coil embolization

1999. 12 . 08

#### Long or Multiple Stenting in Primary Angioplasty

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**Background :**

Primary stenting as a direct reperfusion procedure after acute myocardial infarction might reduce recurrent myocardial infarction and target vessel revascularization. However, result of long or multiple stenting in the long or tandem lesions were not known.

**Method :**

From Jan. 1996 to Dec. 1998, patients with acute myocardial infarction including cardiogenic shock were undergone primary stenting using long or multiple stent. The clinical end points were death, recurrent infarction, subsequent bypass surgery, or repeat angioplasty of the infarct-related vessel. The results were compared with age, sex, lesion, and risk matched standard stenting group.

**Result :**

Baseline characteristics were similar for the 20 patients who underwent standard length stenting and the 13 patients who underwent long or multiple stenting. Stent diameter was similar in two group ( $3.4 \pm 0.3$  mm vs.  $3.5 \pm 0.4$  mm,  $p = 0.65$ ), but total stent length was longer in long or multiple stenting group ( $15.5 \pm 1.8$  mm vs.  $40.18.4$  mm,  $p = 0.01$ ). Average numbers of stent using in multiple stenting were  $1.5 \pm 0.7$ . Stenting in the infarct-related artery was successful in all patients randomized to stent treatment. At 6 months, the incidence of the primary end point was 25% (5/20) in the standard stent group and 31%(4/13) in the long or multiple stent group ( $p = 0.5$ ).

**Conclusion :**

Outcomes of long or multiple stenting including mortality, recurrent myocardial infarction and target vessel revascularization was similar to standard stenting. Long or multiple stenting after acute myocardial infarction may possible procedure in some selective cases having long or tandem lesion.

1999. 12. 07

Significance of eNOS Gene Polymorphism for the Prediction of Restenosis after Coronary Angioplasty in Patients with Ischemic Heart Disease

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**Background :**

The restenosis after coronary angioplasty is the unresolved problem even if the improvement of interventional skills and pharmacological therapies. Nitric oxide, known as endothelial derived relaxing factor (EDRF), regulates the vascular tone and inhibits the proliferation of vascular smooth muscle cells and platelet adhesions and endothelium-leukocyte interactions. Nitric oxide is produced by endothelial nitric oxide synthase (eNOS). We studied the significance of eNOS gene polymorphism for the prediction of restenosis after coronary angioplasty in Koreans with ischemic heart disease.

**Methods :**

We analyzed the two eNOS poly-morphisms using PCR (eNOS A/B polymorphism is the VNTR in intron 4 and eNOS T/G polymorphism is a missense mutation in exon 7) in 199 Korean patients who had 257 lesions undergoing percutaneous coronary angioplasty (ballooning = 152, stenting = 105). The angiography was repeated 6 months later to assess the relation between the rate of restenosis and types of eNOS gene polymorphism.

**Results :**

We found no significant differences of restenosis rate in eNOS A/B and T/G polymorphism in those with balloon angioplasty or with stent (restenosis rate of A/A, A/B, B/B, respectively (n = 257) : 25% (1/4), 26% (14/53), 31% (62/200) (p = not significant), and T/T, T/G, G/G (n = 249) : 0% (0/3), 36% (16/44), 29% (58/202)(p = not significant)) Patients with A allele (non BB) or GG phenotype had lower restenosis rate, so we analyzed protective effect of non BB and GG phenotype on restenosis, but there was no significant statistical difference (restenosis rate of non BB and GG, BB and non GG respectively : 20% (15/57), 34% (16/47)(p = not significant)).

**Conclusion :**

eNOS A/B and T/G polymorphism is not associated with a significantly elevated risk of restenosis after coronary angioplasty.

**Keywords:**Endothelial nitric oxide synthase gene polymorphism, Restenosis, Coronary angioplasty

1999. 12. 02

Relation between Coronary Flow Reserve and Myocardial Perfusion State and Change of Coronary Flow Reserve in Acute Myocardial Infarction

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#### Background and Objectives :

Many western studies have shown that primary percutaneous transluminal coronary angioplasty (PTCA) may have better clinical result over thrombolytic therapy in patients with acute myocardial infarction. There are, however, few reports about the role of primary PTCA in Korea. We reviewed the cases of primary PTCA and thrombolysis with delayed PTCA in Samsung Medical Center to compare the clinical outcomes of two treatment modalities.

#### Materials and Method :

This study was a non-randomized and retrospective trial. From August 1995 to March 1998, 80 AMI patients within 12 hours of symptom onset underwent primary PTCA (n = 26) or thrombolytic therapy (n = 54) in Samsung Medical Center. Patients who had thrombolysis were performed coronary angiography fourth to fifth hospital day routinely. Risk factors and time to treatment (pain-to-needle time and door- to-needle time) were reviewed from patient record. Angiographic data including TIMI flow were obtained from angiography data base and angiographic film. We compared the 30-day and 8-month event rate of death, re-infarction, re-PTCA, and CABG between two groups.

#### Results :

Baseline characteristics (sex, age, blood pressure, heart rate, AMI location, ejection fraction of left ventricle) were similar between two groups. There was no statistically significant difference in pain-to-needle time and door-to-needle time between two groups. The 30-day mortality rate was similar between two groups (primary group 3.8%, thrombolysis 5.6%, p = 1.0). The 30-day event rate also showed no difference between two groups (primary PTCA 7.7%, thrombolysis 11.1%, p = 1.0) and there was similar tendency in 8-month event rate (primary PTCA 19.2%, thrombolysis 14.8%, p = 0.62). However, the admission duration of primary PTCA group was shorter than that of thrombolysis (8.7 vs 12 days, p = 0.03).

#### Conclusion :

Primary PTCA have similar clinical outcome except shorter hospital admission duration when compared to thrombolysis with routine elective coronary angiography and delayed PTCA in AMI patients without cardiogenic shock.

Key words: Primary PTCA,Thrombolysis,Acute myocardial infarction

1999. 11. 13

A Case of Stent Embolizations into the Left Renal and Right Common Iliac Artery during Primary PTCA

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Coronary stent embolization is a rare event but may result in clinically relevant cardiac ischemia or peripheral embolization during the procedure. We report a case of systemic embolizations of two coil stents during the primary PTCA in acute myocardial infarction, who were treated successfully with a double wire helix technique and a gooseneck snare. Although in our experience this rare complication did not produce any clinical complications, care should be taken to prevent this possibility, especially in patients with significant vessel tortuosity, calcification, total occlusion, or mild stenosis proximal to the target lesion.

1999. 11. 11

A Case of Transluminal Stent-Graft Implantation at Right Subclavian Artery Pseudoaneurysm in Beh et's Syndrome

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Behcet's disease is an uncommon disorder characterized by clinical triad of relapsing iritis, ulcer of mouth and genitalia. It is now recognized as a systemic disorder with mucocutaneous, ophthalmic, intestinal, respiratory, musculoskeletal, cardiovascular, urogenital and neurologic involvement. Systemic complications affecting the arterial system of disease are rare and mainly the aorta and iliac arteries are involved. Invasion of arterial wall is the most common lesion, predisposing to false aneurysm or rupture. As the standard open surgery, although often difficult, needed second surgeries in 30% to 50% of the patients due to the occurrence of anastomotic false aneurysms, endovascular repair emerged as an alter-native treatment of aneurysmal or pseudoaneurysmal manifestations in Behcet's disease. We report here a case of the pseudoaneurysm at right subclavian artery which is successfully treated with percutaneous stent-graft.

key word: Behcet's syndrome,Pseudoaneurysm,Subclavian artery,Stent-Graft

1999. 11. 04

Change of Clinical Outcome in Patients with Unstable Angina according to Early Revascularization

## Therapeutic Strategy

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### Background and Objectives :

It has been well known that the Braunwald classification is an appropriate clinical parameter in the prediction of the outcome in patients with unstable angina. However, the ability of the classification to predict prognosis of unstable angina according to treatment strategy is not established. We evaluated the relation between severity of angina on admission and outcome of primary unstable angina with early invasive strategy.

### Materials and Method :

148 patients (M 85, F 63, age  $61 \pm 10$ ) with suspected unstable angina were divided into three subgroups on the basis of the Braunwald classification on admission. The patients were followed up to 6 months prospectively if the final diagnosis was primary unstable angina. Early invasive strategy was used for the treatment of unstable angina. Major cardiac events were assessed during hospitalization and 6 months follow-up period according to the Braunwald classification.

### Results :

Unstable angina was diagnosed in 95 patients (64%). Among these patients, 89 patients with primary unstable angina were followed up to 6 months. Clinical characteristics including number of patients, mean age, sex ratio, risk factors, coronary angiographic findings and revascularization rate during hospitalization were not different in three subgroups of these patients. Among these patients, early coronary revascularizations was performed in 67 patients (75%) and 2 (2%) deaths/myocardial infarctions occurred during hospitalization. During the follow-up period, 1 (1%) myocardial infarction/death and 12 (13%) revascularizations occurred. Cardiac event rate (death, myocardial infarction or revascularization) was not different during hospitalization and 6 months follow-up period among subgroups of severity class.

### Conclusion :

Clinical outcome should be reevaluated after early coronary intervention to predict cardiac event in patients with unstable angina.

1999. 11. 03

Safety of Percutaneous Right Coronary Intervention without Temporary Pacemaker : Prospective Study



treatment of acute or threatened closures complicating balloon angioplasty and in the prevention of restenosis. However, whether equally favorable results are afforded by stent placement in small vessels (<3 mm) remains unclear. Accordingly, we evaluated the safety and feasibility of intracoronary stenting in native coronary vessels less than 2.75 mm in size.

**Methods :**

Between January 1997 and July 1998, seventy eight patients with 81 lesions were treated with 83 stents, regardless of clinical setting. The angiographic criteria for enrollment included at least 70% stenosis and a vessel that reference diameter was less than 2.75 mm. Every patients received aspirin (300 mg qd, indefinitely) and ticlopidine (250 mg bid, one month) and was given a bolus dose of 10,000 U heparin during procedure.

**Results :**

Angiographic success was achieved in 80 of 81 attempts (98%). There was one in-hospital death because of pump failure in AMI patient. There was no acute stent thrombosis. At 6 month follow-up, event free survival was achieved in 90% of patients and angiographic restenosis was found in 28% of patients (9/32).

**Conclusions :**

The present observational study demonstrates that angiography-guided stent placement in coronary artery <2.75 mm in diameter is safe and effective in conjunction with current stent deployment technique and antiplatelet protocol.

**Key word:** Stent, Small coronary artery

1999. 11. 01

**Follow-up Angiographic Results after MultiLink Coronary Stent Implantation**

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**Background and Objectives :**

The objective of this study was to assess the in-hospital clinical outcome and 6 months follow-up angiographic results after flexible balloon expandable MultiLink coronary stenting. The impact of post-stenting excessive high pressure balloon dilation on late outcome is controversial. The other purpose was to investigate the impact of post-stenting high pressure balloon dilation (HPD group 14 atm) on clinical and angiographic outcome in comparison to moderate pressure dilation (MPD group <14 atm).

**Materials and Method :**



The MultiLink stents were implanted in 124 patients (mean age  $58 \pm 9$ , M/F = 94/30) with 128 lesions. Post-stenting high pressure balloon dilation was performed to have less than 10% of residual stenosis and smooth in-stent lumen without IVUS guidance.

**Results :**

The indications for stenting were elective in 88 lesions (69%), suboptimal angioplasty results in 27 lesions (21%), and bail-out in 13 lesions (10%). The incidence of in-hospital major adverse cardiac events was 1.6% and major vascular complication rate was 3.2%. The follow-up angiography was performed in 86 patients (69%) at  $7.9 \pm 2.6$  months. The angiographic restenosis rate was 22.7%. The acute gain of HPD group had a tendency to be higher than MPD group (HPD : MPD =  $2.33 \pm 0.51$  mm :  $2.22 \pm 0.44$  mm,  $p = 0.08$ ) and the late loss of MPD group had a tendency to be lower than HPD group (MPD : HPD =  $0.86 \pm 0.73$  mm :  $0.95 \pm 0.84$  mm,  $p = 0.09$ ). And the net gain and restenosis rate of both groups were similar respectively (HPD : MPD =  $1.38 \pm 0.94$  mm :  $1.36 \pm 0.83$  mm,  $p = ns$ , HPD : MPD = 22.5% : 22.9%,  $p = ns$ ).

**Conclusion :**

The MultiLink coronary stent system is a safe and effective device with high procedural success rate and also has the acceptable angiographic restenosis rate for the treatment of coronary artery disease. The post-stenting excessive high pressure balloon dilation might not be necessary during the deployment of MultiLink stent.

1999. 10. 04

**Coronary Angioplasty for the Total Occlusion Using a New Hydrophilic Guidewire, Crosswire TM**

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**Background and Objectives :**

Coronary angioplasty of total occlusion is associated with low primary success rate. The most common reason for failure is the inability to cross the lesion with a guidewire. The new nitinol wire consists of an extraordinary flexible nitinol core, a platinum/iridium coil at the distal tip, and a polymer hydrophilic coating providing the wire with an extremely slippery surface after moistening.

**Methods and Materials :**

We analyzed the angiographic results in 117 patients (86 M, 31 F,  $58.5 \pm 11.7$  year), who underwent angioplasty for total occlusion with Crosswire TM at Chonnam University Hospital between Oct '97 and Apr '99. Clinical

diagnosis was acute myocardial infarction (MI) in 61, old MI in 16, unstable angina in 23, and stable angina in 17 patients.

Results :

Target coronary arteries were 51 left anterior descending arteries (LAD), 13 left circumflex arteries (LCX) and 53 right coronary arteries (RCA). Lesion morphology was 40 abrupt and 77 tapered lesions, and collateral circulation was observed in 75 cases. The success rate was 80.3% (94/117). The reasons of procedural failure were failure to cross the lesion using wire in 8 and balloon in 6 cases. In the failed cases, clinical diagnosis was acute MI in 10, unstable angina in 8 and stable angina in 5, and target artery was 11 LAD, 2 LCX and 10 RCA, and collateral circulation was observed in 20. In 56 cases of chronic total occlusion, the success rate was 76.8% (43/56) and the reasons of procedural failure were failure to cross the lesion using wire in 6 and balloon in 2 cases. No major cardiac events were developed. There was no predictive factor for the procedural failure with Crosswire TM for total occlusion.

Conclusions :

A new nitinol wire, Crosswire TM was an effective tool for the recanalization of total occlusive coronary artery.

1999. 10. 03

Evaluation of Left Internal Mammary Artery during Right Transradial Coronary Angiography : A New, Fast and Reliable Technique

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Background :

The technique to evaluate left internal mammary artery (LIMA) is not well established during right transradial coronary angiography.

Materials and Methods :

Following coronary angiography via right radial artery, LIMA angiography was performed using 5 French (F) Judkins JL-3.5 catheter in 110 patients (56±9 years [range ; 46-81], 77 males). Eleven (10%) patients had grafted LIMAs. Subclavian and innominate arteries were moderately tortuous in 14 (13%) patients and aortic arches elongated and more vertically oriented in 16 (15%). The catheter, standing in the ascending aorta with its natural curve, was withdrawn slowly while being rotated clockwise to engage its tip in the proximal left



2) Significant coronary lesions were found in 216 (62.5%) patients and left main disease in 12 (3.5%). Coronary spasm test, internal mammary artery or saphenous vein graft angiography, aorto-ileofemoral angiography, and bilateral carotid angiography were safely performed as indicated.

3) Success rate of examination by primary approach was 94.5%, similar to 94.9% of inpatients. Alternative brachial or femoral approaches were needed in 19 (5.5%) patients. 4) No death, cerebral thromboembolism or myocardial infarction were observed and one-day admission was required in 13 (3.7%) patients. Initial 254 patients (33%) showed good radial pulse (94%), weak or absent radial pulse (6%), abnormal reverse Allen test (6%) up to  $61 \pm 25$  days. However, no claudication was observed.

Conclusion :

Cardiac catheterization and angiography was safely performed in the outpatient population selected using much extended inclusion criteria. Transradial approach is useful to set up outpatient procedures with less facilities and personnels and makes it available in the daytime with low readmission rate.

1999. 10. 01

Temporal Changes of Myocardial Capillary Flow after Attempted Reperfusion in Acute Myocardial Infarction

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Background and Objectives :

As lack of myocardial perfusion was demonstrated Microvascular function after reperfusion of infarct related artery (IRA) can be changed in convalescent stage for several possible mechanisms such as hyperemia and microvascular stunning. Therefore, myocardial contrast echocardiography (MCE) performed early stage after reperfusion of IRA may cause over or underestimation of the extent of myocardial necrosis. The aims of the study were to demonstrate the temporal changes of myocardial perfusion after revascularization of IRA and to explore the association of late changes of myocardial capillary flow with contractile recovery.

Methods :

MCE was performed 5-7 days after the attack of acute myocardial infarction (AMI) in 21 patients (M : F = 17 : 4, age :  $58 \pm 12$  yrs) who underwent successful reperfusion of IRA. MCE was graded by semiquantitative score (0 : no opacification, 0.5 : partial opacification, 1 : homogenous opacification) by 16 segment model. Every patient underwent 1-2 months follow up 2D echocardiography and MCE. Improvement of wall motion score more than 1 at follow up was considered to have contractile recovery.



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**Purpose :**

The purpose of this study was to evaluate the safety, feasibility and effectiveness of an endoluminally-placed bifurcated stent-graft (Vanguard) for the treatment of infrarenal abdominal aortic aneurysm (AAA).

**Methods :**

Transluminal endovascular stent-graft placements were attempted in 29 patients (28 male, mean age  $69 \pm 7$  years) with AAAs involving the common iliac arteries from Aug. 1997 to Jan. 1999. Endovascular therapy was performed in the cardiac catheterization laboratory with epidural anesthesia. One side of the femoral artery was opened by surgical cutdown for the bifurcated stent-graft entry and the other side was punctured percutaneously for the straight stent-graft. Computed tomography and/or intraarterial angiography were performed during an average follow-up of 10 months (2-18 months).

**Results :**

Primary success rate was 75.9% (22 of 29 patients) and the overall success rate was 79.3% with successful correction of one perigraft leak. Twenty patients (69.0%) had significant coronary artery disease. There were two technical failure cases, the one was tortuous iliac vessel with spasm, the other was disconnection of the stent-graft connecting portion. Complications related to procedure occurred in 13.8% of patients (4 of 29 patients) and two of these four patients had procedure-related mortality because of acute renal failure following contrast overdose and sepsis after operation.

**Conclusions :**

Endovascular treatment of infrarenal AAA with bifurcated stent-graft (Vanguard<0A397>) is effective, feasible and relatively safe. However, further investigation for the outcome, complication and long-term follow-up are needed.

1999. 09. 03

**Simultaneous Bilateral Carotid Stenting in de Novo Internal Carotid Artery Stenosis in Patients at High Surgical Risk**

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**Background and Objectives :**

For patients with bilateral carotid artery stenosis, simultaneous bilateral carotid endarterectomy is rarely performed due to a higher perioperative risk for death and strokes. We assessed the immediate and long-term outcomes of simultaneous bilateral carotid stenting (SBCS) for internal carotid stenosis in patients at high surgical risk.

**Materials and Methods :**

We analyzed 10 patients who underwent SBCS for de novo stenoses of both internal carotid arteries (ICA). Included were those who had 60% to 99% stenosis of extracranial ICAs irrespective of neurologic symptoms and had more than 2 risk factors of Mayo grade (medical risks) or (neurologic risks).

**Results :**

The patients had a mean age of  $67 \pm 7$  years. Technical success was achieved in all lesions. The mean percent diameter stenosis was reduced from  $79 \pm 13\%$  to  $8 \pm 8\%$ . A total of 21 Wallstents were deployed at 20 lesions. One patient had a minor stroke just after the procedure which was completely resolved with local injection of urokinase. There were no deaths, major strokes or myocardial infarctions during the 30 day follow-up. Six months imaging studies were available on all 9 eligible patients with 18 lesions by duplex sonography and angiography. Late clinical follow-up at a mean of  $15.1 \pm 8.1$  months revealed no occurrence of neurologic event or death.

**Conclusion :**

SBCS is feasible, safe and effective to treat bilateral de novo ICA stenoses in patients at high surgical risk. The procedure, however, is investigational and more experience is required to define its role in the treatment of this patient population.

1999. 09. 02

**Clinical Follow-up of Excimer Laser Coronary Angioplasty for In-stent Restenosis**

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**Background and Objectives :**

Previous studies have shown a high restenosis rate after balloon angioplasty for diffuse in-stent restenosis. Debulking strategy has been expected to be helpful to reduce the restenosis rate. This study evaluated the safety and long-term clinical event rate after excimer laser coronary angioplasty (ELCA) and adjunctive balloon angioplasty for in-stent restenosis.

**Materials and Method :**

We included 29 in-stent restenotic lesions treated in 28 patients (18 men, 10 women, mean age  $60 \pm 2$  years) admitted to Samsung Medical Center between June 1997 and August 1998. Quantitative coronary angiography was performed and clinical characteristics, acute complications, 30-day and 8-month major cardiac adverse event rate was analyzed.

**Results :**

Initial success rate was 97%. We stopped the ELCA procedure in one lesion located in the proximal left anterior descending artery due to bradycardia and hypotension. In the 28 lesions successfully treated with ELCA and adjunctive balloon angioplasty, the minimal luminal diameter increased from  $0.7 \pm 0.1$  mm before ELCA to  $1.9 \pm 0.1$  mm after ELCA and to  $2.7 \pm 0.1$  mm after adjunctive balloon angioplasty ( $p < .0001$ ). The acute luminal gain after ELCA was 60%. The diameter stenosis decreased from  $75 \pm 2\%$  before ELCA to  $36 \pm 2\%$  after ELCA and to  $15 \pm 2\%$  after adjunctive balloon angioplasty ( $p < .0001$ ). There was no in-hospital death, Q wave acute myocardial infarction (AMI), emergency coronary artery bypass graft (CABG), but non-Q AMI was noted in 1 case (3%). During the followed-up period of 8 months, there were 1 death (4%) due to congestive heart failure, 1 nonQ-AMI (4%) and 7 target lesion revascularization (26%) among the successfully treated 27 patients, but there was no CABG, Q-AMI. Combined event rate at the 8-month follow-up was 33% and target lesion revascularization rate at 8-month follow-up was 26%.

**Conclusion :**

The ELCA and adjunctive balloon angioplasty seems to be safe and effective for the treatment of in-stent restenosis. A prospective randomized trial comparing ELCA versus other ablative technique is required.

1999. 09. 01

Frequency of Combined Atherosclerotic Disease of the Coronary, Periphery, and Carotid Arteries Found by Angiography

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#### Background :

The real incidence of atherosclerotic lesions in carotid and peripheral arteries in coronary artery disease patients is not well known in Korea. The aim of this study was to prospectively evaluate the prevalence of atherosclerotic involvement of the coronary, carotid, and peripheral arteries in each arterial disease patients. This study was also designed to evaluate the risk factors, the clinical characteristics of associated carotid artery stenosis in patients with coronary artery disease, and associated peripheral vascular disease in patients with coronary artery disease.

#### Methods :

Between June 1996 and March 1998, 475 patients (369 males, 106 females, mean age  $60 \pm 10$  years) were studied. Three hundred and seventy-three patients who presented with ischemic symptoms were enrolled in the coronary artery disease group, 81 patients were enrolled in the peripheral vascular disease group due to presenting claudications, and 21 patients were enrolled in the carotid stenosis group due to presenting cerebrovascular symptoms. Coronary angiography was done by the routine method. Carotid angiography was performed at the aortic arch by the digital subtraction angiography method. Peripheral vascular angiography was taken from the suprarenal abdominal aorta to both femoral arteries.

#### Results :

- 1) Risk factors for coronary stenosis, peripheral vascular disease, and carotid stenosis : The risk factors were not different between coronary stenosis, peripheral vascular disease, and carotid stenosis groups, but smoking was more frequent among patients with peripheral vascular disease than in patients with coronary stenosis (p-value = 0.001).
- 2) Coronary artery stenosis and carotid artery stenosis : The mean age of coronary artery patients with carotid stenosis was significantly older (p-value = 0.006) than for patients without carotid stenosis. The prevalence of peripheral vascular disease was more common in patients with carotid stenosis than in patients without carotid stenosis.
- 3) Coronary artery stenosis and peripheral vascular disease : Carotid stenosis was more common in patients with peripheral vascular disease than in patients without peripheral vascular disease in the coronary stenosis group.
- 4) Prevalence of coronary, carotid, and peripheral artery disease : In patients with coronary stenosis, the prevalence of carotid stenosis was 13.9% and that of peripheral vascular disease was 29.2%. In patients with peripheral artery stenosis, the prevalence of coronary stenosis was 45.7% and that of carotid artery disease was 33.3%. In patients with carotid stenosis, the prevalence of coronary stenosis was 81.0% and that of peripheral vascular disease was 52.4%.

#### Conclusion :

Carotid artery disease and peripheral vascular disease developed concurrently with coronary artery disease in a significant proportion of patients. Therefore, routine angiography of peripheral and carotid arteries in patients with coronary artery disease is considered, especially in old age.

Key words: Coronary artery disease,Peripheral vascular disease,Carotid artery disease

1999. 08. 10

### Primary Coronary Stenting as a Successful Treatment of Acute Myocardial

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Fewer than one half of patients with acute myocardial infarction is a candidate for thrombolytic therapy. Current data revealed that primary coronary stenting may be useful alternative to intravenous thrombolytic therapy for acute myocardial infarction in these subset of patients. We experienced a patient presenting with acute myocardial infarction and acute promyelocytic leukemia in whom thrombolytic therapy was thought be not eligible due to hemorrhagic tendency. Primary coronary stenting was performed successfully without complications. Follow-up angiography revealed no evidence of restenosis or stent occlusion.

Key words: Acute promyelocytic leukemia,Acute myocardial infarction,Stent

1999. 08. 01

### Fractional Flow Reserve in Coronary Artery Disease : Comparison with Intravascular Ultrasound

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#### Background and Objective :

Precise assessment of lesion severity is fundamental for the clinical decision making in the patients with coronary artery disease. Coronary angiography has limitation to projection imaging techniques. Intravascular ultrasound (IVUS) has been known to be a gold standard of morphological severity of coronary stenosis. Fractional flow reserve (FFR) is known to be a lesion specific functional index of epicardial stenosis that can be derived from intracoronary pressure assessed during maximal vasodilation. The objective of this study was to

investigate the validity of fractional flow reserve for stenosis severity in comparison with IVUS.

**Methods :**

The study population consisted of 24 patients with angina pectoris (M : F = 19 : 5, age :  $58 \pm 12$  yrs). The IVUS and intracoronary pressure wire performed at 26 lesions after diagnostic coronary angiography. We measured angiographical diameter stenosis (DST), minimal luminal diameter (MLD), minimal luminal area (MLA) and reference area stenosis (r-AST). FFR was defined by the ratio of distal mean coronary pressure (Pd) to aortic mean pressure (Pa).

**Results :**

FFR showed significant correlation with both r-AST ( $r = -0.93$ ,  $p < 0.00001$ ) than DST ( $r = -0.79$ ,  $p < 0.0001$ ). When the lesions with MLD less than 1.1 mm were excluded, considering the limitation of IVUS for the thickness of its catheter, FFR showed excellent correlation with r-AST with higher correlation coefficient ( $r = -0.96$ ,  $p < 0.00001$ ). FFR showed significant correlation with MLA ( $r = 0.87$ ,  $p = 0.0001$ ) or MLD ( $r = 0.83$ ,  $p = 0.0005$ ).

**Conclusion :**

FFR with excellent correlation with r-AST measured by IVUS seems to be a useful lesion specific functional index for the assessment of coronary stenosis in angina patients.

1999. 07. 04

**A Randomized Comparison of Cilostazol and Ticlopidine after Coronary-artery**

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**Background and Objectives :**

Combination of ticlopidine and aspirin has been accepted as a standard antiplatelet regimen after coronary stenting because it reduced the rate of cardiac events and hemorrhagic-vascular complications compared with intensive anticoagulation. Ticlopidine use, however, may accompany serious side effects such as neutropenia or liver dysfunction. Cilostazol, a c-AMP phosphodiesterase inhibitor, is a novel antiplatelet agent which is known to have less side effects.

**Materials and Methods :**

We compared the efficacy and safety of cilostazol plus aspirin (CA) with ticlopidine plus aspirin (TA) after elective coronary stenting. Patients were randomly assigned to receive either CA or TA two days before stenting. The primary end point was a composite of angiographic stent thrombosis, death, myocardial



anterior descending artery and 19 right coronary artery. Rotational atherectomy was done in 37 de novo lesion (58%) and 27 (42%) restenosis patients. Transradial approach was done in 33 patients (52%). Mean maximal burr size was 1.68 mm and mean burr to reference artery ratio was 0.63. Rotastenting were done in 58% of the patients with higher post-procedure minimal lumen diameter, % diameter stenosis and net gain than rotablator with adjunctive balloon angioplasty. Overall procedural success was 94% (62/64). Complications were one non-Q infarction, one coronary artery perforation, two slow flow, and one guidewire fracture. None of the patients showed inhospital mortality or 30 day cardiac event (death, emergency CABG, Q-infarction, or re-intervention).

Conclusion :

Rotational atherectomy is a useful technique with high success rate without showing major cardiac events during inhospital period and within 30 days.

1999. 06. 02

Feasibility of Low-Molecular-Weight-Heparin(Fraxiparine) for Primary Stenting in Acute Myocardial Infarction

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Background and objectives :

The optimal anti-thrombotic strategy for primary stenting in acute myocardial infarction (AMI) is still controversial. We evaluated prospectively the efficacy and safety of low-molecular-weight-heparin (LMWH) for primary stenting in AMI.

Materials and Method :

From 1/1997 to 7/1998, 54 AMI pts underwent primary stenting with 96% of procedural success rate (52/54). Of these, five pts were excluded from the study for warfarinization or use of GP IIb/IIIa inhibitor despite of successful stenting (TIMI 3 flow and less than 30% of residual stenosis). In 47 pts included in the study, 5,000-10,000 U of unfractionated heparin was administered ( /bolus) before primary stenting. After sheath removal, LMWH(Fraxiparine, 7500 U/S.C.BID) maintained for  $10.6 \pm 5.7$  days. Aspirin and ticlopidine (500mg/day for 4 weeks) were given before stenting. Pts were followed to determine early (0-30 days) and late (31-180 days) major adverse cardiac events (MACE). Subsequent revascularization involving other coronary arteries did not constitute an end point.

Results :









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#### Background and Objectives :

Though the surgical intervention of subclavian artery stenosis has been effective, its high morbidity and mortality have limited its clinical application. In 1980 percutaneous balloon angioplasty of stenotic artery was introduced as a substitute for surgical intervention and subsequent reports have supported its efficacy noting that it is more effective when combined with stent. The purpose of this study was to assess the feasibility, safety, and efficacy of percutaneous intervention as an alternative or primary therapy for symptomatic subclavian artery stenosis.

#### Methods :

Between September 1993 and October 1998, 17 lesions in 16 patients of symptomatic subclavian artery stenosis were enrolled as candidates for nonsurgical intervention. We performed percutaneous balloon angioplasty with stenting to the subclavian artery stenosis and evaluated the early results.

#### Results :

- 1)The patients had a mean age of  $55 \pm 14$  years and 13 of 16 patients were male.
- 2)Subclavian artery stenting was successful in 94% (16/17) of the lesion without significant complications. The cause of failure was suboptimal result after deployment of stent.
- 3)The types of stents deployed were Strecker stents in 4, Palmaz stents in 8, Wall stents in 3 and Jo stents in 2 cases.
- 4)The peak and mean pressure gradient reduced from  $58.5 \pm 17.0$  to  $8.5 \pm 7.4$  and  $31.4 \pm 13.0$  to  $4.7 \pm 5.5$  mmHg respectively ( $p < 0.01$ ) and the degree of luminal stenosis decreased from  $92.5 \pm 8.5\%$  to  $10.0 \pm 14.3\%$ . ( $p < 0.01$ )

#### Conclusion :

Subclavian artery stenosis can be managed safely and effectively through percutaneous balloon angioplasty with stenting, with an excellent technical success rate and less morbidity and mortality particularly in patients coexisting other vascular and systemic diseases. However, the long-term patency and clinical effects should be warranted.

1999. 05. 03

Long-term Clinical and Angiographic Outcomes of Side Branch Occlusion after Coronary Stenting

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**Background :**

Coronary stent is one of effective and well-accepted treatments for coronary artery diseases. Stenting of coronary lesions, however, sometimes involves the coverage of relatively large side branches located in the vicinity of the target lesion. Serial angiographic changes in side branches of stented coronary segments were analyzed to determine the incidence and clinical outcomes of side branch occlusion.

**Methods :**

Serial angiographic findings of 51 patients who had total 60 side branches originating from the stented segments including large branches more than one millimeter in diameter were analyzed. Side branches were divided into two types : type A (  $\geq 1$  mm in diameter, with ostial narrowing  $>50\%$ ), type B (  $\geq 1$  mm in diameter, with ostial narrowing  $<50\%$ ). Side branch occlusion was defined as development of total occlusion or morphologic changes from type B to A or reduction of TIMI flow more than 1 after stenting.

**Results :**

After stent deployment, 4 out of 60 side branches occluded totally and 2 out of 4 side branches regained luminal patency with the improvement of TIMI flow (type A, TIMI 1-2) on follow-up coronary angiography. Another one branch which showed type B, TIMI flow 2 changed into type A, TIMI flow 1. There were no clinical cardiovascular events associated with acute side branch occlusion. On follow-up coronary angiogram, side branch occlusion developed in 20 (33.3%) side branches. The incidences were significantly related with in-stent restenosis (11/17, 64.7% in group with restenosis vs. 9/34, 26.4% in group without restenosis,  $p = 0.003$ ).

**Conclusions :**

Acute side branch occlusion can develop in a few stented patients without any clinical deteriorations and delayed side branch occlusion may be associated with in-stent restenosis.

1999. 04. 10

A cute Closure of Target and Remote Coronary Arteries Complicated by Balloon Rupture during Primary Stenting of Acute Myocardial Infarction

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### Background and Objectives :

Identification of coronary sites susceptible to progression or nonprogression might provide additional information to select medical or surgical treatment and furthermore for appropriate timing for percutaneous transluminal coronary angioplasty or coronary artery bypass graft.

### Methods :

We reviewed serial coronary arteriograms of 50 patients with coronary artery disease retrospectively. Patients were managed with standard treatment including anti-hypertensives, antiplatelets, lipid-lowering agents and other risk factor management by attending physician's decision. Patients who received percutaneous transluminal angioplasty, coronary artery bypass graft or thrombolysis were excluded. Cononary arteriographies were undertaken with average 33 months interval. Criteria for the progression and regression were the changes of the luminal diameter narrowing of the arterial segment by 20% or more reduction or increase, respectively.

### Results :

Patients show progressive change, regressive change or no significant interval change in 50%, 12% and 30% of total 50 patients, respectively. Male gender, angiographic interval were the significant predictor of progressive change. In terms of coronary segment, stable segments are most frequent 52.2% (72/138) and progression in 40.2% (74/184), regression in 27.5% (38/138). Initial coronary lesions with low grade stenosis (less than 50%) have a tendency to progress than that of high grade stenosis (70% or more) Percentage diameter stenosis of new lesion are not related linearly with the interval between two sequential angiographies.

### Conclusion :

Number of patients with progressive coronary arteriogram are more frequent than the patients with regressive change or no interval change. Progression and regression are frequent finding of serial coronary arteriography in usual clinical practice. Progression and regression are found frequently in the same patient at different coronary branches (16 patients). It suggested that the local factors may play an important role in the pathogenesis of coronary artery disease as well as systemic risk factors.

1999. 04. 01

The Effects of Anti-Platelet Agents in Preventing Coronary Stent Restenosis

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#### Background :

Restenosis is still remained as the most important limitation in clinical practice with coronary stent. Experimental study in a porcine model and clinical study in patients with coronary artery disease were performed to test the efficacy and safety of various anti-platelet agents (Aspirin, Ticlopidine, Cilostazol) to prevent restenosis of coronary stent.

#### Methods :

In animal study, Cilostazol 200 mg/day (Group I, n = 7) or Ticlopidine 500 mg/day (Group II, n = 4) in addition to Aspirin (300 mg/day) was administered to pigs from 3 days before stenting to 4 weeks after stenting. Angiographic and pathologic findings were compared at 4 weeks after stenting. In clinical study, 134 patients underwent coronary stent as Group A (46 patients with 49 lesions : 39 M, 7 F : 60.8±10.1 year) receiving 300 mg Aspirin and 200 mg Cilostazol, and Group B (88 patients with 92 lesions : 63 M, 25 F : 60.6±8.8 year) receiving 300 mg Aspirin and 500 mg Ticlopidine between Sep '97 and May '98 at Chonnam University Hospital.

#### Results :

Angiographic degree of stenosis at baseline, immediately after and at 4 weeks after stent was not different between Group I and II. With the histopathologic examination of the stented artery segments 4 weeks after stenting, diameter stenosis was 44.8±25.5% in Group I and 64.2±6.7% in Group II, which was not different (p = 0.054). In clinical study, clinical diagnosis and indications for stent were not different between two Groups. Acute stent thrombosis developed in one (1.1%) of Group B and subacute stent thrombosis in three (6.5%) of Group A. Restenosis of the stented coronary artery was observed in 3 (18.8%) in Group A and 10 (37.0%) in Group B (p = NS). Minimal luminal diameter was 2.17±1.49 mm in Group A and 2.05±1.15 mm in Group B (p = NS). No patient in Group A developed side effect, while 4 (4.5%) patients developed side effects including toxic hepatitis in one, gastritis in one patient and thrombocytopenia in two patients.

#### Conclusion :

Combination antiplatelet therapy with Cilostazol and Aspirin is equally effective and more safe in the prevention of coronary stent restenosis, compared with the conventional therapy using Ticlopidine and Aspirin.

1999. 03. 09

Successful Percutaneous Transluminal Coronary Angioplasty and Stent Implantation in a Patient with Dextrocardia and Situs Inversus

Situs inversus with dextrocardia is a rare congenital anomaly of development involving a left-handed malrotation of visceral organs. The patients with dextrocardia usually have structurally normal heart but characterized by a mirror image position of the heart and abdominal aorta (descending aorta, left atrium, cardiac apex and stomach are all on the right side). Therefore the factors for complete coronary arteriography and revascularization are appropriate selection of catheters, originality and ingenuity of procedural technique based on the anatomic characteristics. We report a case of percutaneous transluminal coronary angioplasty (PTCA) and stent implantation to the left anterior descending artery (LAD) and left circumflex artery (LCX) in a patient with dextrocardia and situs inversus.

1999. 03. 06

#### Early and Mid-term Results of Coronary Stenting in the Diabetic Patient

##### Background and Objectives :

Diabetes mellitus is a significant risk factor for adverse outcome after PTCA, which is associated with an increased late mortality and target lesion revascularization (TLR) rates. The beneficial role of coronary stenting on the clinical and angiographic outcomes of diabetic patients is not clearly defined. The aim of this study was to evaluate the early and mid-term outcomes in diabetic patients undergoing elective stenting of native coronary lesions compared with those in non-diabetic patients.

##### Materials and Methods :

Between July 1997 and June 1998, coronary stenting was performed on 46 lesions in 38 diabetic patients and 126 lesions in 117 non-diabetic patients. Follow-up angiography at mean day of  $189 \pm 45$  was performed in 58.7% (91 patients) and analysed by quantitative coronary angiography (QCA).

##### Results :

There was a higher incidence of multi-vessel disease in diabetic patients than non-diabetic patients but not statistically significant (71.1% vs 51.3%,  $p = 0.106$ ). There were no differences in major procedural complications and in-hospital events (myocardial infarction, angina and death) in diabetics and non-diabetics. During the

follow-up, the incidence of target lesion revascularization (TLR) and cardiac event free survival did not differ between two groups.

**Conclusion :**

Coronary stenting in diabetics resulted in a low rate of immediate procedural complications and early major adverse cardiac event (MACE), similar to non-diabetics. There were no differences in the mid-term clinical and angiographic outcomes in diabetics and non-diabetics.

1999. 03. 04

**Clinical and Angiographic Characteristics and Long-term Follow-up in Patients with Variant Angina Who Presented as Acute Myocardial Infarction**

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**Background and Objectives :**

There were numerous reports for clinical characteristics and prognosis of patients with variant angina (VA) but little information is available for patients with VA who presented as acute myocardial infarction (AMI). The purpose of this study is to determine the clinical and angiographic predictors for initial development of AMI in patients with VA and prognosis of patients with VA who presented as AMI.

**Materials and Methods :**

The study group comprised 166 patients with VA : forty one (25%) of whom presented as AMI (Group A ; Male 32, mean age 50 years) and 125 presented as typical VA or unstable angina (Group B ; Male 73, mean age 54 years). The diagnosis of VA was made by spontaneous spasm and ergonovine or acetylcholine (only Group B) provocation.

**Results :**

1)Male gender (78% vs. 58%,  $p<0.05$ ), smoking (74% vs. 53%,  $p<0.05$ ), and disease duration ( $18\pm 5$  vs.  $7\pm 1$  month,  $p<0.0001$ ), and ST-segment elevation during chest pain (71% vs. 23%,  $p<0.05$ ) were significantly higher in group A than in Group B.

2)Prevalence of fixed stenosis of 50% or greater was higher in Group A than in group B (12% vs. 2%,  $p<0.05$ ) and the percent stenosis after nitroglycerin injection was also greater in group A than in group B ( $43\pm 5\%$  vs.  $28\pm 2$ ,  $p<0.01$ ), but the disease activity such as frequency of resting angina, spontaneous spasm, and multivessel

spasm were not different between two groups.

3) During clinical follow-up at a mean duration of 2.7 years, three patient (2%) in group B died of a cardiac cause. Non-fatal MI occurred 1 (2%) and 3 patients (2%) in group A and B, respectively.

Conclusions :

Our data show that male gender, smoking, duration of disease, ST-segment elevation during chest pain, and a fixed stenosis of 50% or greater are predictors for initial development of AMI in patients with VA. The prognosis in group A is excellent and this may be associated with less severe atherosclerotic disease and a high rate of medication with calcium channel blocker or nitrate compared with those in previous studies.

1999. 03. 02

Clinical and Angiographic Outcomes : Subcutaneous Nadroparin versus Ticlopidine after Coronary Stenting

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Background and Objectives :

It was reported that low molecular weight heparin (LMWH) was more effective than unfractionated heparin in patients with acute coronary syndrome. Recent studies have shown that the pathophysiology of restenosis in stented lesions was different from those of nonstented lesions. Treatment strategies designed to limit cellular proliferation that were ineffective in nonstented lesions may be efficacious in reducing in-stent restenosis. This study was aimed to compare the clinical and angiographic results of LMWH (nadroparin) after coronary stenting with those of conventional ticlopidine regimen.

Materials and Methods :

Patients were eligible for inclusion if they had angina and/or objective evidence of myocardial ischemia, and a significant (>50%) stenosis that was documented on a recent coronary angiogram. After stenting, prospective randomized comparison study was performed. Patients were randomly assigned to either nadroparin (200 IU/kg, sc, bid) or ticlopidine (250 mg bid) plus aspirin (200 mg qd) treatment groups. Repeat coronary angiography was performed at  $236 \pm 90$  days after stenting, and quantitative coronary angiographic analysis (QCA) was done.

Results :

Intracoronary stent implantation was performed in eighty five lesions in eighty one patients (ticlopidine : 40, nadroparin : 41). There was no significant difference in any baseline clinical/angiographic variables between



the two treatment groups. There were no subacute stent thrombosis, infarction and death in both groups. Six-month event-free survival was 36 (90%) in the ticlopidine group and 35 (85.4%) in the nadroparin group. Follow-up quantitative angiographic data such as late loss ( $1.35 \pm 0.70$  vs  $1.32 \pm 0.69$ ), loss index ( $0.53 \pm 0.70$  vs  $0.56 \pm 0.23$ ) and restenosis rate (36% vs 25.8%) were not different between ticlopidine and nadroparin groups.

**Conclusion :**

Effects of nadroparin were not different from those with ticlopidine therapy in the prevention of restenosis and subacute stent thrombosis after coronary stenting. Clinical outcomes between two strategies were similar. Low molecular weight heparin may be an alternative to ticlopidine in patients that ticlopidine cannot be administered because of severe adverse effects.

**Key words:** Restenosis, Low molecular weight heparin, Ticlopidine

1999. 02. 11

**A Histopathologic Analysis of Atherectomized Human Coronary Stent Restenosis : Potential Role of Cell Migration and Extracellular Matrix Formation**

**Background :**

Neointimal ingrowth rather than stent recoil has thought to be important for coronary arterial in-stent restenosis. Intuitively cell migration and extracellular matrix (ECM) formation seems to be important in the pathogenesis of stent restenosis. Therefore, with specific aim of identifying molecules implicated in cell migration and extracellular matrix formation, histopathologic analysis on atherectomized coronary arterial in-stent restenotic tissue was performed.

**Methods :**

In the present study we analyzed 29 atherectomized coronary arterial in-stent restenotic tissue specimens (LAD 14, LCX 5, RCA 10) retrieved ( $5.7 \pm 5.4$  months after stent deployment) from 25 patients (age  $59 \pm 13$ , M/F : 18/7) in whom restenosis complicated previous revascularization with Palmaz-Schatz stent. Histopathologic analysis was performed after immunostaining. Antibodies against TGF-  $\beta$  1, hyaluronan synthase (HAS) 1, MMP1, MMP9, urokinase type plasminogen activator, PDGF receptor were used for immunostaining.

**Results :**

Myxoid tissue characterized by stellate-shaped cells embedded in a loose ECM was present in 20 out of 29

specimens, and tends to decrease over time after stenting. Foci of cell poor area (48-320 cells/mm<sup>2</sup>) in a microscopic field was present in 17 out of 29 specimens, and tends to increase over time after stenting (13/16 in <4 mo vs. 4/13 in 4 mo, p<0.01). Various proportions of specimens show positive stained cells with respect to each antibodies : TGF 1 in 16 out of 20 ; HAS1 in 10 out of 13 ; MMP1 in 8 out of 16 ; MMP9 in 4 out of 13 ; PDGF receptor in 12 out of 17 specimens. Abundant cells labeled with certain antibodies (TGF 1, uPA, PDGF receptor) were frequently found in myxoid tissue.

Conclusions :

Myxoid tissue, frequently found in stent restenotic tissue, may be a biologically active tissue in terms of cell migration and of ECM formation. ECM accumulation tends to increase over time after stenting and may be important in pathogenesis of coronary arterial stent restenosis.

1999. 02. 04

Assessment of coronary artery stenosis with intracoronary Doppler guide wire and modified continuity equation method ; A comparison with dipyridamole stress Thallium-201 SPECT

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Background :

Previous studies of animal and human experiments have shown excellent correlation between true or angiographic stenosis severity and stenosis severity calculated from intracoronary Doppler flow measurements and continuity equation method. However, there remains practical problems to be solved on its clinical application. To minimize these problems, the concept of modified continuity equation method, calculating the percent area stenosis by comparing the maximal in-stenosis flow velocity to the distal reference flow velocity, was introduced and compared with dipyridamole stress thallium-201 SPECT.

Methods :

In this prospective study, 102 patients (mean age 57±10 years, 69 men, 33 women) with coronary artery stenoses ranging from 23-89% in percent diameter stenosis, who received coronary angiography, dipyridamole stress thallium-201 SPECT, and successful intracoronary flow velocity measurements were included. Modified continuity equation method and distal coronary flow velocity reserve were compared to the result of dipyridamole stress thallium-201 SPECT and quantitative coronary angiography.

Results :

Measurements of adequate intralumenal and stenosis distal flow velocities were successful in 102 out of 106 stenoses (96%). Minimal luminal area and percent area stenosis calculated from modified continuity equation method showed significant correlations with those of quantitative coronary angiography. Modified continuity equation method significantly underestimated the severity of stenosis than quantitative coronary angiography did. The test accuracy in relation to the result of dipyridamole stress thallium-201 SPECT were 91% in modified continuity equation method, 80% in quantitative coronary angiography and 63% in distal coronary flow velocity reserve.

Conclusions :

Application of intracoronary Doppler guide wire and modified continuity equation method appears to provide useful on-site implications for the anatomic and functional assessment of coronary artery stenosis. The modified continuity equation method would be one of the promising concepts for clinical decision making during coronary interventions.

1999. 02. 03

The Safety and Feasibility of Transradial Primary Coronary Intervention in Acute Myocardial Infarction

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Background and Objectives :

Aggressive antithrombotic therapy and transfemoral primary intervention during acute myocardial infarction (AMI) restricts the patient's movement and may increase the risk of access site bleeding complications, and lengthen the duration of movement restriction and hospital stay. Transradial approach provides less bleeding complications and early ambulation. The purpose of this study is to know whether transradial primary intervention is safe and feasible in the patients with AMI.

Materials and Method :

From April 1998 to December 1998, transradial primary interventions were performed in the consecutive 28 patients (24 male,  $57 \pm 7$  years) by two experienced operators. The results were compared to the results of 44 (15 patients during same period, 29 during previous year) transfemoral primary interventions.

Results :

1)The success rates of transradial primary interventions was 93% (26/28) and comparable to 95% (42/44) of transfemoral primary interventions.

2) In transradial group, the time from the arrival of catheterization laboratory to arterial access and to reperfusion, the time from the arrival of emergency room to reperfusion were  $8.1 \pm 3.4$  minutes,  $22.0 \pm 5.3$  minutes, and  $71.7 \pm 9.2$  minutes, respectively and comparable to  $9.0 \pm 3.1$  minutes,  $21.7 \pm 5.3$  minutes, and  $68.9 \pm 8.1$  minutes of transfemoral group, respectively.

3) The complications of the procedure were treated successfully during transradial interventions.

4) In transradial group, puncture site bleeding complications were absent though heparin was continued and mild ambulation was possible early after the procedure. The hospital stay of transradial group was  $5.3 \pm 1.3$  days and shorter than  $7.7 \pm 4.2$  days of transfemoral group.

Conclusion :

In the low risk patients with AMI, transradial primary intervention might be safe and feasible with acceptable time delay by the experienced operators. It might be effective to reduce access site bleeding complications and to initiate early ambulation, resulting in the shortened hospital stay.

Congenital Absence of Left Circumflex Coronary Artery: Circumflex Artery Extended from Right Coronary Artery

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Nonvisualization of left circumflex coronary artery from the left coronary artery is commonly due to anomalous origin of circumflex artery from the right coronary artery or right sinus of Valsalva. However, complete ostial obstruction of circumflex artery, circumflex artery extended from the right coronary artery, anomalous origin of circumflex artery from the pulmonary artery may be the cause. We report two cases of absent left circumflex artery from the left coronary artery, in which the circumflex artery arose as a terminal extension of the right coronary artery. Angiographic features of absent left circumflex artery from the left coronary artery were described.

1999. 01. 04

Mid-term Clinical & Angiographic Outcomes of Primary Stenting in Acute Myocardial Infarction

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#### Background and Objectives:

The goal of this study was to examine the safety and feasibility of a primary (direct) stenting in acute myocardial infarction (AMI). In the treatment of AMI, Percutaneous transluminal coronary angioplasty (PTCA) has documented superior reperfusion rate and improved clinical outcomes than thrombolytic therapy. However, there are several limitations of PTCA, such as recurrent ischemia in 10 to 15%, reinfarction in 3 to 5% and restenosis in 30 to 50% of patients. There are several reports that, compared with PTCA, the implantation of coronary stent has been shown to reduce angiographic restenosis and improve late clinical outcomes. But in general, stenting has been contraindicated in thrombus containing lesion due to the risk of subacute thrombosis. With advance in technique and the recognition of the importance of adequate platelet inhibition, the incidence of subacute thrombosis has fallen in patients with acute coronary syndrome and thrombus laden lesion.

#### Methods and Results:

In our study, primary stenting was performed in 42 patients of AMI. There are 6 cases (22.5%) target lesion restenosis during the follow up coronary angiography ( $150 \pm 86$ day) and no in-hospital death. Three cases (7.1%) of them require revascularization including two re-PCTA and a coronary artery bypass graft for the recurrent ischemic symptoms. There were no reinfarction and death after discharge. Six-months event free survival reate was 85.7%.

#### Conclusion:

Primary stenting is safe and feasible in the majority of patients with AMI and results in excellent mid-term outcomes compared with PTCA.

1999. 01. 03

#### Predictors of Acute Thrombotic Occlusion after Coronary Intervention in Acute Myocardial Infarction

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#### Background:



1998. 12. 13

### Recurrent Cardiac Tamponade Complicated by Coronary Intervention

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Coronary perforation is a rare, but potentially catastrophic complication of percutaneous coronary intervention. It rarely results in cardiac tamponade with the use of standard anticoagulant regimens. But spontaneous cardiac tamponade was reported recently during balloon angioplasty under the large dose of heparin infusion, and after stent implantation under powerful antiplatelet therapy including platelet IIb/IIIa receptor inhibitor administration. We report a case of delayed cardiac tamponade complicated by guidewire manipulation under powerful anticoagulant and antiplatelet therapy, which recurred early after the first pericardiocentesis.

1998. 12. 02

### Transradial Interventions in Coronary Artery Disease: Comparison with Transfemoral Interventions

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#### Background:

Transradial coronary intervention was introduced recently. It has less bleeding and vascular complications and advantage of early ambulation.

#### Methods:

We compared 142 transradial coronary interventions (101 stents, 56 balloon angioplasty and 18 rotablation) with 120 transfemoral interventions in 230 patients from January to August 1998.

#### Results:

Overall success rate was not different between two approaches (92% vs 89%), but smaller sized sheath and less amount of contrast agent were required in transradial interventions compared to transfemoral interventions.

Conventional guiding catheters which are used in transfemoral approach were used in most cases(94%) of transradial interventions. Judkins left 3.5 (in stead of JL4.0 in femoral approach) and Judkins right 4.0 were the most frequently used guiding catheters in transradial approach. Stent implantation was successfully done in 99 out of 101 lesions (98%) in transradial intervention and 76 out of 78 lesions (97%) in transfemoral intervention. Rotational atherectomy and primary balloon angioplasty or stenting were done successfully in 10-20% of the patients in both groups. All procedures were done successfully without any major procedure-related complications (myocardial infarction, death, bypass surgery) or major vascular complications in both groups. During the clinical follow-up of transradial group, punctured arteries showed 10% incidence of radial artery pulse weakness with 3% of pulse loss.

**Conclusion:**

Transradial approach is useful another feasible route for coronary interventions. The feasibility of primary balloon angioplasty or stenting and rotational atherectomy by transradial approach should be evaluated in the future.

1998. 12. 01

**Rescue Utilization of Abciximab(ReoPro) for the Thrombus**

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The presence of pre-existing intracoronary thrombus has consistently been shown to be among the strongest predictors of unsuccessful angioplasty and abrupt vessel closure. Abciximab, platelet glycoprotein IIb/IIIa receptor antagonist, through prevention platelet aggregation and coronary thrombosis, has shown promise in helping to decrease the incidence of complications of PTCA when prophylactically administered in patients presenting with unstable angina or complex lesion morphology for PTCA and in lower risk patients as well. However, the cost of abciximab and its associated increased risk of bleeding may limit its use as a prophylactic treatment. This study was performed to evaluate the effect of the rescue administration of abciximab in seven patients with thrombus containing lesion during angioplasty. Thrombus was disappeared in 4 patients and decreased in 2 patients, and the follow-up angiogram showed normal brisk flow in all 6 patients. There were no death or myocardial infarction on clinical follow-up at a mean of 7 months except one which was developed restenosis at the angioplasty lesion. Dissolution of thrombus and restoration or maintenance of TIMI grade 3 flow were achieved without complications after administration of abciximab when delivered in a “rescue”



manner on thrombus containing lesion during angioplasty. These results showed that failure to give preprocedural prophylactic abciximab did not appear to exclude the possibility of a beneficial effect of abciximab, given therapeutically during the early stage of thrombus formation in patients with complicated lesion during angioplasty.

Key words: Angioplasty,Thrombus,Rescue utilization of abciximab

1998. 11. 12

Aspiration Thromboembolectomy in the Management of Acute Coronary Occlusion during Percutaneous Transluminal Coronary Angioplasty

Percutaneous transluminal coronary angioplasty (PTCA) is often used in the management of coronary artery disease and the advances in equipment, technical skill and acquisition of operator experiences have improved initial success rates and reduced the frequency of complications. However, acute coronary occlusion is the most common and serious complication related to angioplasty and its several potential mechanisms are intracoronary thrombus, coronary artery spasm and coronary artery dissection. Accordingly,heparinization, intracoronary thrombolysis, re-PTCA, stent implantation and emergency coronary artery bypass grafting have been previously used for reopening of an occluded coronary artery during angioplasty. In this report we describe our experience in the management of acute coronary occlusion of left anterior descending artery caused by dislodgement of thrombotic material during PTCA by means of aspiration thromboembolectomy instead of medical therapy,re-PTCA and stent implantation.

PTCA,Acute coronary occlusion,Aspiration thromboembolectomy

1998. 11. 02

Edge Dissection after Intracoronary Stenting : Predictor, Angiographic and Clinical Follow-up after Additional Procedures



#### Background and Objectives :

Carotid artery stenting has evolved as a potential alternative to carotid endarterectomy in patients(pts) with significant carotid artery stenosis. We evaluated the feasibility and long-term outcome of carotid artery stenting in selected pts at high surgical risk.

#### Materials and Methods :

Between May, 1996 and September 1998 we performed carotid artery stenting at 35 lesions in 25 pts. There were 23 males and 2 fe-males. Mean age was  $63.2 \pm 6.6$  (range 54-77). Eight four percent(21/25) of the pts had significant coronary artery disease. Sixty four percent(16/25) of the pts had significant peripheral artery lesions. Sixty percent(15/25) of the pts had neurologic symptoms or non-disabling stroke. We used Wallstent in 32 lesions and Palmaz stent in 3 lesions. Carotid stenting was undertaken in 33 internal carotid, 1 common carotid and 1 external carotid lesions. Bil-ateral carotid stenting was undertaken in forty percent(10/25) of the pts.

#### Results :

Carotid stenting was successful in all lesions. One patient died due to massive cerebral hemorrhage 3 days after carotid stenting, who had und-erwent stenting as a rescue procedure for failed endarterectomy. One major stroke developed during procedure with partial recovery. For the combined endpoint of strokes and death within 30 days of procedure, the incidence was 8% and 5.7% in terms of pts and procedures, respectively. On follow-up( $12 \pm 7$  months), we found neither neurologic complications nor death. Angiographic and/or duplex sonography which were performed at 5.5 month in all(18) eligible pts with 24 lesions revealed no evidence of stent deformity or restenosis( 50% of diameter stenosis). Mean angiographic stenosis was 20% on follow-up angiography.

#### Conclusion :

Carotid artery stenting can be performed with high success and low complication rate in pts with significant carotid artery stenosis especially at high surgical risk. Follow-up clinical outcome of average 12 month was good with low restenosis rate.

1998. 10. 18

A Case of Congenital Atresia of Left Main Coronary Ostium

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Congenital atresia of left main coronary ostium is a rare congenital coronary anomaly. This anomaly was detected during elective coronary angiogram in a 40 year-old female patient with chest pain and exertional dyspnea. Treadmill exercise test demonstrated 2 mm upslope depression of ST segment at stage and the test was terminated due to chest pain. Myocardial stress SPECT using  $^{201}\text{Tl}$ -dipyridamole showed reversible perfusion defects at anterior, apex and lateral wall. It was impossible to select left coronary artery ostium and right coronary angiogram revealed 30% eccentric stenosis at proximal right coronary artery with grade 3 collateral flow to left anterior descending and circumflex arteries. Operative finding revealed totally occluded left coronary ostium with membrane-like, non-atheromatous tissue similar to aortic wall. The patient was successfully treated with coronary artery bypass grafts (CABG) using left internal mammary artery and great saphenous vein. She underwent follow-up coronary angiogram, which revealed patent grafts, at one year after CABG and no cardiovascular event was observed on 5-year clinical follow-up.

1998. 10. 17

#### A Case of Successful Coronary Stenting in a Ninety Three-Year-Old Patient

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The incidence of coronary artery diseases in elderly patients has been increased in Korea. Coronary intervention may be one of the effective therapeutic modalities in elderly patients instead of coronary bypass surgery. We hereby report a case of coronary stenting in a 93 year-old male patient with unstable angina. He had a long segmental diffuse stenosis over middle left anterior descending coronary artery, which was treated successfully by long MicroStent II. He has no cardiovascular event or target vessel revascularization on two-year clinical follow-up.

#### Interventional Articles from Korea

Clinical Comparison of Coronary Flow Reserve and Fractional Flow Reserve after PTCA in Patients with

## Coronary Artery Disease

Keum Soo Park, June Kwan, Jeong Kee Seo, Eui Soo Hong,  
Seong Wook Cho, Woo Hyung Lee

**Objectives :** Severity of coronary artery stenosis has been defined in terms of geometric dimensions, pressure gradient-flow relations, resistance to flow and coronary flow reserve(CFR) after maximum arteriolar vasodilation. Myocardial fractional flow reserve(FFR) is a new index of the functional severity of coronary stenosis that is calculated from pressure measurements during coronary angiography. We compared the relationship between FFR and CFR after PTCA and the residual stenosis with FFR and CFR in the patients with acute myocardial infarction (AMI) and angina. **Methods :** The study population consisted of 25 patients with AMI and 18 patients with angina. All AMI patients had successful restoration of infarct-related artery by thrombolysis or direct PTCA. Doppler index was measured using 0.014 inch Doppler wire 15 minutes after successful restoration of infarct-related artery. Hyperemic index was measured after intracoronary injection of adenosine(16-18ug). Baseline and hyperemic distal coronary artery pressure was measured using 0.014 inch pressure wire with advancing the wire distal to the lesion and simultaneous proximal aortic pressure was measured using guiding catheter. **Results :** 1) Post-interventional FFR and CFR were  $0.91 \pm 0.09$  and  $1.87 \pm 0.45$  in AMI and  $0.93 \pm 0.06$  and  $2.73 \pm 0.67$  in angina. There was no significant correlation between FFR and CFR in AMI and angina( $p=NS$ ). CFR showed the weak correlation with hyperemic distal pressure(hPd) in AMI( $p=0.04$ ) and FFR with hDSVR in angina( $p=0.04$ ). FFR and CFR were not correlated with mean blood pressure and heart rate( $p=NS$ ). 2) FFR and hyperemic pressure gradient had the close correlation with residual stenosis after successful PTCA in AMI and angina( $p<0.001$ ). Baseline pressure gradient also showed weak correlation with FFR( $p<0.05$ ). 3) CFR was  $1.87 \pm 0.45$  in AMI and  $2.73 \pm 0.67$  in angina with significant difference between two groups ( $p<0.001$ ) and FFR was  $0.91 \pm 0.09$  in AMI and  $0.93 \pm 0.06$  in angina without difference( $p=NS$ ). hPa and hPd showed the significant difference between the two groups( $p<0.05$ ). **Conclusion :** FFR seems to be a new index of the functional severity of coronary stenosis that is calculated from pressure measurements during coronary angiography.

keyword

Fractional flow reserve , Coronary flow reserve , PTCA, Angina , Acute myocardial infarction

## The Feasibility and Safety of Transradial Coronary Stenting Using 6 French Guiding Catheter

Kwang Soo Cha, Moo Hyun Kim, Hye Jin Kim, Doo Kyung Yang, Jeong Whan Cho, Tae Ho Park, Hyung Ryul Park, Bong Keun Kim, Young Dae Kim, Jong Seong Kim

**Objectives :** Powerful anticoagulant and antiplatelet therapies after coronary stenting may carry the risk of increased bleeding complications if large-bore guiding catheters are introduced via the femoral artery. Recently smaller radial artery is introduced as an entry site for coronary interventions owing to miniaturization of equipments, easy hemostasis and lower access site complications, and little hand ischemia. The purpose of this study is to evaluate the feasibility and safety of coronary stent implantation via the radial artery. **Methods :** After a learning curve for transradial diagnostic coronary angiography, stent implantation was attempted in 131 consecutive patients, 135 lesions. Immediately after procedure, the introducer sheath was withdrawn and mobilization was initiated. Clinical follow-up was done for punctured radial arteries. **Results :** Procedural success and uncomplicated clinical course was achieved in 129(98%) patients, 133(99%) lesions. No stent embolization or migration within the coronary artery, and no procedure-related death, Q wave myocardial infarction or emergent bypass surgery were happened. No stroke or severe arm vessel complications were happened except 4(3%) cases of moderate hematoma. Failed 2 cases were in early period and stents did not pass the lesions due to inappropriate selection and poor backup of guiding catheters. During follow-up of  $124 \pm 36$  days, punctured radial arteries showed weak or absent radial pulse in 10(7%) patients, but no claudication or ischemia of hand was observed. **Conclusion :** Transradial coronary stenting was performed safely with high success rate and low complication rate. This study supports that transradial approach is a promising primary route for coronary stenting.

The Korean Journal of Medicine 1999 56 ;2 ;9

## The Effects of Local Endothelin Receptor Blocker Delivery on Porcine Coronary Stent Restenosis

Jin Woo Kim, Jung Chae Kang, Chang Soo Park, Wan Kim, Myung Ho Jeong, Yong Rok Kim, Jang Hyun Cho, Ju Han Kim, Sung Hee Kim, Yeul Bae, Young Keun Ahn,  
Joo Hyung Park, Jeong Gwan Cho, Jong Chun Park

**Objectives :** Coronary stent is one of the most effective currently available devices in the treatment of coronary artery diseases. But, coronary stent restenosis is one of major limitations in clinical stenting. Local drug delivery may be a new strategy for the prevention of stent restenosis. Endothelin receptor blocker is known to have vasodilatory and antiproliferative activities. To investigate the effects of local endothelin receptor blocker delivery on stent restenosis, local delivery was performed in the porcine model of coronary stent restenosis. **Methods :** Stent overdilation injury alone was performed in the control porcine coronary arteries (n=4, group A) and local delivery of endothelin receptor blocker prior to stenting was performed in the porcine coronary artery (n=9, group B). Endothelin receptor blocker (TAK-044, Takeda, Japan) was delivered at a rate of 1 ml/min (50 mg/10 ml) using the Dispatch Catheter. Follow-up quantitative coronary angiogram (QCA) and immunohistopathologic assessment were performed 4 weeks after stenting. **Results :** 1) On QCA, percent diameter stenosis was significantly higher in Group A than in Group B ( $29.4 \pm 6.1$  % vs.  $14.5 \pm 11.6$ %,  $p < 0.05$ ). 2) Area stenosis was higher in Group A than in Group B ( $63.5 \pm 23.2$  % vs.  $40.9 \pm 13.3$  %) measured by histopathologic method ( $p < 0.05$ ). 3) Neointimal area was higher in Group A than in Group B ( $3.53 \pm 1.9$  mm<sup>2</sup> vs.  $1.75 \pm 0.8$  mm<sup>2</sup>,  $p = 0.03$ ). 4) By immunocytochemistry, proliferating cell nuclear antigen index was higher in Group A compared with Group B ( $46.8 \pm 5.2$  % vs.  $31.1 \pm 3.7$  %,  $p < 0.05$ ). **Conclusion :** Local delivery of endothelin receptor blocker is effective in the prevention of stent restenosis in a porcine model, which may be related with the partial inhibition of cell proliferation of neointimal cells.

keyword

Stent Restenosis , Local Delivery , Endothelin Receptor Blocker

The Korean Journal of Medicine 1999 56 ;6 ;10

The preventive effects of the heparin-coated coronary stent in a porcine coronary stent restenosis model

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The coronary stent reduces acute coronary arterial occlusion and late restenosis during and after coronary intervention. However, stent thrombosis and restenosis are still major limitations in widespread use of coronary stent. Local drug delivery with use of heparin-coated stent will be a new approach reducing the incidence of stent thrombosis and restenosis. In order to evaluate the effects of heparin-coated stent on stent

restenosis, heparin-coated stents were compared with control stents in a porcine coronary stent restenosis model. Methods : Stent overdilation injury (stent:artery= 1.3:1.0) was performed with bare Wiktor (Group I, n=10) and heparin-coated Wiktor (Group II, n=20) stents (HEPAMED™, Medtronic, U.S.A.) in porcine coronary arteries. Follow-up quantitative coronary angiography (QCA) was performed at 4 weeks after stenting and histopathologic assessments of stented porcine coronary arteries were compared in both groups. Results : 1) On QCA, percent diameter stenosis was significantly higher in Group I than in Group II ( $16.3 \pm 6.62\%$  vs.  $9.6 \pm 5.06\%$ ,  $p < 0.05$ ). 2) Injury score of stented porcine coronary artery was not different in both groups ( $1.26 \pm 0.23$  vs.  $1.20 \pm 0.22$ ). 3) Pathologic area stenosis of stented artery was higher in Group I than in Group II ( $41.6 \pm 12.5\%$  vs.  $27.1 \pm 9.9\%$ ,  $p < 0.005$ ). 4) Neointimal area was higher in Group I than in Group II ( $4.58 \pm 1.41 \text{ mm}^2$  vs.  $2.57 \pm 1.07 \text{ mm}^2$ ,  $p < 0.05$ ). 5) By immunohistochemistry, proliferating cell nuclear antigen (PCNA) index was higher in Group I compared with in Group II ( $11.2 \pm 6.75\%$  vs.  $6.3 \pm 4.14\%$ ,  $p < 0.05$ ). Conclusions : Heparin-coated stent is effective in the prevention of late coronary stent restenosis in a porcine coronary stent restenosis model, which may be related with the inhibition of neointimal cell proliferation.

keyword

Coronary stent , Heparin-coating , Porcine coronary artery , Restenosis

The Korean Journal of Medicine 1999 ;57 ;1 ;10

#### Comparison of balloon

angioplasty , stent insertion and medical therapy in the treatment of single LAD lesion

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Dong Hoon Choi, Won Heum Shim

With recent advances in transarterial interventional technique, there is a tendency to treat single LAD lesion with balloon angioplasty or stent insertion rather than with medical therapy alone. Therefore, it is important to evaluate the long-term clinical outcomes of such interventional therapy. Methods : Subjects are comprised of patients who underwent coronary angiogram from 1993 to 1996 and diagnosed as having single LAD lesion without decrease of left ventricular function. The incidence of major ischemic complications, revascularization and reduction of angina pectoris after different therapeutic strategies in these patients are evaluated. Result : 1) There was total of 190 patients. Patients receiving medical therapy, balloon angioplasty and stent insertion were 70, 75, and 45 respectively. There was no significant difference in mean age, sex ratio, and risk factors of coronary artery occlusive disease between each groups. 2) The medical therapy group(30%) had a significantly



lower incidence of proximal stenosis lesion compared to the balloon angioplasty group (45%) and stent insertion group(52%) according to the location of the lesion( $p<0.05$ ). The lesion characteristics according to the AHA/ACC criteria showed that the proportion of type A lesion was significantly higher in the balloon angioplasty group(33.3%) compared to the medical therapy group(8.6%) and stent insertion group(13.3%), whereas the proportion of type C lesion was significantly higher in the medical therapy group(41.4%) compared to the balloon angioplasty group(14.3%) and stent insertion group(22.2%). 3) The incidence of ischemic complication were low with 9 out of total 190 patients during follow up consisting of 2 cases of cardiogenic death(1.1%) and 7 cases of acute myocardial infarction(3.7%). 4) During the follow-up period revascularization was performed in 10% of medical therapy group, 27% of balloon angioplasty group and 22% of stent insertion group. There was higher rate of revascularization in patients who received interventional therapy. 5) During the mean follow-up period of 38 months, event-free survival rate was 85% in the patient group receiving medical therapy, 71% in the patient group undergoing balloon angioplasty and 74% in the patient group undergoing stent insertion. There was lower incidence of major events in medical therapy patients, but the difference of the rate among each group was not significant. In considering the patients with proximal LAD stenotic lesion, event-free survival rate was 73% in medical therapy group, 75% in balloon angioplasty group and 81% in stent insertion group, but the difference between each groups did not show any significant difference. 6) Follow-up of each study groups at 6 months, 1 year and 3 years showed that the proportion of chest pain-free patients in balloon angioplasty and stent insertion group were higher than those in medical therapy group despite the lack of statistical significance( $p>0.05$ ). Conclusion : For patients with single LAD stenotic lesion interventional therapies such as balloon angioplasty and stent insertion might be more effective without statistical significance in reducing chest pain compared to medical therapy. There was no significant difference in the incidence of ischemic complication and rate of revascularization among different study groups. Further studies will be needed to clarify the beneficial effects of interventional coronary artery therapy such as improvement of chest pain, increased exercise capacity, and improved quality of life along with other parameters. (Korean. J. Med 57:896-905, 1999)

keyword

Single LAD lesion , Balloon angioplasty , Stent insertion , Medical therapy

The Korean Journal of Medicine 1999 ; 57 ;5 ;10

Comparison between Adaptive Arterial Remodeling and Inadequate Arterial Remodeling Assessed by Intravascular Ultrasound

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Hyung Lee

**Objectives :** Adaptive arterial remodeling (AAR) is a process to maintain luminal patency despite atherosclerotic plaque accumulation, whereas some of the lesions undergo a negative remodeling (vessel shrinkage), namely inadequate arterial remodeling (IAR). Histopathologic and intravascular ultrasound (IVUS) studies have shown lumen compromise is delayed until the atherosclerotic lesion occupies more than an estimated 40% to 50% of the potential area within the internal elastic lamina and proposed contributors to lumen compromise are medial and adventitial damage, superficial calcification, apoptosis. However the precise mechanisms and factors leading to these two vascular remodeling patterns are still unclear. The aim of this study is to investigate the effect of plaque accumulation on compensatory dilatation in arterial remodeling and their relationship according to their remodeling patterns. **Methods :** Preinterventional intravascular ultrasound images of 56 focal, de novo native and nonsteal lesions on coronary angiography were obtained. Cross sectional area of external elastic membrane (LEEM), Minimal lumen (MLA) and plaque plus media (P&M;  $P\&M = EEM - MLA$ ) in the target lesions were measured. Cross sectional area of external elastic membrane (REEM) and lumen (RLA) in proximal reference segments were measured. The lesions were divided into two groups according to their remodeling patterns ; adequate arterial remodeling ( $LEEM/REEM > 0.78$ ) and inadequate arterial remodeling ( $LEEM/REEM \leq 0.78$ ). **Results :** 1) Forty-three patients (34 men, 9 women; mean age  $58 \pm 11$  years) who had not undergone previous coronary intervention were studied. 2) Adaptive arterial remodeling was observed in 47 (84%) of 56 lesions and inadequate arterial remodeling in 9 (16%). 3) No significant difference of clinical diagnosis, risk factors including hypertension, diabetes mellitus, smoking and lipid profiles was found between AAR and IAR group. 4) P&M/RLA of AAR was significantly higher than that of IAR ( $1.21 \pm 0.41$  vs  $0.91 \pm 0.23$ ;  $p < 0.001$ ), whereas reference area stenosis (r-AST%) of AAR was significantly lower than that of IAR ( $59.8 \pm 23.0$  vs  $80.1 \pm 9.5$ ;  $p < 0.001$ ). 5) In AAR group, P&M/RLA showed more significant correlation with LEEM/REEM ( $r = 0.66$ ,  $p < 0.001$ ) than r-AST% ( $r = 0.36$ ,  $p < 0.05$ ). 6) In IAR group, P&M/RLA showed significant correlation with r-AST% ( $r = 0.79$ ,  $p < 0.05$ ) but no correlation with LEEM/REEM ( $r = 0.07$ ,  $p > 0.05$ ). **Conclusion :** In adaptive arterial remodeling, the amount of plaque accumulation seems to be an important determinant of compensatory arterial dilatation and contribute weakly to stenosis severity. On the contrary, in inadequate arterial remodeling, it seems to contribute greatly to stenosis severity.

Korean Circulation J 2000;30 :260-270

The Development of Collateral Circulation in Patients with Total Occlusion of Coronary Artery and its Clinical

## Significance

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## Background and Objectives

Coronary collateral circulation is known to have beneficial effects in patients with angina pectoris and myocardial infarction. The purpose of this study is to determine the predictors of collateral vessels development, the pathways of collateral circulation and the changes in collateral flow after coronary intervention and its functional significance in patients with total occlusion.

## Materials and Methods :

One hundred thirty five patients who underwent coronary angiogram between Jan '97 and Dec '97 in Chonnam University Hospital ( out of 3,264 cases ) had total occlusion of one coronary artery were classified into two groups ; angina pectoris ( Group I : 50 M, 19 F,  $62.4 \pm 11.0$  years ) and acute myocardial infarction ( Group II : 47 M, 19 F,  $62.0 \pm 9.5$  years ) .

## Results :

Among 135 patients, 123 patients had collateral circulation. Collaterals were more frequently observed and better developed ( grade 2 or 3 ) in Group I than Group II. Proximal and ostial lesions were associated with well developed collaterals. Collateral circulation was more frequently observed and well developed in proportion to the duration of angina in Group I. In 123 patients with collateral circulation, 247 collateral circulations were observed. Right coronary artery ( RCA ) and Left circumflex coronary artery ( LCX ) were more frequent recipient arteries than left anterior descending coronary artery ( LAD ) ( RCA :  $2.20 \pm 1.02$ , LCX :  $1.88 \pm 0.94$ , LAD :  $1.29 \pm 0.8$  respectively, RCA vs. LAD :  $p < 0.001$ , LCX vs. LAD :  $p = 0.014$  ) . Coronary interventions were performed in 50 out of 135 patients, collateral flow of Group II decreased much more than Group I after intervention ( Group I : 5/14, Group II : 24/36,  $p = 0.046$  ) . The wall motion score was lower in patients with well developed than poorly developed collaterals (  $20.7 \pm 4.91$  vs.  $23.7 \pm 6.22$ ,  $p = 0.015$  ) .

## Conclusion :

Proximal or ostial lesion and duration of angina are major predictive factors for the development of collateral circulation. Collateral circulation is associated with preserved myocardial contractility. After coronary intervention in patients with acute myocardial infarction, recruitment of preexisting collaterals may be more important mechanism rather than neoangiogenesis.

The Prognostic Significance of Troponin-T in Patients with Acute Myocardial Infarction : Can Late Peak Concentration of Troponin-T after Myocardial Infarction Predict Cardiovascular Events?

**Backgrounds and Objectives :** It has been demonstrated that the estimated infarct size is a prognostic variable which significantly influences the short-term and long-term prognosis after an acute myocardial infarction (AMI). Recently, the late peak level of troponin-T has been determined as a reliable and simple non-invasive method for estimation of infarct size. This study was performed to determine whether the late peak level of troponin-T can be used to predict cardiovascular events during in-hospital stay and out-patient follow-up in patients with AMI. **Materials and Method :** The study was comprised 100 patients (male 91, mean age  $57 \pm 1$  years) with AMI and thrombolysis which was initiated within 6 hours after the onset of symptoms. The late peak concentration of troponin-T was defined as a more larger level between 48 and 72 hours after thrombolysis. We investigated the factors influencing on the late peak level of troponin-T and assessed the relation of the late peak level and cardiovascular events. **Results :** 1) The late peak level of troponin-T was significantly correlated with the peak creatine kinase (CK) level, ( $r = 0.69$ ,  $p = 0.0001$ ) but not ejection fraction of left ventricle (LVEF) at 7 days after AMI. The late peak level of troponin-T was significantly higher in patients with LVEF of  $<40\%$  at 7 days after AMI ( $13.49 \pm 3.62$  vs.  $6.44 \pm 0.72$ ,  $p = 0.035$ ) but not different by location of AMI and reperfusion status. 2) During clinical follow-up at a mean duration of 27 months, 1 cardiac death, 10 congestive heart failure, 8 recurrent infarction, and 20 post-myocardial infarction angina were occurred. 3) In patients who occurred cardiac events during in-hospital stay, the peak level of CK ( $4377 \pm 938$  vs.  $2661 \pm 234$ ,  $p = 0.001$ ) and TIMI forward flow grade  $<3$  ( $5/13$  vs.  $6/55$ ,  $p = 0.022$ ) were significantly higher, but the late peak level of troponin-T ( $8.69 \pm 1.22$  vs.  $6.91 \pm 0.79$ ,  $p = 0.021$ ) and the peak level of troponin-T ( $21.09 \pm 2.29$  vs.  $13.28 \pm 1.37$ ,  $p = 0.021$ ) were significantly higher in patients who occurred cardiac events during out-patient follow-up. On multi-variate analysis by logistic regression, the late peak level of troponin-T was predicted the cardiac events during clinical follow-up (CI 1.0221.196,  $p = 0.022$ ). **Conclusions :** The late peak level of troponin-T is significantly correlated with peak CK level and higher in patients with LVEF of  $<40\%$  at 7 days after AMI and in patients who occurred cardiac events during clinical follow-up. These results suggest that the late peak level of troponin-T is a simple and useful non-invasive method to predict the cardiac events during clinical follow-up in patients with acute myocardial infarction.



coronary syndrome.

Korean Circulation J 2000;30 :295-302

## A Prospective Study of Reperfusion Arrhythmias in Primary Coronary Angioplasty for Acute Myocardial Infarction

### Background and Objectives :

Arrhythmia is known to be a major cause of death in acute myocardial infarction (AMI). Reperfusion arrhythmias (RA) may also occur during angioplasty or thrombolysis. As yet, the clinical significances of RA and angiographic characteristics of the patients who develop RA during primary angioplasty and stenting are not clearly defined.

Methods : The study group consisted of 60 patients treated with primary angioplasty or stenting for AMI (angioplasty 13, stenting 47 patients). The patients were classified into 2 groups according to RA [RA (-) N = 36/RA (+) N = 24]; demographic and angiographic characteristics including time to reperfusion and incidence of pre-infarct angina were analyzed. Results : The RA occurred in 40% of patients undergoing primary angioplasty or stenting (24/60 patients). The minor arrhythmias were more common after reperfusion (transient bradycardia 14, accelerated idioventricular rhythm 11, premature ventricular contraction 4 cases); major arrhythmias were uncommon (ventricular tachycardia/fibrillation 5, asystole 1 case). In the two groups, baseline clinical characteristics were similar except for pain to reperfusion time [RA (-) : RA (+) =  $490.8 \pm 291.7$  :  $252.9 \pm 109.2$  minutes,  $P = 0.001$ ]. There was a trend toward a greater incidence of RA in the right coronary infarct-related artery [RA (-) : RA (+) = 16.7 : 41.7%,  $P = \text{NS}$ ]. The RA occurred in totally occluded artery (TIMI 0) with a giant thrombus and first ballooning in 19/24 patients (79.2%). The RA disappeared with conservative managements including pacemaker insertion and cardiopulmonary resuscitation and there were no differences in major adverse cardiac events in the two groups during follow-up. Conclusions : These findings suggest that the RA are frequent events during primary angioplasty but unrelated to clinical and angiographic characteristics except for reperfusion time and do not influence short-term prognosis in AMI.

Korean Circulation J 2000;30 :287-294

## Relations Among Coronary Flow Reserve, Left Ventricular Mass and Diastolic Function in Patients with Chest Pain and Normal Coronary Angiograms

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### Background and Purpose:

Left ventricular hypertrophy (LVH) is a well known cardiovascular risk factor, independent of hypertension, even in the absence of epicardial coronary artery disease. Possible mechanisms have been proposed, including increased LV mass, reduced coronary flow reserve (CFR) and diastolic filling abnormalities. However, the relations among LV hypertrophy, diastolic function, hypertension and coronary flow reserve (CFR) in patients with chest pain and normal coronary angiograms have not been well defined.

### Subjects and Method :

Twenty-six patients with chest pain and normal coronary angiograms were included. LV mass, isovolumic relaxation time (IVRT), deceleration time (DT) and E/A ratio were assessed by 2-D echo-cardiography. Coronary blood flow velocity before and after intracoronary adenosine were measured using intracoronary Doppler wire (FloWire). CFR was defined as ratio of peak flow velocity after adenosine to baseline flow velocity. Subjects were divided into 4 groups according to presence of LVH and hypertension and the parameters were compared among groups.

### Results :

CFR was lower ( $p < 0.01$ ) in the groups with either hypertension or LVH or both than in the groups without them. The decrement in CFR was not linearly related to the degree of LVH ( $r = 0.31$ ,  $p = 0.135$ ). Although there were modest increment in IVRT and DT and decrement in E/A ratio in the groups with hypertension or LVH or both, there was no statistical significance.

### Conclusion :

These findings suggest that the underlying mechanism of impaired CFR in patients with LVH or hypertension may be the consequence of primary coronary microvascular lesion rather than the process of left ventricular hypertrophy

## Chronic Chlamydia pneumoniae Infection as a Risk Factor for Acute Myocardial Infarction in Korea

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### Background and Objectives :

To evaluate the association between chronic infection with Chlamydia pneumoniae, as measured by Immunoglobulin G and A, and acute myocardial infarction (AMI) in Korea. Materials and

### Methods :

A total of 136 patients [normal control 65 cases (male : female 27 : 38, mean age  $55.1 \pm 11.7$  years) , AMI 71 cases (male : female 54 : 17, mean age  $58.9 \pm 12.7$  years) ] had immunoglobulin G, A, and M antibody titers measured against Chlamydia pneumoniae by microimmunofluorescence assay and had coronary angiography performed. We investigated the incidence of major adverse cardiac events (MACE) at 6 month follow-up. Controls were defined as patients with no significant stenosis on coronary angiography.

### Results :

- 1) AMI patients were more likely to be male (76.1 ; 41.5%) and smokers (67.6 ; 16.9%) compared with the controls. >
- 2) In AMI patients, there was a weak correlation with IgG and IgA antibody titers ( $r = 0.39, p = 0.001$ ) .>
- 3) After adjusting for gender and smoking status, IgG and IgA antibody titers were similar between two groups.>
- 4) Increased IgG and IgA titers did not affect the MACE during follow-up.

### Conclusion :

Chronic Chlamydia pneumoniae infection detected by immunoglobulin assay is not significantly associated with AMI. Further studies, such as polymerase chain reaction, immunocytochemistry, or culture of the atheromatous plaques, are needed to better define the association

Korean Circulation J 2000;30 :416-423

Results of percutaneous transluminal coronary angioplasty of chronic total occlusion.

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#### Background and Objective :

Percutaneous transluminal coronary angioplasty of chronic total occlusion has been limited by a relatively low success rate and a high restenosis rate. This study investigated procedural outcome, factors predictive of procedural success and safety of coronary angioplasty for chronic total coronary occlusion.

#### Materials and Methods :

The study population was composed of 45 lesions attempting PTCA with or without stent implantation for recanalization of chronic total coronary occlusion between January 1997 and July 1999. The clinical and angiographic data of the 45 lesions were reviewed. The results of successful PTCA in 28 lesions were compared with those in 17 lesions whose PTCA was failed.

#### Results :

The overall success of balloon angioplasty and stenting was achieved in 28 lesions (62.2%) and did not differ significantly by clinical variables. The most common cause of failure of balloon angioplasty was inability to pass the guide wire across the occlusion( 14 of 23 lesions, 61%). Procedural success was more common in patients with occlusions with a tapered entry configuration(77.2% vs. 47.8%,  $p=0.042$ ), with lesions without side branches(82.3% vs. 50%,  $p=0.03$ ). Multiple logistic regression analysis identified the absence of side branch( $p<0.01$ ) and the presence of a tapered entry configuration( $p<0.05$ ) as independent predictors of procedural success. One case(2.2%) needed emergency coronary bypass surgery after failure to recanalize the occluded vessel. There was no Q wave acute myocardial infarction, death.

#### Conclusions :

The favorable cases(>60%) of chronic total coronary occlusions can be successfully dilated by balloon angioplasty with or without stent implantation, with a major complication rate of 2.2%. Therefore, with careful patient selection, we need to try the aggressive recanalization for chronic total coronary occlusion.

Korean Circulation J 2000;30:424-432

#### The Reliability and Safety of Selective Carotid Angiography from the Right Transradial Approach

#### Background :



tachyarrhythmias and sudden cardiac death in patients with coronary artery disease. Restenosis after coronary stenting was not infrequent. However, there was no reliable ECG predictor for stent restenosis. This study was performed to evaluate the value of QTd as a predictor of coronary artery stent (CAS) restenosis. Methods; One hundred eighty eight patients who underwent both successful coronary artery stenting for significant coronary artery stenosis and follow-up coronary artery angiography were included in this study. QTcd (difference of maximum and minimum QTc intervals) was measured in the 12-lead surface ECG, which was recorded 6-12 hours after the successful CAS and 1218 hours before the follow-up coronary angiography, which was performed 1-12 months (Group I :  $6 \pm 3$  months ; Group II :  $7 \pm 2$  months,  $p = \text{NS}$ ) after CAS. The follow-up coronary angiography demonstrated no restenosis of the stented coronary artery in 122 patients (Group I : 97 men, 25 women ;  $58 \pm 13$  years), but restenosis in 66 patients (Group II : 58 men, 8 women ;  $61 \pm 13$  years). Results; There were no significant differences in the distribution of the target vessels between the two groups. The minimal luminal diameters of the target vessels were similar in the two groups before and after CAS ( $0.99 \pm 0.49$  mm vs.  $0.92 \pm 0.51$  mm ;  $2.94 \pm 0.71$  mm vs.  $2.71 \pm 0.79$ , respectively). QTcd after CAS was  $52.6 \pm 22.0$  ms in the Group I and  $51.6 \pm 30.5$  ms in the Group II, with no significant difference between the two groups. QTcd at the follow-up examination was  $50.0 \pm 19.8$  ms in the Group I and  $58.3 \pm 21.6$  ms in the Group II, showing a significant difference between the two groups ( $p < 0.05$ ). The change in QTcd (DQTcd) during the follow-up period was significantly different between the two groups : QTcd significantly increased in the Group II, particularly in patients with angina pectoris, single or two-vessel disease, or left coronary artery stenosis, compared with the Group I (Group I :  $2.18 \pm 22.11$  ms, Group II :  $8.77 \pm 28.82$  ms,  $p < 0.05$ ). The sensitivity, specificity, negative predictive value, positive predictive value and diagnostic accuracy of DQTcd (cut-off value, 7 ms) in predicting coronary artery stent restenosis were 64%, 65%, 77%, 49%, and 64%, respectively. Conclusion; The change of QTc dispersion according to restenosis was significantly different, but its clinical usefulness is limited due to low positive predictive value.

Korean Circulation J 2000;30 :563-570

The Early Result of Primary NIR Stenting in Acute Myocardial Infarction

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Background and Objectives; The intracoronary stent may be useful in the preventing of abrupt closure and coronary restenosis after coronary angioplasty, and recently primary stenting has been one of therapeutic

modalities. We assessed the clinical and angiographic results of primary NIR stenting in patients with acute myocardial infarction (AMI). Materials and Methods ; Between November 1997 to January 1999, 55 stentings with NIR stents were done in 51 patients with acute myocardial infarction. Angiographic follow-up was available at  $7 \pm 2.3$  days in 35 patients. Results ;1 ) Among 51 patients ( M/F : 37/14 ) , 44 patients had Q-wave MI ( 86% ) , 7 patients had non-Q-wave MI ( 14% ) . 2 ) The mean age was  $61 \pm 12.4$  years ( range : 26 to 82 years ) . 3 ) The mean time from the onset of chest pain to the arrival at emergency room was  $4.6 \pm 4.2$  hours. The mean door-to-balloon time was  $93 \pm 46$  minutes 4 ) Treated vessels were as follows ; 28 in LAD, 17 in RCA, 10 in LCX. 5 ) The indications for stent implantation were suboptimal angiographic results after PTCA in 38 lesions ( 69% ) , dissection in 9 lesions ( 16% ) , abrupt vessel closure in 1 lesion and elective in 7 lesions ( 13% ) . 6 ) Single stent implantation was done in 47 patients. Overlapping stents were done in 4 patients. 7 ) A procedure related complication occurred in one patient, peri-stent dissection without flow limitation. 8 ) Full expansion of the stent failed in three lesions with coronary calcifications and the residual stenosis was 35, 40, 50% in each case. In these cases, in-stent thrombus was not demonstrated in follow up angiography. 9 ) The minimal lumen diameter increased from  $0.11 \pm 0.39$  to  $2.96 \pm 0.40$  mm. 10 ) Angiographic follow-up on 38 stents in 35 patients demonstrated in-stent thrombus in 3 stents, in-stent restenosis in 1 stent. But in-stent flow limitations were not found in these 4 cases and TIMI flow were maintained. Patients with Q-wave MI and coronary thrombus on initial angiography were more prone to subacute thrombosis. Conclusion ; The NIR stent could be used successfully in primary coronary stenting in acute myocardial infarction. The present study shows relatively low risk of subacute stent thrombosis. The rate of restenosis needs to be confirmed by long term study.

Korean Circulation J 2000;30 :571-579

#### Immediate Coronary Angiographic Findings in Patients with Acute Myocardial Infarction

Background and Objectives; Most reports about coronary angiographic findings in acute myocardial infarction were done after thrombolytic therapy or several days after onset of symptom. The aim of this study is to evaluate coronary angiographic findings in patients with AMI within 24 hours after onset of symptoms and without thrombolytic therapy. Also we evaluated the correlation between the risk factors and severity of coronary artery disease. Materials and Methods; We studied 70 patients with acute myocardial infarction

admitted to Kyungpook National University Hospital (KNUH) from November 1997 to January 1999, and evaluated the clinical and coronary angiographic findings. We analyzed risk factors of coronary artery disease; age, total cholesterol, triglyceride, high density lipoprotein (HDL)-cholesterol, low density lipoprotein (LDL)-cholesterol, hypertension, smoking, diabetes and family history of CAD. Coronary angiography was done immediately after the arrival at emergency room (door-to-angiography time). Exclusion criteria were delayed arrival (more than 24 hours after symptom onset), previous history of anticoagulation or medication of antiplatelet agents. Results; 1) Among 70 patients (M/F: 53/17), 59 patients had Q wave myocardial infarction (QMI) (84%), 11 patients had non-Q wave-MI (NQMI) (16%). 2) The mean age was  $61 \pm 12.2$  years (range: 26 to 82 years). 3) The mean time from the onset of chest pain to angiography was  $6.2 \pm 4.7$  hours. 4) Twenty eight patients (40%) had one-vessel disease, 25 (36%) had two-vessel disease and 17 (24%) had three-vessel disease. 5) The location of infarct related arteries were as follows; LAD in 33 (47%), LCX in 13 (19%) and RCA in 24 (34%). 6) The mean diameter stenosis of infarct related artery (IRA) was  $95 \pm 10.9\%$ . According to the American College of Cardiology/American Heart Association (ACC/AHA) classification of IRA, type B lesion occurred most commonly in 56 patients (80%). 7) Thrombus was observed in 44 patients (63%) with QMI versus 3 patients (27%) with NQMI ( $p = 0.006$ ). 8) Calcifications of the wall of coronary arteries were observed in 28 patients (40%) and correlated with ages of patients. 9) History of cigarette smoking was present in 73%, hypertension in 31% and hypercholesterolemia in 15% of patients. The mean number of risk factor for each patient was 1.3. 10) Multivessel disease was significantly more frequent in patients who had two or more risk factors. 11) The frequency of cigarette smoking was greater and the level of plasma triglyceride were higher in patients under 50 years of age. 12) One patient died during coronary angiography and another 2 patients died at 5 and 8 days after coronary angiography due to cardiogenic shock. Conclusion; In immediate coronary angiographic findings in patients with AMI, multivessel disease and thrombus, and severe stenosis of IRA were observed more frequently than other studies after thrombolytic therapy or after several days of delay. Multivessel disease was significantly more frequent in the patients who had two or more risk factors of atherosclerosis. )

Korean Circulation J 2000;30 :592-598

Carotid Artery Stenting in Patients With Takayasu's Arteritis: Early and long-term follow-up results

Takayasu's arteritis is a chronic inflammatory disease of unknown etiology involving the aorta, major branches of aorta, and pulmonary arteries and leads either stenosis and occlusion of the involved artery or aneurysm formation or both. The clinical course and prognosis are variable according to two major prognostic factors, ie, complications and the pattern of the past clinical course, as well as by ESR. Though the aggressive medical and surgical treatment are required for patients with a major complication and a progressive course, surgical reconstruction entails a high incidence of suture line complications including stenosis or dilatation. Moreover all the vascular lesions are amenable for vascular surgery. Initial reports revealed excellent results of percutaneous transluminal angioplasty ( PTA ) in patients with Takayasu's arteritis. However the suboptimal results and restenosis have been the main limitations of the PTA. Stenting has some benefits for early elastic recoil of the fibrotic vessels and restenosis as in other large vessels in Takayasu's arteritis or atherosclerosis. We report early and long-term results of two cases of carotid stenting in patients with symptomatic carotid stenosis and Takayasu's arteritis, which revealed variable angiographic results according to clinical courses and recommend that stenting in Takayasu's arteritis may be another treatment modality in inactive Takayasu's arteritis.

Korean Circulation J 2000;30:702-715

#### Genetic Variants of Thrombomodulin Gene as Risk Factors for Myocardial Infarction

Thrombomodulin ( TM ) is thrombin receptor present on the luminal surface of endothelial cells. Because the thrombin-TM complex acts as an anticoagulant, the functional variants or deficiency of TM may lead to increment of thrombotic tendency. In this study, we screened the genetic variants of the TM gene in patients with myocardial infarction ( MI ) and analyzed the genotype to elucidate the effects of genetic variations of TM gene on the development of the MI. We screened a promoter region and coding sequence of the TM gene using single strand conformation polymorphism-heteroduplex analysis and identified three common genetic variants ; those were TM G-33A, TM Ala455Val, and TM C1922T. The genotype frequencies were investigated in the patients with MI ( n = 234 ) and control subjects ( n = 291 ) by the method of allele-specific oligomer hybridization. The frequencies of mutant genotypes ( TM 33A, TM 455Val, and TM 1922T ) were higher in patient group compared to the control subjects in males while there were no significant differences in females. In the multiple logistic regression analysis, TM 455Val and TM 1922T alleles were independent risk factors for MI ( OR[95% CI ; 1.799[1.1252.878] p = 0.014 and 5.624[1.01931.025], p = 0.048, respectively ) in males.

However, the genetic variations were not independent risk factors for MI in females. There were significant linkage disequilibriums among three genetic variants. These linkage disequilibriums explain the similar effects of three genetic variants on the development of MI. To investigate the effect of the TM G-33A mutation on TM promoter activity, the two TM promoter constructs ( pTM-355 and pTM-125, bearing TM 33G or TM 33A ) containing of firefly luciferase gene were transfected into HepG2, BAE, and CHO cells. The promoter activities were higher in the promoter constructs with TM 33G compared to the constructs with TM 33A in pTM-355. These results suggest the possibility of the positive predisposing effect of TM 33A allele on MI in males. The functional study for TM Ala455Val and TM C1922T should be followed to elucidate the genotype effects of these mutations on the development of MI. In this study, we identified three genetic variants of TM gene and showed the significant associations between genetic variants and MI in males. These results proposed that TM gene is an attractive candidate for genetic risk factor for MI in Koreans.

, 30 (3); 2000

#### The Effects of Probucol Combined with Antiplatelets on the Coronary Stented Patients

##### Background

An antioxidant, probucol, prevents endothelial dysfunction and low density lipoprotein oxidation and also inhibits the secretion of interleukin-1 by macrophages. These effects of probucol may result in decreased production of matrix metalloproteinases by smooth muscle cells and thus modify remodeling of the extracellular matrix.

##### Methods and Materials

We analyzed clinical events at 1 month and 6 months in 337 patients with 363 coronary arterial lesions after coronary stenting at Chonnam National University Hospital between January 1998 and May 1999. The patients were assigned to following four modalities: 500 mg of ticlipidine daily (Group I), 200 mg of cilostazol daily (Group II), 500 mg of probucol in addition to 500 mg of ticlipidine daily (Group III), and 500 mg of probucol in addition to 200 mg of cilostazol daily (Group IV). All patients received aspirin.

##### Results

Group I comprised of 149 (104 M, 45 F, 62±10 years), Group II 96 (73 M, 23 F, 60±10 years), Group III 50 (32

M, 18 F,  $61 \pm 10$  years), and Group 42 (32 M, 10 F,  $62 \pm 10$  years) patients. Clinical diagnosis was not different among four groups. Major adverse cardiac events, including myocardial infarction, cardiac death, and repeated intervention, at 1 month were 7 (4.7%) in Group I, 2 (2.1%) in Group , 0 (0%) in Group , 2 patients (4.8%) in Group , and those at 6 months were 29 (19.5%) in Group I, 17 (17.7%) in Group , 9 (18.0%) in Group , and 6 patients (14.3%) in Group .

#### Conclusions

Probucol combined with aspirin and cilostazol has a tendency reducing the major cardiac events compared with aspirin and ticlopidine or cilostazol after stenting.

, 30 (3); 2000

#### Clinical and Angiographic Characteristics, and Long-Term Clinical Follow-Up of Myocardial Bridge

#### Background

An anatomical anomaly in which myocardial fibers make the bridge over the epicardial coronary artery is called 'myocardial bridge'. Its clinical significance has been emphasized, because some serious cardiac diseases such as myocardial infarction or sudden cardiac death can be developed.

#### Method

Forty five patients (30 male and 15 female,  $48 \pm 11.0$  years) out of 4,694 patients who underwent diagnostic coronary angiography and diagnosed as myocardial bridge at Chonnam National University Hospital between January 1996 and March 1999 were analyzed retrospectively.

#### Results

The incidence of myocardial bridge on the coronary angiography was 0.95%. Middle left anterior descending artery was most common (36 patients, 80%) in the location. Associated stenoses were observed in 5 cases (11.1%). For the pharmacological treatment, calcium antagonist (26 cases, 57.7%), -blocker (23 cases, 51.1%) and nitrate (9 cases, 20.0%) were used. Single regimen was used in 30 (66.7%) cases, dual drugs were administered in 11 (24.4%) and triple drugs in 2 (4.4%) cases. During clinical follow-up of 40 patients for  $14 \pm 11$  months (4 40 months), no major cardiac events developed in all patients.

#### Conclusion

The incidence of the myocardial bridge is 0.95% and middle left anterior descending artery was the most





## The Effects of Two-Month Combination Therapy of Cilostazol and Aspirin after Intracoronary Stenting

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### Background and Objectives

It is well known that anti-platelet agents decrease the rate of subacute thrombosis after intracoronary stenting significantly. The aim of this study is to assess the antithrombotic effect and safety of 2-month combined regimen of cilostazol and aspirin on intracoronary stenting.

### Methods

The study population consisted of 78 lesions of 57 patients (age:  $58.1 \pm 10.3$ , male 47, female 10) with ischemic heart disease who were underwent successful intracoronary stenting. They were received cilostazol(200mg/day) and aspirin(100mg/day) two days before intracoronary stenting and continued for 8 weeks, and then aspirin was medicated continuously during the study. The laboratory and clinical findings were evaluated before cilostazol administration, 4 weeks, 8 weeks and 6 months after intervention. The exercise treadmill test was done at 6 months after intervention.

### Results

Subacute thrombosis occurred in 2 patients(3.5%). Target lesion revascularization(TLR) was done in 4 patients(7.3%). Clinical restenosis (symptomatic or positive stress test, subacute thrombosis and TLR) occurred in 15 patients(26.3%). There was no granulocytopenia, or severe liver dysfunction. HDL-cholesterol was increased significantly at 2 months( $36.6 \pm 7.4$  mg/dl versus  $41.6 \pm 9.3$  mg/dl.  $p < 0.01$ ) and 6 months( $36.6 \pm 7.4$  mg/dl versus  $42.4 \pm 10.6$  mg/dl.  $p < 0.01$ ) follow up

### Conclusion

Two-month combined regimen of cilostazol and aspirin was effective and safe after intracoronary stenting. Subacute thrombosis and clinical restenosis rate were comparable with pervious reports. Further large randomized trials are needed for the evaluation of favorable effect of cilostazol on lipid metabolism.

, 30 (3); 2000

Analysis of Angiographic Outcome by Thrombolysis in Myocardial Infarction(TIMI) Frame Count for Primary Stenting in Patients with Acute Myocardial Infarction



advantages of reduced vascular complication and increased comfort of patients. We evaluated the feasibility and problems of transradial coronary angiography and intervention as a routine procedure.

#### Materials and Method

Between February 1998 and December 1999 transradial approach was attempted in 750 patients with normal Allen test. Radial angiography was performed to assess the radial artery spasm and tortuosity. Arterial sheath was removed immediately after the procedure and vascular complications were evaluated before discharge.

#### Results

Radial artery puncture was successful in 738(98%) patients. Transradial coronary angiography was successful in 719(96%) patients. We failed in coronary angiography in 19 patients and the main reasons were tortuous subclavian artery in 11 patients and radial artery spasm in 5 patients. Transradial coronary angioplasty was performed successfully in 185(95%) of 194 patients. In 9 patients intervention was switched to transfemoral approach because of tortuous subclavian artery. Complications were severe radial artery spasm in 13(1.8%), minor subcutaneous hemorrhage in 7(0.9%), non-ischemic radial artery occlusion in 4(0.5%) and radial artery perforation in 1(0.1%). But, there were no major complications requiring vascular surgery or transfusion.

#### Conclusion

Transradial coronary angiography and intervention might be useful and safe as a routine procedure. The major limitations in transradial approach were radial artery spasm and tortuosity of brachial or subclavian artery.

, 30(3) ; 2000

#### Angiographic Differences Analysis of Coronary Artery Lesions in Patients with Stable and Unstable Angina Pectoris

Background and Objectives ; As previously reported, unstable angina is usually related to characteristic coronary artery lesion's morphology analyzed by coronary angiogram. This takes the form of an eccentrically placed convex stenosis with a narrow neck due to one or more overhanging edges or irregular, scalloped borders, or both. Although most studies were done for lesions with high degree stenosis(>50%), recent studies emphasized the role of vulnerability of plaque in acute coronary syndrome and even mild degree stenotic lesions may progress rapidly to evoke acute coronary syndrome. Therefore in this study, we analyzed the morphological characteristics of coronary artery lesions with mild degree stenosis as well as severe stenosis .

**Materials and Methods ;** We conducted a retrospective study of 96 patients with angina pectoris (42 of stable patients and 54 of unstable patients) who underwent coronary angiography. Each lesions with 25% or greater diameter stenosis were categorized into simple and complex lesion(convex intraluminal obstruction with a narrow neck or irregular borders, diffuse irregularities, ulceration, thrombus). Calcification of coronary artery, extents of lesions were analyzed and stenosis grade and location were categorized by AHA classification. **Results ;** There were no significant differences between the stable angina and unstable angina in risk factors and vessel involvement, numbers of lesions, calcification and total obstruction. In morphologic analysis, complex lesions were more frequent in unstable angina than stable angina (49% vs 33%,  $p<0.05$ ). The mean of percent diameter stenosis was not significantly different between two groups, but severe stenotic lesions with 90% or more stenosis were more frequent in unstable angina (34% vs 22%,  $p<0.05$ ). Locations of involved vessels were similar between the angina groups. Complex lesions were distributed more frequent in RCA and simple lesions were more in LAD and LCX ( $p<0.05$ ). **Conclusions ;** The lesions with both complex morphology and severe degree stenosis are closely implicated in unstable angina

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