TCT AP2013

Surgery Should Be the Dominant Therapy

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Professor of Cardiovascular Surgery, University of Oxford

Conflicts of Interest:
(i) Clinical: Cardiac Surgeon
(ii) Commercial: Consultant to Medtronic, Abbott, AstraZeneca, Novadaq, VGS,
(iii) One of 25 ESC/EACTS Guidelines Writers on Myocardial Revascularization
(iv) Chairman Surgical Committee of EXCEL trial

1. EVIDENCE FROM RCT of PCI vs CABG (Pre-SYNTAX)

Coronary artery bypass surgery compared with percutaneous coronary interventions for multivessel disease: a collaborative analysis of individual patient data from ten randomised trials

Mark A Hlatky, Derek B Boothroyd, Dena M Bravata, Eric Boersma, Jean Booth, Maria M Brooks, Didier Carrié, Tim C Clayton, Nicolas Dan
Marcus Flather, Christian W Hamm, Whady A Hueb, Jan Kähler, Sheryl F Kelsey, Spencer B King, Andrzej S Kosinski, Neuza Lopes,
Kathryn M McDonald, Alfredo Rodriguez, Patrick Serruys, Ulrich Sigwart, Rodney H Stables, Douglas K Owens, Stuart J Pocock

	10 RCT C… PCI
Patients	7812
Median Follow-up	6 years
HR for death with CABG	0.91 (p=0.12)
HR for death with P…	-
Death/Re… …asc	✓10% vs 25% (p=0.001)
H… …CABG in Diabetics	✓0.7 (p=0.014)
HR Death CABG >65 yrs	✓0.82 (p=0.002)

Highly select populations: 95% of eligible patients excluded !!!

CABG Has Survival Benefit Over PCI in 'Real Life' Clinical Practice

Author	Year	Patients	DM	Stents	F-Up	CABG vs PCI
Weintraub	NEJM 2012	189793	+	78% DES	4yrs	4.4% survival CABG
Wu	ATS2011	7235	+	BMS	8yrs	7% survival CABG
Hannan	NEJM 2008	17,400p	-	DES	1.5 yrs	HR 0.8 (p=0.03)
Bair	CIRC 2007	6,369	-	DES	5 yrs	HR 0.85 (p<0.001)
Javaid	CIRC 2007	1,680	-	DES	1 yr	97% vs 89%
Hannan	NEJM 2005	59,314p	-	BMS	3 yrs	↓ mortality 5%
Malenka	CIRC 2005	14,493	-	BMS	7 yrs	HR 0.6 (p <0.01)
BARI	JACC 2007	353	+	-	10 yrs	58% vs 46%
Javaid	CIRC 2007	601	+	DES	1 yr	3% vs 12-18%
Niles	JACC 2001	2,766	+	-	5 yrs	HR 0.25-0.5
SUMMARY		300,004			<10 yr	↓ mortality

- In (>300,00) 'REAL-LIFE' patients with 3VD, by 3-5 years
  - CABG increases ABSOLUTE survival by around 5% vs PCI
  - CABG decreases ABSOLUTE reintervention x5 vs PCI

IMPORTANT WARNING FOR SYNTAX TRIAL !!

2. EVIDENCE FROM REGISTRIES of PCI vs CABG (Pre-SYNTAX)

NEJM 2005

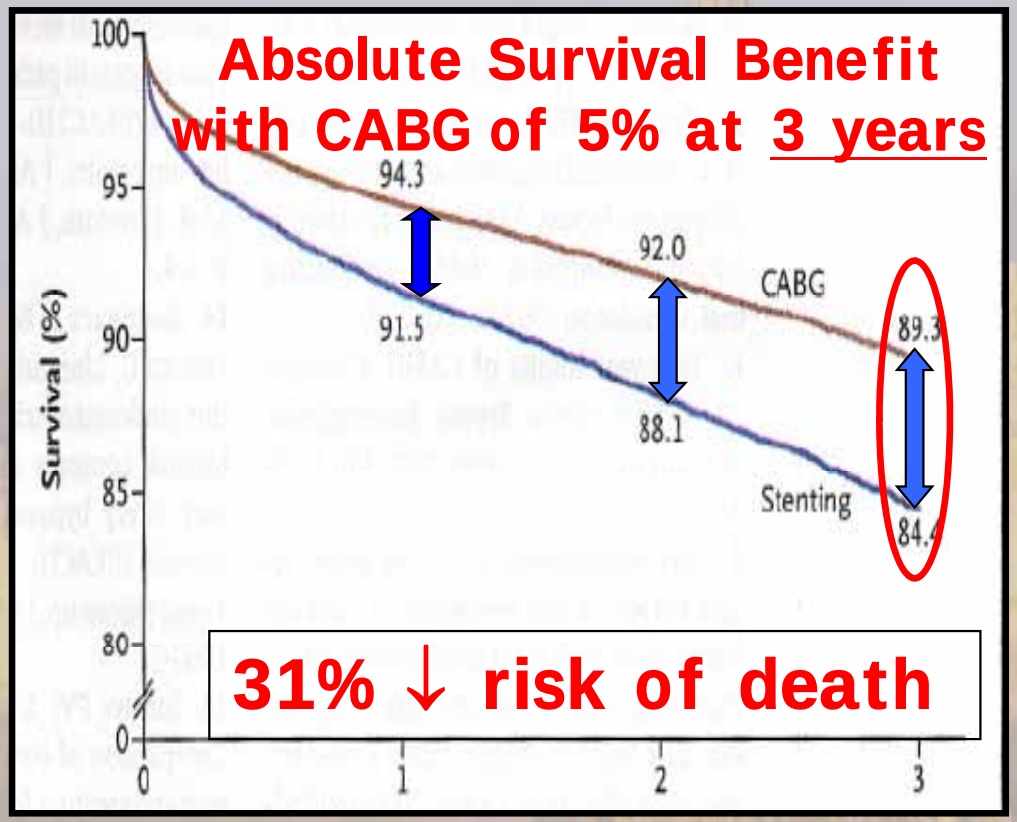
The NEW ENGLAND JOURNAL of MEDICINE

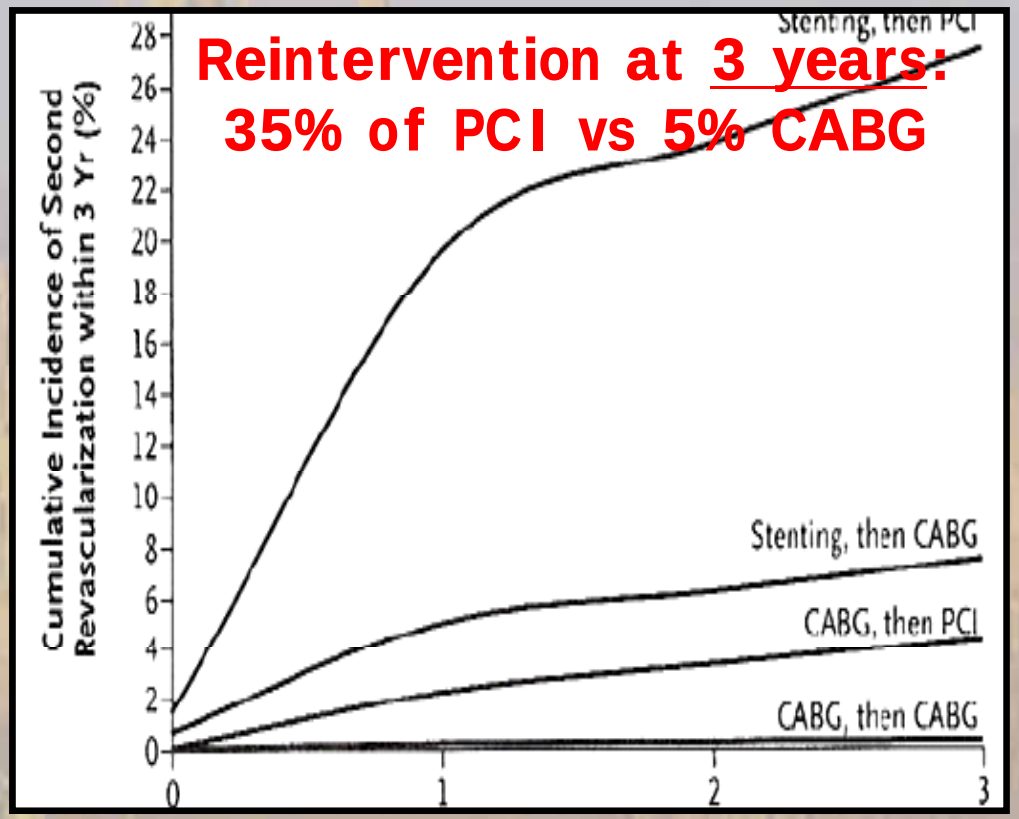
ORIGINAL ARTICLE

Long-Term Outcomes of Coronary-Artery Bypass Grafting versus Stent Implantation

Edward L. Hannan, Ph.D., Michael J. Racz, Ph.D., Gary Walford, M.D., Robert H. Jones, M.D., Thomas J. Ryan, M.D., Edward Bennett, M.D.

- New York Registry: 37,212 CABG and 22,102 PCI (BMS) patients with > 2VD
- Propensity matched for cardiac and non-cardiac co-morbidity risk





✔ CABG: Survival + freedom from revasc INCREASE WITH TIME !!

✗ PCI/CABG studies with <3 years follow up are only 'interim'

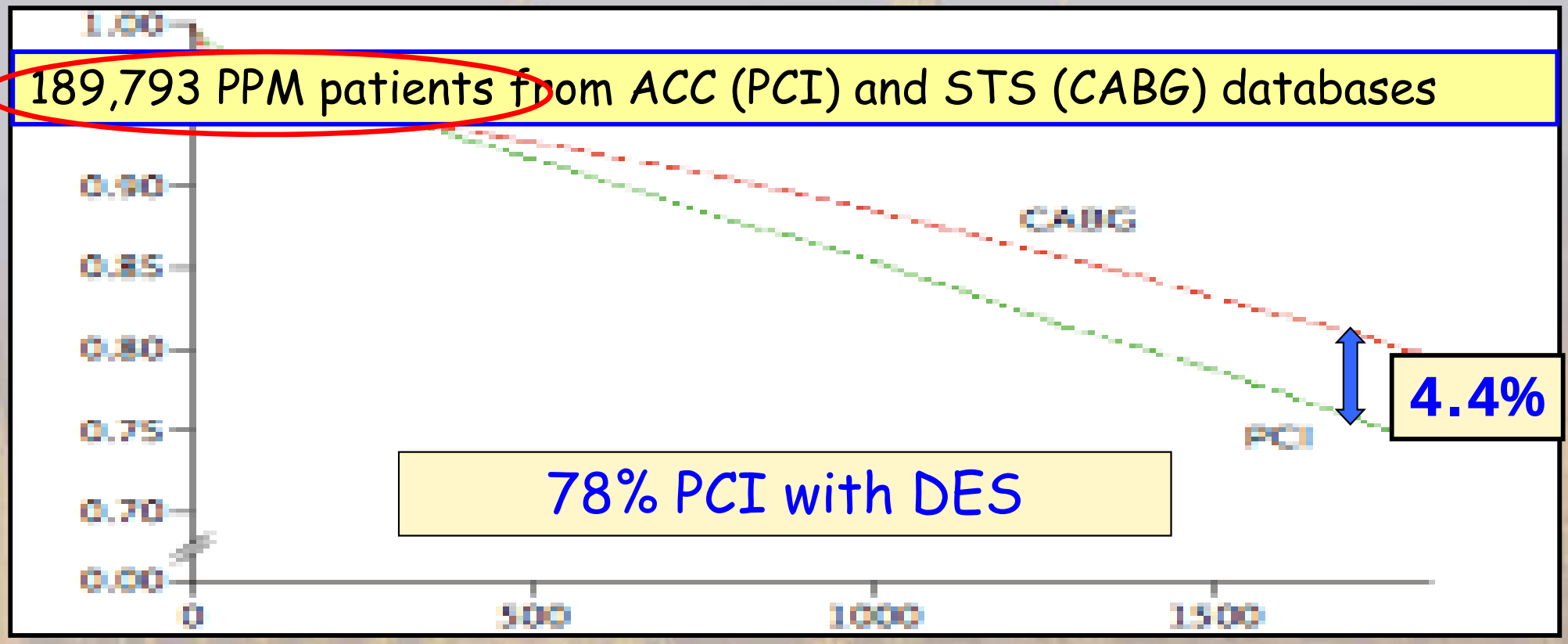
The NEW ENGLAND JOURNAL of MEDICINE

NEJM 2012

ORIGINAL ARTICLE

Comparative Effectiveness of Revascularization Strategies

William S. Weintraub, M.D., Maria V. Grau-Sepulveda, M.D., M.P.H.,



- At 4 years CABG increases survival by 4.4%: HR 0.79 (0.76-0.82)
- Survival benefit of CABG increases with time

SYNTAX RCT Results (5/5 Years): 3 Vessel Disease

	PCI	CABG	
nos	546	549	
Death	14.6	9.2 (-5.4%)	.006
Cardiac Death	9.2	4.0 (-5.2%)	.001
MI	10.6	3.3 (-7.3%)	<.001
CVA	3.0	3.4 (+0.6%)	.66
D+C+M	22	14 (-8%)	<.001
Revasc	25.4	12.6 (-12.8%)	<.001

Consistent with PPM registry data
Similar rate of stroke in PCI/CABG

Survival curves still diverging at 5 years implying survival benefit of CABG may be even greater !!!

Low <23	nos	181	171	
	death	10.2	9.3	.81
	CVA	1.8	3.9	.24
	MI	8.8	4.9	.20
	D+C+M	17.5	14.8	.56
	Revasc	23.1	14.6	.04
Int 23-32	nos	207	208	
	death	16.3	9.6	.047
	CVA	2.5	3.6	.53
	MI	13.8	3.1	<.001
	D+C+M	23.2	14.7	.04
	Revasc	25.1	11.0	.000
High >32	nos	155	166	
	death	17.8	8.8	.02
	CVA	5.1	2.6	.31
	MI	8.7	1.9	.008
	D+C+M	26.2	12.5	.002
	Revasc	28.2	12.6	.000

Fundamental Question

WHY DOES CABG HAVE SUCH A SURVIVAL BENEFIT OVER PCI ?

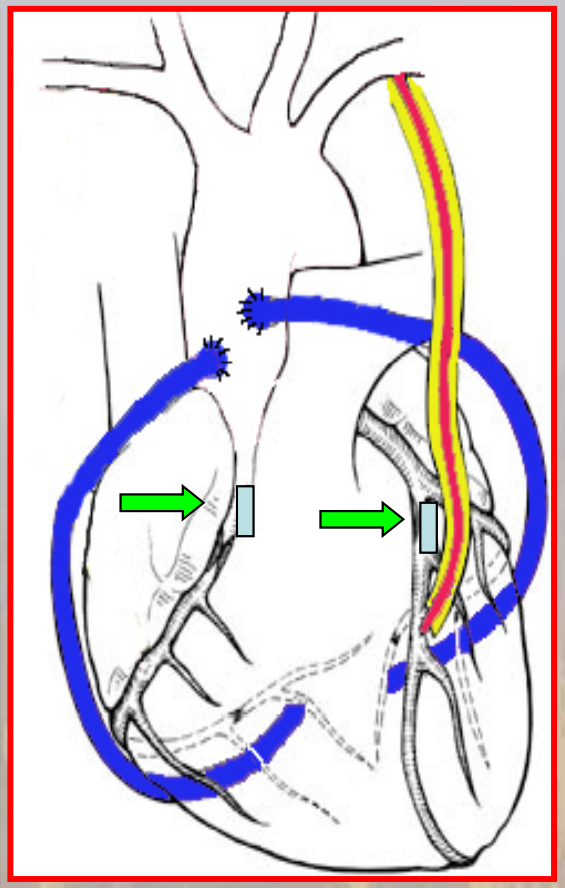
Anatomically, atheroma is mainly located in the proximal coronary arteries

During CABG placing bypass grafts to the **MID CORONARY VESSEL** has **TWO** effects

(i) Complexity of 'CULPRIT' lesion irrelevant

(ii) over the long term, CABG offers prophylaxis against FUTURE 'culprit' lesions by protecting whole zones of vulnerable proximal myocardium in diffusely unstable coronary endothelium

- In contrast, PCI with stents ( ) only treats **'SUITABLE'** localised proximal 'culprit' lesions but has **NO PROPHYLACTIC BENEFIT** against new disease (proximal to, within or distal to the stent) which nullifies the benefit of the stent



2. PCI means incomplete revascularization (Hannan Circ 2006)

- Of 22,000 PCI 69% had incomplete revascularization
- >2 vessels (+/- CTO) HR for mortality 1.4 (95% CI = 1.1-1.7)

PCI will 'never' match the results of CABG for LM/MVD (POBA;BMS;DES)

The Guidelines…what do they recommend ?

	CABG		PCI	
Subset of CAD by anatomy	ESC	ACC	ESC	ACC
Heart team Approach for LM or complex CAD	I C	I C	I C	I C
1 VD: NON proximal LAD	IIb C	III B	I C	III B
1 VD: proximal LAD	I A	IIa B	IIa B	IIb B
2 VD: NON proximal LAD	IIb C	IIa B / IIb C	I C	IIb B
2 VD: proximal LAD	I A	I B	IIa B	IIb B
3 VD, simple lesions, full functional revasc achievable with PCI, SYNTAX scores <22	I A	I B	IIa B	IIb B / III B
3 VD, complex lesions, incomplete revasc achievable with PCI, SYNTAX scores >22 **79%**	I A	I B	III A	IIb B / III B
LM (isolated or 1VD, ostium/shaft)	I A	I B	IIa B	IIa B
LM (isolated or 1VD, distal bifurcation)	I A	I B	IIb B	IIb B / III B
LM + 2VD or 3VD, SYNTAX scores <33	I A	I B	IIb B	IIb B / III B
LM + 2VD or 3VD, SYNTAX scores >32 **66%**	I A	I B	III B	IIb B / III B

Long-Term Mortality of Coronary Artery Bypass Grafting and Bare-Metal Stenting

ATS 2011

Chuntao Wu, MD, PhD, Songyang Zhao, MS, Andrew S. Wechsler, MD,

7235 pairs propensity matched for 32 factors with 8 yr FU

		PCI	CABG		CABG HR	
	numbers	7235	7235			
	All Deaths	29%	22% (-7%)		0.68 (.64-.74)	<0.001

	LAD DISEASE	nos	PCI death	CABG death	CABG HR	
3 VD	Proximal	2692	35%	22% (-13%)	0.68 (.64-.74)	<0.001
3 VD	Non Proximal	2784	30%	22% (-8%)	0.53 (.55-.76)	<0.001
2 VD	Proximal	5948	24%	21%(-3%)	0.78 (.69-.88)	<0.001
2 VD	Non Proximal	1818	30%	23% (-7%)	0.70 (.58-.85)	<0.001
2 VD	None	1228	30%	25% (-5%)	0.78 (.62-1.0)	<0.05

DES do NOT have a survival benefit over BMS !!!!

Evidence Basis for an Intervention (CABG vs PCI)

	RCT The Gold standard	Registries (Propensity Matched)
Strengths	**No Bias**	**Large Numbers of Patients** **(often tens of thousands)** **Represent real clinical practice** **(1/20 RCT of CABG vs PCI)**
Potential Weaknesses	**Small numbers of patients** **Small % of eligible population** **Atypical patient populations** **Short duration of follow-up** **Large numbers of cross-overs** **(19/20 RCT of CABG vs PCI)**	**Confounding/Bias**

Results of contemporary CABG are excellent !!!

European Heart Journal
doi:10.1093/eurheartj/ehq318

FASTTRACK
ESC HOT LINE

Randomized trial to compare bilateral vs. single internal mammary coronary artery bypass grafting: 1-year results of the Arterial Revascularisation Trial (ART)

David P. Taggart[1]*, Douglas G. Altman[2], Alastair M. Gray[3], Belinda Lees[4,5], Fiona Nugara[4], Ly-Mee Yu[2], Helen Campbell[3] and Marcus Flather[4,5], on behalf of the ART Investigators

- 3102 patients randomized to single or bilateral IMA grafts
- primary outcome is 10 year survival (5 yr results in 2012)
- 67 surgeons, 28 centres, seven countries
- 30 day mortality 1.2%, 1 yr mortality 2.4%
- 1 year incidence of stroke, MI, repeat revascularization all < 2%

✓ Five year results will be published January 2014
✗ Only 5% of patients in USA and <10% in Europe receive BIMA

REVIEW ARTICLE

LESS IS MORE

Initial Coronary Stent Implantation With Medical Therapy vs Medical Therapy Alone for Stable Coronary Artery Disease

Meta-analysis of Randomized Controlled Trials

Kathleen Stergiopoulos, MD, PhD; David L. Brown, MD

Arch Intern Med 2012

8 trials with 7729 patients with mean follow-up > 4 years

	Medical therapy	+ STENT	
Death %	9.1	8.9	✗ 0.98 (0.84-1.16)
Non Fatal MI %	8.1	8.9	✗ 1.12 (0.93-1.34)
Revascularization %	30.7	21.4	✗ 0.78 (0.57-1.06)
Recurrent Angina %	33	29	✗ 0.80 (0.60-

Conclusion: Initial stent implantation for stable CAD shows no evidence of benefit compared with initial medical therapy for prevention of death, non fatal MI, unplanned revascularization or angina

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	10 RCT CABG vs PCI
Patients	7812
Median Follow-up	6 years
HR for death with CABG	0.91 (p=0.12)
HR for death with PCI	-
Death/Repeat Revasc	✓10% vs 25% (p=0.001)
HR Death CABG in Diabetics	✓0.7 (p=0.014)
HR Death CABG >65 yrs	✓0.82 (p=0.002)

Coronary Artery Bypass Grafting is Still the Best

- 8826 patients in total: but highly selected
- ✗ Only enrolled 5% of total potentially eligible population
- ✗ 65% had 1 or 2 VD all with normal LV function
- ✗ only 40% had proximal LAD disease
- ✗ only 79% received an IMA

Trials all reported no survival benefit of CABG over PCI but
(i) this was entirely predictable by only including a population in whom it was already well established that there was NO prognostic benefit from revascularization
(ii) results were then (mis)presented in medical literature as if they were applicable to all patients
(iii) leading to an explosive growth in PCI !!!!

ONLY EXCEPTION IS SYNTAX (a relative 'All Comer' RCT)

AGE </>75

Gender

BMI

Race

DM

Lung fn

PVD

Prior MI

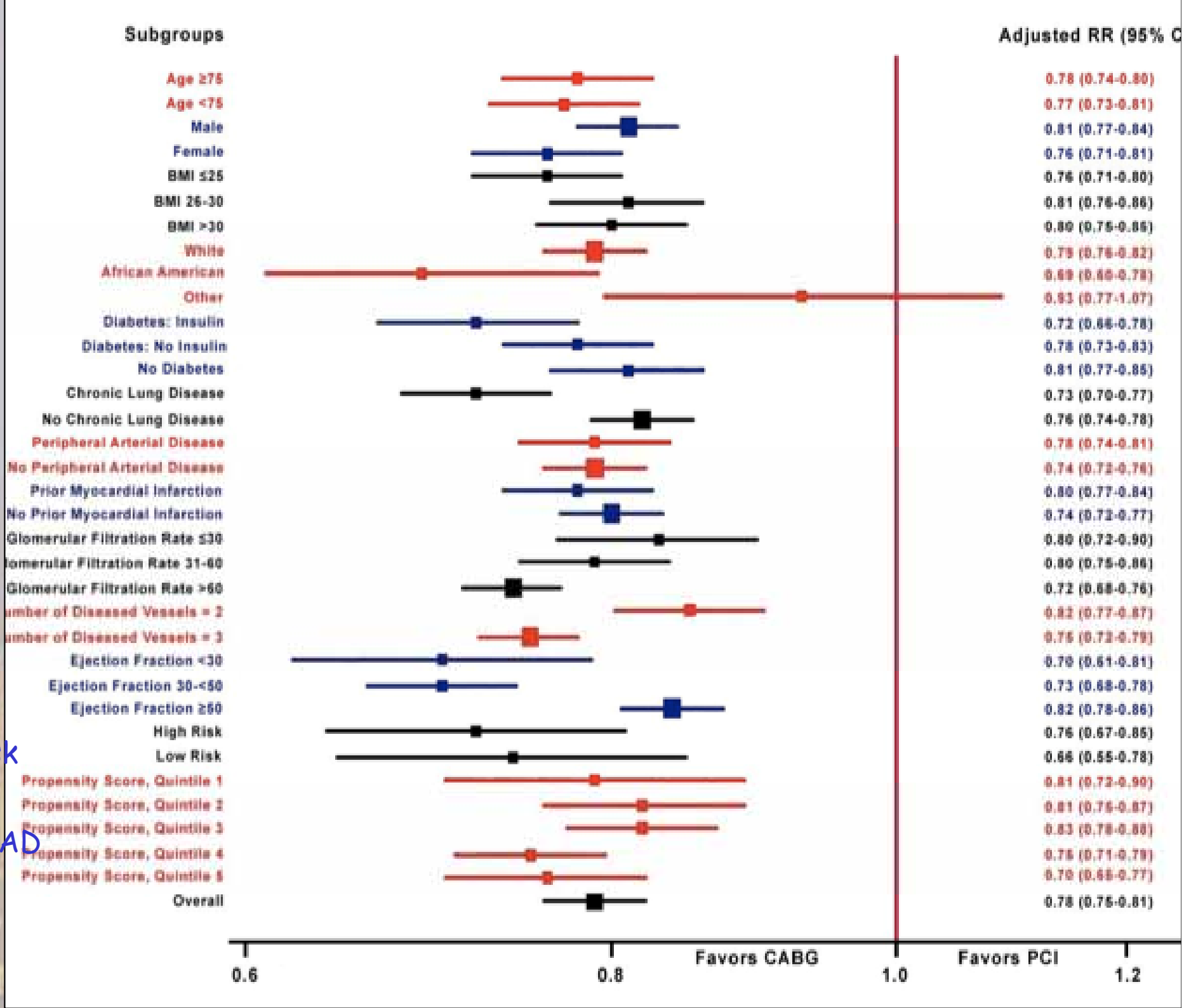
Renal fn

EF

Overall Risk

Severity CAD

OVERALL



THE SYNTAX TRIAL

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 MARCH 5, 2009 VOL. 360 NO. 10

Percutaneous Coronary Intervention versus Coronary-Artery Bypass Grafting for Severe Coronary Artery Disease

Patrick W. Serruys, M.D., Ph.D., Marie-Claude Morice, M.D., A. Pieter Kappetein, M.D., Ph.D., Antonio Colombo, M.D., David R. Holmes, M.D., Michael J. Mack, M.D., Elisabeth Ståhle, M.D., Ted E. Feldman, M.D., Marcel van den Brand, M.D., Eric J. Bass, B.A., Nic Van Dyck, R.N., Katrin Leadley, M.D., Keith D. Dawkins, M.D., and Friedrich W. Mohr, M.D., Ph.D., for the SYNTAX Investigators*

ABSTRACT

BACKGROUND

Percutaneous coronary intervention (PCI) involving drug-eluting stents is increas-

From Erasmus University Medical Center

Landmark trial (most important trial ever of PCI vs CABG)

- 5 year outcomes death and MACCE [Lancet Feb 22 2013]
- 'All comer' trial (vs highly select patients in all previous RCTs)
- Parallel Registry (35% of patients straight to CABG !!)

Journal of the American College of Cardiology
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Vol. 51, No. 9, 2008
ISSN 0735-1097/08/$34.00
doi:10.1016/j.jacc.2007.09.067

STATE-OF-THE-ART PAPER AND COMMENTARY

Revascularization for Unprotected Left Main Stem Coronary Artery Stenosis

Stenting or Surgery

David P. Taggart, MD (Hons), PhD, FRCS,* Sanjay Kaul, MD, FACC,†
William E. Boden, MD, FACC,‡ T. Bruce Ferguson, Jr, MD, FACC,§
Robert A. Guyton, MD, FACC,¶ Michael J. Mack, MD,# Paul T. Sergeant, MD, PhD,††
Richard J. Shemin, MD, FACC,** Peter K. Smith, MD, FACC,‖
Salim Yusuf, DPhil, FRCPC, FRSC, FACC‡‡

Oxford, United Kingdom; Los Angeles, California; Buffalo, New York; Greenville and Durham,

O<90% of LMS are distal/bifurcation (very high risk of restenosis)
O<90% have multivessel CAD (CABG already offers survival benefit)

(CABG) is traditionally regarded as the "standard of care" because of its well-documented and durable survival advantage. There is now an increasing trend to use drug-eluting stents for LMS stenosis rather than CABG despite very little high-quality data to inform clinical practice. We herein: 1) evaluate the current evidence in support of the use of percutaneous revascularization for unprotected LMS; 2) assess the underlying justification for randomized controlled trials of stenting versus surgery for unprotected LMS; and 3) examine the optimum approach to informed consent. We conclude that CABG should indeed remain the preferred revascularization treatment in good surgical candidates with unprotected LMS stenosis. (J Am Coll Cardiol 2008;51:885–92) © 2008 by the American College of Cardiology Foundation

SYNTAX RCT Results (5/5 Years): Left Main: n=705

	PCI	CABG	
nos	357	348	p
Death	12.8	14.6 (+1.8%) *	.53
Cardiac Death	8.6	7.2 (-1.4%)	.46
MI	8.2	4.8 (-3.4%)	.10
CVA	1.5	4.3 (+2.8%) *	.03
D+C+M	19	20.8 (+1.8%)	.57
Revasc	26.7	15.5 (-11.2%)	<0.01

* = different from SYNTAX 3VD

Low <23	nos	118	104	
	death	7	11.3	.28
	CVA	1.8	4.1	.28
	MI	6.2	3.1	.32
	D+C+M	13.9	15.2	.71
	Revasc	23	20.3	.65
Intd 23-32	nos	103	92	
	death	8.9	19.3	.04
	CVA	1.0	3.6	.23
	MI	6.0	4.6	.71
	D+C+M	15.7	24.9	.11
	Revasc	22.2	16.6	.40
High >32	nos	135	149	
	death	20.9	14.1	.11
	CVA	1.6	4.9	.13
	MI	11.7	6.1	.40
	D+C+M	26.1	22.1	.33
	Revasc	34.1	11.6	<.001

EXCEL TRIAL (Abbott Vascular)

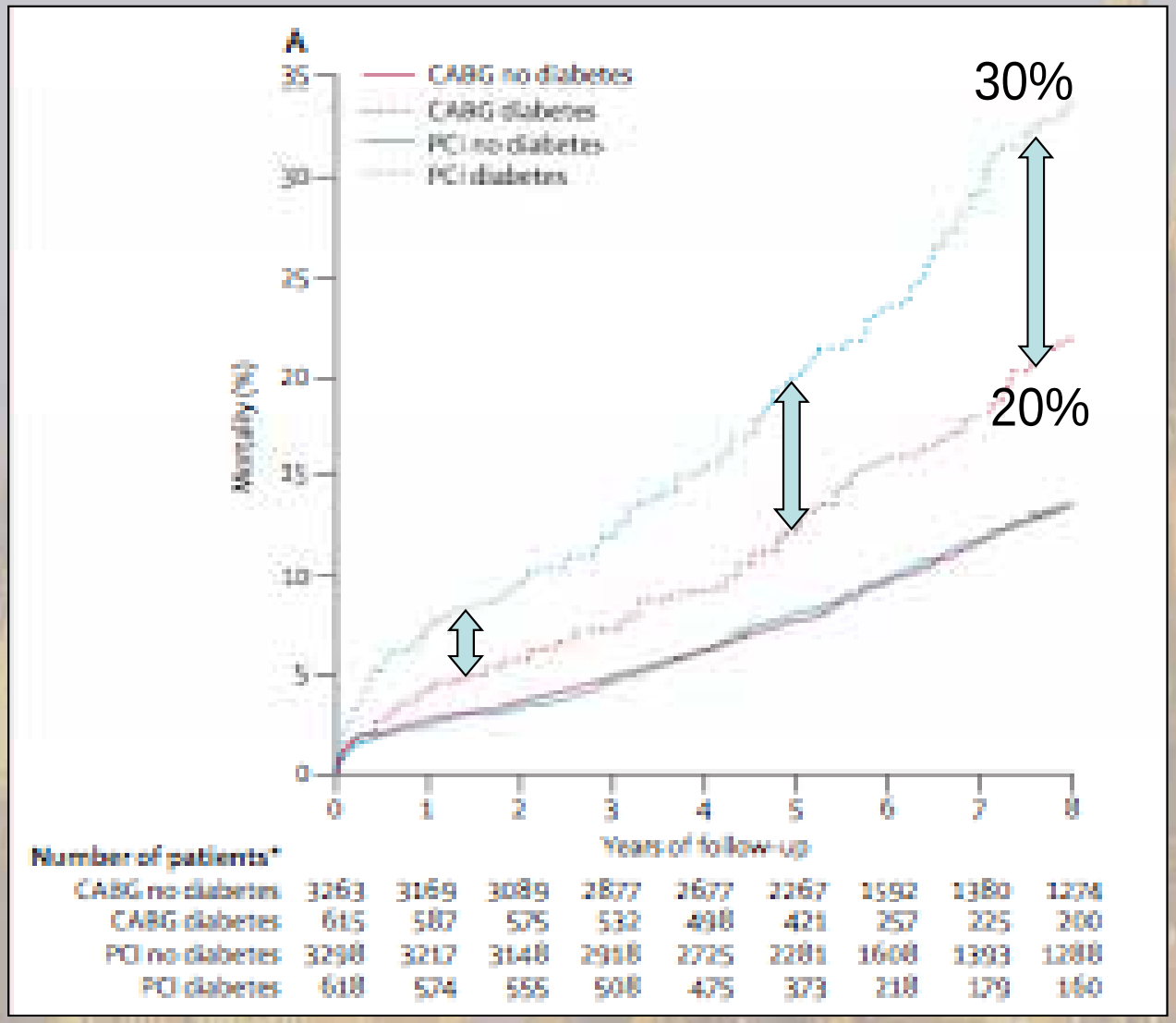
- **2600 patient RCT: PCI vs CABG**
- **only in SYNTAX Score <33**
- **1000 registry patients now enrolled**
- **ie 3600 in total**
- **started Sept 2010**
- **>1150 RCT patients enrolled to date**

Coronary artery bypass surgery compared with percutaneous coronary interventions for multivessel disease: a collaborative analysis of individual patient data from ten randomised trials Lancet 2009

Mark A Hlatky, Derek B Boothroyd, Dena M Bravata, Eric Boersma, Jean Booth, Maria M Brooks, Didier Carrié, Tim C Clayton, Nicolas Danchin, Marcus Flather, Christian W Hamm, Whady A Hueb, Jan Kähler, Sheryl F Kelsey, Spencer B King, Andrzej S Kosinski, Neuza Lopes, Kathryn M McDonald, Alfredo Rodriguez, Patrick Serruys, Ulrich Sigwart, Rodney H Stables, Douglas K Owens, Stuart J Pocock

24 Authors. NO Surgeons!!!

- 7812 patients
- Median follow up 6 years
- 65%: 1 or 2 VD; all normal LV
- HR *CABG*: 0.91: p=0.12
- 1233 with DM



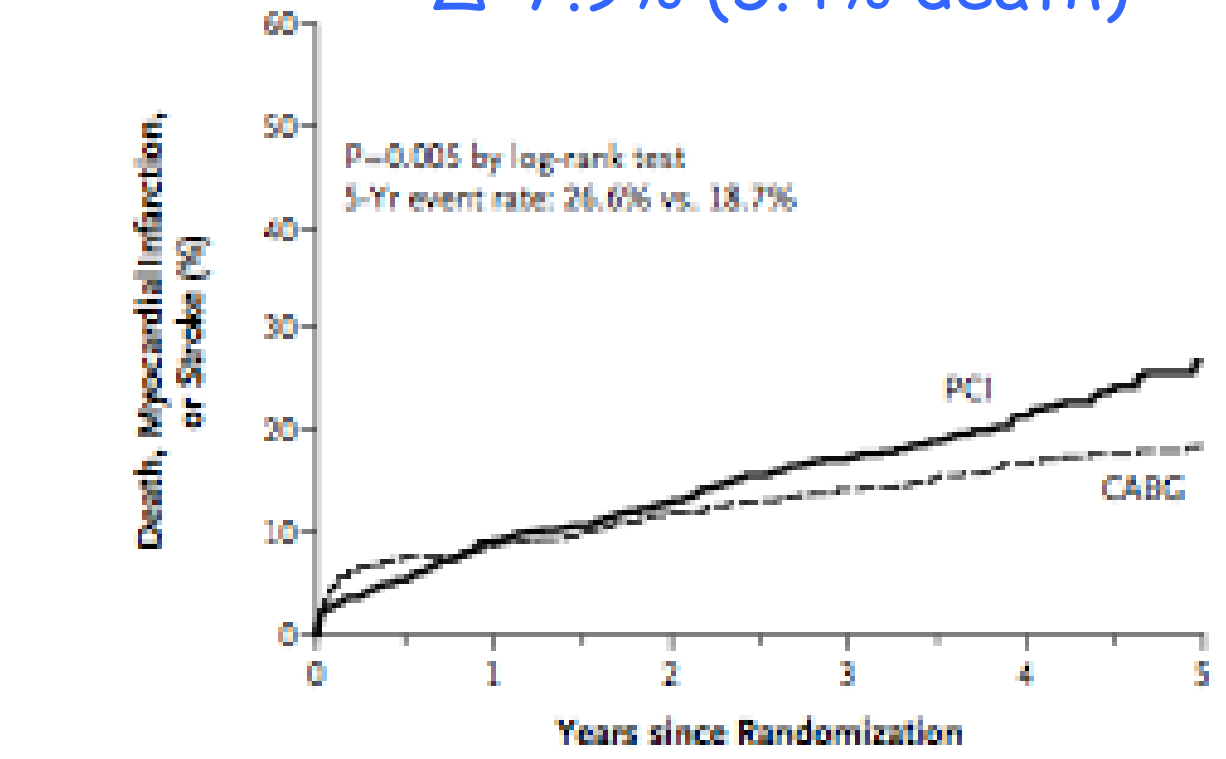
- HR for *CABG* vs PCI in DM 0.70; p=0.01
- Survival benefit of *CABG* increases with time

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Strategies for Multivessel Revascularization in Patients with Diabetes

Δ=7.9% (5.4% death)



NO Heart Team/Guidelines increases rate of wrong interventions

Adherence of Catheterization Laboratory Cardiologists to ACC/AHA Guidelines for PCI and CABG: What happens in Actual Practice ? [Hannan et al Circ 2010]

- 16142 catheter lab patients in New York 2005-07
- Treatment decision made by catheter lab cardiologist alone in 64%

ACC/AHA Recommendation	Numbers	% CABG	% PCI	% Medical	None
CABG	1337	53	34	12	1
PCI	6071	2	94	4	<1
CABG or PCI	1722	5	93	2	<1
Neither	1223	6	21	71	2
Total	10333	10	77	13	<1

- 92% of PCI procedures ad hoc (ie no time for real choice/ genuine consent)
- Chance of PCI increased in hospitals with PCI facilities

Summary and Conclusions

① 65% of all left main disease (SYNTAX >32) and 79% of 3 vessel disease (SYNTAX >22) have strong survival advantage with CABG by 3 years and continuing to increase past 5 years

② Possible to improve both PCI and CABG results

③ Strong evidence that ABSENCE of Heart Team (using approved guidelines) results both in the majority of elective PCI patients failing to understand the rationale for the procedure and also a large number of inappropriate or wrong PCI interventions

④ Guidelines are transparent and protect the patients (against wrong interventions) and doctors and should be mandatory

⑤ Professional bodies should persuade statutory bodies/payers that they only interventions which are approved by the Heart Team based on official guidelines (or documented as to why guidelines were not followed) should be reimbursed.

NO Heart Team/Guidelines increases rate of inappropriate interventions

Appropriateness of Percutaneous Coronary Intervention

Paul S. Chan, MD, MSc
Manesh R. Patel, MD
Lloyd W. Klein, MD
Ronald J. Krone, MD
Gregory J. Dehmer, MD
Kevin Kennedy, MS
Brahmajee K. Nallamothu, MD, MPH
W. Douglas Weaver, MD
Frederick A. Masoudi, MD, MSPH
John S. Rumsfeld, MD, PhD
Ralph G. Brindis, MD, MPH
John A. Spertus, MD, MPH

Context Despite the widespread use of percutaneous coronary intervention (PCI), the appropriateness of these procedures in contemporary practice is unknown.

Objective To assess the appropriateness of PCI in the United States.

Design, Setting, and Patients Multicenter, prospective study of patients within the National Cardiovascular Data Registry undergoing PCI between July 1, 2009, and September 30, 2010, at 1091 US hospitals. The appropriateness of PCI was adjudicated using the appropriate use criteria for coronary revascularization. Results were stratified by whether the procedure was performed for an acute (ST-segment elevation myocardial infarction, non–ST-segment elevation myocardial infarction, or unstable angina with high-risk features) or nonacute indication.

Main Outcome Measures Proportion of acute and nonacute PCIs classified as appropriate, uncertain, or inappropriate; extent of hospital-level variation in inappropriate procedures.

Results Of 500 154 PCIs, 355 417 (71.1%) were for acute indications (ST-segment elevation myocardial infarction, 103 245 [20.6%]; non–ST-segment eleva-

- National Cardiovascular Data Registry 01/07/09-30/09/10
- 500154 PCIs in 1091 US hospitals
- 71% Acute: 98.6% Appropriate; 0.3% uncertain; 1.1% Inappropriate
- 29% NonAcute: 50% Appropriate; 38% uncertain; 12% Inappropriate
  - ✗ Inappropriate: No angina 54%; No ischaemia 72%; Suboptimal medication 96%

NO Heart Team/Guidelines increases rate of wrong interventions

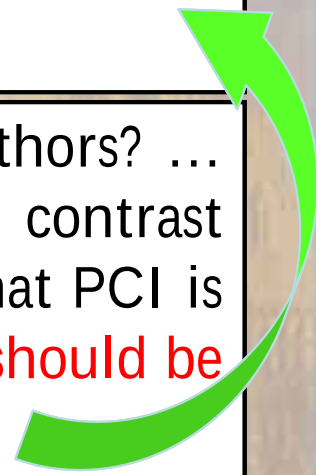
Adherence of Catheterization Laboratory Cardiologists to ACC/AHA Guidelines for PCI and CABG: What happens in Actual Practice ? [Hannan et al Circ 2010]

Get With the Guidelines: A New Chapter ?

Raymond J. Gibbons, MD Circulation 2010;121:194-6

A final potential explanation, and in my view the most concerning, is that these recommendations for PCI in patients indicated for CABG reflect a "grow the business" and "make it up on volume" mentality in response to declining reimbursement rates. There are compelling financial incentives for cardiologists performing intervention to do more procedures, even when the patient might be better treated with CABG.

Should surgical consultation be encouraged, as suggested by the authors? … there are many patients with stable symptoms for whom issues of contrast load, and the need for further discussion with the patient, dictate that PCI is performed on a different day. In such patients surgical consultation should be considered, but not mandated.



Both the SCAI and ACC/AHA guidelines have indicated that ad hoc PCI should not be a standard strategy for all patients. For patients in stable condition we should consider less ad hoc PCI.

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The Impact of Revascularization on Mortality in Patients with Nonacute Coronary Artery Disease

Allen Jeremias, MD, MSc,[a] Sanjay Kaul, MD,[c] Todd K. Rosengart, MD,[b] Luis Gruberg, MD,[a] David L. Brown, MD[a]

	Hlatky [Lancet 2009]	Jeremias [Am J Med 2009]
Studies	10 RCT CABG vs PCI	28 RCT CABG or PCI vs OMT
Patients	7812	13121
Median Follow-up	6 years	3 years
HR for death with CABG	0.91 (p=0.12)	0.62 (0.50-0.77)
HR for death with PCI	-	0.82 (0.68-0.99) ??
Death/Repeat Revasc	10% vs 25% (p=0.001)	-
HR Death CABG in Diabetics	0.7 (p=0.014)	-
HR Death CABG >65 yrs	0.82 (p=0.002)	-

SURVIVAL BENEFIT WITH A SINGLE IMA GRAFT

The New England
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INFLUENCE OF THE INTERNAL-MAMMARY-ARTERY GRAFT ON 10-YEAR SURVIVAL AND OTHER CARDIAC EVENTS

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- 10 years after CABG, an IMA to the LAD ↓ risk of:
  - death (x1.6), MI (x1.4), angina (x1.25), redo surgery (x2)
  - Patency rate of > 95% at 10 years (veins ≅ 25% - 50%)

Internal Thoracic Artery Graft: 20-Year Clinical Follow-Up

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New York, New York

JACC 1995; 25; 188-82

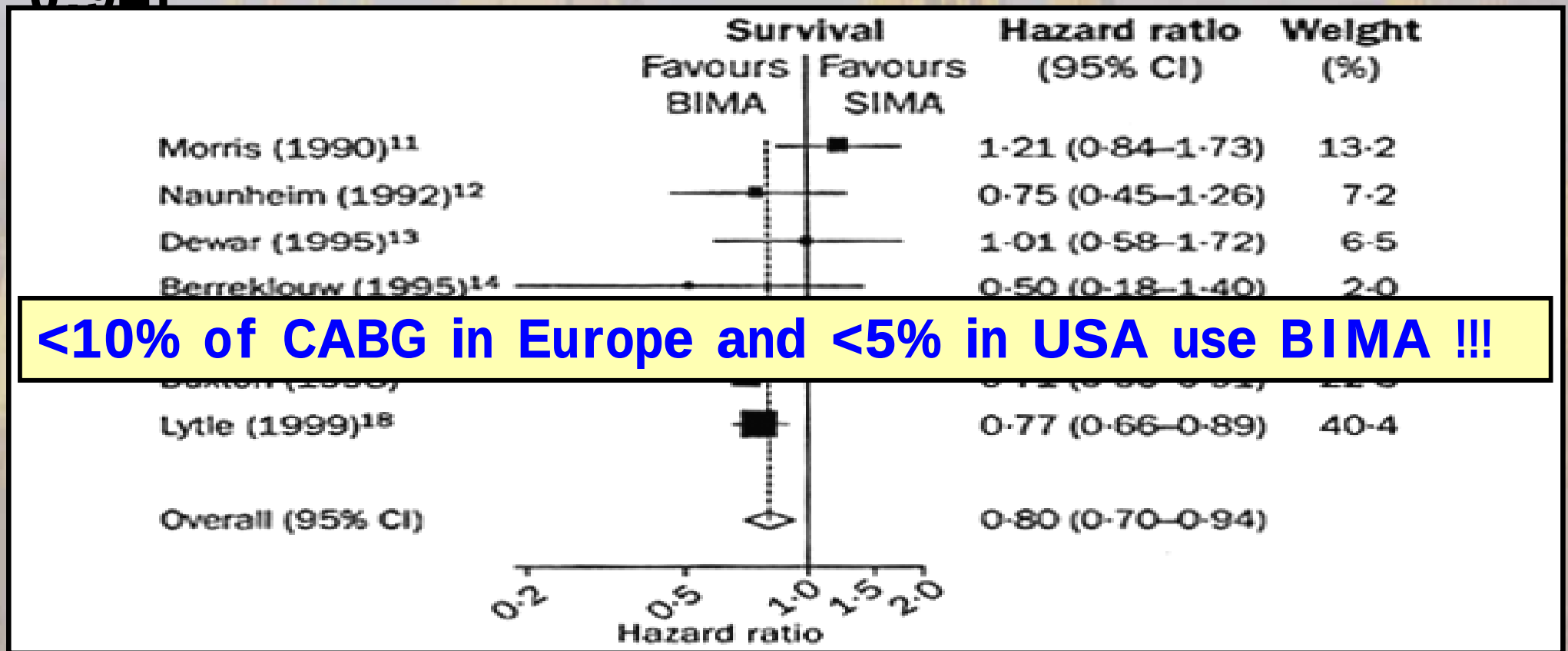
If it was not for the IMA there would be no CABG today !!!

SURVIVAL BENEFIT WITH TWO IMA GRAFTS ?

Effect of arterial revascularisation on survival: a systematic review of studies comparing bilateral and single internal mammary arteries

David P Taggart, Roberto D'Amico, Douglas G Altman — Lancet 2001

- 4693 BIMA vs 11269 SIMA (from 7 databases)
- Matched for age, gender, LV function, DM
- HR for death with BIMA: 0.80 [95% CI=0.70 to 0.94]



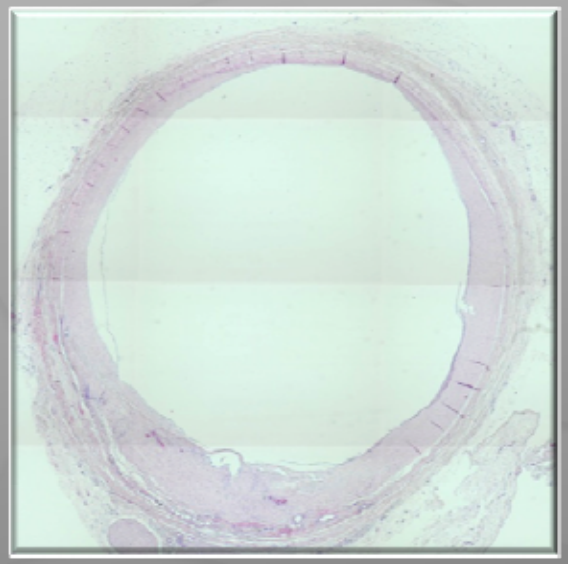
<10% of CABG in Europe and <5% in USA use BIMA !!!

Current Use of CABG Conduits

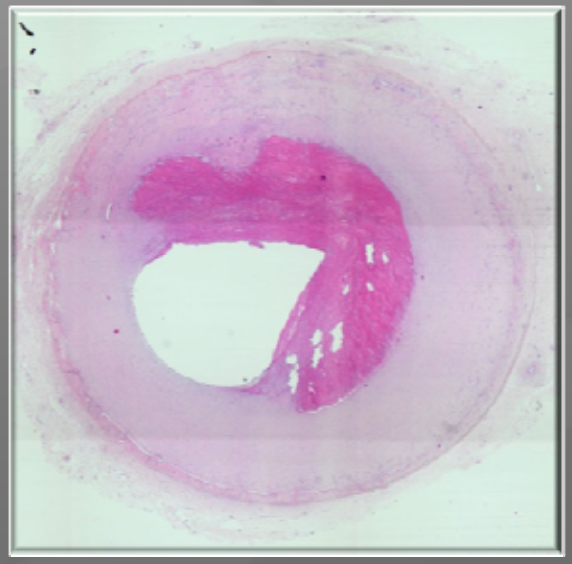
- Approx 10 years after CABG 75% of SVG occluded or heavily diseased
- Strong circumstantial evidence of survival benefit with single IMA
- Strong circumstantial evidence of additional survival benefit with both IMA (Taggart et al Lancet 2001)
- Strong evidence that both IMA have patency rates >90% at 20 years (Kurlansky et al, Tatoulis et al)
- In Europe <10% of CABG patients and in USA <5% of CABG patients receive 2 IMA
- >80% of all grafts on heart are vein grafts !!!!

Vein Graft Remodeling: 2 Distinct Phases

✓An early pattern dominated by shear induced remodeling → luminal enlargement

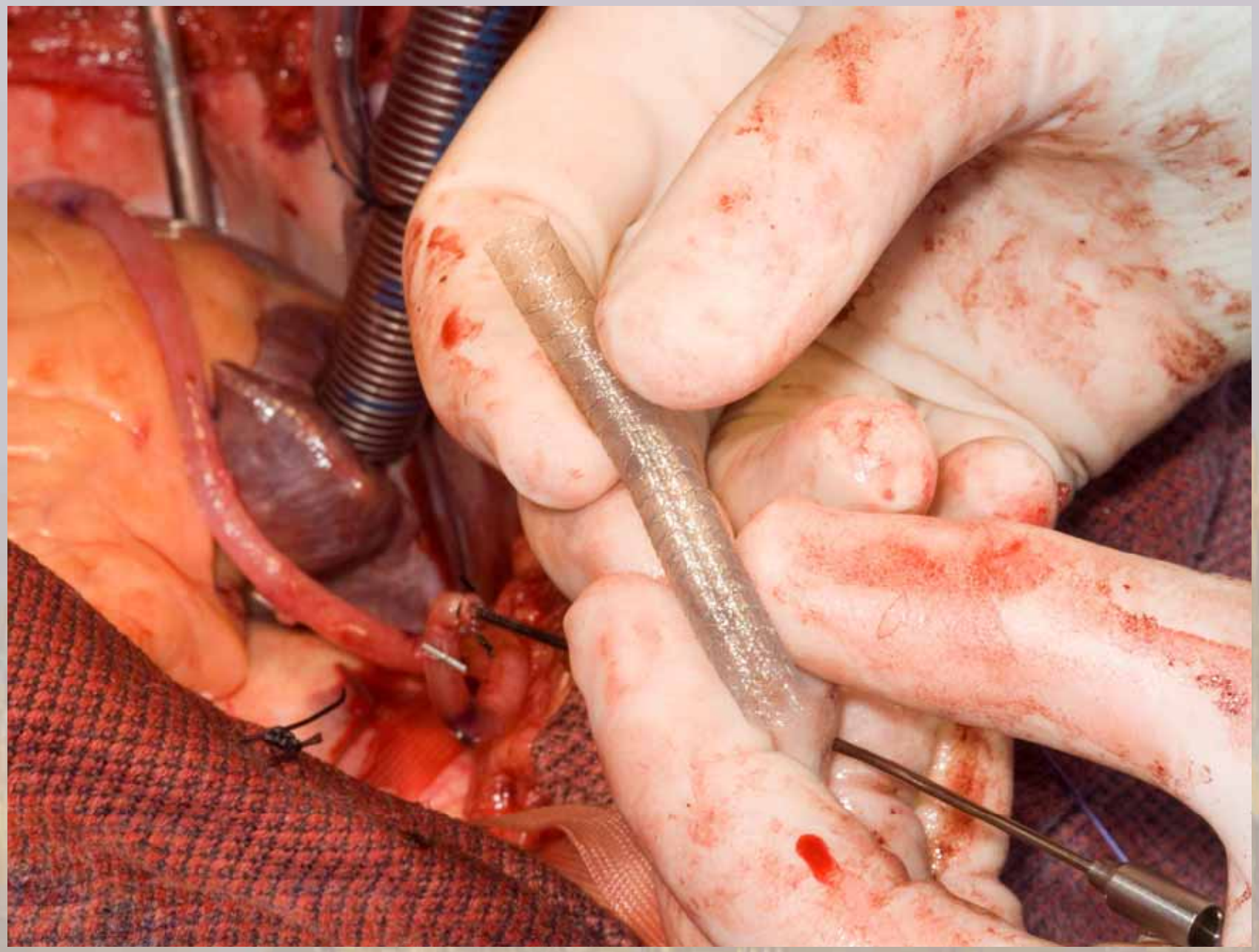


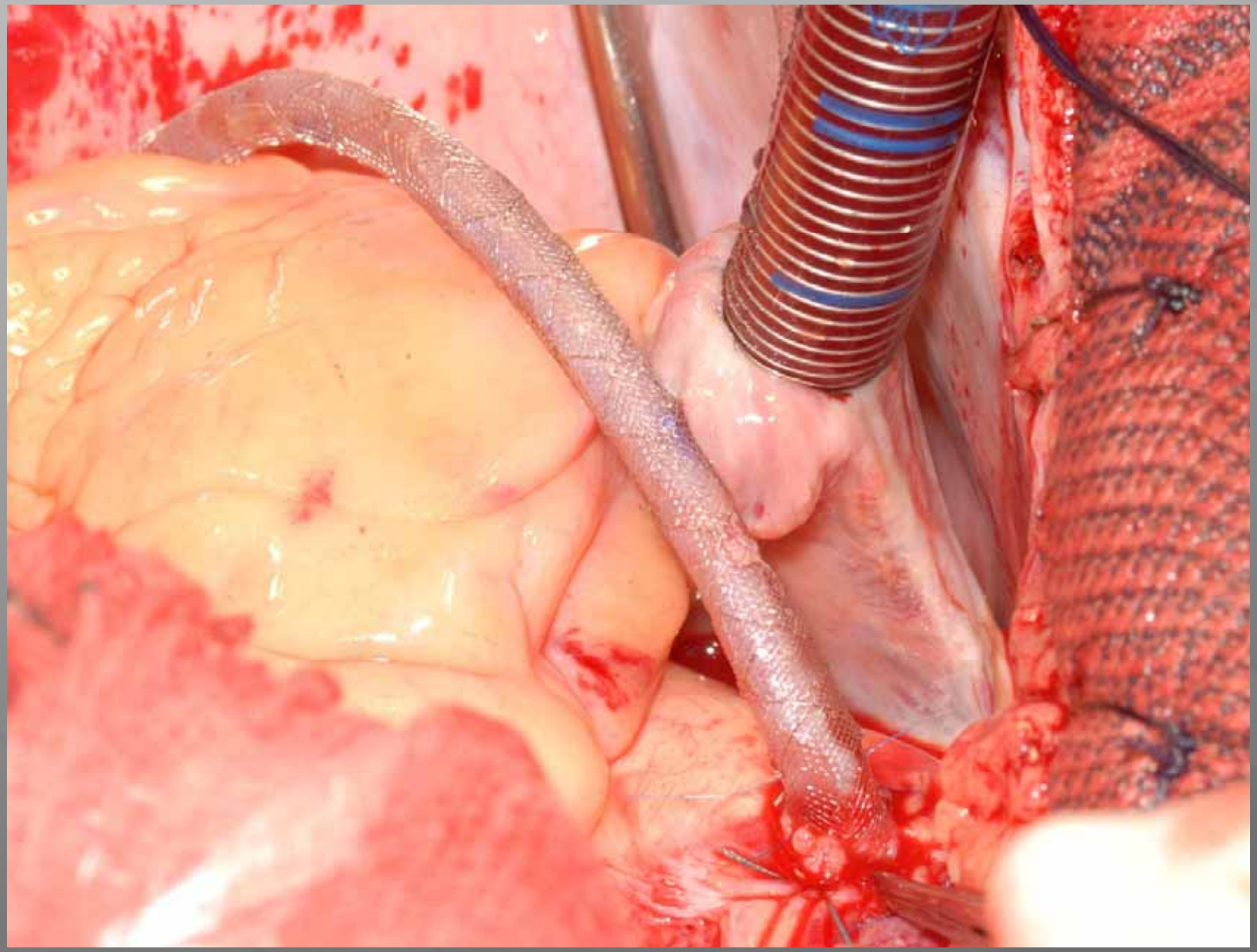
✓A **later** phase dominated by wall tension induced remodeling → wall thickening and stiffening



By 10 years $\frac{3}{4}$ of vein grafts are occluded or significantly diseased

Fluent Device: 4 or 5 mm diameter and 6 lengths 12-20cm





Summary and Conclusions

① 65% of all left main disease (SYNTAX >32) have strong survival advantage with CABG even by 3 years (7.4% by 4 years)

② Conflicting data between SYNTAX and PRECOMBAT about risk of death and stroke with CABG vs PCI in low and intermediate Left Main groups (SYNTAX <33) …EXCEL TRIAL

③ Possible to improve PCI results with more use of IVUS,FFR and interval staging

④ Possible to improve results of CABG with lower mortality and risk of stroke

⑤ Possible that CABG is disadvantaged in lower severity left main by the presence of too much competitive flow
(but NOT if additional 2 or 3 vessel coronary artery disease)

⑥ Following guidelines avoids need to discuss all patients;
reserve MDT for interventions which do not follow guidelines

⑦ Guidelines are transparent and protect the best interests of patients and doctors and should be mandatory

⑧ Statutory bodies/payers should only pay for interventions which are approved by the Heart team

STATE-OF-THE-ART PAPER AND COMMENTARY

Revascularization for Unprotected Left Main Stem Coronary Artery Stenosis

Stenting or Surgery

David P. Taggart, MD (Hons), PhD, FRCS,* Sanjay Kaul, MD, FACC,†
William E. Boden, MD, FACC,‡ T. Bruce Ferguson, Jr, MD, FACC,§

- <90% of LMS are distal/bifurcation (very high risk of restenosis)
- <90% have multivessel CAD (CABG already offers survival benefit)

Oxford, United Kingdom; Los Angeles, California; Buffalo, New York; Greenville and Durham, North Carolina; Atlanta, Georgia; Dallas, Texas; Leuven, Belgium; and Hamilton, Ontario, Canada

For coronary artery disease with unprotected left main stem (LMS) stenosis, coronary artery bypass grafting (CABG) is traditionally regarded as the "standard of care" because of its well-documented and durable survival advantage. There is now an increasing trend to use drug-eluting stents for LMS stenosis rather than CABG despite very little high-quality data to inform clinical practice. We herein: 1) evaluate the current evidence in support of the use of percutaneous revascularization for unprotected LMS; 2) assess the underlying justification for randomized controlled trials of stenting versus surgery for unprotected LMS; and 3) examine the optimum approach to informed consent. We conclude that CABG should indeed remain the preferred revascularization treatment in good surgical candidates with unprotected LMS stenosis. (J Am Coll Cardiol 2008;51:885–92)

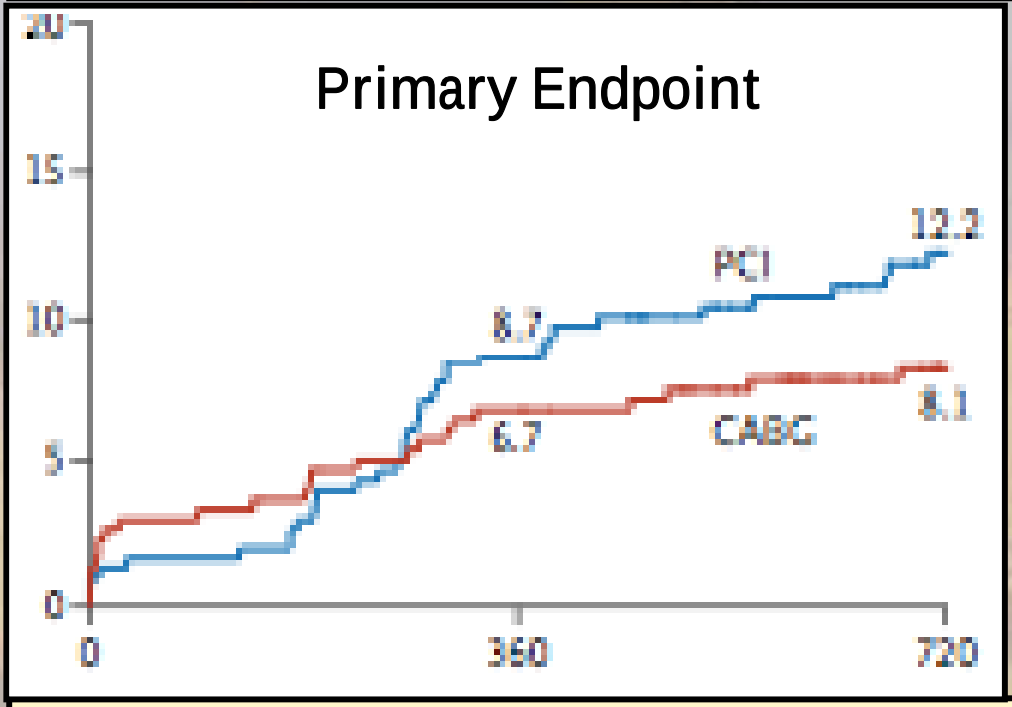
- ✓SYNTAX reports increase death and stroke in LM (<33) with CABG vs PCI
- ✓PRECOMBAT reports same death and stroke in LM (<33) with CABG vs PCI
- ✓EXCEL will resolve this issue in 2600 RCT patients

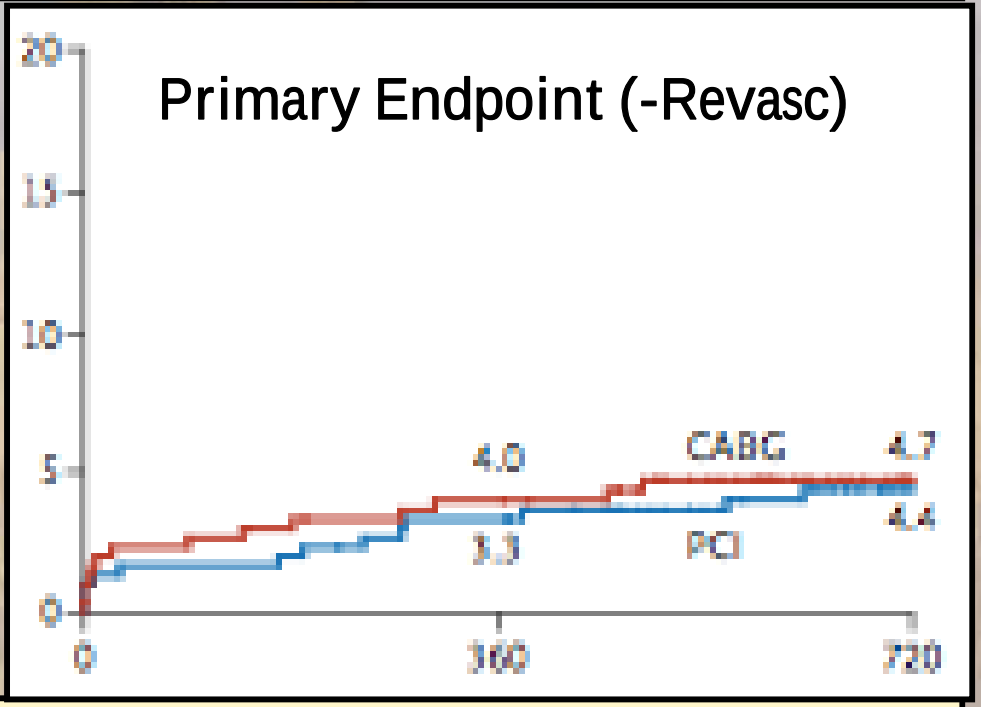
Randomized Trial of Stents versus Bypass Surgery for Left Main Coronary Artery Disease

Seung-Jung Park, M.D., Young-Hak Kim, M.D., Duk-Woo Park, M.D.,

'PRECOMBAT': 600 patient RCT (300 PCI vs 300 CABG)

- Cohort of 1454 LM patients (59% NOT randomized)
- Mean SYNTAX score: 25 (vs 30 in SYNTAX)
- Mean Euroscore: 2.7 (vs 3.8 in SYNTAX)
- Primary endpoint: Death; CVA; MI; Repeat Revasc





- Incidence of stroke 0.4% PCI vs 0.7% CABG
- No increase in mortality or stroke with CABG (vs SYNTAX)

Appropriate use of stents in LMS

Favorable Long-Term Outcome After Drug-Eluting Stent Implantation in Nonbifurcation Lesions That Involve Unprotected Left Main Coronary Artery

A Multicenter Registry [*Circulation.* 2007;116:158-162]

Alaide Chieffo, MD; Seung J. Park, MD, PhD; Marco Valgimigli, MD; Young H. Kim, MD, PhD; Joost Daemen, MD; Imad Sheiban, MD; Alessandra Truffa, MD; Matteo Montorfano, MD; Flavio Airoldi, MD; Giuseppe Sangiorgi, MD; Mauro Carlino, MD; Iassen Michev, MD; Cheol W. Lee, MD, PhD; Myeong K. Hong, MD, PhD; Seong W. Park, MD, PhD; Claudio Moretti, MD; Erminio Bonizzoni, PhD; Renata Rogacka, MD; Patrick W. Serruys, MD, PhD; Antonio Colombo, MD

- 790 LMS:
- 19% NonBifurcation Lesions
- ostial (52%) or mid shaft (28%) or both (+35% RCA disease)
- 1 hospital death
- 73% repeat angiogram at 6 months with 1 restenosis
- at 2.5 years 3.4% mortality and 5% revascularization

'Stent thrombosis could not be excluded in the 4 patients (2.7%) who died of unknown causes'

A collaborative systematic review and meta-analysis on 1278 patients undergoing percutaneous drug-eluting stenting for unprotected left main coronary artery disease

Am H J 2008

Giuseppe G.L. Biondi-Zoccai, MD,[a,o] Marzia Lotrionte, MD,[b,o] Claudio Moretti, MD,[a] Emanuele Meliga, MD,[a] Pierfrancesco Agostoni, MD,[c] Marco Valgimigli, MD, PhD,[d,e] Angela Migliorini, MD,[f] David Antoniucci, MD,[f] Didier Carrié, MD,[g] Giuseppe Sangiorgi, MD,[h,i] Alaide Chieffo, MD,[h,i] Antonio Colombo, MD,[h,i] Matthew J. Price, MD,[j] Paul S. Teirstein, MD,[j] Evald H. Christiansen, MD,[k] Antonio Abbate, MD,[l] Luca Testa, MD,[b] Julian P.G. Gunn, MD,[m] Francesco Burzotta, MD,[b] Antonio Laudito, MD,[n] Gian Paolo Trevi, MD,[a] and Imad Sheiban, MD[a] *Turin, Rome, Ferrara, Gussago, Florence, and Milan, Italy; Antwerp, Belgium; Toulouse, France; La Jolla, CA; Aarhus, Denmark; Richmond, VA; and Sheffield, United Kingdom*

CATEGORY		In-hospital (%)	6-10 month follow up		
	n	death	death	TVR	MACE
All DES	1278	2.3	5.5	6.5	16.5
Nonbifurcation (25%)	285	0.9	4.1	6.7	14.7
Low –risk: ES<6	260	3	4.8	8.5	15.7
High-risk: ES>6	312	6.6	12	6.4	20.6

Emphasises 2 key issues regarding left main

1) Lesion: bifurcation vs non-bifurcation
2) Patient: low vs high risk

THE SYNTAX TRIAL

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 MARCH 5, 2009 VOL. 360 NO. 10

Percutaneous Coronary Intervention versus Coronary-Artery Bypass Grafting for Severe Coronary Artery Disease

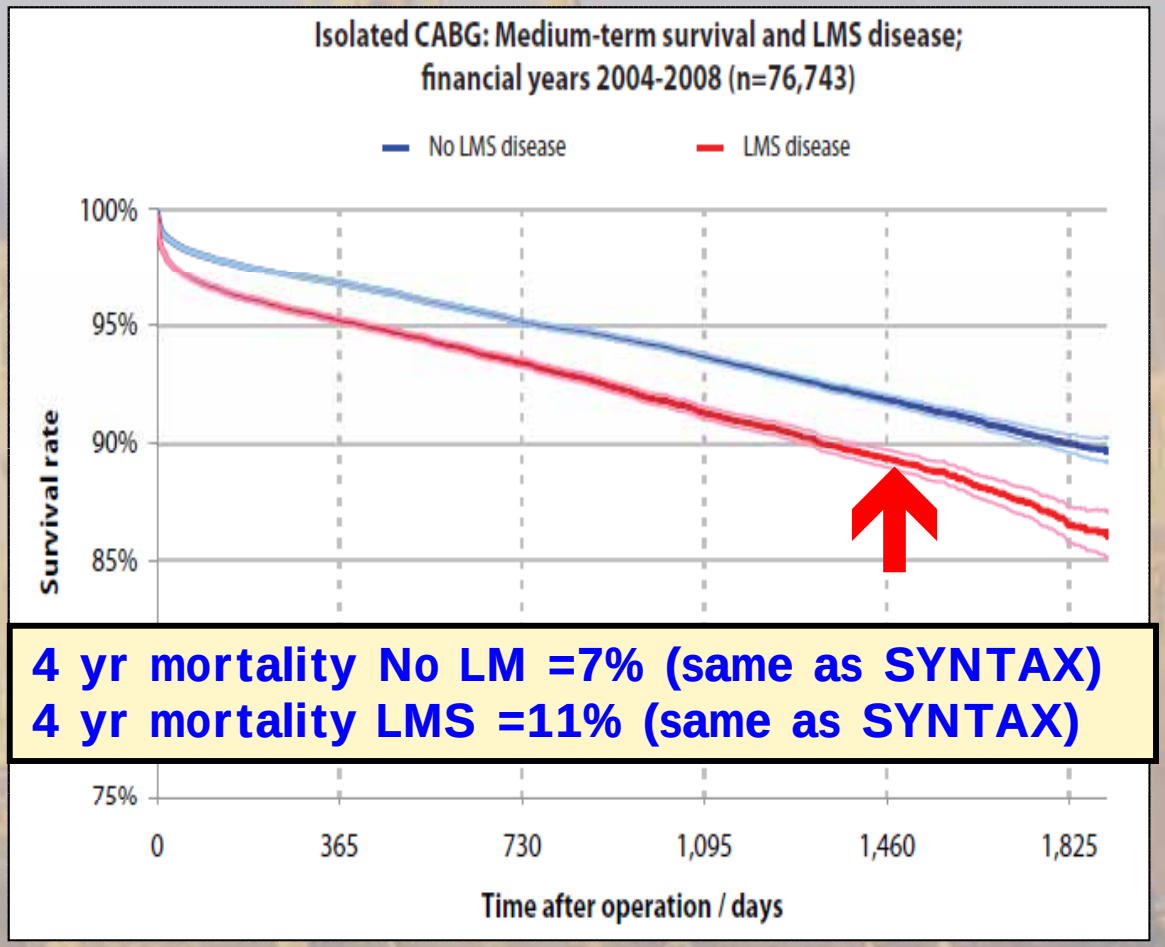
Patrick W. Serruys, M.D., Ph.D., Marie-Claude Morice, M.D., A. Pieter Kappetein, M.D., Ph.D., Antonio Colombo, M.D., David R. Holmes, M.D., Michael J. Mack, M.D., Elisabeth Ståhle, M.D., Ted E. Feldman, M.D., Marcel van den Brand, M.D., Eric J. Bass, B.A., Nic Van Dyck, R.N., Katrin Leadley, M.D., Keith D. Dawkins, M.D., and Friedrich W. Mohr, M.D., Ph.D., for the SYNTAX Investigators*

Landmark trial (most important trial ever of PCI vs CABG)

- Designed to look at 5 year outcomes death and MACCE
- 'All comer' trial (vs highly select patients in all previous RCTs)
- Parallel Registry (35% of patients straight to CABG !!)

Results of CABG for Left Main

	2004-08	MORTALITY	
		All	Elective
Total CABG	114300	1.8%	1.1%
No LMS	69775 (70%)	1.5%	0.9%
LMS	30218 (30%)	2.5%	1.5%



4 yr mortality No LM =7% (same as SYNTAX)
4 yr mortality LMS =11% (same as SYNTAX)

ACC/AHASCAI guidelines for PCI focussed update 2009 [JACC 2009]

- PCI is CLASS III indication in virtually all Left Main patients (2001)
- PCI is CLASS III indication in Left Main candidate for CABG (2005)
- PCI is CLASS IIbB if low risk for PCI and increased risk for CABG (2009)
- PCI is CLASS IIa/b if easy anatomy and low risk, otherwise III (2011)

Task Force for Percutaneous Coronary Interventions of the European Society of Cardiology. [Eur Heart J 2005;26:804-47]

- 'Stenting for unprotected Left Main disease should only be considered in the absence of other revascularization options'

Joint ESC/EACTS Guidelines for Myocardial Revascularization

Table 9. Indications for CABG versus PCI in stable patients with lesions suitable for both procedures and low predicted surgical mortality

	CABG	PCI
Left main (isolated or 1VD, ostium/shaft)	I A	IIa B
Left main (isolated or 1VD, distal bifurcation)	I A	IIb B
Left main + 2VD or 3VD, SYNTAX score ≤ 32	I A	IIb B
Left main + 2VD or 3VD, SYNTAX score ≥ 33	I A	III B

65%

The Guidelines…what do they recommend ?

	CABG		PCI	
Subset of CAD by anatomy	ESC	ACC	ESC	ACC
Heart team Approach for LM or complex CAD	I C	I C	I C	I C
1 VD: NON proximal LAD	IIb C	III B	I C	III B
1 VD: proximal LAD	I A	IIa B	IIa B	IIb B
2 VD: NON proximal LAD	IIb C	IIa B / IIb C	I C	IIb B
2 VD: proximal LAD	I A	I B	IIa B	IIb B
3 VD, simple lesions, full functional revasc achievable with PCI, SYNTAX scores <22	I A	I B	IIa B	IIb B / III B
3 VD, complex lesions, incomplete revasc achievable with PCI, SYNTAX scores >22 **79%**	I A	I B	III A	IIb B / III B
LM (isolated or 1VD, ostium/shaft)	I A	I B	IIa B	IIa B
LM (isolated or 1VD, distal bifurcation)	I A	I B	IIb B	IIb B / III B
LM + 2VD or 3VD, SYNTAX scores <33	I A	I B	IIb B	IIb B / III B
LM + 2VD or 3VD, SYNTAX scores >32 **66%**	I A	I B	III B	IIb B / III B

SYNTAX RCT Results (5/5 Years): 3 Vessel Disease

	PCI	CABG	
nos	546	549	
Death	14.6	9.2 (-5.4%)	.006
Cardiac Death	9.2	4.0 (-5.2%)	.001
MI	10.6	3.3 (-7.3%)	<.001
CVA	3.0	3.4 (+0.6%)	.66
D+C+M	22	14 (-8%)	<.001
Revasc	25.4	12.6 (-12.8%)	<.001

Consistent with PPM registry data
Similar rate of stroke in PCI/CABG

Survival curves still diverging at 5 years implying survival benefit of CABG may be even greater !!!

Low <23	nos	181	171	
	death	10.2	9.3	.81
	CVA	1.8	3.9	.24
	MI	8.8	4.9	.20
	D+C+M	17.5	14.8	.56
	Revasc	23.1	14.6	.04
Int 23-32	nos	207	208	
	death	16.3	9.6	.047
	CVA	2.5	3.6	.53
	MI	13.8	3.1	<.001
	D+C+M	23.2	14.7	.04
	Revasc	25.1	11.0	.000
High >32	nos	155	166	
	death	17.8	8.8	.02
	CVA	5.1	2.6	.31
	MI	8.7	1.9	.008
	D+C+M	26.2	12.5	.002
	Revasc	28.2	12.6	.000