CABG vs. PCI for Myocardial Infarction and Left Main Disease

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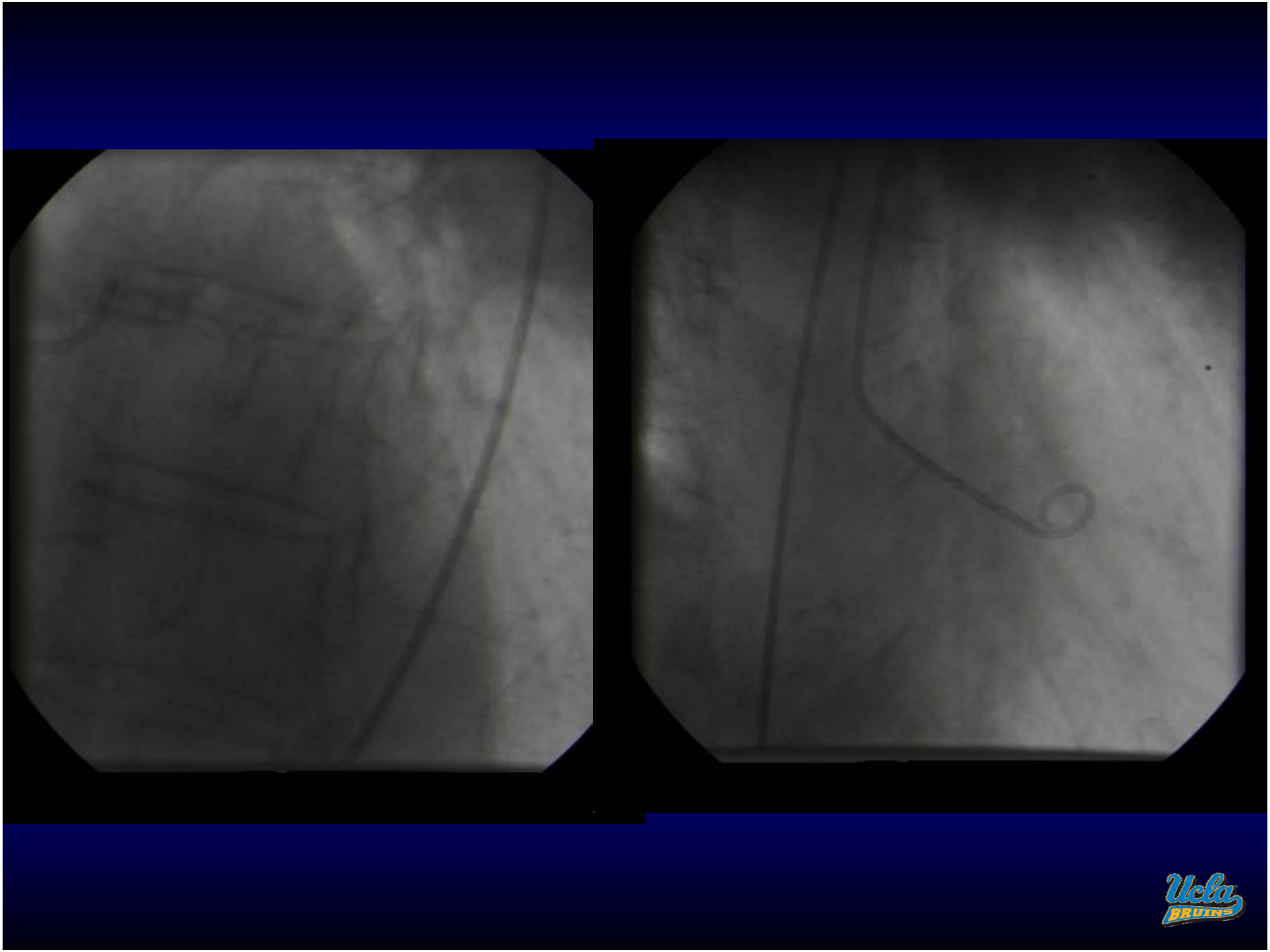
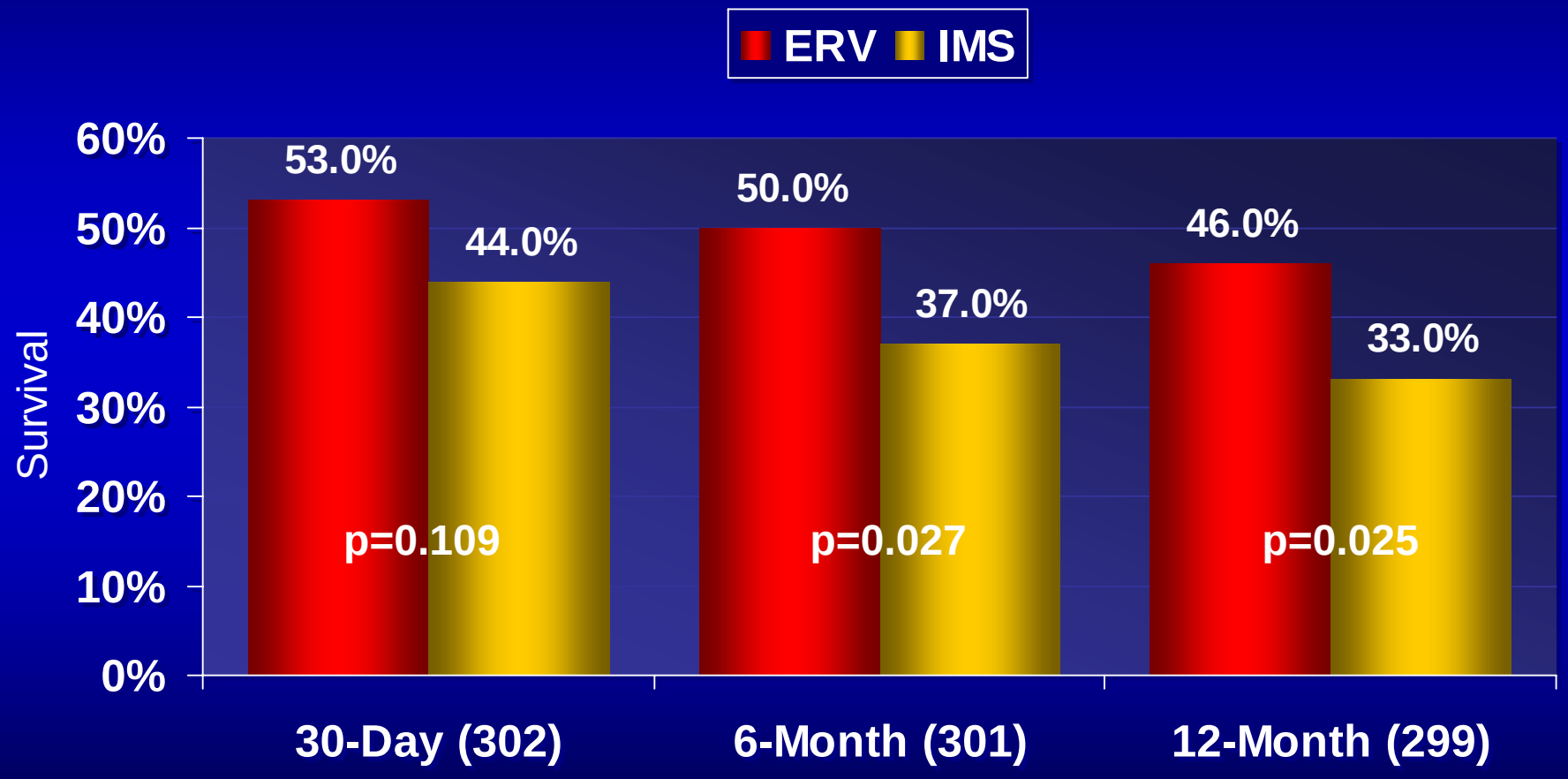


Cardiogenic Shock

- Cardiogenic shock occurs in approximately 5 to 10% of patients with STEMI and is the leading cause of death in these patients (1-3).
- In the SHOCK Trial, patients treated with CABG and PCI had similar survival rates at one and six years (4,5).

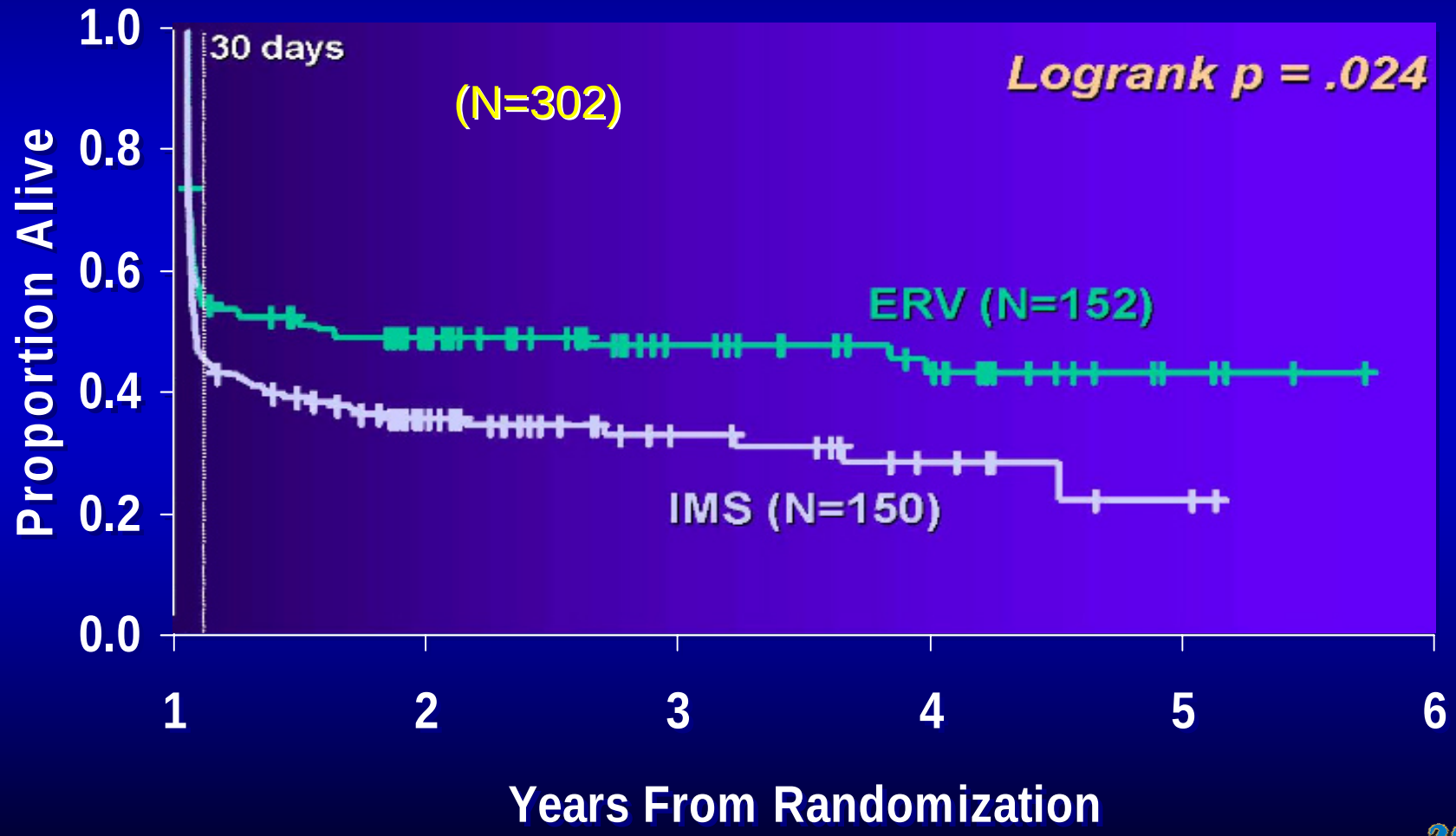
1. Hasdai D, et al. Lancet 2000
2. Goldberg RJ, et al. NEJM 1999
3. Becker RC, et al. JACC 1996
4. White HD, et al. Circulation 2005
5. Hochman JS, et al. JAMA 2006

SHOCK Trial



Hochman, JAMA 2001;285:190.

SHOCK Trial: Long-term Survival



Hochman et al JAMA 2006; 295:2511

Left Main Coronary Disease

- Left main disease is a significant independent predictor of mortality in patients with MI complicated by cardiogenic shock, with the highest mortality observed in patients with the LM as the infarct-related artery.[1]
- The ACC/AHA STEMI guidelines indicate that PCI as a class IA indication for the management of MI complicated by cardiogenic shock as well as a class IA indication for CABG if there is suitable coronary anatomy.[2]
- The standard of care for patients with LMCA disease is CABG.[3]

1. Zeymer U, et al. Eur Heart J 2004
2. Antman EM, et al. Circulation 2004
3. Smith SC Jr, et al. Circulation 2006

What is the ideal revascularization strategy in acute MI patients with cardiogenic shock and left main disease?

Outcome After Surgery and Percutaneous Intervention for Cardiogenic Shock and Left Main Disease

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OBJECTIVE

Evaluate the 30-day survival with CABG and PCI in patients with LMCA disease in the SHOCK Trial and Registry.

Back

pass su .43 to 0.69) [PCI]) (95% confi- of left ($p \leq 0.001$). artery, the

Meth oup (n = 6) Occlud). Coronary Regist 1; 95% con-

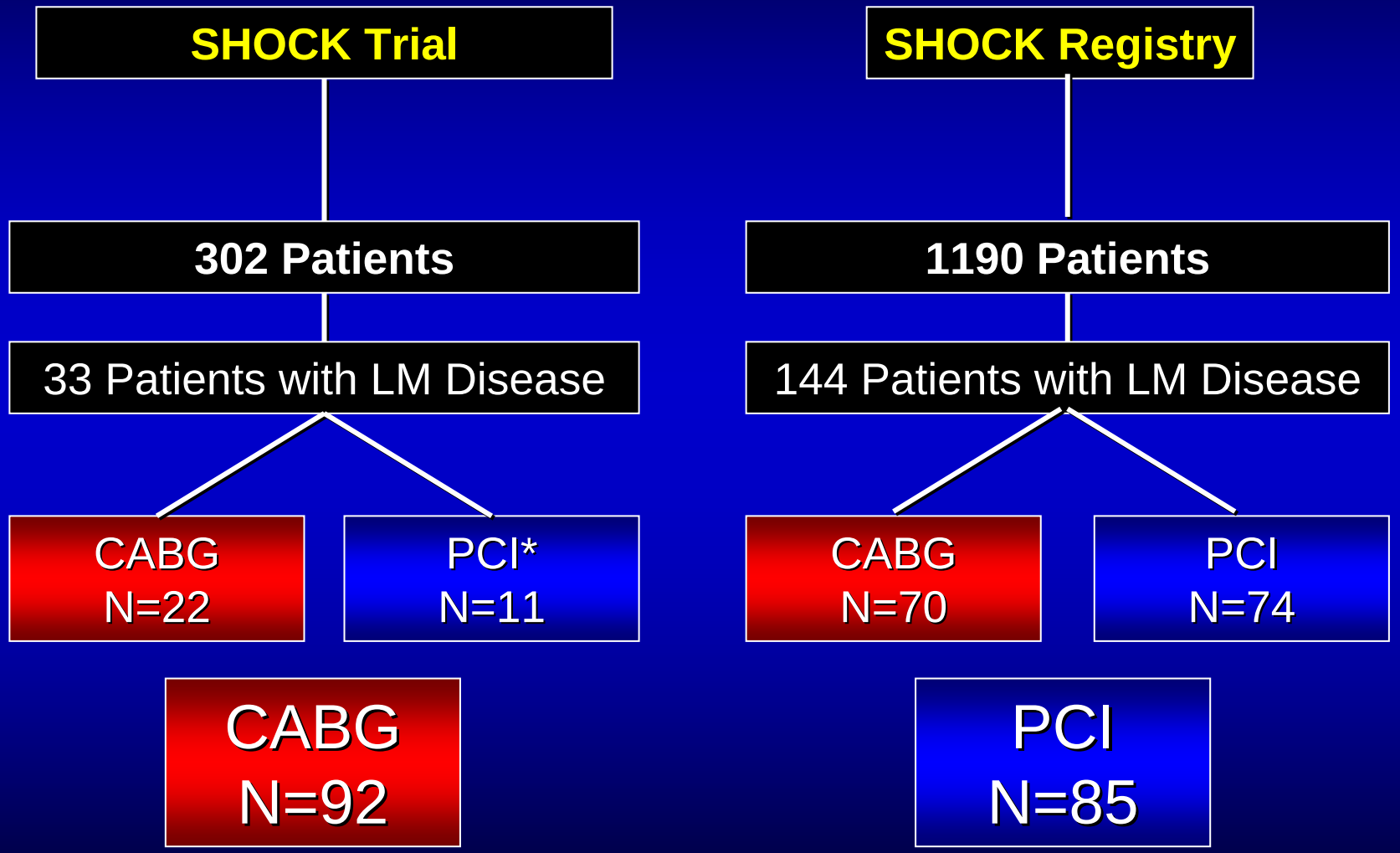
who underwent revascularization. Although the standard of care at the time and the trial protocol recommended coronary artery bypass graft surgery for patients with left main disease, the revascularization strategy (79 coronary artery bypass graft surgery and 85 PCI) was individualized for each patient by site investigators.

Results. The median time from myocardial infarction to revascularization was 24.3 hours (interquartile range, 8.7 to 82.5 hours) in the surgical group and 7.4 hours (interquartile range, 3.7 to 19.5 hours) in the PCI group ($p < 0.05$). Overall 30-day survival with surgery in this fidence interval, 0.22 to 0.77; $p = 0.006$) and age (per 10 years, hazard ratio, 1.04; 95% confidence interval, 1.01 to 1.08; $p = 0.02$) were independently associated with 30-day survival.

Conclusions. Coronary artery bypass graft surgery appeared to provide a survival advantage over PCI at 30-day follow-up in patients with left main coronary artery disease. The impact of current PCI strategies on this subgroup is undetermined.

(Ann Thorac Surg 2008;86:29–34)

Methods



*Emergency CABG was recommended for patients with LMCA stenosis ≥50% in the SHOCK Trial

Table 1. Baseline Demographic and Angiographic Characteristics

Variable	CABG (n = 79)	PCI (n = 85)	*p* Value
Age (y)[a]	68.1 ± 10.8	67.6 ± 9.8	0.34
Men (%)	70.9	67.1	0.60
Hypertension (%)	54.7	49.4	0.51
Diabetes mellitus (%)	25.3	23.8	0.82
Renal insufficiency (%)	11.7	10.3	0.78
Previous myocardial infarction (%)	34.6	33.3	0.87
Previous CABG (%)	6.4	14.6	0.12
Previous PCI (%)	4.0	12.4	0.08
Triple-vessel disease (%)	87.3	72.9	0.02
Infarct-related artery			0.81
Left main (%)	24.5	24.4	
Left anterior descending artery (%)	33.9	32.1	
Left circumflex artery (%)	13.2	15.4	
Right coronary artery (%)	28.3	25.6	
Saphenous vein graft (%)	0.0	2.6	
Peak creatinine kinase (U/L)[a]	2,502 ± 2,593	4,203 ± 5,364	0.011

Timing Data

Table 2. Timing Data[a]

Variable	CABG (n = 79 patients)	PCI (n = 85 patients)
Median time from AMI to revascularization (h)	24.3 (8.7–82.5)	7.4 (3.7–19.5)
Median time from shock to revascularization (h)	11.3 (3.9–77.8)	3.8 (1.9–7.6)
	(n = 22 trial patients)	(n = 11 trial patients)
Median time from AMI to revascularization (h)	19.1 (10.4–31.0)	7.1 (4.5–14.8)
Median time from shock to revascularization (h)	10.7 (6.2–16.0)	4.8 (2.4–9.9)
	(n = 57 registry patients)	(n = 74 registry patients)
Median time from AMI to revascularization (h)	33.2 (8.6–113.0)	7.1 (4.5–14.8)
Median time from shock to revascularization (h)	18.1 (2.2–100.3)	4.8 (2.4–9.9)

[a] Values are reported as median (interquartile range).

AMI = acute myocardial infarction; CABG = coronary artery bypass graft surgery; PCI = percutaneous coronary intervention.

Table 3. Hemodynamic Data[a]

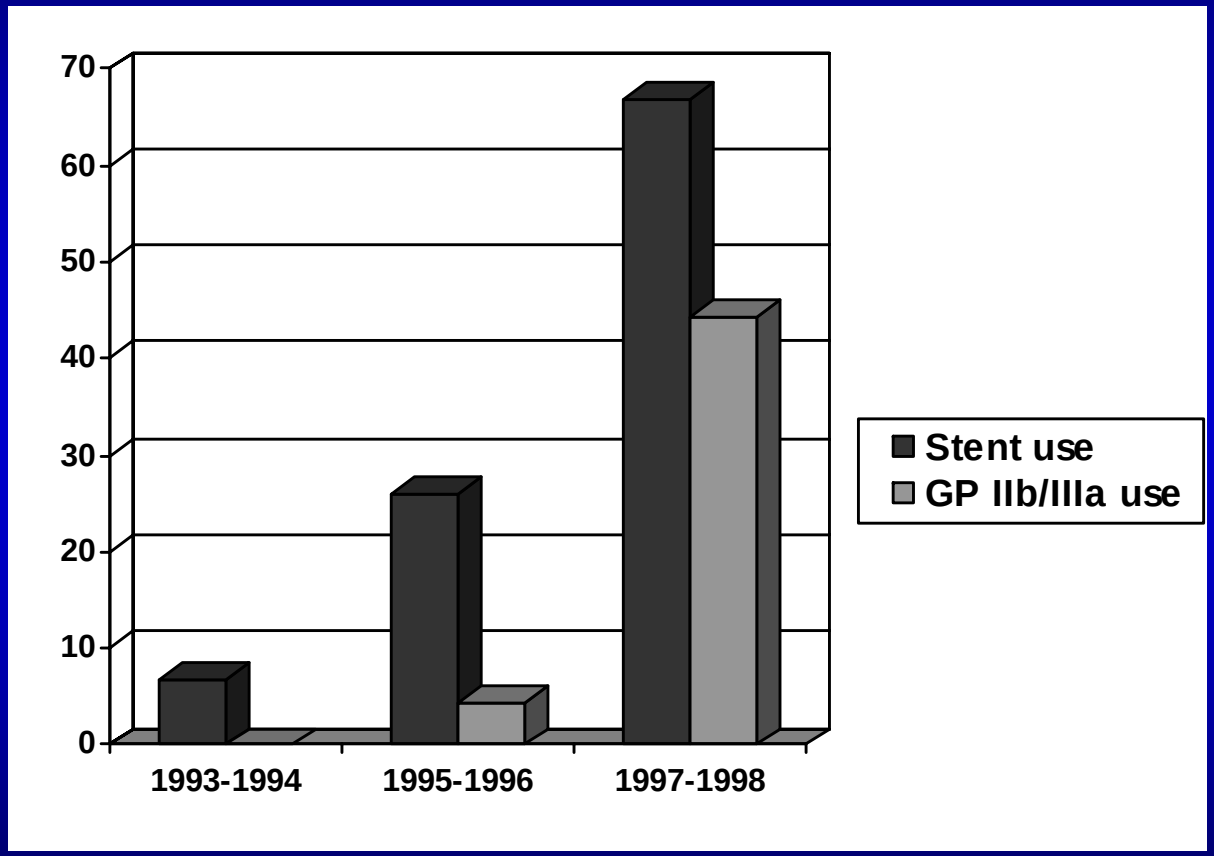
Variable	CABG (n = 79)	PCI (n = 85)	*p* Value
Heart rate (beats/min)	100.1 ± 21.8	95.5 ± 23.1	0.19
Systolic blood pressure (mm Hg)	85.3 ± 19.2	84.9 ± 25.8	0.89
Ejection fraction	0.269 ± 0.099	0.374 ± 0.110	0.91
Cardiac index ($L \cdot min^{-1} \cdot m^{-2}$)	2.0 ± 0.6	1.9 ± 0.8	0.60
Wedge pressure (mm Hg)	23.3 ± 7.2	24.5 ± 9.5	0.43
Cardiac power index	132.5 ± 49.8	133.6 ± 78.8	0.78

[a] Measurement often obtained while patients were receiving support. Values are mean ± standard deviation.

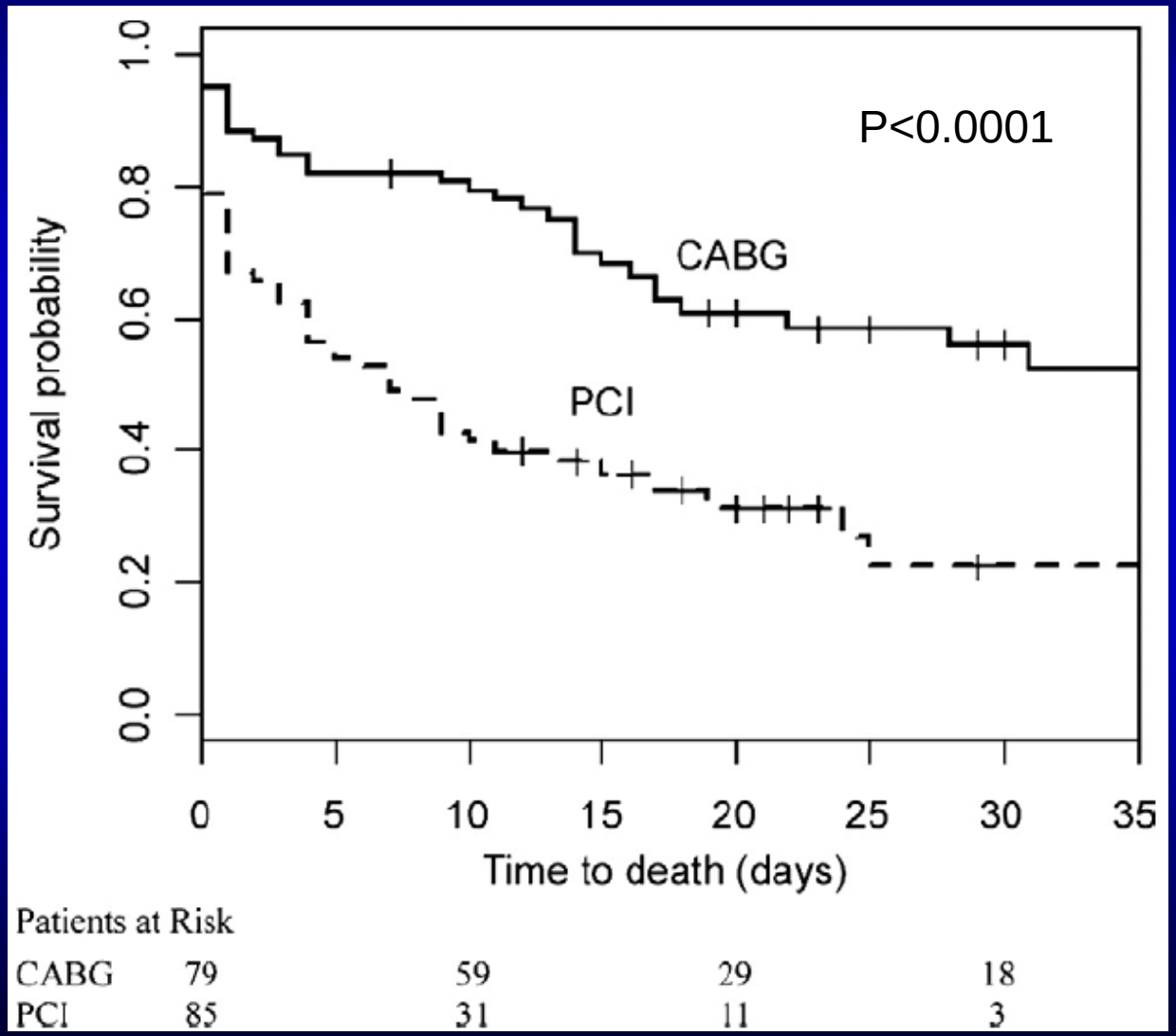
Procedural details of PCI

Multiple vessels treated initially (%)	17.9
Stenting (%)	30.6
Glycoprotein IIb/IIIa antagonists (%)	11.8
Hemodynamic support with IABP (%)	93.5
Subsequent CABG (%)	14.1

Trends in Stent and GP IIb/IIIa Antagonist Use



Kaplan-Meier 30-day Survival Estimates



Why was there a Mortality Benefit with CABG?

- Despite the SHOCK trial protocol recommending CABG in patients with LMCA disease, nearly half underwent PCI.
  - Surgeons may have deemed these patients unsuitable for surgery (e.g. patients had poor distal vessel that were not amenable to CABG) and led to an attempt at PCI.
  - More stable patients may have been referred for CABG and unstable patients may have been underwent PCI as emergency PCI could be performed more expeditiously for more unstable patients.

Was there a Selection Bias?

- Despite the similar baseline hemodynamic data, the longer time from MI and cardiogenic shock to CABG suggests that surgeons selected patients who survived the early, highest risk period
  - Those who underwent CABG days after shock onset likely had resolution of shock prior to surgery and despite use of statistical adjustment, this bias cannot be completely accounted for.

Effect of Complete Revascularization?

- There was a higher prevalence of triple-vessel disease in the CABG group, which was adjusted for in the model.
- A possible explanation of the improved survival observed in those who underwent CABG may be due to a high proportion of complete revascularization (89%).
- Therefore, CABG may be preferred when LMCA disease with or without severe triple-vessel disease is present or when unsatisfactory and less complete revascularization with PCI is likely.

Size of Infarct

- The higher mortality in the PCI group may have been due to larger infarcts compared with the CABG group.

Multicenter International Registry of Unprotected Left Main Coronary Artery Percutaneous Coronary Intervention With Drug-Eluting Stents in Patients With Myocardial Infarction

Michael S. Lee,[1]* Dario Sillano,[2] Azeem Latib,[3] Alaide Chieffo,[3] Giuseppe Biondi Zoccai,[2] Ravi Bhatia,[1] Imad Sheiban,[2] Antonio Colombo,[3] and Jonathan Tobis[1]

Background: Patients who present with myocardial infarction (MI) and unprotected left main coronary artery (ULMCA) disease represent an extremely high-risk subset of patients. ULMCA percutaneous coronary intervention (PCI) with drug-eluting stents (DES) in MI patients has not been extensively studied. Methods: In this retrospective multicenter international registry, we evaluated the clinical outcomes of 62 consecutive patients with MI who underwent ULMCA PCI with DES (23 ST-elevation MI [STEMI] and 39 non-ST-elevation MI [NSTEMI]) from 2002 to 2006. Results: The mean age was 70 ± 12 years. Cardiogenic shock was present in 24%. The mean EuroSCORE was 10 ± 8. Angiographic success was achieved in all patients. Overall in-hospital major adverse cardiac event (MACE) rate was 10%, mortality was 8%, all due to cardiac deaths from cardiogenic shock, and one patient suffered a periprocedural MI. At 586 ± 431 days, 18 patients (29%) experienced MACE, 12 patients (19%) died (the mortality rate was 47% in patients with cardiogenic shock), and target vessel revascularization was performed in four patients, all of whom had distal bifurcation involvement (two patients underwent repeat PCI and two patients underwent bypass surgery). There was no additional MI. Two patients had probable stent thrombosis and one had possible stent thrombosis. Diabetes [hazard ratio (HR) 4.22, 95% confidence interval (CI) (1.07–17.36), $P = 0.04$), left ventricular ejection fraction [HR 0.94, 95% CI (0.90–0.98), $P = 0.005$), and intubation [HR 7.00, 95% CI (1.62–30.21), $P = 0.009$) were significantly associated with increased mortality. Conclusions: Patients with MI and ULMCA disease represent a very high-risk subgroup of patients who are critically ill. PCI with DES appears to be technically feasible, associated with acceptable long-term outcomes, and a reasonable alternative to surgical revascularization for MI patients with ULMCA disease. Randomized trials are needed to determine the ideal revascularization strategy for these patients.

Lee MS, et al. Catheter Cardiovasc Interv 2008

TABLE I. Baseline Clinical Characteristics	N=62
Clinical presentation	
STEMI (%)	35
NSTEMI (%)	65
Age (years ± SD)	70 ± 12
Male (%)	86
Hypertension (%)	82
Hypercholesterolemia (%)	66
Diabetes mellitus (%)	28
Chronic renal insufficiency (Cr ≥ 1.5 mg/dl) (%)	16
Smoking (%)	32
Ejection fraction (%)	46 ± 15
Ejection fraction >40% (%)	65
Previous PCI	16
Previous MI	65
Mean Euroscore (%)	10 ± 8
Euroscore ≥ 6 (%)	58
Cardiogenic shock (%)	24
Peak CK (U/l)	1,280 ± 1,714

TABLE II. Angiographic and Procedural Characteristics

LMCA as infarct-related artery (%)	33
Location of LMCA disease	
Ostial/Body (%)	29
Distal (%)	71
Calcification of LM (%)	21
Type of DES	
Cypher stent (%)	86
Taxus stent (%)	14
No. of implanted stents/patient (mean ± SD)	1.6 ± 0.8
Total stent length (mm)	27 ± 16
Significant right coronary artery disease (%)	44
Treatment of right coronary artery (%)	29
Glycoprotein IIb/IIIa antagonist (%)	35
Intra-aortic balloon pump (%)	24
Intravascular ultrasound (%)	6

TABLE III. In-Hospital Outcomes

Angiographic success (%)	100
MACE (%)	10
Death (%)	8
MI (%)	2
Target vessel revascularization (%)	0

Kaplan-Meier Survival

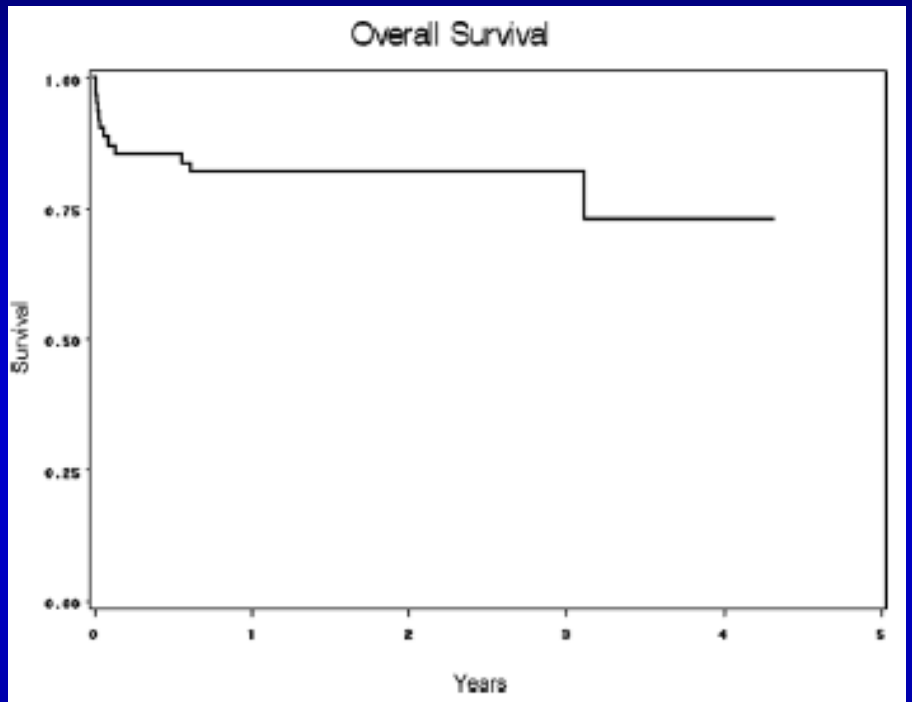


Fig. 1. Kaplan-Meier curves for survival proportion for all 62 patients with MI who underwent ULMCA PCI with DES.

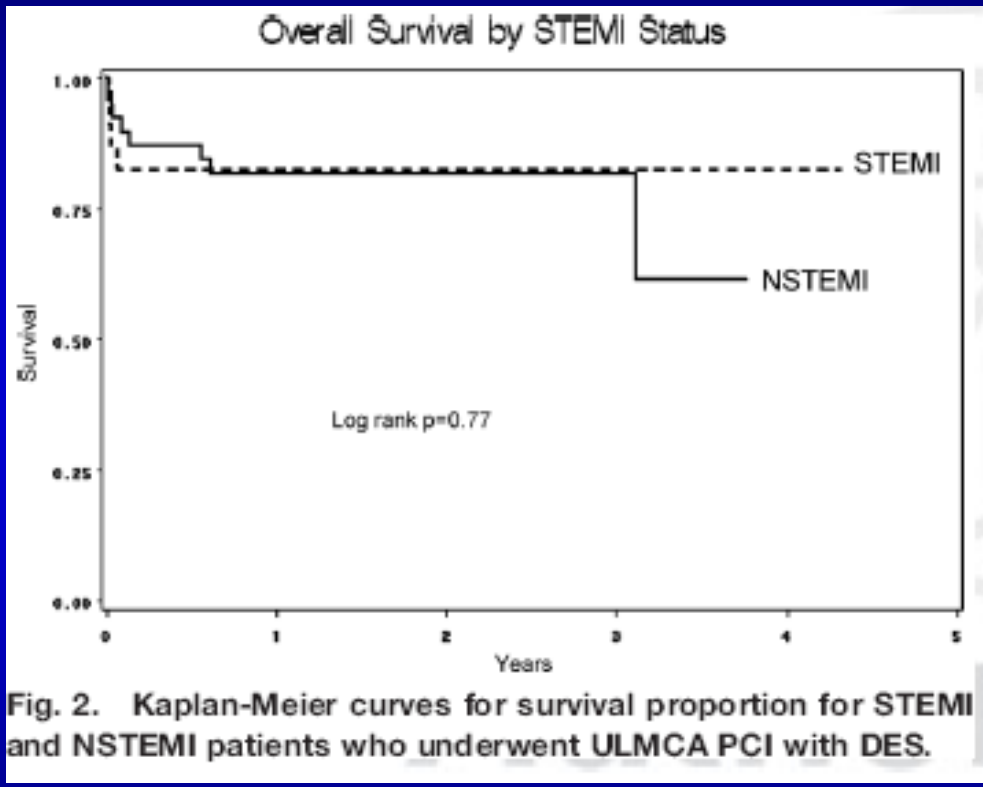


Fig. 2. Kaplan-Meier curves for survival proportion for STEMI and NSTEMI patients who underwent ULMCA PCI with DES.

Long-term Follow Up

- F/u angiography was performed in 37 patients (60%)
- TVR occurred in 4 patients (11%), all with distal bifurcation disease (2 underwent repeat PCI, and 2 CABG)
- No additional MI after hospital discharge
- Stent thrombosis
  - No definite
  - 2 probable (sudden death within 30 days)
  - 1 possible

TABLE 4. Cox Proportional Hazard Model Results

Variables	*P* value	Hazard ratio (95% CI)
Multivariable analysis		
Diabetes	0.04	4.31 (1.07−17.36)
Left ventricular ejection fraction	0.005	0.94 (0.900.98)
Intubation	0.009	6.99 (1.62−30.21)

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Drug-Eluting Stenting of Unprotected Left Main Coronary Artery Stenosis in Patients With Orthotopic Heart Transplantation: Initial Clinical Experience

Michael S. Lee,* MD, Kook-Jin Chun, MD, and Jonathan M. Tobis, MD

Objectives: To assess the safety and efficacy of percutaneous coronary intervention (PCI) with drug-eluting stents (DES) in orthotopic heart transplantation (OHT) patients with unprotected left main coronary artery (ULMCA) disease. Background: Accelerated transplant coronary artery disease occurs in 50% of patients at 5 years and is the restenosis was present in four patients who underwent surveillance angiography. One patient underwent repeat OHT for progressive left ventricular dysfunction. Conclusions: In OHT patients, ULMCA PCI with DES is feasible with an excellent technical success rate and is a reasonably palliative treatment option for this difficult patient population.

- 8 out of 82 transplant patients who underwent PCI had ULMCA disease
- 5 of the 8 transplant patients underwent PCI with DES

ULMCA PCI with DES in Cardiac Transplant Patients

Patient	Stent	Size (mm)	Location	IABP	Length of follow up	MACE
1	Cypher	3.5 x 13	Mid body	No	577	No
2	Cypher	3.5 x 8	Ostial	Yes	990	No
3	Taxus	3.0 x 16	Ostial	Yes	143	No
4	Cypher	3.0 x 18, 3.0 x 18	Distal bifurcation	Yes	124	No
5	Cypher	3.5 x 18, 3.0 x 13	Distal bifurcation	Yes	755	*

*Patient underwent repeat cardiac transplantation

Lee MS, et al. Catheter Cardiovasc Interv 2008

PCI with DES for Unprotected Left Main Disease in Patients With Cardiogenic Shock

- A 64 year-old male s/p cardiac transplantation 5 years ago had a witnessed sudden cardiac death in his physician's office.
- After successful CPR, the patient was started on IV epinephrine and an IABP was inserted for cardiogenic shock.
- Emergent coronary angiography

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Comparison of Percutaneous Coronary Intervention With Bare-Metal and Drug-Eluting Stents for Cardiac Allograft Vasculopathy

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Los Angeles, California

Objectives We sought to compare percutaneous coronary intervention (PCI) with bare-metal stents (BMS) and drug-eluting stents (DES) for cardiac allograft vasculopathy (CAV).

Background Cardiac allograft vasculopathy is a rapidly progressive form of atherosclerosis and is one of the main limitations to long-term survival after orthotopic heart transplantation. Percutaneous coronary intervention has been used as a palliative treatment option for CAV but is associated with worse clinical outcomes and greater rate of restenosis compared with PCI of native coronary arteries.

Methods Between 1995 and 2007, data on 82 consecutive heart transplant patients who underwent PCI with BMS and DES at the University of California at Los Angeles Medical Center were retrospectively analyzed.

Results A total of 82 lesions were treated with 98 BMS and 76 lesions were treated with 80 DES. Follow-up angiography was performed on 57 of 82 lesions (70%) treated with BMS and 58 of 76 (76%) treated with DES ($p = 0.7$) at a mean follow-up of 9.5 ± 5.5 months for BMS and 12.6 ± 8.2 months for DES ($p = 0.02$). Compared with BMS, DES was associated with a lower binary restenosis rate (12% vs. 30%, $p = 0.02$), lower percent diameter stenosis (24 ± 20 vs. 34 ± 36, $p = 0.06$), and less late lumen loss (0.24 ± 0.75 mm vs. 0.82 ± 1.03 mm, $p = 0.01$). No angiographic stent thrombosis was observed with DES.

Conclusions When compared with BMS, PCI with DES was safe and reduced the rate of angiographic restenosis in patients with CAV. A randomized clinical trial comparing BMS versus DES with longer follow-up is needed to identify the optimal long-term revascularization strategy in patients with CAV. (J Am Coll Cardiol Intv 2008;1:710–5) © 2008 by the American College of Cardiology Foundation

Table 3. Follow-Up Angiographic Data

	BMS	DES	p Value
Lesions with angiographic follow-up	58/82 (71%)	55/76 (72%)	0.8
Mean duration of follow-up (months)	9.5 ± 5.5	12.6 ± 8.2	0.02
Minimal luminal diameter (mm)	1.94 ± 0.78	2.31 ± 0.78	0.045
Percent diameter stenosis	34 ± 36	24 ± 20	0.06
Late luminal loss (mm)	0.82 ± 1.03	0.24 ± 0.75	0.01
Late luminal loss index	0.07 ± 0.40	0.42 ± 0.58	0.001
Binary restenosis (% of patients)	30	12	0.02

Abbreviations as in Table 2.

Conclusions

- PCI with DES in MI patients with ULMCA disease appears to be technically feasible and a reasonable alternative to CABG in this very high-risk patients.
- The mortality rate was acceptable and compares favorably with historical data with CABG in MI patients with ULMCA disease.
- The ideal revascularization strategy for patients with MI and ULMCA disease is unknown.
- The decision to perform CABG or PCI in MI patients with ULMCA disease may be difficult.
- The decision needs to be individualized taking into consideration all relevant factors including discussion with the cardiologist, surgeon, and patient and family if possible.
- Ultimately, randomized, controlled trials are needed to further elucidate the optimal treatment strategy.