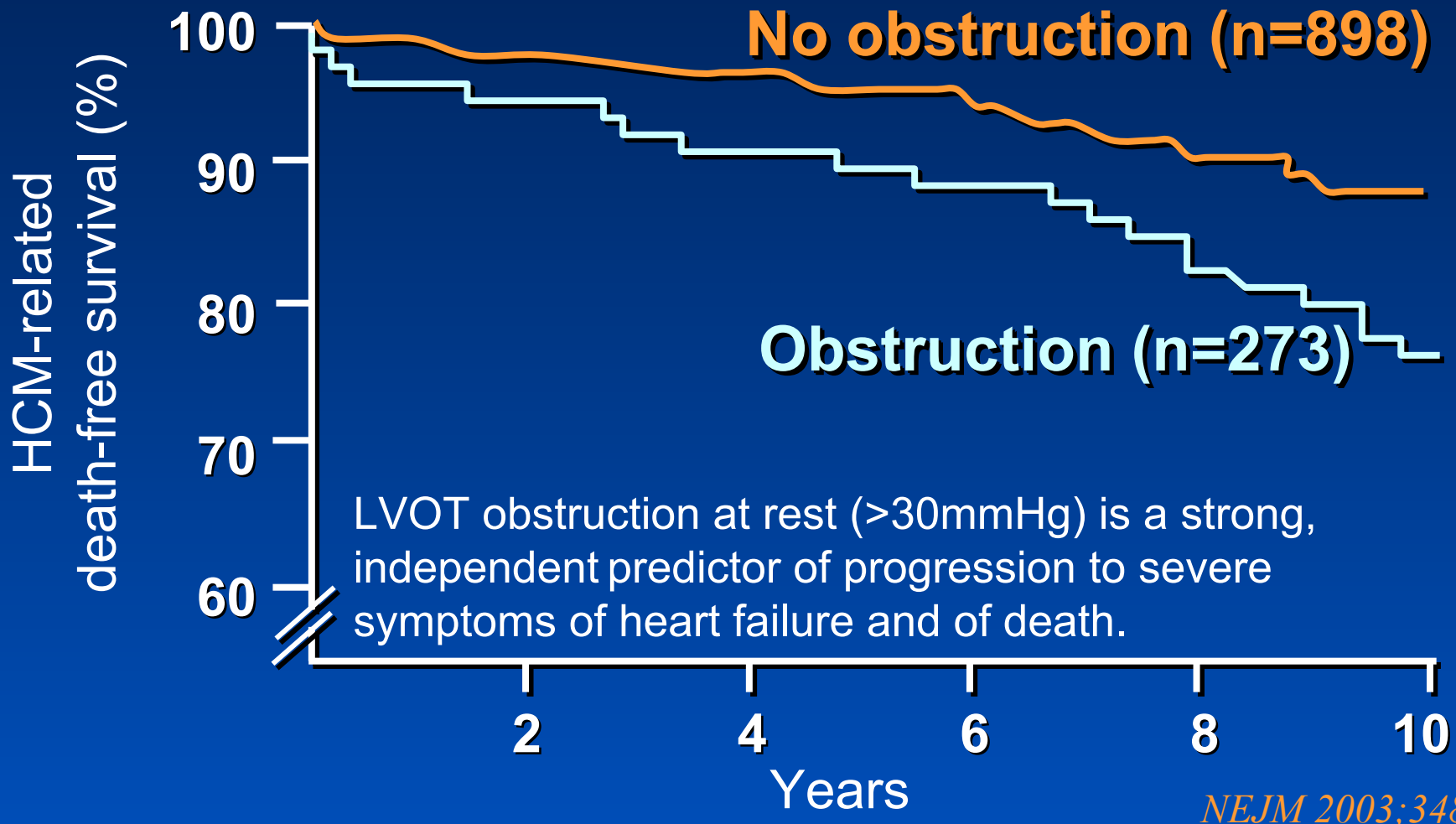
Nonsurgical Septal Reduction Therapy for Hypertrophic Obstructive Cardiomyopathy

Hypertrophic Obstructive Cardiomyopathy

- Left ventricular(LV) outflow obstruction
  : an important determinant of symptoms
- Therapies that reduce the LV outflow perssure gradient
  → may improve LV filling pressure and symptoms

Effect of LVOT obstruction on Survival



NEJM 2003;348:295

Nonpharmacologic Therapies that Reduce LVOT Obstruction

- Surgical myectomy or myotomy
- DDD pacemaker therapy
- Nonsurgical septal reduction therapy (NSRT); introduced by Sigwart et al

Merits of NSRT

- Nonsurgical technique
- Marked hemodynamic improvement
- Technically easy to interventional cardiologist

* There have been an estimated 3,000 NSRT procedures performed worldwide.

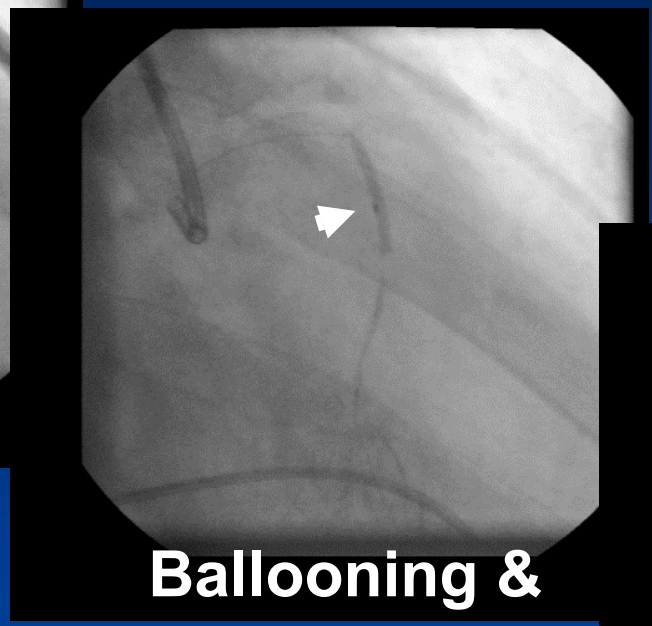
Current Indications

Symptomatic HOCM with

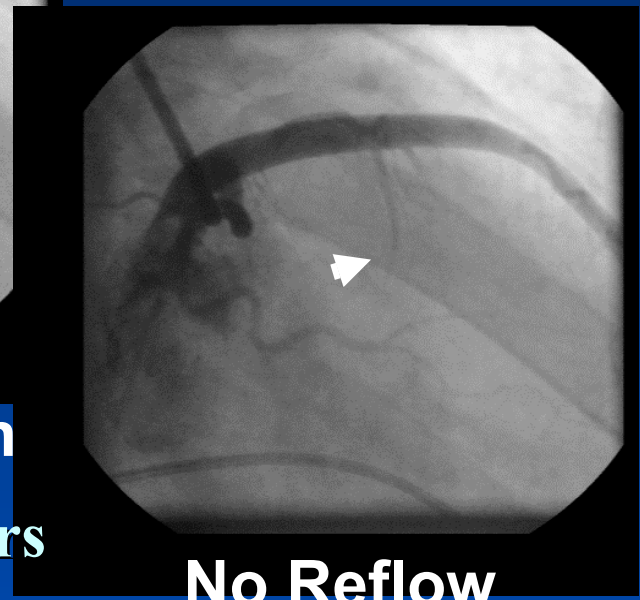
- **Unresponsive to medical therapy**
- **LVOT pressure gradient**
  - **Resting ≥ 30 mmHg**
  - **Stress induced ≥ 60 mmHg**
- **Septal thickness ≥ 18 mm**

Procedure of NSRT

Target Artery



Ballooning &
Ethanol injection



No Reflow

Identification of the appropriate perforators
MCE after balloon occlusion
Injection of 1-3 ml alcohol into the target artery
Acute reduction in resting PG by > 50% or < 20 mmHg

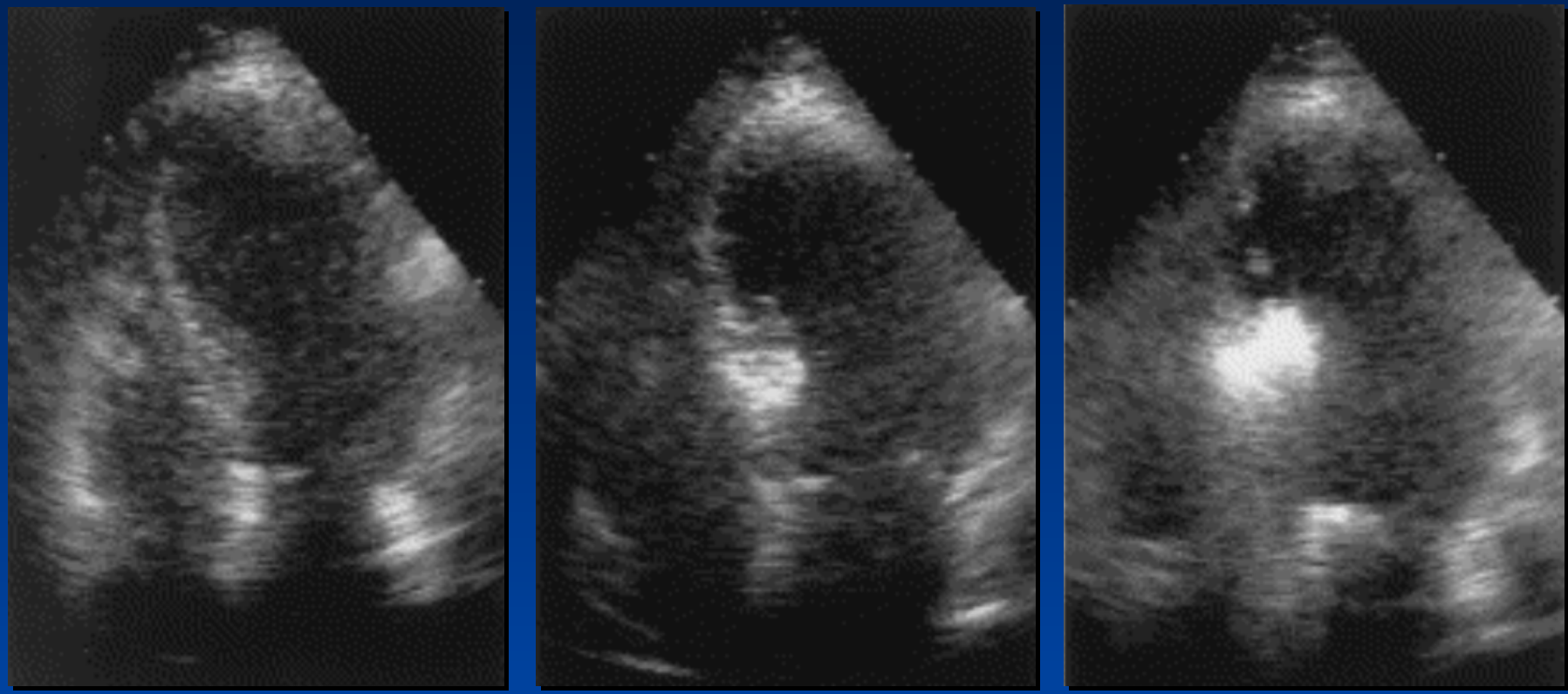
Procedure

- Temporary pacemaker insertion
- Hemodynamic measurements
- 7~8F guiding catheter into the LCA ostium
- Angioplasty balloon (1.5~2.5 mm) positioned at proximal portion of the septal artery

Procedure

- Myocardial contrast echocardiography for proper localization and quantification of septal infarct after enthanol injection
- Exclusion of dye reflux into the LAD

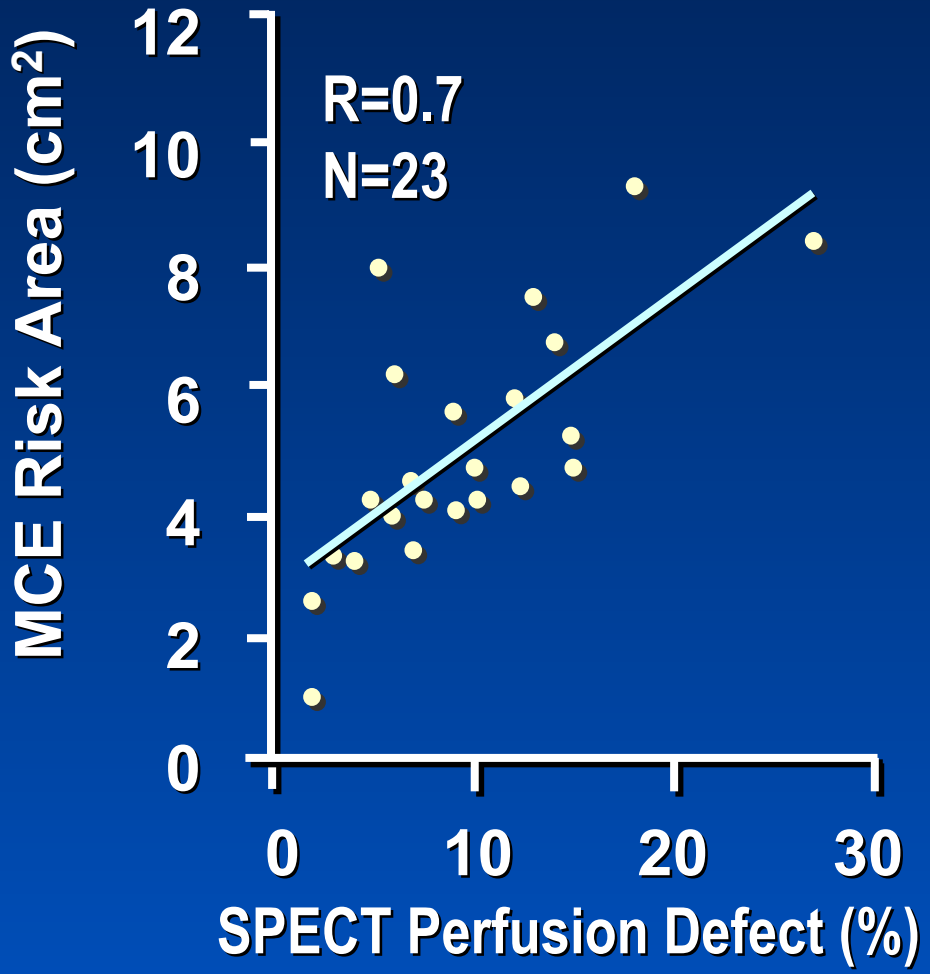
Myocardial Contrast EchoCG



Baseline Contrast Ethanol

MCE enhances the effectiveness and safety of NSRT by avoiding arteries that supply distant regions of myocardium

Myocardial Contrast Echocardiography



- Estimation of the size of the septal vascular territory with MCE

→ Accurate, safe and feasible in patients during NSRT.

JACC 1998; 32 : 225-9

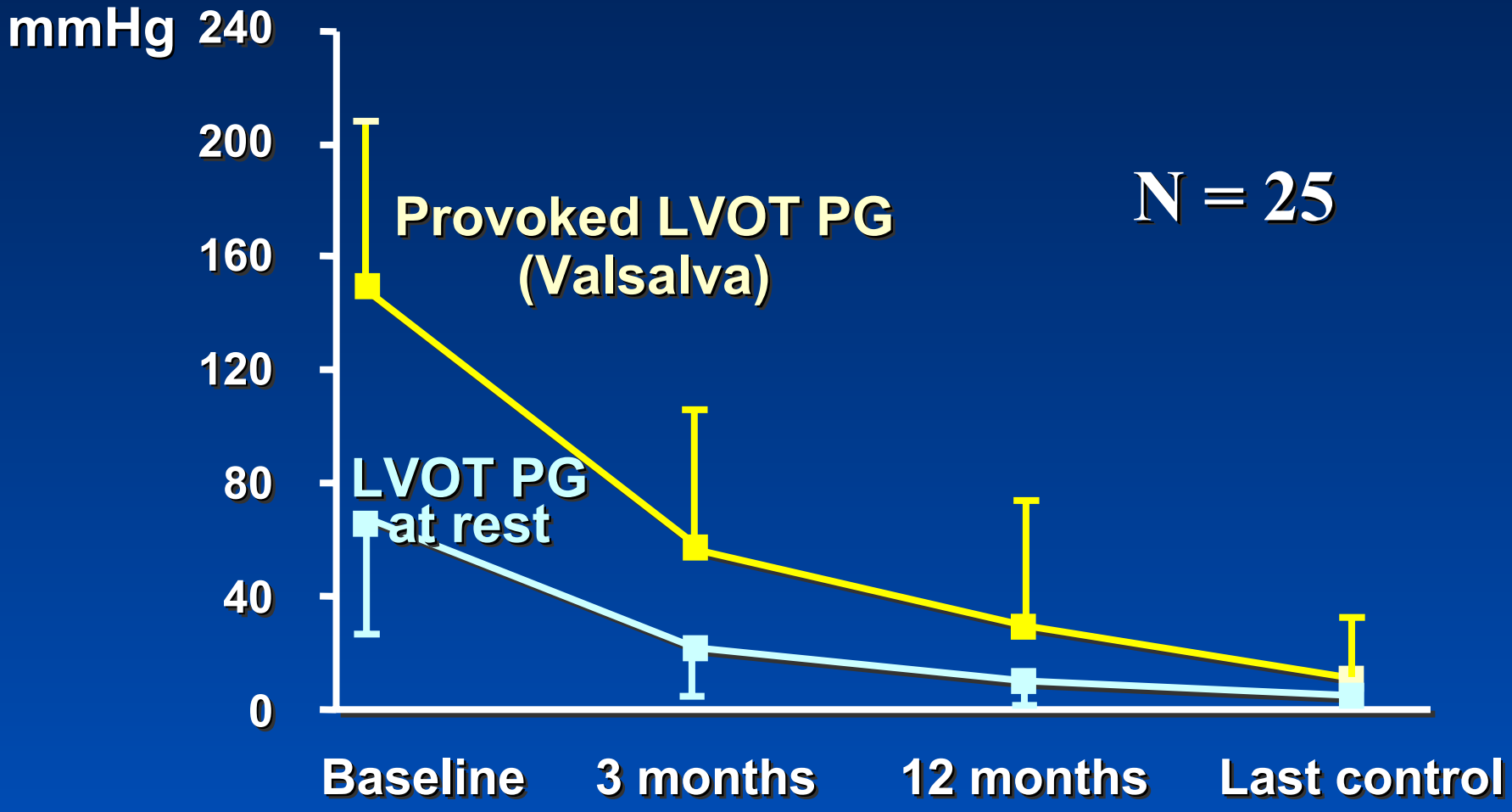
Procedure

- 4-8 mg morphine IV for pain control
- Absolute alcohol (1 - 3 ml) injection
- 5 minutes dwelling before balloon deflation

Postprocedural Management

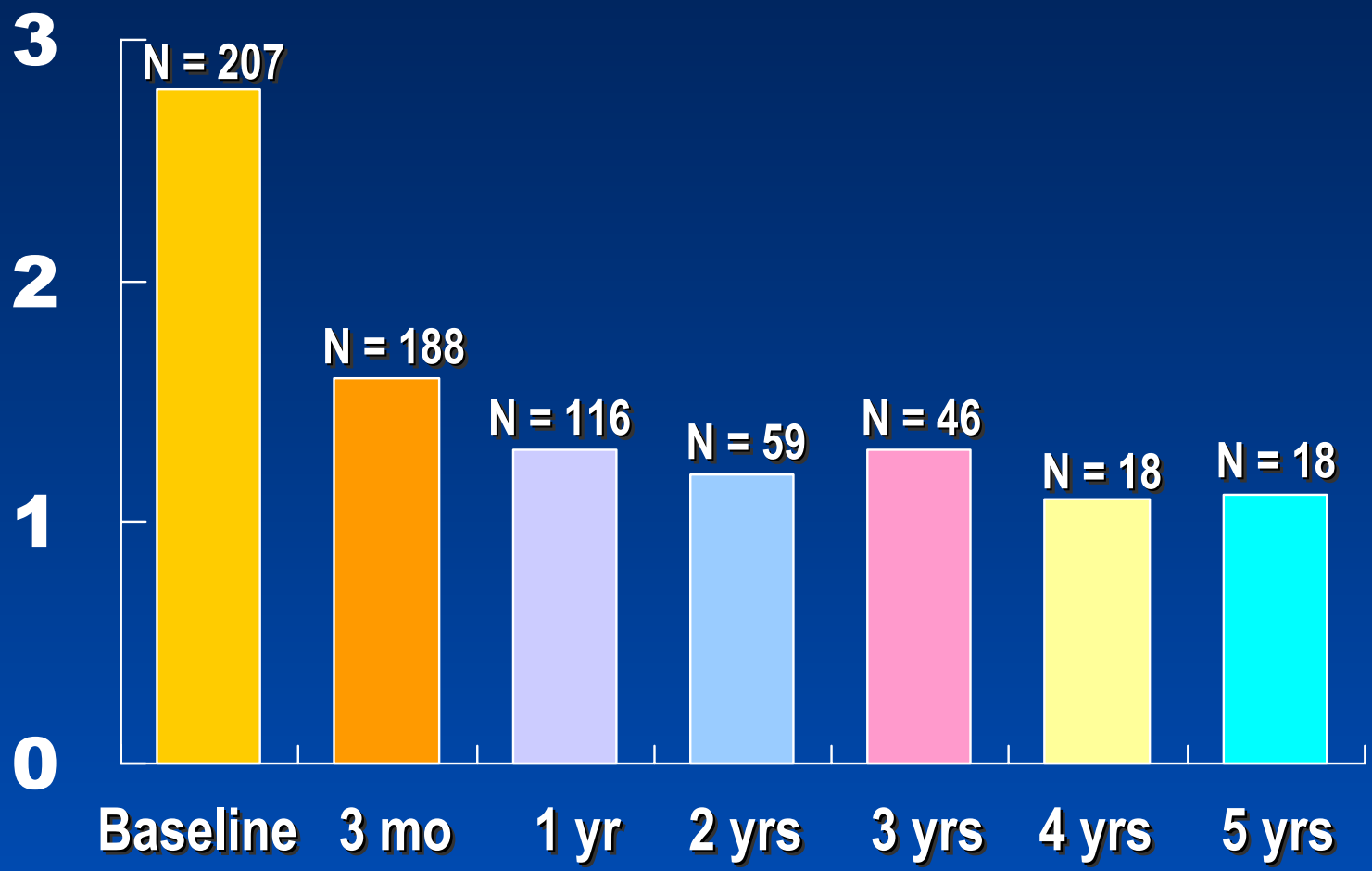
- Admission to CCU
  - Careful ECG monitoring with temporary pacemaker back up
  - Cardiac enzyme F/U for 1 ~ 3 days
- Discharge : usually 7 days after procedure

Evolution of LVOT PG Estimated by Echo Doppler



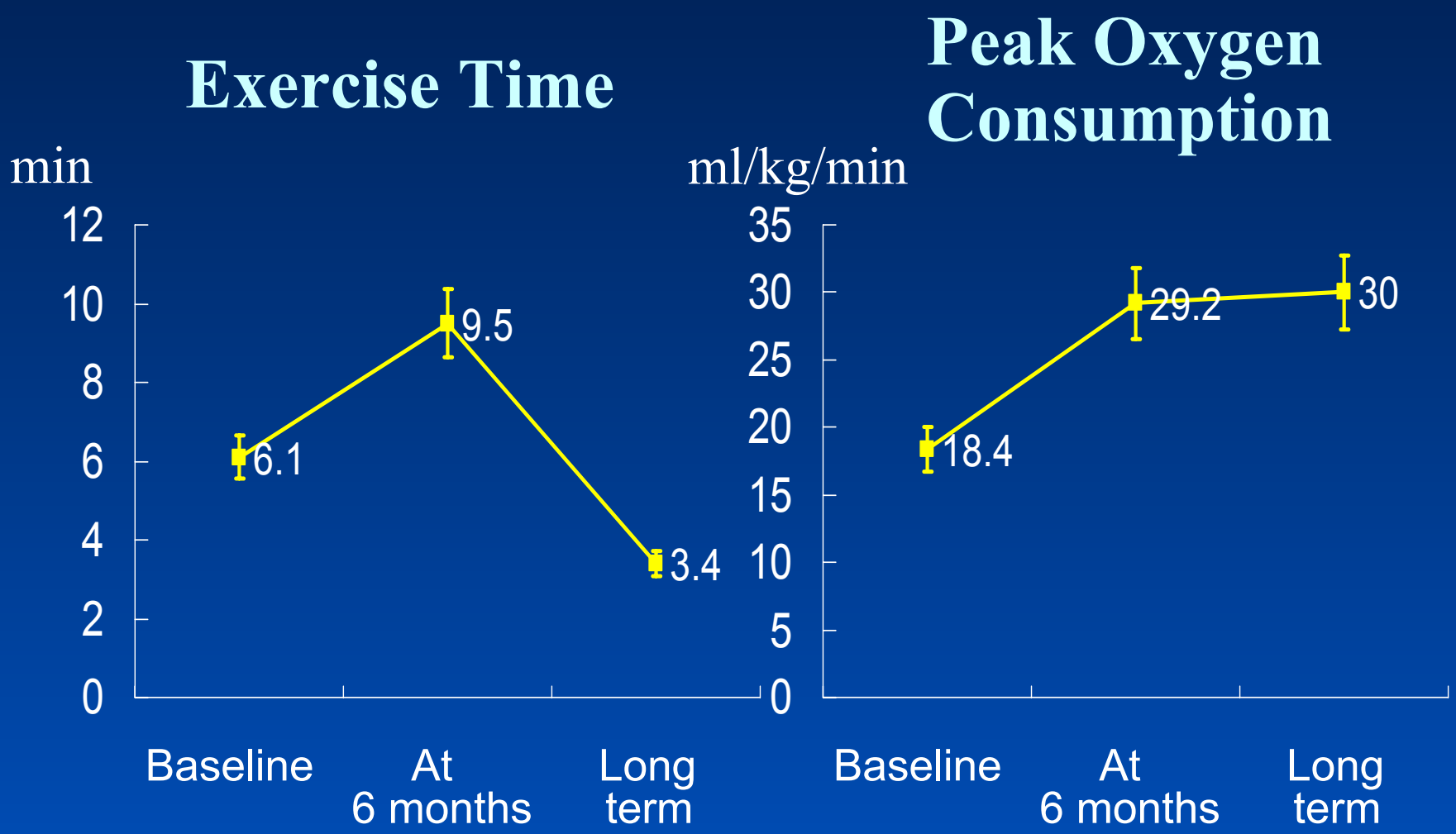
Heart 2000; 83 : 326-31

NYHA Class After NSRT



Spencer W, TCT 2003

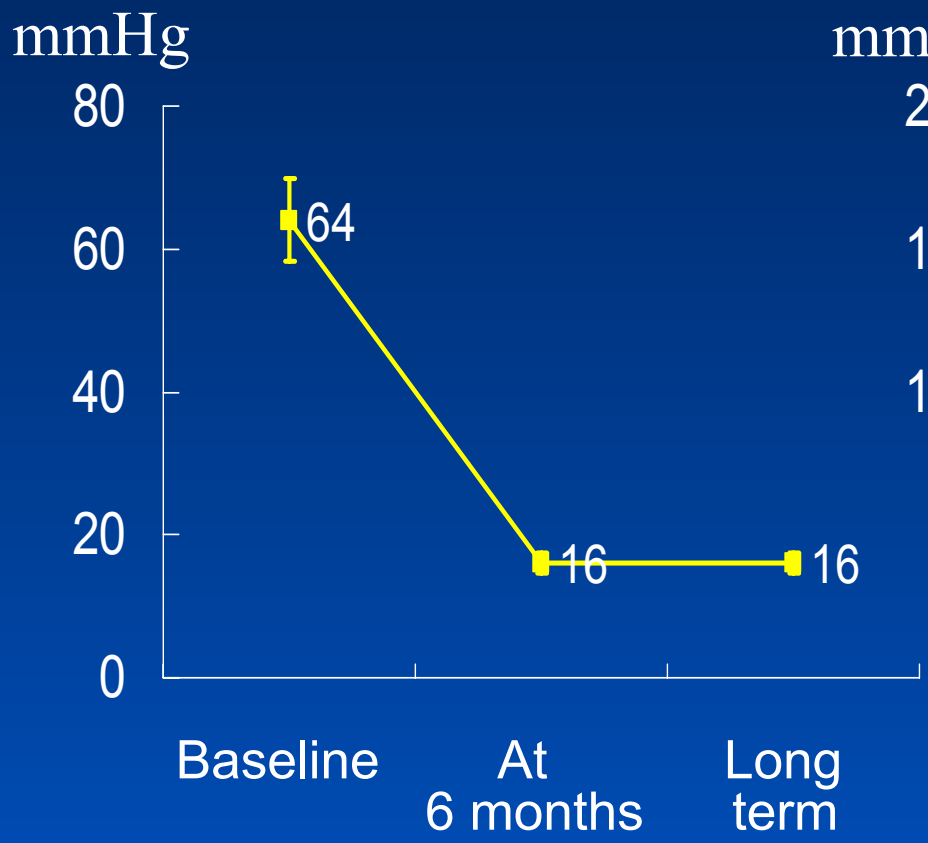
Exercise Testing After NSRT



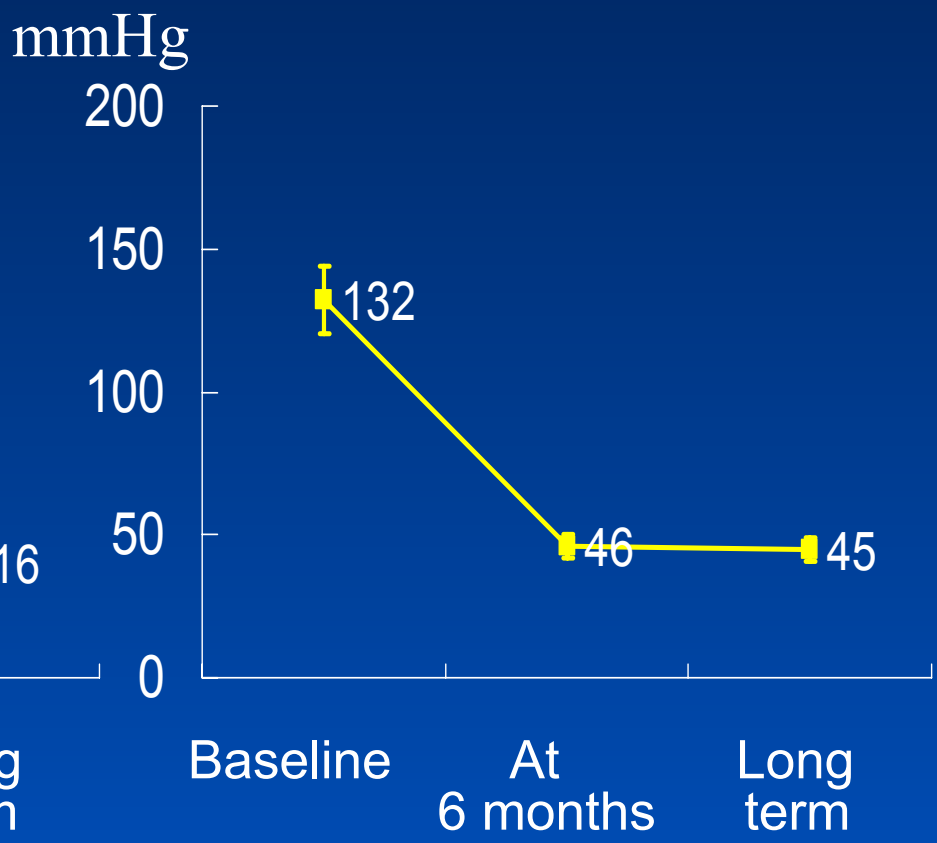
Shamim W et al. NEJM 2002;347:1326

Echocardiography After NSRT

Resting LVOT gradient

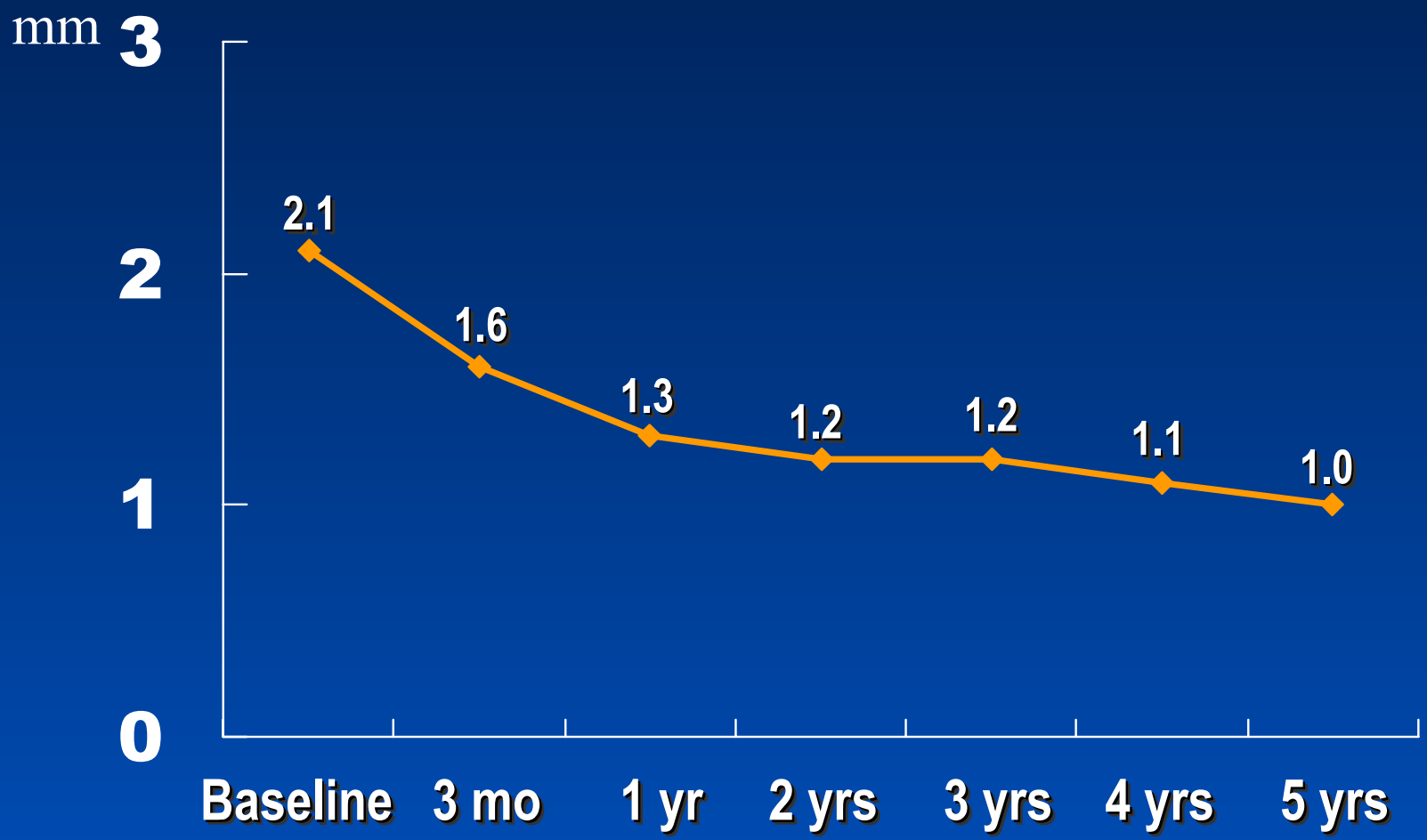


Dynamic LVOT gradient



Shamim W et al. NEJM 2002;347:1326

Septal Thickness After NSRT



Spencer W, TCT 2003

Predictors of Unsatisfactory Outcome after NSRT

39/173 (22.5%)

- **Resting LVOT gradient at cath lab ≥ 25 mm Hg (OR, 5.5; *P*=0.01)**
- **Peak CK <1300 U/L (OR, 2.5; *P*=0.04): critical site and mass**

"the importance of not only a critical site but also a critical mass of septal necrosis for an effective NSRT"

Circulation 2004;109:824-827

Complete AV block
Predictor of PPM

	OR	95%CI	P-Value
LBBB	39	3.6-416	0.002
> 2 septal injected	4.6	1.3-16	0.016
Bolus ethanol injection	51	3.5-735	0.004
1st-degree AVB	14	3-69	0.001
Female	4.3	1.3-15	0.02

Complete AV block:30~40% → The incidence is reduced to 5~20% after using reduced amount of alcohol, slow infusion, MCE

Complications

- Complete AV block; 30~40%
  ; the incidence is reduced to 5~20%
  - Smaller doses of alcohol
  - Slow injection
  - MCE
- Large myocardial infarction
- VSD or myocardial perforation
- Intractable ventricular fibrillation
- No reflow of LAD artery
- Death (Pooled data: 1.5 %)

AMC Experience

Patients

- **December 1996 and May 2003**
- **37 patients with symptomatic HCMP**

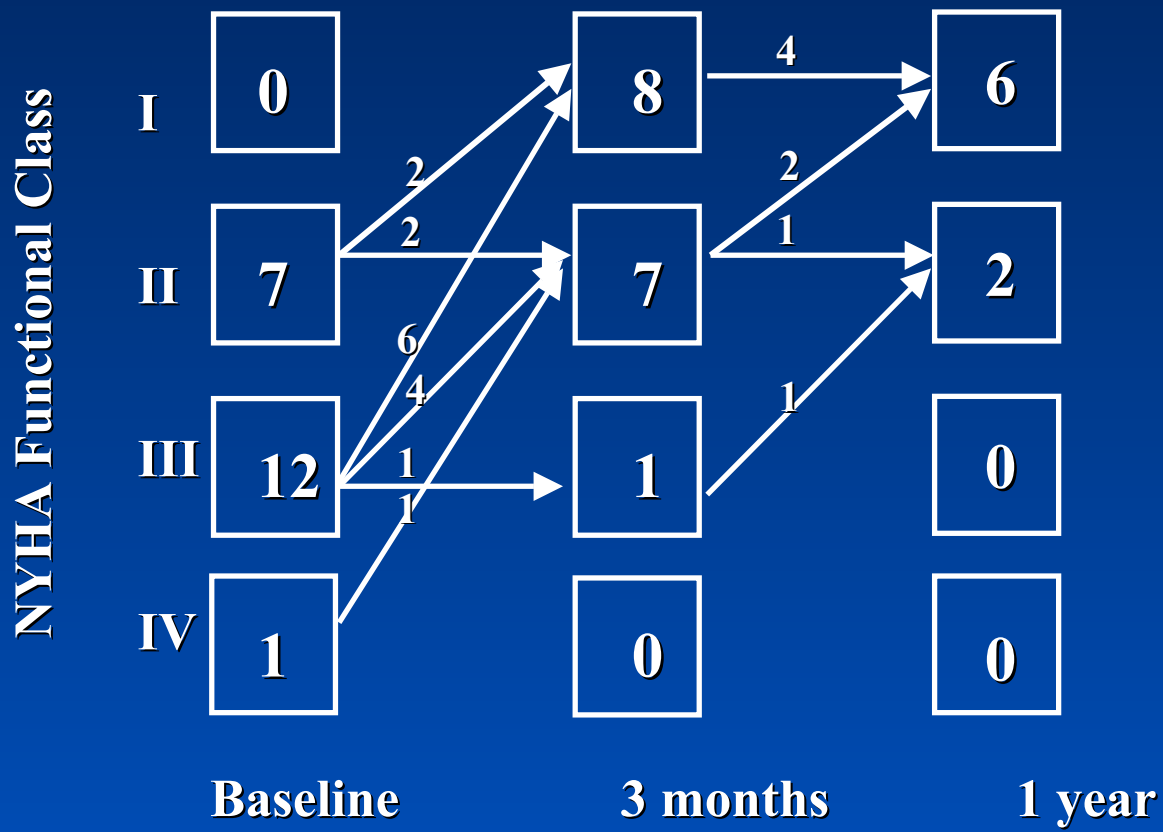
  (20 females, 17 males)

Procedure Summary

- **Target artery**
  - **1st septal branch; 31 (80%)**
  - **2nd septal branch; 6 (15%)**
  - **1st and 2nd septal branches; 2 (5%)**
- **Alcohol amount: 4.0 ± 2.2ml (1.5~10)**
- **Use of MCE: 12 cases (31%)**

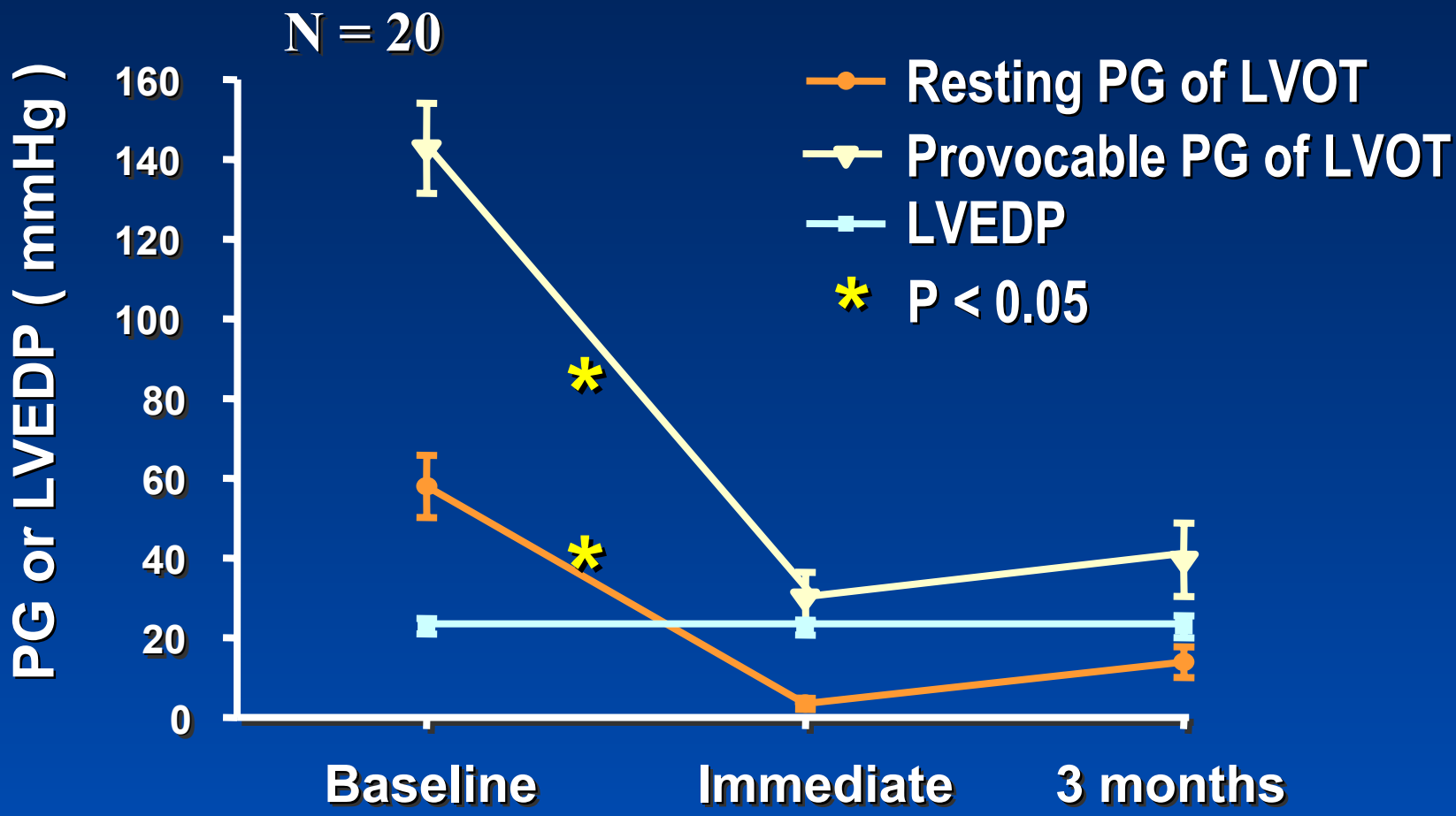
Therapeutic effect

Symptomatic improvement in the majority of patients after NSRT (≈ 80%)



AJC1999;83:1220

Hemodynamic effect



AJC1999;83:1220

Exercise Test

(n=20)

	Baseline	3 months	1 year
Exercise time(s)	573 ± 47	742 ± 46†	763 ± 58†
Peak HR	137 ± 11	142 ± 6	139 ± 76
Peak SBP(mmHg)	132 ± 10	160 ± 5†	166 ± 7†
VO_2 at rest(ml/min)	238 ± 13	268 ± 11*	271 ± 18*
VO_2max(ml/min/kg)	18.5 ± 1.5	22.6 ± 1.3†	22.9 ± 1.8†

**p<0.05 and †p<0.01 vs baseline*

NSRT leads to significant improvement of overall exercise capacity as well as symptomatic improvement.

AJC1999;83:1220

Echocardiographic Data

N = 37

	Baseline	Immediate post-procedure	6 months after procedure	F/U data
LVESD (mm)	23.3 ± 5.6	23.4 ± 4.7	25.9 ± 5.3*	26.5 ± 5.6*
LVEDD (mm)	41.7 ± 7.5	41.9 ± 6.4	45.1 ± 6.8*	45.3 ± 6.5*
IVS (mm)	22.0 ± 5.0	21.7 ± 4.8	18.6 ± 4.4*	18.4 ± 4.9*
LVPW (mm)	12.7 ± 2.3	12.4 ± 1.9	11.9 ± 2.5	11.9 ± 2.4
LA (mm)	47.0 ± 7.4	44.9 ± 6.1	46.6 ± 8.2	47.2 ± 7.5
LVOT PG (mmHg)	85.1 ± 45.8	53.7 ± 40.9*	47.1 ± 49.0*	49.2 ± 40.3*

** $p<0.05$*

Complications

53.8 ± 22.2 months F/U

- **Early complications:**
  - **Death: 1 (3%)**
  - **LAD infarct: 1 (3%)**
  - **CAVB: permanent 2 (5%)**
    transient 18 (46%)
- **Late outcomes:**
  - **Death: 4 (2 cardiac, 2 non-cardiac)**

SCD: a consequence of NSRT or underlying HCMP ?

Conclusions

- **NSRT is a promising nonsurgical technique for septal myocardial reduction in HOCM**
- **Further follow-up studies may be needed to recommend NSRT as a primary therapy for HOCM.**