Left Main Revascularization - who should do it and how?

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Disclosure of Relevant Financial Relationships

I, Mamas Mamas DO NOT have any relevant financial relationships to disclose relevant to this talk.

Should you revascularize LMS?

Keele Cardiovascular Research Group

ELEVEN-YEAR SURVIVAL IN THE VETERANS ADMINISTRATION RANDOMIZED TRIAL OF CORONARY BYPASS SURGERY FOR STABLE ANGINA

The Veterans Administration Coronary Artery Bypass Surgery Cooperative Study Group

Abstract We evaluated long-term survival after coronary-artery bypass grafting in 686 patients with stable angina who were randomly assigned to medical or surgical treatment at 13 hospitals and followed for an average of 11.2 years. For all patients and for the 595 without left main coronary-artery disease, cumulative survival did not differ significantly at 11 years according to treatment. The 7-year survival rates for all patients were 70 per cent with medical treatment and 77 per cent with surgery (P = 0.043), and the 11-year rates were 57 and 58 per cent, respectively. For patients without left main coronary-artery disease, the 7-year rates were 72 and 77 per cent in medically and surgically treated patients, respectively (P = 0.267), and the 11-year rates were 58 per cent in both groups.

A statistically significant difference in survival suggesting a benefit from surgical treatment was found in patients without left main coronary-artery disease who were subdivided into high-risk subgroups defined angiographically, clinically, or by a combination of angiographic and clinical factors: (1) high angiographic risk (three-vessel disease and impaired left ventricular function) — at 7 years, 52 per cent in medically treated patients versus 76 per cent in surgically treated patients (P = 0.002); at 11 years, 38 and 50 per cent, respectively (P = 0.026); (2) clinically defined high risk (at least two of the following: resting ST depression, history of myocardial infarction, or history of hypertension) — at 7 years, 52 per cent in the medical group versus 72 per cent in the surgical group (P = 0.003); at 11 years, 36 versus 49 per cent, respectively (P = 0.015); and (3) combined angiographic and clinical high risk — at 7 years, 36 per cent in the medical group versus 76 per cent in the surgical group (P = 0.002); at 11 years, 24 versus 54 per cent, respectively (P = 0.005). Survival among patients with impaired left ventricular function differed significantly at 7 years (63 per cent in the medical group versus 74 per cent in the surgical group [P = 0.049]) but not at 11 years (49 versus 53 per cent).

The surgical treatment policy resulted in a nonsignificant survival disadvantage throughout the 11 years in subgroups with normal left ventricular function, low angiographic risk, and low clinical risk, and a statistically significant disadvantage at 11 years in patients with two-vessel disease.

We conclude that among patients with stable ischemic heart disease, those with a high risk of dying benefit from surgical treatment, but beyond seven years the survival benefit gradually diminishes. (N Engl J Med 1984; 311:1333-9.)

IN 1975 the Veterans Administration Cooperative Study of Surgery for Coronary Arterial Occlusive Disease first reported a statistically significant survival difference in favor of surgery in the subgroup of patients with left main coronary-artery disease.[1] Two years later, in a preliminary report[2] on patients without disease in the left main artery who were followed for a minimum of 21 months, no significant difference in survival was found between medical and surgical treatment groups either overall or in angiographically defined subgroups. Subsequently, a high-risk subgroup of patients without left main coronary-artery disease, defined on the basis of clinical risk factors alone, was reported to have a significantly reduced five-year cumulative mortality with surgery.[3]

This report compares 7-year and 11-year survival after assignment to medical and surgical treatment in patients who were followed for a minimum of 107 months. Survival results for the entire group as well as for risk groups defined by angiographic and clinical measures are also presented for patients without left main coronary-artery disease. Updated survival results for patients with such disease have been reported previously.[4]

Report prepared by Katherine M. Detre, M.D., D.P.H., Peter Peduzzi, Ph.D., Timothy Takaro, M.D., Herbert N. Hultgren, M.D., Marvin L. Murphy, M.D., and George Kroncke, M.D. Address reprint requests to Dr. Detre at the Veterans Administration Medical Center, West Haven, CT 06516. For a complete listing of participants, members of the Operations and Executive Committees, Coordinating Center staff, and consultants, refer to *Circulation* 1981; 63:1329 (Appendix C).

Supported by the Veterans Administration Cooperative Studies Program, Medical Research Service, Veterans Administration Central Office, Washington, D.C.

Methods

The Veterans Administration cooperative study of coronary-artery bypass grafting is a randomized controlled trial of medical therapy versus medical plus surgical therapy for the treatment of patients with stable angina pectoris and angiographically confirmed coronary-artery disease. The study design, entry criteria, and baseline characteristics of the patient population have been described previously.[5] Briefly, between 1972 and 1974, 686 patients with stable angina pectoris of more than six months' duration who had been receiving medical therapy for three months and who had resting or exercise electrocardiographic evidence of myocardial ischemia were randomly assigned to medical or surgical therapy. Patients were excluded from randomization if they had had a myocardial infarction within six months or if they had refractory systemic diastolic hypertension (>100 mm Hg), left ventricular aneurysm or other serious cardiac disease, other organ-system disease making surgery inadvisable or limiting life expectancy to less than five years, unstable angina, or uncompensated congestive heart failure.

In the 1972-1974 cohort, 354 patients were randomly assigned to medical therapy, and 332 to surgical therapy, at a total of 13 clinical sites. The base-line distribution of risk factors (history, angiographic findings, electrocardiographic findings, and severity of angina) was comparable in the two treatment groups.[6]

Twenty patients randomly assigned to bypass surgery did not have an operation. Ninety-four per cent of those who underwent surgery did so within three months after random assignment. The average number of diseased vessels in surgically treated patients was 2.4, and the average number of grafts placed was 2.0. All 45 patients with single-vessel disease received at least one graft, and one fourth received multiple grafts. Of the 102 patients with two-vessel disease, 80 per cent received two or more grafts. Of the 163 patients with triple-vessel disease, 90 per cent received two or more grafts, and 37 per cent received three or more.

The overall 30-day operative mortality rate was 5.8 per cent. The incidence of perioperative myocardial infarction, calculated on the basis of the development of new Q waves, was 9.9 per cent. Vein-graft angiography was performed in 79 per cent of surgical patients (247 of 312) between 10 and 15 months after surgery, and 353 of 503 grafts placed (70 per cent) were patent at one year; 87 per cent of

TWELVE-YEAR FOLLOW-UP OF SURVIVAL IN THE RANDOMIZED EUROPEAN CORONARY SURGERY STUDY

Edvardas Varnauskas, M.D., and the European Coronary Surgery Study Group*

Abstract We studied survival rates among 767 men with good left ventricular function who participated in the European Coronary Surgery Study, 10 to 12 years after they were randomly assigned to either early coronary bypass surgery or medical therapy.

At the projected five-year follow-up interval, we observed a significantly higher survival rate (±95 percent confidence interval) in the group that was assigned to surgical treatment than in the group assigned to medical treatment (92.4±2.7 vs. 83.1±3.9 percent; P = 0.0001). During the subsequent seven years, the percentage of patients who survived decreased more rapidly in the surgically treated than in the medically treated group (70.6±5.8 vs. 66.7±5.3 percent at 12 years). Thus, the improvement in the survival rate among patients with stable angina who were treated surgically appears to have been attenuated after five years. However, the gradually diminishing difference between the two survival curves still favored surgical treatment after 12 years (P = 0.04), despite the fact that 136 patients in the medically treated group had coronary bypass surgery and 23 in the "surgically treated" group did not.

The benefit of surgical treatment tended to be greater, but not significantly so, as assessed by interaction analysis in the subgroups of patients who were older or who had signs of ischemia or previous infarction on the resting electrocardiogram, a markedly ischemic response to exercise testing, peripheral arterial disease, an absence of hypertension, and proximal obstruction in the left anterior descending artery. The reasons for the loss of a beneficial effect of surgery after five years are unknown and merit further study. (N Engl J Med 1988; 319:332-7.)

THE European Coronary Surgery Study[1,2] was designed to evaluate the effect of surgical treatment on survival among 767 patients with chronic angina who were randomly assigned to undergo early coronary bypass surgery or to receive medical therapy. Patients in the "medically treated" group were treated surgically only if the angina failed to respond to intensive medical management. At the projected five-year follow-up assessment (the formal end of the study), the survival rate and symptomatic and functional status were significantly better among those who had early coronary bypass surgery than among those who received medical treatment.[1,2] Subsequently, the patients randomly assigned to medical treatment were eligible for surgical treatment if their symptoms worsened or if they had a high calculated risk of premature death, as suggested by the study.

Hypothetically, the large number of coronary bypass operations performed on patients in the medically treated group (n = 136) might have improved late survival in this group, whereas the survival rate in the surgically treated group might have declined with time as a result of the progression of disease affecting both grafts and native coronary arteries.[3-5] Eventually, the potential and therapeutic benefit of surgical treatment might be diluted, so that the cumulative survival curves would converge, resulting in the disappearance of treatment differences, as suggested by the results of the Veterans Administration study.[6]

To test this hypothesis, we evaluated survival rates for the 7 years after the end of the study; 12-year follow-up data are presented here.

*Past and present participants in the European Coronary Surgery Study Group are as follows: *Coordinating center* — Göteborg: E. Varnauskas (director), S.B. Olsson, the late E. Carlström, T. Karlsson, and K.K. Talwar; *Participating centers* — Edinburgh: D.G. Julian, H.C. Miller, and M.F. Oliver; Glasgow: A.R. Lorimer, I. Hutton, R.G. Murray, A. Tweddel, T. Lawrie, W. Bain, the late P. Caves, and D. Wheatly; Helsinki: M.H. Frick, P.T. Harjola, and M. Valle; Leiden: B. Buis, J. Drauläns, A.G. Brom, and H.A. Huysmans; London: C.M. Oakley, J.F. Goodwin, W. McKenna, H.H. Bentall, W.P. Cleland, K.S.C. Wong, and H. Yousif (Hammersmith Hospital); R. Balcon, M. Honey, and J.E.C. Wright (London Chest Hospital); E. Sowton, P. Roy, A.C. Edwards, J. Crick, A. Yates, and C.E. Handler (Guy's Hospital); Harefield, Middlesex: M. Towers, R. Thomson, S.A. Qureshi, R. Pridie, M. Yacoub, and J. Al-Khatib, (Harefield Hospital); Oslo: S. Simonsen, O. Storstein, L. Efskind, and T. Frøjsaker (Rikshospitalet); E. Sivertsen, L. Meldahl, and G. Semb (Ullevål Hospital); Prague: J. Fabian, the late L. Hejhal, and F. Firt; Zurich: M. Rothlin, Å. Senning, and W. Meier.

Address reprint requests to Dr. Varnauskas at Sahlgrenska Hospital, S-413 45 Göteborg, Sweden.

Methods

Previous reports from the European Coronary Surgery Study Group described the patients, the design of the study, and the results at five years.[1,2] In summary, 767 men, under the age of 65, who had mild or moderate angina pectoris of at least three months' duration, an obstruction of 50 percent or more in at least two major coronary arteries, and an absence of marked left ventricular dysfunction were randomly assigned between September 1973 and March 1976 to receive either medical or surgical treatment. Patients with severe anginal pain that could not be controlled by medical treatment were not eligible for inclusion in the study.

The patients' base-line clinical variables, coronary arteriograms, left ventriculograms, electrocardiograms, and exercise tests were evaluated according to a standardized protocol, and the patients were randomly assigned to treatment at each participating center. Continuous monitoring of data and site visits disclosed no major deviations from the protocol.

Medical care was not standardized in detail. Drug treatment, measures to control risk factors, and procedures to promote rehabilitation for both groups were initiated on the basis of the physicians' clinical judgment and were maintained as long as medically indicated. If at any time a patient in the medical group had unacceptable symptoms despite adequate medical treatment, he was eligible for surgical intervention.

In the group assigned to surgical treatment, coronary-artery bypass grafting was carried out as soon as possible after random assignment to treatment (mean [±SD] delay, 3.9±3.5 months). An average of 1.9 grafts per patient were inserted in the patients with two-vessel disease and 2.4 grafts per patient in the patients with three-vessel disease. The rate of patency of the grafts was 90 percent up to 9 months after surgery in 92 patients and 77 percent between 9 and 18 months after surgery in 209 patients.[1]

The present survey was carried out 10 years after the last patient was enrolled in the study. The data to be retrieved for each patient who was alive at the five-year follow-up assessment included the date of the survey; the date of death, if applicable; the date of the last known checkup, in the cases of patients who could not be traced at the time of the survey; and the date of the first and subsequent

What do guidelines tell us- ESC

Recommendations on criteria for the choice between coronary artery bypass grafting and percutaneous coronary intervention

Recommendations	Class[a]	Level[b]
Assessment of CAD complexity		
In patients with LM or multivessel disease, it is recommended that the SYNTAX score is calculated to assess the anatomical complexity of CAD and the long-term risk of mortality and morbidity after PCI.[117–124]	I	B
When considering the decision between CABG and PCI, completeness of revascularization should be prioritized.[131,132,134–136]	IIa	B

Recommendation for the type of revascularization in patients with stable coronary artery disease with suitable coronary anatomy for both procedures and low predicted surgical mortality[d]

Recommendations according to extent of CAD	CABG		PCI	
	Class[a]	Level[b]	Class[a]	Level[b]
Left main CAD				
Left main disease with low SYNTAX score (0-22).[69,121,122,124,145–148]	I	A	I	A
Left main disease with intermediate SYNTAX score (23-32).[69,121,122,124,145–148]	I	A	IIa	A
Left main disease with high SYNTAX score (≥33).[c 69,121,122,124,146–148]	I	A	III	B

Percutaneous coronary intervention with drug-eluting stents versus coronary artery bypass grafting in left main coronary artery disease: an individual patient data meta-analysis

Marc S Sabatine, Brian A Bergmark*, Sabina A Murphy, Patrick T O'Gara, Peter K Smith, Patrick W Serruys, A Pieter Kappetein, Seung-Jung Park, Duk-Woo Park, Evald H Christiansen, Niels R Holm, Per H Nielsen, Gregg W Stone, Joseph F Sabik, Eugene Braunwald*

	PCI		CABG		Ratio (95% CI)	p value	Absolute risk difference (95% CI)
	n/N	Percentage (95% CI)	n/N	Percentage (95% CI)			
5-year all-cause deaths*	239/2197	11·2% (9·9–12·6)	216/2197	10·2% (9·0–11·6)	HR 1·10 (0·91–1·32)	0·33	0·9% (–0·9 to 2·8)
Cardiovascular death	131/2197	6·2% (5·3–7·4)	121/2197	5·9% (4·9–7·0)	HR 1·07 (0·83–1·37)	0·61	0·4% (–1·1 to 1·8)
Non-cardiovascular death	106/2197	5·2% (4·3–6·3)	90/2197	4·5% (3·7–5·5)	HR 1·16 (0·88–1·54)	0·30	0·7% (–0·6 to 2·0)
10-year all-cause deaths†	310/2197	22·4% (19·9–25·3)	277/2197	20·4% (17·9–23·2)	HR 1·10 (0·93–1·29)	0·25	2·0% (–1·8 to 5·8)
Spontaneous myocardial infarction	127/2197	6·2% (5·2–7·3)	54/2197	2·6% (2·0–3·4)	HR 2·35 (1·71–3·23)	<0·0001	3·5% (2·3 to 4·8)
Procedural myocardial infarction (protocol definition)‡§	60/1901	3·2% (2·4–4·0)	86/1843	4·7% (3·7–5·7)	OR 0·65 (0·47–0·92)	0·013	–1·5% (–2·8 to –0·3)
Procedural myocardial infarction (universal definition)‡¶	41/1286	3·2% (2·3–4·3)	29/1278	2·3% (1·5–3·2)	OR 1·42 (0·88–2·30)	0·15	0·9% (–0·3 to 2·2)
Any myocardial infarction§‖	187/2197	8·9% (7·8–10·2)	138/2197	6·5% (5·5–7·6)	HR 1·34 (1·08–1·67)	0·0087	2·4% (0·8 to 4·0)
Stroke**	54/2197	2·7% (2·0–3·5)	63/2197	3·1% (2·4–3·9)	HR 0·84 (0·59–1·21)	0·36	–0·4% (–1·4 to 0·6)
Coronary revascularisation	381/2197	18·3% (16·7–20·0)	218/2197	10·7% (9·4–12·1)	HR 1·78 (1·51–2·10)	<0·0001	7·6% (5·5 to 9·8)

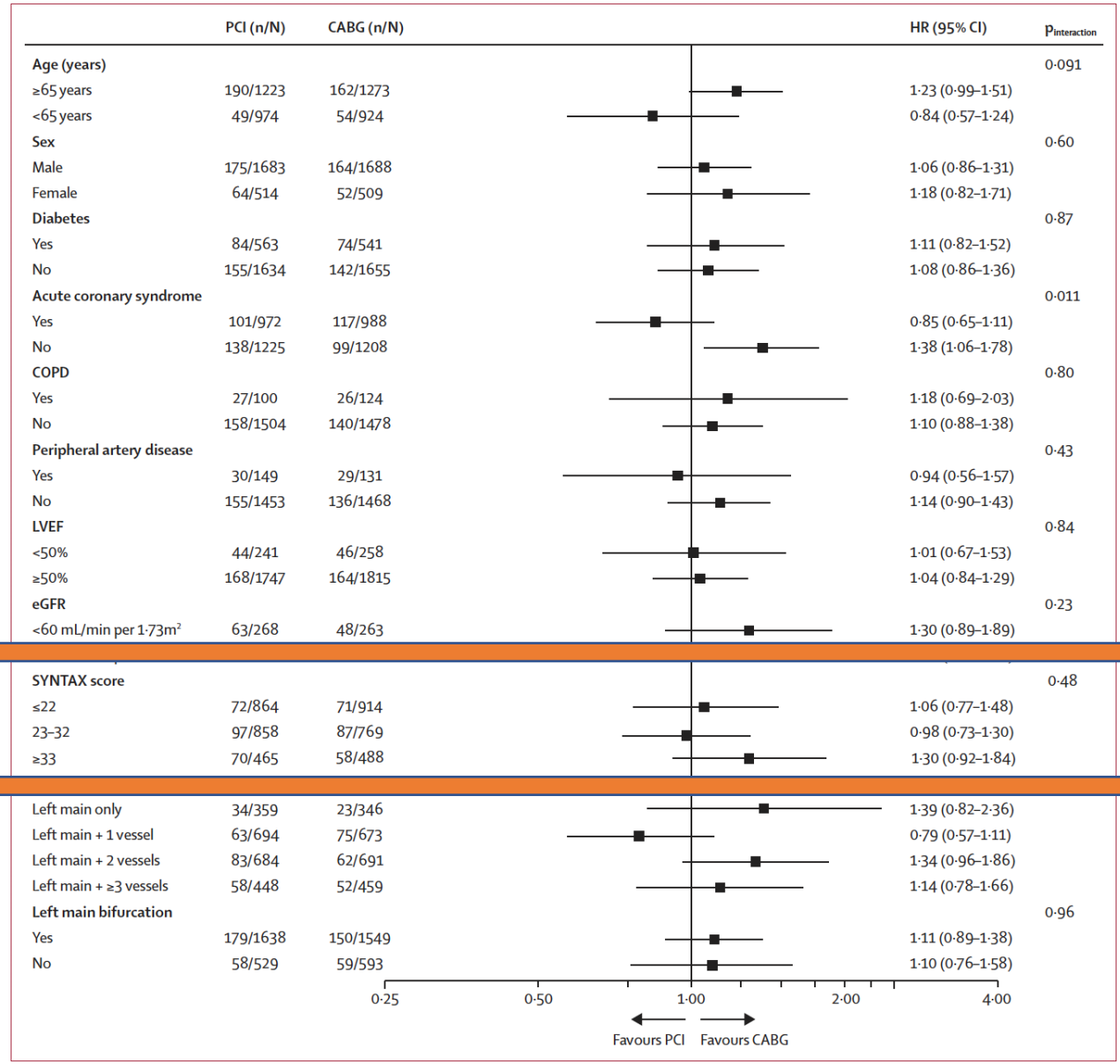

Figure 3: **5-year all-cause deaths in key subgroups**
CABG=coronary artery bypass grafting. COPD=chronic obstructive pulmonary disease. eGFR=estimated glomerular filtration rate (calculated using the Chronic Kidney Disease Epidemiology Collaboration formula). HR=hazard ratio. LVEF=left ventricular ejection fraction. PCI=percutaneous coronary intervention.

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Do CABG or PCI provide definitive treatment for the patient ?

Keele Cardiovascular Research Group

Circulation

ORIGINAL RESEARCH ARTICLE

Ten-Year Outcomes After Drug-Eluting Stents Versus Coronary Artery Bypass Grafting for Left Main Coronary Disease

Extended Follow-Up of the PRECOMBAT Trial

Table 2. Primary and Secondary Outcomes at 10 Years

Outcomes	PCI Group (N=300)	CABG Group (N=300)	Risk Difference (95% CI)	Hazard Ratio (95% CI)*
	No. of Events (%) at 10 Years		Percentage Points	
Ischemia-driven target-vessel revascularization	45 (16.1)	22 (8.0)	8.1 (2.8 to 13.5)	1.98 (1.21–3.21)
Any revascularization	59 (21.3)	29 (10.6)	10.7 (4.6 to 16.7)	2.04 (1.33–3.11)
Stent thrombosis or symptomatic graft occlusion	4 (1.4)	10 (3.7)	–2.3 (–4.9 to 0.3)	0.56 (0.20–1.55)

Neither CABG or PCI provides definitive treatment for the patient

Both strategies will require further revascularization

Mortality after coronary artery bypass grafting versus percutaneous coronary intervention with stenting for coronary artery disease: a pooled analysis of individual patient data

Stuart J Head, Milan Milojevic, Joost Daemen, Jung-Min Ahn, Eric Boersma, Evald H Christiansen, Michael J Domanski, Michael E Farkouh, Marcus Flather, Valentin Fuster, Mark A Hlatky, Niels R Holm, Whady A Hueb, Masoor Kamalesh, Young-Hak Kim, Timo Mäkikallio, Friedrich W Mohr, Grigorios Papageorgiou, Seung-Jung Park, Alfredo E Rodriguez, Joseph F Sabik 3rd, Rodney H Stables, Gregg W Stone, Patrick W Serruys, Arie Pieter Kappetein

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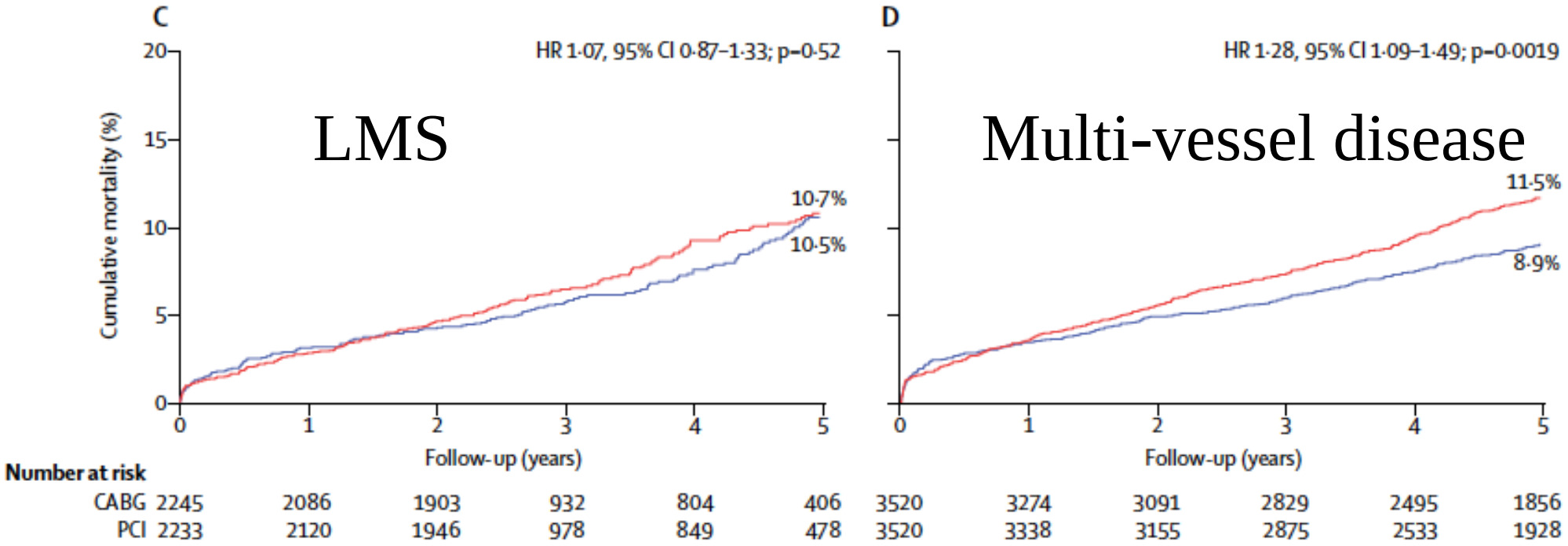
If patient is young and will need further interventions in future

CABG better down the line where patient will have prognostic benefit



Who should do LMS PCI ?

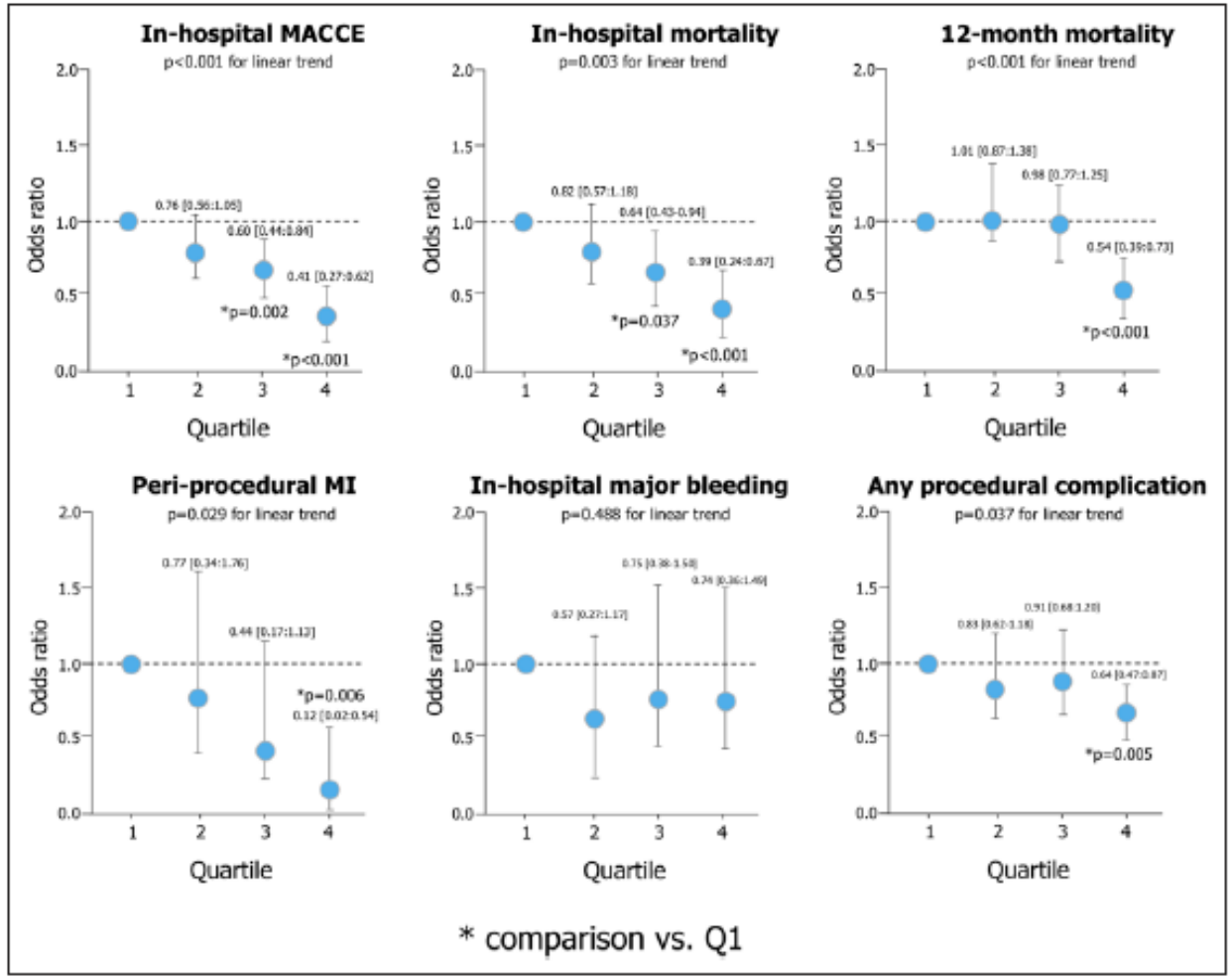


Figure 2. Operator volume and clinical outcomes after unprotected left main stem percutaneous coronary intervention (uLMS-PCI) in England and Wales, 2012 to 2014.

Top line: adjusted in-hospital major adverse cardiac and cerebral events (MACCE) and mortality and 12-mo mortality indicating an association between higher operator volume and improved clinical outcomes. Bottom line: adjusted in-hospital complications with an association observed between higher operator volume and fewer periprocedural complications. MI indicates myocardial infarction. *Comparison vs Q1.

Circulation: Cardiovascular Interventions

ORIGINAL ARTICLE

Are Higher Operator Volumes for Unprotected Left Main Stem Percutaneous Coronary Intervention Associated With Improved Patient Outcomes?

A Survival Analysis of 6724 Procedures From the British Cardiovascular Intervention Society National Database

Tim Kinnaird, MD; Sean Gallagher, MD; Richard Anderson, MD; Andrew Sharp, PhD; Vasim Farooq, PhD; Peter Ludman, MD; Samuel Copt, PhD; Nick Curzen, PhD; Adrian Banning, MD; Mamas Mamas, DPhil

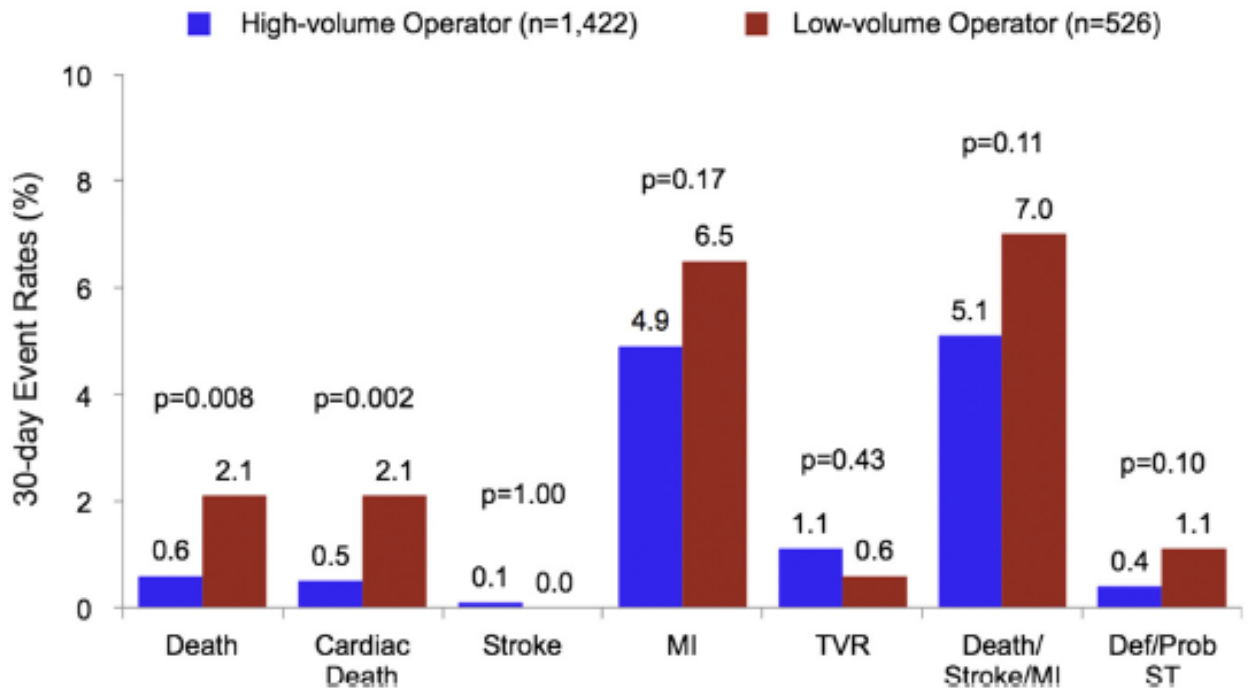
CLINICAL RESEARCH

CORONARY

Impact of Operator Experience and Volume on Outcomes After Left Main Coronary Artery Percutaneous Coronary Intervention

Bo Xu, MBBS,[a] Björn Redfors, MD, PhD,[b,c] Yuejin Yang, MD,[a] Shubin Qiao, MD,[a] Yongjian Wu, MD,[a] Jilin Chen, MD,[a] Haibo Liu, MD,[a] Jue Chen, MD,[a] Liang Xu, MSc,[a] Yanyan Zhao, BS,[a] Changdong Guan, MSc,[a] Runlin Gao, MD,[a] Philippe Généreux, MD[b,d,e,f]

FIGURE 1 Outcomes at 30 Days



Def = definite; MI = myocardial infarction; Prob = probable; ST = stent thrombosis; TVR = target vessel revascularization.

(High volume: 15 / year)

Intravascular imaging

Keele Cardiovascular Research Group

Mandatory in LMS

Imaging useful:

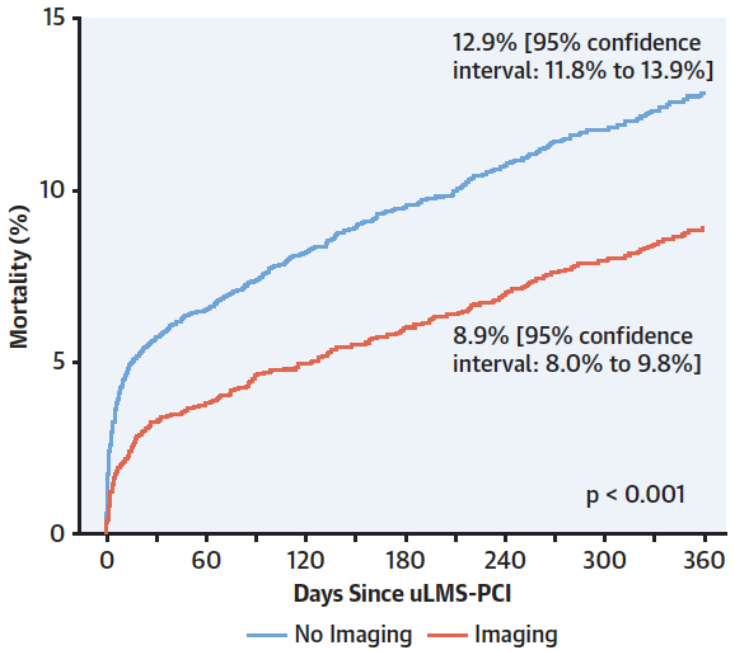
- Helps understand the plaque burden in MV + SB
- Help define landing zone/ strategy
- Characterise Ca2+ (circumferential / depth) & guide lesion prep strategy
- Optimise expansion / stent result

Intravascular Imaging and 12-Month Mortality After Unprotected Left Main Stem PCI

An Analysis From the British Cardiovascular Intervention Society Database

Tim Kinnaird, MD,[a,b] Thomas Johnson, PhD,[c] Richard Anderson, MD,[a] Sean Gallagher, MD,[a] Alex Sirker, PhD,[d] Peter Ludman, MD,[e] Mark de Belder, MD,[f] Samuel Copt, PhD,[g] Keith Oldroyd, MD,[h] Adrian Banning, MD,[i] Mamas Mamas, DPhil,[a,j] Nick Curzen, PhD[k]

CENTRAL ILLUSTRATION **Survival by Intravascular Imaging Use After uLMS PCI in England and Wales From 2007 to 2014**



Kinnaird, T. et al. J Am Coll Cardiol Intv. 2020;13(3):346–57.

Kaplan-Meier curves of 12-month survival when intravascular imaging was used compared with when imaging was not used to guide unprotected left main stem percutaneous coronary intervention in England and Wales in from 2007 to 2014. This illustrates a significant association between improved survival and imaging use during unprotected left main stem percutaneous coronary intervention.

Circulation: Cardiovascular Interventions

Keele Cardiovascular Research Group

ORIGINAL ARTICLE

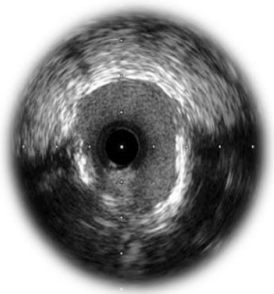
Long-Term Clinical Impact of Intravascular Ultrasound Guidance in Stenting for Left Main Coronary Artery Disease

Do-Yoon Kang, MD; Jung-Min Ahn, MD; Sung-Cheol Yun, PhD; Hanbit Park, MD; Sang-Cheol Cho, MD; Tae Oh Kim, MD; Sangwoo Park, MD; Pil Hyung Lee, MD; Seung-Whan Lee, MD; Seong-Wook Park, MD; Duk-Woo Park, MD; Seung-Jung Park, MD

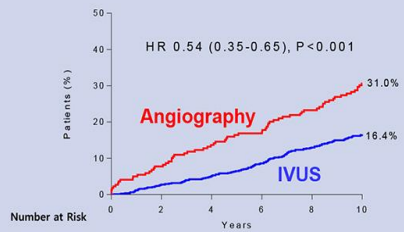
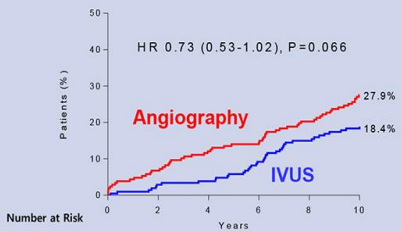
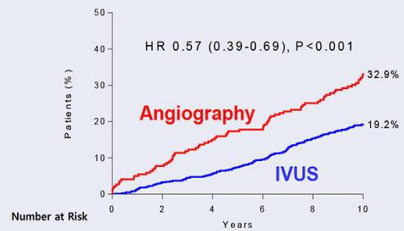
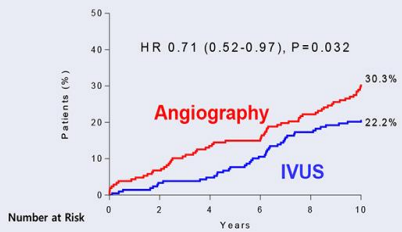
Long-term (10-year) Impact of IVUS-guidance for Left Main PCI

Left Main Disease

IVUS-guided PCI



10-Year Follow-up

	Overall Population	After Propensity-score Matching
All-cause death		
Composite of all-cause death, Q-wave MI, or stroke		

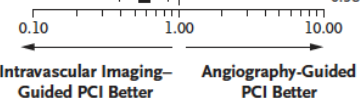
The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Intravascular Imaging–Guided or Angiography-Guided Complex PCI

J.M. Lee, K.H. Choi, Y.B. Song, J.-Y. Lee, S.-J. Lee, S.Y. Lee, S.M. Kim, K.H. Yun, J.Y. Cho, C.J. Kim, H.-S. Ahn, C.-W. Nam, H.-J. Yoon, Y.H. Park, W.S. Lee, J.-O. Jeong, P.S. Song, J.-H. Doh, S.-H. Jo, C.-H. Yoon, M.G. Kang, J.-S. Koh, K.Y. Lee, Y.-H. Lim, Y.-H. Cho, J.-M. Cho, W.J. Jang, K.-J. Chun, D. Hong, T.K. Park, J.H. Yang, S.-H. Choi, H.-C. Gwon, and J.-Y. Hahn, for the RENOVATE-COMPLEX-PCI Investigators*

Subgroup	Intravascular Imaging–Guided PCI	Angiography-Guided PCI	Hazard Ratio (95% CI)
	no. of events/total no. of patients (cumulative incidence, %)		
Overall	76/1092 (7.7)	60/547 (12.3)	0.64 (0.45–0.89)
Type of imaging devices			
Intravascular ultrasonography	59/800 (8.0)	60/547 (12.3)	0.66 (0.46–0.95)
Optical coherence tomography	15/278 (5.8)	60/547 (12.3)	0.47 (0.27–0.83)
Type of complex coronary lesions			
True bifurcation	23/233 (10.3)	13/126 (11.8)	0.97 (0.49–1.93)
Chronic total occlusion	9/220 (5.9)	13/99 (14)	0.39 (0.13–0.71)
Unprotected left main coronary artery disease	9/138 (6.8)	11/54 (25)	0.31 (0.13–0.76)
Diffuse long coronary artery lesion	36/417 (8.9)	31/251 (11.9)	0.72 (0.42–1.22)
Multivessel PCI involving ≥2 major coronary arteries	36/409 (9.5)	22/213 (11.7)	0.84 (0.50–1.44)
Lesion necessitating use of ≥3 stents	16/208 (8.1)	6/97 (6)	1.24 (0.49–3.18)
Lesion with in-stent restenosis	22/158 (15.6)	12/78 (17)	0.90 (0.45–1.82)
Severely calcified lesion	11/157 (7.3)	11/74 (17)	0.46 (0.20–1.06)
Ostial lesions of major coronary artery	8/182 (4.4)	9/69 (16)	0.33 (0.13–0.85)
Initial presentation			
Stable ischemic heart disease	25/532 (5.0)	27/275 (10.4)	0.46 (0.27–0.80)
Acute coronary syndrome	51/560 (10.4)	33/272 (14.6)	0.74 (0.48–1.15)
Age			
<65 yr	36/517 (7.8)	23/238 (10.6)	0.72 (0.42–1.21)
≥65 yr	40/575 (7.4)	37/309 (13.6)	0.57 (0.36–0.88)
Sex			
Male	66/869 (8.3)	46/431 (11.7)	0.70 (0.48–1.02)
Female	10/223 (5.2)	14/116 (14.5)	0.35 (0.16–0.80)
Diabetes mellitus			
Yes	45/394 (12.9)	26/223 (12.3)	0.97 (0.60–1.57)
No	31/698 (4.7)	34/324 (12.2)	0.41 (0.25–0.67)
Chronic kidney disease			
Yes	22/203 (13.3)	19/93 (23)	0.51 (0.27–0.93)
No	54/889 (6.4)	41/454 (9.9)	0.66 (0.44–0.99)
Left ventricular ejection fraction			
<50%	22/210 (12.0)	12/84 (15)	0.72 (0.35–1.45)
≥50%	54/882 (6.7)	48/463 (11.8)	0.58 (0.39–0.85)

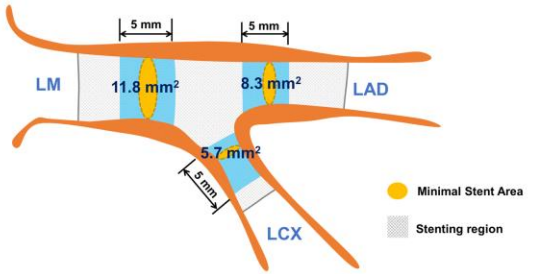


Optimal Minimal Stent Area and Impact of Stent Underexpansion in Left Main Up-Front 2-Stent Strategy

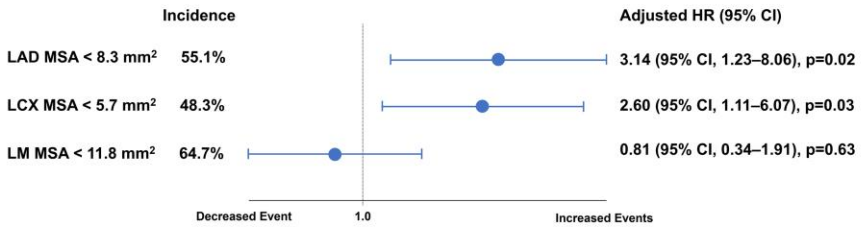
Ju Hyeon Kim, Do-Yoon Kang, Jung-Min Ahn ✉, Jihoon Kweon ✉, Yeonwoo Choi, Hoyun Kim, Jinho Lee, Jihye Chae, Soo-Jin Kang, Duk-Woo Park and Seung-Jung Park

Originally published 16 Jan 2024 | https://doi.org/10.1161/CIRCINTERVENTIONS.123.013006 | Circulation: Cardiovascular Interventions. 2024;17

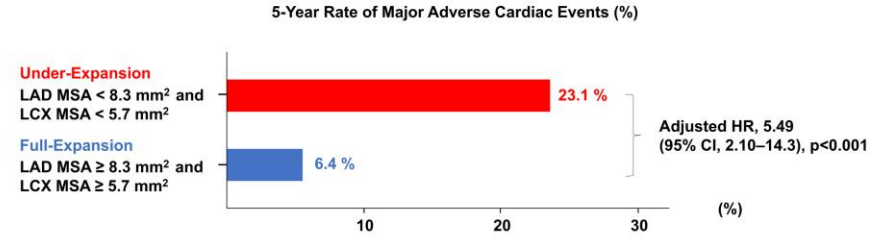
The Optimal Minimal Stent Area within Each Left Main Segment



Stent Under-Expansion Criteria in LM Two-Stenting With the Crush Technique

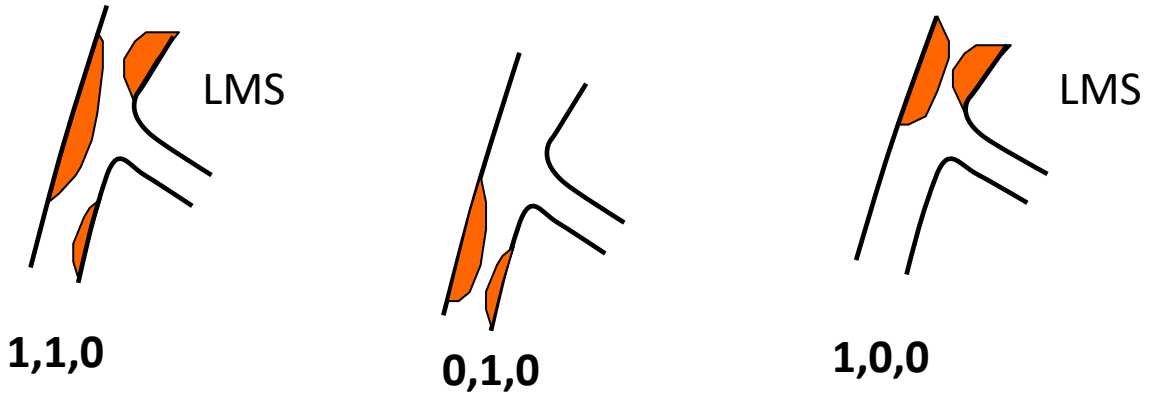


Major Adverse Cardiac Events at 5 Years according to Stent Under-Expansion



One vs two stents

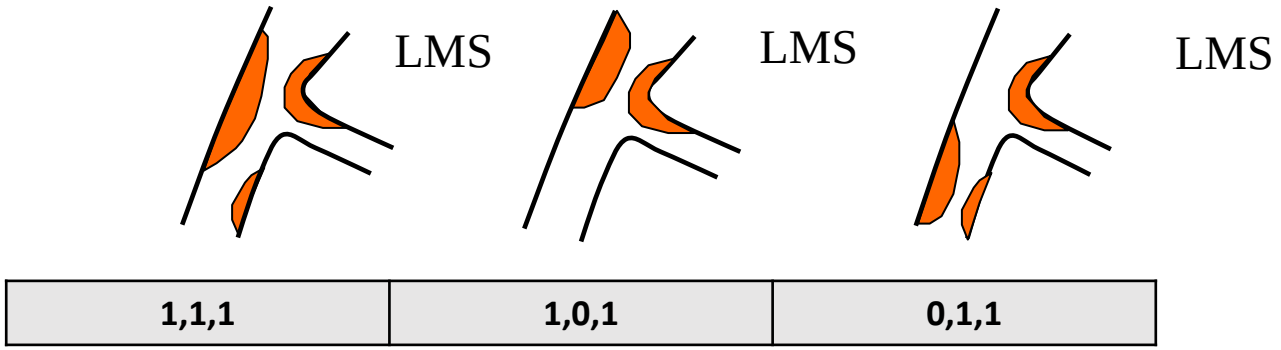
Non-true bifurcations



- Single 1 stent (provisional) approach sized to distal vessel
- Proximal optimization (POT)
- FKB if side branch compromise or future Cx access may be required
- Repeat POT if FKB performed ie POT-Kiss-POT

One vs two stents

True bifurcation lesions



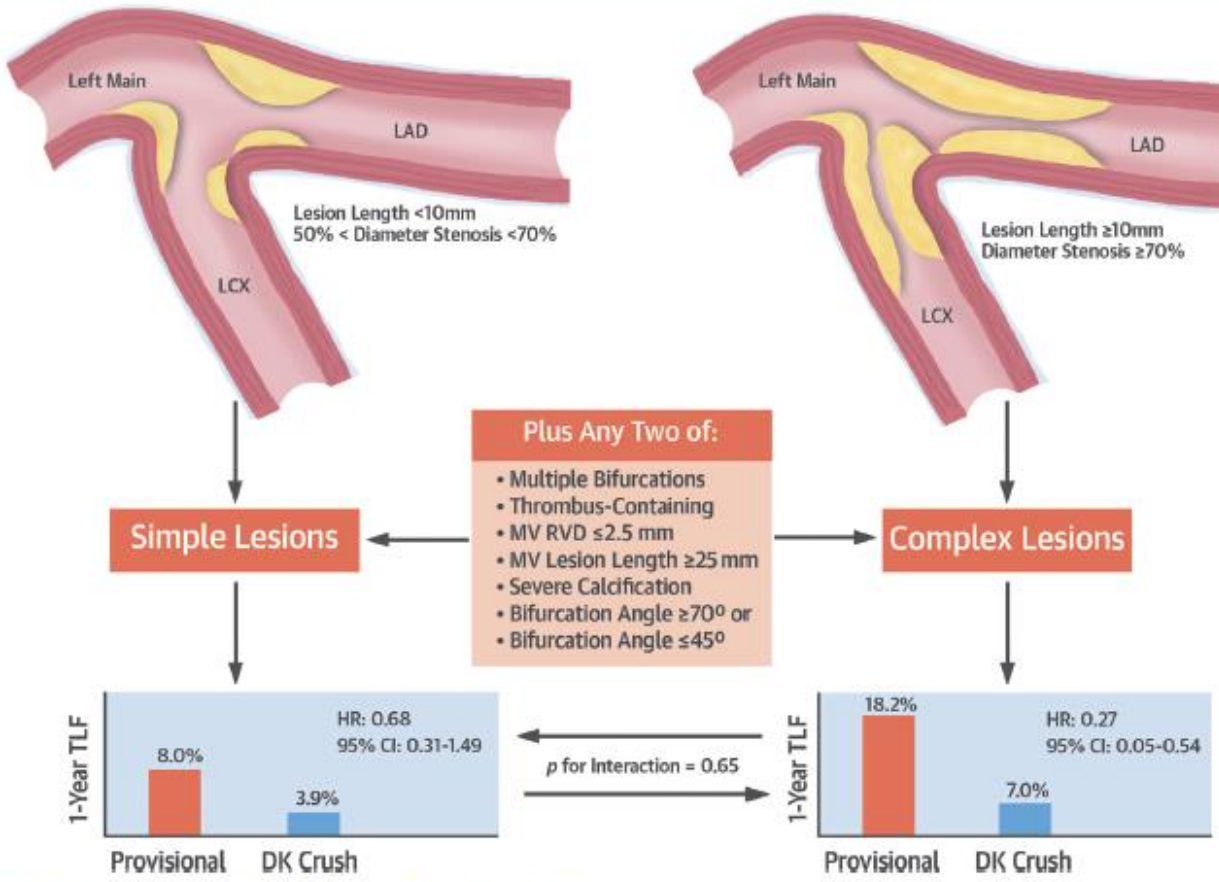
Approach depends on anatomy / severity of SB disease

Double Kissing Crush Versus Provisional Stenting for Left Main Distal Bifurcation Lesions

DKCRUSH-V Randomized Trial

Shao-Liang Chen, MD,[a] Jue-Jie Zhang, PhD,[a] Yaling Han, MD,[b] Jing Kan, MBBS,[a] Lianglong Chen, MD,[c] Chunguang Qiu, MD,[d] Tiemin Jiang, MD,[e] Ling Tao, MD,[f] Hesong Zeng, MD,[g] Li Li, MD,[h] Yong Xia, MD,[i] Chuanyu Gao, MD,[j] Teguh Santoso, MD,[k] Chootopol Paiboon, MD,[l] Yan Wang, MD,[m] Tak W. Kwan, MD,[n] Fei Ye, MD,[o] Nailiang Tian, MD,[o] Zhizhong Liu, PhD,[a] Song Lin, MD,[o] Chengzhi Lu, MD,[p] Shangyu Wen, MD,[q] Lang Hong, MD,[r] Qi Zhang, MD,[s] Imad Sheiban, MD,[t] Yawei Xu, MD,[u] Lefeng Wang, MD,[v] Tanveer S. Rab, MD,[w] Zhanquan Li, MD,[x] Guanchang Cheng, MD,[y] Lianqun Cui, MD,[z] Martin B. Leon, MD,[aa] Gregg W. Stone, MD[aa]

CENTRAL ILLUSTRATION Stenting for LM Bifurcations



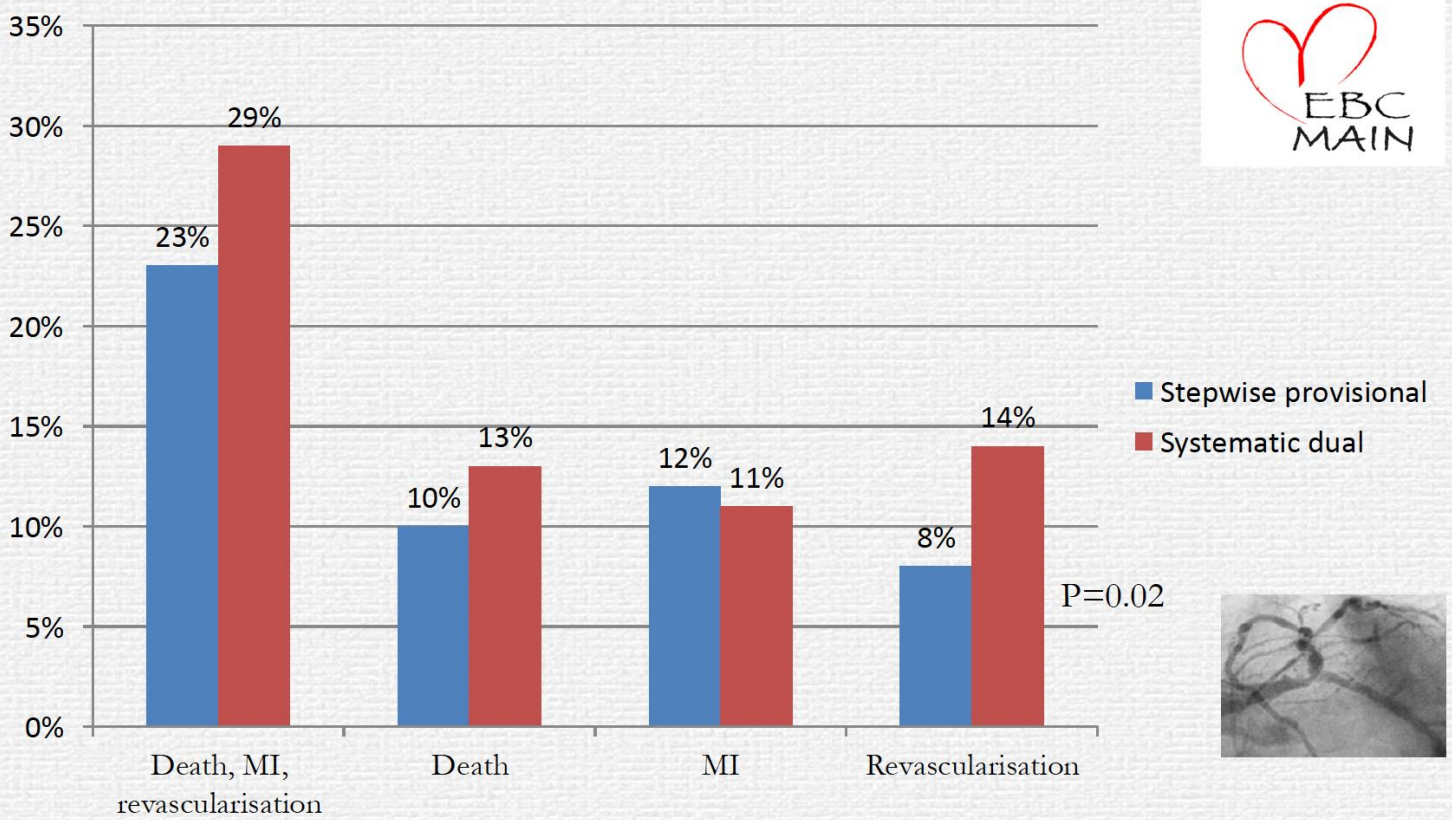
Chen, S.-L. et al. J Am Coll Cardiol. 2017;70(21):2605–17.

ESC European Society of Cardiology
European Heart Journal (2021) 42, 3829–3839
doi:10.1093/eurheartj/ehab283
FASTTRACK CLINICAL RESEARCH
Ischaemic heart disease

The European bifurcation club Left Main Coronary Stent study: a randomized comparison of stepwise provisional vs. systematic dual stenting strategies (EBC MAIN)

David Hildick-Smith[1*], Mohaned Egred[2], Adrian Banning[3], Philippe Brunel[4], Miroslaw Ferenc[5], Thomas Hovasse[6], Adrian Wlodarczak[7], Manuel Pan[8], Thomas Schmitz[9], Marc Silvestri[10], Andreis Erglis[11], Evgeny Kretov[12], Jens Flensted Lassen[13], Alaide Chieffo[14], Thierry Lefèvre[6], Francesco Burzotta[15], James Cockburn[1], Olivier Darremont[16], Goran Stankovic[17], Marie-Claude Morice[6], and Yves Louvard[6]

EBC MAIN 3 year results



Conclusions - considerations

- Body of RCT data no significant difference in mortality out to 10 years
- Patients treated with PCI and CABG will require future revascularization- need to consider lifetime risk. Undertake CABG when prognostically significant

Conclusions – How and who

- Intracoronary imaging mandatory for all cases pre / post. Not just passing a catheter but actioning findings.
- For simple cases provisional approach, for more complex cases 2 stent approach better.
- DK Crush may be better in high volume LMS operators (300 PCI cases / yr for 5 yrs and 20 LMS PCI cases a year)
- Volume outcome relationship in LMS PCI