



Soroka University Medical Center

המרכז הרפואי האוניברסיטאי סורוקה



CABG - update

Sahar Gideon MD

מנהל המחלקה לניתוחי לב

המרכז הרפואי סורוקה

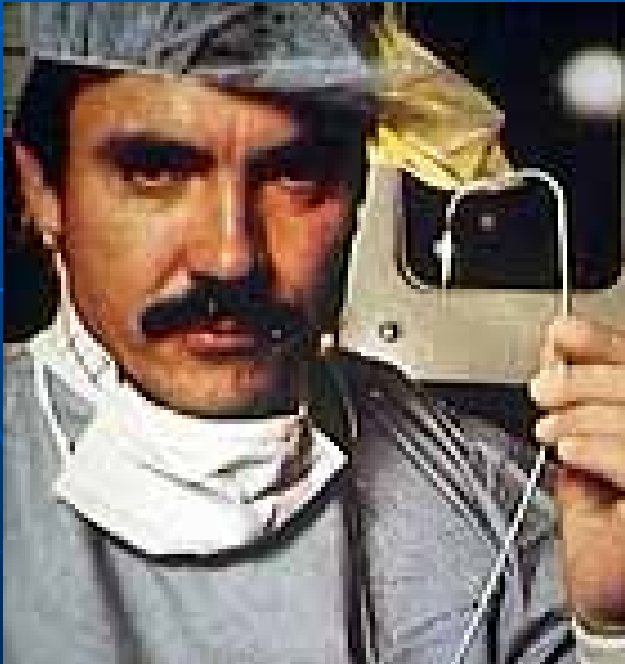
השתלמות לבוגרי התמחות בקרדיולוגיה

2010

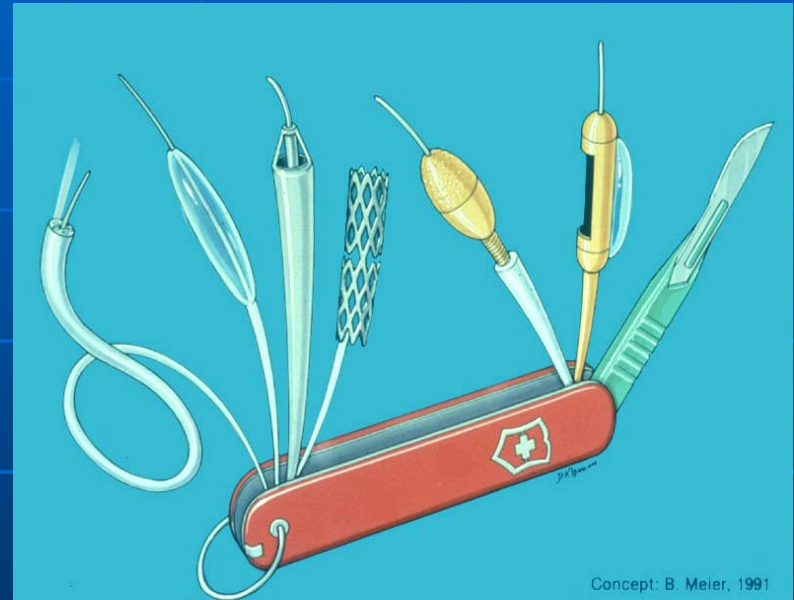
Percutaneous Coronary Interventions (PCI)

1977: 1st Coronary
angioplasty by
Gruntzig

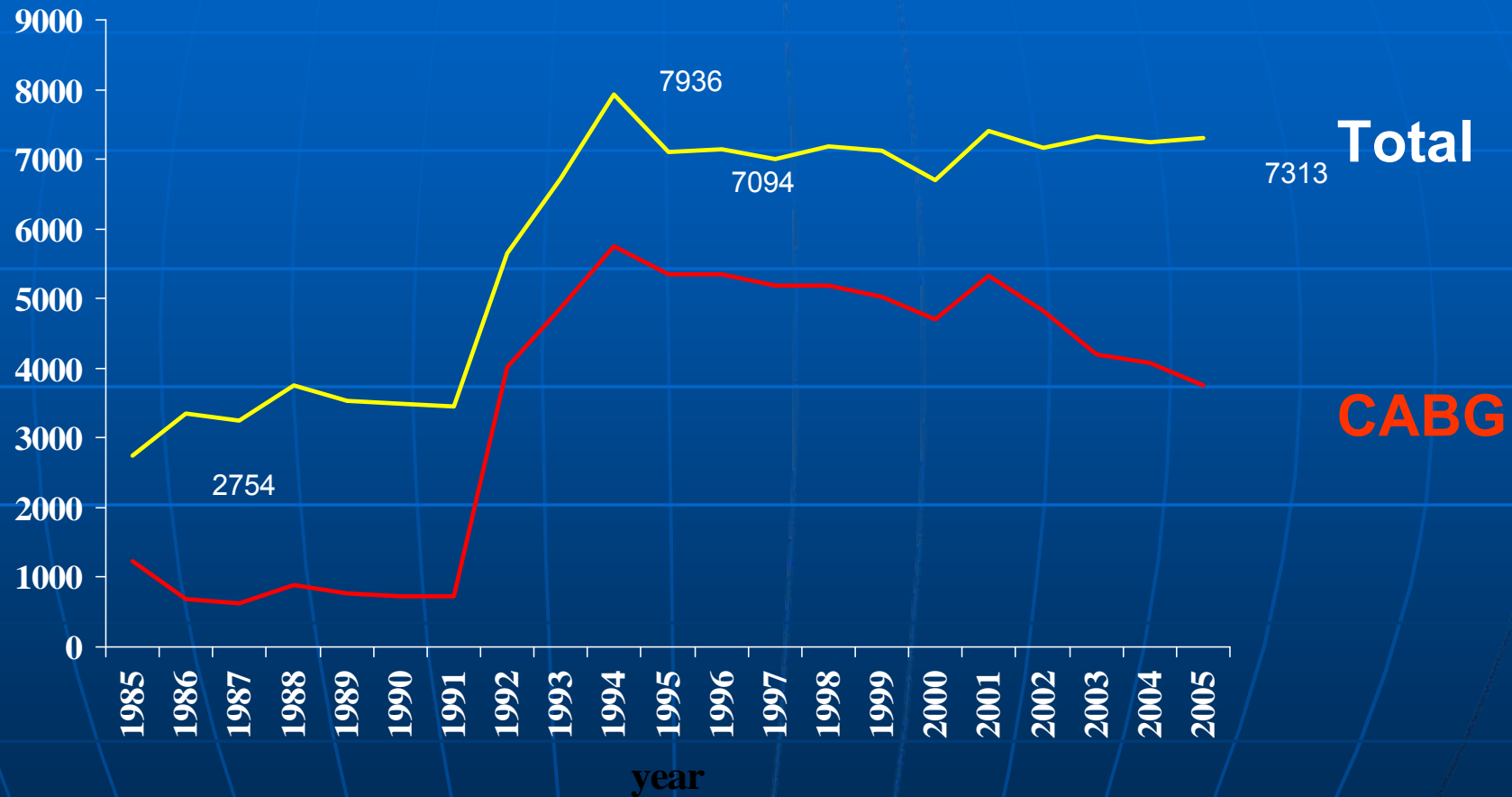
Limitation: restenosis



1939-1985



Open Heart Surgery - Israel 1985-2005



PCI vs CABG Trial Results Summary

Superior treatment modality

CABG

PCI

No difference

	Mortality & MI	Angina relief	Repeat revascularization	Stroke	
No stents used	GABI	No difference	CABG	n/a	
	EAST	No difference	CABG	No difference	
	RITA	No difference	CABG	n/a	
	ERACI	No difference	CABG	n/a	
	CABRI	No difference	CABG	n/a	
	BARI	No difference	No difference	CABG	n/a
BMS stents used	MASS-II	CABG (MI)	CABG	No difference	
	AWESOME	No difference	CABG	No difference	
	ERACI-II	PCI	n/a	CABG	n/a
	SoS	CABG (mortality)	CABG	CABG	n/a
	ARTS-I	No difference	n/a	CABG	No difference
DES stents used	ARTS-II	No difference	n/a	CABG	No difference
	MAIN-COMPARE	No difference	n/a	CABG	No difference
	LE MANS	No difference	No difference	CABG	No difference

drug-eluting stents



META-ANALYSIS of 13 RCT CABG vs PCI Hoffman SN et al: JACC 2003

OPATIENTS:

- 2/3 had 2VD (41% prox LAD disease) and **100% had normal LV function**
- **Excluded patients (L main, severe/complex 3VD, occlusions, poor LV)**

	FREEDOM FROM	nos	% RD (95% CI) favouring CABG	p	NNT
5 yr RESULTS All trials PCI vs CABG	ALL DEATH	4714	1.9 (0.33-3.4)	0.02	53
	Cardiac Death	2649	2.0 (0.29-3.7)	0.02	51
	REINTERVENTION	4572	37 (31-44)	<0.001	3
	Repeat CABG	3660	22 (16-27)	<0.001	5
	Repeat PCI	3660	23 (16-30)	<0.001	4
	Death/MI/Revasc	276	31 (21-41)	<0.001	3
	Angina	4322	5.3 (-0.08 - 11)	0.09	-

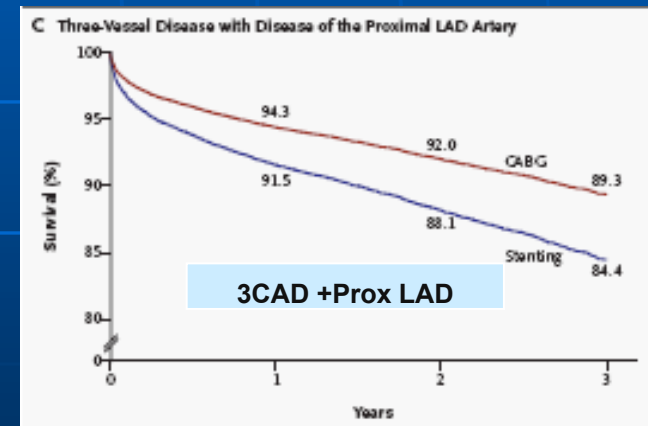
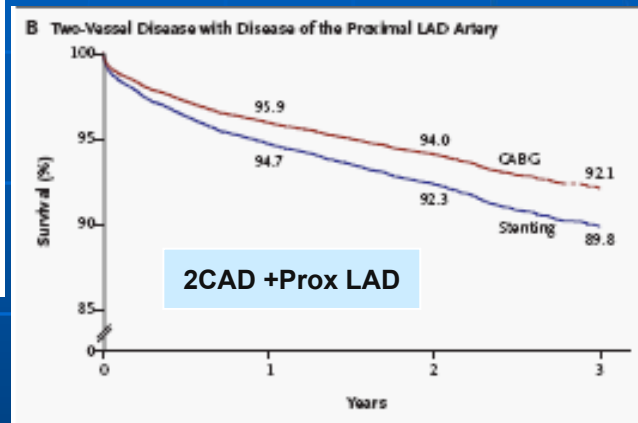
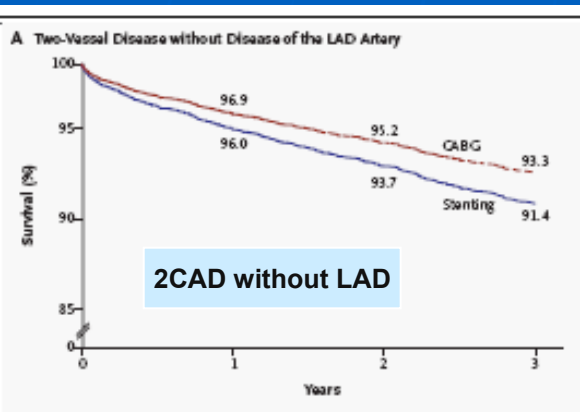
- A small survival advantage (p=0.02, NNT=53)
- A marked reduction in the need for reintervention (p<0.001, NNT=4)

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., Alfred T. Culliford, M.D., O. Wayne Isom, M.D., Jeffrey P. Gold, M.D., and Eric A. Rose, M.D.

Stenting (N=22,102) CABG (N=37,212)

Adjusted Survival Curves :

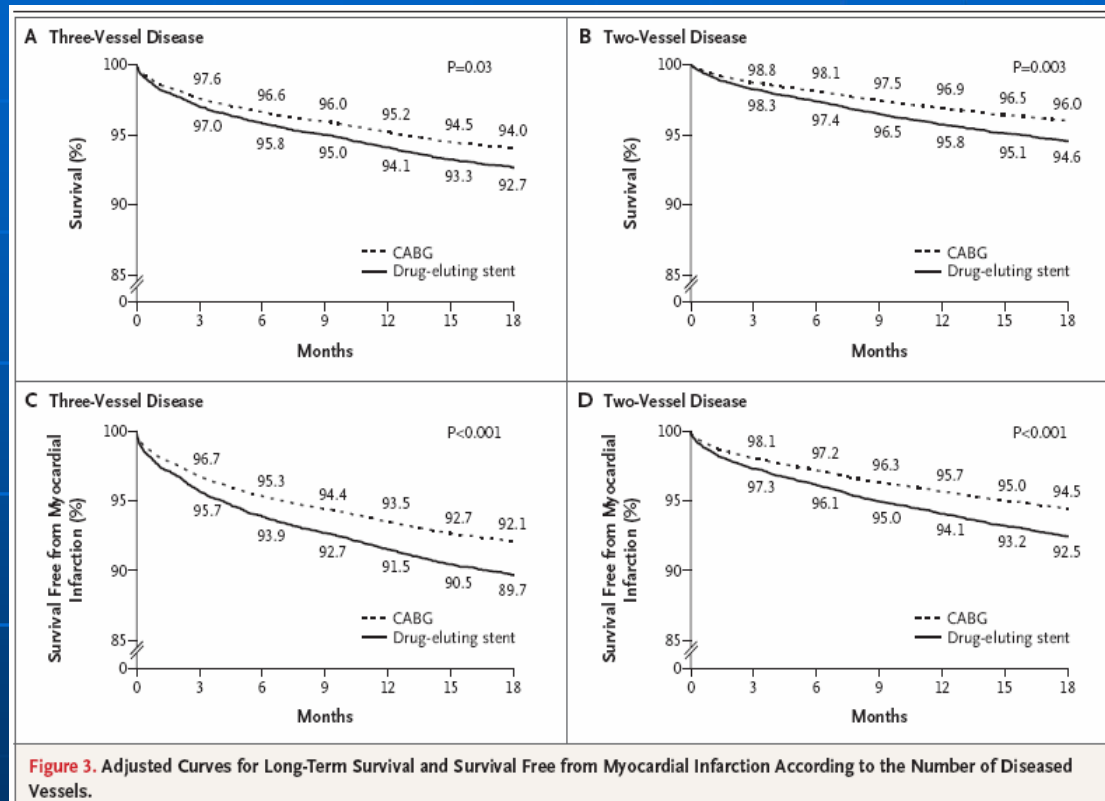


CONCLUSIONS

For patients with two or more diseased coronary arteries, CABG is associated with higher adjusted rates of long-term survival than stenting.

Drug-Eluting Stents vs. Coronary-Artery Bypass Grafting in Multivessel Coronary Disease

Edward L. Hannan, Ph.D., Chuntao Wu, M.D., Ph.D., Gary Walford, M.D., Alfred T. Culliford, M.D., Jeffrey P. Gold, M.D., Craig R. Smith, M.D., Robert S.D. Higgins, M.D., Russell E. Carlson, M.D., and Robert H. Jones, M.D.



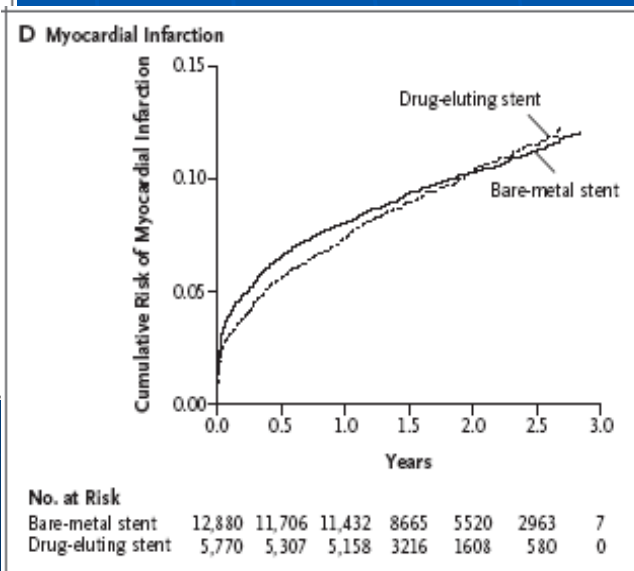
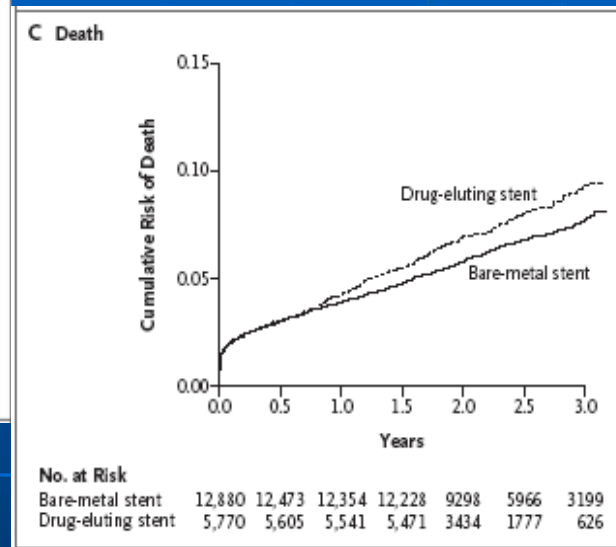
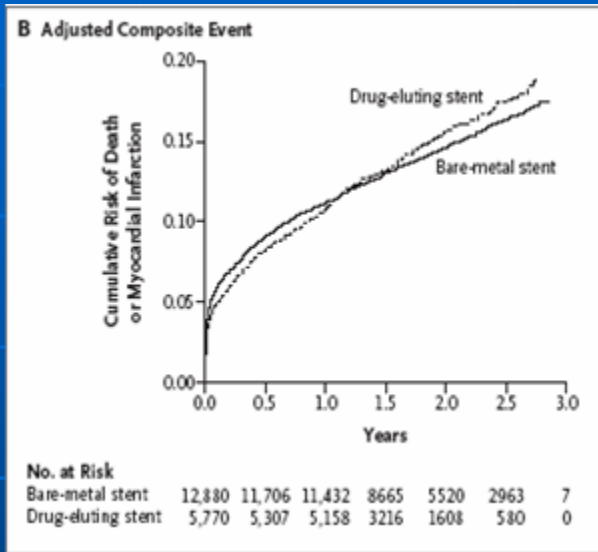
Multivessel disease
DES(N = 9963)
CABG(N = 7437)
in New York State

CABG is associated with lower rates of death or MI and repeat revascularization for 2 and 3 vessel disease

Long-Term Outcomes with Drug-Eluting Stents versus Bare-Metal Stents in Sweden

SCAAR DATA

6033 pt's treated with DES
13,738 pt's treated with BMS



DES were associated with increased rate of death, as compared with BMS after six months

Troponin Elevation After Percutaneous Coronary Intervention Directly Represents the Extent of Irreversible Myocardial Injury

Insights From Cardiovascular Magnetic Resonance Imaging

Joseph B. Selvanayagam, MBBS, FRACP; Italo Porto, MD; Keith Channon, MD, FRCP;
Steffen E. Petersen, MD; Jane M. Francis, DCCR; Stefan Neubauer, MD, FRCP; Adrian P. Banning, MD, FRCP

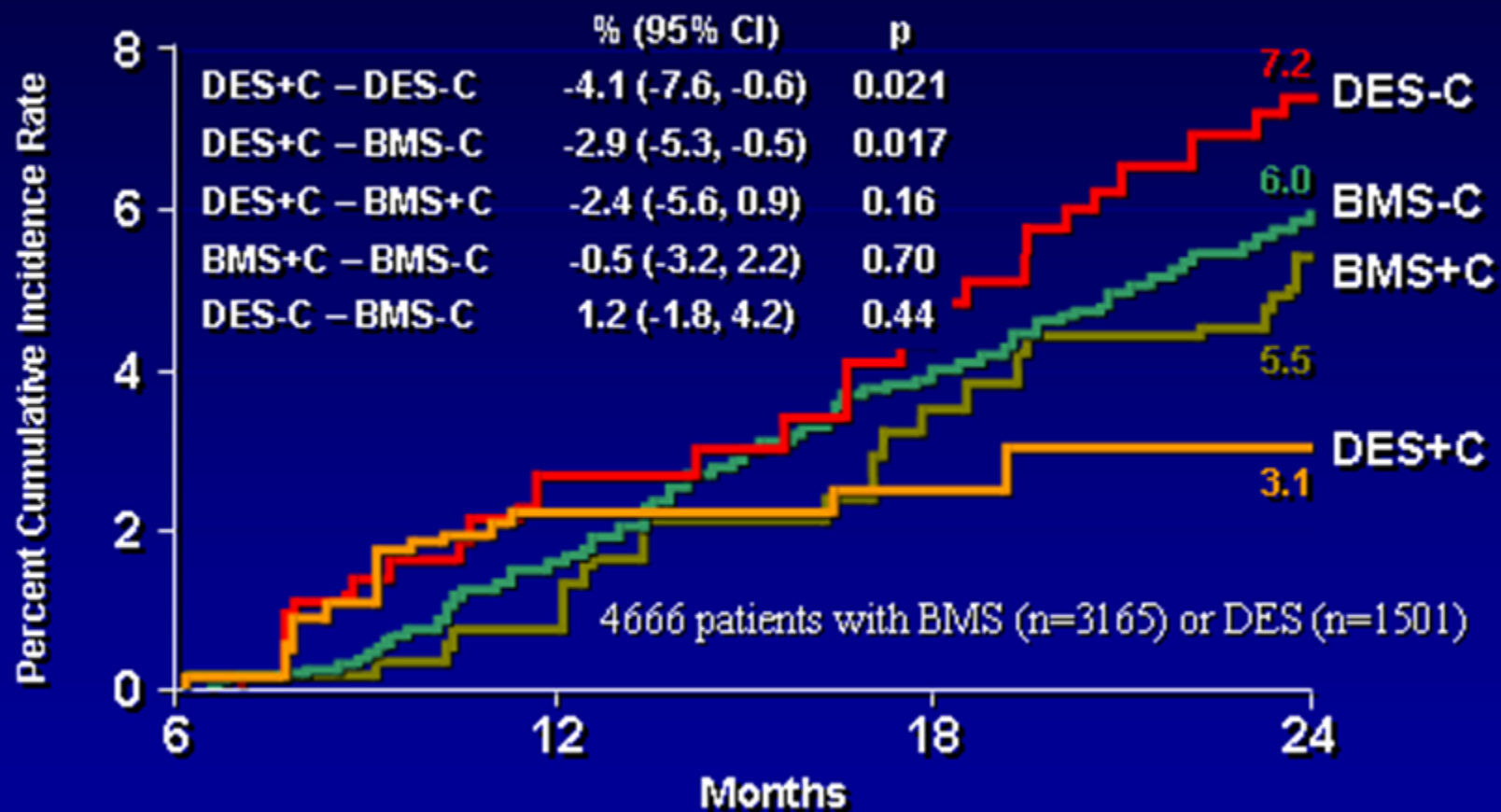
Circulation, Mar 2005; 111: 1027 - 1032

antiplatelet therapy. We found that irreversible myocardial injury occurred in ≈30% of patients, despite the use of (preloaded) clopidogrel and abciximab in all patients. The

myocardial injury on CMR imaging. In these patients, the magnitude of irreversible injury represented, on average, 5% of total LV mass. Furthermore, we found a strong linear

6-Month Landmark Analysis

Adjusted Cumulative Rates of Death or Nonfatal MI



E Eisenstein, et al. *JAMA* 2007;297:159-168



Duke Clinical Research Institute
DUKE UNIVERSITY MEDICAL CENTER

121206

ACCF/SCAI/STS/AATS/AHA/ASNC 2009 Appropriateness Criteria for Coronary Revascularization

	CABG	PCI
	Depressed LVEF	Depressed LVEF
Two vessel coronary artery disease with proximal LAD stenosis	A	A
Three vessel coronary artery disease	A	U
Isolated left main stenosis SYNTAX ??	A	I
Left main stenosis and additional coronary artery disease	A	I

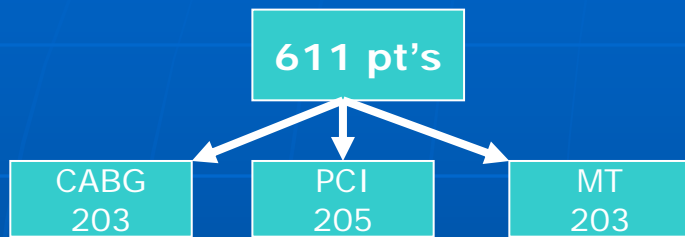
Appropriate : Score 7 to 9
Uncertain : Score 4 to 6
Inappropriate: Score 1 to 3

Medical treatment

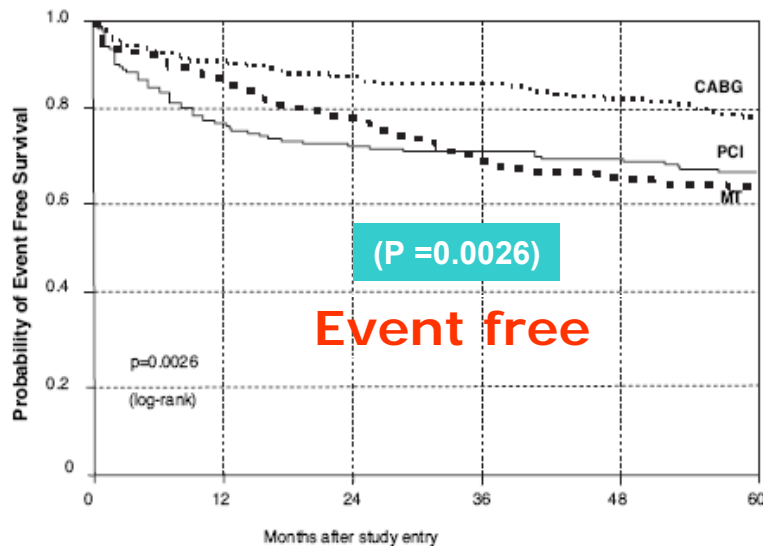
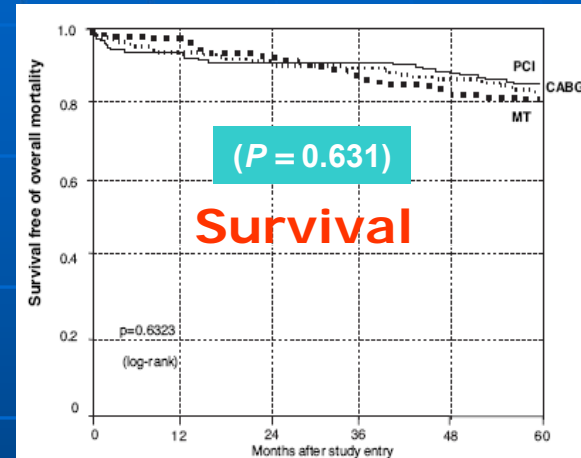


Five-Year Follow-Up of the Medicine, Angioplasty, or Surgery Study (MASS II)

A Randomized Controlled Clinical Trial of 3 Therapeutic Strategies for Multivessel Coronary Artery Disease



Probability of survival free of overall mortality



Conclusions :

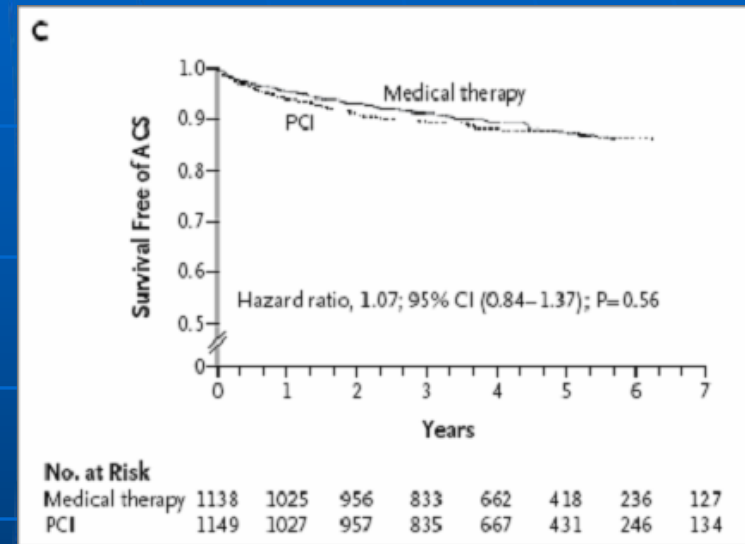
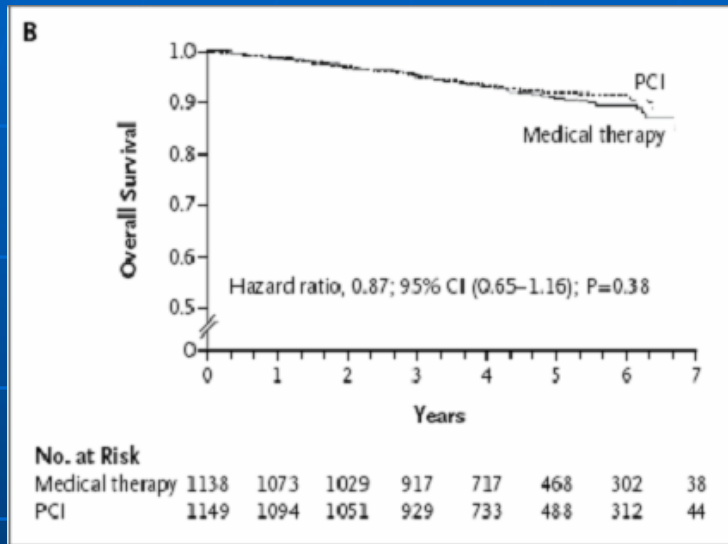
- Long-term events and rate of additional revascularization MT similar to PCI.
- CABG was superior to MT in terms of the primary end points, reaching a significant **44%** reduction

The primary end points were total mortality, Q-wave myocardial infarction, or refractory angina requiring revascularization.

Optimal Medical Therapy with or without PCI for Stable Coronary Disease

Clinical Outcomes Utilizing Revascularization and Aggressive Drug Evaluation (COURAGE) trial

- Randomized trial
- 2287 pt's
- F/U median- 4.6yr



CONCLUSIONS

As an initial management strategy in patients with stable coronary artery disease, PCI did not reduce the risk of death, myocardial infarction, or other major cardiovascular events when added to optimal medical therapy. (ClinicalTrials.gov number,

(COURAGE)

N Engl J Med 2007;356.

A Meta-Analysis of 17 Randomized Trials of a Percutaneous Coronary Intervention-Based Strategy in Patients With Stable Coronary Artery Disease

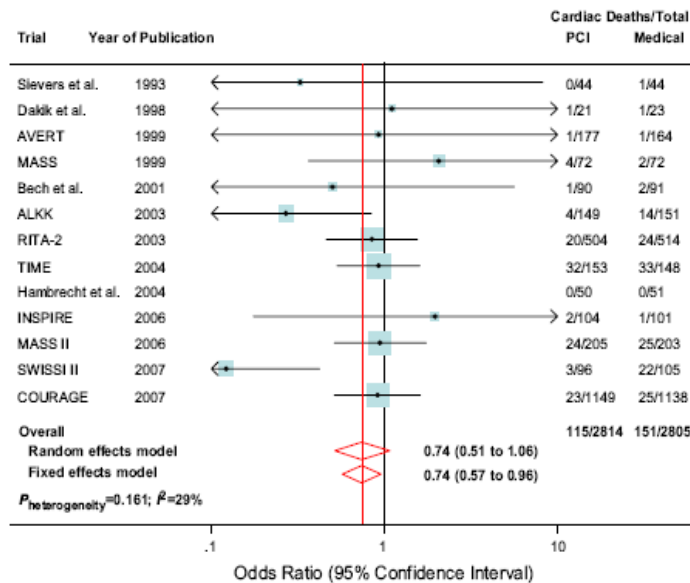


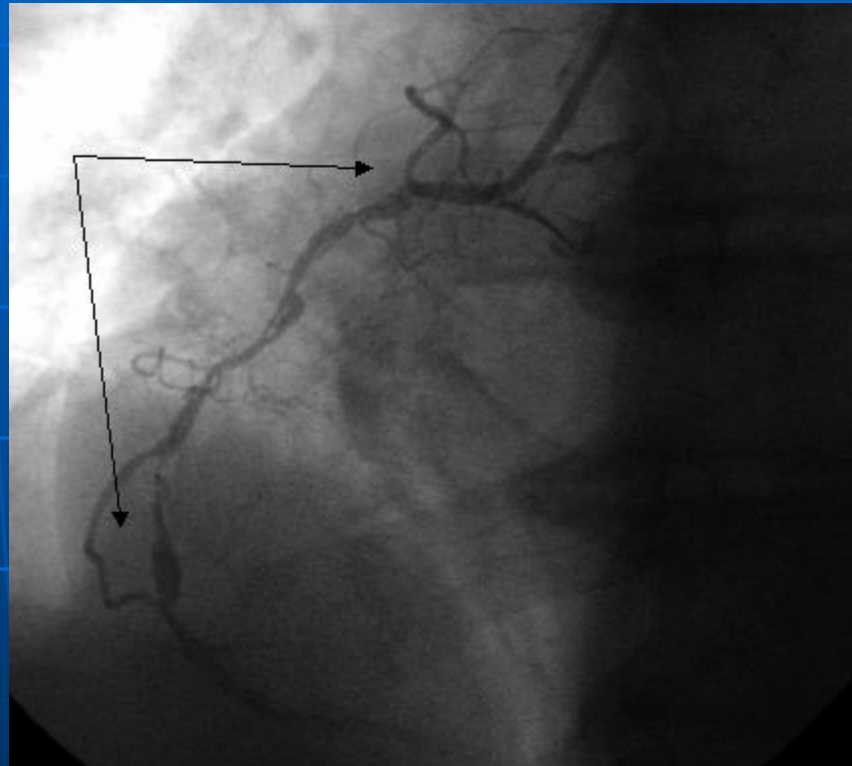
Figure 5 Odds Ratios for Cardiac Death in Individual Trials Comparing the PCI-Based Strategy With Medical Treatment Strategy

3,675 - PCI
3,838 - medical

Conclusions

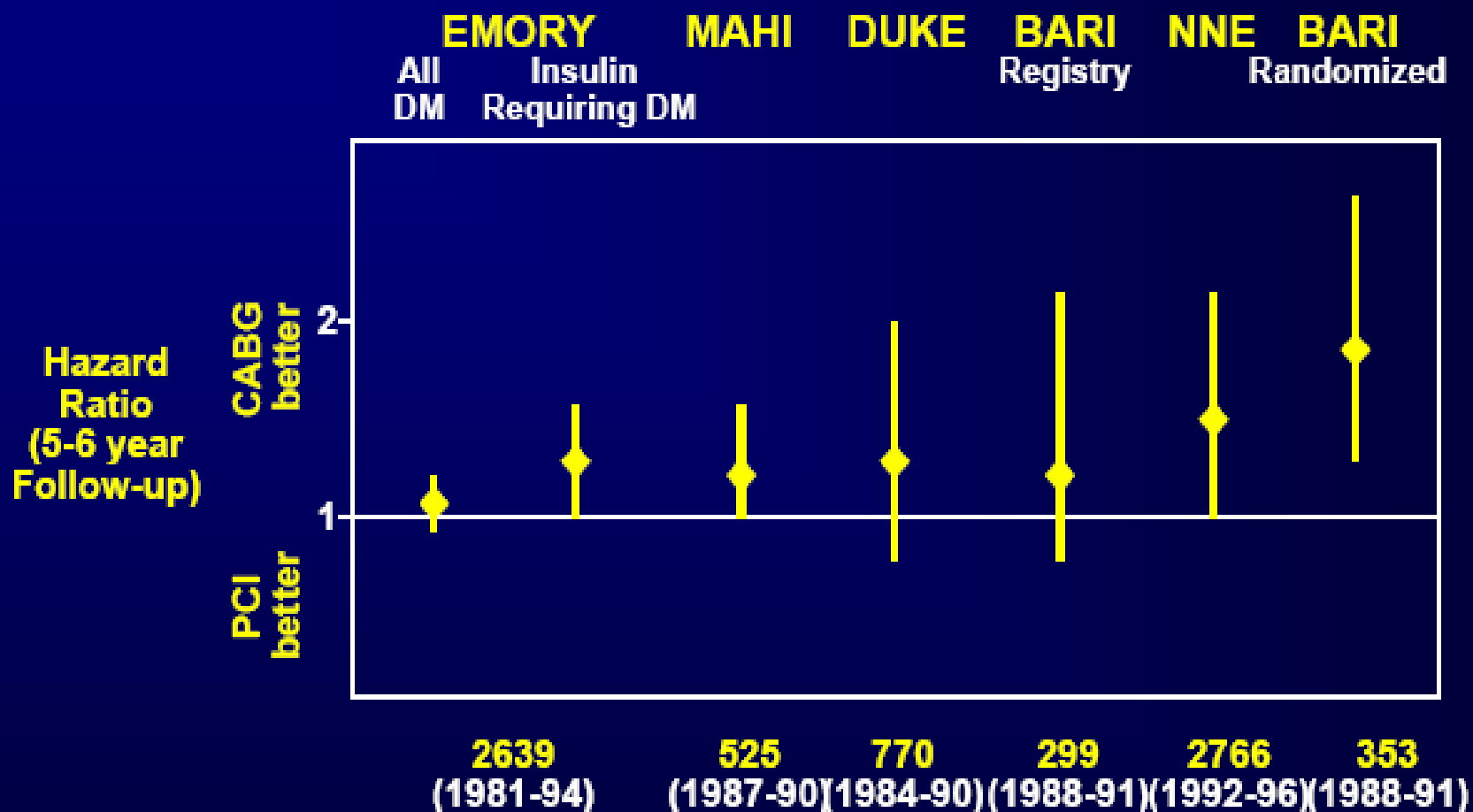
These findings suggest that a PCI-based invasive strategy may improve long-term survival compared with a medical treatment-only strategy in patients with stable coronary artery disease. (J Am Coll Cardiol 2008;52: 894-904) © 2008 by the American College of Cardiology Foundation

Diabetes Mellitus





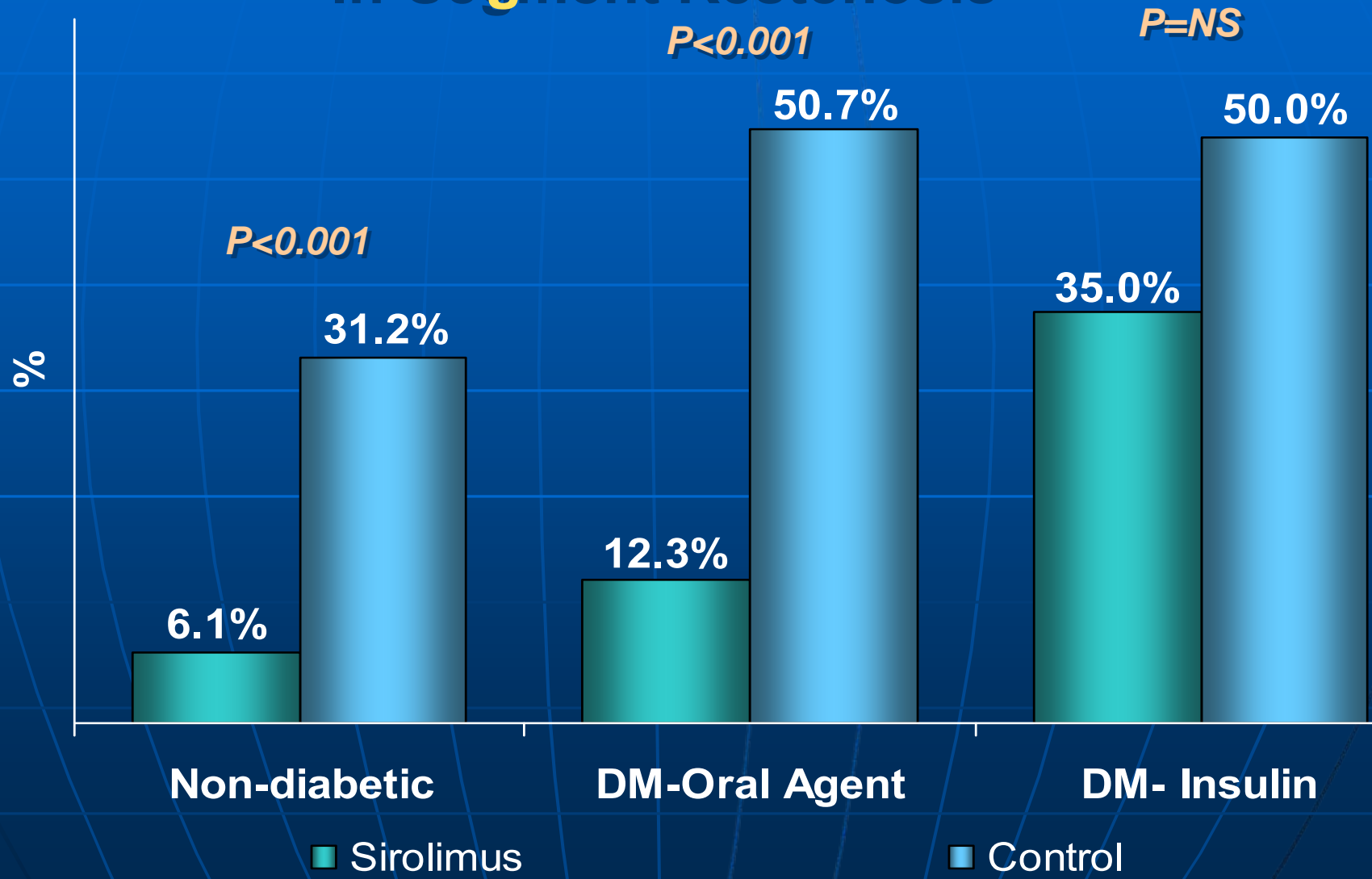
DIABETIC SURVIVAL - PCI vs CABG



NNE (NW Niles et al.) JACC 2001; 37:1008

SIRIUS – Reduced Efficacy in IDDM

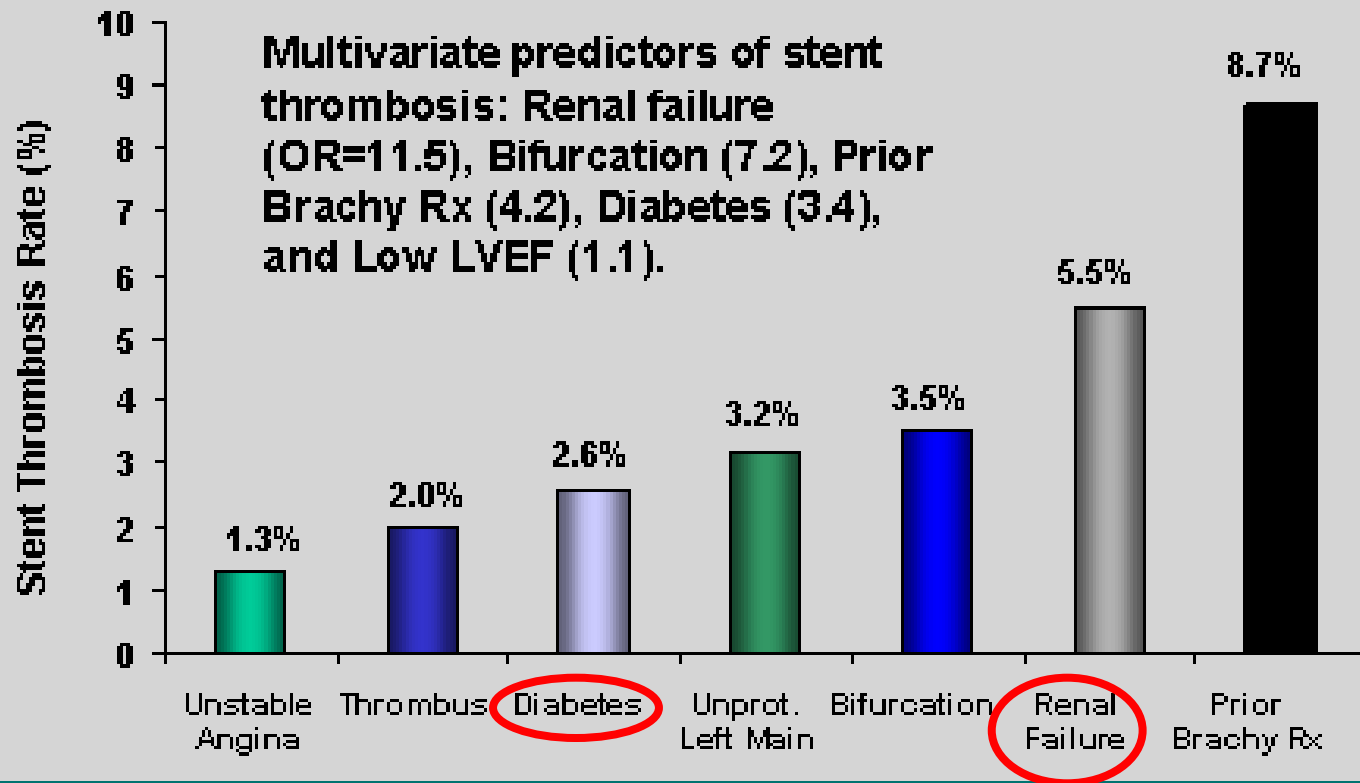
In-Segment Restenosis



Incidence of Stent thrombosis after DES

2229 consecutive with successful DES implantation

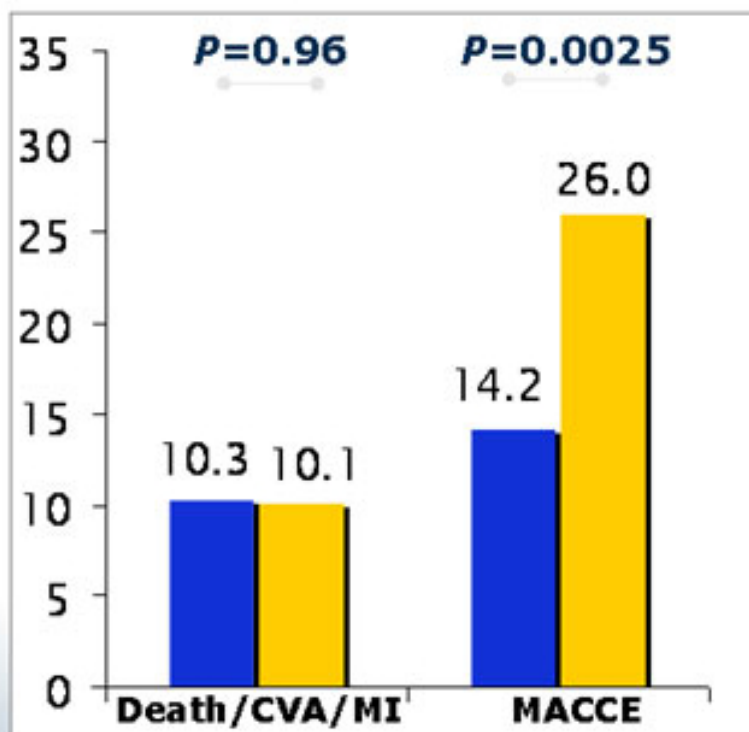
ASA indefinitely; Plavix or Ticlid ≥ 3 months (SRL) and ≥ 6 months (PXL)



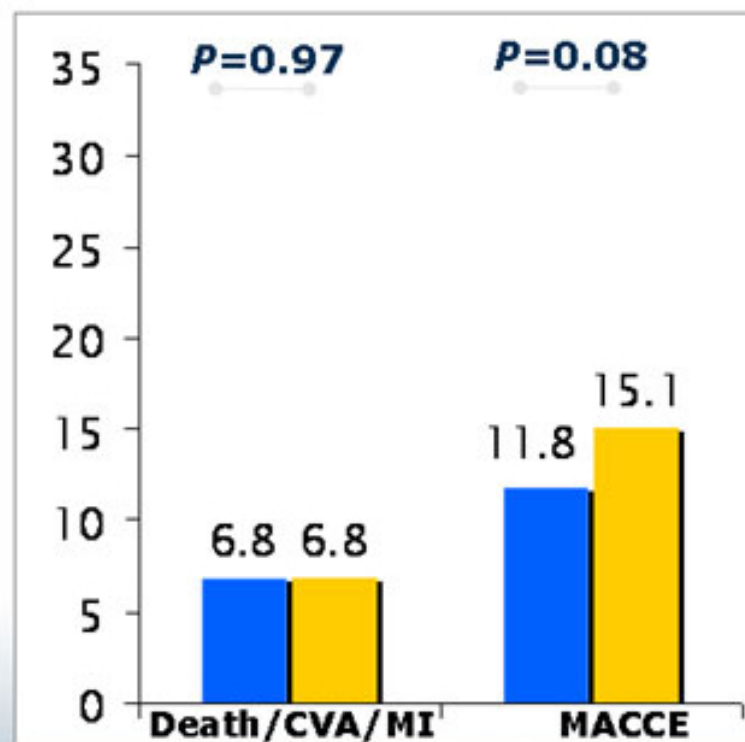
Iakovou I et al. JAMA 2005;293:2126-2130

Outcome According to Diabetic Status

■ CABG ■ TAXUS



Diabetes (medical treatment)
N=452



Nondiabetic
N=1348

Single Versus Bilateral Internal Mammary Artery for Isolated First Myocardial Revascularization in Multivessel Disease: Long-Term Clinical Results in Medically Treated Diabetic Patients

Antonio Maria Calafiore, MD, Michele Di Mauro, MD, Gabriele Di Giammarco, MD, Giovanni Teodori, MD, Angela Lorena Iacò, MD, Valerio Mazzei, MD, Giuseppe Vitolla, MD, and Marco Contini, MD

Division of Cardiac Surgery, University Hospital, Torino, Division of Cardiac Surgery, "G D'Annunzio" University, Chieti, and Division of Cardiac Surgery, Papardo Hospital, Messina, Italy

Table 3. Postoperative Results

	BIMA Group n = 200	LIMA Group n = 200	p Value
Deaths	6 (3.0)	10 (5.0)	0.307
<u>Cardiac deaths</u>	0	7 (3.5)	<u>0.015</u>
Acute myocardial infarction	1 (0.5)	5 (2.5)	0.215
Cerebrovascular accident	4 (2.0)	2 (1.0)	0.688
Early negative primary endpoints	8 (4.0)	12 (6.0)	0.358
Early major events	14 (7.0)	24 (12.0)	0.088
<u>Sternal wound problems</u>	6 (3.0)	3 (1.5)	<u>0.500</u>

- **Pedicled IMA harvesting** was related to a higher incidence of sternal complications, both in the LIMA and in the BIMA group

CRF DES Evidence-based Medicine Guidelines Summary 2007

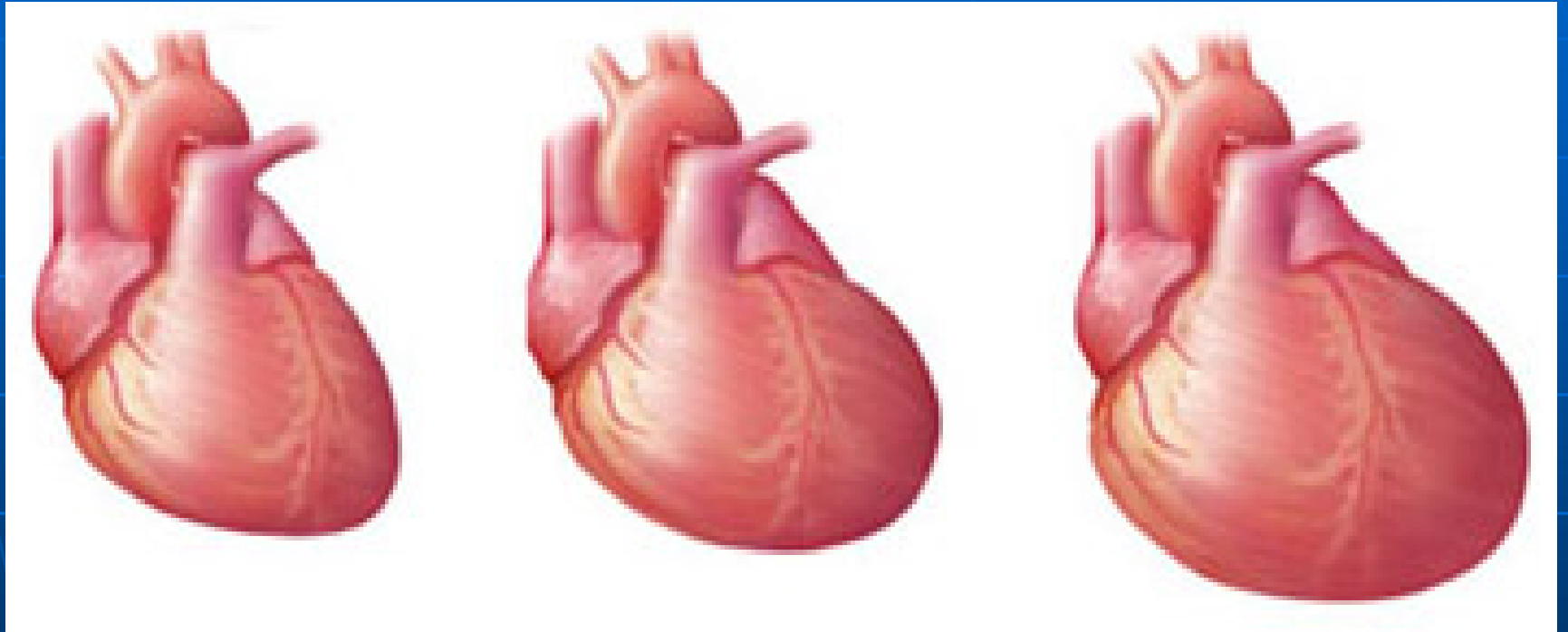
IIb



- Routine bifurcation dual DES (T, SKS (V), culotte or crush of sidebranch)
- Ultra-long lesions (full metal jacket)
- Unprotected left main
- Multivessel disease (complex and diffuse esp DM)
- Acute myocardial infarction
- ISR after failed brachy (if no surgical option!)

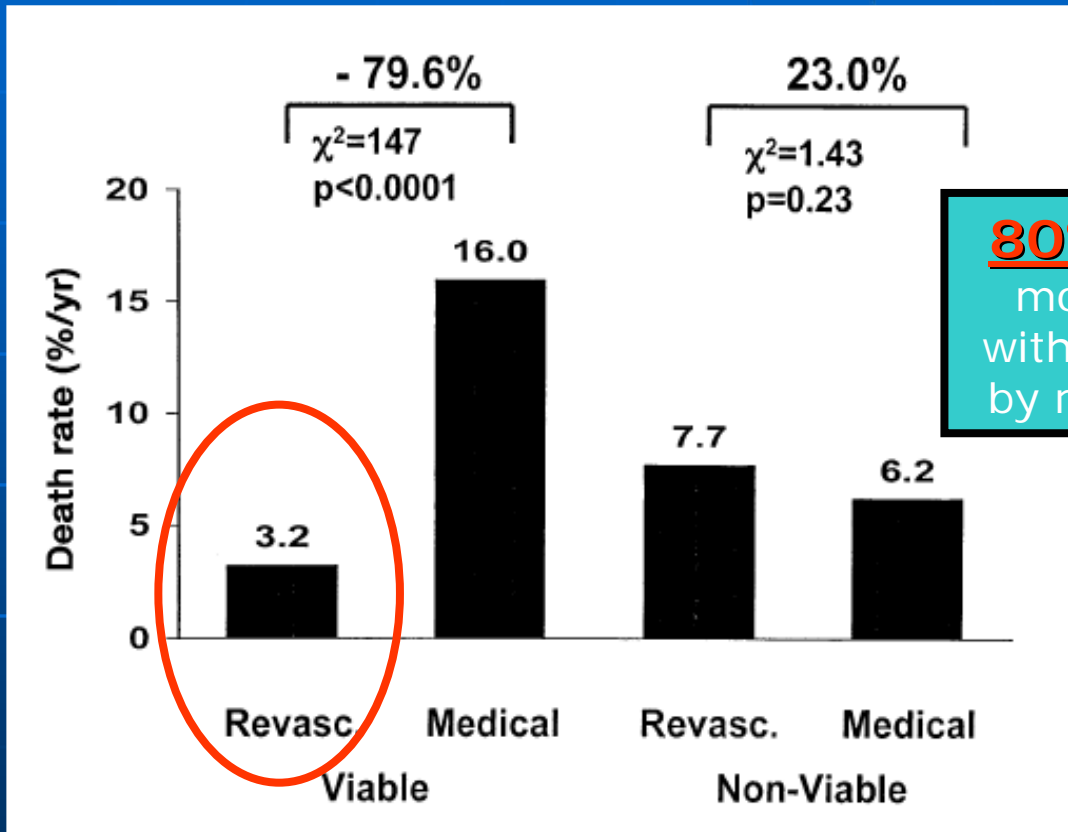
“Large, multicenter trials are underway (FREEDOM, SYNTAX, HORIZONS) which will provide critical evidence-based guidance to the appropriate use of DES in many of these off-label conditions”

LV Dysfunction



Myocardial Viability Testing and Impact of Revascularization on Prognosis in Patients With Coronary Artery Disease and Left Ventricular Dysfunction: A Meta-Analysis

3,088 pt's



80% reduction in mortality for pt's with viability treated by revascularization

When 25% to 30% of the LV is viable by noninvasive testing, revascularization might be considered



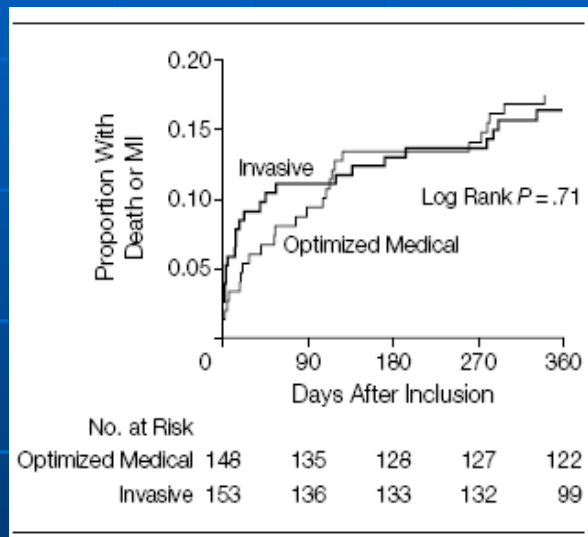
יש לי תור לניתוחי "חזה" ...

Outcome of Elderly Patients With Chronic Symptomatic Coronary Artery Disease With an Invasive vs Optimized Medical Treatment Strategy

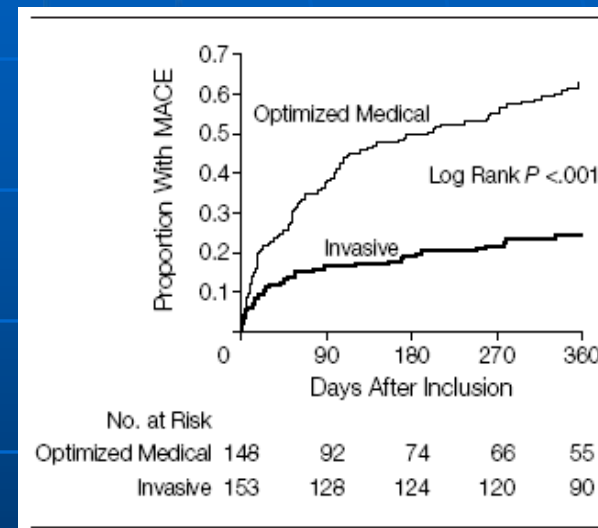
One-Year Results of the Randomized TIME Trial

- Prospective randomized trial
- **282 pt's** ; mean age- **80 yr**
- 14 centers in Switzerland

Time to Death or Nonfatal MI

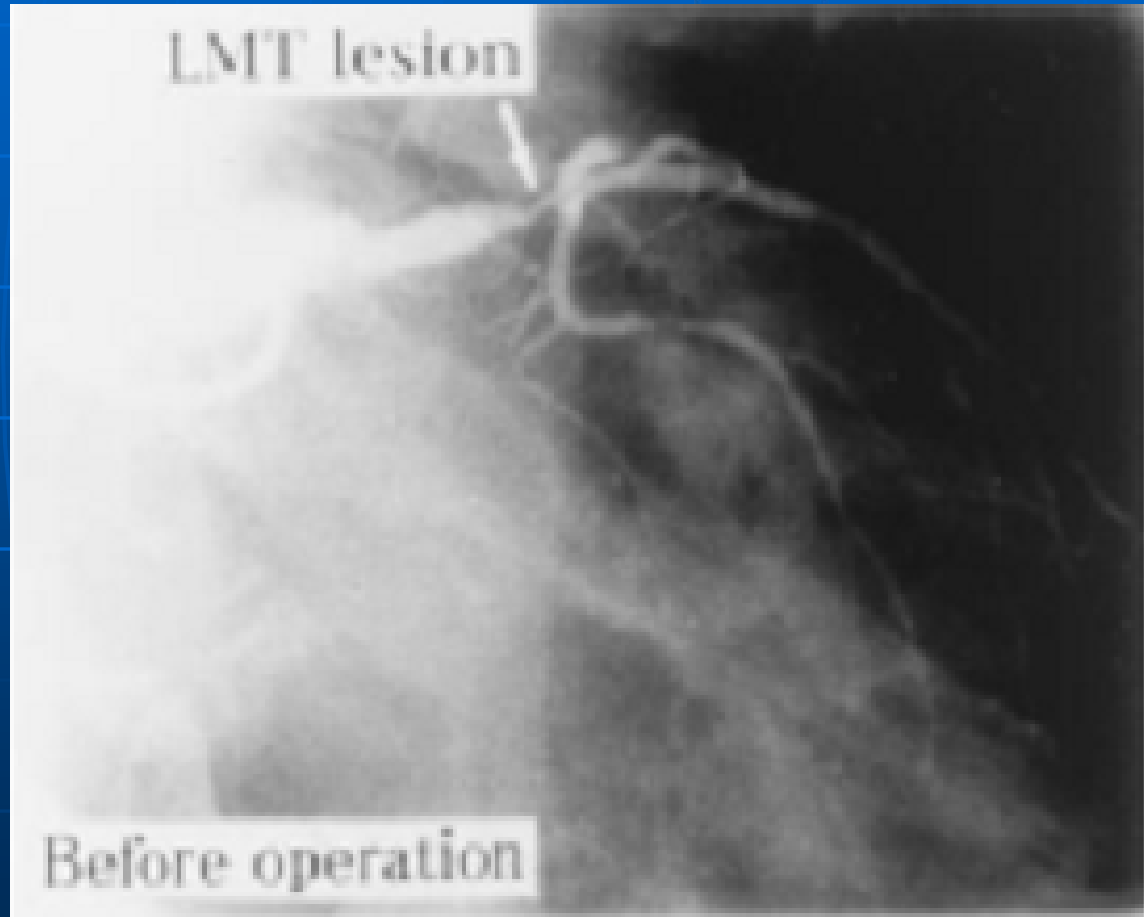


Rates of Major Adverse Clinical Events (MACE)



INV - symptom relief "cost" intervention
MT - 50% late nonfatal events

Left Main Disease



PCI vs. CAVG

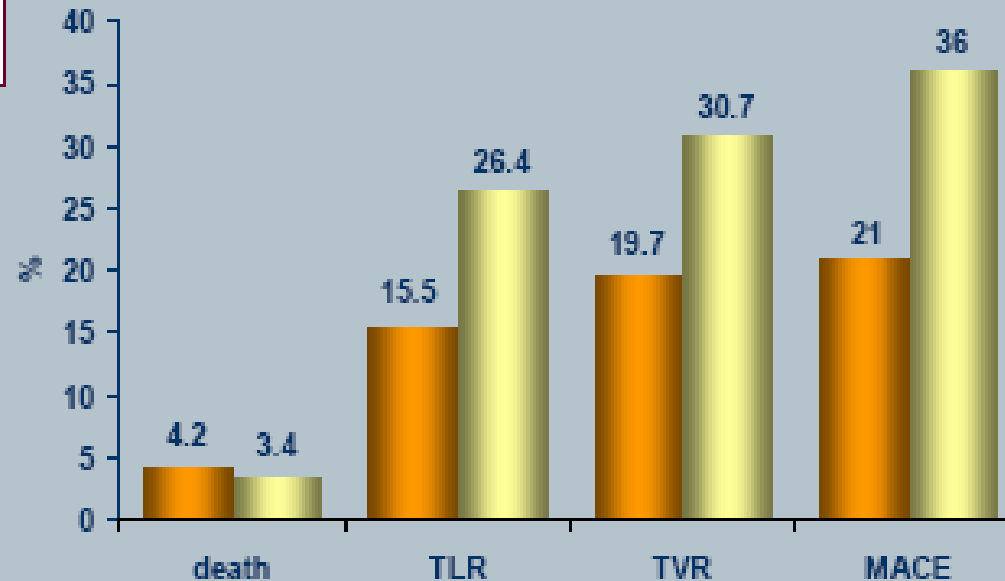
Left main stenosis

- LM is a potentially attractive target for PCI because of its **large diameter** and **proximal position**
- Two important pathophysiological features may mitigate **against** the success of PCI:
 - (i) Up to 80% of LM disease involves the **bifurcation** known to be at particularly high risk of restenosis
 - (ii) Up to 80% of LM patients also have **multivessel** CAD where CABG, as already discussed, may already offer a survival advantage.

DES in unprotected LMS

The Milan experience

Crush	59%
Culotte	9%
V	24%
T	8%



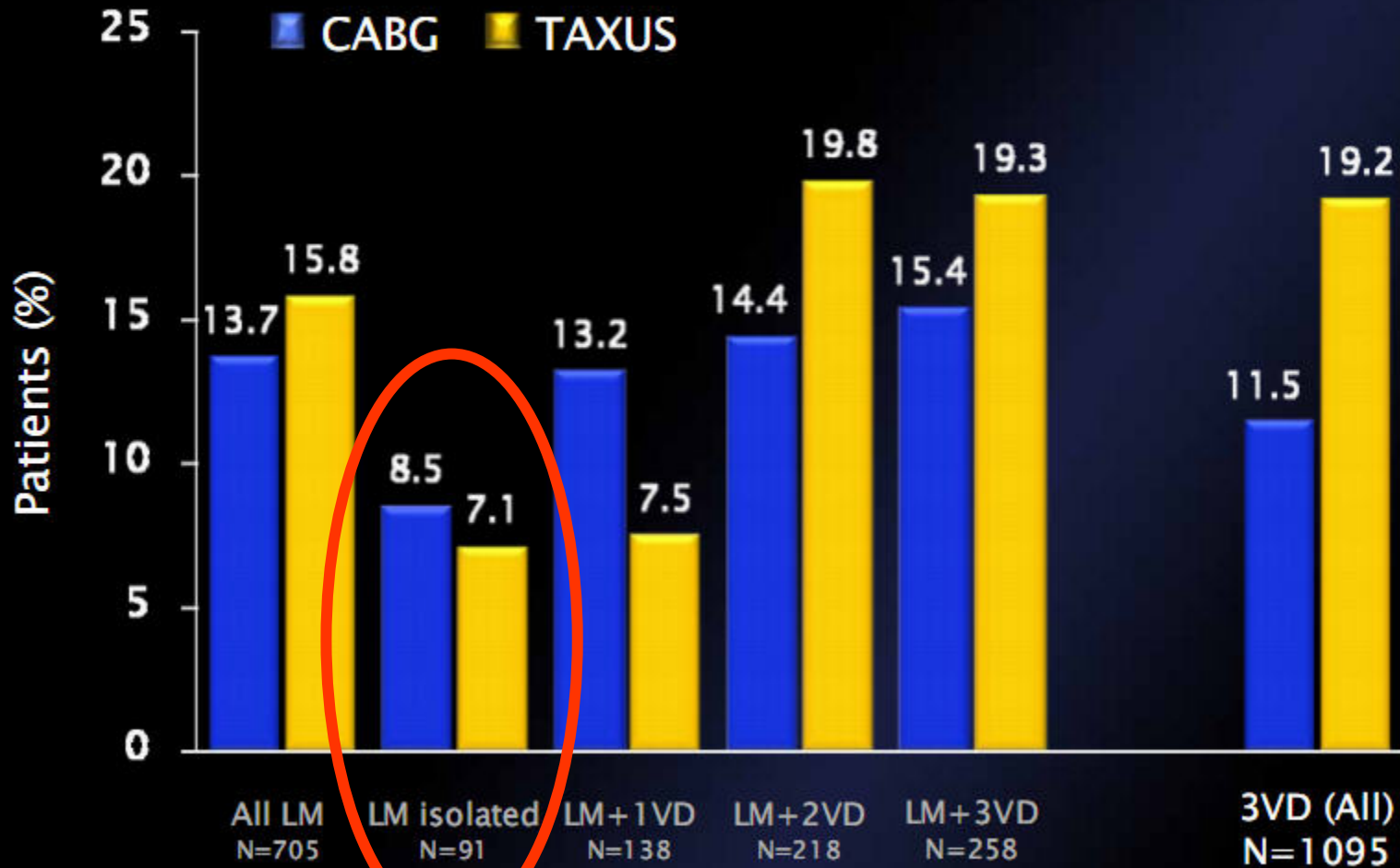
P<0.08

71 DES vs. 67 historical BMS control

Drug eluting stents (DES) vs BMS in Left Main

		Chieffo/Colombo Circ 2005		Valgimigli/Serruys Circ 2005	
		64 BMS	85DES	86 BMS	95 DES
30 day	% Mortality			7	11
	% Repeat Revascularization			2	0
	% MACE			19	15
6 months	% Mortality	9	4		
	% Repeat Revascularization	31	19		
	% MACE	36	20		
18 months	% Mortality			16	14
	% Repeat Revascularization			23	6
	% MACE			45	24

12 Month Subgroup MACCE Rates

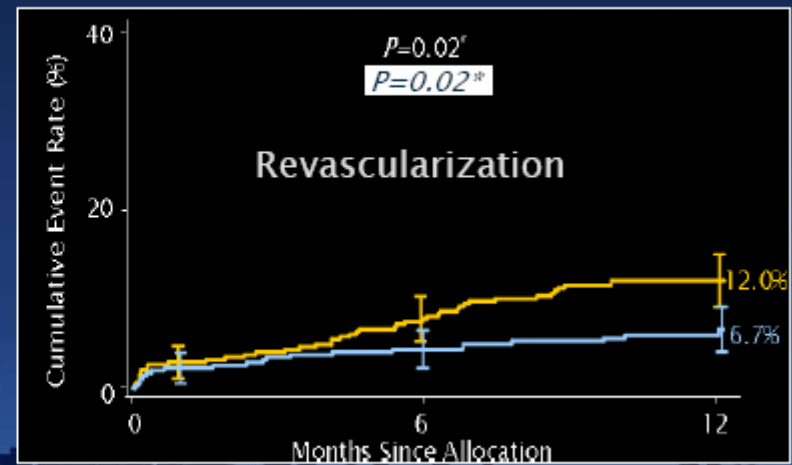
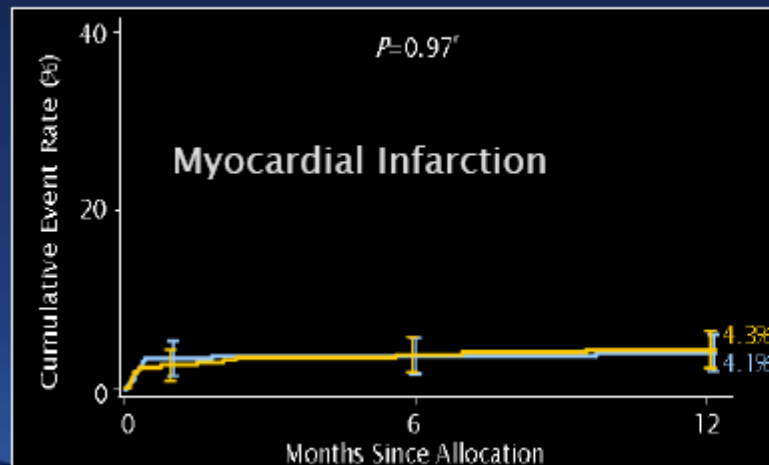
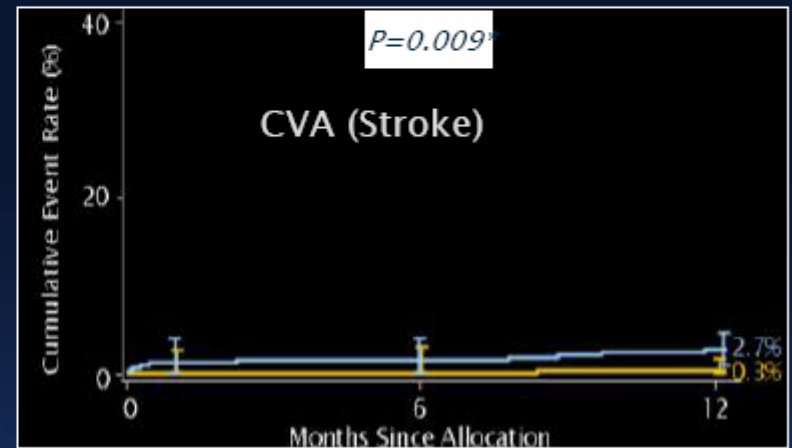


SYNTAX Trial – Left Main Subset

Adverse Events to 12 Months

CABG (N=348)

TAXUS® Express® Stent (N=357)



* Any revascularization (PCI or CABG): ITT population

Event rate \pm 1.5 SE, *Fisher exact test

10.3 Early post-operative risk

- The survival outcome for all CABG operations performed in the UK in the 2004–08 period showed :
 - 1.1% hospital mortality in 78,367 elective patients .
 - 2.6% in 32,990 urgent patients.
- In all pt's without and 30,218 pt's with LM stenosis, the respective mortalities were 1.5% and 2.5% (respective predicted elective mortalities 0.9% and 1.5%).
- In all pt's without or 26,020 pt's with DM, the respective mortalities were 1.6% and 2.6% (respective predicted elective mortalities 1.0% and 1.6%).

CRF DES Evidence-based Medicine Guidelines Summary 2007

IIb



- Routine bifurcation dual DES (T, SKS (V), culotte or crush of sidebranch)
- Ultra-long lesions (full metal jacket)
- Unprotected left main
- Multivessel disease (complex and diffuse, esp DM)
- Acute myocardial infarction
- ISR after failed brachy (if no surgical option!)

“Large, multicenter trials are underway (FREEDOM, SYNTAX, HORIZONS) which will provide critical evidence-based guidance to the appropriate use of DES in many of these off-label conditions”

Do you prefer a reintervention or a
CVA ?

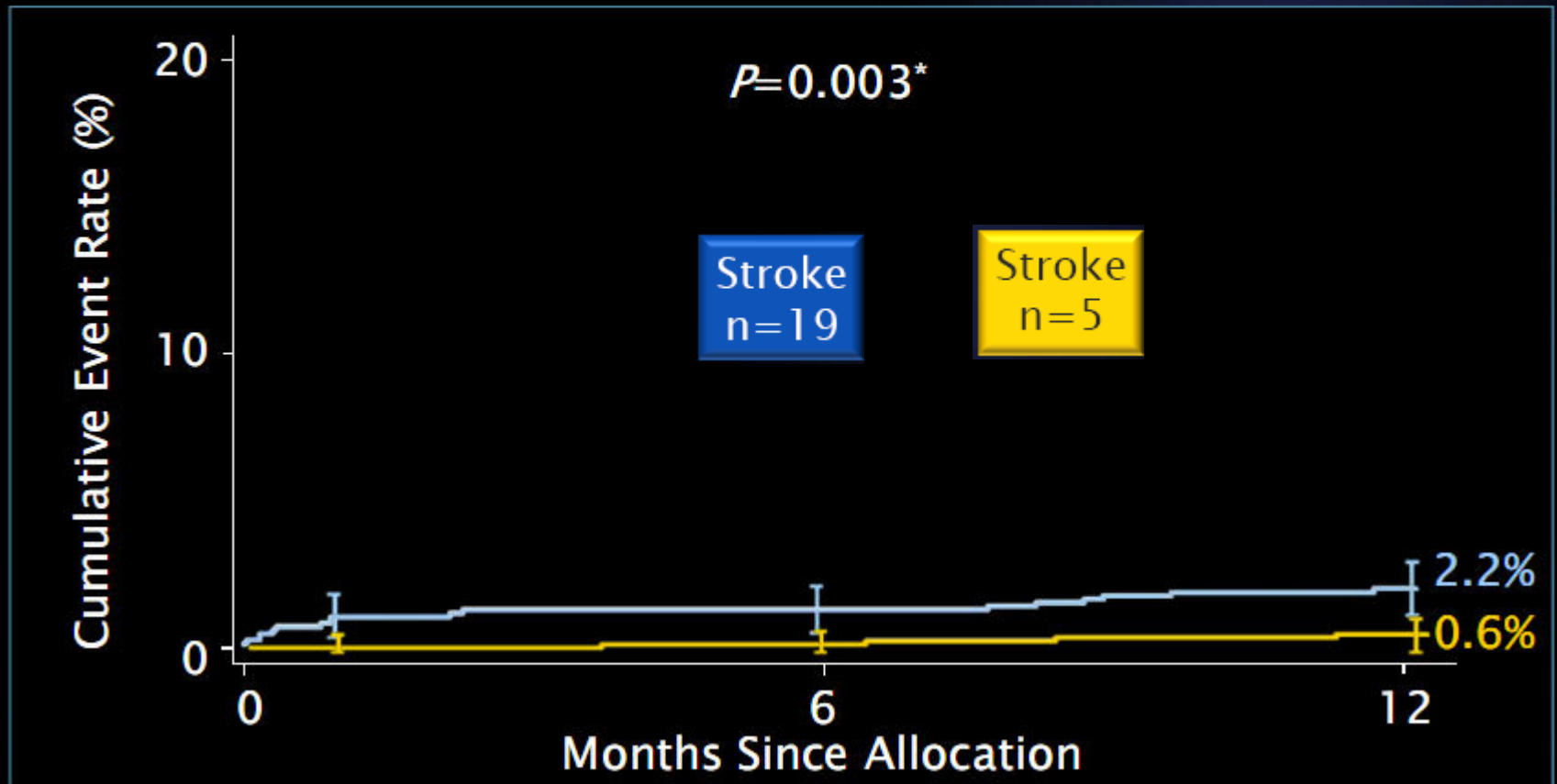


CVA to 12 Months



■ CABG (N=897)

■ TAXUS (N=903)



Event Rate \pm 1.5 SE. *Fisher's Exact Test

ITT population

The Society of Thoracic Surgeons: 30-Day Operative Mortality and Morbidity Risk Models

A. Laurie W. Shroyer, PhD, Laura P. Coombs, PhD, Eric D. Peterson, MD, Mary C. Eiken, MSN, Elizabeth R. DeLong, PhD, Anita Chen, MS, T. Bruce Ferguson, Jr, MD, Frederick L. Grover, MD, and Fred H. Edwards, MD

STS

Ann Thorac Surg 2003;75:1856-1865

Table 2. CABG-Only Outcomes (1997–1999)

Outcome	Percentage for All CABG Records n = 503,478
30-day operative mortality	3.05
Permanent stroke	1.63
Renal failure requiring dialysis	3.53
Prolonged ventilation	5.96
Deep sternal wound infection	0.63
Cardiac surgery reoperation	5.17
Composite major morbidity/mortality	13.40

Number of records = 503,478 CABG-only records.

Procedural Characteristics

Potential Risk Factors for Stroke



	CABG N=897	TAXUS N=903	P value
Urgent Procedure, %	3.8	4.1	0.72
Emergent Procedure, %	3.9	1.8	0.007
Time to procedure, [†] d, mean ± SD	17.4 ± 28.0	6.9 ± 13.0	<0.001
Off-pump surgery %	15.0	--	--

	Off Pump	On Pump	P value
Stroke	1 / 134 (0.7%)	18 / 763 (2.3%)	ns

Site-reported data

SYNTAX: Stroke - TCT 2009 - M.J. Mack

[†]Allocation to procedure
[#]For PCI patients, includes time for staged procedure

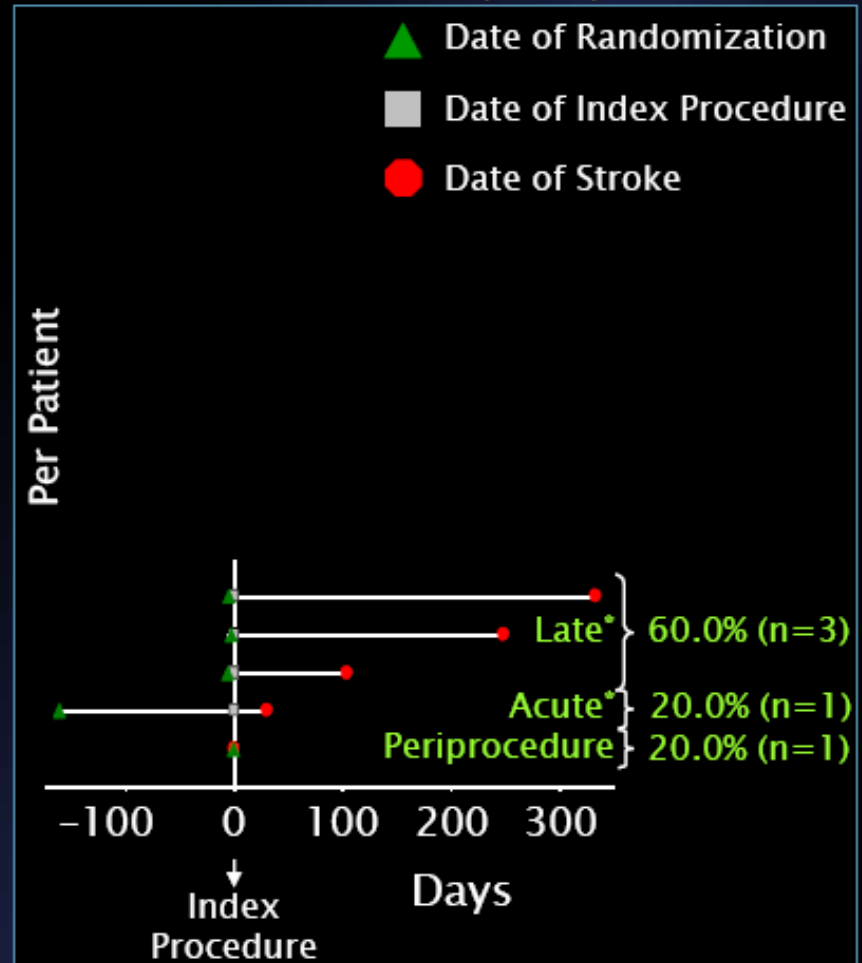
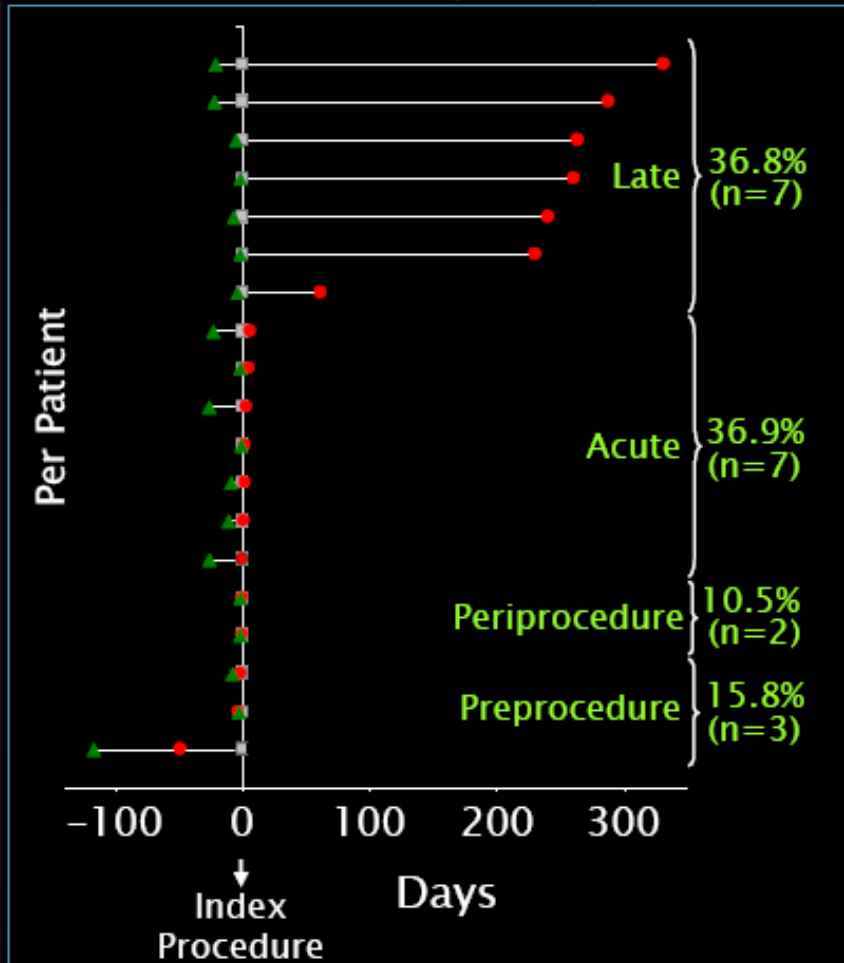
San Francisco, CA - 22sep2009 - Slide 9

Timing of Stroke (Per Patient)



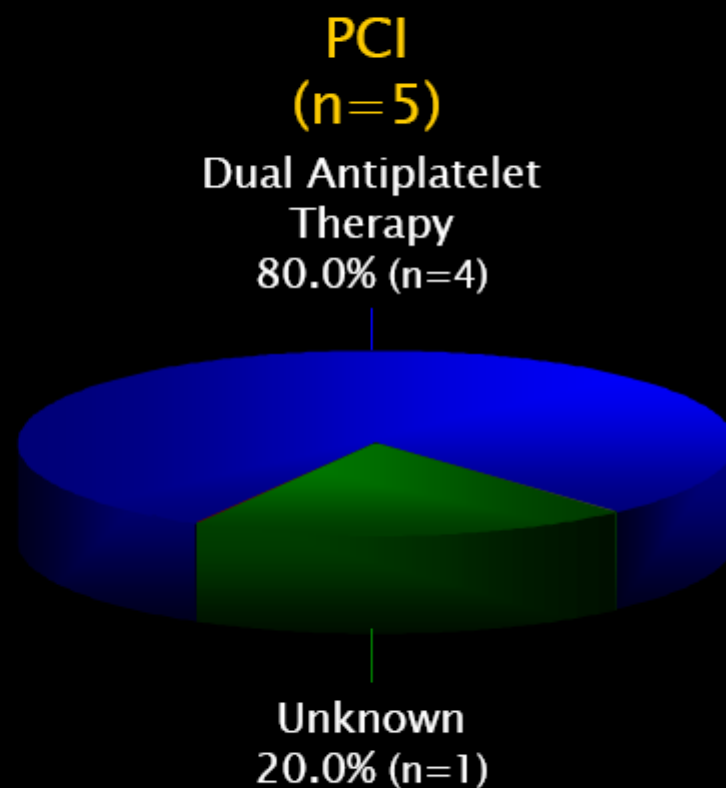
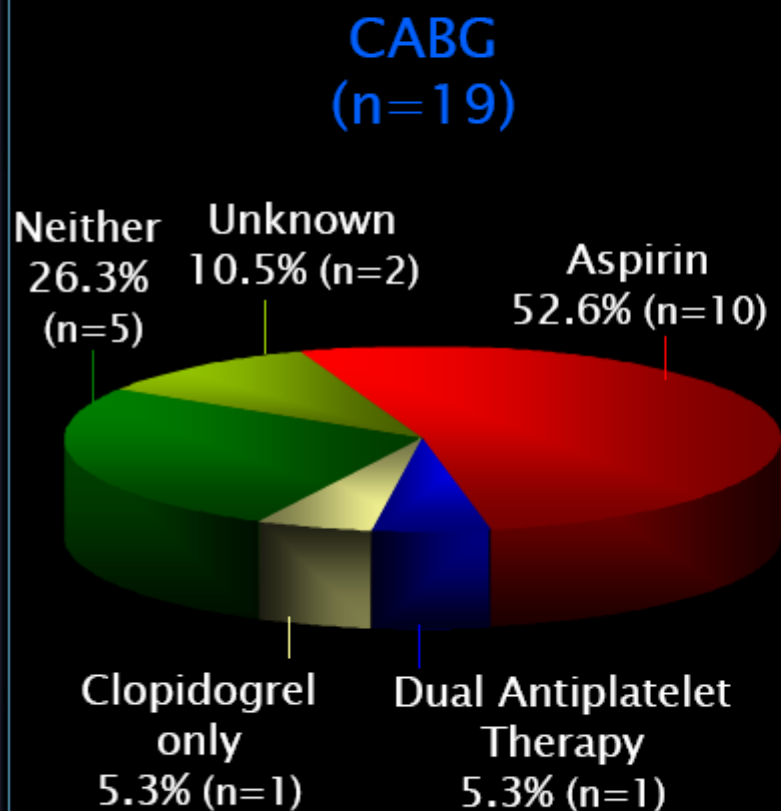
CABG Arm (n=19)

PCI Arm (n=5)



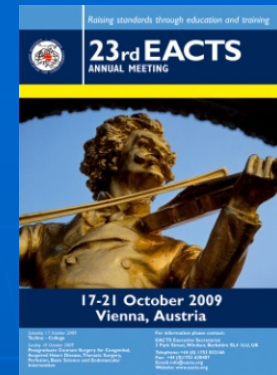
*Late: >30days; Acute: postprocedure to ≤30d

Antiplatelet Therapy Status at Time of Stroke (Per Patient)



RESULTS OF AORTIC NO-TOUCH MYOCARDIAL REVASCULARISATION: A COMPARATIVE ANALYSIS IN 1713 PATIENTS

M. Albert, Germany



- Group A : Complete no aortic touch technique - OFFPUMP (n=679)
- Group B : ON/OPCAB + partial clamping of the aorta (n=1034)

RESULTS :

	Group A	Group B	P
Mortality (30d)	4 (0.6%)	24(2.3%)	<0.05
CVA	1(0.1%)	7(0.7%)	<0.05

- Conclusions – Total arterial revascularisation with bilateral ITA graft using the aortic no touch technique allow the reduction of cerebrovascular event after CABG to zero

Procedural Characteristics

CABG Randomized Cohort

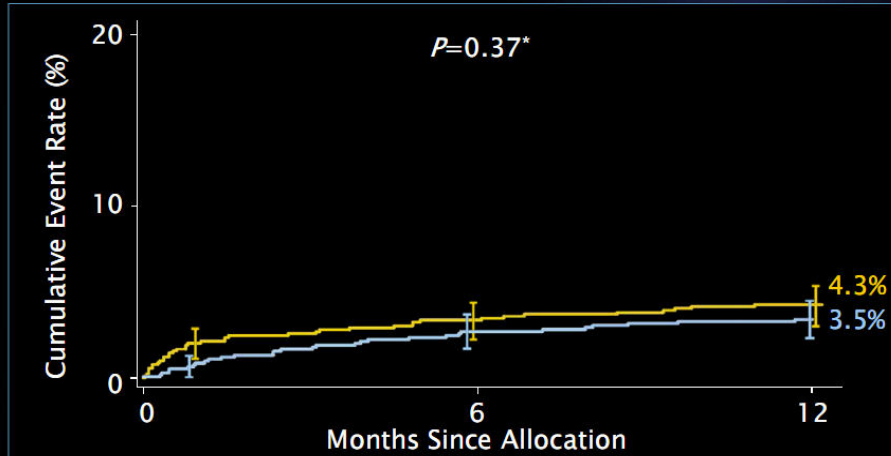
SYNTAX[®]

	CABG N=897
Off-pump surgery, %	15.0
Graft revascularization, %	
At least one arterial graft	97.3
Arterial graft to LAD	95.6
LIMA+venous	78.1
Double LIMA/RIMA	27.6
Complete arterial revascularization	18.9
Radial artery	14.1
Venous graft only	2.6
Grafts per patient, mean \pm SD	2.8 \pm 0.7
Distal anastomosis/pt, mean \pm SD	3.2 \pm 0.9

All-Cause Death to 12 Months

SYNTAX

CABG (N=897) TAXUS (N=903)



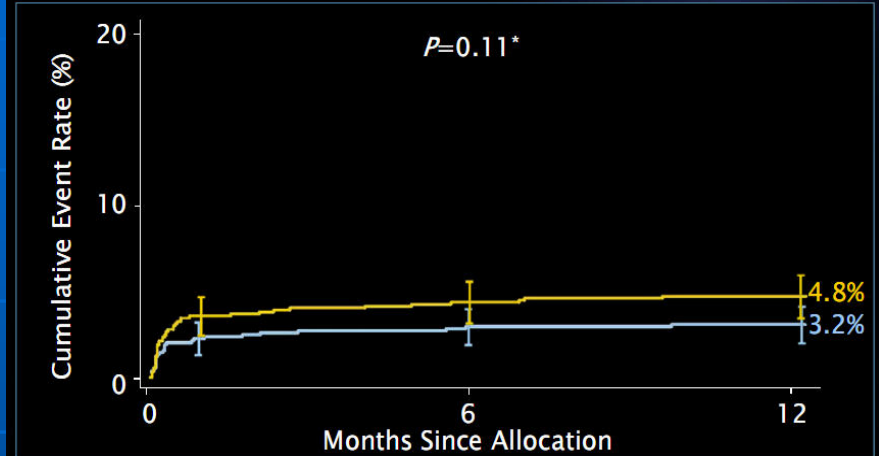
Event Rate \pm 1.5 SE. *Fisher's Exact Test

ITT population

Myocardial Infarction to 12 Months

SYNTAX

CABG (N=897) TAXUS (N=903)



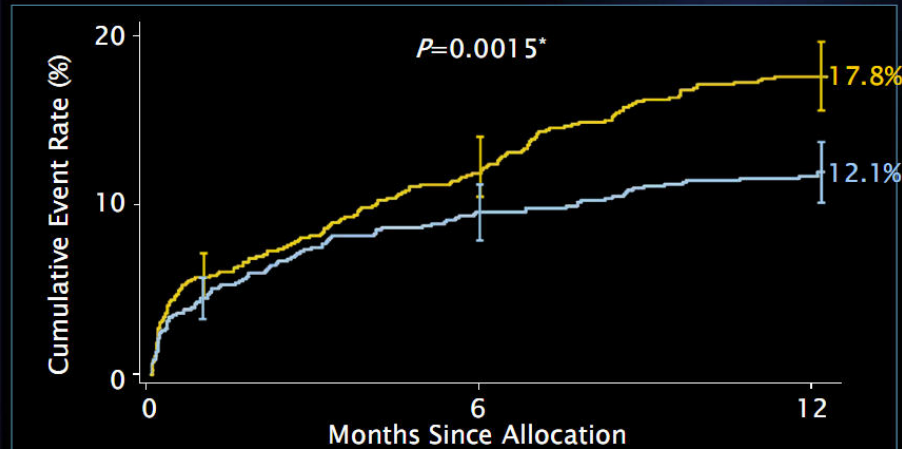
Event Rate \pm 1.5 SE. *Fisher's Exact Test

ITT population

MACCE to 12 Months

SYNTAX

CABG (N=897) TAXUS (N=903)



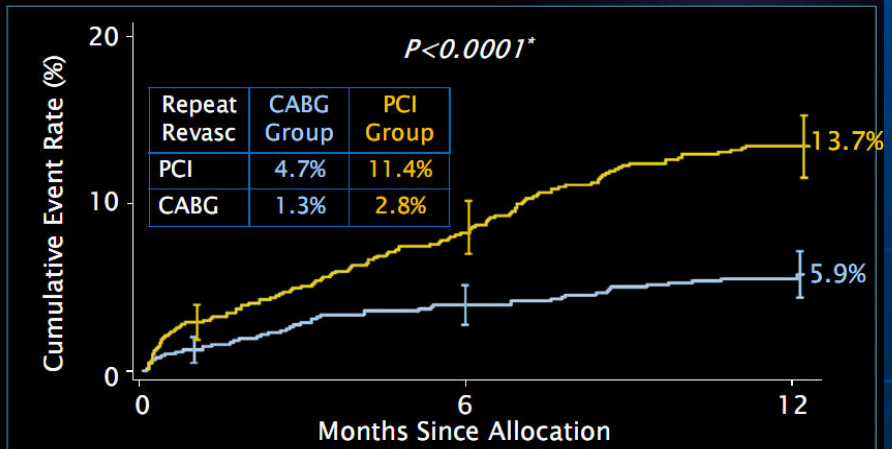
Event Rate \pm 1.5 SE. *Fisher's Exact Test

ITT population

Repeat Revascularization to 12 Months

SYNTAX

CABG (N=897) TAXUS (N=903)



Event Rate \pm 1.5 SE. *Fisher's Exact Test

ITT population

SYNTAX Trial Design



62 EU Sites + 23 US Sites

Total enrollment
N=3075

Stratification:
LM and Diabetes

Randomized Arms
N=1800

Two Registry Arms

CABG
N=897

vs.

TAXUS*
N=903

CABG
N=1077

PCI
N=198

5yr FU
N=649

No FU
N=428

*TAXUS Express

Reasons for Registry Allocation



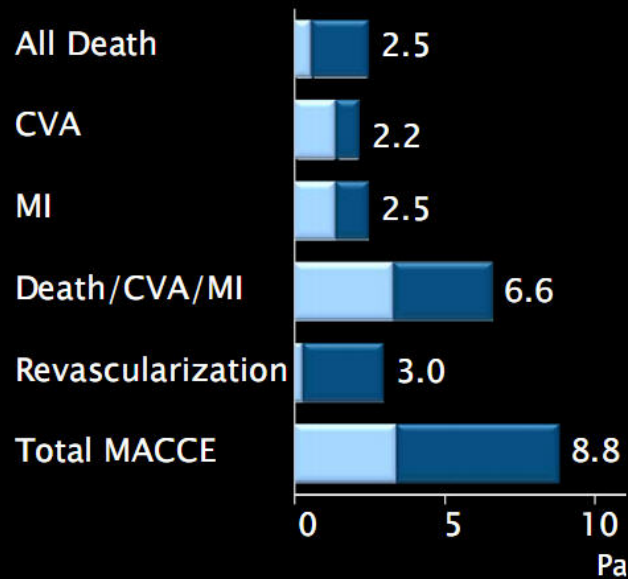
PCI Registry– CABG ineligible due to:

- Co-morbidities (70.7%)
- No graft material (9.1%)
- Small or poor quality of distal vessel (1.5%)
- Patient refused CABG (5.6%)
- Other (13.1%)

CABG Registry– PCI ineligible due to:

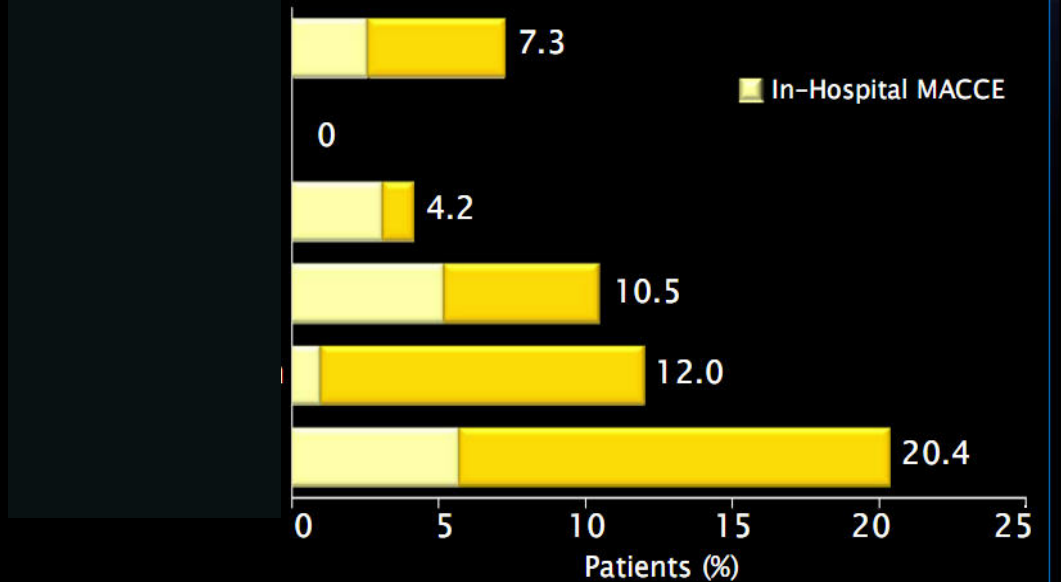
- Complex anatomy (70.9%)
- Untreatable CTO (22.0%)
- Unable to take anti-platelet medications (0.9%)
- Patient refused PCI (0.5%)
- Other (5.7%)

12 Month MACCE Rates CABG Registry (N=644)



12 Month MACCE Rates PCI Registry (N=192)

SYNTAX



Per-protocol population

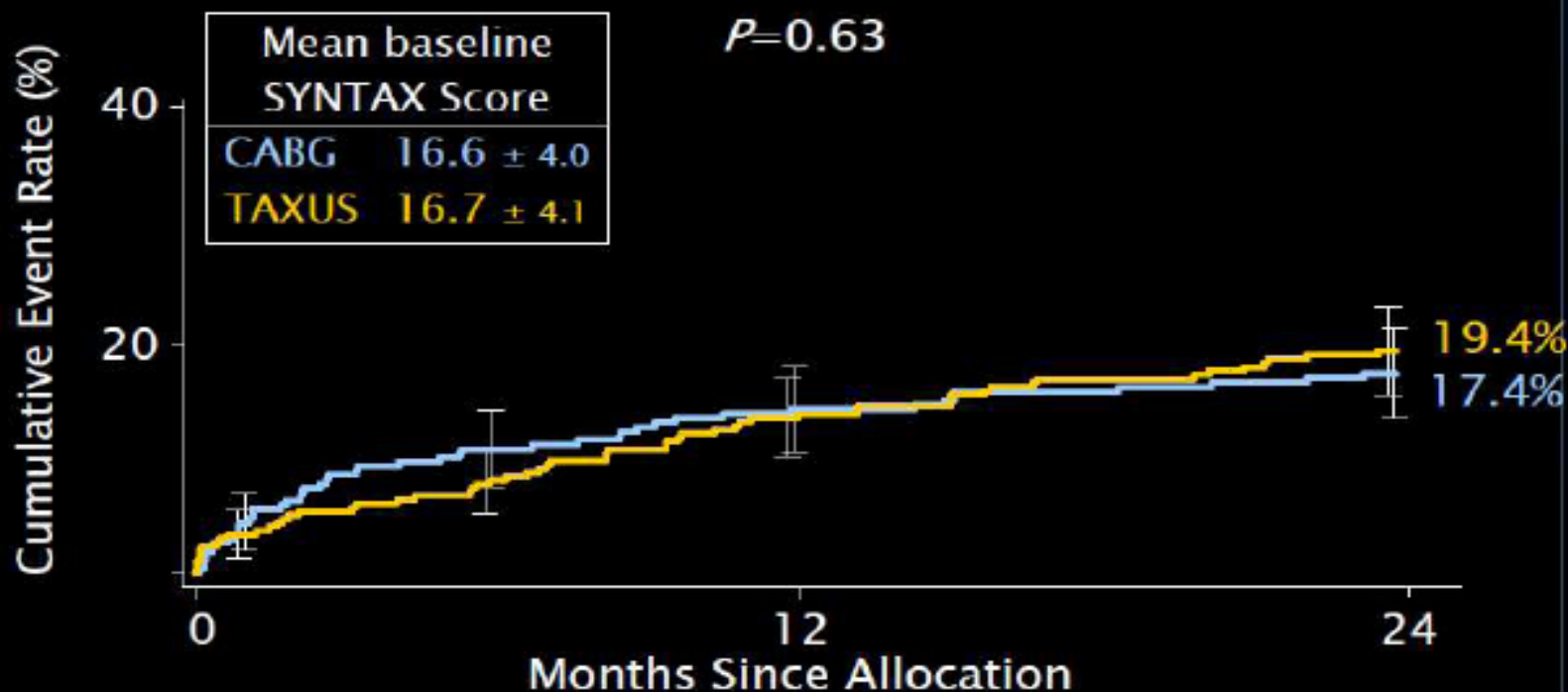
SYNTAX Study: Results (6)

MACCE to 2 Years by SYNTAX Score Tercile
Low Scores (0-22)

SYNTAX

■ CABG (N=275)

■ TAXUS (N=299)



Cumulative KM Event Rate \pm 1.5 SE; log-rank P value

Calculated by core laboratory; ITT population

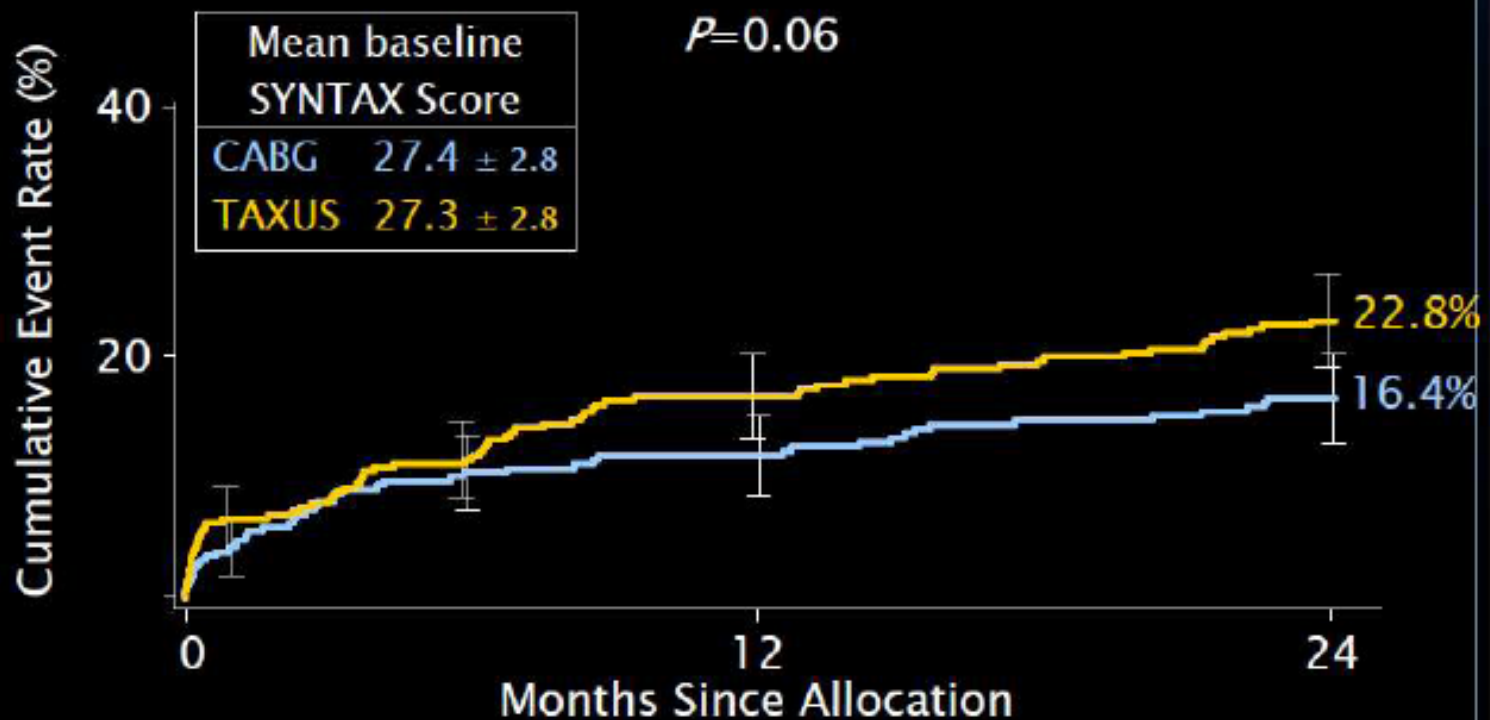
SYNTAX Study: Results (6)

MACCE to 2 Years by SYNTAX Score
Tercile
Intermediate Scores (23-32)

SYNTAX
CORONARY

■ CABG (N=300)

■ TAXUS (N=310)



Cumulative KM Event Rate ± 1.5 SE; log-rank P value

Calculated by core laboratory; ITT population

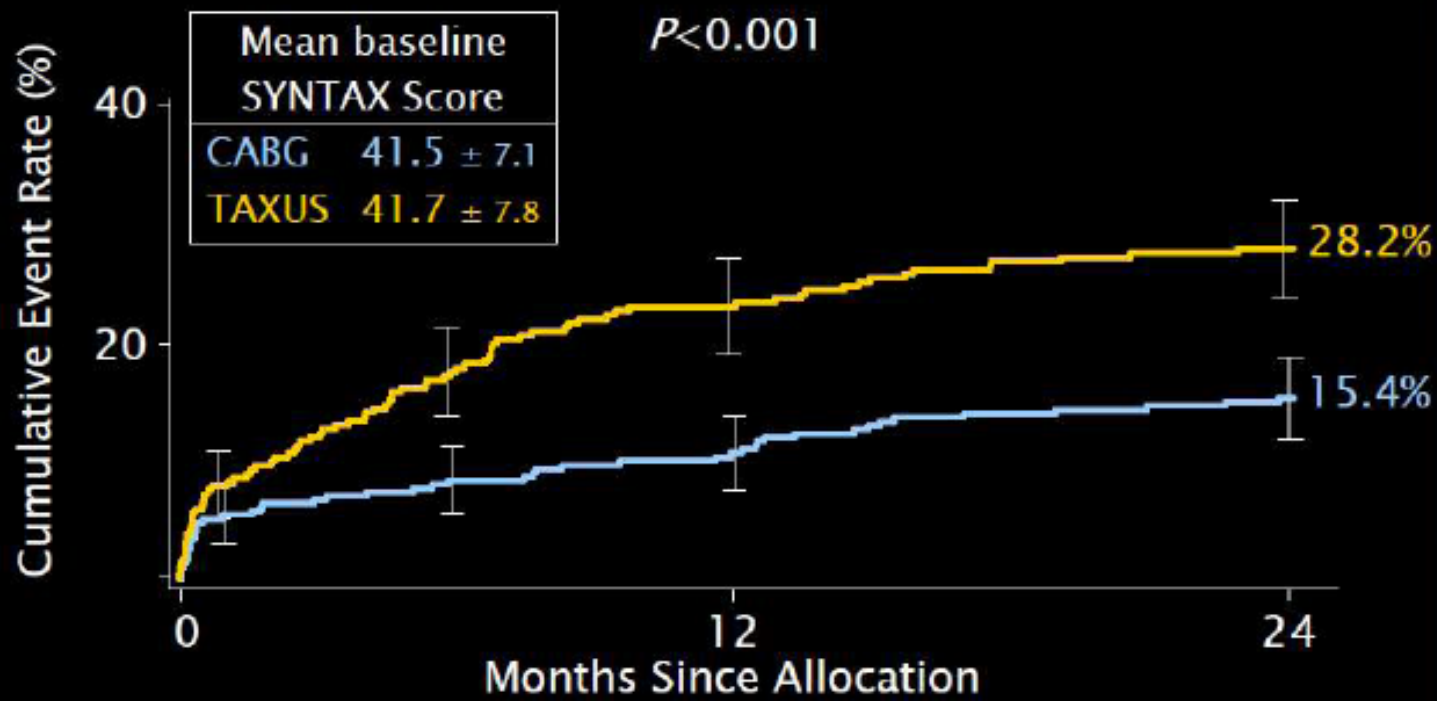
SYNTAX Study: Results (6)

MACCE to 2 Years by SYNTAX Score
Tercile
High Scores (≥ 33)

SYNTAX

CABG (N=315)

TAXUS (N=290)



Cumulative KM Event Rate \pm 1.5 SE; log-rank P value

Calculated by core laboratory; ITT population

Patient Profiling

SYNTAX

Local Heart team (surgeon & interventional cardiologist) assessed each patient in regards to :

- Patient's operative risk (EuroSCORE & Parsonnet score)
- Coronary lesion complexity (Newly developed SYNTAX score)
- Goal: SYNTAX score to provide guidance on optimal revascularization strategies for patients with high risk lesions



Sianos et al, EuroIntervention 2005;1:219-227
Valgimigli et al, Am J Cardiol 2007;99:1072-1081
Serruys et al, EuroIntervention 2007;3:450-459

BARI classification of coronary segments
Leaman score, Circ 1981;63:285-299
Lesions classification ACC/AHA, Circ 2001;103:3019-3041
Bifurcation classification, CCI 2000;49:274-283
CTO classification, J Am Coll Cardiol 1997;30:649-656

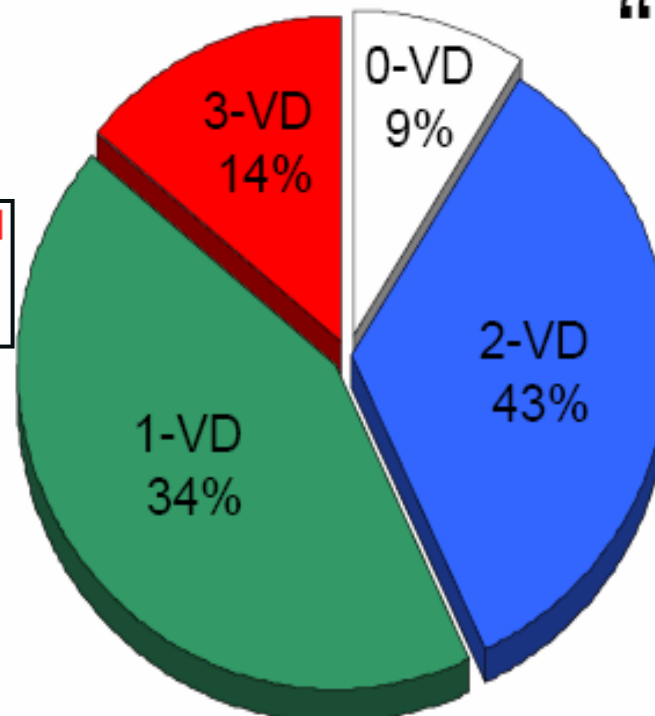
SYNTAX score:

- Score < 22, no difference PCI vs CABG
- Score 22-33, slight advantage for CABG
- Score > 33, surgical candidate

Angiography versus FFR in the FAME study

Proportions of functionally diseased coronary arteries in patients with angiographic 3 vessel disease

“3-VD”



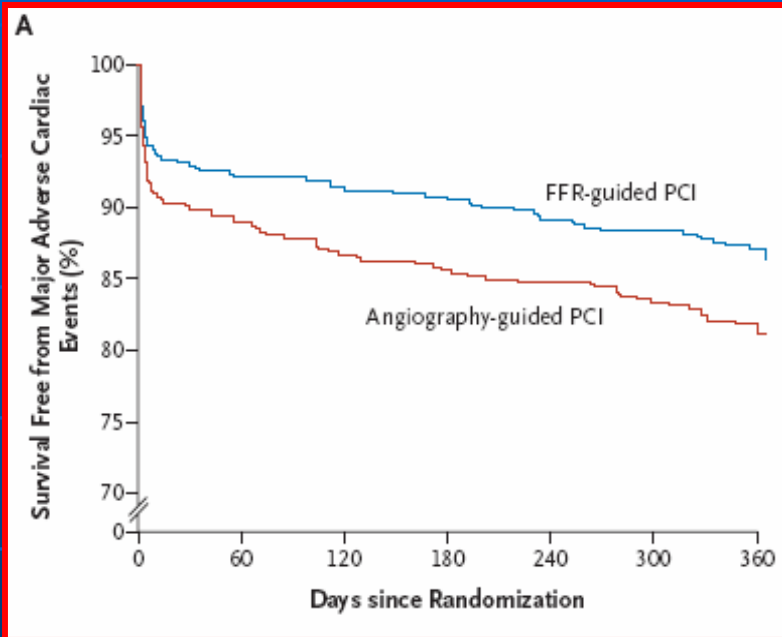
Only 1/513 or 0.2% of deferred lesions resulted in a late myocardial infarction

Only 10/513 or 1.9% of deferred lesions clearly progressed requiring repeat revascularization

Fractional Flow Reserve versus Angiography for Guiding Percutaneous Coronary Intervention

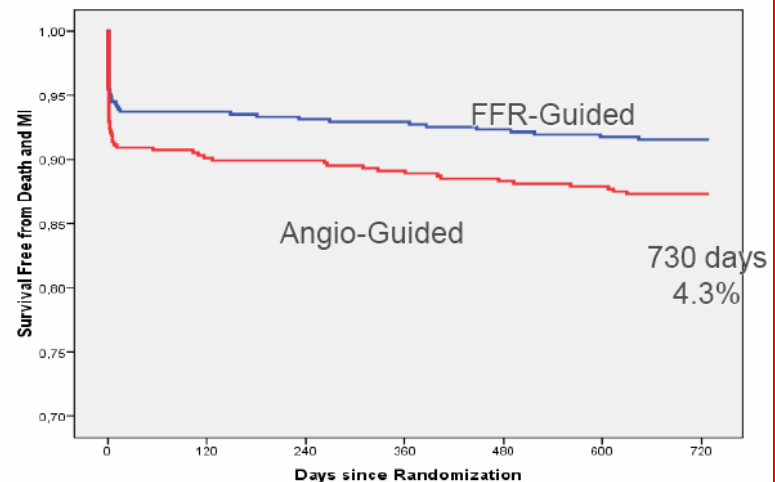
(FAME) study

1005 pt's



FAME Study: Results

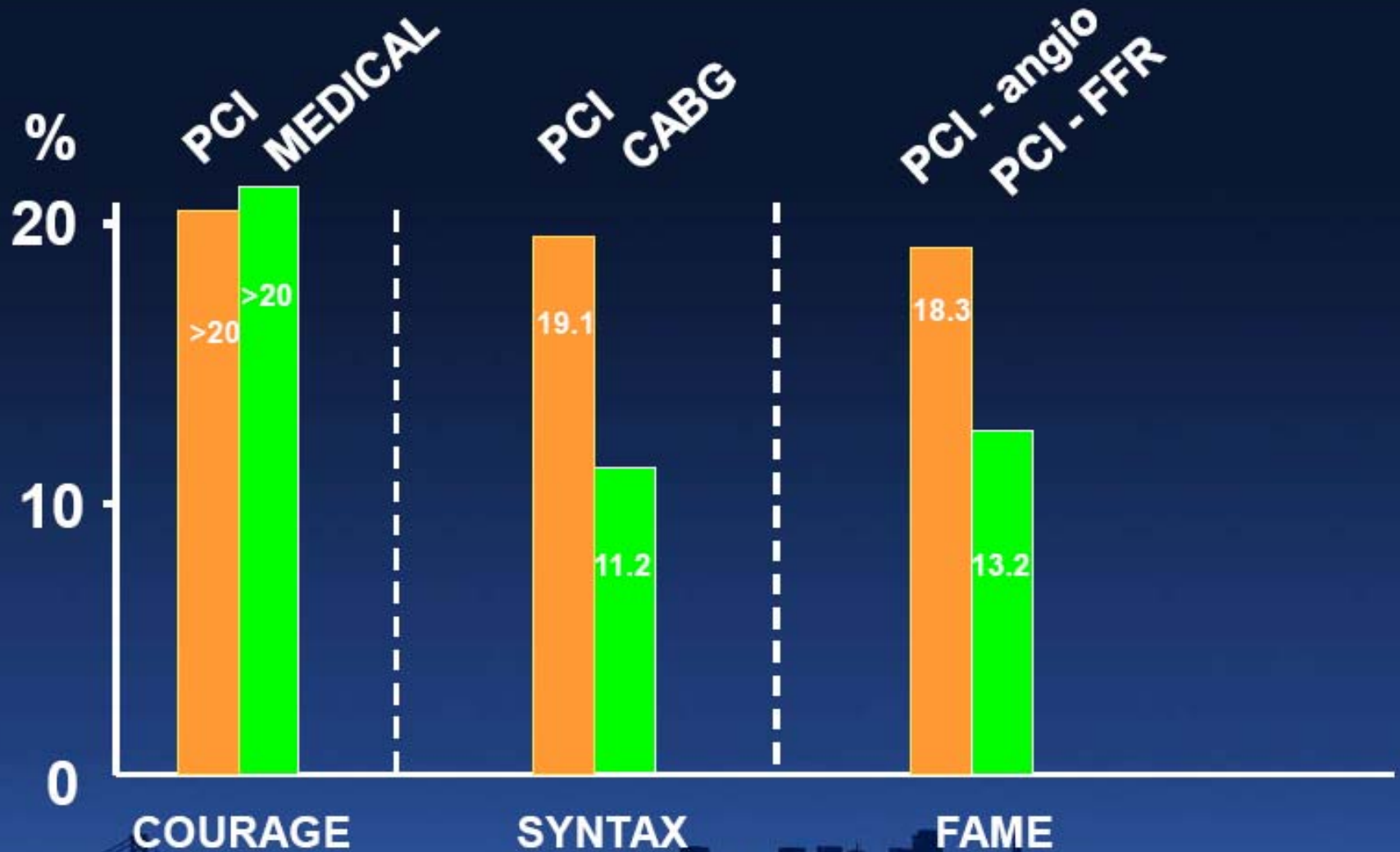
2-Year Survival-Free of Death / MI



CONCLUSIONS

Routine measurement of FFR in patients with multivessel coronary artery disease who are undergoing PCI with drug-eluting stents significantly reduces the rate of the composite end point of death, nonfatal myocardial infarction, and repeat revascularization at 1 year. (ClinicalTrials.gov number, NCT00267774.)

MACE in COURAGE, SYNTAX-3VD, and FAME STUDY





EUROPEAN
SOCIETY OF
CARDIOLOGY®

Guidelines on myocardial revascularization

The Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)

Eur. Heart J. [October 2, 2010](#)

ESC/EACTS GUIDELINES



Heart Team

- Heart Team - cardiac surgeon, and an interventional cardiologist.
- Myocardial revascularization should in general not be performed at the time of diagnostic angiography, thereby allowing the Heart Team sufficient time to assess all available information, reach a consensus, and clearly explain and discuss the findings with the patient.

6.7 Recommendations

Table 9 Indications for coronary artery bypass grafting vs. percutaneous coronary intervention in stable patients with lesions suitable for both procedures and low predicted surgical mortality

Subset of CAD by anatomy	Favours CABG	Favours PCI	Ref.
IVD or 2VD - non-proximal LAD	IIb C	I C	—
IVD or 2VD - proximal LAD	I A	IIa B	30, 31, 50, 51
3VD simple lesions, full functional revascularization achievable with PCI, SYNTAX score ≤ 22	I A	IIa B	4, 30–37, 53
3VD complex lesions, incomplete revascularization achievable with PCI, SYNTAX score > 22	I A	III A	4, 30–37, 53
Left main (isolated or IVD, ostium/shaft)	I A	IIa B	4, 54
Left main (isolated or IVD, distal bifurcation)	I A	IIb B	4, 54
Left main + 2VD or 3VD, SYNTAX score ≤ 32	I A	IIb B	4, 54
Left main + 2VD or 3VD, SYNTAX score ≥ 33	I A	III B	4, 54

<i>Class IIa</i>	<i>Weight of evidence/opinion is in favour of usefulness/efficacy.</i>
<i>Class IIb</i>	<i>Usefulness/efficacy is less well established by evidence/opinion.</i>

Table 26 Recommendations for patients with chronic heart failure and systolic left ventricular dysfunction (ejection fraction $\leq 35\%$), presenting predominantly with anginal symptoms

	Class ^a	Level ^b	Ref. ^c
CABG is recommended for: <ul style="list-style-type: none"> • significant LM stenosis • LM equivalent (proximal stenosis of both LAD and LCx) • proximal LAD stenosis with 2- or 3- vessel disease. 	I	B	158
CABG with SVR may be considered in patients with LVESV index ≥ 60 mL/m ² and scarred LAD territory.	IIb	B	159, 160
PCI may be considered if anatomy is suitable, in the presence of viable myocardium.	IIb	C	—

^aClass of recommendation.

^bLevel of evidence.

^cReferences.

CABG = coronary artery bypass grafting; LAD = left anterior descending; LCx = left circumflex; LM = left main; LVESV = left ventricular end-systolic volume; PCI = percutaneous coronary intervention; SVR = surgical ventricular reconstruction.

Table 27 Recommendations for patients with chronic heart failure and systolic left ventricular dysfunction (ejection fraction $\leq 35\%$), presenting predominantly with heart failure symptoms (no or mild angina: Canadian Cardiovascular Society 1–2)

	Class ^a	Level ^b	Ref. ^c
LV aneurysmectomy during CABG is indicated in patients with a large LV aneurysm.	I	C	—
CABG should be considered in the presence of viable myocardium, irrespective of LVESV.	IIa	B	16
CABG with SVR may be considered in patients with a scarred LAD territory.	IIb	B	159, 160
PCI may be considered if anatomy is suitable, in the presence of viable myocardium.	IIb	C	—
Revascularization in the absence of evidence of myocardial viability is not recommended.	III	B	16

^aClass of recommendation.

^bLevel of evidence.

^cReferences.

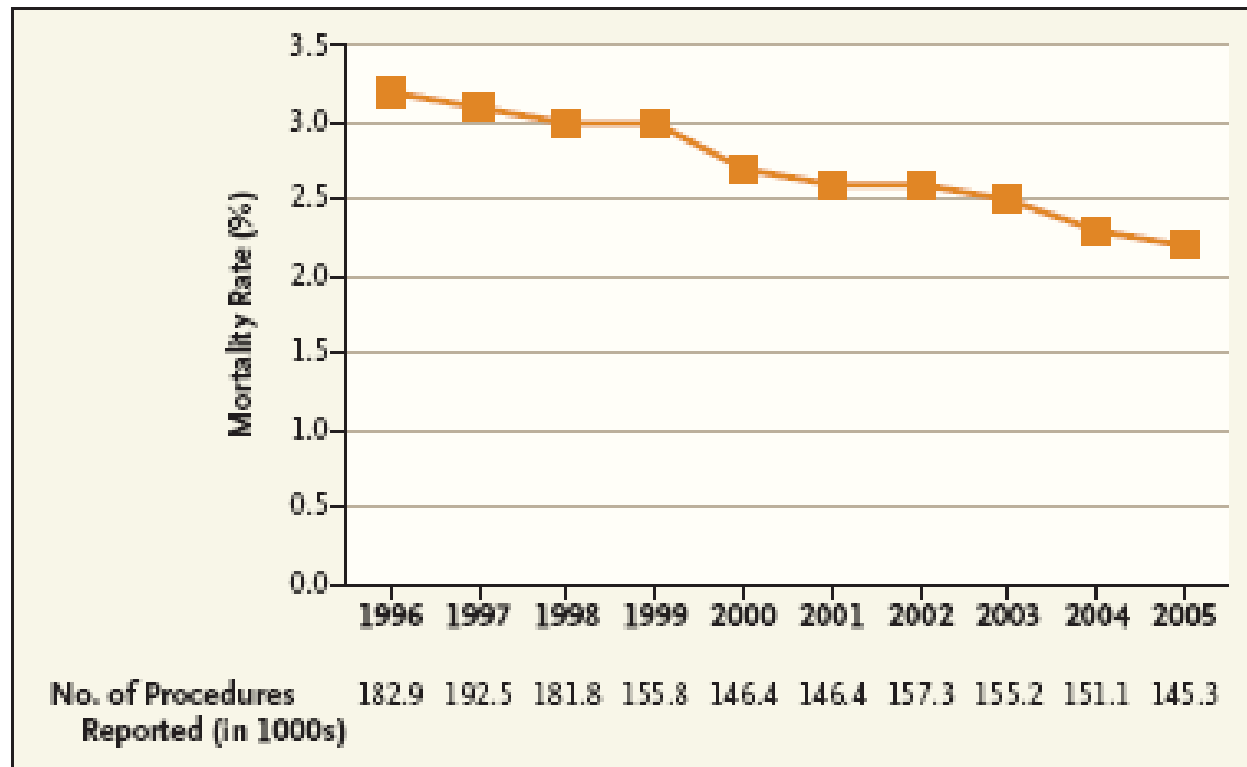
CABG = coronary artery bypass grafting; LAD = left anterior descending;

LV = left ventricle; LVESV = left ventricular end-systolic volume;

PCI = percutaneous coronary intervention; SVR = surgical ventricular reconstruction.

CABG

- CABG DEALS WITH THE 'CULPRIT' LESION AND ANY **FUTURE** CULPRIT LESION (because graft is to mid vessel) BUT PCI only deals with 'suitable' culprit lesion
- CABG – **COMPLETE** revascularization



Unadjusted Operative Mortality Associated with Coronary-Artery Bypass Grafting in the United States, 1996–2005.

Data are from the Society of Thoracic Surgeons' adult cardiac database, spring 2006 report (prepared by the Duke Clinical Research Institute). The database currently receives data from about three quarters of all U.S. sites that perform cardiac surgery; participation rates have varied in previous years. Operative mortality includes all deaths before hospital discharge, as well as deaths after discharge but within 30 days after the procedure, unless the cause was clearly unrelated. Patients undergoing repeat surgery are included; those also undergoing aortic or mitral valve replacement are excluded.

Table 2. Preoperative Estimation of Risk of Mortality, Cerebrovascular Accident, and Mediastinitis

For use only in isolated CABG surgery

Directions: Locate outcome of interest, e.g., mortality. Use the score in that column for each relevant preoperative variable; then sum these scores to get the total score. Take the total score and look up the approximate preoperative risk in the table on page 8.

Patient or Disease Characteristic	Mortality Score	CVA Score	Mediastinitis Score
Age 60–69	1.5	1.5	1
Age 70–79	2.5	2.5	1.5
Age ≥ 80	6.5	3	2
Female sex	2	1.5	
Obesity (BMI 31–36)			2
Severe Obesity (BMI ≥ 37)			4.5
Diabetes	1	1.5	1.5
COPD	2		2
PVD	1.5	1.5	
Dialysis	4	2	3
Creatinine ≥ 2	2	2	
MI ≤ 7 days	1.5		
Prior CABG	2.5		
LVEF < 40%	2	1.5	1.5
3-Vessel Disease	1.5		
LM 50–89%	1.5		
LM 90%	2		
WBC > 12K	2.5		
Urgent surgery	2	1.5	2
Emergency surgery	5	3.5	2
Total Score			

Table 2 continued

Preoperative Risk

Total Score	Mortality %	CVA %	Mediastinitis %
0	0.2	0.4	0.3
1	0.2		0.3
2	0.3	0.6	0.4
3	0.3	0.9	0.5
4	0.5	1.3	0.7
5	0.7	1.4	0.9
6	1.0	2.0	1.3
7	1.3	2.7	1.7
8	1.8	3.4	2.5
9	2.3	4.2	3.2
10	3.0	5.9	4.2
11	4.0	7.6	5.6
12	5.3	≥ 10.0	≥ 7.3
13	6.9		
14	8.8		
15	11.5		
16	14.1		
17	18.7		
18	≤ 23.0		

Report Overview – Risk Adjustment Supplement STS Spring 2007 Report

Table 4. Predicted Risk Percentage Distribution – 2006 Isolated CABG

<i>Predicted risk percentage</i>	25 th percentile	50 th percentile	75 th percentile
Mortality	0.8%	1.4%	2.7%
Renal Failure	1.6%	2.7%	4.7%
Reoperation	3.6%	4.7%	6.6%
Deep Sternal Wound Infection	0.4%	0.6%	0.9%
Prolonged ventilation	2.7%	4.3%	7.5%
Permanent stroke	0.7%	1.3%	2.3%
Morbidity or mortality	7.6%	11.3%	17.7%
Short length of stay	37.8%	51.6%	64.6%
Long length of stay	2.2%	3.8%	6.6%

What Constitutes Optimal Surgical Revascularization?

Answers From the Bypass Angioplasty Revascularization Investigation (BARI)

Thomas J. Vander Salm, MD, FACC,* Kevin E. Kip, PhD,† Robert H. Jones, MD, FACC,‡
Hartzell V. Schaff, MD, FACC,§ Richard J. Shemin, MD, FACC,|| Gabriel S. Aldea, MD, FACC,¶
Katherine M. Detre, MD, DRPH, FACC†

J. Am. Coll. Cardiol. 2002;39:565-572

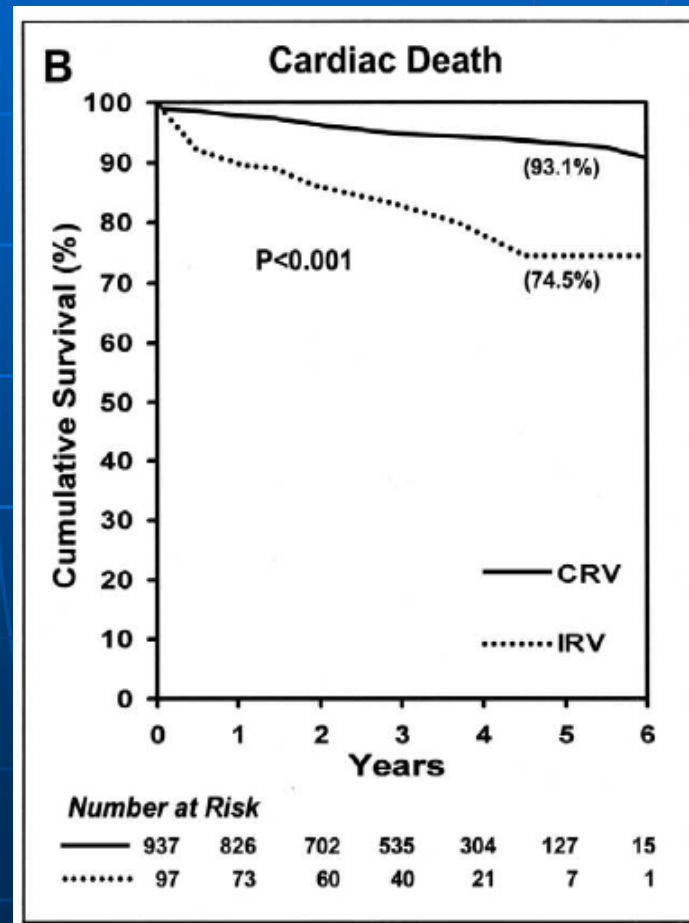
■ Controversial

- **Definition 1:** “Traditional” revascularization was defined as all diseased arterial systems receiving at least one graft insertion.
- **Definition 2:** “Functional” revascularization was defined as bypassing all diseased “primary” coronary segments (LAD, LCX, RCA)

Nondiseased vessel : <1.5 mm in diameter
regardless of the degree of stenosis, or with a stenosis of <50%.

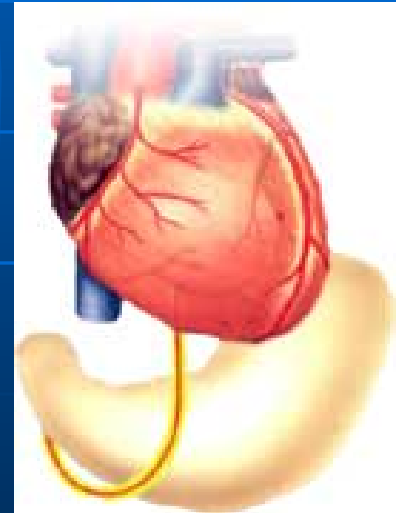
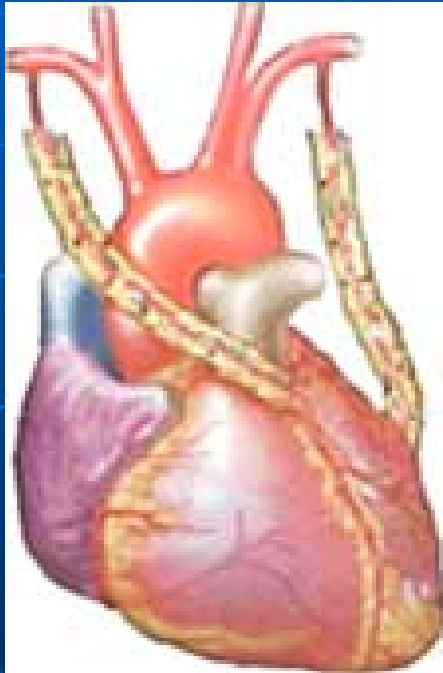
In the current era, complete revascularization improves survival after coronary artery bypass surgery

Thomas Kleisli, BS, Wen Cheng, MD, Milagros J. Jacobs, MPH, James Mirocha, MS, Michele A. DeRobertis, RN, Robert M. Kass, MD, Carlos Blanche, MD, Gregory P. Fontana, MD, Sharo S. Raissi, MD, Kathy E. Magliato, MD, and Alfredo Trento, MD



1034pt's

Arterial Revascularization



Effect of LIMA

- SVG compared to LIMA to LAD:
 - X 1.61 risk of death in 10 y
 - X 1.41 risk of late MI
 - X 2.00 risk of re-operation

Loop et al, N Engl J Medicine 1986

LIMA + RIMA

- Resistance to atherosclerosis.
- Production of vasodilators nitric oxide and prostacyclin - "downstream" effect
- Response to : vasodilators (milrinone + nitroglycerin)
- No Response to Norepinephrine.
- Remodeling - adapting to demand

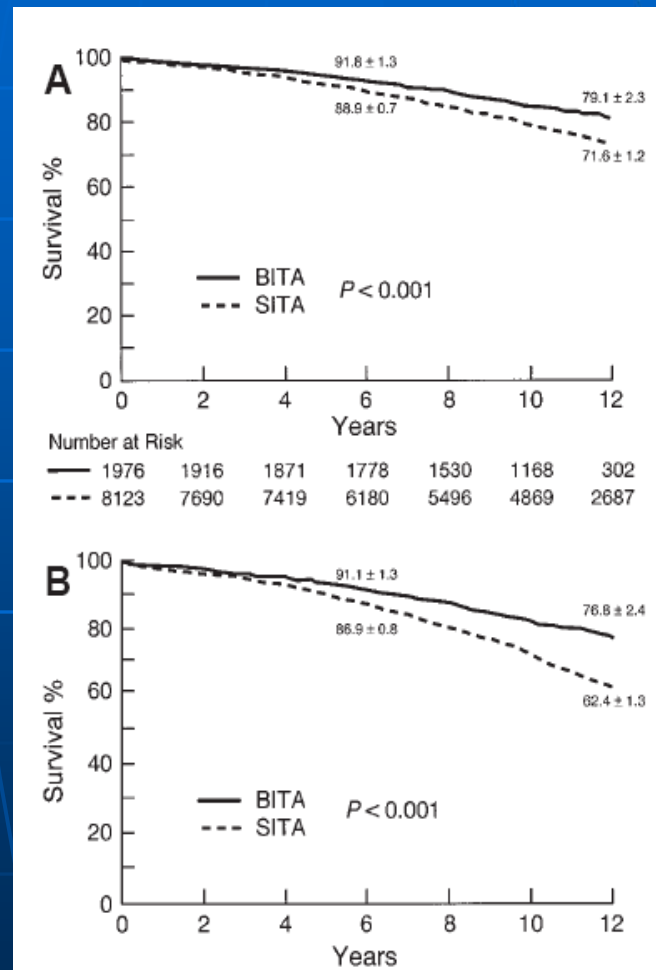
Effect of Bilateral IMA

- 10 y outcomes:
 - 76% survival compared with 85% with bilateral IMA
 - *Pick et al Ann Thoracic Surg 1997*
- 20 y outcomes:
 - Bilat IMA had improved survival and reduced re-interventions
 - Lytle et al, Ann Thorac Surg 2004

TWO INTERNAL THORACIC ARTERY GRAFTS ARE BETTER THAN ONE

Bruce W. Lytle, Eugene H. Blackstone, Floyd D. Loop, Penny L. Houghtaling, John H. Arnold, Rami Akhrass, Patrick M. McCarthy and Delos M. Cosgrove

J Thorac Cardiovasc Surg 1999;117:855-872

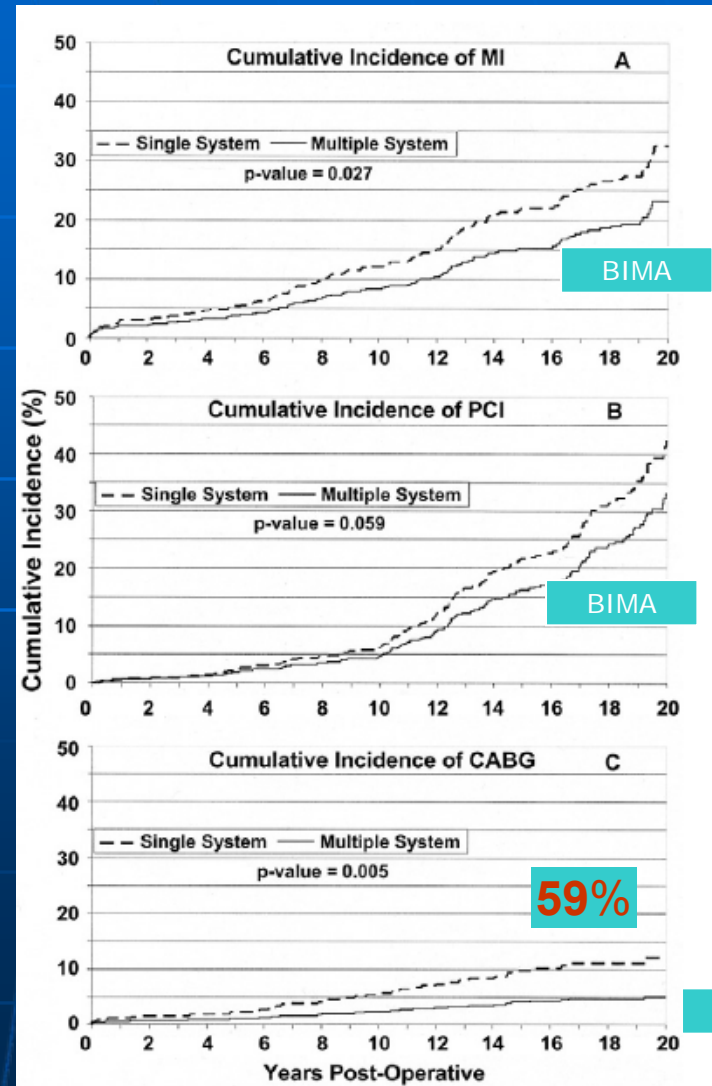
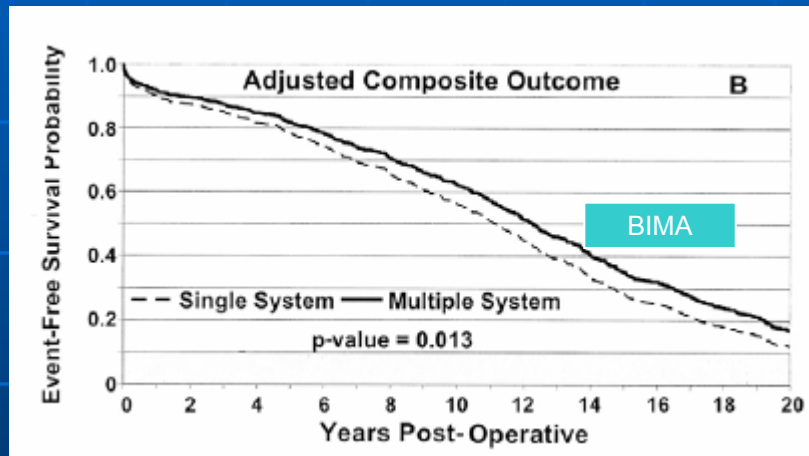


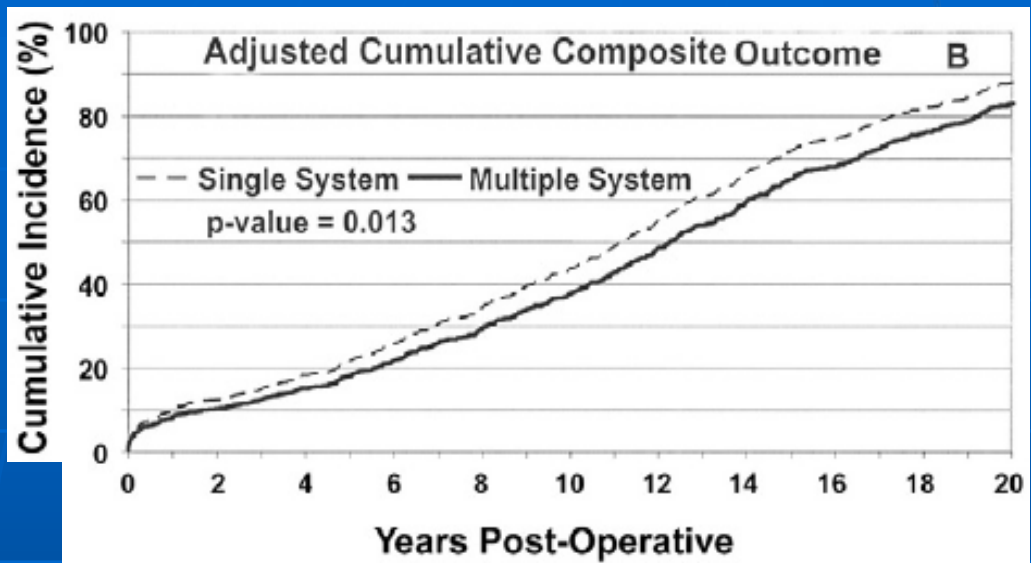
Comparison of the bilateral ITA (*BITA*) and single ITA (*SITA*) groups in terms of survival (**A**) and reoperation-free survival (**B**).

Techniques and Benefits of Multiple Internal Mammary Artery Bypass at 20 Years of Follow-Up

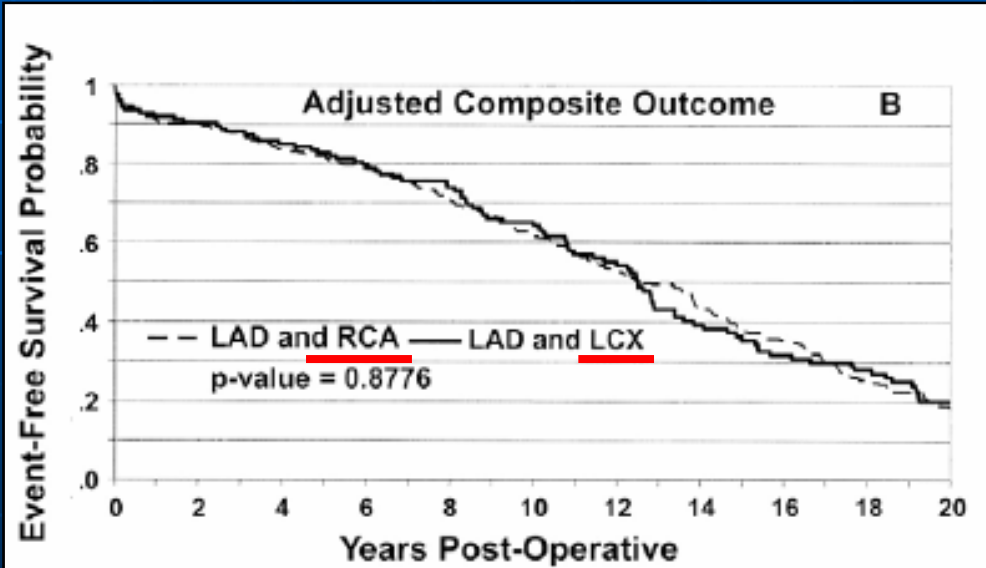
(Ann Thorac Surg 2007;83:1008–15)

- Single (SIMA) IMA grafts were used in **490**
- Multiple (MIMA) IMA grafts in **377**, along with concomitant saphenous veins.



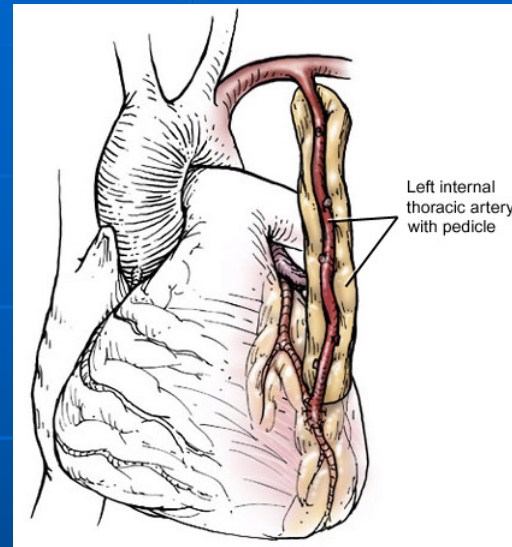
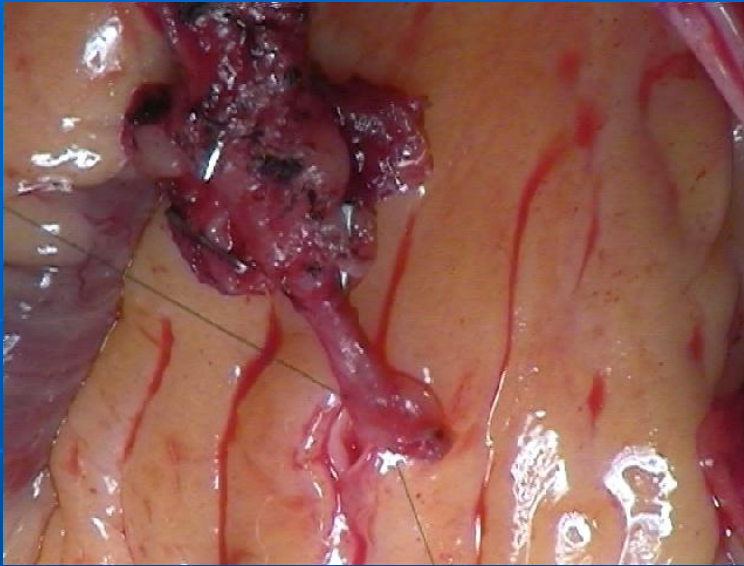


One year gained

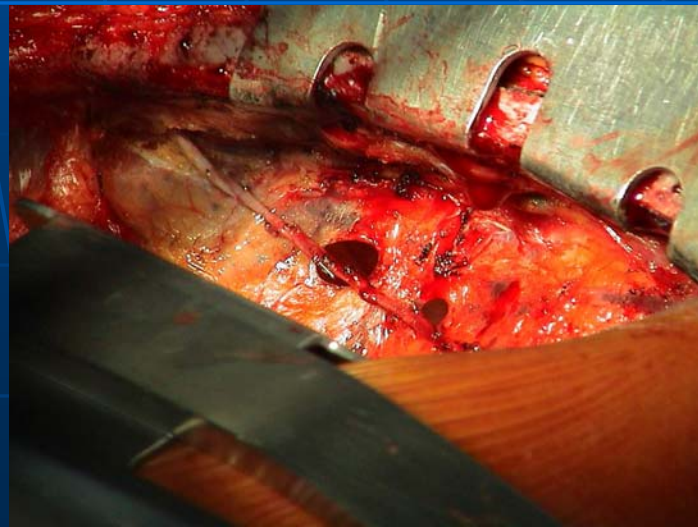


(Ann Thorac Surg 2007;83:1008-15)

Pediced



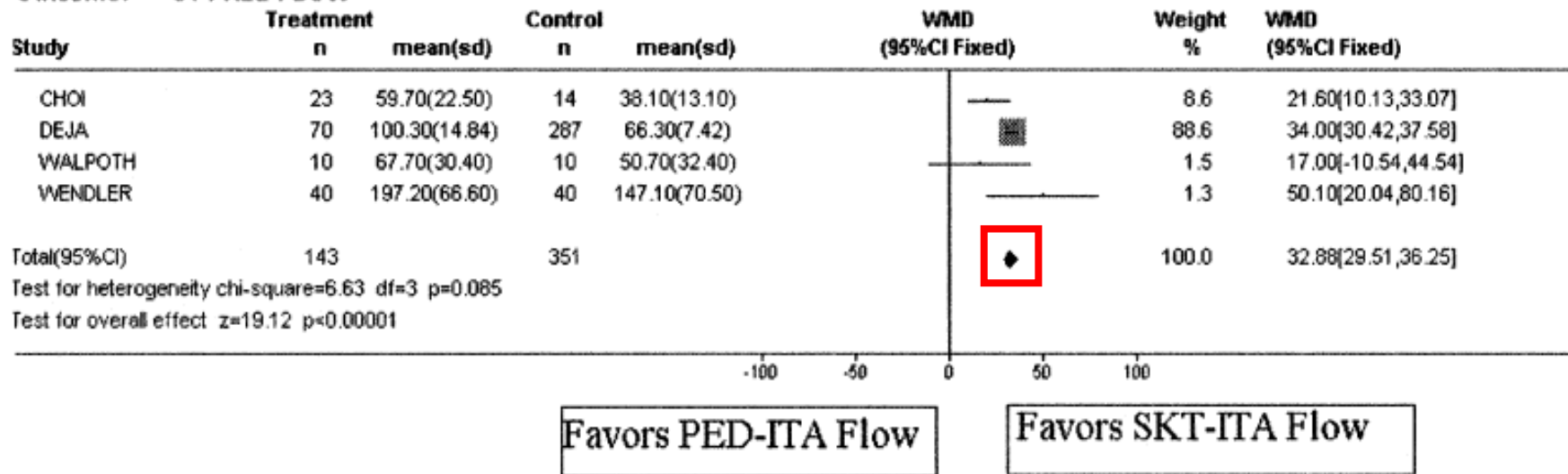
Skeletonized



Should the Internal Thoracic Artery Be Skeletonized?

Comparison: 01 SKELETONIZED VERSUS PEDICLED

Outcome: 01 FREE FLOW

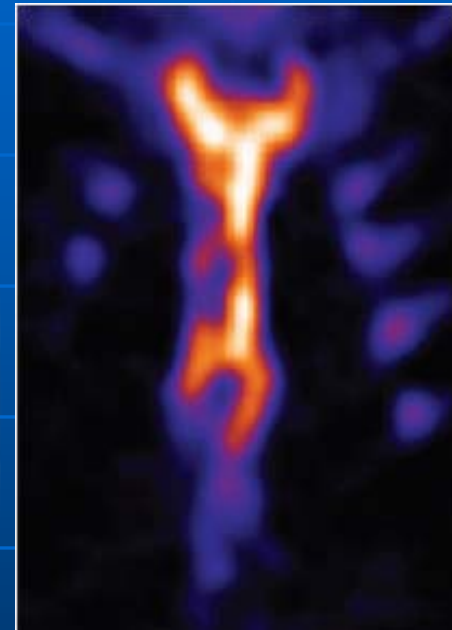
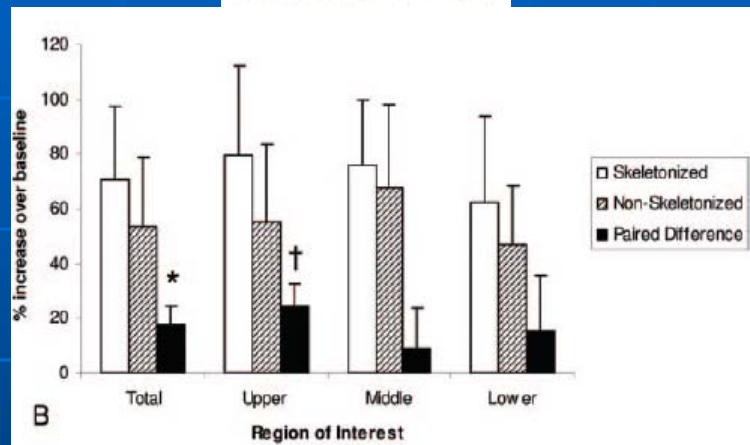


Flow of ITA harvested as pedicled or skeletonized conduit.

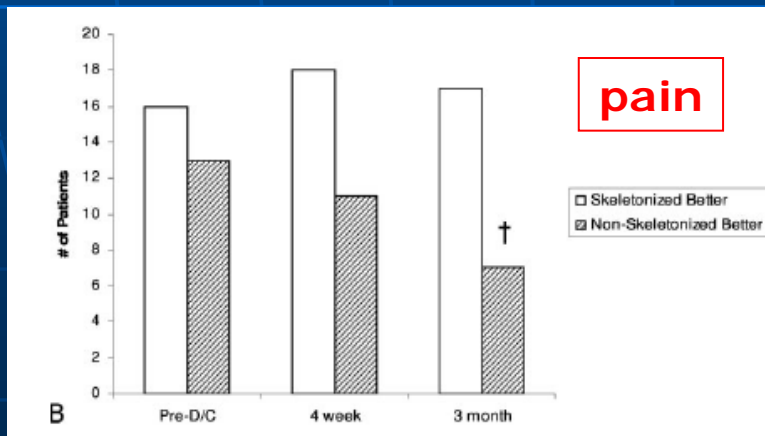
Skeletonized Internal Thoracic Artery Harvest Reduces Pain and Dysesthesia and Improves Sternal Perfusion After Coronary Artery Bypass Surgery

A Randomized, Double-Blind, Within-Patient Comparison

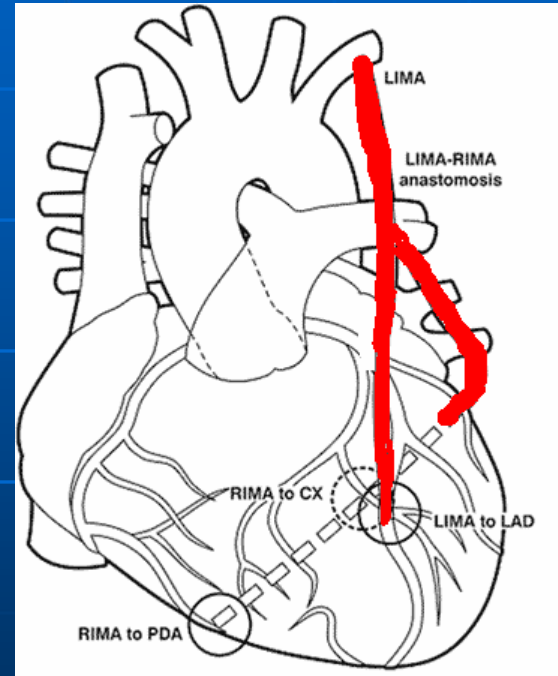
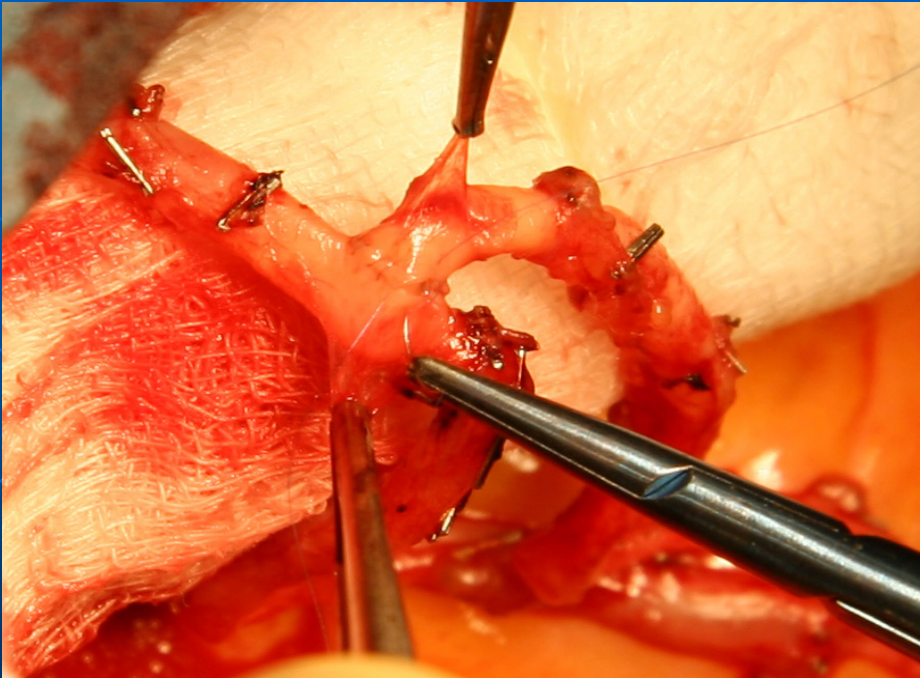
Sternal Perfusion



Lt skeletonized and a Rt nonskeletonized



T garft



Adequacy of Flow Capacity of Bilateral Internal Thoracic Artery T Graft

Masami Ochi, MD, Nobuo Hatori, MD, Ryuzo Bessho, MD, Masahiro Fujii, MD, Yoshiaki Saji, MD, Shigeo Tanaka, MD, and Hiroshi Honma, MD

- 40 pt's
- 6 months - angiography

Table 2. Angiographic Findings of the Lumen of Each Segment of the T Graft

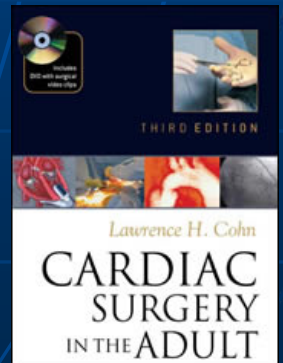
	Luminal Narrowing			
	Normal	Mild-		
		Moderate	Stringlike	Occlusion
LITA				
Main stem	40			
Distal	37	3	0	0
RITA				
Proximal	40			
Distal	35	4	1	0
T-Anastomosis	39	1	0	0

Table 1. Destination of ITA and Other Grafts

Coronary Artery	LITA	RITA	GEA (n = 16)	RA (n = 5)	SVG (n = 12)
LAD	40				
Diagonal	16	12			
IM		11			
OM		30			
PL		22			
RCA			19	5	14
Sequential graft	16	26	3	0	2

Radial artery :

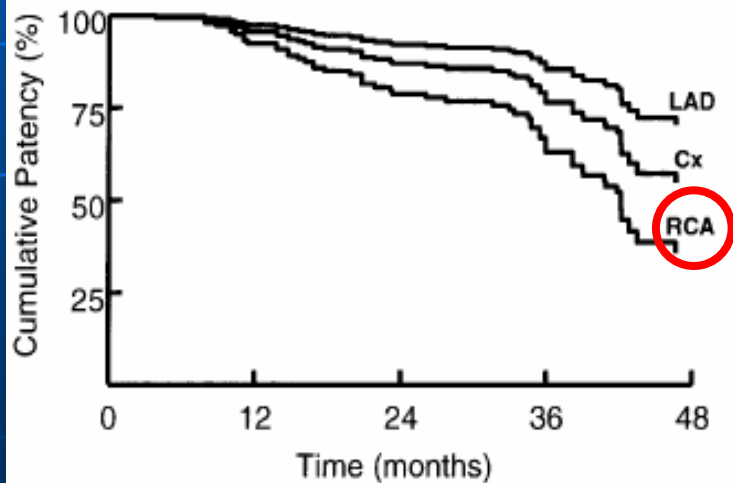
- 5-year patency : 83 - 95%
- Very susceptible to competitive flow.
- The graft failure rate is higher if :
 1. The target vessel stenosis is less than severe
 2. On the right coronary system.



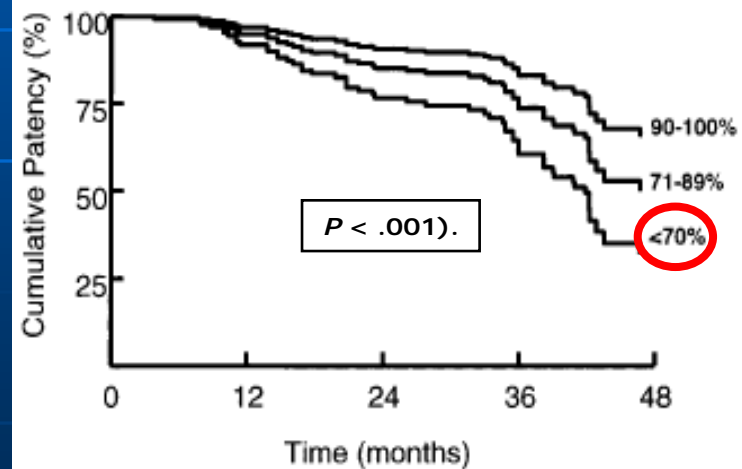
Effect of target stenosis and location on radial artery graft patency

- 231 radial artery anastomoses
- Angiography -109 patients
- Mean 27.1 mo postOP for symptoms of ischemia

Cumulative patency for RA anastomotic locations.



Cumulative RA patency associated with proximal target stenosis:



The relative risks for the targets of the RCA were statistically significant versus those of the LAD ($P = .01$) and bordered on significance versus those of the circumflex artery

Bilateral Radial Artery Grafts in Coronary Reconstruction: Technique and Early Results in 261 Patients

James Tatoulis, FRACS, Brian F. Buxton, FRACS, and John A. Fuller, FRACP
Departments of Cardiac Surgery, Royal Melbourne and Epworth Hospitals, University of Melbourne, Victoria, Australia

Conclusions. Bilateral RA to coronary grafting extends the scope of arterial myocardial revascularization, and is safe. Late angiographic results are required.

(Ann Thorac Surg 1998;66:714–20)

Impact of Radial Artery Cannulation for Coronary Angiography and Angioplasty on Radial Artery Function

Jason M. Burstein, MD^a, Dominica Gidrewicz, MSc^b, Stuart J. Hutchison, MD^{b,c},
Kate Holmes, RVT^c, Sanjit Jolly, MD^c, and Warren J. Cantor, MD^{b,d,*}

This study has important implications for cardiologists performing transradial procedures and for the selection of conduits by cardiac surgeons. For patients who are likely to require bypass surgery using a radial conduit, it may be prudent to avoid radial access for coronary angiography.

(Am J Cardiol 2007;99:457–459)

Gastroepiploic

LATE ANGIOGRAPHIC RESULT OF USING THE RIGHT GASTROEPIPLOIC ARTERY AS A GRAFT

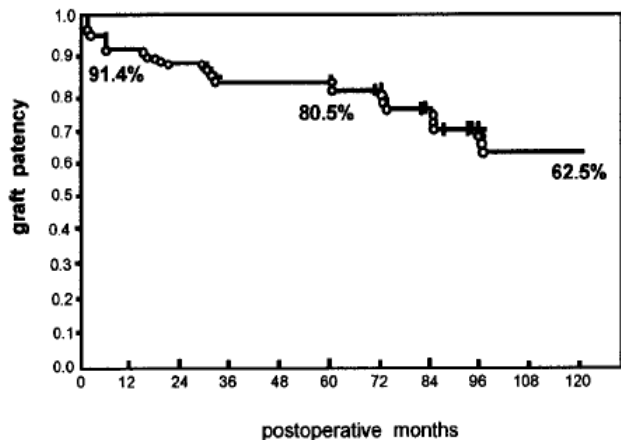


Fig 1. The 10-year cumulative patency rate of the right GEA graft estimated by the Kaplan-Meier method.

J Thorac Cardiovasc Surg 120:496-498;2000

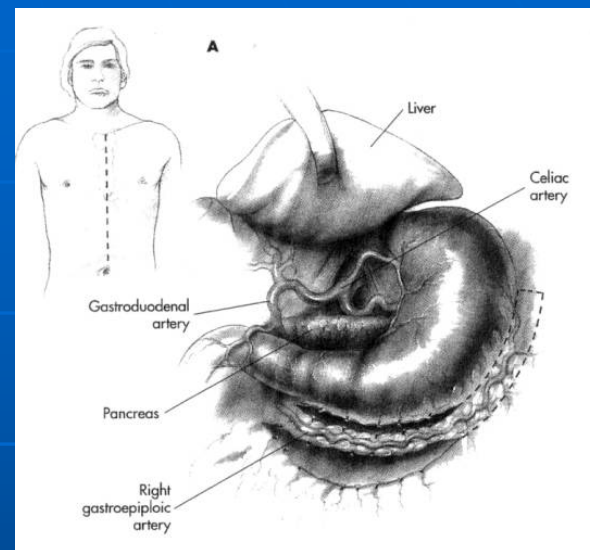


Table 1. Early, Mid- and Long-Term Postoperative Gastroepiploic Artery Patency Rate

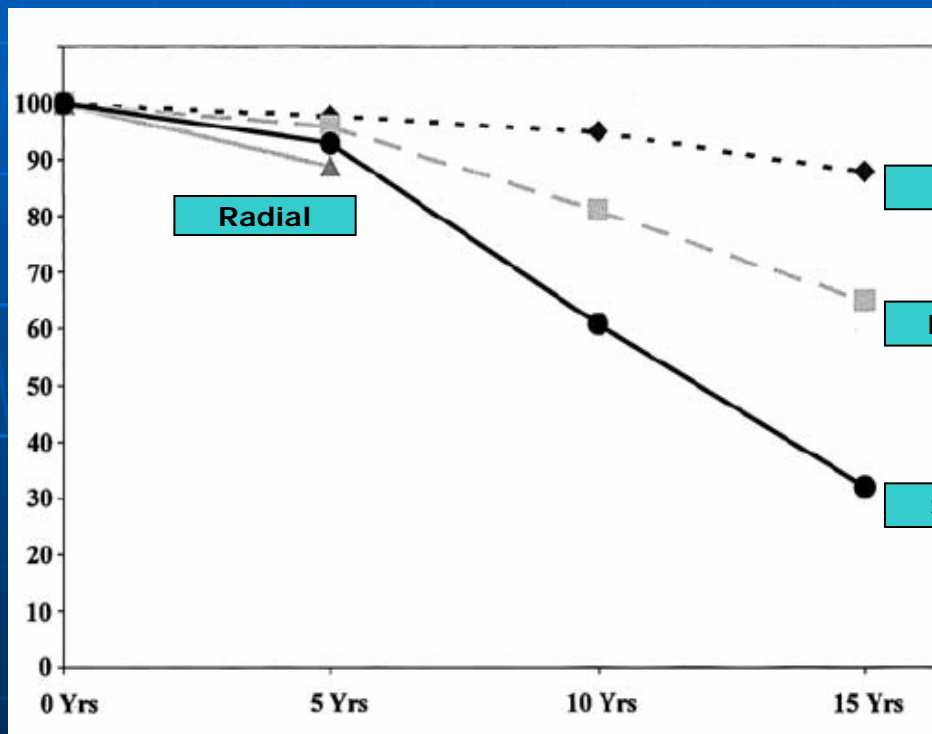
Anastomosed Method (average of follow up duration)	Sequence	Early Result (n = 67)	Mid- and Long-Term Result (n = 49)
GEA-LAD (102 months)		94.1% (16/17)	57.1% (8/14)
GEA-LAD-Dx (126 months)	GEA-LAD	100% (8/8)	66.7% (2/3)
	LAD-Dx	100% (8/8)	66.7% (2/3)
GEA-RCA-LAD (96 months)	GEA-RCA	100% (3/3)	100% (1/1)
	RCA-LAD	33.3% (1/3)	0% (0/1)
GEA-Cx (98 months)		100% (14/14)	91.7% (11/12)
GEA-Cx-Cx (101 months)	GEA-Cx	100% (4/4)	100% (3/3)
	Cx-Cx	75% (3/4)	66.7% (2/3)
GEA-RCA-Cx (108 months)	GEA-RCA	100% (21/21)	87.5% (14/16)
	RCA-Cx	80.9% (17/21)	71.4% (10/14)
GEA-RCA only in the same duration (112 months)		98.1% (155/158)	93.8% (120/128)

Cx = circumflex artery; Dx = diagonal branch; GEA = gastroepiploic artery; LAD = left anterior descending coronary artery; RCA = right coronary artery.

Patencies of 2,127 Arterial to Coronary Conduits Over 15 Years

James Tatoulis, FRACS, Brian F. Buxton, FRACS, and John A. Fuller, FRACP

Royal Melbourne Hospital and Epworth Hospital, University of Melbourne, Melbourne, Victoria, Australia



At 10 ; 15 yrs
LITA - 95 and 88%
SVG - 61 and 32%

Contemporary Coronary Graft Patency: 5-Year Observational Data From a Randomized Trial of Conduits

Philip A. R. Hayward, FRCS, and Brian F. Buxton, FRACS

Department of Cardiac Surgery, Austin Hospital, Heidelberg, Melbourne, Australia

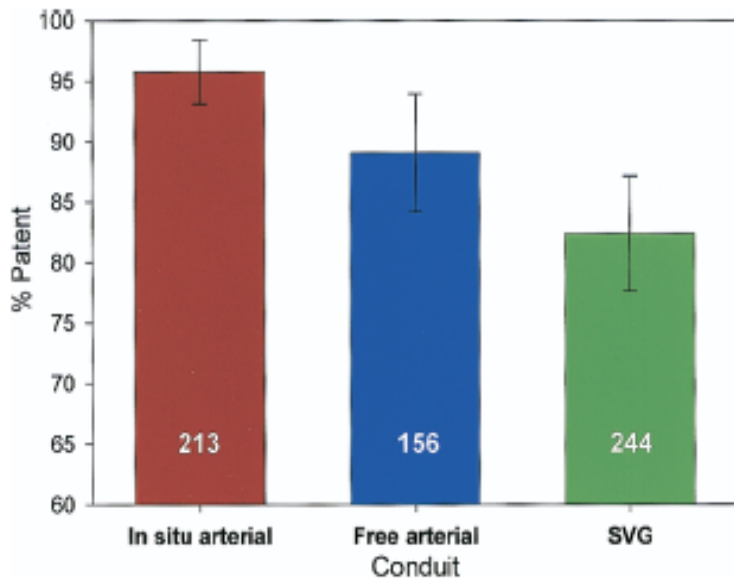


Fig 1. Five-year patency of three subgroups of conduits. Fisher's exact test: in situ versus free arterial, $p = 0.02$; in situ versus saphenous vein graft (SVG), $p < 0.0001$; and free arterial versus SVG, $p = 0.08$.

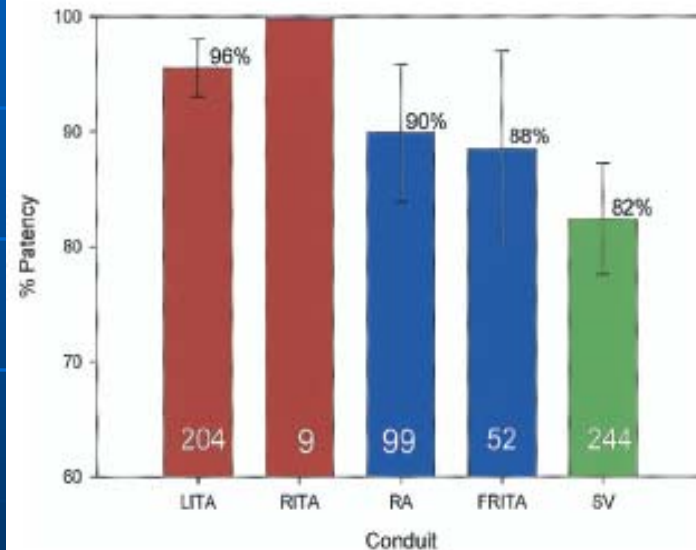
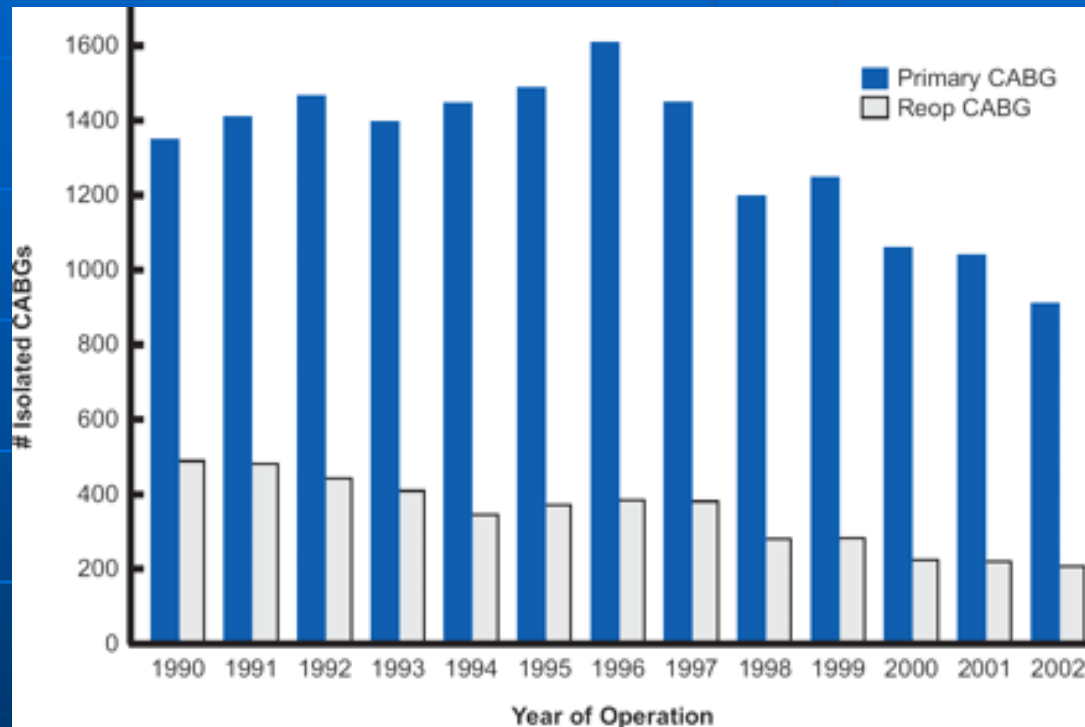


Fig 3. Comparative patencies of different in situ and free arterial conduits at 5 years. Fisher's exact test: left internal thoracic artery (LITA) versus right internal thoracic artery (RITA), $p = 0.7$; and radial artery (RA) versus free right ITA (FRITA), $p = 0.5$. (SV = saphenous vein.)

Coronary Artery Reoperations



21,568 pt's who underwent bypass surgery from **1990 - 2003** showed a steady decrease in the number of patients undergoing redo coronary artery operations .

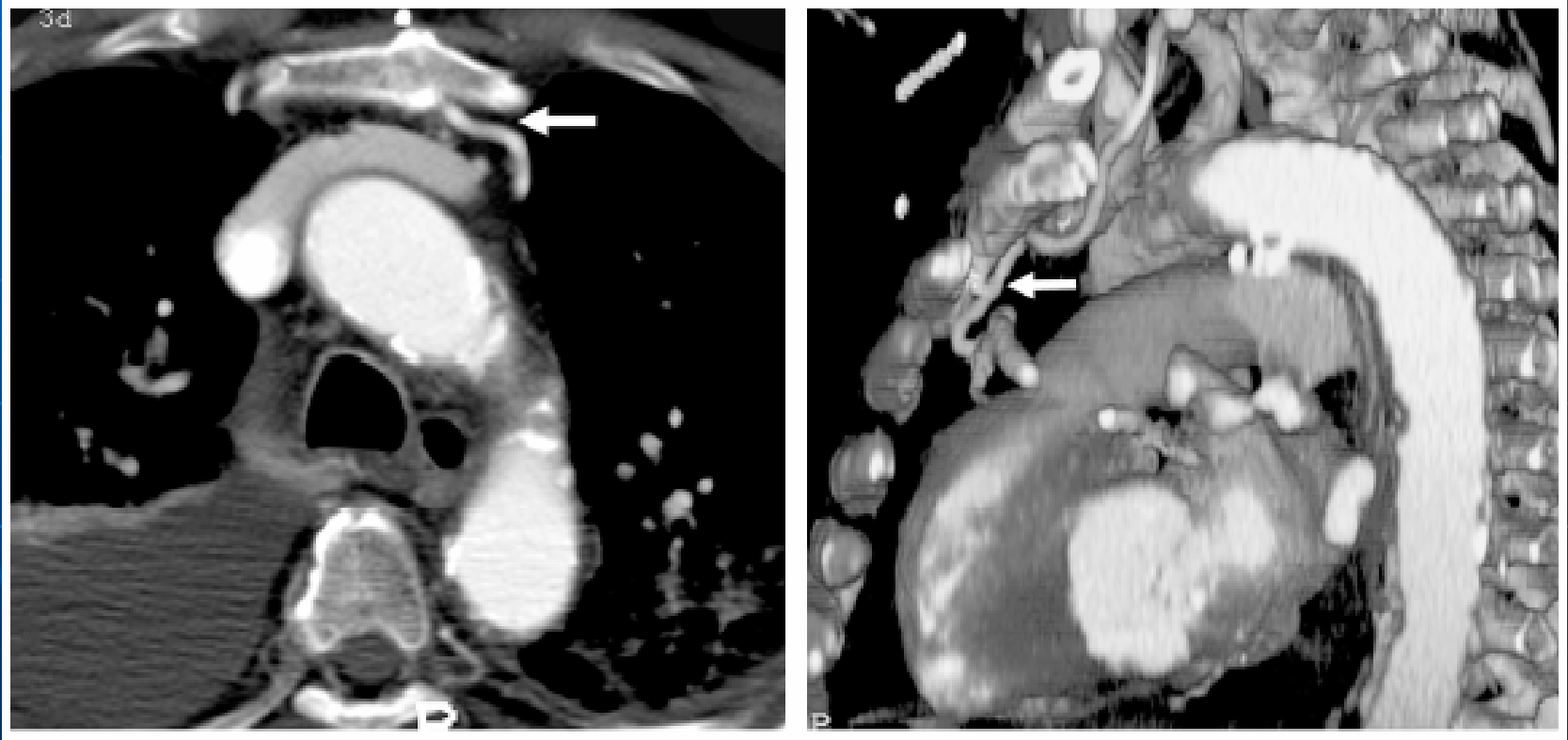
RESULTS OF CORONARY ARTERY REOPERATIONS

- STS database - in-hospital mortality rate of 6.95% (1991–1993).
- Recent mortality rates from other large series range from 4.2 to 11.4% , most being around 7%.



2-5 times higher than the risk of primary CABG.

CORONARY ARTERY REOPERATIONS



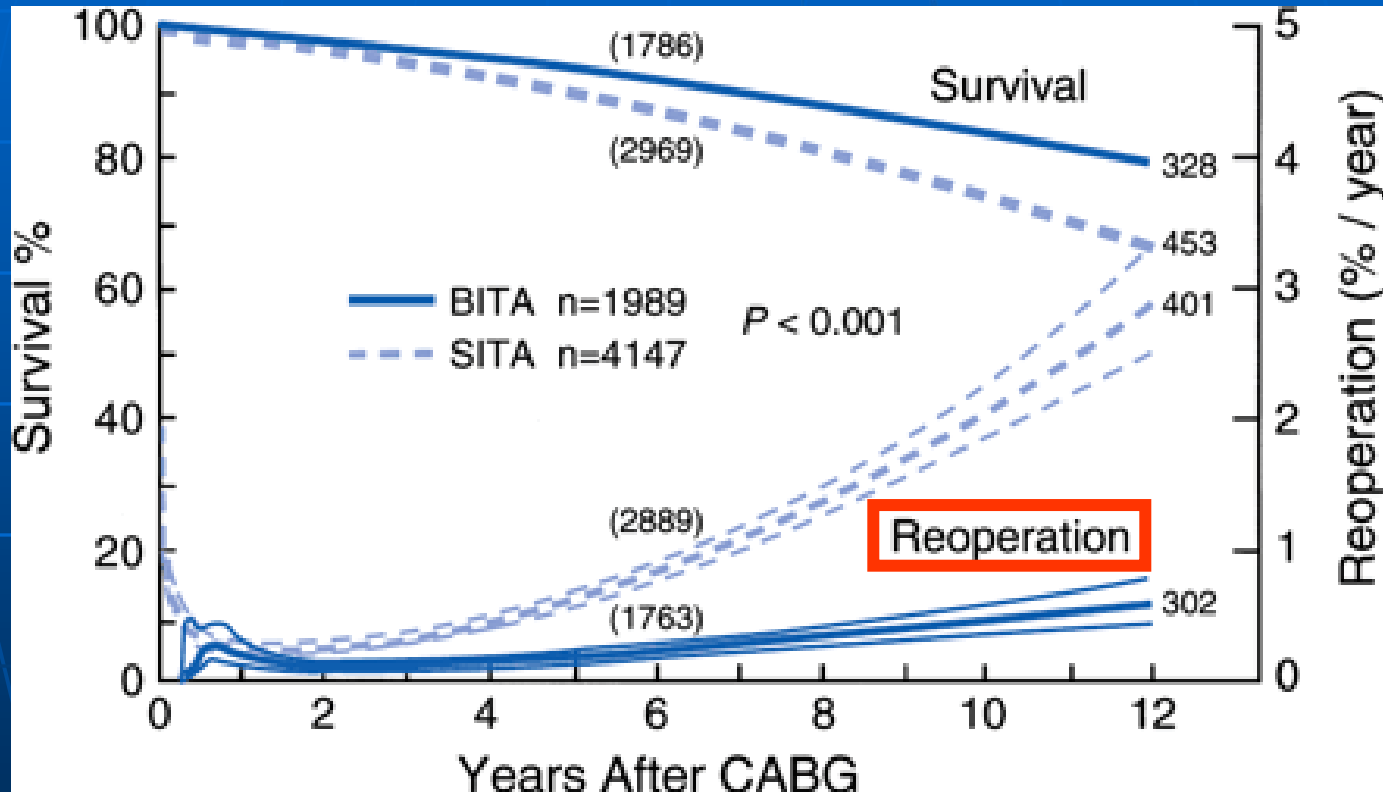
[Axial CT image :](#)

Preoperative assessment for aortic valve replacement in a 67-year-old man who had undergone CABG.

TWO INTERNAL THORACIC ARTERY GRAFTS ARE BETTER THAN ONE

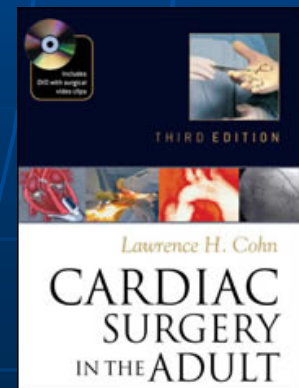
Bruce W. Lytle, Eugene H. Blackstone, Floyd D. Loop, Penny L. Houghtaling, John H. Arnold, Rami Akhrass, Patrick M. McCarthy and Delos M. Cosgrove

J Thorac Cardiovasc Surg 1999;117:855-872



Factors favoring PTCA

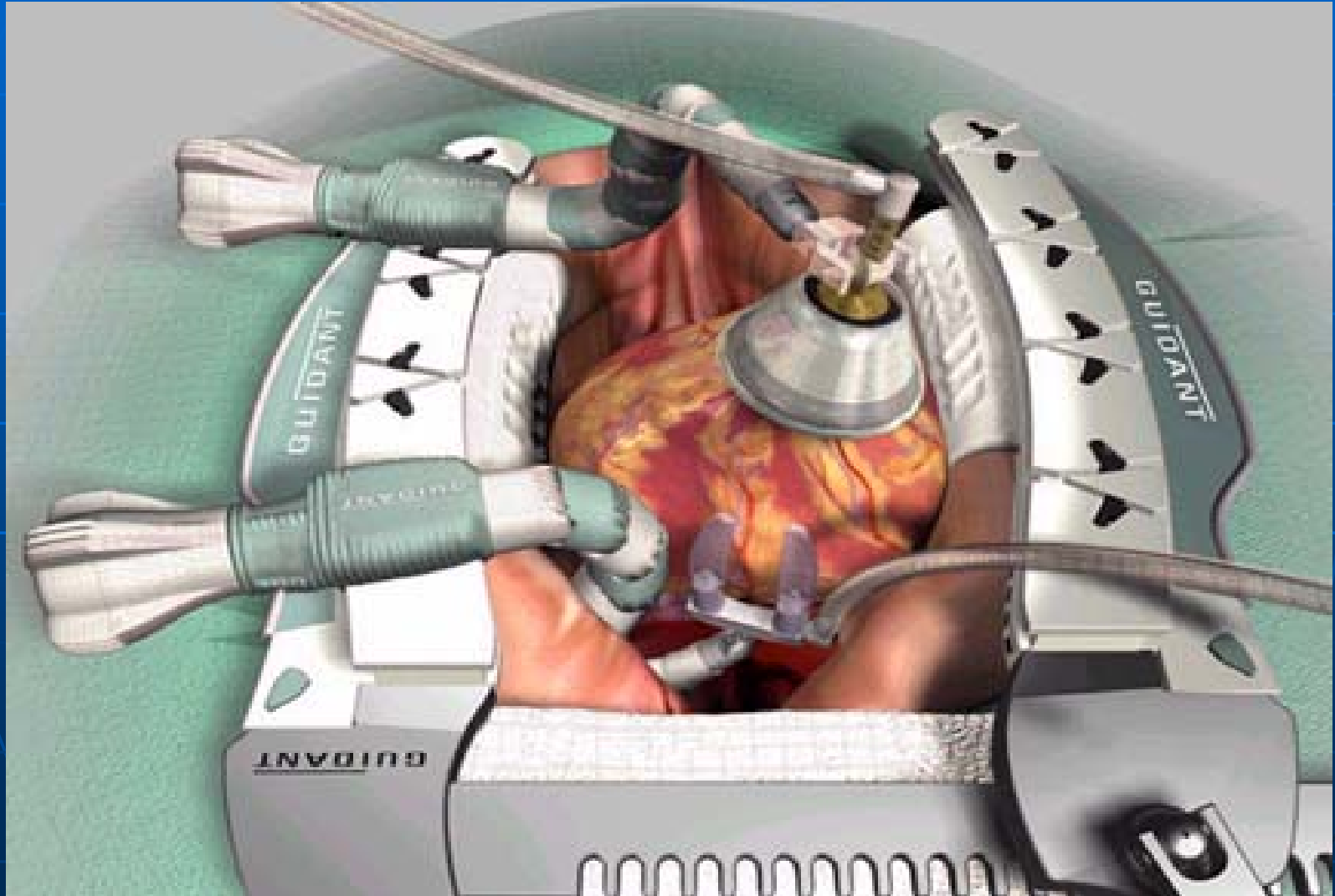
- Early (<5 years) stenoses
- Single stenotic vein graft
- Focal graft lesions
- Patent ITA-LAD graft
- Normal left ventricular function



9.6 Crossed revascularization procedures

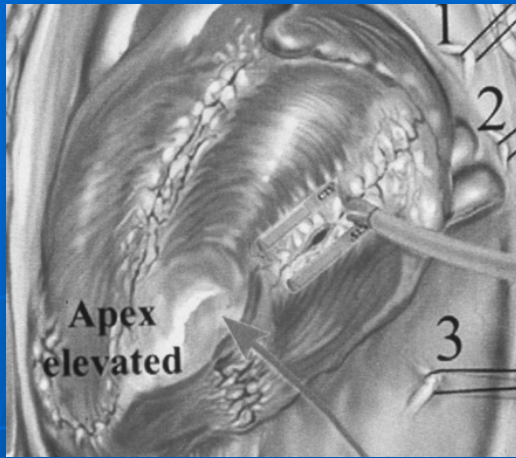
	Class ^a	Level ^b	Ref. ^c
Following CABG			
In early graft failure			
Coronary angiography is indicated for highly symptomatic patients, or in the event of post-operative instability, or with abnormal biomarkers/ECG suggestive of perioperative MI.	I	C	—
Decision of redo CABG or PCI should be made by the Heart Team.	I	C	—
PCI is a superior alternative to re-operation in patients <u>with early ischaemia after CABG.</u>	I	B	161
The preferred target for PCI is the <u>native vessel or ITA graft, not the freshly occluded SVG.</u>	I	C	—
For freshly occluded SVG, redo CABG is recommended rather than PCI if the native artery appears unsuitable for PCI or several important grafts are occluded.	I	C	—
In late graft failure following CABG			
PCI or redo CABG is indicated in patients with severe symptoms or extensive ischaemia despite OMT.	I	B	32, 164
PCI is recommended as a first choice, rather than redo CABG.	I	B	32, 165–168
PCI of the bypassed native artery is the preferred approach when stenosed grafts > 3 years old.	I	B	170
ITA is the conduit of choice for redo CABG.	I	B	169
Redo CABG should be considered for patients with several diseased grafts, reduced LV function, several CTO, or absence of a patent ITA.	IIa	C	—
PCI should be considered in patients with patent left ITA and amenable anatomy.	IIa	C	—

Off Pump Coronary Bypass

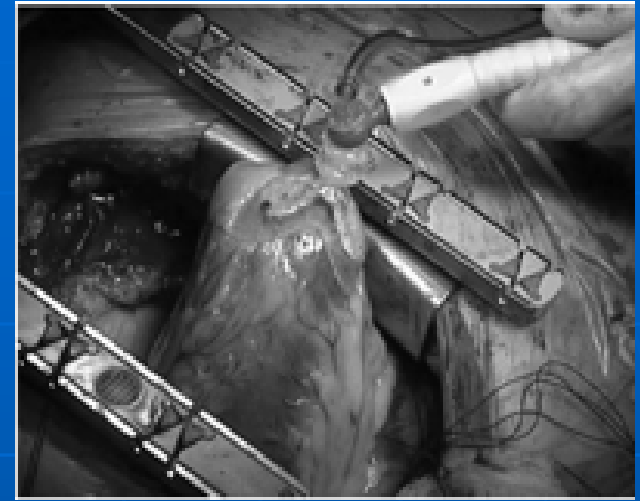


C.P.B חסרונות

- פגיעה במערכת קרישת הדם
- שפעול המנגנון הדלקתי בגוף inflammatory response
- הפרעה בזילוח הרקמתי- ריאות , כליות
- נזקים נוירולוגים
- הפרעות קוגניטיביות



Off PUMP



- Revascularization without the potential complications of extracorporeal support.
- 20 - 25% of all procedures performed in the United States.
- **Completeness of Revascularization and Graft Patency ?**
- Technically demanding
- Learning curve



Off Pump Coronary Bypass

- Only 1 randomized study 200 patients:
 - Similar graft patency, similar cardiac outcomes, lower cost.....
 - *Puskas et al, JAMA 2004*

Off-pump coronary artery bypass surgery may be superior to conventional CABG in many patients, especially those who are considered “high-risk”¹

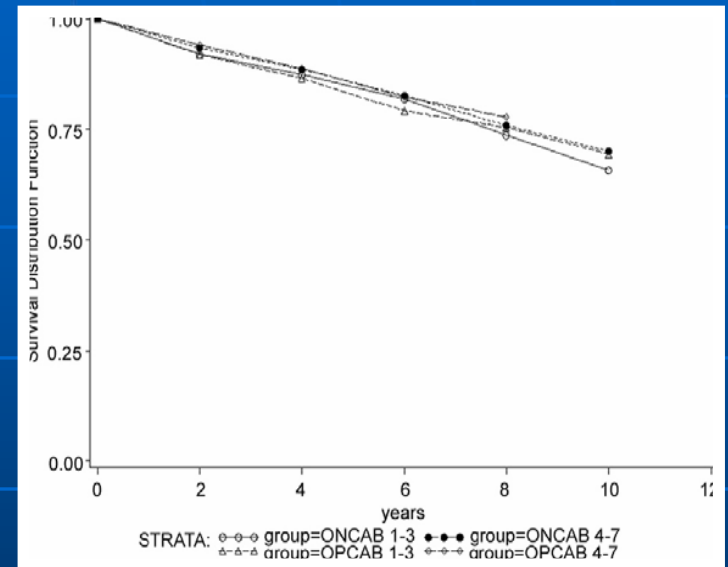
- ☑ Reduced transfusions and bleeding ^{2,4}
- ☑ Reduced inotropes^{2,4}
- ☑ Reduced arrhythmias²⁻⁴
- ☑ Reduced sternal wound infection²⁻⁴
- ☑ Reduced cerebral emboli and cognitive dysfunction³
- ☑ Reduced postoperative hospital length of stay²

Influence of On-Pump Versus Off-Pump Techniques and Completeness of Revascularization on Long-Term Survival After Coronary Artery Bypass

Omar M. Lattouf, MD, PhD, Vinod H. Thourani, MD, Patrick D. Kilgo, MS, Michael E. Halkos, MD, Kim T. Baio, MSN, RN, Richard Myung, MD, William A. Cooper, MD, Robert A. Guyton, MD, and John D. Puskas, MD

(Ann Thorac Surg 2008;86:797-805)

- 12,812 consecutive pt's
- Ten-year survival data
- Four groups:
 - OPCABG 1 - 3 grafts (n = 3,946)
 - OPCABG 4 - 7 grafts (n = 1,721)
 - On-pump CABG 1 - 3 grafts (n = 3,380)
 - On-pump CABG 4 - 7 grafts (n = 3,765)

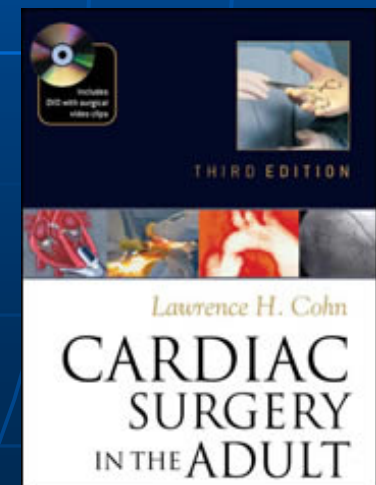


Conclusions. Long-term survival was similar for patients receiving 1 to 3 or 4 to 7 grafts by either on-pump or off-pump techniques. However, higher ICOR was associated with improved long-term survival within all groups.

ICOR - Index of Completeness of Revascularization

Patients Most Likely to Benefit from OPCAB

- Atheromatous calcified aorta
- Patients with significant comorbidities:
 - Cerebral vascular disease
 - Peripheral vascular disease
 - Hepatic disease
 - Bleeding disorders
 - COPD
 - Renal dysfunction
- Reoperative surgery
- Patients who refuse blood products

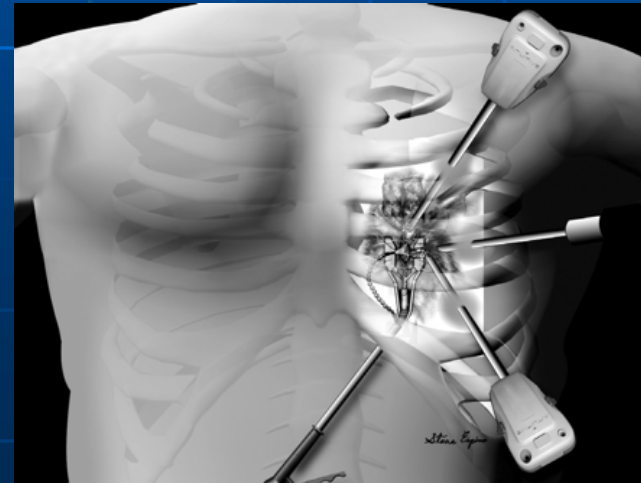


Minimally Invasive Myocardial Revascularization

- MINIMALLY INVASIVE DIRECT CORONARY ARTERY BYPASS (MIDCAB)



- TOTAL ENDOSCOPIC CORONARY ARTERY BYPASS GRAFTING (TECAB)



Results of graft patency by immediate angiography in minimally invasive coronary artery surgery

Michael J. Mack, James A. Magovern, Tea A. Acuff, Rodney J. Landreneau, Denise M. Tennison, Erin J. Tinnerman and John A. Osborne
Ann Thorac Surg 1999;68:383-389

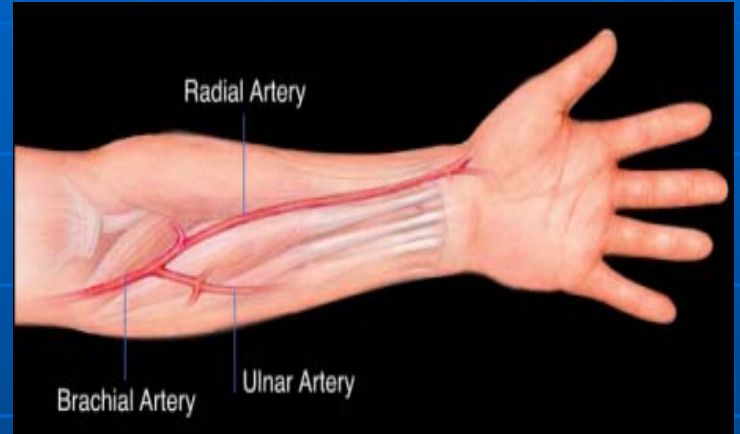
Table 2. Minimally Invasive Coronary Artery Bypass Procedures: Operative Data

Operative Data	Number of Patients (n = 103)
Conversions	0
Operating time	139.85 ± 46.32 min
Internal mammary artery harvest time	32.63 ± 12.49 min
Anastomosis time	16.52 ± 5.00 min

Table 8. Published Series of Left Internal Mammary Artery Graft Patency in Minimally Invasive Coronary Artery Bypass

Author	Year	No. Studied/ Operated	Angio/ Operation	Interval Post-op Study	Graft Patency	Exclusions/Notes
Schaff [12]	1996	15/16	94%	intraoperative	100%	3 revised
Calafiore [13]	1996	53/155	34%	1-26 days	91%	
Subramanian [14]	1997	169/189	89%	24-36 h	92%	stenosis = occlusion
Gill [10]	1997	29/29	100%	4-6 h	97.5%	additional 19% stenosis > 50%
Current series	1998	100/103	97%	38 intraoperative 62 48-96 h	99%	additional 8% stenosis > 50%

Endoscopic Surgery



Endoscopic Saphenous Vein Harvesting

Complications (wound infection) was reduced significantly by **69%**



Cheng D, Allen K, Cohn W, et al: Endoscopic vascular harvest in coronary artery bypass grafting surgery : A meta-analysis of randomized trials and controlled trials. *Innovations* (in press).

Randomized trial of endoscopic versus open vein harvest for coronary artery bypass grafting: Six-month patency rates

J Thorac Cardiovasc Surg 2005;129:496-503

Follow-up angiography of all vein grafts - 6 months after the operation.

TABLE 5. Graft patency and disease according to vein harvest method

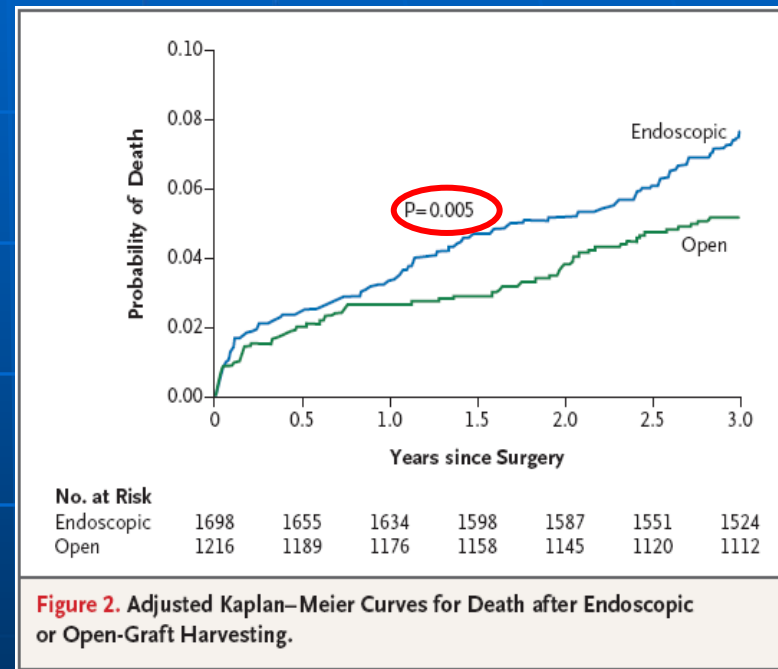
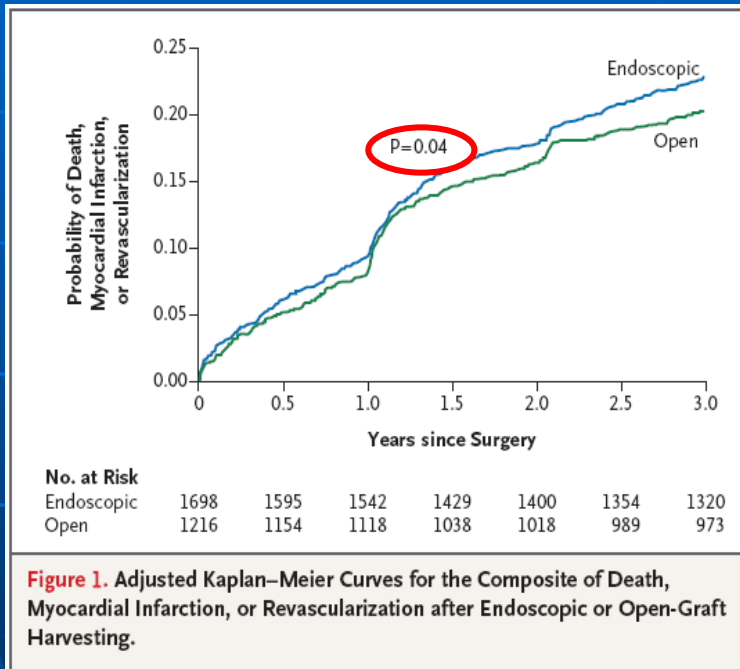
	EVH (n = 166)	OVH (n = 170)
Patent	113 (68%)	119 (70%)
Significant disease	17 (10%)	21 (12%)
Occlusion	36 (22%)	30 (18%)

$P = .584$. EVH, Endoscopic vein harvest; OVH, open vein harvest

Endoscopic versus Open Vein-Graft Harvesting in Coronary-Artery Bypass Surgery

Endoscopic -1,753 ; Open – 1,247
Angiography 12 -18 months

PREVENT IV:



CONCLUSIONS

Endoscopic vein-graft harvesting is independently associated with vein-graft failure and adverse clinical outcomes. Randomized clinical trials are needed to further evaluate the safety and effectiveness of this harvesting technique.

Endoscopic Radial Artery Harvesting may be the Procedure of Choice for Coronary Artery Bypass Grafting



Table 5 Radial Artery Graft Patency Assessed by MDCT

at least 6 months after surgery

	Open group (n=18)	Endoscopic group (n=76)	p value
Radial artery	17 (94.4%)	74 (97.4%)	0.476
Left IMA	17 (94.4%)	76 (100%)	0.191
Saphenous vein	16 (88.9%)	62 (82.7%)	0.727

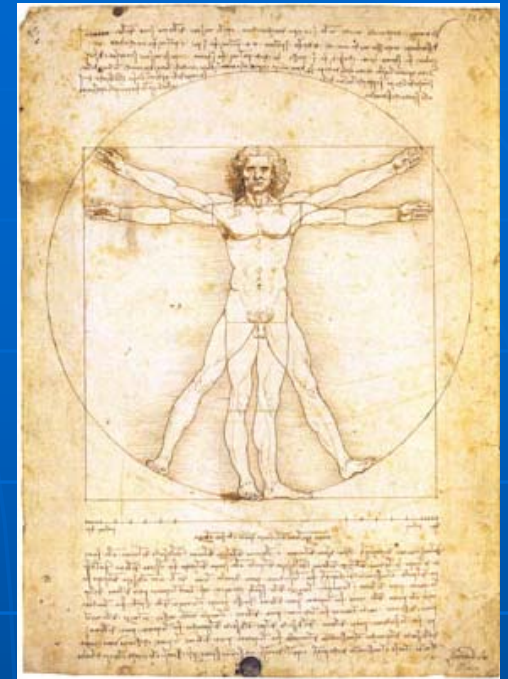
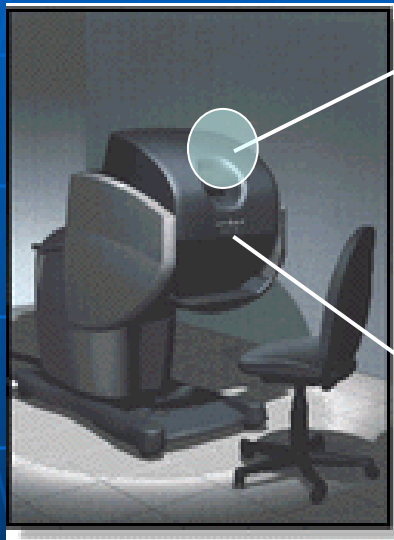
MDCT, multidetector computed tomography; IMA, internal mammary artery.

Robotics

The Da Vinci System

Visualization

Console



Stereo Visualization: Direct connection of surgeon hands to tool tips

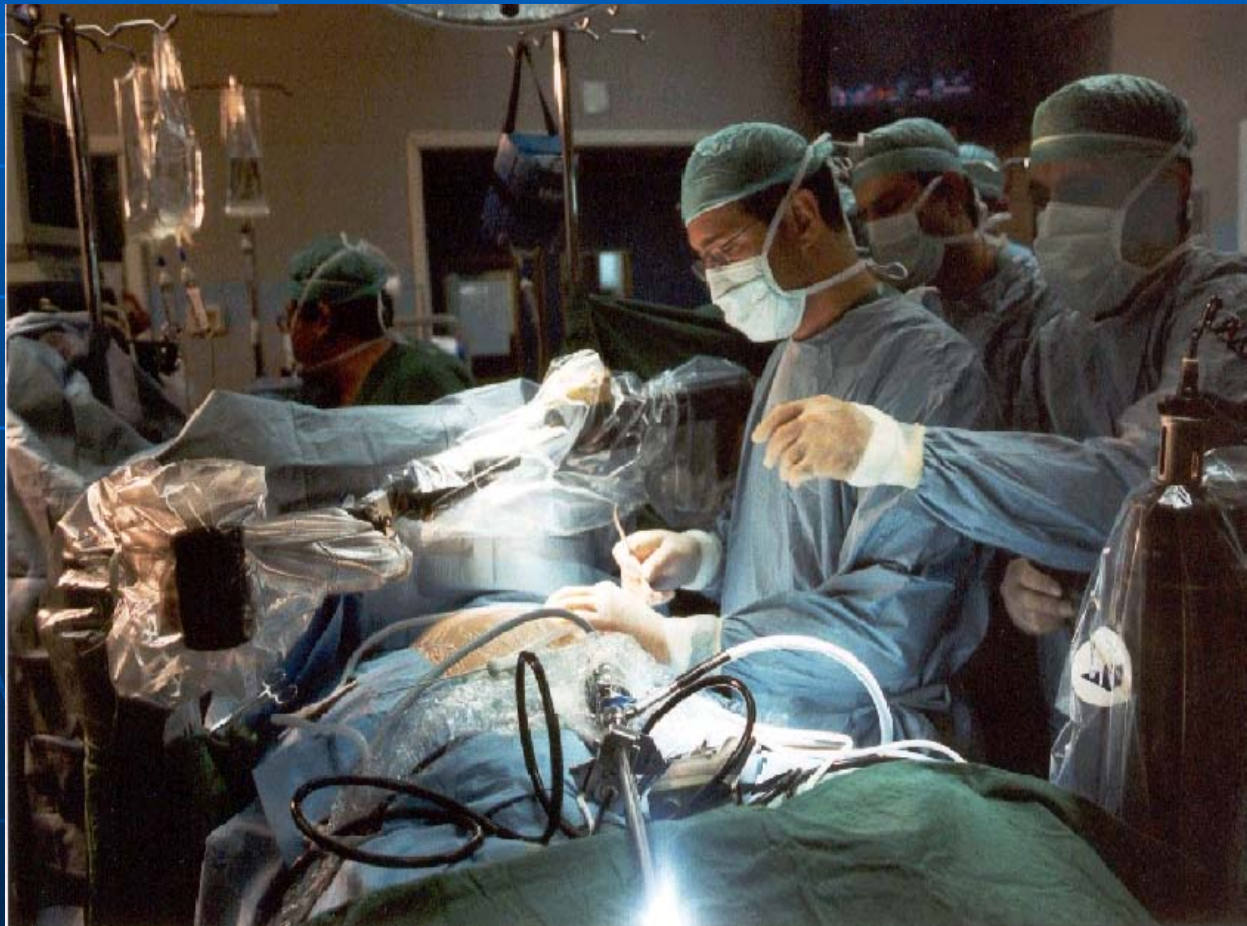
Registration is both visual and spatial

Eye-hand coordination is restored

One image per eye



**Addition of a 3 DOF
wrist at the tip
(total of 7 DOF)**



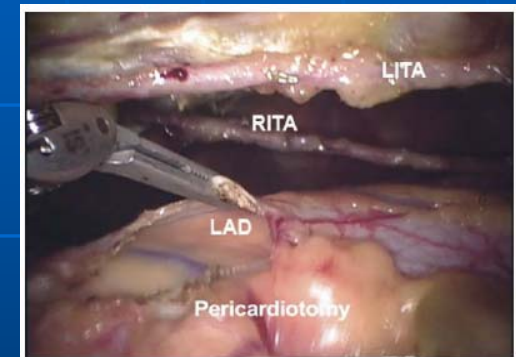
Use of Bilateral Internal Thoracic Arteries in CABG Through Lateral Thoracotomy With Robotic Assistance in 150 Patients

Sudhir Srivastava, MD, Suresh Gadasalli, MD, Madhava Agusala, MD, Ram Kolluru, MD, Jayaram Naidu, MD, Manish Shroff, MD, Reyna Barrera, PAC, Shaune Quismundo, RN, and Vishwa Srivastava, BA

Departments of Cardiovascular Surgery and Cardiology, Alliance Hospital, and Cardiac Surgical Associates, Odessa, Texas

Table 3. Postoperative Results

	Number of Patients
Bilateral internal thoracic artery revascularization	148/150 (99%)
Mortality	0
Conversion to cardiopulmonary bypass	0
Postoperative bleeding	5/150 (3.3%)
Myocardial infarction	0
Cerebrovascular accident	0
Respiratory failure	2/150 (1.3%)
Renal failure	4/150 (2.7%)
New onset atrial fibrillation	14/150 (9.3%)
Wound infection	0
Blood transfusion	19/150 (13%)



Hybrid Procedure



Hybrid Revascularization

- Lima to LAD followed by PCI to other targets- problem if PCI does not succeed
- PCI to CX and/or RCA territory followed by Minimally invasive LIMA to LAD- problem anti-platelets during surgery and PCI with significant LAD lesion



Simultaneous **integrated** coronary artery revascularization with long-term angiographic follow-up

- 58 pt's underwent simultaneous, integrated coronary artery revascularization in an operating theater equipped with angiographic equipment.
- CONCLUSION: For multivessel coronary artery disease, simultaneous integrated coronary artery revascularization with bivalirudin is **safe and feasible.**



Thank you