PCI for Renal Artery stenosis

Renal Artery Stenosis

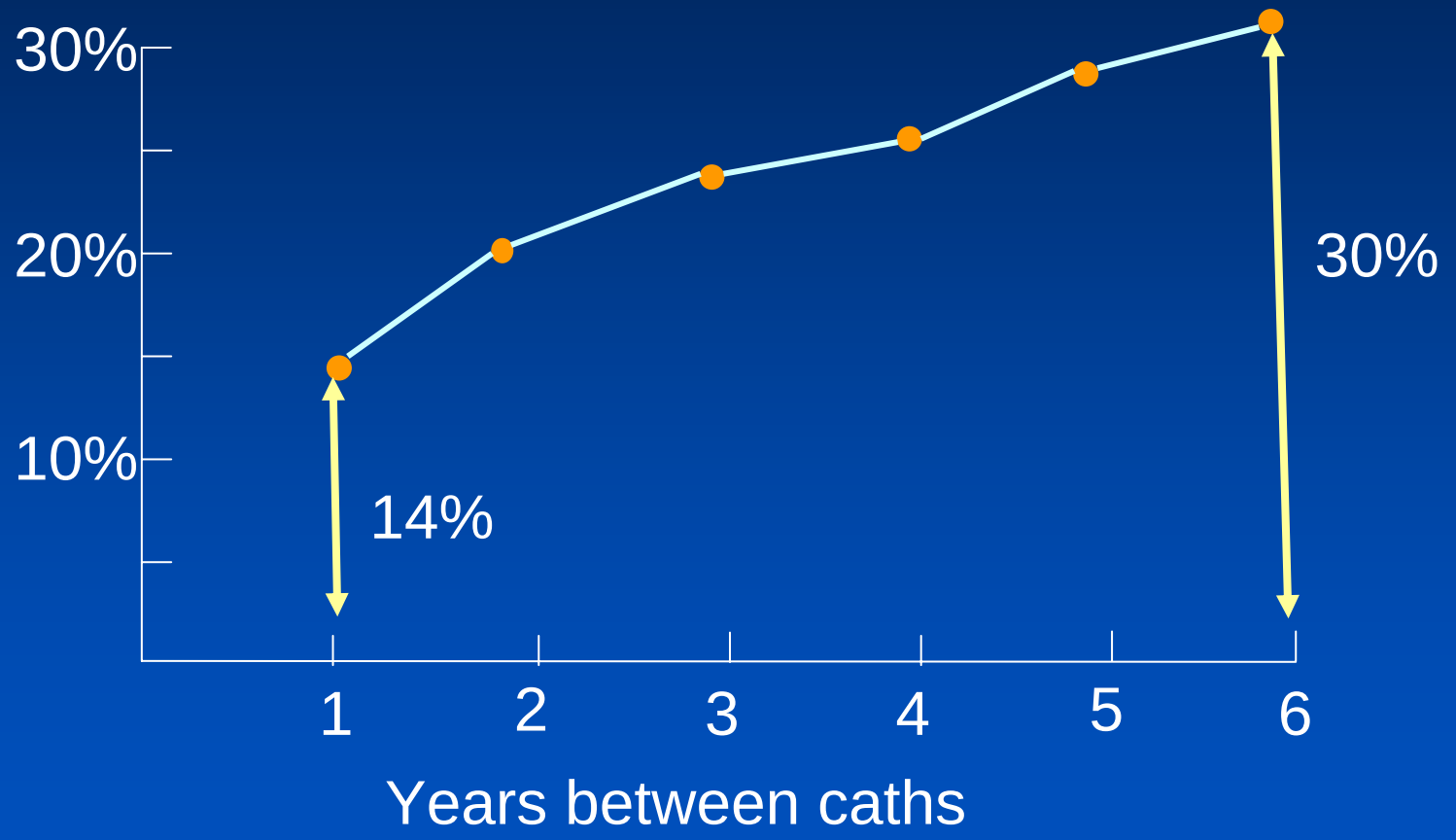
- **Common Disease**

	Incidence
General population	0.1%
Hypertensive population	4.0%
HTN & suspected CAD	10-20%
Malignant HTN	20-30%
Malignant HTN & renal insufficiency	30-40%

- **Prevalence increases with age: 7% over 65yrs**

Progression of RAS

Progression according to time between studies (N=1189)



Crownley JJ, et al: Am Heart J 1998;136:913-918

Renal Artery Stenosis
Clinical Consequences

Cardiovascular

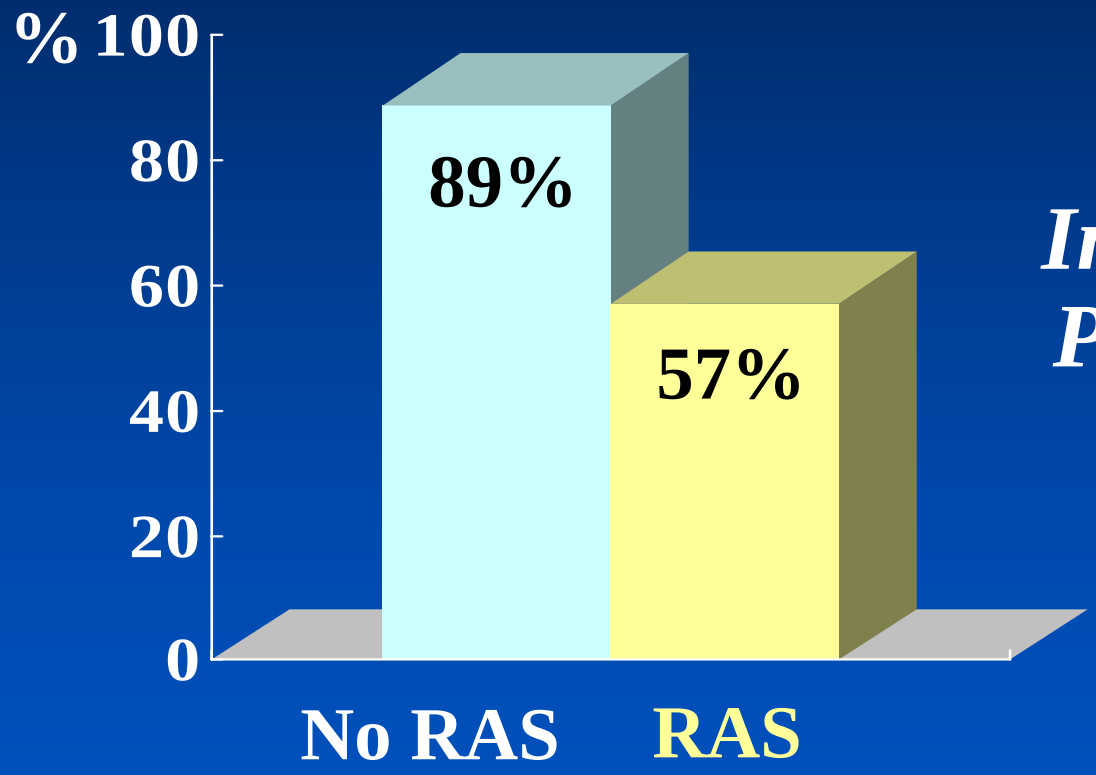
- Angina pectoris
- “Flash” pulmonary edema
- Myocardial infarction
- Left ventricular hypertrophy
- Stroke
- Aortic dissection

Renal

- Hyper-reninemia
- Nephropathy
  - Ischemic
  - Hypertensive
- Edema

Renal Artery Stenosis

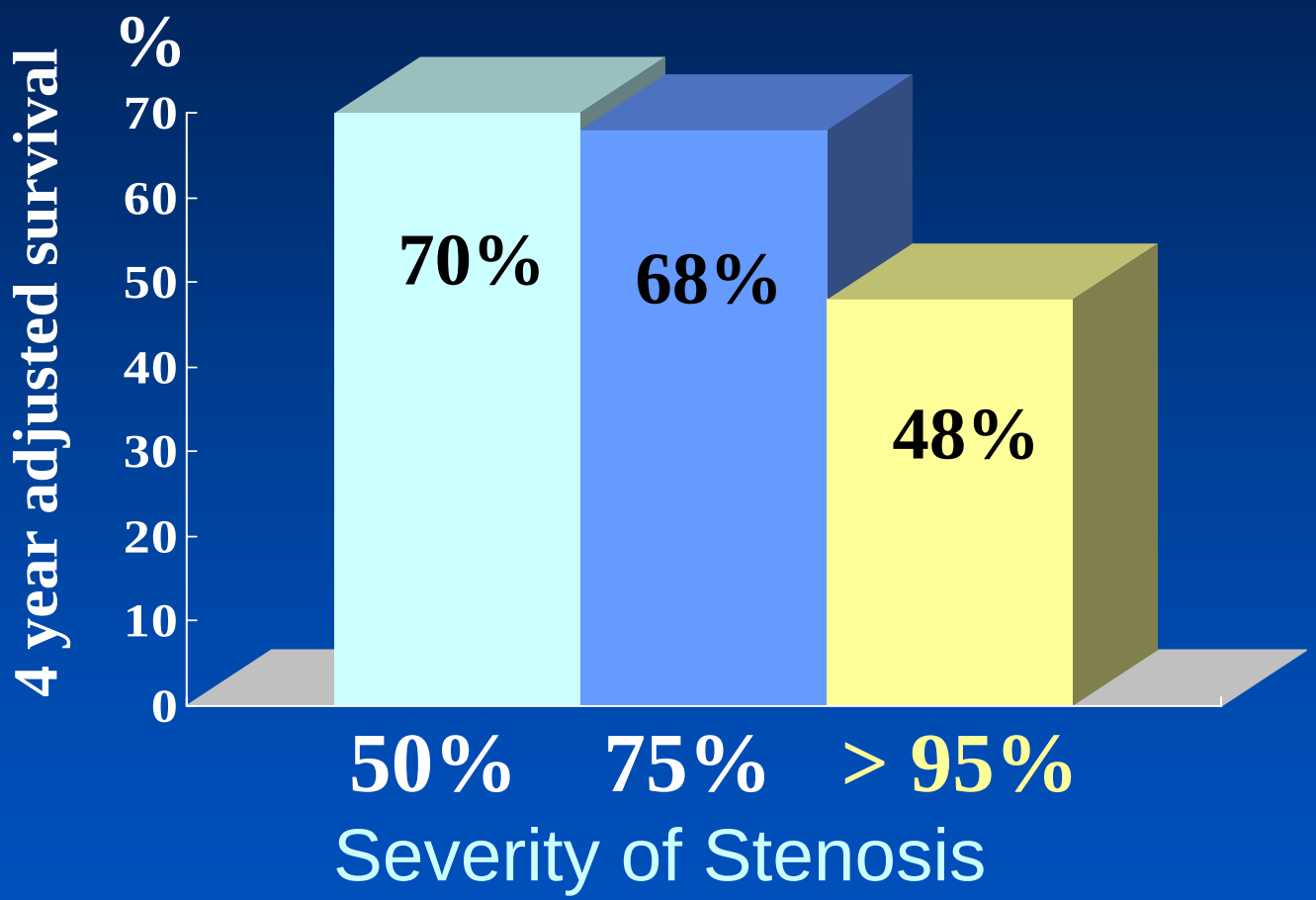
4 year adjusted survival



Independent Predictor of Mortality

Conlon et al. Kidney Int 2001;60(4):1490-7

Severity of RAS vs Survival



Conlon et al. Kidney Int 2001;60(4):1490-7

Why should we treat Renal Artery Stenosis?

Improve Morbidity / Mortality

Salvage Renal Function

Adequate BP Control

RAS Treatment

Medical therapy is considered

- Underlying advanced nephropathy: unilateral RAS and Cr ≥ 2.5 mg/dL
- Renal length ≤ 7 cm
- Proteinuria ≥ 1 g/d
- Severe diffuse intrarenal vascular disease
- Target kidney RI ≥ 80

RAS Treatment

Revascularization is favored

- Bilateral RAS and Cr ≥ 1.5 mg/dL
- Unilateral RAS and GFR ≤ 40%
- ACEI-induced renal failure
- Hypertensive crisis
- Nonischemic pulmonary edema

Medical Treatment

Aggressive pharmacologic therapy is sufficient for adequate BP control and maintenance of renal function ?

Outcome of RAS

Medical treatment

69 pts with RAS > 70%, Follow-up 36 Mo

- Mean Cr : 1.4 → 2.0 mg/dl ($p<0.05$)
- SBP : 157 mmHg → 155 mmHg (p=NS)
- 10 % progressed to ESRD
  10 % progressed to renal intervention
  29 % mortality

Chabova V et al. Mayo Clin Proc 2000;75:437-44

Outcome of RAS

Managed without Revascularization

Renal Insufficiency in 10% of patients can be progressive despite aggressive BP control.

Renal Artery Revascularization

- **Surgery**
  - Endarterctomy
  - Aorto-renal bypass
  - Extra-anatomic bypass
- **Balloon angioplasty (PTA)**
  - Non-ostial atherosclerotic lesions
  - Fibromuscular disease
- **Stent placement**
  - Atherosclerotic aorto-ostial lesions
  - Provisional/bailout

Renal Artery Stenosis

Rationale for Invasive Treatment

- Progressive disease
- Cause of hypertension and decline in renal function
- Associated with increased mortality
- Limited benefit of aggressive medical therapy

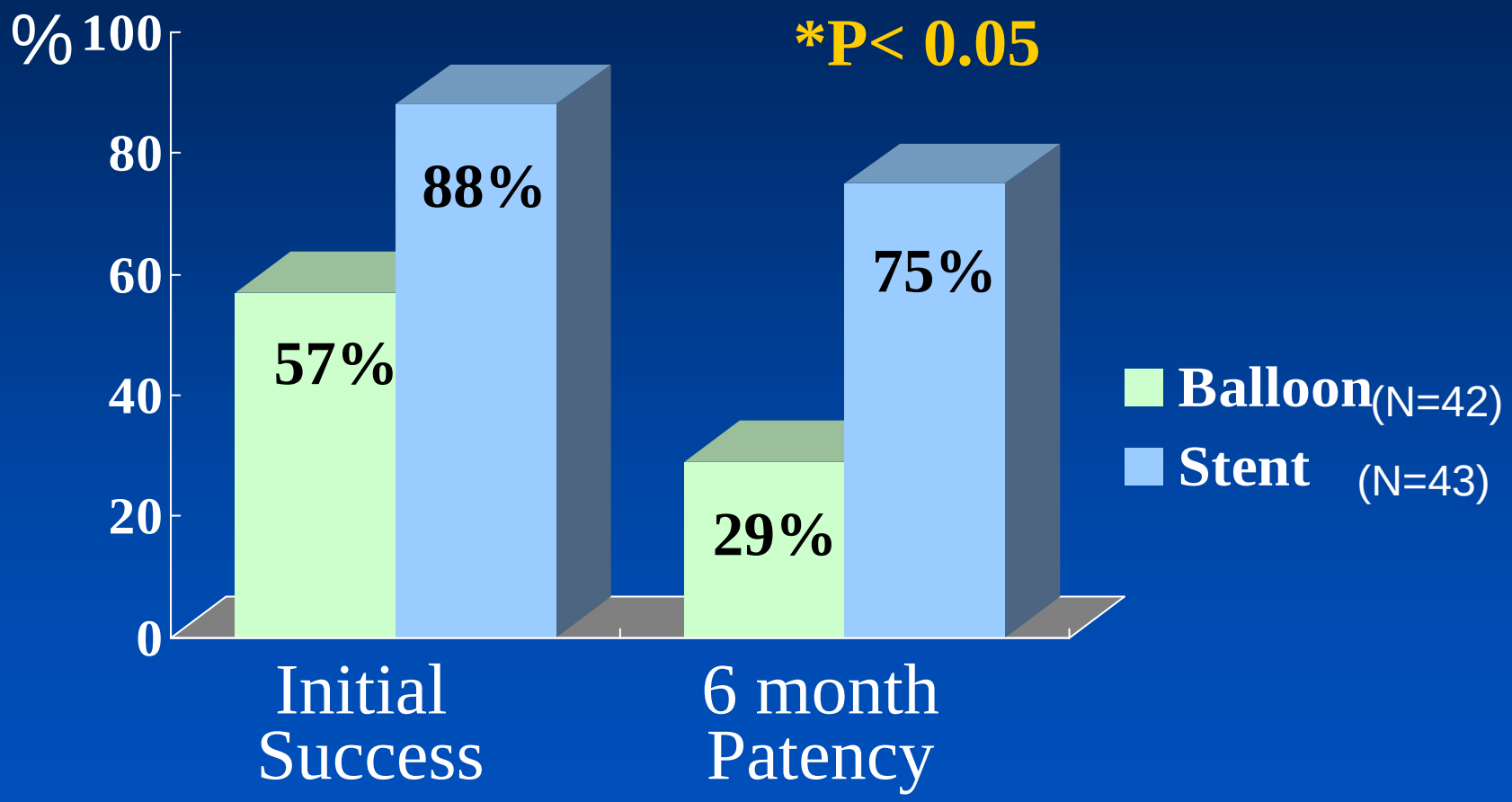
Renal Artery stenosis

Should we stent it ?

Balloon Angioplasty

- Percutaneous technque
- Low morbidity and mortality
- Excellent therapy for fibromuscular disease
- Poor technology for “bulky” aortic plaque

POBA vs Stent



Van de Ven et al. Lancet 1999;353:282-86

Renal Artery Stenting

Technical Success

Study series	No. of Arteries	Ostial Lesion(%)	Success (%)
Rodriguez-Lopez	125	66	98
Henry	104	77	99
Rocha-Singh	180	43	98
Tuttle	148	100	98
Dorros	202		99

~ 98%

Lim and Rosenfield, Curr Int Cardiol 2000;2:130-9

Renal Artery Stenting

Restenosis

Study	RA evaluated (% original total a.)	F/U (mo)	Restenosis (%)
van de Ven	52 (95%)	6	21
Rocha-Singh	158 (88%)	13	12
Rundback	28 (52%)	12	26
Tuttle	49 (33%)	8	14
White	80 (60%)	9	19

~ 20%

Lim and Rosenfield, Curr Int Cardiol 2000;2:130-9

Benefit of Renal Artery Stenting

- Technically feasible
- Safe & durable
- Superior to balloon
- Effective in improving hypertension
- Beneficial to preserve renal function
- Safer than surgery
- FDA approved (July 10, 2002)

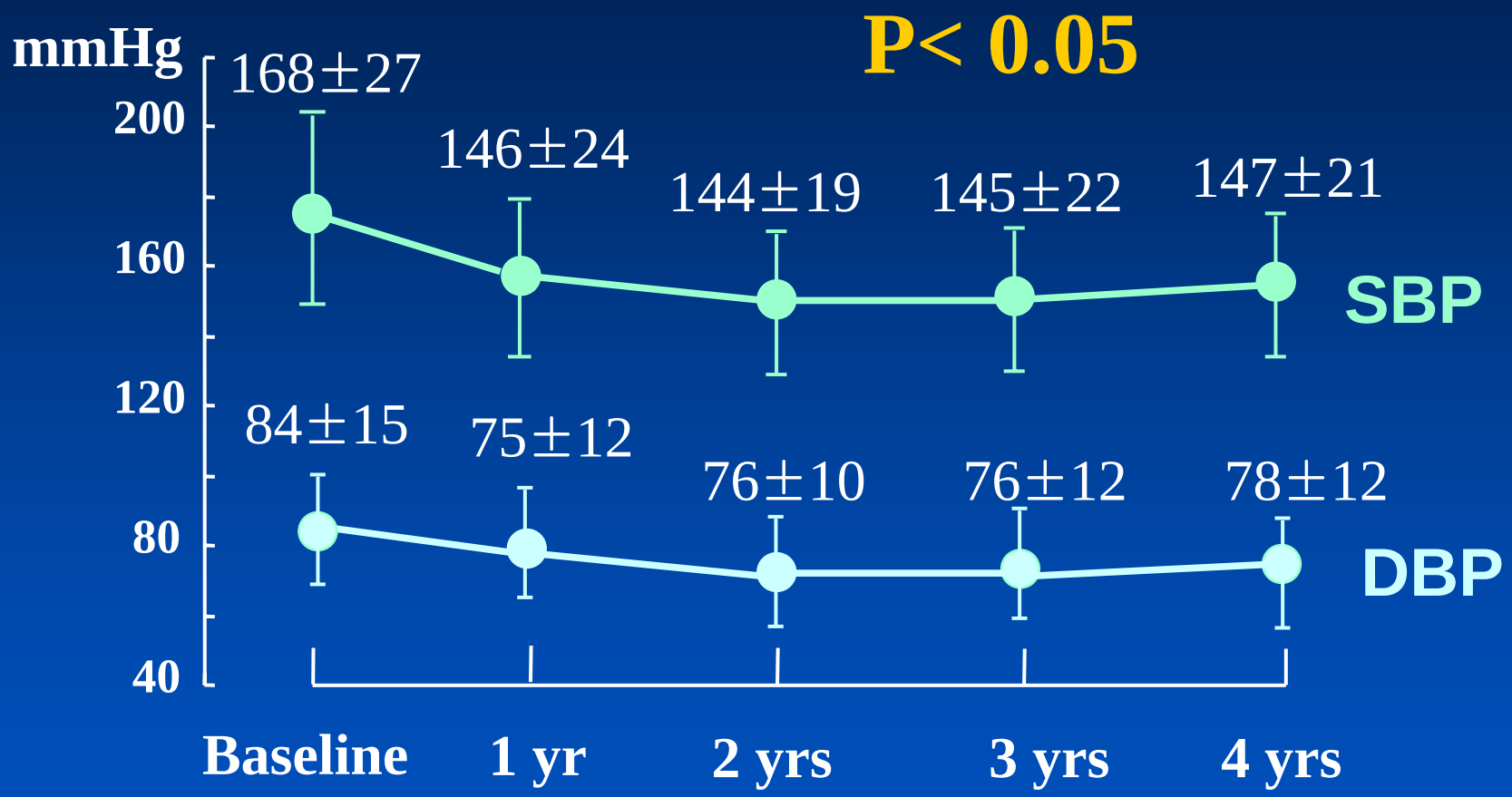
Renal Artery Stenting

Is it effective in improving Hypertension & slowing progressive decline in renal function ?

Renal Artery Stenting

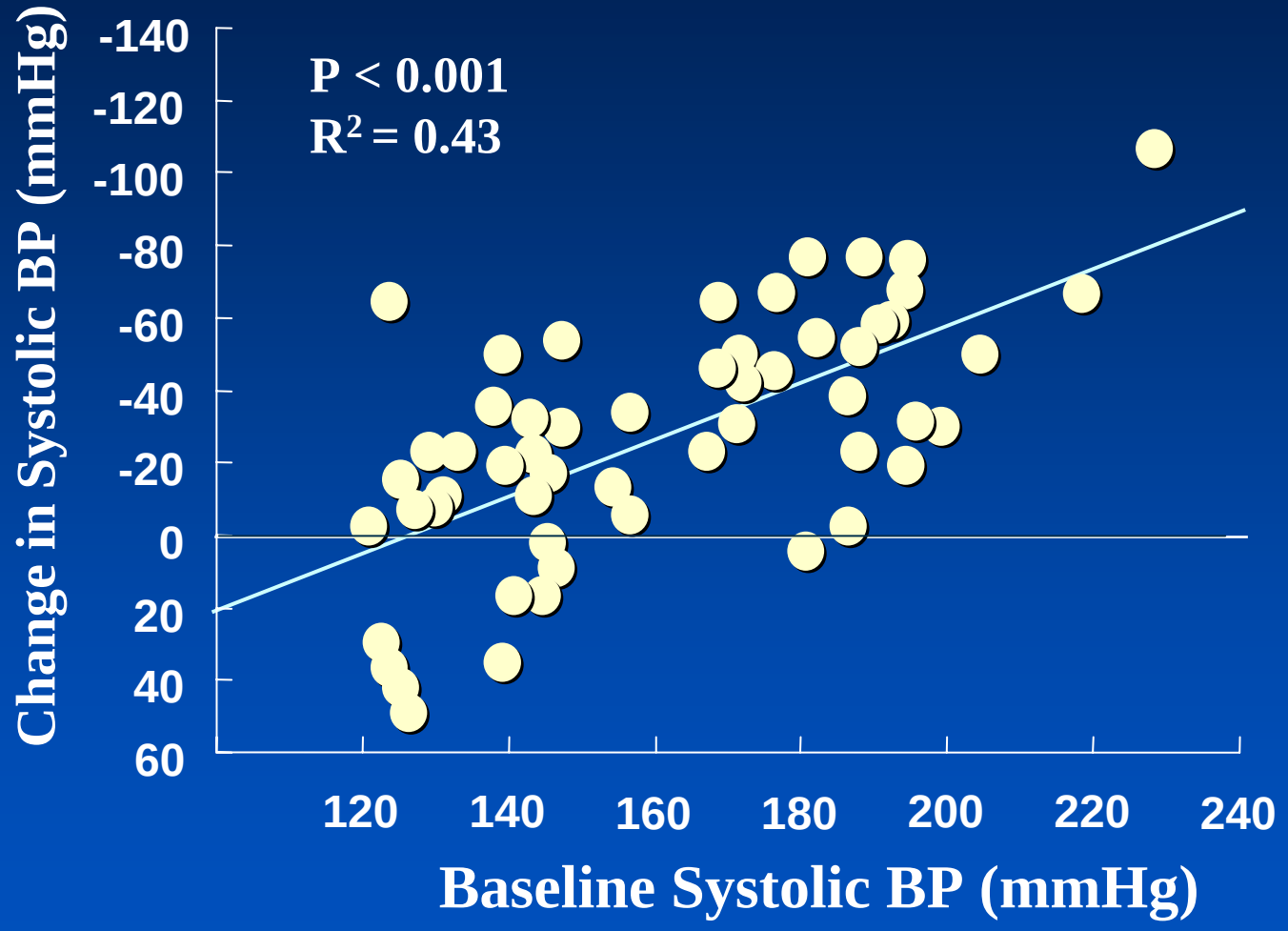
Effect on Hypertension

BP Change after Stenting



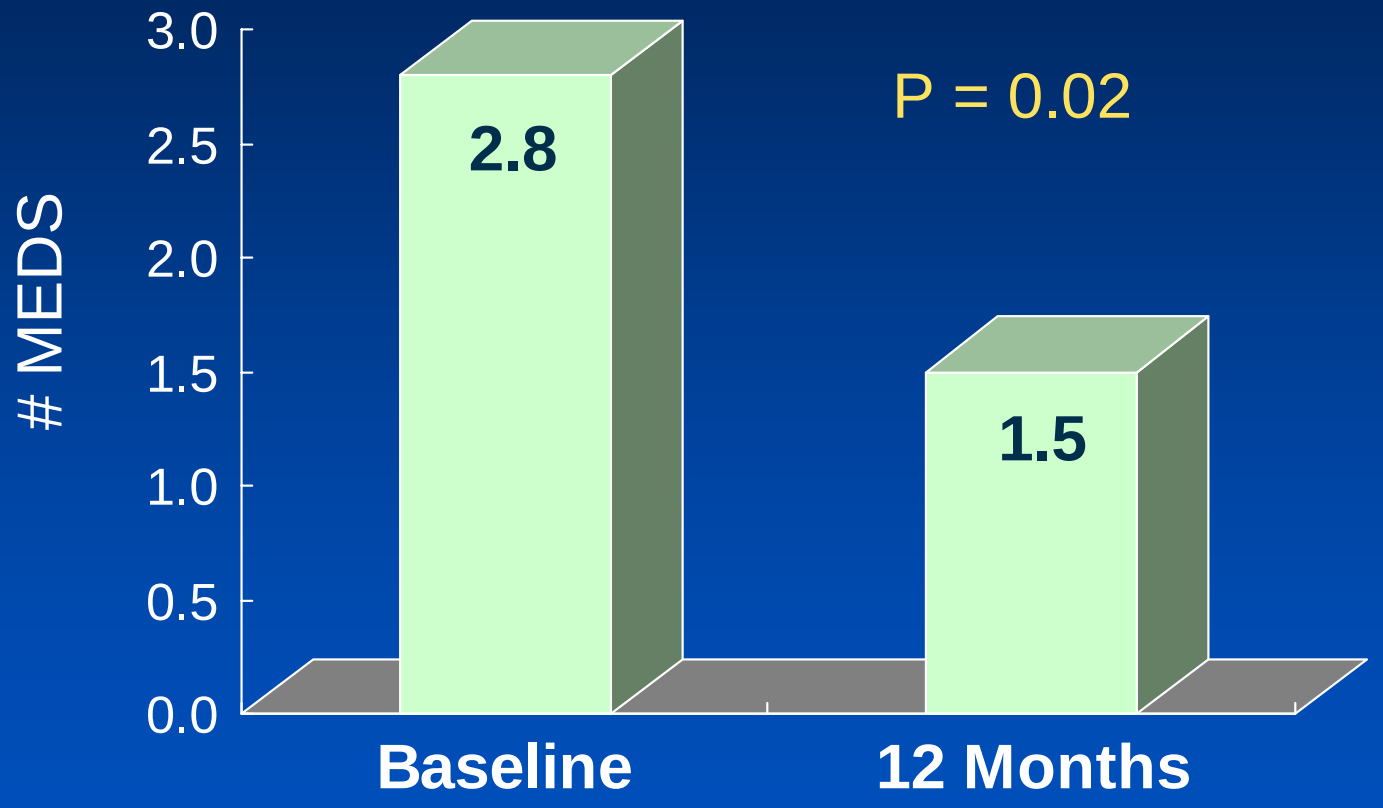
Doroso G, et al. Cathet Cardiovasc Intervent 2002;55:182-188

BP Change by Baseline BP



Burket MW, et al. Am Heart J 2000;139:64-71

Antihypertensive Medication



Van Jaarsveld, e al. NEJM 2000; 342:1007-14

Renal Artery Stenting

Effect on Hypertension

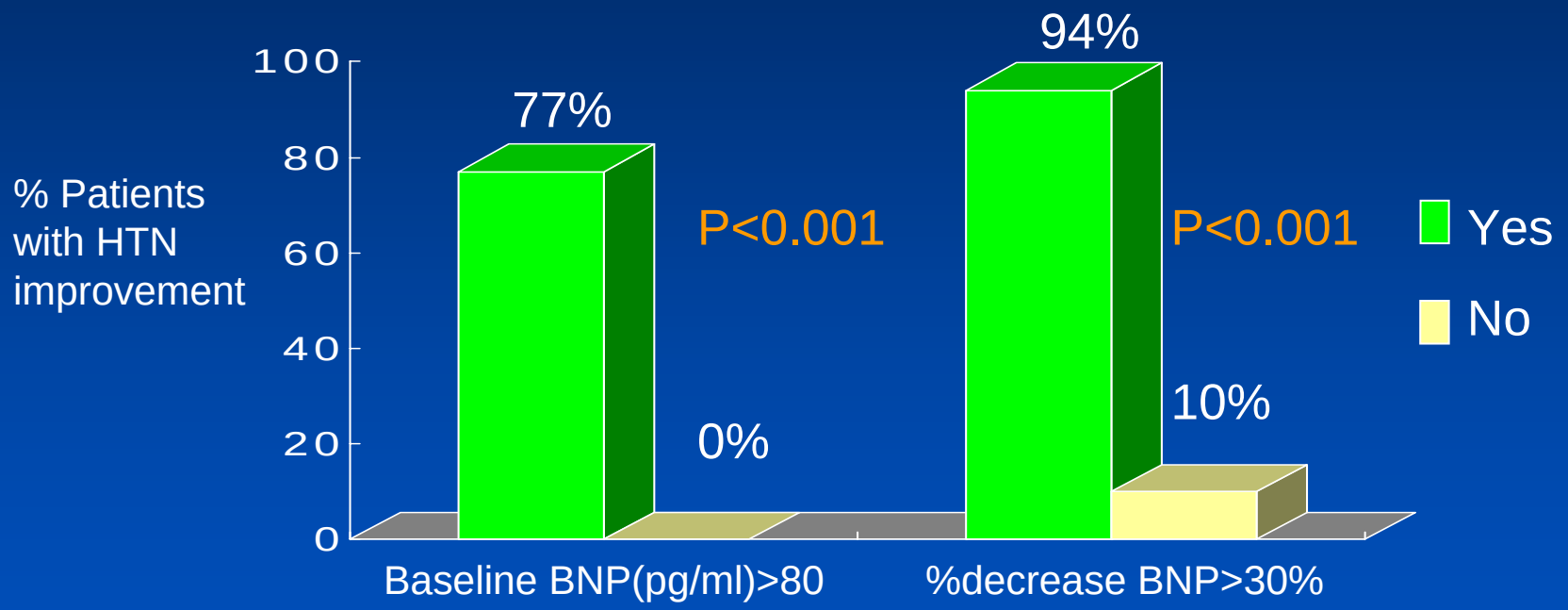
Study series	No.	Cure (%)	Improved (%)	**Benefits** (%)
Tegtmeyer	65	23	71	94
Klinge	134	10	68	78
Martin	94	22	46	68
Lossino	153	12	51	63
Rodriguez-Perez	37	0	81	81
Blum	74	16	62	78
Pooled Result	586	14	63	**~ 77%**

Effect on hypertension

Cure	12 ~ 23 %
Improved	46 ~ 81 %

Who can be a good candidate?

Elevated BNP predicts BP response after stenting.



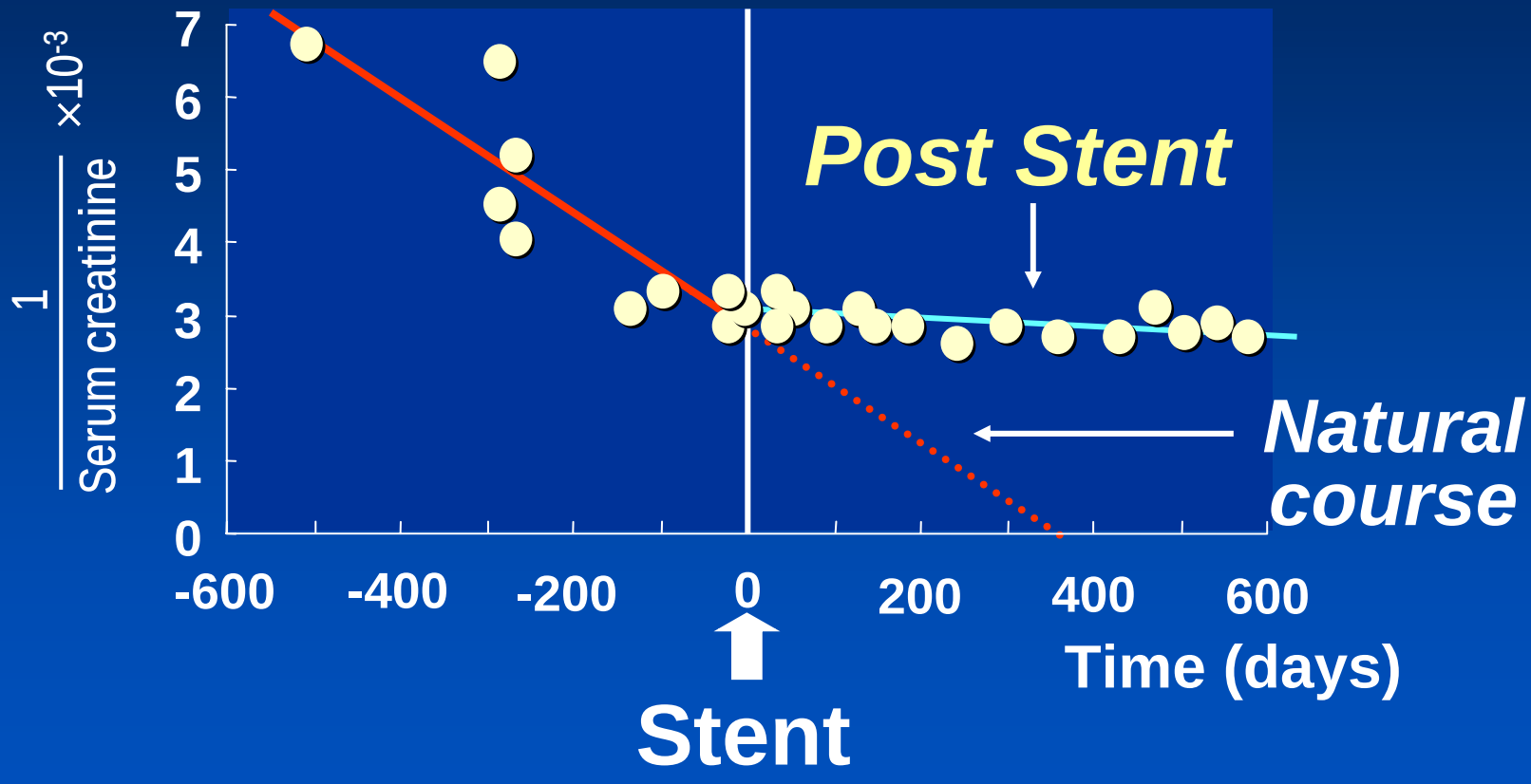
Jose A, et al.Circulation. 2005;111:328-333

Renal Artery Stenting

Can We Salvage Renal Function ?

Stabilization of Renal Function

Reciprocal serum creatinine plot



Harden, et al. Lancet 1997;349:1133-6

Renal Artery Stenting

Effect on Renal Function

Study	No	Improved (%)	Stable (%)	*Deteriorated* (%)
Van de Ven	42	12	62	26
Rocha-Singh	150	22	70	8
Tuttle	129	15	81	4
Dorros	163	18	48	34
Rundback	45	20	47	33
Harden	32	34	38	28
TOTAL	561	**19%**	**62%**	**19 %**

Lim and Rosenfield, Curr Int Cardiol 2000;2:130-9

Renal Artery Stenting

Effect on Renal Function

- **Improved** **23 ~ 41%**
- **Stabilized** **29 ~ 100 %**
- **Deteriorated** **5 ~ 38 %**

Renal Artery Stenting

Superior to Surgery ?

No Randomized Trials of Renal Artery Stenting vs Surgery

Surgical Revascularization

Aorto-renal bypass
Renal endarterectomy

Death	**2 ~ 6 %**
MI	**2 ~ 9 %**
Stroke	**0 ~ 3 %**
Bleeding	**2 ~ 3 %**
Cholesterol Emboli	**1 ~ 4 %**

Libertino JA, et al. J Urol 1992;147:1485-7
Cambria RP, et al. J Vasc Surg 1994;20:76-87
Clair DG, et al. J Vasc Surg 1995;21:926-34

Late Results of Surgery

5 year results

- **Graft failure 6 ~ 18 %**
- **Reoperation 5 ~ 15 %**

Libertino JA, et al. J Urol 1992;147:1485-7
Cambria RP, et al. J Vasc Surg 1994;20:76-87
Clair DG, et al. J Vasc Surg 1995;21:926-34

Renal artery stenting

- **Acute success rate > 98 %**
- **Restenosis < 15 %**

Surgical Revascularization

Surgery should be reserved patients with comorbidities

- concurrent abdominal aortic dissection
- renal artery aneurysm
- failed PTA/stenting.

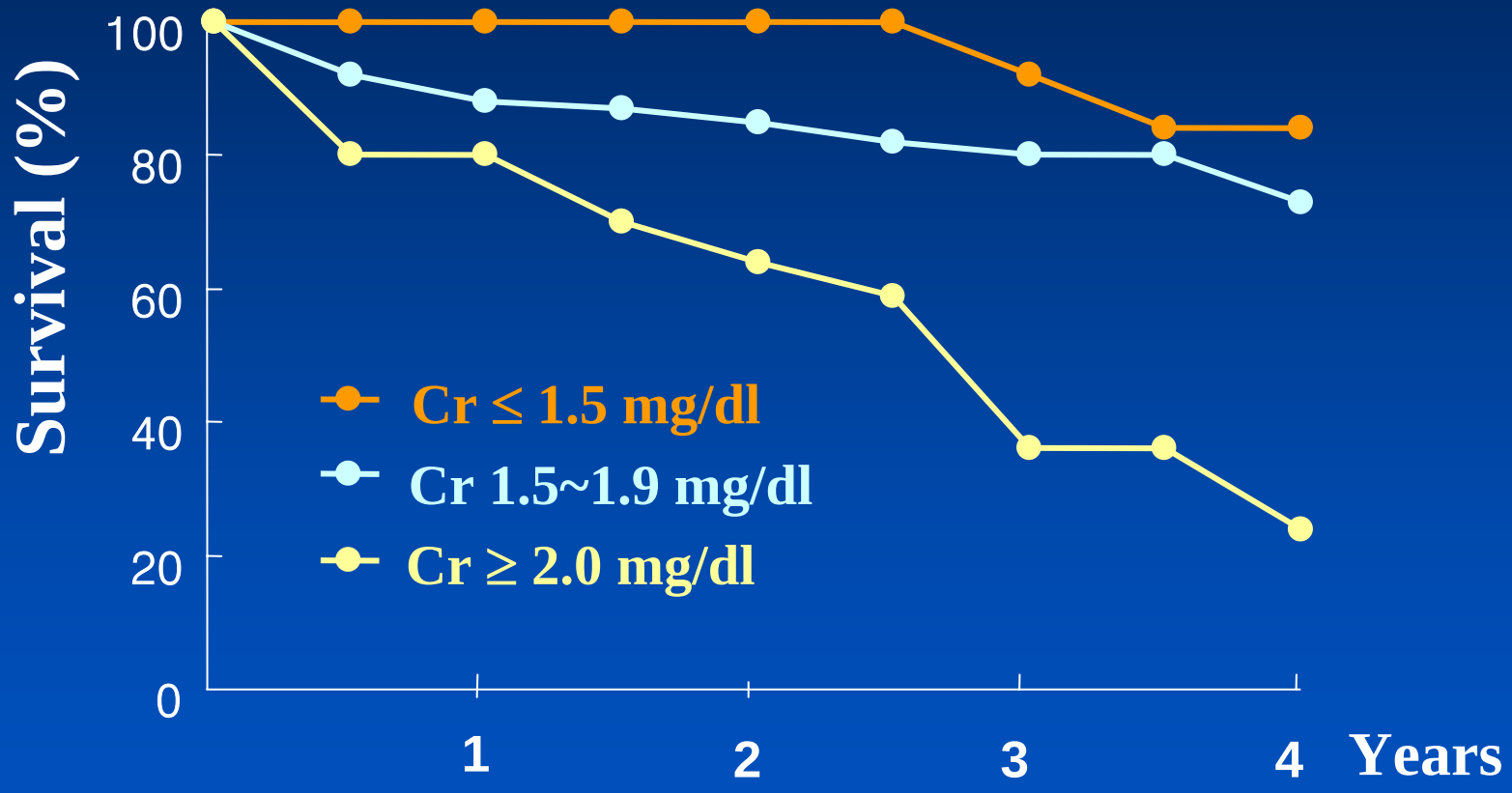
Renal Artery Stenting

Long-Term Survival

Do All Benefit ?

Survival after Stenting

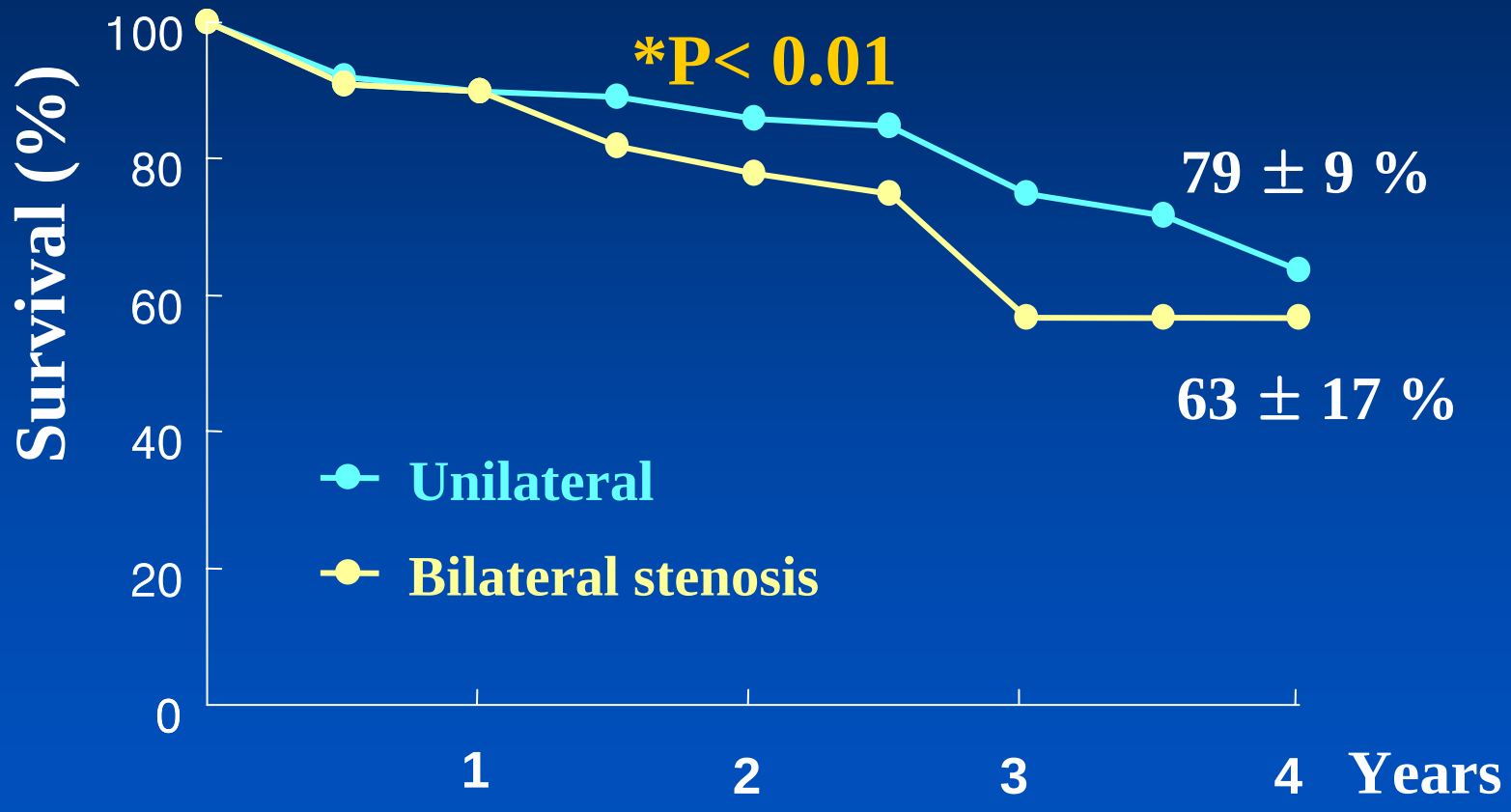
Categorized by baseline Creatinine



Dorros, et al. Circulation 1998;98:642-647

Survival after Stenting

Unilateral vs Bilateral Stenosis



Dorros, et al. Circulation 1998;98:642-647

Survival after Stenting

4 year survival (N=1058)

Baseline creatinine

- Cr ≤ 1.4 mg/dL 85±3% (622)
- Cr 1.5 - 1.9 mg/dL 78±5% (168) *
- Cr ≥ 2.0 mg/dL 49±5% (268) *

***P< 0.05**

Doroso G, et al. Cathet Cardiovasc Intervent 2002;55:182-188

Survival after Stenting

4 year survival (N=1058)

	Renal artery stenosis	
Baseline creatinine	**Unilateral**	**Bilateral**
• Cr ≤ 1.4 mg/dL	86±3% (397)	85±7% (225)
• 1.5 - 1.9 mg/dL	78±7% (103)	78±5% (65)
• Cr ≥ 2.0 mg/dL	49±5% (173)	49±5% (95)

Doroso G, et al. Cathet Cardiovasc Intervent 2002;55:182-188

Renal Artery Stenting

Impact on survival

Renal artery stenting before the onset of renal dysfunction !!!

Predictors of RAS Restenosis

- 132 vessel ,Palmatz (n = 102) or Corinthian (n = 30) stents
- Restenosis rate: 26% at 2-20month
- Predictors of restenosis
  - Smaller vessel(<4mm): 40%
  - Smokers: 53%

Shmmas, et al. J Invasive Cardiol 2004;16(1):10-13

“Dark Side” of Renal Artery Stenting

Atheroembolism…

Incidence of Atheroembolism

During Renal Artery Stenting

Study	No	Embolism
Van de Ven	42	7 %
Rocha-Singh	42	5.9 %
White	150	2 %

Promoting Factors of Atheroembolism

Procedural

- Length of the procedure
- Difficulties of the procedure
- Size of the devices
- Primary stenting
- High pr. dilatation
- Guiding catheter intubation

Clinical

- Elderly (> 60 years)
- Male
- Renal insufficiency
- Multisegment dis
- Associated aorta / peripheral lesions
- Anticoagulants – Fibrinolytic drugs

Distal Protection During Renal Artery Stenting

Will it make a difference ?

Distal Protection with Filter

Angioguard

37 pts, 46 renal arteries

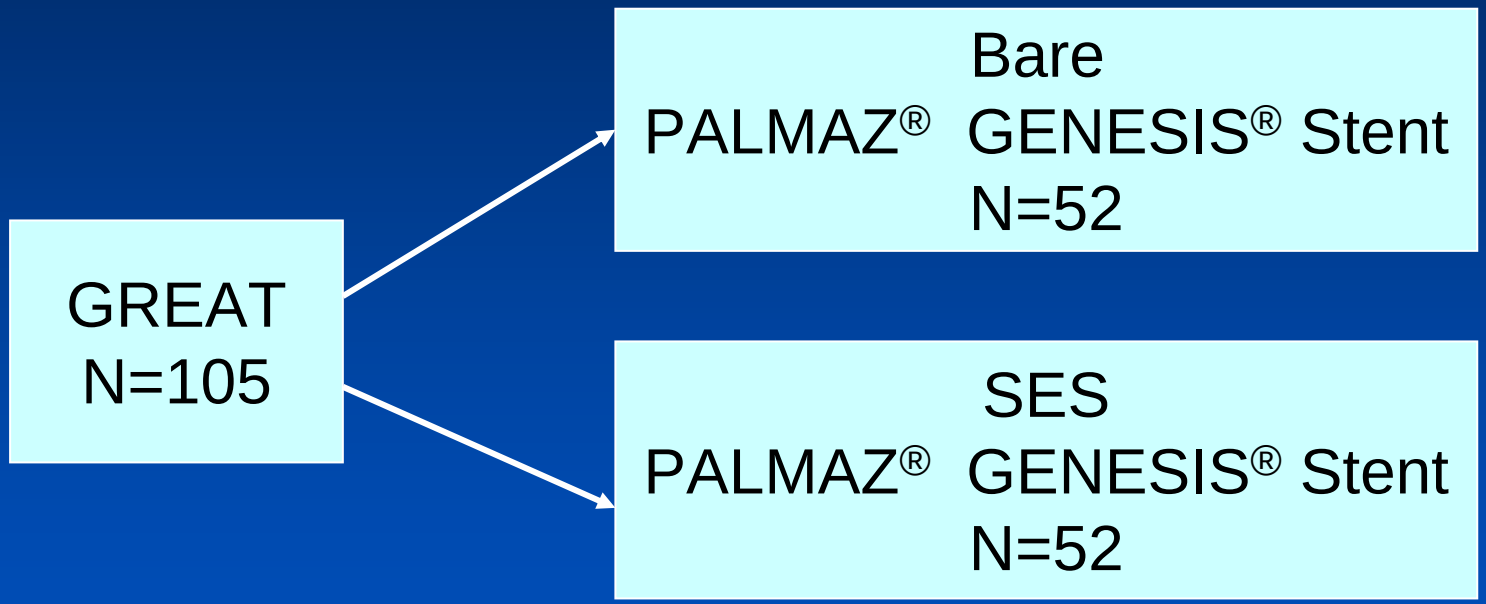
Outcome	No. of procedures			
	Without distal protection		With distal protection	
	N	%	N	%
Improved renal fuction		0	14	38
Stabilized renal fuction	15	75	21	57
Unchanged decline	4	20	2	5
Acute deterioation	1	5		0

A distal protection device may significantly improve results during stent revascularization.

Holden A, et al. J Vasc Surg. 2004;38:963-968

DES in Renal Artery Stenting

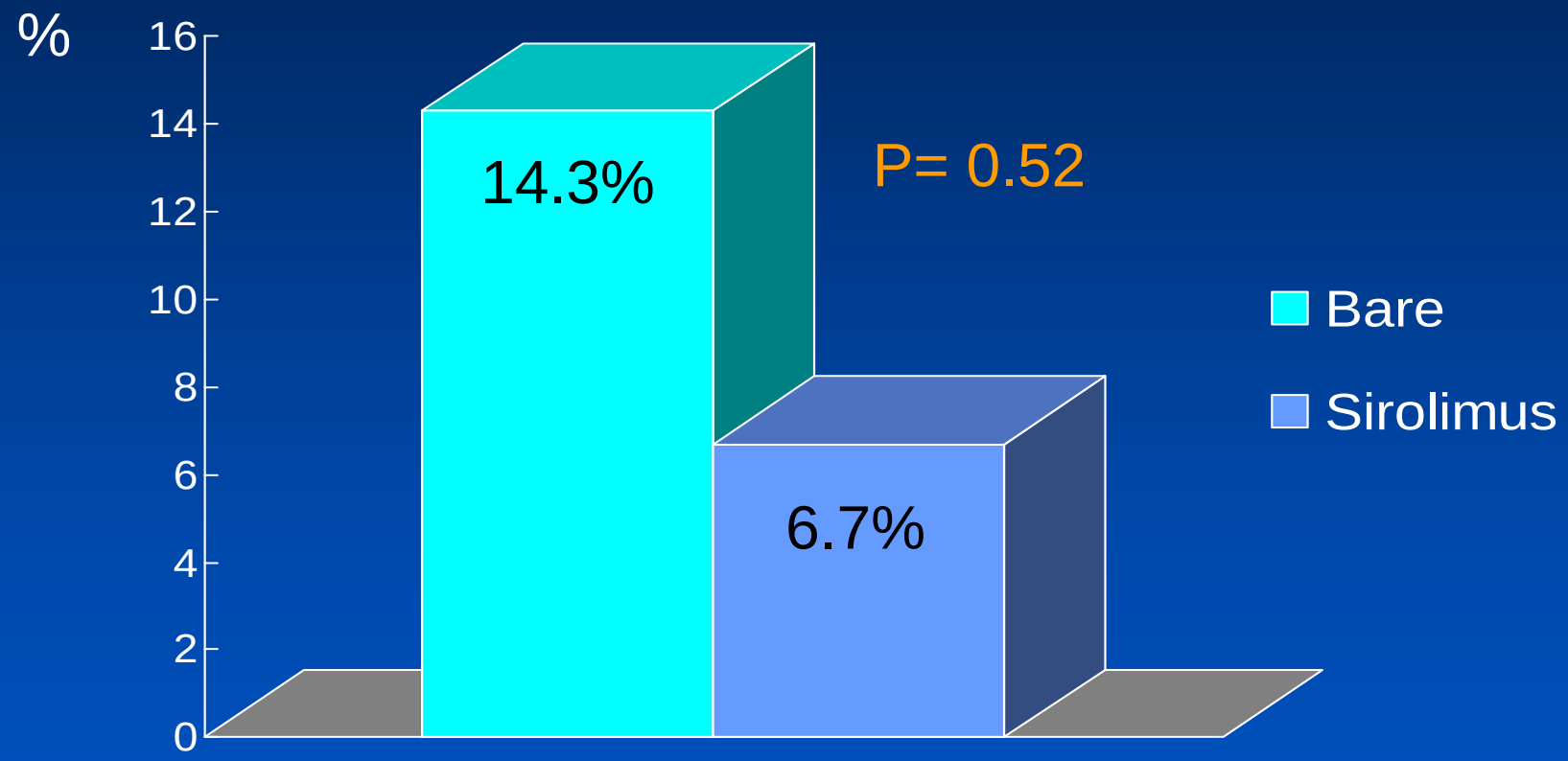
GREAT Trial



Primary End point : mean in-stent % DS at 6-month F/U

Secondary End point: MACE at 6,12 and 25 months

6-month Restenosis



M. Zähringer et al. TCT 2004

Safety of DES

Up to 6 month	Bare	SES	P-value
Death	0	1	NS
Clinical patency	92.3%	96.2%	NS
	(48/52)	(51/53)	
TLR	7.7 %	3.8 %	NS
Significant embolic event	1.9 %	0	NS
Worsening of renal function	2	5	NS

M. Zähringer et al. TCT 2004

Renal Artery Stenting

In the near future

Outcomes will be advanced by

- improved stents/delivery systems
- Distal protection device
- Drug – eluting stent