Percutaneous Treatment of Saphenous Vein Grafts

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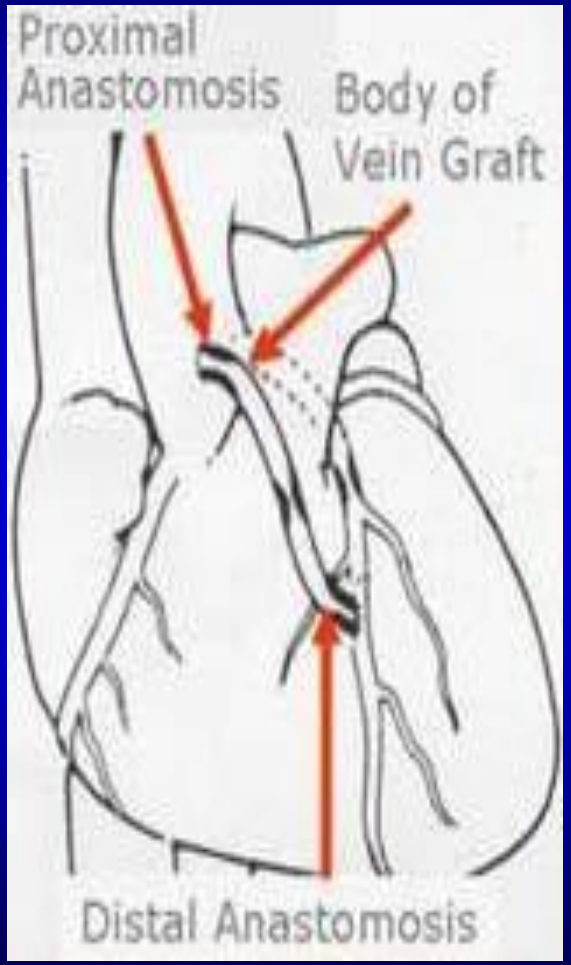
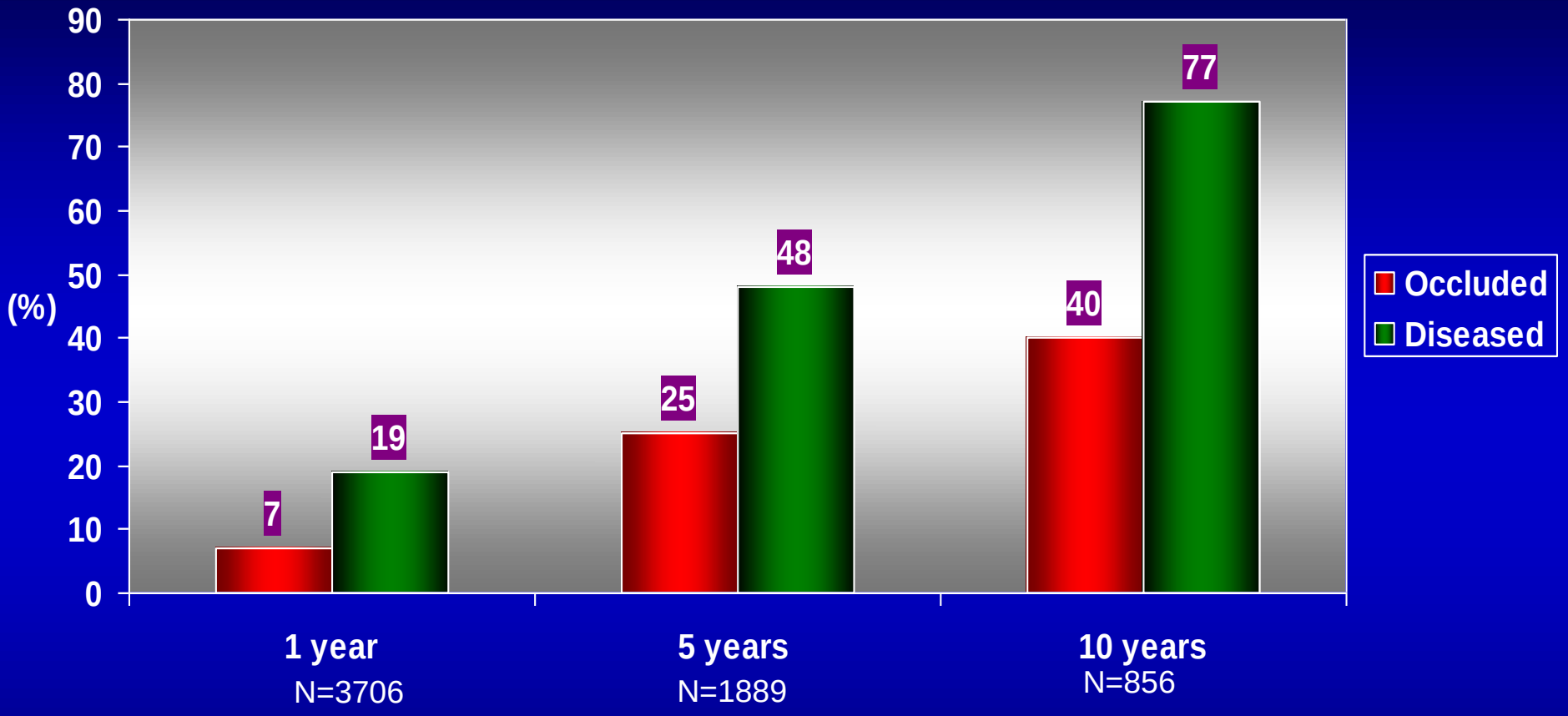
SVG Intervention

- 300,000 new CABG/year*
- 10% of PCI case volume



*MedPar Data

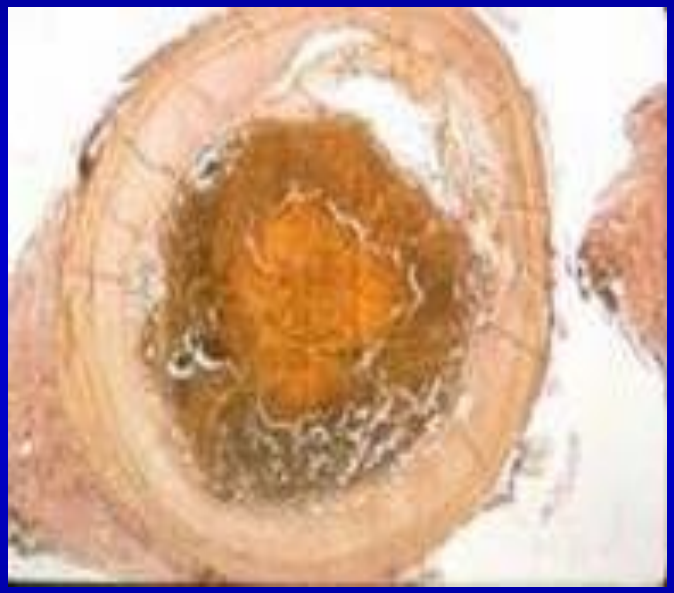
SVG Angiographic Patency



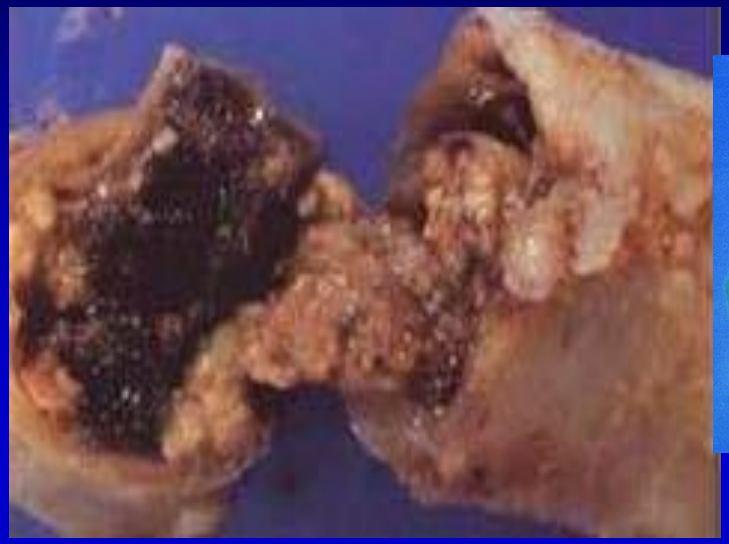
Fitzgibbon et al. JACC 1996;28:616

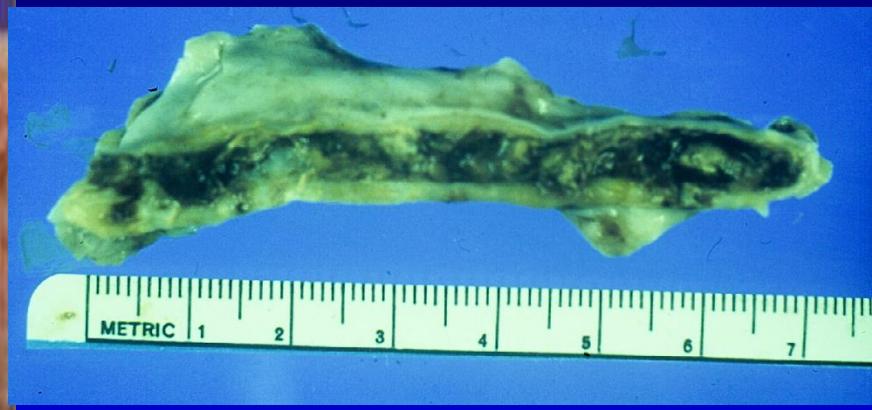
Typical SVG disease progression

- **First month**
  - Thrombosis
  - Intimal hyperplasia
- **1-7 years**
  - Build-up of atherosclerosis with superimposed thrombus
- **7-10 years**
  - Occlusion



SVG Pathology





- **Friable atheroma and thrombi are bulky and particularly prone to distal embolization during PCI, leading to a significant increase in the risk of death or MI**

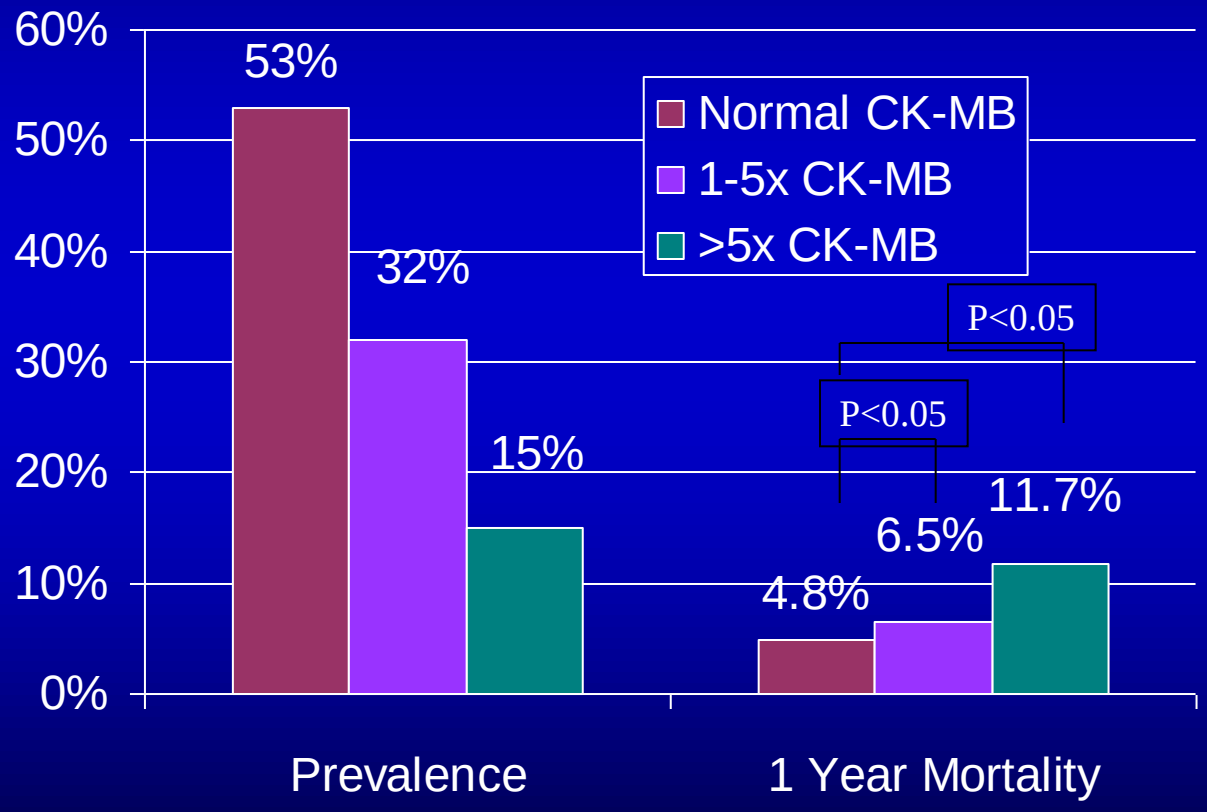
Saphenous Vein Graft PCI

- Is associated with worse outcomes compared with PCI of native coronaries
  - **Acute complications**
    - Periprocedural MI
    - No-reflow
  - **Long-term**
    - Restenosis
- Patients often have comorbid conditions, extensive disease, and LV dysfunction

CK-MB Rise in SVG PCI

Rates After Successful SVG Intervention

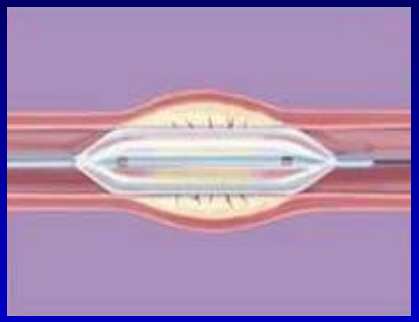
n=1056 consecutive SVG interventions

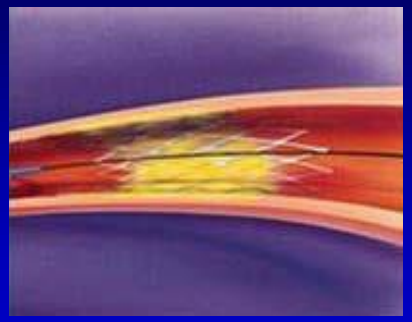


- 47% had CK-MB rise, even after successful PCI
- 15% had major CK-MB rise
- Even minor CK-MB rise related to a significant late mortality increase
- Patients with major CK-MB rise had 2.5x the mortality as those with normal CK-MB

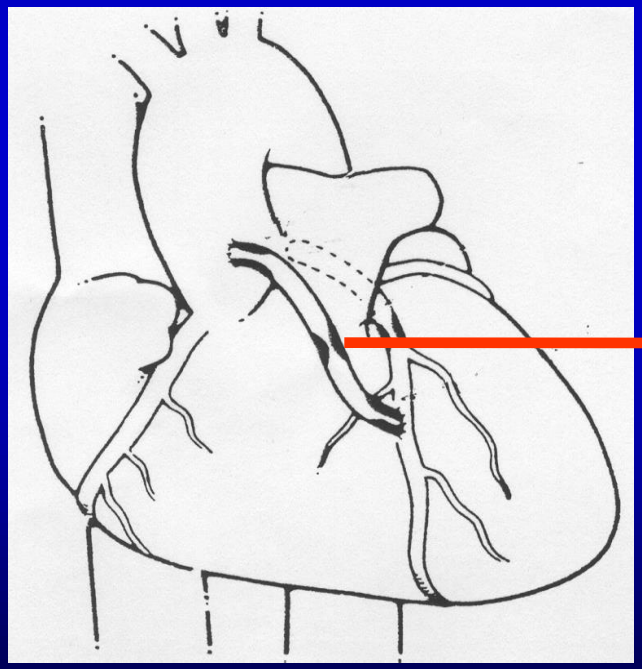
Hong, *et al.,* Circulation. 1999;100:2400-2405.

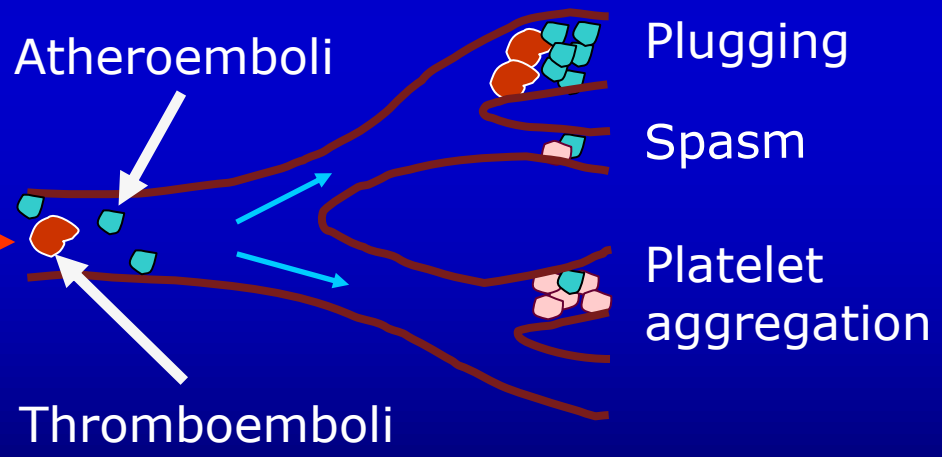
Causes of Microvascular Obstruction





- Distal embolization from PCI causes microvascular obstruction via plugging, with secondary spasm and platelet aggregation





Adapted from Hori M, *et al.*, *Am J Physiol.* 1986;250:H509-518.
Illustration by Boston Scientific Corporation.

No-Reflow Has Lasting Consequences

- Complicates 10–15% of SVG PCI[1]
- 31% rate of AMI[2]
- Increases in-hospital mortality by 10-fold[2]
- Atheroembolization is a key contributor[3]

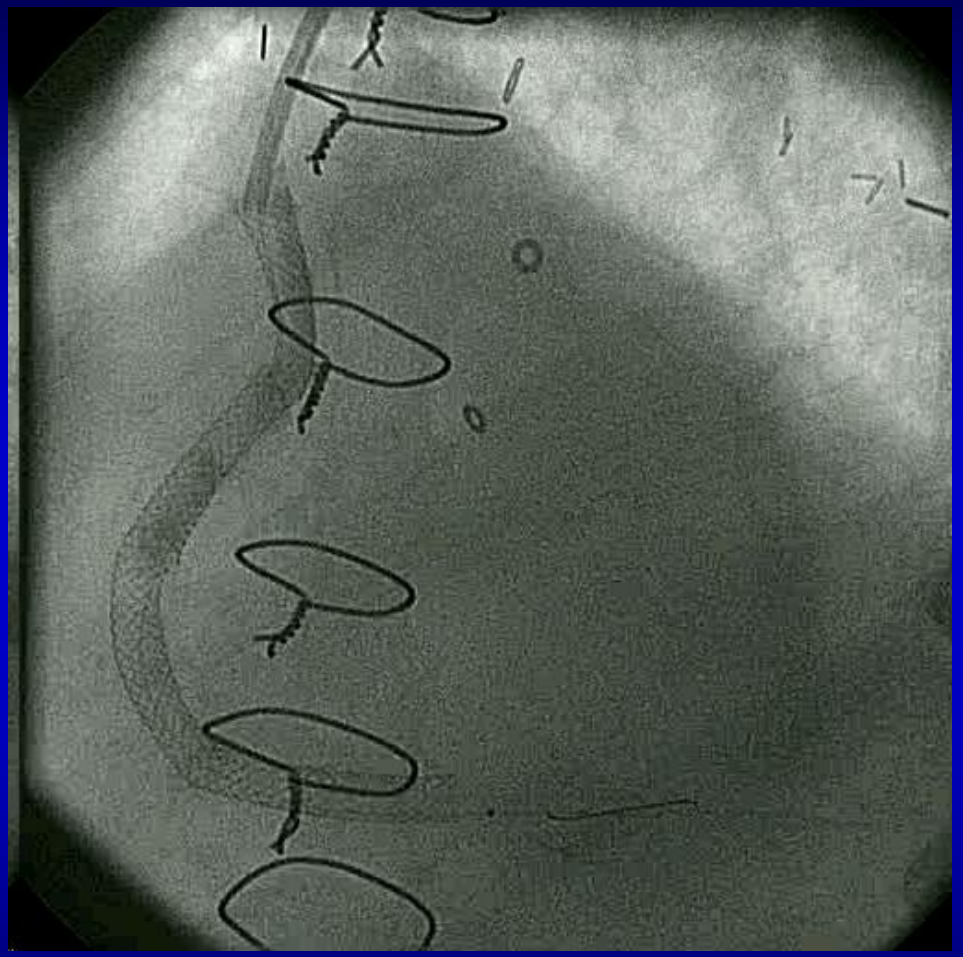


Image courtesy of Dr. Donald S. Baim

1 Sdringola, *et al.,* Cathet Cardiovasc Intervent. 2001
2 *Abbo, et al*., American Journal of Cardiology, 1995.
3 Rezkalla, *et al.,* Circulation. 2002.

STATE-OF-THE-ART PAPER

Saphenous Vein Graft Intervention

State-of-the-Art 2011

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Saphenous vein grafts are commonly used conduits for surgical revascularization of coronary arteries but are associated with poor long-term patency rates. Percutaneous revascularization of saphenous vein grafts is associated with worse clinical outcomes including higher rates of in-stent restenosis, target vessel revascularization, myocardial infarction, and death compared with percutaneous coronary intervention of native coronary arteries. Use of embolic protection devices is a class I indication according to the American College of Cardiology/American Heart Association guidelines to decrease the risk of distal embolization, no-reflow, and periprocedural myocardial infarction. Nonetheless, these devices are underused in clinical practice. Various pharmacological agents are available that may also reduce the risk of or mitigate the consequences of no-reflow. Covered stents do not decrease the rates of periprocedural myocardial infarction and restenosis. Most available evidence supports treatment with drug-eluting stents in this high-risk lesion subset to reduce angiographic and clinical restenosis, although large, randomized trials comparing drug-eluting stents and bare-metal stents are needed. (J Am Coll Cardiol Intv 2011;xx:xxx)

Should embolic protection be used for SVG Intervention?

Helping Cardiovascular Professionals Learn. Advance. Heal.

American Heart Association.

SCAI The Society for Cardiovascular Angiography and Interventions

SVG PCI

Recommendation	COR	LOE
Embolic protection device use when technically feasible	I	B
GP IIb/IIIa inhibitors	III - No Benefit	B
PCI for chronic SVG occlusions	III - Harm	C

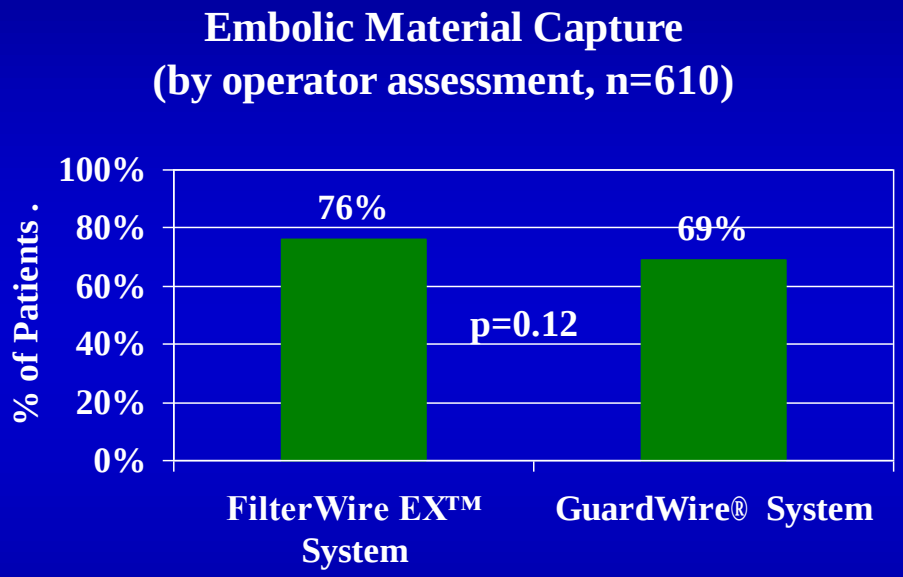
2011 ACCF/AHA/SCAI Guideline for PCI (and Coronary Revascularization)

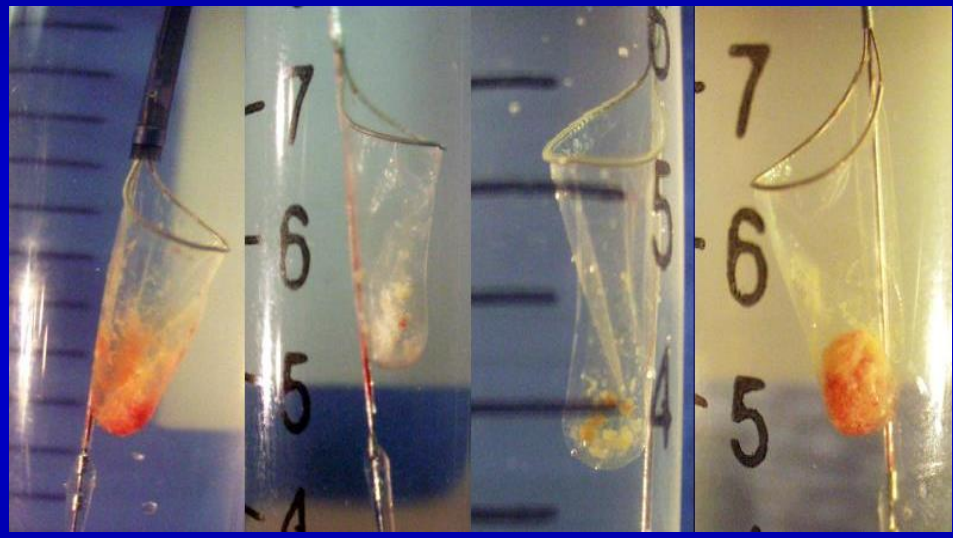
UCLA BRUINS

Rationale for Embolic Protection

- **Embolization is common and is associated with 8-10 fold increase in mortality**
- **Although risk factors can be identified, embolization cannot be reliably predicted**

Material Capture: FIRE Trial



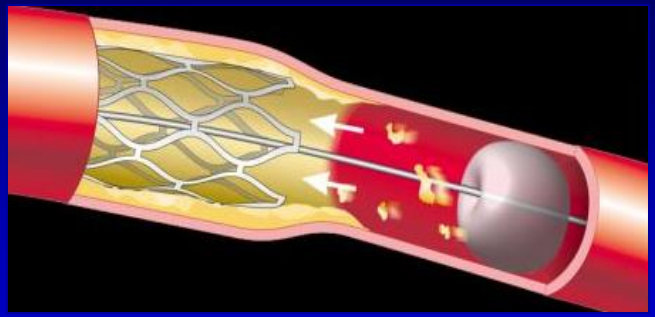


Material capture is common and independent of patient demographics, clinical presentation, and lesion characteristics.

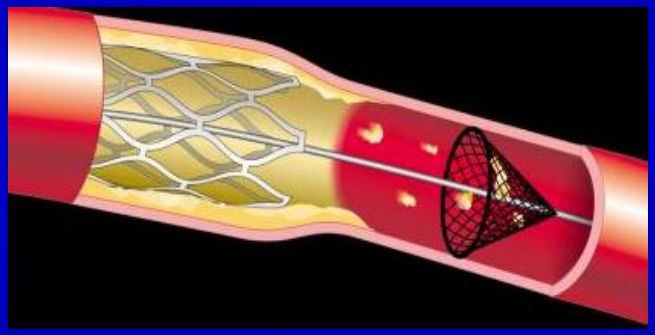
Weisz, et.al. JACC Vol. 43, (suppl A); 72A-73A

Embolic Protection Devices

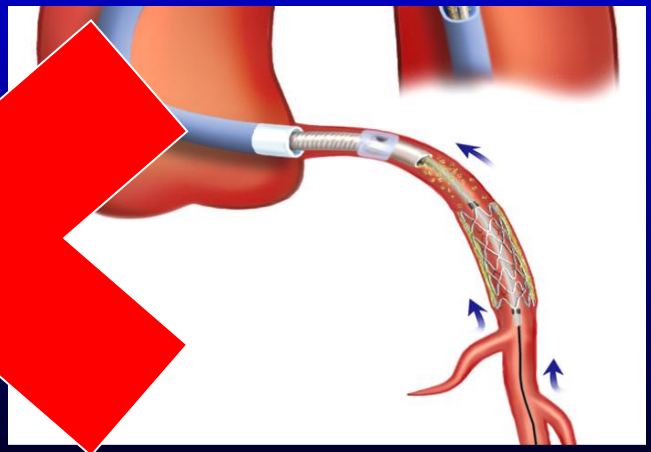
Distal occlusion + aspiration (Percusurge)



Distal filters



Proximal occlusio
aspiration



Occlusion and Aspiration

Advantage

- Easy to cross lesion
- Captures smaller particles and “humoral” mediators
- Easy device retrieval

Disadvantage

- Difficult to image during stenting
- Balloon injury
- Transient occlusion/ischemia
- May not catch particles near balloon and not get full evacuation
- Cumbersome operation

SAFER (Saphenous Vein Graft Angioplasty Free of Emboli Randomized) Trial

801 patients with SVG Disease

Mean graft age 10.4 yrs (range 7-13)

Randomized

GuardWire Plus
n=406

Conventional Guidewire
n=395

Endpoint: 30-day MACE

Baim DS, et al. Circulation 2002

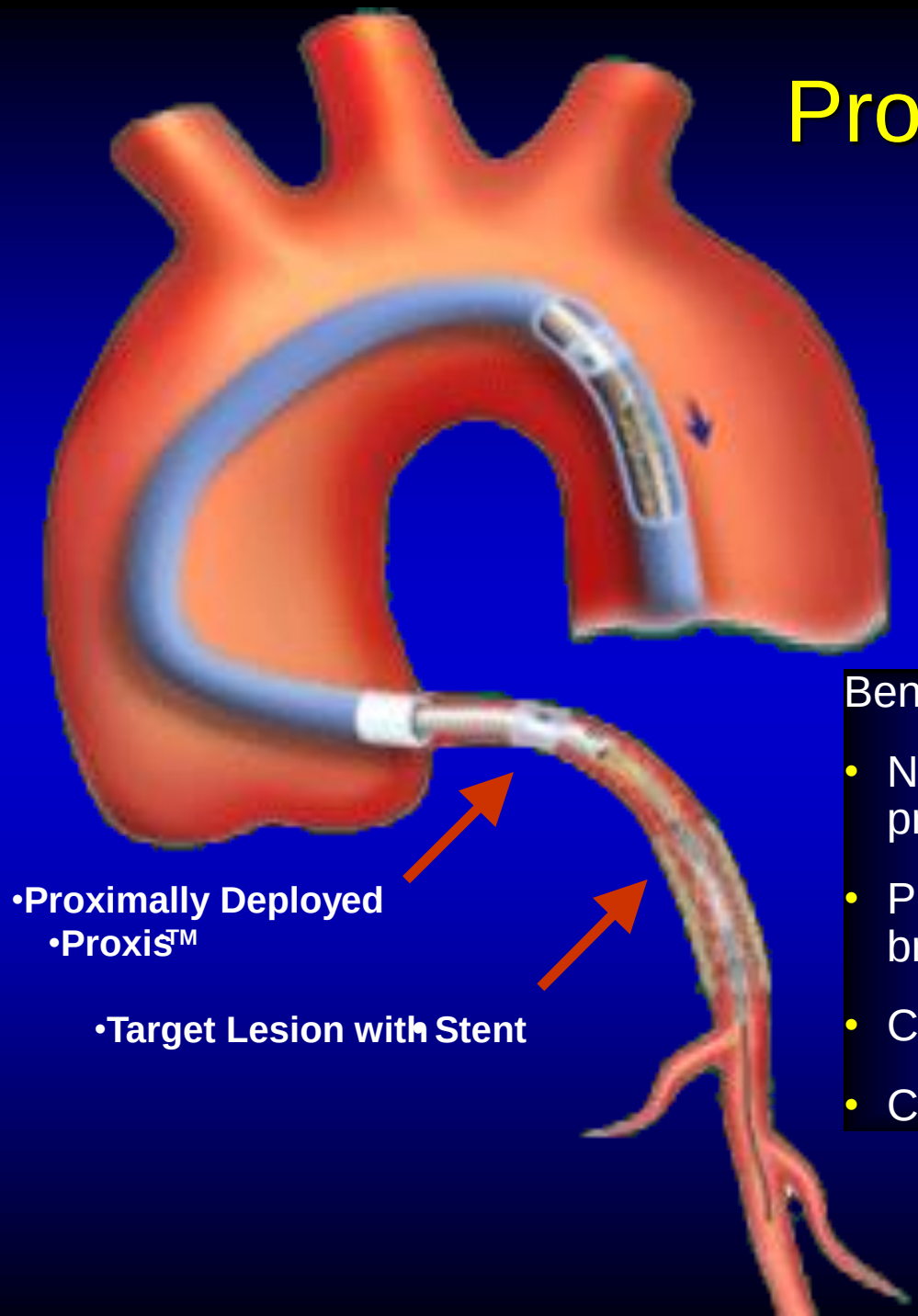
SAFER Trial

*Primary Endpoint

	With protection (n=406)	No protection (n=395)	P-value
***MACE out to 30 days**	9.6%	16.5%	*p=.004*
•All MI	8.6%	14.7%	*p=.008*
•*Q-wave MI*	*1.2%*	*1.3%*	*NS (p=1.00)*
•*Non Q-wave MI*	*7.4%*	*13.7%*	*p=.004*
•Death	1.0%	2.3%	*NS (p=.171)*
•Emergent CABG	0.0%	0.5%	*NS (p=.243)*
•TLR	1.0%	2.0%	*NS (p=.257)*

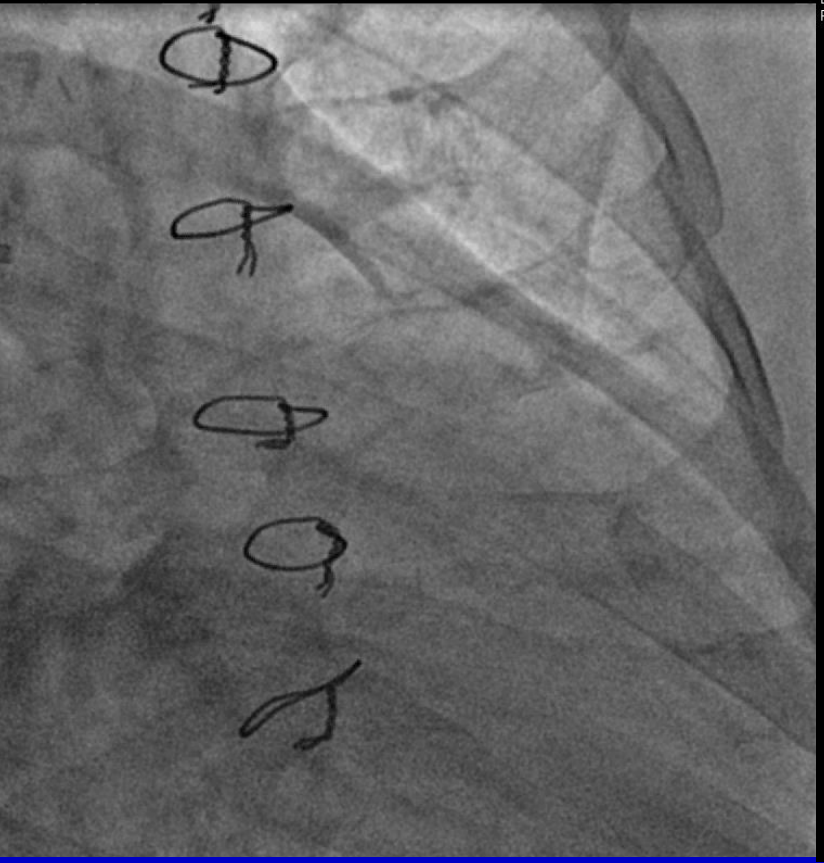
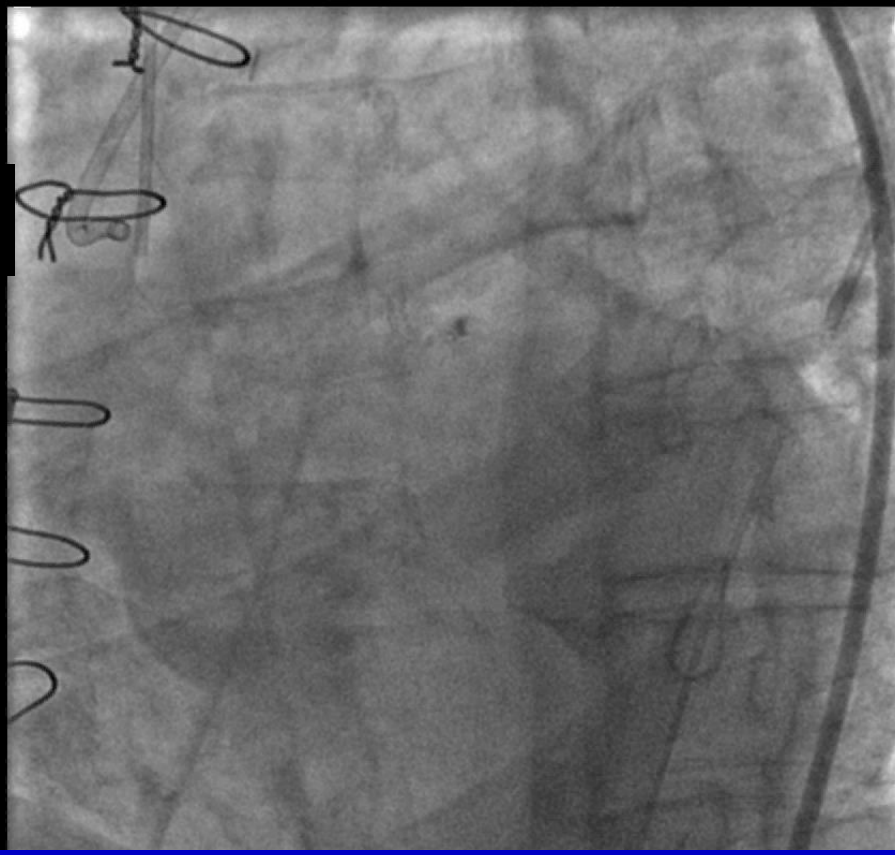
Baim DS, *et.al.,* Circulation. 2002;105:1285-1290.

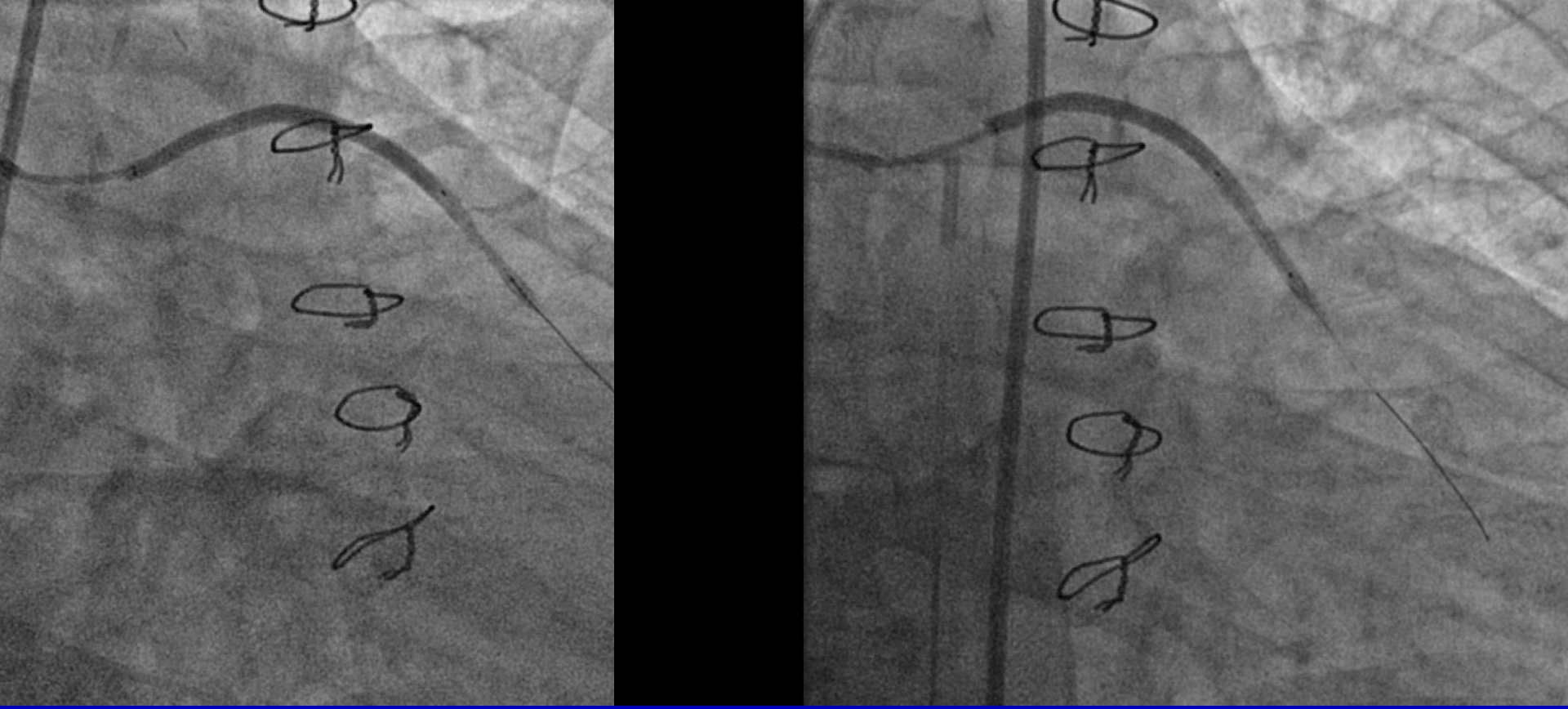
Proxis

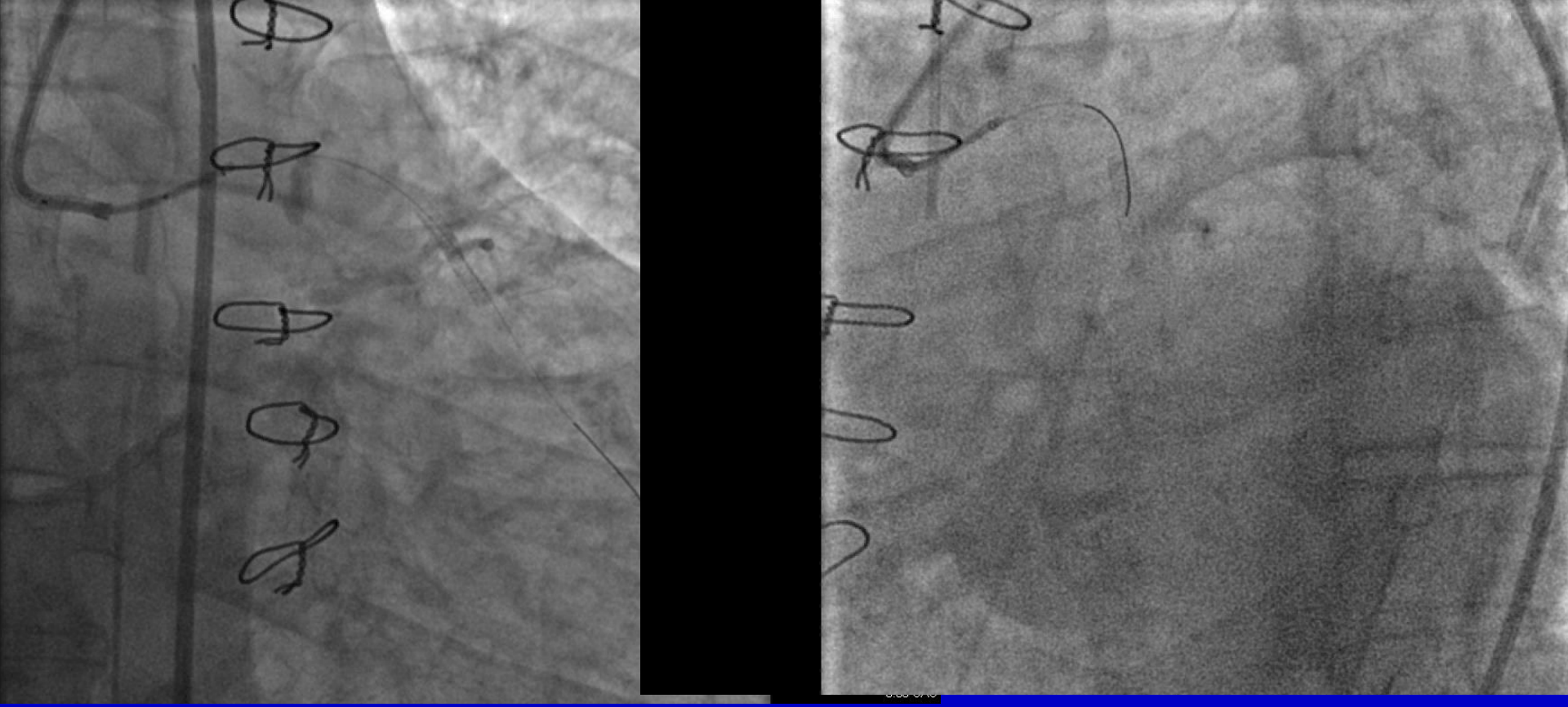


Benefits

- Nothing crosses the lesion prior to protection
- Protection of main vessel and side branches
- Captures large and small particles
- Can handle large embolic loads


LEE,JM
Ronald Reagan UCLA Medical






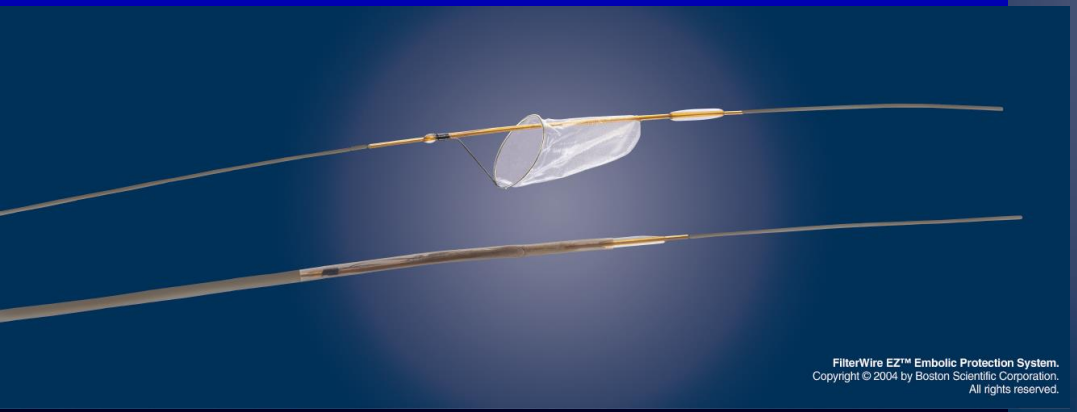
Filters

Advantage

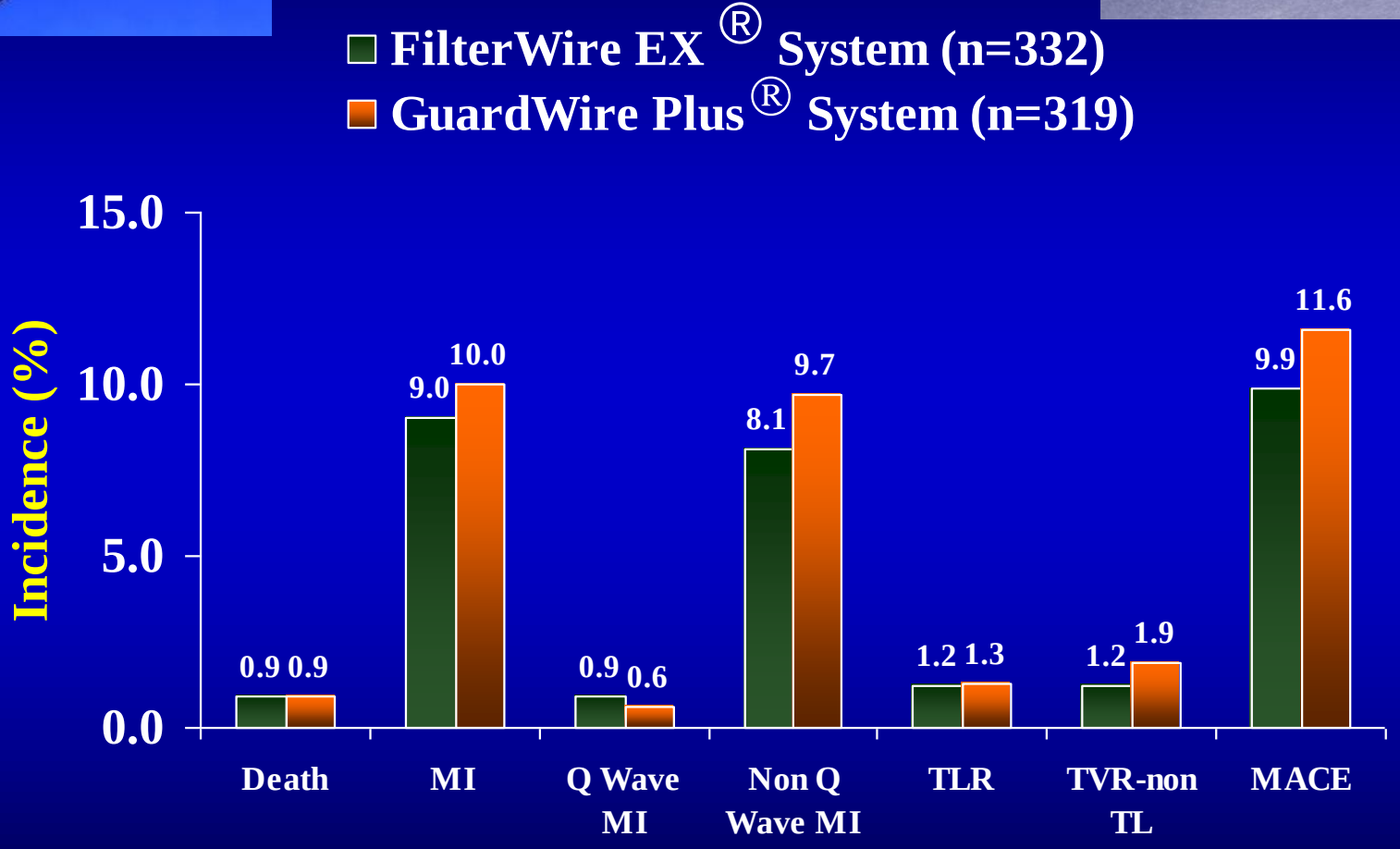
- Maintain Flow
- Visualization during procedure
- Non-ischemic
- Intuitive operation

Disadvantage

- May not capture all particles <100 micron
- Does not control secretions of humoral factors

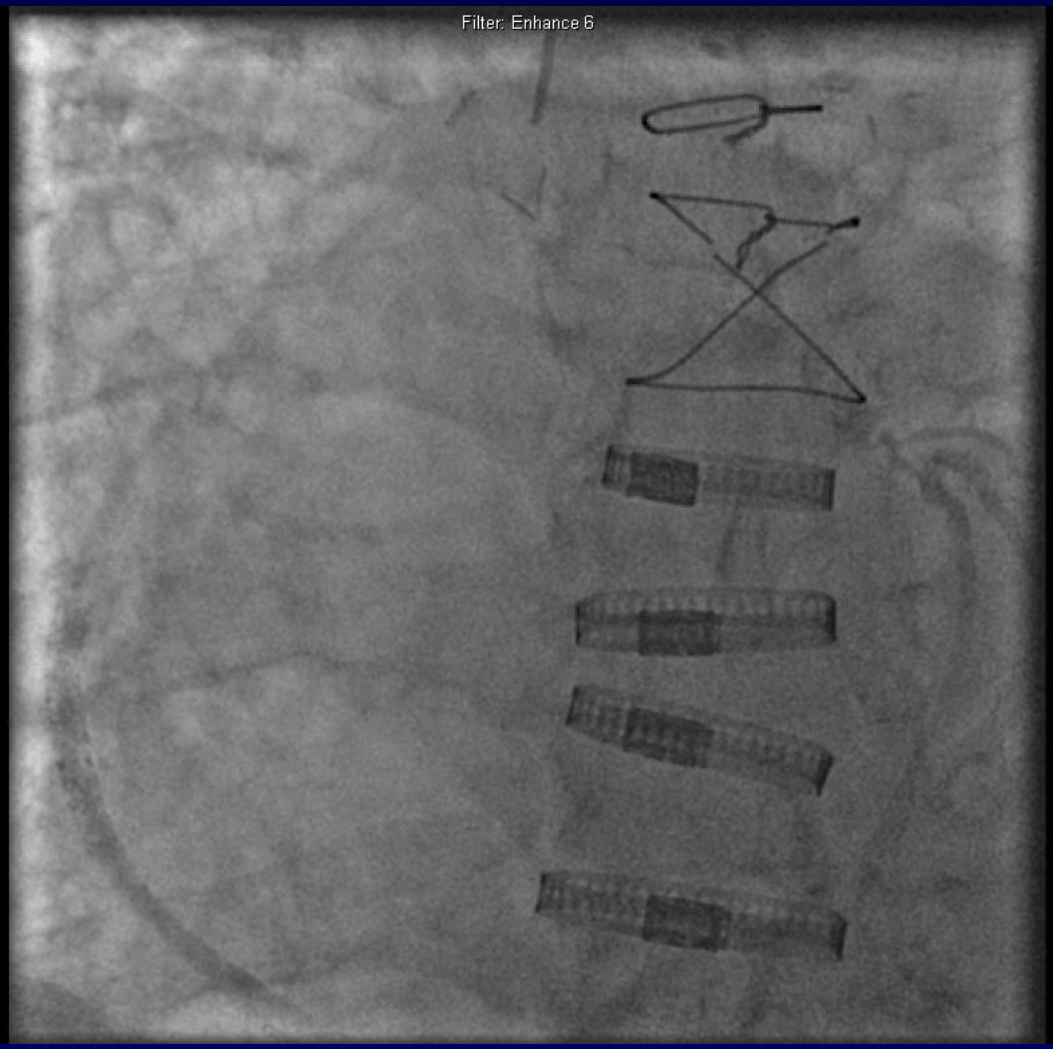


FIRE Trial
30-Day MACE



P = 0.0016 (non-inferiority for MACE with 5.5% delta)

Stone et al. Circulation 2003.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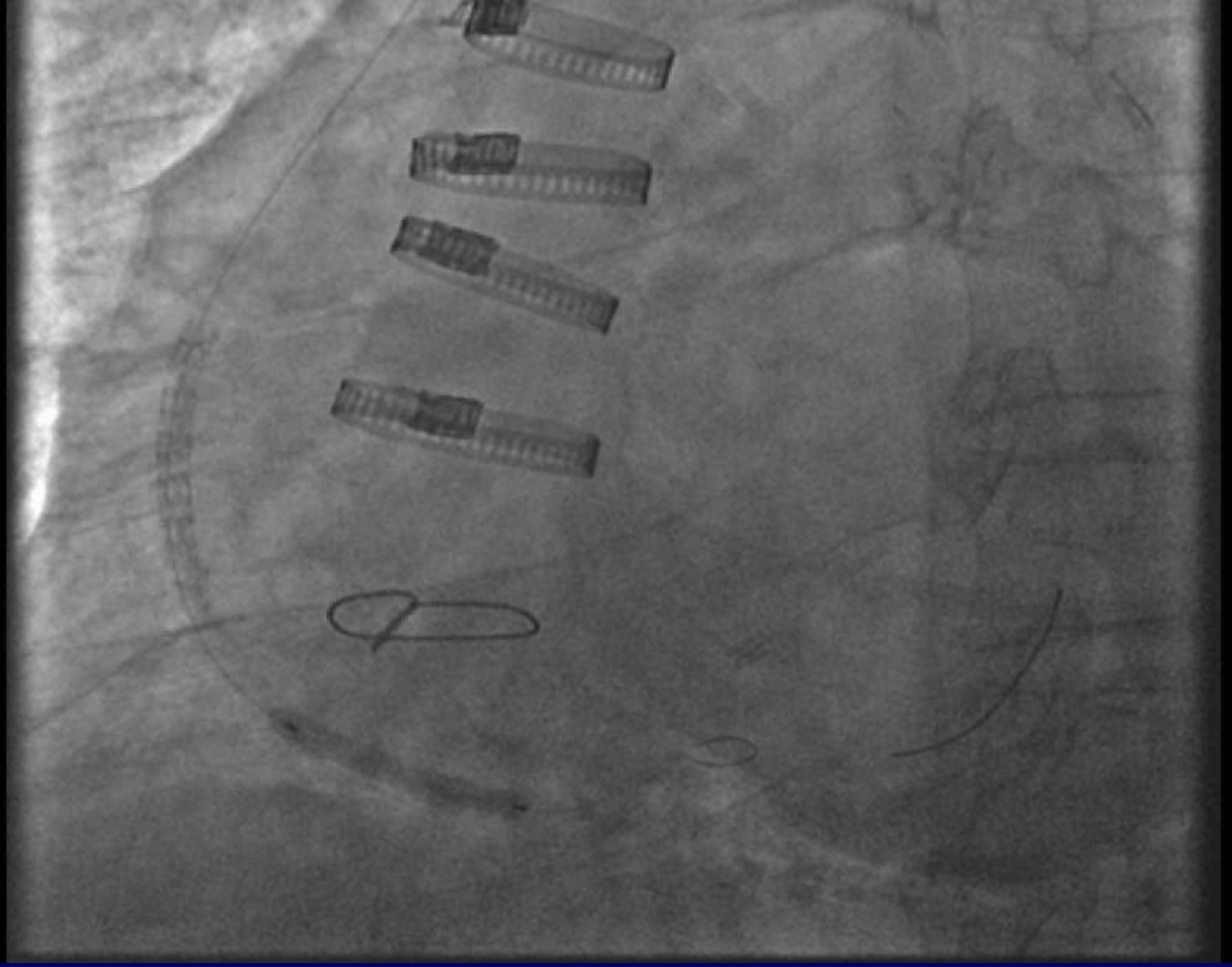
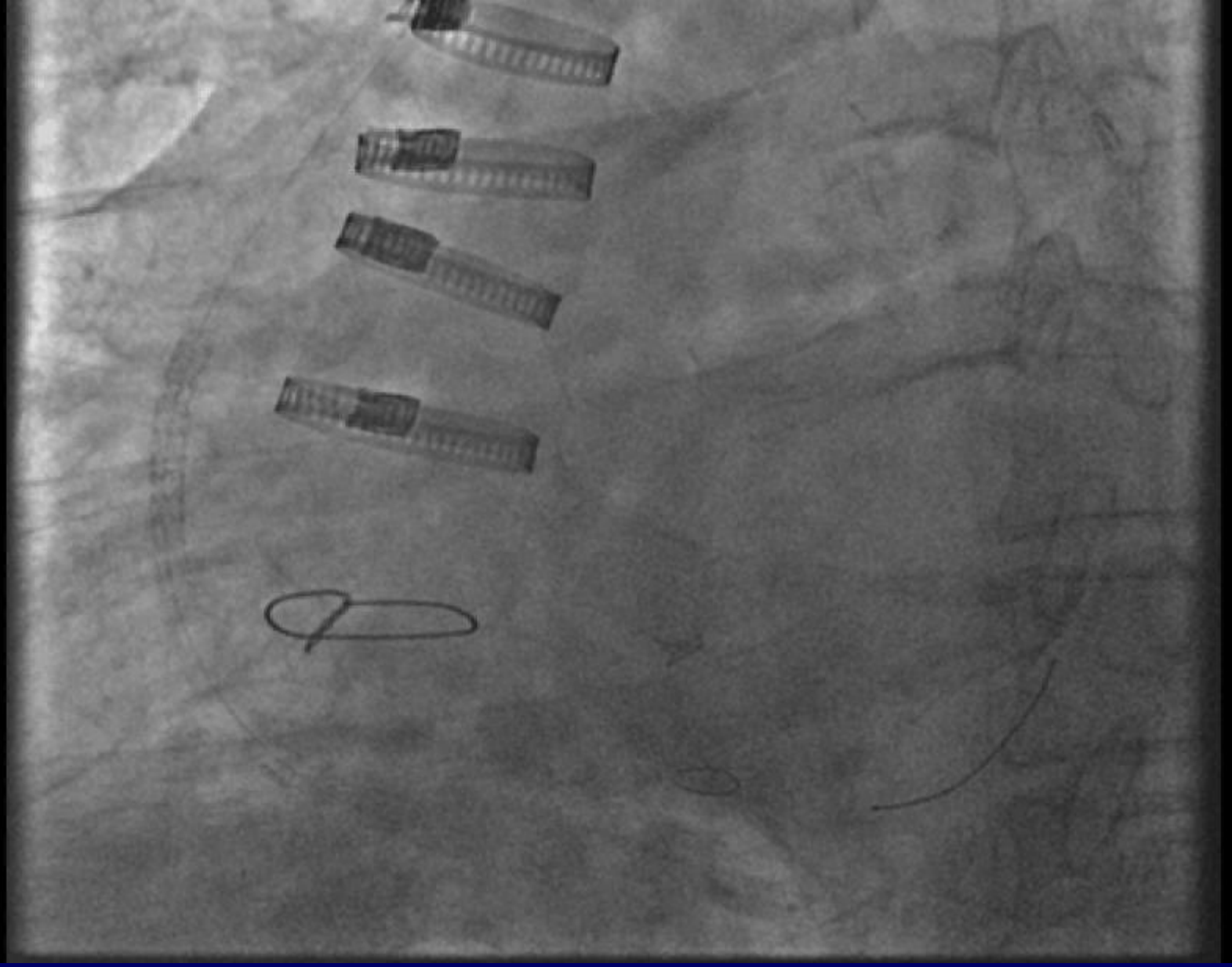
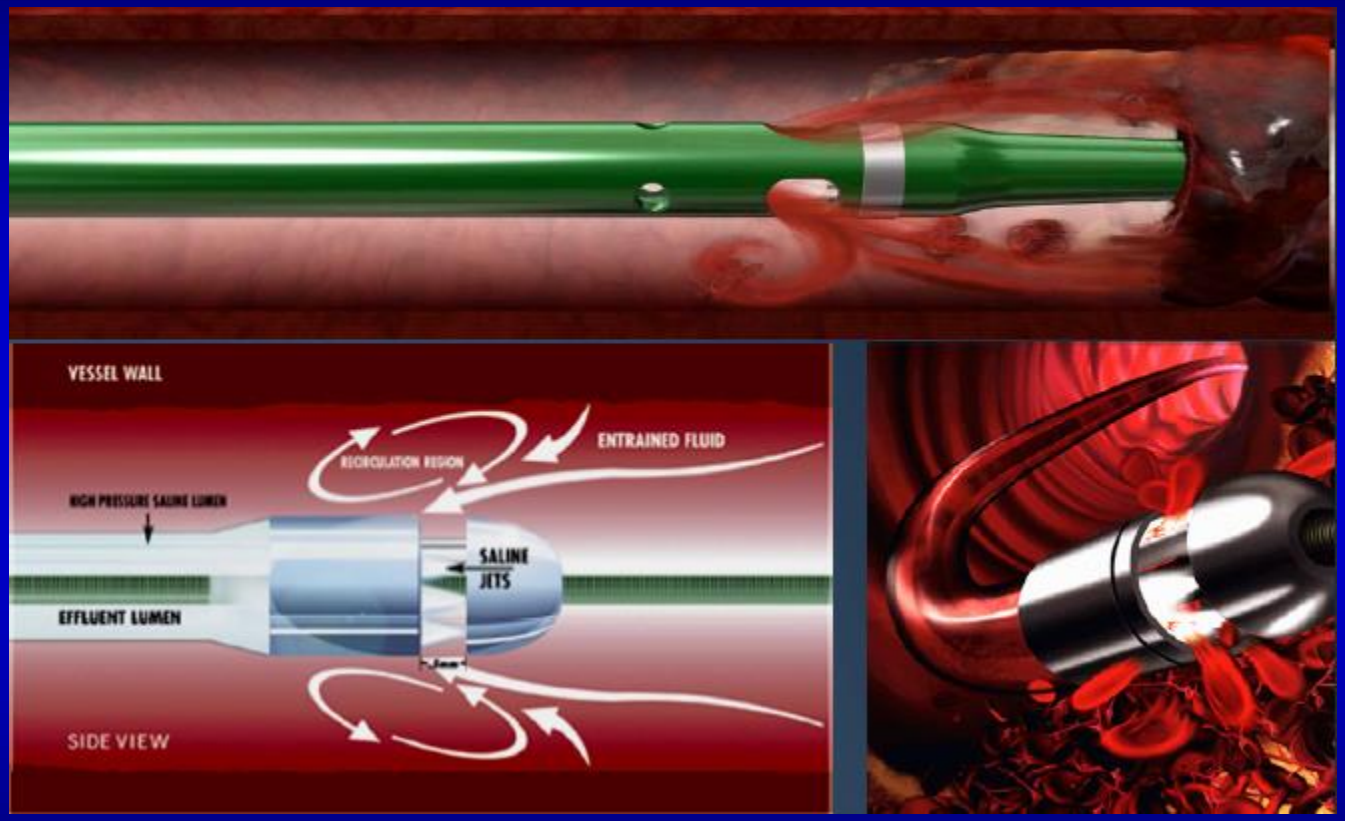


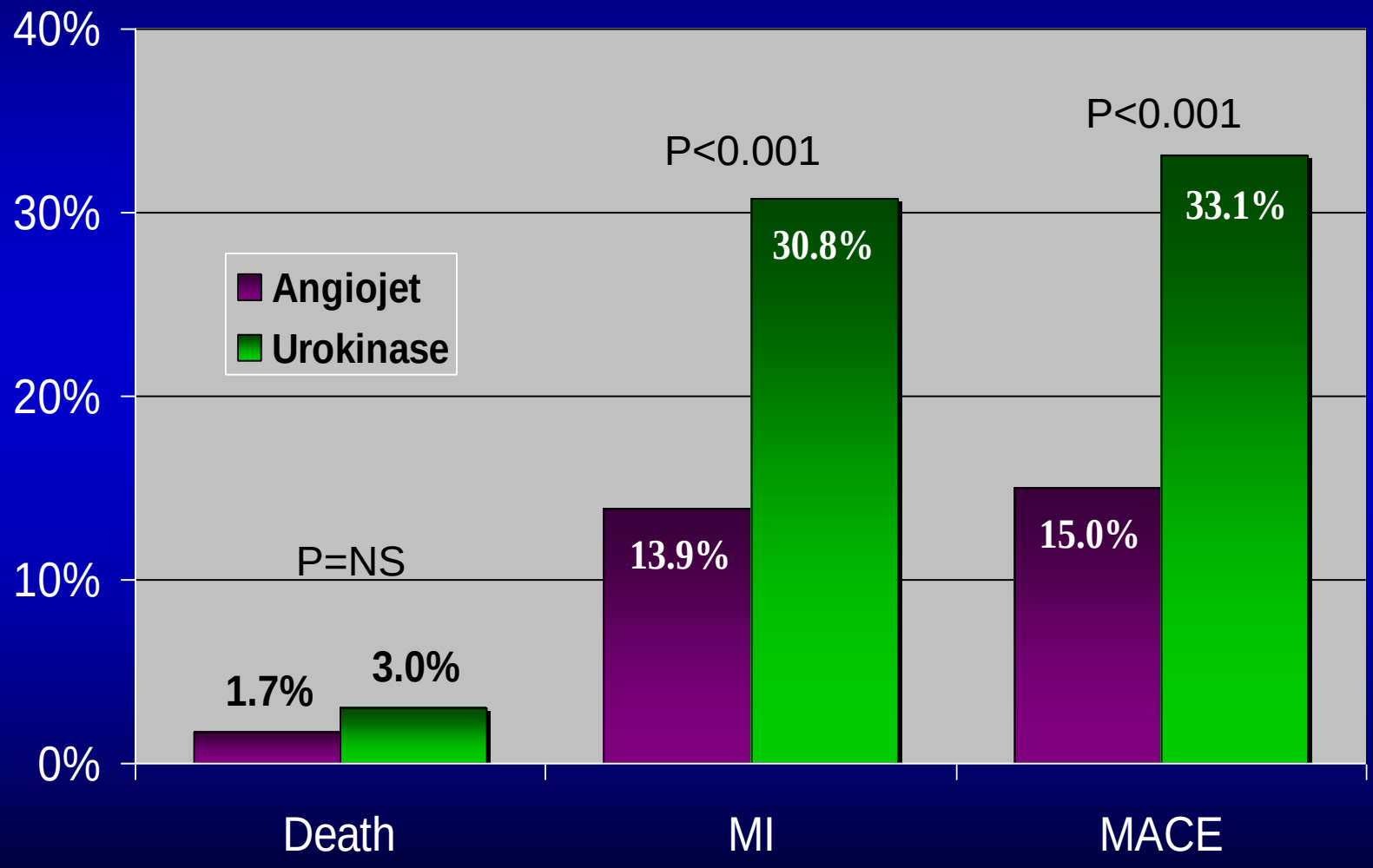


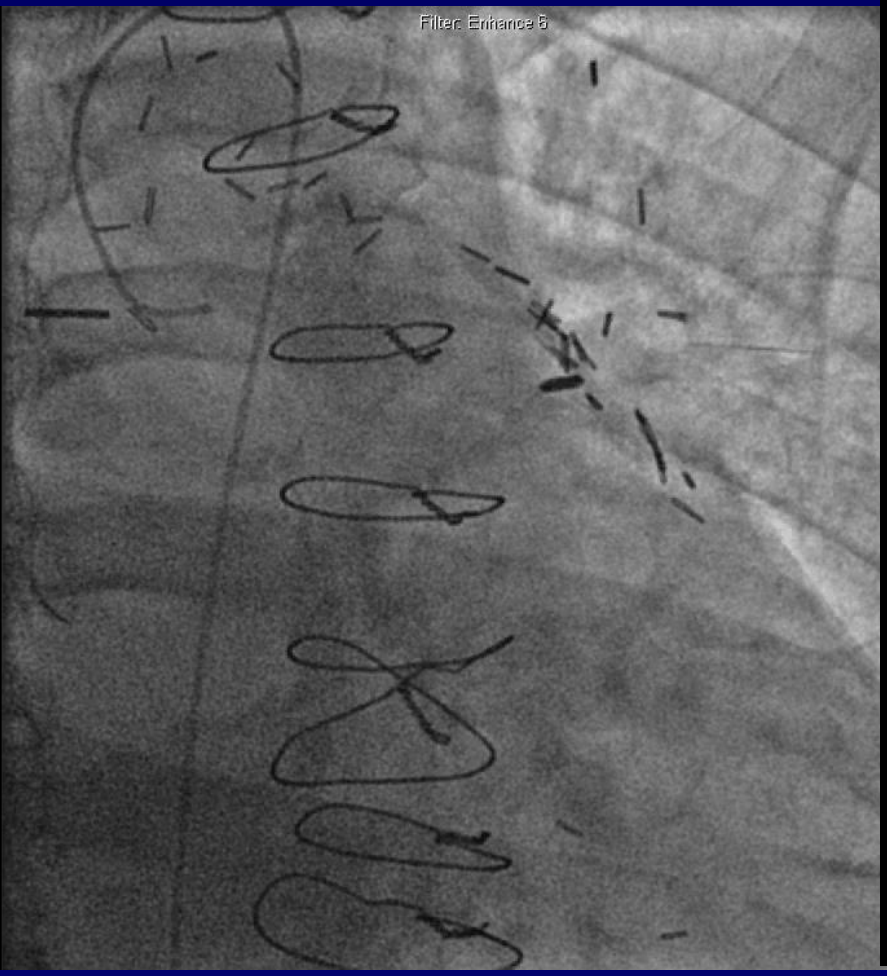
AngioJet Thrombectomy



30-Day Clinical Results

Stopped early (349 vs 500) by DSMB!

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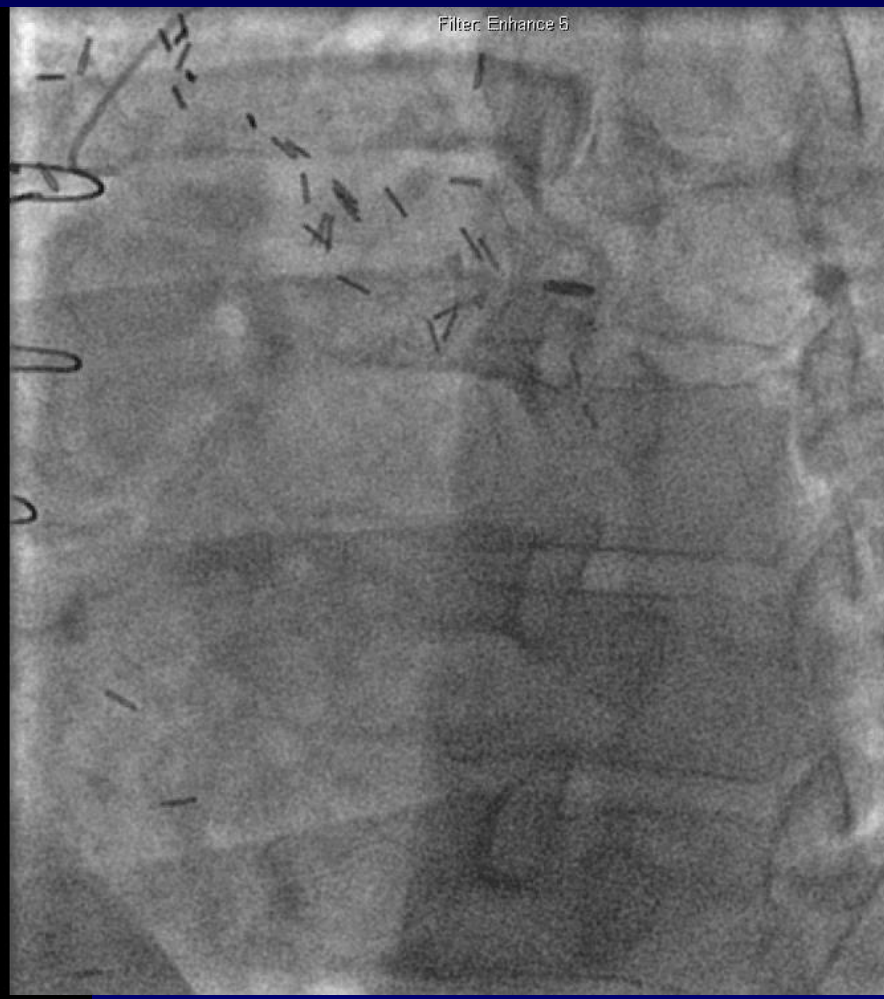
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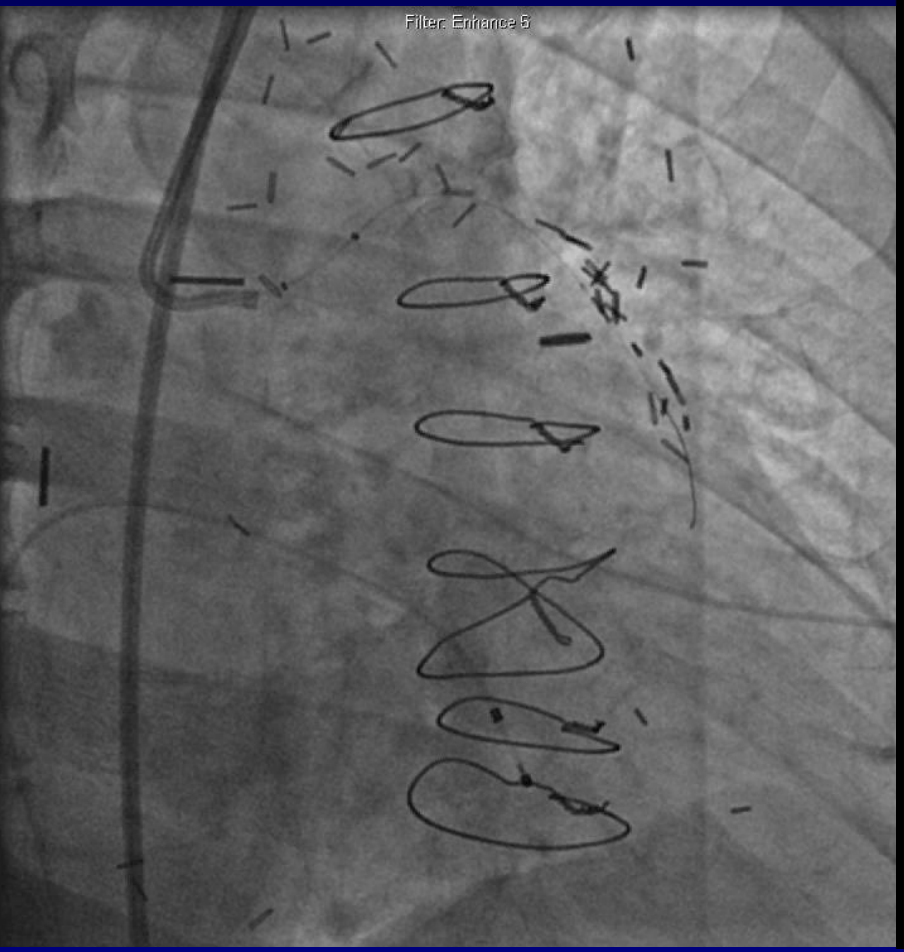
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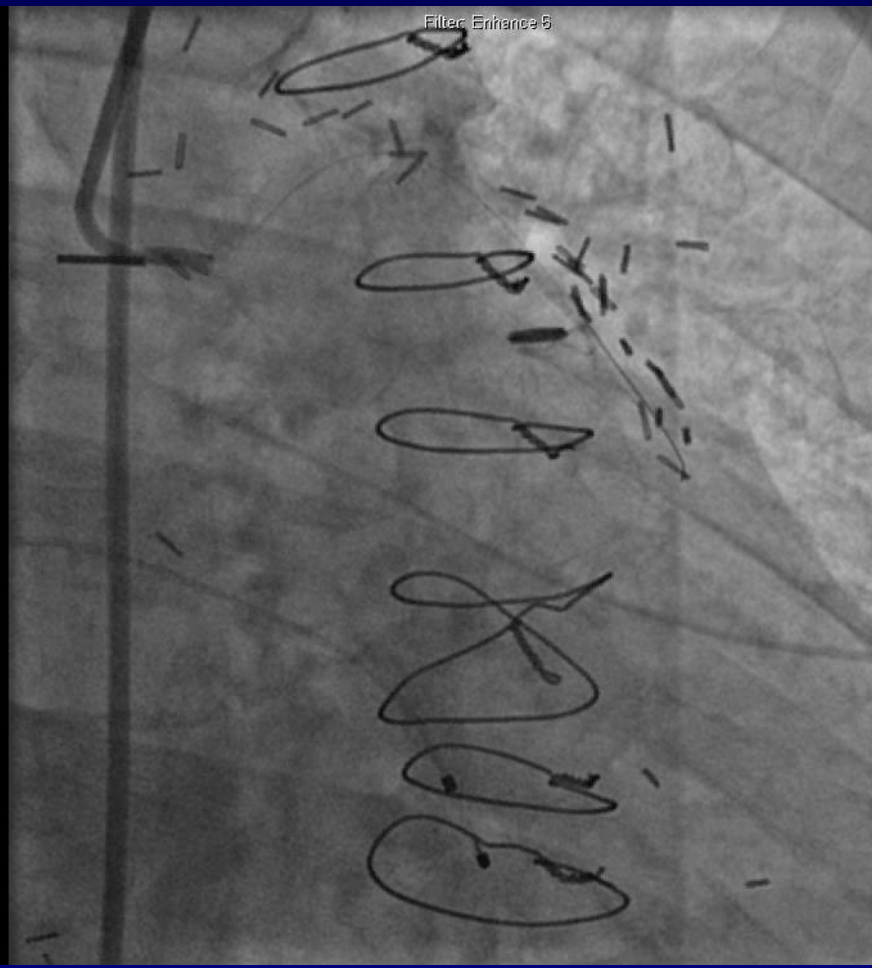
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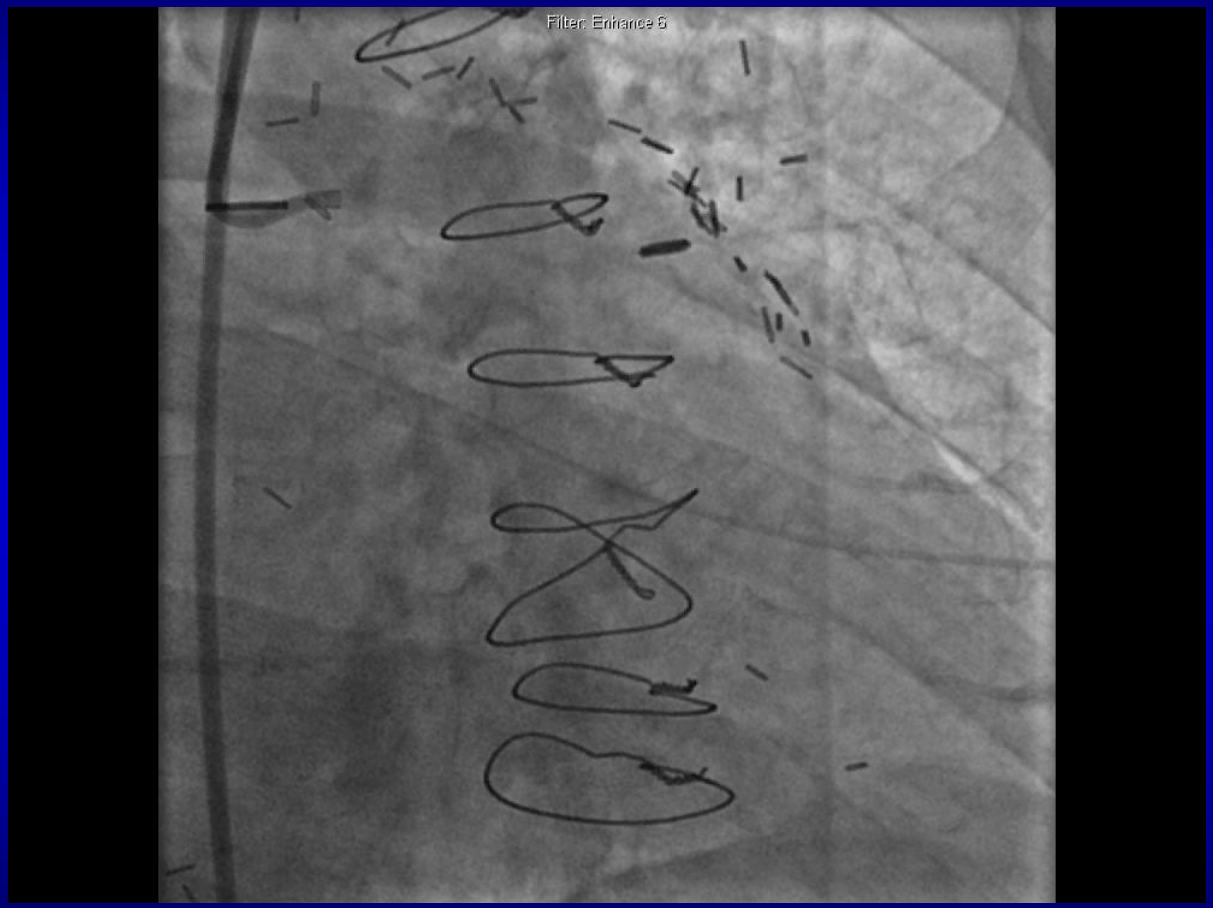
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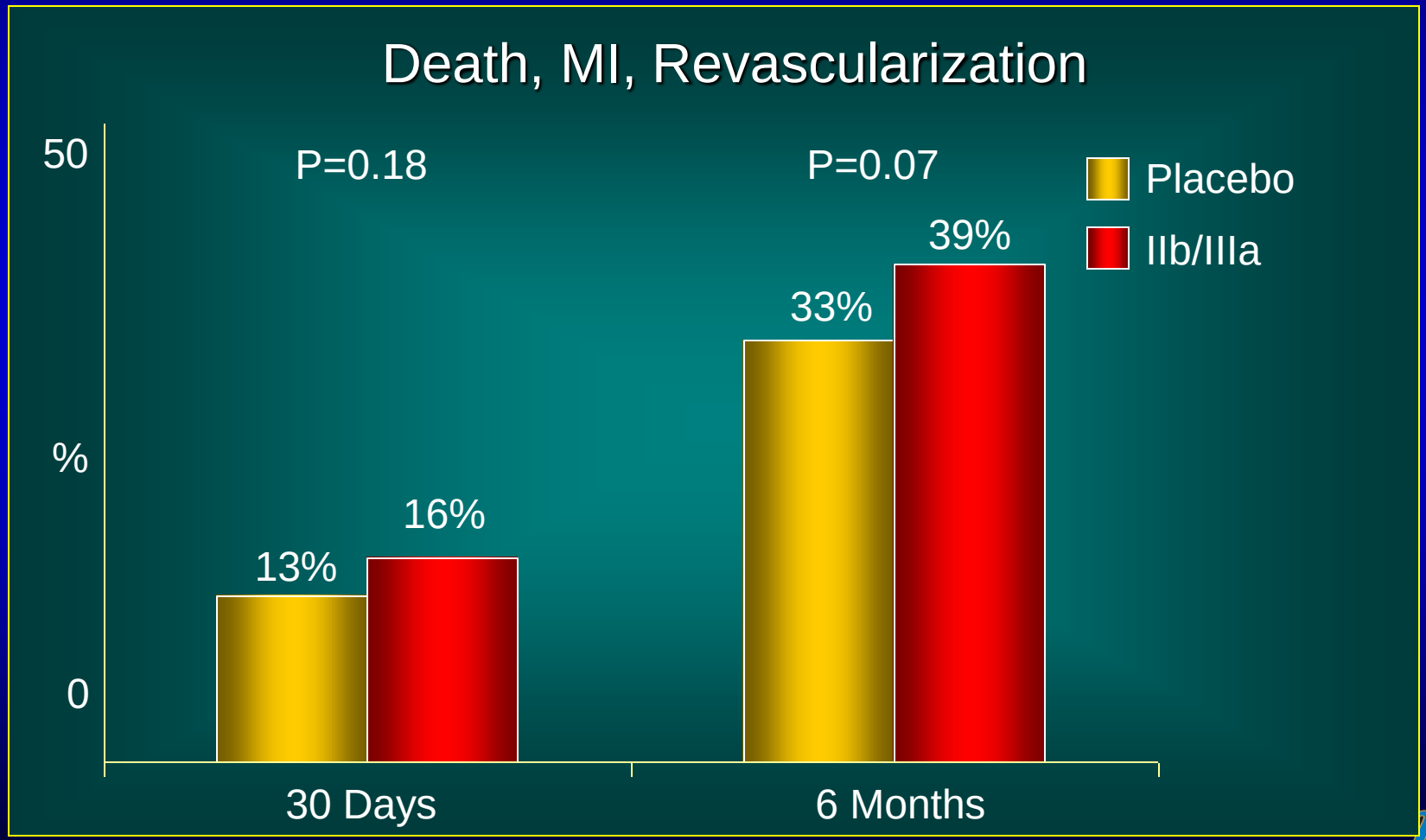
Is there any role of GP IIb/IIIa receptor antagonists in SVG Intervention?

Lack of Benefit of GPIIb/IIIa Inhibitors in SVG PCI

Pooled Analysis of 5 Randomized Trials



Roffi et al. Circulation 2002

Conclusion

IIbIIIa inhibitors offer NO benefit in SVG intervention

DES vs. BMS for SVG Intervention

223 consecutive patients underwent SVG intervention

Non-randomized, single center, retrospective analysis

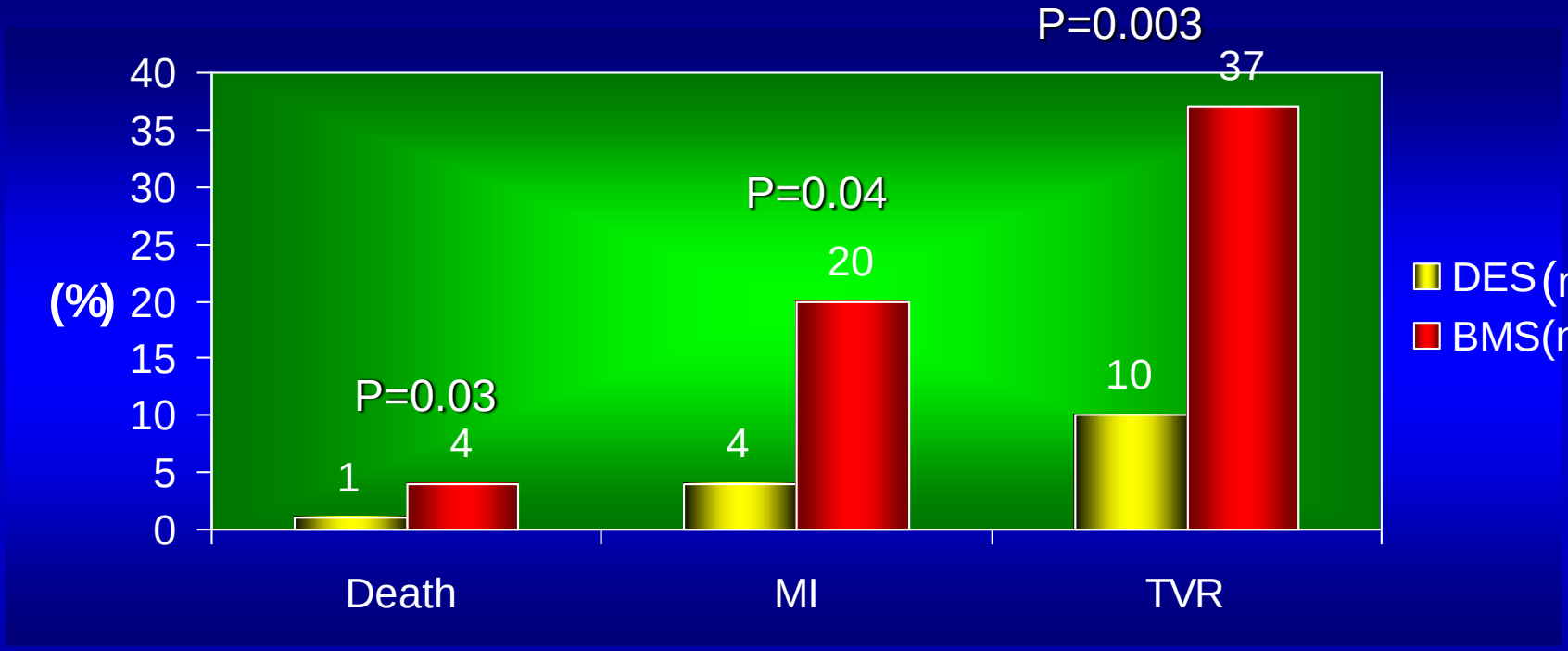
Operator discretion

BMS (201 stents)
n=84 patients

DES (289 stents: 211 SES, 78 PES)
n=139 patients

Lee MS, et al. Catheter Cardiovasc Interv 2005

Clinical Outcomes at 9 Months



Lee MS et al. Cathet Cardiovas Interv 2005.

RRISC Trial

Reduction of Restenosis In Saphenous vein grafts with Cypher stent

75 patients with 96 lesions localized in 80 diseased SVG.
Prospective, randomized, double-blind, non industry sponsored, single center, trial

Randomized

BMS
n=37

Cypher stent
n=38

Primary endpoint
- -6-month in-stent late loss

Secondary endpoints (all at 6 months follow up):
- -Binary angiographic restenosis (in-stent/in-segment)
- -Clinical events (death, MI, TLR, TVR)

Vermeersch et al. JACC 2006

6-month MACE

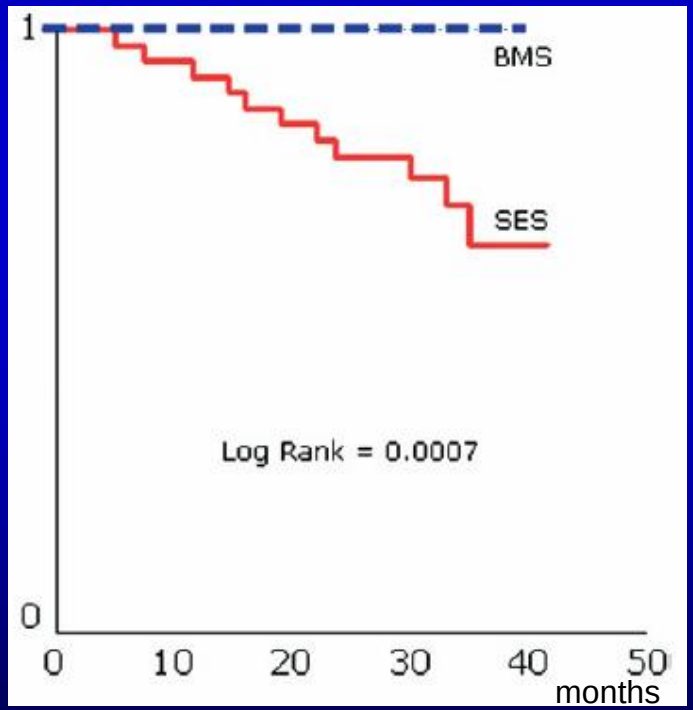
	BMS n=37	SES n=38	P value
In-hospital			
Death	**0**	**0**	
Repeat revascularization	**0**	**0**	
Periprocedural MI	**1 (2.7%)**	**2 (5.3%)**	**0.99**
Between discharge and 6 months			
Death	**0**	**1 (2.6%)**	**0.99**
Myocardial infarction	**0**	**1 (2.6%)**	**0.99**
TLR (per-patient)	**8 (21.6%)**	**2 (5.3%)**	**0.047**
TVR (per-patient)	**10 (27%)**	**2 (5.3%)**	**0.012**
Cumulative 6-month MACE	**11 (29.7%)**	**6 (15.8%)**	**0.15**

Vermeersch et al. JACC 2006

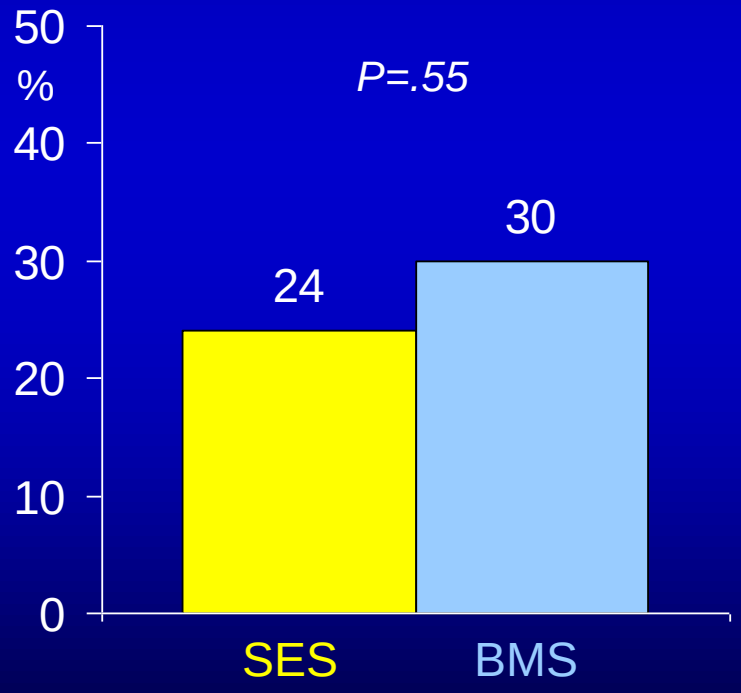
DES vs. BMS in Saphenous Vein Graft Lesions

DELAYED RRISC Trial
N=75

Survival



TLR



Vermeersch et al., JACC 2007

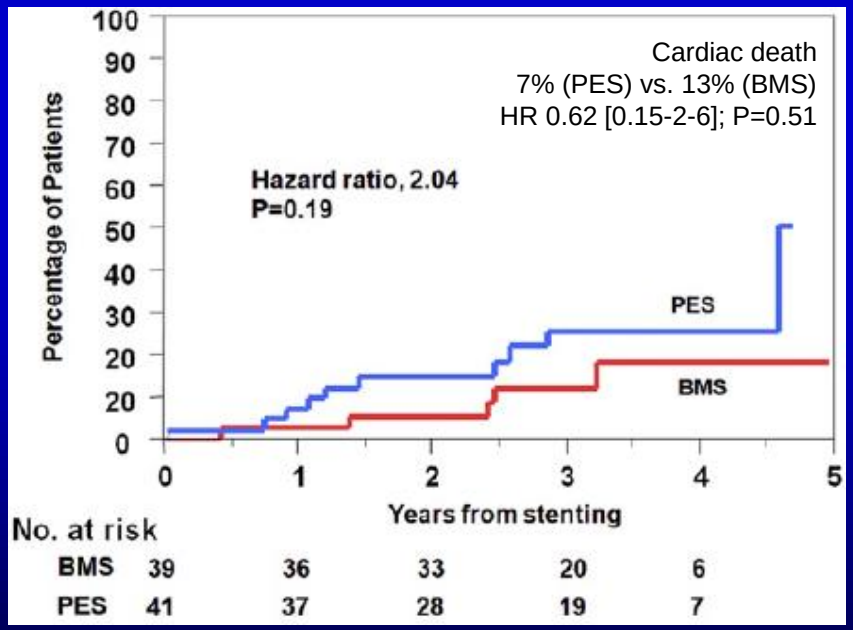
Stent Thrombosis
(ARC criteria)

	BMS n=37	SES n=38	P value
Definite	0	2 (5.2%) 1 fatal at 13 mo 1 non fatal at 30 mo	0.49
Probable	0	0	-
Possible	0	3 (7.9%) 1 sudden death at 7.5 mo 1 sudden death at 11.5 mo 1 sudden death at 35 mo	0.30
Total	0	5 (13.1%)	0.02 Log Rank

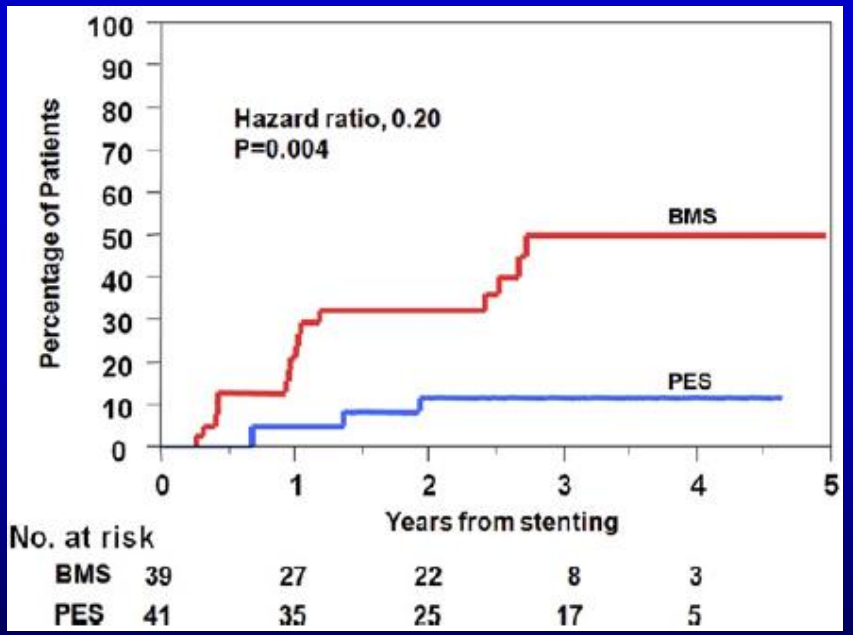
DES vs. BMS in Saphenous Vein Graft Lesions

SOS Trial
N=80

All-cause Death



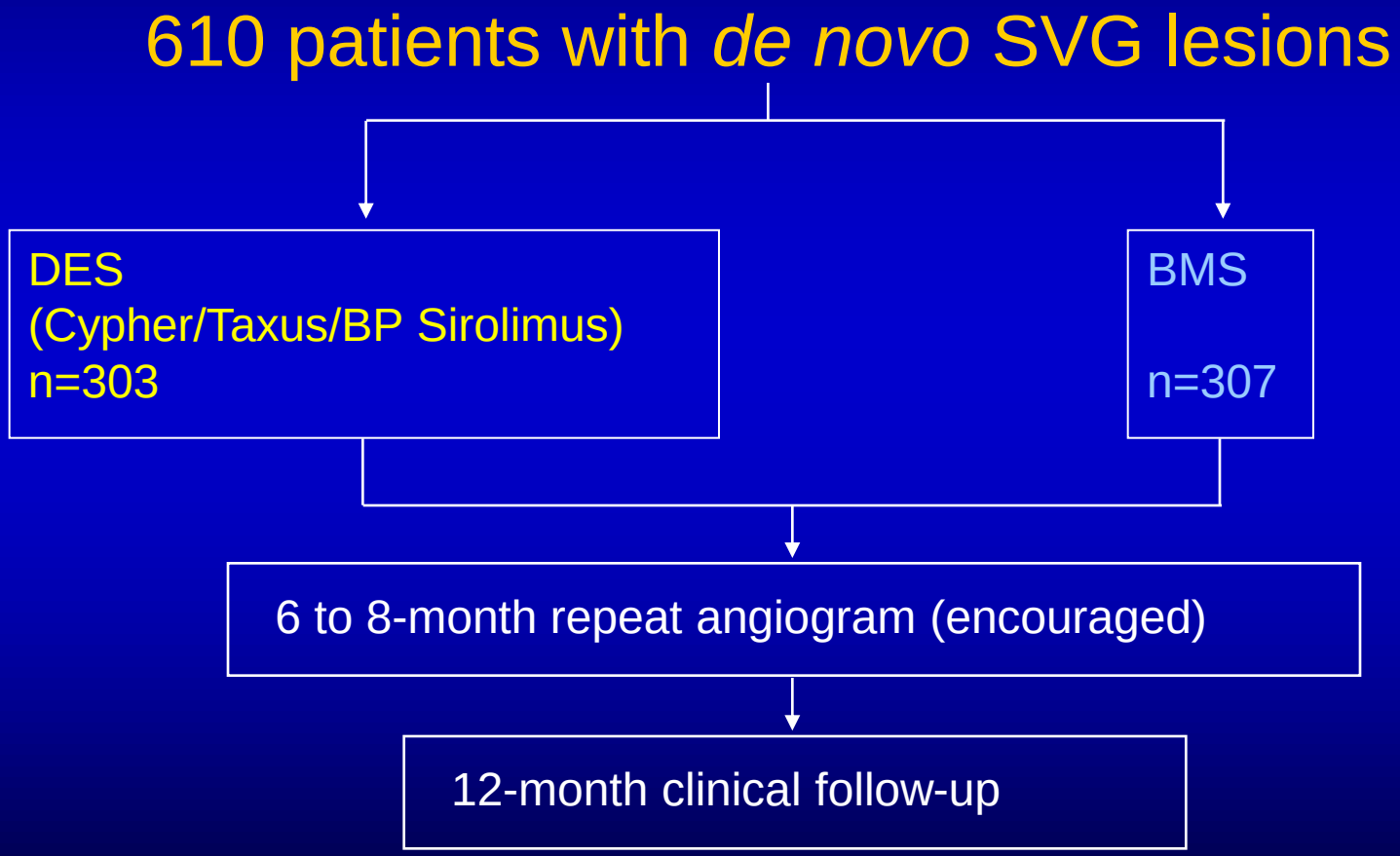
Target Lesion Revascularization



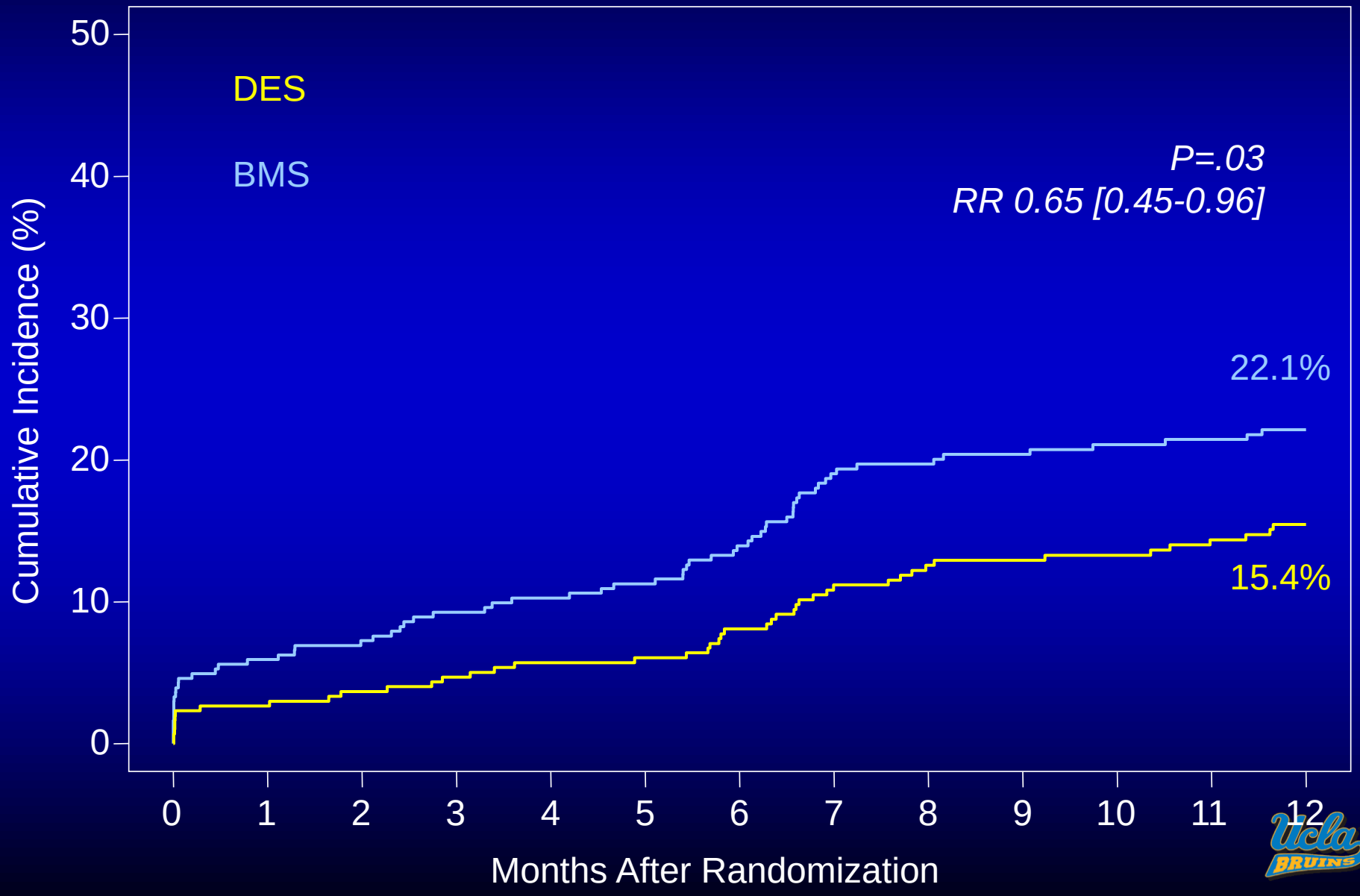
Brilakis et al., JACC Intv 2011

ISAR-CABG

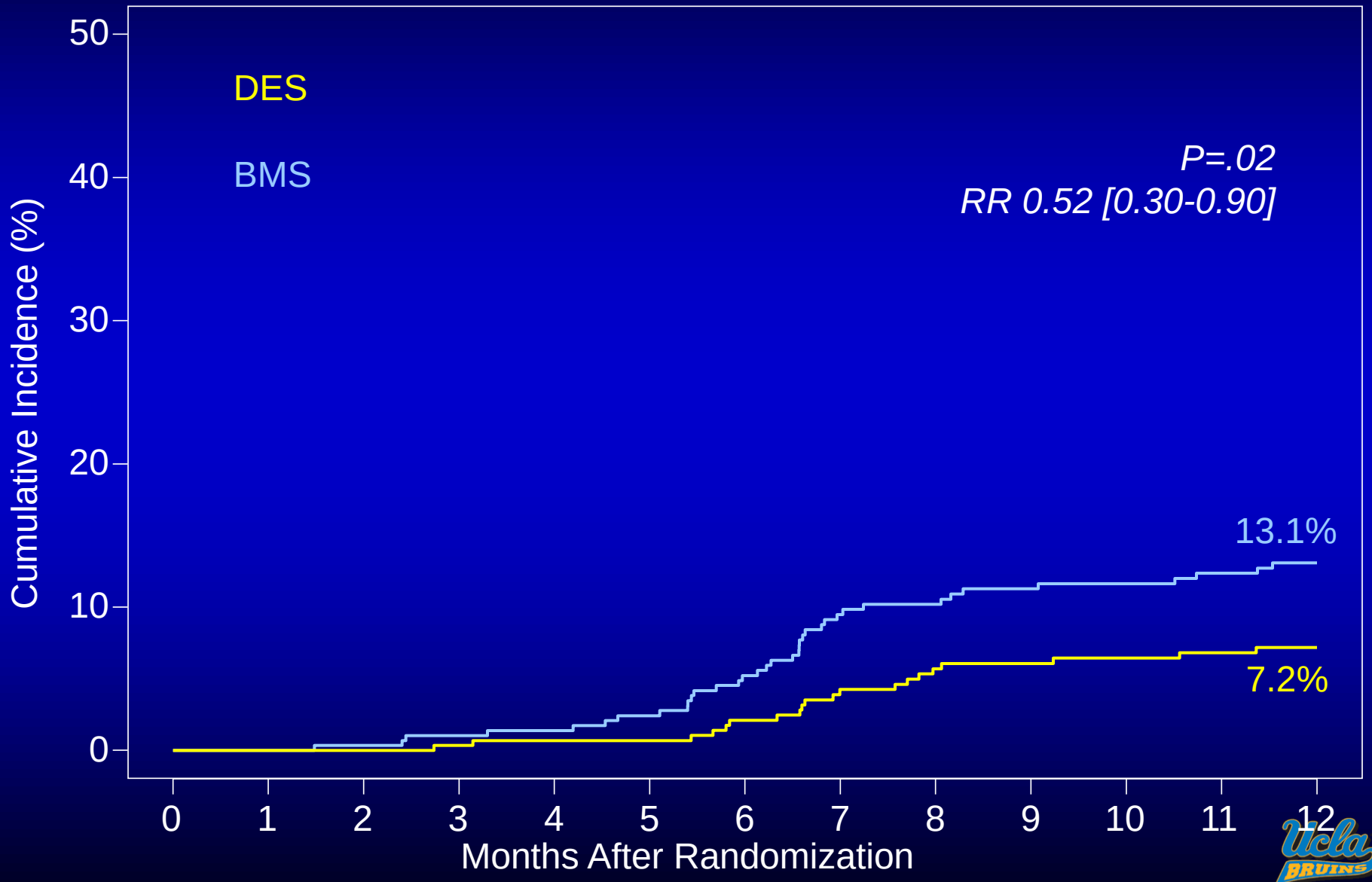
*I*s Drug-Eluting *S*tenting *A*ssociated With Improved *R*esults in *C*oronary *A*rtery *B*ypass *G*rafts?



Primary Endpoint: Death/MI/TLR

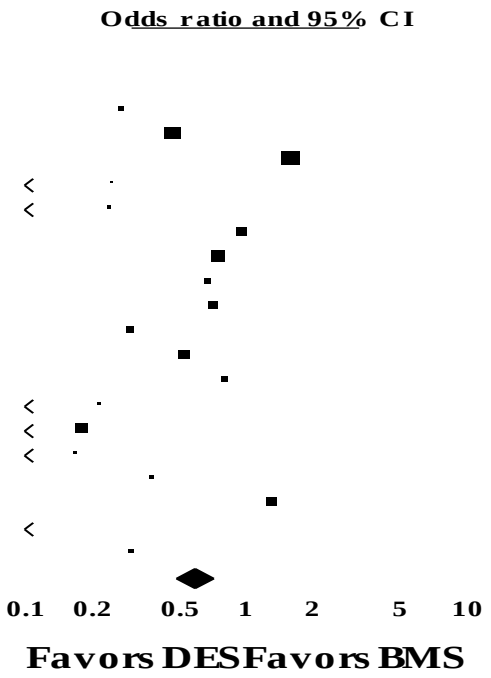


Target Lesion Revascularization



TVR Rate for SVG Patients Treated with DES vs. BMS

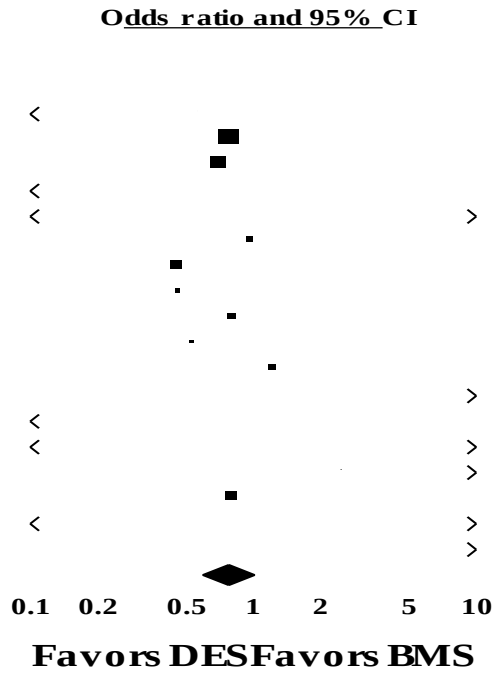
Study name	DES	BMS	Odds ratio	Lower limit	Upper limit	Relative weight
Assali et al.	68	43	0.29	0.10	0.80	3.55
van Twisk et al.	122	128	0.49	0.27	0.89	10.75
Okabe et al.	138	344	1.67	0.99	2.82	13.94
BASKET	34	13	0.26	0.06	1.04	1.94
Kaplan et al.	37	33	0.25	0.07	0.88	2.39
Gioia et al.	106	119	1.00	0.47	2.13	6.68
Ramana et al.	141	170	0.78	0.41	1.49	9.29
Vignali et al.	72	288	0.70	0.28	1.78	4.41
Bansal et al.	37	72	0.74	0.33	1.69	5.63
Minutello et al.	59	50	0.31	0.13	0.79	4.50
Ellis et al.	175	175	0.55	0.26	1.15	6.97
DELAYED RRISK	38	37	0.84	0.33	2.16	4.26
Hoffman et al.	60	60	0.23	0.07	0.77	2.52
Lee et al.	139	84	0.19	0.09	0.38	7.55
Ge et al.	61	89	0.18	0.05	0.62	2.42
SOS	41	39	0.39	0.13	1.17	3.18
Lozano et al	98	114	1.37	0.64	2.93	6.60
Wohrle et al	13	26	0.10	0.01	1.82	0.44
Guo et al	50	47	0.32	0.10	0.98	2.97
	1489	1931	0.59	0.49	0.72	



Lee MS. Am J Cardiol 2010.

Death Rate for SVG Patients Treated with DES vs. BMS

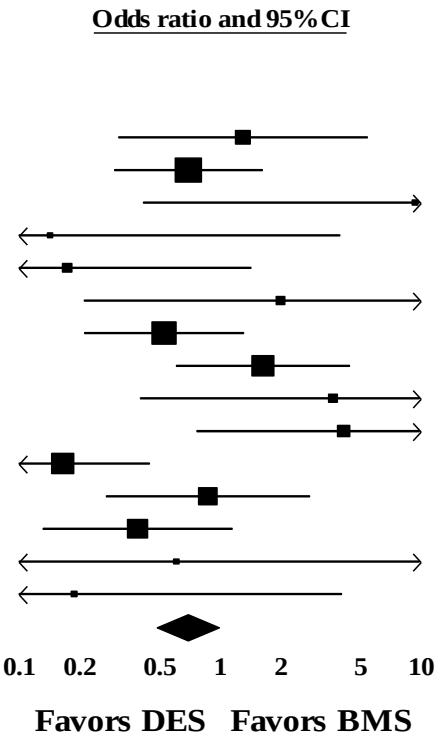
Study name	DES	BMS	Odds ratio	Lower limit	Upper limit	Relative weight
Assali et al.	68	43	0.59	0.08	4.15	1.90
van Twisk et al.	122	128	0.81	0.45	1.43	21.95
Okabe et al.	138	344	0.73	0.37	1.41	16.26
BASKET	34	13	0.18	0.01	2.11	1.17
Kaplan et al.	37	33	1.00	0.06	15.66	0.96
Gioia et al.	106	119	1.00	0.33	3.01	5.96
Ramana et al.	141	170	0.47	0.20	1.08	10.40
Vignali et al.	72	288	0.48	0.14	1.68	4.61
Bansal et al.	37	72	0.83	0.31	2.24	7.35
Minutello et al.	59	50	0.55	0.15	2.05	4.19
Ellis et al.	175	175	1.26	0.46	3.49	7.01
DELAYED RRISC	38	37	31.44	1.78	556.63	0.88
Lee et al.	139	84	0.24	0.03	1.78	1.82
Ge et al.	61	89	1.00	0.10	10.25	1.34
SOS	41	39	2.59	0.46	14.48	2.45
Lozano et al	98	114	0.83	0.36	1.91	10.38
Wohrle et al	13	26	0.61	0.02	15.91	0.68
Guo et al	50	47	2.88	0.11	72.43	0.70
	1429	1871	0.78	0.59	1.02	



Lee MS. Am J Cardiol 2010.

MI Rate for SVG Patients Treated with DES vs. BMS

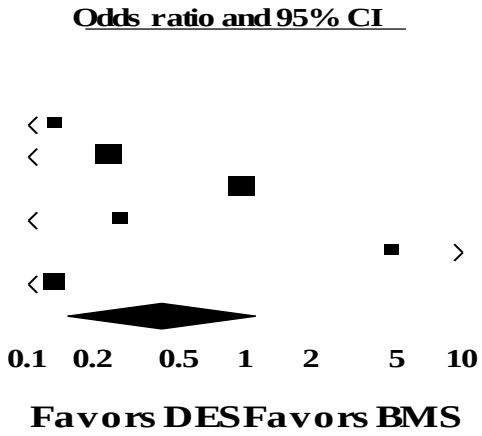
Study name	DES	BMS	Odds ratio	Lower limit	Upper limit	Relative weight
Assali et al.	68	43	1.31	0.31	5.52	6.11
van Twisk et al.	122	128	0.70	0.30	1.66	17.16
Okabe et al.	138	344	9.45	0.42	215.00	1.29
BASKET	34	13	0.14	0.01	4.03	1.14
Kaplan et al.	37	33	0.18	0.02	1.46	2.81
Gioia et al.	106	119	2.02	0.21	19.37	2.47
Ramana et al.	141	170	0.53	0.21	1.34	14.83
Vignali et al.	72	288	1.65	0.61	4.50	12.53
Minutello et al.	59	50	3.69	0.40	33.89	2.56
DELAYED RRISC	38	37	4.17	0.77	22.70	4.39
Lee et al.	139	84	0.17	0.06	0.45	12.53
Ge et al.	61	89	0.88	0.27	2.85	9.11
SOS	41	39	0.39	0.13	1.17	10.54
Wohrle et al	13	26	0.61	0.02	15.91	1.19
Guo et al	50	47	0.19	0.01	4.11	1.33
	1119	1510	0.69	0.49	0.99	



Lee MS. Am J Cardiol 2010.

ST Rate for SVG Patients Treated with DES vs. BMS

Study name	DES	BMS	Odds ratio	Lower limit	Upper limit	Relative weight
Assali et al.	68	43	0.14	0.01	3.03	10.41
van Twisk et al.	122	128	0.24	0.03	1.77	25.13
Okabe et al.	138	344	1.00	0.14	7.28	25.27
Bansal et al.	37	72	0.27	0.01	5.50	11.09
DELAYED RRISC	38	37	4.92	0.23	107.09	10.49
SOS	41	39	0.14	0.01	1.47	17.62
	444	663	0.41	0.15	1.11	



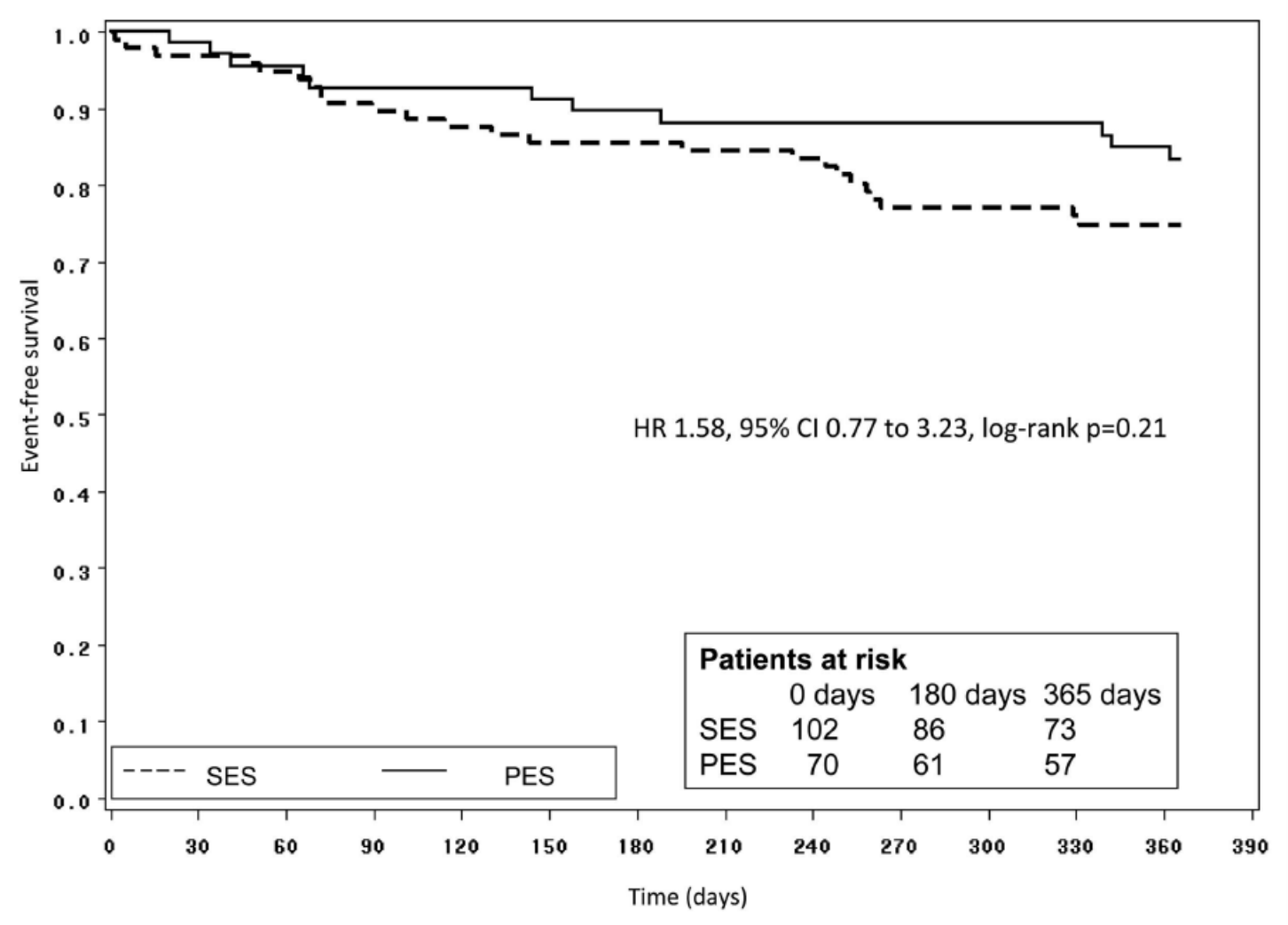
Lee MS. Am J Cardiol 2010.

Comparison of *Sirolimus*-Eluting Stents With *Paclitaxel*-Eluting Stents in Saphenous Vein Graft Intervention (from a Multicenter Southern California Registry)

Michael S. Lee, MD[a,b,c,d,e,*], Patrick P. Hu, MD[a,b,c,d,e], Joseph Aragon, MD[a,b,c,d,e], Atman P. Shah, MD[a,b,c,d,e], Jared Oyama, MD[a,b,c,d,e], Jashdeep Dhoot, MD[a,b,c,d,e], Zahid Iqbal, BA[a,b,c,d,e], Nathaniel Jones, BS[a,b,c,d,e], William Penny, MD[a,b,c,d,e], Jonathan Tobis, MD[a,b,c,d,e], Ehtisham Mahmud, MD[a,b,c,d,e], and William French, MD[a,b,c,d,e]

This study was designed to compare the safety and efficacy of sirolimus-eluting stents (SESs) to paclitaxel-eluting stents (PESs) in percutaneous intervention of saphenous vein graft (SVG) lesions. SVGs develop atherosclerosis at high rates and often require repeat revascularization. Percutaneous intervention with drug-eluting stents has become the preferred method of revascularization due to higher restenosis with bare metal stents and increased morbidity and mortality with repeat coronary artery bypass grafting. We sought to compare the rate of major adverse cardiac events and stent thrombosis between SESs and PESs in patients undergoing SVG intervention. A multicenter analysis of 172 patients with SVG lesions treated with SESs or PESs was performed. The 30-day and 1-year clinical outcomes of 102 patients receiving SESs were compared to those of 70 patients receiving PESs. There was no significant difference in baseline demographic, angiographic, and procedural characteristics between the SES and PES treatment groups. There was no statistical difference in major adverse cardiac events at 30 days and at 1 year (hazard ratio [HR] 1.58, 95% confidence interval [CI] 0.77 to 3.23, log-rank $p = 0.21$). There was also no difference in survival (HR 1.28, 95% CI 0.39 to 4.25, log-rank $p = 0.69$) or target vessel revascularization (HR 2.54, 95% CI 0.84 to 7.72, log-rank $p = 0.09$). In conclusion, this multicenter analysis of real-world patients demonstrated that SESs and PESs have similar clinical outcomes when used in SVG intervention. (Am J Cardiol 2010;xx:xxx)

MACE-Free Survival Comparing SES vs. PES



Impact of Chronic Renal Insufficiency on Clinical Outcomes in Patients Undergoing Saphenous Vein Graft Intervention With Drug-Eluting Stents: A Multicenter Southern Californian Registry

Michael S. Lee,* MD, Patrick P. Hu, MD, Joseph Aragon, MD, Atman Shah, MD, Ravi Bhatia, Nathanial Jones, BA, MD, William Penny, MD, William French, MD, Jonathan Tobis, MD, and Ehtisham Mahmud, MD

Objectives: To evaluate the clinical outcomes in patients with chronic renal insufficiency (CRI) who undergo saphenous vein graft (SVG) intervention with drug-eluting stents (DES). Backgroud: Patients with CRI have higher rates of major adverse cardiac events (MACE) after percutaneous revascularization. SVG intervention is associated with increased rates of MACE compared with percutaneous revascularization of native arteries. However, the impact of CRI on SVG intervention with DES has not been well characterized. Methods: Consecutive patients who underwent SVG intervention with DES at six medical centers from April 2003 to December 2007 were included in this analysis. Results: A total of 172 patients, 39 patients with CRI and a serum creatinine $\geq$1.5 mg dL^{-1}, and 133 patients without CRI, underwent SVG intervention with DES. Patients with CRI were more often older, diabetic, and had a longer mean total stent length. At 1 year, patients with CRI had a higher MACE rate (35.9% vs. 15.8%, hazard ratio [HR] 2.48, 95% confidence interval [CI] 1.26 to 4.88, log rank $P = 0.009$), mainly driven by higher mortality (20.5% vs. 9.8%, HR 3.41, 95% CI 1.10–10.58, log rank $P = 0.024$). There was a trend toward higher rates of target vessel revascularization in the CRI group (21.8% vs. 10.3%, HR 2.42, 95% CI 0.94–6.24, log rank $P = 0.059$). Stent thrombosis rates were not different between patients with and without CRI (2.6% vs. 3.0%, $P = 0.8$). Multivariable analysis revealed that CRI was the only significant predictor of 1-year MACE (HR 2.2, 95% confidence interval 1.1–4.3; $P = 0.03$). Conclusions: Patients with CRI who underwent SVG intervention with DES had higher risks of MACE and death compared with patients with preserved renal function. Further treatment strategies are needed in this high-risk group who undergo SVG intervention with DES.

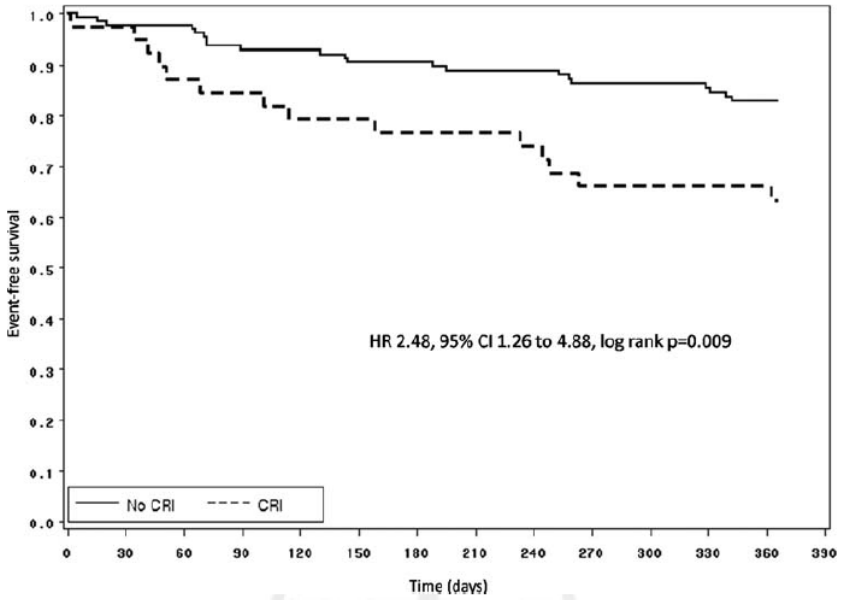


Fig. 1. Kaplan–Meier estimates of the probability of MACE-free survival in patients with and without chronic renal insufficiency.

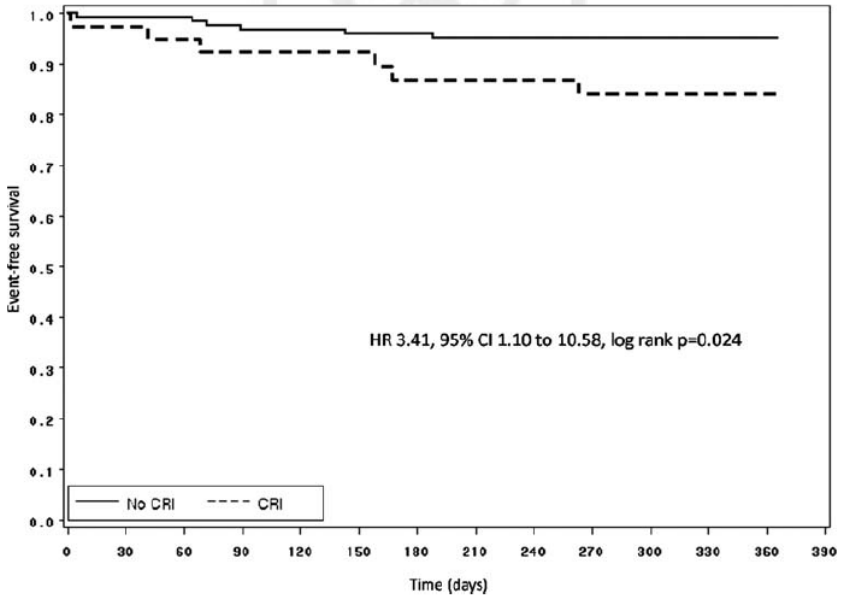


Fig. 2. Kaplan–Meier estimates of the probability of survival in patients with and without chronic renal insufficiency.

Conclusions

- The behavior of SVG disease is substantially different from native CAD-with higher incidence of procedural complications and long-term failure
- Glycoprotein IIb/IIIa antagonists are ineffective in SVG intervention, presumably due to their ineffectiveness against atheroemboli
- Embolic protection in SVG PCI can dramatically reduce 30 day MACE rates and should be used in SVG PCI
- Data continue to show that DES is preferred over BMS
- Perhaps hybrid revascularization may be considered.

Thank You!