Aortic Stenosis
Difficult Issues

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Epidemiology

- AS is the most common cardiac-valve lesion in the United States.
- The prevalence of AS is 2% to 7% in the population above 65 years of age.
- AS caused by degenerative calcification has become the most common valvular disease requiring cardiac surgery.
  - Two factors account for its common occurrence:
    - Approximately 1 to 2 percent of the population is born with a bicuspid aortic valve
    - The population is aging.

AS severity

- **AVA**
  - >1.5 cm² (>0.9 cm²/m²) - mild
  - 1-1.5 cm² (0.6-0.9 cm²/m²) - moderate
  - <1 cm² (<0.6 cm²/m²) - severe *

- Forward velocity across the valve
  - moderate AS - 3.0-4.0 m/s
  - Severe - >4 m/s

**Branwald:** <0.8-0.9 cm² (<0.5-0.6 cm²/m²)

* Cutoff levels 0.8, 0.9 or 1.0 cm² (various authors)

AS severity

<table>
<thead>
<tr>
<th>Peak gradient</th>
<th>Mean gradient</th>
<th>Severe AS</th>
</tr>
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<tbody>
<tr>
<td>≥80</td>
<td>≥70</td>
<td>Highly likely</td>
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<tr>
<td>60-79</td>
<td>50-69</td>
<td>Probable</td>
</tr>
<tr>
<td>&lt;60</td>
<td>&lt;50</td>
<td>Uncertain</td>
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Rahimtoola, JACC 1989; 14: 1-23

Pitfalls in aortic valve gradient estimation

- **Underestimation:**
  - failure to record true peak velocities
  - inadequate signal
  - inappropriate recording angle
  - lack of technical expertise

- **Overestimation:**
  - comparison of peak gradient with peak-to-peak gradient
  - MR - recording of the wrong jet
  - High CO
  - Dynamic subaortic gradient
  - Post-extrasystolic beat - non representative selection of velocity data
  - Pressure recovery (prostheses) - recording of the wrong jet

Aortic stenosis from apical view

Bad tracing   Good tracing
Confusion among aortic stenosis and mitral regurgitation jets

CW Doppler – AS vs. MR vs. LVOT Obstruction

Importance of multiple windows assessment

TEE in AS

MRI in AS

Complications in cardiac catheterization

Magnetic resonance planimetry of the AVA correlates well with TEE and less well with the catheter-derived AVA

- Moderate AS
- Severe AS

- John AS et al JACC 2003

- Mortality 0.14 – 0.75%
- Myocardial infarction 0.07 – 0.6%
- Cerebrovascular events 0.03 – 0.3%
- Major vascular 0.4%
- Renal failure 1.4 – 2.3%
- Minor 4%
Silent and apparent cerebral embolism after retrograde catheterisation of the aortic valve in valvular stenosis: a prospective, randomised study

Omran Heyderetal
The Lancet
361; 1235-1310 (April 2003)

Findings

• Acute cerebral embolic events after the procedure occurred in 22 (22%) patients
• Clinically apparent neurological deficits occurred in 3 (3%) patients
• None of the patients without passage of the valve, or any of the controls, had evidence of cerebral embolism as assessed by MRI.

Interpretation

• Patients with valvular aortic stenosis who undergo retrograde catheterisation of the aortic valve have a substantial risk of clinically apparent cerebral embolism, and frequently have silent ischaemic brain lesions.
• Patients should be informed about these risks, and this procedure should be used only in patients with unclear echocardiographical findings when additional information is necessary for clinical management.

ACC/AHA guidelines: Class I indications for cardiac catheterization

1. Coronary angiography before surgery in patients at risk of CAD
2. Assessment of the severity of VHD when
   • Noninvasive tests are inconclusive
   • Discrepancy between clinical findings and noninvasive tests
3. To perform percutaneous mitral balloon valvotomy

Should we cross the valve: the risk of retrograde catheterization of the left ventricle in patients with aortic stenosis.

Meine TJ, Harrison JK.

• 22 of 101 patients (22%) assigned to retrograde catheterization developed new focal MRI abnormalities consistent with acute cerebral embolic events.
• 3 of these patients (3%) demonstrated clinically apparent neurologic deficits.
• None of the patients who did not undergo retrograde catheterization—and none of the control patients—had MRI or clinical evidence of cerebral embolism.

Am Heart J. 2004

AS progression

• Yearly rate of AS progression
  • 0.1 cm²/s
  • 0.3 m/s
  • 6-8 mmHg
• Considerable individual variability
• Methodological flaws
  • Selected population
  • Many with short F-U period
  • Technical difficulties, esp. in critical stenosis
### Potential determinants of AS progression

**Echo factors**
- Leaflet calcifications
- Leaflet thickening
- Baseline AVA

**Clinical factors**
- Men
- Older age
- Smoking
- Cholesterol
- CRF/dialysis
- Ca/Phos product
- Hypertension
- Etiology

### Pathophysiology and Concepts in AS Progression

- **Lipid process** - (“cholesterol hypothesis”)
- Inflammatory process
- Renin angiotensin system
- Calcification and ossification
- Genetic factors

All these processes are involved in atherosclerosis

### New Insights Into the Progression of Aortic Stenosis

**Implications for Secondary Prevention**

Sanjeev Palta, MD; Anita M. Pai, MD; Kanwaljit S. Gill, MD; Ramdas G. Pai, MD

*Circulation.* 2000;101:2497.

The impact of cholesterol level on AS progression

- In patients with a serum cholesterol level $>200$ mg/dL, the annual reduction in AVA was $0.14\pm0.35$ cm², compared with $0.07\pm0.19$ cm² in those with a level $<200$ mg/dL ($P=0.04$).

### Conclusions

- Absolute and percentage reduction in AVA per year in those with AS is greater in those with milder degrees of stenosis.

- Factors associated with rapid AS progression:
  - smoking
  - hypercholesterolemia,
  - elevated serum creatinine
  - calcium levels.

### Effect of Hydroxymethylglutaryl Coenzyme A Reductase Inhibitors on the Progression of Calcific Aortic Stenosis

Gian M. Novaro, MD; Irving Y. Tiong, MD; Gregory L. Pearce, MS; Michael S. Lauer, MD; Dennis L. Sprecher, MD; Brian P. Griffin, MD

*Circulation.* 2001;104:2205.
Main Results

• The decrease in aortic valve area for the nonstatin group was 0.11±0.18 cm² compared with 0.06±0.16 cm² for those treated with a statin (P=0.030).

(Gian M et al, Circulation. 2001;104:2205.)

Multivariate analysis

• Statin usage was a significant independent predictor of a smaller decrease in valve area (P=0.01) and a lesser increase in peak gradient (P=0.02).

(Gian M et al, Circulation. 2001;104:2205.)

Conclusions

• Statin-treated patients had reduced aortic stenosis progression compared with those not treated with a statin.

Gian M et al, Circulation. 2001;104:2205.)

Statins for aortic biological prosthesis

• Statin-treated pts showed a lower rate of progression of prosthetic gradients and a reduction in worsening of AR
• Thus, statins slow bioprosthesis degeneration.

F. Antonini Canterin, IT, 2885

Predictors of outcome in AS

Natriuretic Peptides (BNP, NIBNP)

• Natriuretic peptides, are significantly higher in asymptomatic AS pts
• Non-survivors had significantly higher natriuretic peptides.
• Thus, natriuretic peptides are predictors of outcome in AS and can optimise timing of surgery in asymptomatic pts.

Mc Cann, UK, 2287 J. Bergler-Klein, AT, 3536

(P. Lim, FR, 2286)

(n=0.001)

C-reactive protein- predicts progression of degenerative aortic valve stenosis

• C-reactive protein > 3 mg/L predicts progression of degenerative aortic valve stenosis

Peak aortic velocity progression and CRP

(Circulation. 2004 May)
**AS - natural history**

- Yearly mortality in asymptomatic AS - <1%
- Crude adjusted operative mortality in AVR
  - 4% for isolated AVR
  - 7% for AVR + CABG
- No data to support prevention LVH & diastolic dysfunction by early AVR
- Symptoms → 2 year survival < 50%.

**Systematic review of the outcome of aortic valve replacement in patients with aortic stenosis.**

- Meta-analyses of the change in LVM and EF after AVR in adult patients
- 27 articles published between 1980 and 2003 in 1546 AS patients
- Increase in EF after surgery is more pronounced in the pts that have low preoperative EF (28% vs 40%)
- However, regression of LV mass; predominantly within the first 6 months after surgery - 181 vs. 124 g/m² - uniformly achieved regardless of age, sex, time of operation, or types of valve substitute.

  * Sharma UC Ann Thorac Surg. 2004

**Asymptomatic severe AS**

- Goals of early intervention:
  - Prevent SD?
  - Prevent LV dysfunction?
  - Prevent LVH?

**Sudden death in AS**

- SD in AS - mostly arrhythmic (Holter)
- An extreme case of syncope?
- SD usually occurs in symptomatic patients*
- SD is rare in asymptomatic severe AS*.
  - 5 out of 229 (2%) in one study

  E Braunwald (jacc 1990)

**F-U of 123 initially asymptomatic patients With AS**

- F-U - 32±12 months
- 8 (7%) died, 48 (39%) AVR
- In all 4 patients with cardiac death - CHF requiring hospitalization preceded death
- Multivariant analysis of adverse outcome:
  - High initial Vmax
  - Low initial FC
  - Rapid rate of progression

Otto et al. Circ 1997; 95: 7262-70
Conclusions

- In adults with asymptomatic AS, the rate of hemodynamic progression and clinical outcome are predicted by jet velocity, the rate of change in velocity, and functional status.

Predictors of outcome in severe, asymptomatic aortic stenosis.


Asymptomatic severe AS

- 128 consecutive patients with asymptomatic, severe aortic stenosis
- 59 women and 69 men
- Age 60±18 years
- Aortic-jet velocity, 5.0 ± 0.6 m/s.

Asymptomatic severe AS

- Follow-up - 22±18 months (98%)
- Percent event-free survival
  - 1y - 67 ± 5
  - 2y - 56 ± 5,
  - 4y - 33 ± 5
- End points: death (n=8), AVR for symptoms (n=59)
- Among cardiac deaths, 5/6 were preceded by symptoms.

Extent of aortic-valve calcification - the only independent predictor of outcome.

Parameters that did not predict adverse outcome:

- age
- sex
- Coronary artery disease
- hypertension
- diabetes
- hypercholesterolemia

Influence of rate of progression of stenosis

- Patients who had cardiac events:
  - 0.45 ± 0.38 m/s/y
- Patients who did not have cardiac events:
  - 0.14 ± 0.18 m/s/y (P<0.001)
- Moderately or severely calcified aortic valves + velocity increase by ± 0.3 m/s/y - 79% underwent surgery or died within two years of the observed increase.
Conclusions

- In asymptomatic patients with aortic stenosis, it appears to be relatively safe to delay surgery until symptoms develop.

- The presence of moderate or severe valvular calcification, together with a rapid increase in aortic-jet velocity, identifies patients with a very poor prognosis. These patients should be considered for early valve replacement rather than have surgery delayed until symptoms develop.


Aortic stenosis

Indications for surgery

- **Class I**
  - Severe, symptomatic AS
  - Severe AS when CABG other valvular / aortic surgery is indicated

- **Class IIA**
  - Moderate AS when CABG / other valvular / aortic surgery is indicated
  - Severe AS + LV dysfunction
  - Severe AS + abnormal exercise response (BP ↓)

Bonow et al. JACC 1998; 32: 1486-588

Aortic stenosis

Indications for surgery (Cont’d)

- **Class IIB**
  - Asymptomatic severe AS + VT
  - Asymptomatic severe AS + severe LVH (≥15 mm)
  - Critical AS (<0.6 cm²)

- **Class III**
  - None of the above

Bonow et al. JACC 1998; 32: 1486-588

Exercise test in AS

- **Goal:**
  - To elucidate symptoms / signs in sedentary / dissimulant patients

- **Target population:**
  - Patients with moderate or severe AS, who claim to be asymptomatic, and are not excluded from surgery

- **Contraindicated if**
  - Unequivocal heart failure
  - Angina
  - Presyncope/syncope

Bonow et al. JACC 1998; 32: 1486-588

Exercise test in AS

- **Safety:**
  - Safe if conducted properly

- **Endpoints:**
  - BP fall by >10 mmHg
  - Symptoms
  - Significant arrhythmia
  - Significant ST depression NOT an indication to stop study if unaccompanied by symptoms / hemodynamic / arrhythmic complications

“It is usually better to have a complication under observation during a treadmill test than walking up a hill in the country”

AS with low gradients

- **AVR in AS + LV dysfunction:**
  - 20% operative mortality
  - Worse if additional CABG
  - Highest risk period: from induction to pump

- **AVR is never late when associated with LV dysfunction if AVG is high**
### AS with low gradients

**Subgroups**

- 1a - contractile reserve present but no increase of the aortic valve area*
- 1b - contractile reserve present and increase of the aortic valve area
- 2 - no contractile reserve present

* Likely to benefit from AVR

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### AS with severe LV dysfunction and low transvalvular pressure gradients

**Risk stratification by low-dose dobutamine echocardiography**

Jean-Luc Monin MD*, Mehran Monchi MD, Virginie Gest MD*, Anne-Marie Duval-Moulin MD, Jean-Luc Dubois-Rande MD, PhD* and Pascal Gueret MD, FACC.

_JACC 2001; 37: 2101-2107_

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### Patients and Methods

- Low-dose DSE was performed in 45 patients
- Mean age 75 [69 to 79]
- Mean LV ejection fraction: 29%
- Aortic valve area [cm^2]: 0.7 [0.5 to 0.8]
- Mean transaortic gradient 26 [mm Hg]

_JACC 2001; 37: 2101-2107_

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### AS with severe LV dysfunction and low transvalvular pressure gradients

- Patients were classified into two groups:
  - group I (n = 32) - LV contractile reserve on DSE
  - group II (n = 13) no contractile reserve.
- Valve replacement was performed in 24 and 6 patients in groups I and II, respectively.

_JACC 2001; 37: 2101-2107_

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### Low Gradient severe AS

**Perioperative Mortality**

- Group I (LV contractile reserve) - 8%
- Group II (No LV contractile reserve) - 50%

_Jean-Luc Monin et al JACC 2001; 37: 2101-2107_

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### CONCLUSIONS

- In patients with AS, LV dysfunction and low transvalvular gradients, contractile reserve on DSE is associated with a low operative risk and good long-term prognosis after valve surgery.
- In contrast, operative mortality remains high in the absence of contractile reserve.

_Jean-Luc Monin et al JACC 2001; 37: 2101-2107_
Low-output, low-gradient aortic stenosis in patients with depressed left ventricular systolic function:

The clinical utility of the dobutamine challenge in the catheterization laboratory.


Results

• Patients will have true fixed aortic stenosis if they have
  – a mean aortic valve gradient >30 mm Hg at rest or dobutamine infusion
  – an aortic valve area that remains <1.2 cm² during dobutamine infusion

Nishimura et al, Circulation 2002;106:809

Results

• In the 15 patients in whom contractile reserve was identified during dobutamine challenge (increase in stroke volume >20%) mortality rate was 7%.
• 12 patients were alive in New York Heart Association class I or II status at follow-up.

Nishimura et al, Circulation 2002;106:809

Low-Gradient Aortic Stenosis Operative Risk Stratification and Predictors for Long-Term Outcome: A Multicenter Study Using Dobutamine Stress Hemodynamics

Jean-Luc Monin et al Circulation. 2003;108:319

Patients

• 136 patients with aortic stenosis –6 centers
• Median age, 72 years [range, 65 to 77 years
• Median aortic valve area, 0.7 cm² (<1.0 cm²)
• Mean transaortic gradient 29 mm Hg [range, 23 to 34 mm Hg] MPG < 40 mm Hg
• Follow-up were obtained in all patients at a median interval of 14 months (range, 7 to 29 months)

Dobutamin stress echo

• Presence of LV contractile reserve on the dobutamine stress Doppler study was present in 92 patients (group I)
• Absent contractile reserve in 44 patients (group II)
Results

**Operative mortality:**
- 5% in group I with contractile reserve
- 32% (10 of 31 patients) in group II without contractile reserve
  \((P=0.0002)\)

Background

- Vasodilators are considered to be contraindicated in patients with severe aortic stenosis because of concern that they may precipitate life-threatening hypotension. However, vasodilators such as nitroprusside may improve myocardial performance if peripheral vasoconstriction is contributing to afterload.

Results

- After six hours of therapy with nitroprusside
  - the cardiac index had increased to 2.22
- After 24 hours of nitroprusside infusion
  - the cardiac index had increased further, to 2.52

Conclusions

- Nitroprusside rapidly and markedly improves cardiac function in patients with decompensated heart failure due to severe left ventricular systolic dysfunction and severe aortic stenosis.
- It provides a safe and effective bridge to aortic-valve replacement or oral vasodilator therapy in these critically ill patients.
Hemodynamic effects of the ACI, ramipril, in patients with mild to moderate AS and preserved LV function.

• 13 elderly patients with mild to moderate AS
• 7.5 mg of ramipril twice daily.
• There were no significant changes from baseline to week 8 in any echocardiographic parameters
• Short-term treatment with ramipril was well tolerated in pts with mild to moderate AS and preserved LV function. A surprisingly high proportion of patients (30%) with documented AS were already receiving ACE inhibitors.


Outcome after aortic valve replacement in octogenarians.

• Surgical outcome in 115 octogenarians after aortic valve replacement between January 1992 and April 2003
• Age 82.3 years (mean, 80 to 92 years)
• The in-hospital mortality rate was 8.5%
• Actuarial survival at 1 and 5 years was 86.4% and 69.4%, respectively
• STROKE - 1 (0.8%)
• Predictors of late mortality were EF, preop heart failure and the type of prosthesis

Chiappini B et al; Ann Thorac Surg. 2004

AVR in mild to moderate AS scheduled for CABG operation

Consider:

• Natural history of AS (including progression rate)
• Additional operative risk by adding AVR to CABG
• Additional risk at F-U from AVR
• Operative risk of delayed AVR
• Hemodynamic benefit from AVR for mild/mod. AS

Hilton TC, Clin Cardiol 2000:23:141-7

AVR in mild to moderate AS scheduled for CABG operation

• CABG alone - 1-3% mortality
• CABG + AVR - 4-6% mortality
• Additional operative risk 1-3%
• Additional yearly mortality from AVR - 1-2%
• Additional yearly morbidity from AVR - 1-2%
• Mortality from Re-AVR late after CABG: 14-24%

Hilton TC, Clin Cardiol 2000:23:141-7
If aortic gradient is >20-25 mmHg, symptomatic AS may develop prior to reaching the end of expected benefit from CABG → consider AVR

If aortic gradient is <25 mmHg - AVR generally unnecessary

Hilton TC, Clin Cardiol 2000;23:141-7

Late AVR after CABG with initial “mild to moderate AS” - 14-19% mortality

Collins et al, J Cardiovasc Surg 1994; 9 (Suppl) 145-7
Fighali et al, Circ 1995 92 (Suppl II): II 163-8

Conclusion: AVR in mild to moderate AS in adjunct to CABG !?

Management of patients undergoing coronary artery bypass graft surgery with mild to moderate aortic stenosis.

- To examine the outcome in patients with mild to moderate AS undergoing CABG.
- 200 patients requiring CABG and with a peak AS gradient < 40 mmHg by Doppler echo between 1990 and 2000.
- 154 underwent isolated CABG (group A) and 46 CABG + AVR (group B).

Karagounis A et al; J Heart Valve Dis. 2004

Management of patients undergoing coronary artery bypass graft surgery with mild to moderate aortic stenosis.

- Mortality was 2.6% (n = 4) in group A and 6.5% (n = 3) in group B (p = NS)
- There was no significant difference in postoperative complications
- median postoperative stay was 6 and 8 days, respectively (p = 0.02)
- During the median follow up period of 4.2 years no patient in group A required AVR

Morbidity and mortality in patients who underwent combined surgery was comparable with that in patients who had isolated CABG. However, none of the patients who underwent only CABG required AVR during the follow up period.

It is concluded that patients with mild AS at the time of CABG should not undergo AVR. It is possible that a cut-off AS gradient > 40 mmHg should be considered for combined surgery.

AVR in mild to moderate AS scheduled for MVR

N=131, Age 61±12
MVR for rheumatic disease in 1975-1992
F-U 13 ±7 years (1-33)
Aortic valve disease:
42% at baseline (all mild)
73% at end of follow-up
Severe AS/AR at end of follow-up - only 3

Vaturi; Sagie et al, JACC 1999; 33: 2003-8
Severe AS in a patient scheduled for non-cardiac surgery

- Hemodynamically significant AS - 13% risk of perioperative death
- In severe symptomatic AS - AVR is preferred before an elective non-cardiac surgery (JACC 1996; 27: 910-48)
- In severe symptomatic AS who need emergent non-cardiac surgery - consider PBAV (Hayes et al, Mayo Clin Proc 1989; 64: 737-57; Rahimtoola, Circ 1987; 75: 895-901)

Severe AS in a patient scheduled for non-cardiac surgery

- 19 pts., AVAI<0.5 cm²/m², mean AVG >50 mmHg
- 28 procedures - 12 orthopedic, 6 intraabdominal, 4 vascular and more.
- 16/19 (84%) - at least 1 symptom of AS.
- Arterial line in 20/28
- Hypotension - treated with phenylephrine
- 2 deaths (postoperative)

Torcher et al, Am J Cardiol 1998; 81: 448-452

AS and pregnancy

- Commonest cause - BAV
- Normal LV, Mild to moderate AS - normal pregnancy
- Severe (>50 mmHg) or symptomatic - relief AS before conception
- Severe AS in a pregnant woman - consider intervention (PBAV / AVR) before labor
- Severe symptomatic AS in a pregnant woman - deliver

Bonow et al. JACC 1998; 32: 1486-588

Aortic stenosis

Balloon valvotomy

- 1st experience - Cribier, 1985
- Post-procedural AVA 0.7-1.1 cm²
- Hospital mortality 3.5-13.5%
- 20-25% - ≥1 complication within 24h
- If not operated - few months of alleviation of symptoms. Benefit disappears within 2 years
- Later AVR - improves survival

Survival after balloon aortic valvuloplasty (n=674)


Balloon valvuloplasty in critical AS with shock

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>AVA pre</th>
<th>AVA post</th>
<th>In hospital death</th>
<th>Death &lt;30 days</th>
<th>AVR</th>
<th>1Y survival</th>
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<tr>
<td>NHLBI</td>
<td>39</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>51%</td>
<td>*</td>
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<tr>
<td>Cribier</td>
<td>10</td>
<td>0.47±0.1</td>
<td>0.95±0.3</td>
<td>10%</td>
<td>20%</td>
<td>66%</td>
<td>*</td>
</tr>
<tr>
<td>Moreno</td>
<td>21</td>
<td>0.48±0.04</td>
<td>0.84±0.06</td>
<td>*</td>
<td>5%</td>
<td>33%</td>
<td>*</td>
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<tr>
<td>Buchwald</td>
<td>14</td>
<td>0.38±0.09</td>
<td>0.81±0.12</td>
<td>71%</td>
<td>67%</td>
<td>21%</td>
<td>29%</td>
</tr>
</tbody>
</table>
Balloon valvuloplasty in critical AS with shock
- The only independent predictor of mortality is duration of shock
- 0/10 (0%) survival if shock >48h
- 4/4 (100%) survival if shock <48h

Buchwald et al, Clin Cardiol 2001; 24: 214-218

Aortic stenosis

Indications for balloon valvotomy
- **Class IIA**
  - Hemodynamically unstable patients, as a bridge to AVR
- **Class IIB**
  - Palliation in serious comorbidities
  - Palliation when urgent non-cardiac surgery indicated
- **Class III**
  - Alternative to AVR

Percutaneous aortic valve replacement
- Around 1/3 of elderly patients with severe AS are declined by cardiac surgeons for AVR and therefore, there is a real need for non surgical AVR.
- This concept might become a feasible option for treating patients with relevant aortic valve disease but a high operative risk

Percutaneous implantation of aortic valve
- Six PHV implantations
- PHV was successfully delivered in 5 patients
- No residual gradient
- AVA was increased from 0.5 to 1.70 cmsq.
- Aortic regurgitation (paravalvular) was mild (3 pts) or severe (2 pts)
- Patent coronary arteries

Cribier A et al
- J Am Coll Cardiol. 2004

Post- PHV Implantation
AVAs: 0.6 cm², 1.9 cm²
Percutaneous implantation of aortic valve

- The first 3 patients died of a non-cardiac cause at 18, 4, and 2 weeks
- The other patients are alive at 8 weeks with no signs of heart failure
- CONCLUSION: Implantation of the PHV can be achieved in patients with end-stage calcific aortic stenosis and might become an important therapeutic option for patients not amenable to surgical valve replacement.

Acute Improvement in Global and Regional LV Systolic Function After Percutaneous Heart Valve Implantation in Patients With Symptomatic AS.

Department of Cardiology, Hospital Charles Nicolle, Rouen, France.

- Circulation, 2004 Jun 28

Acute Improvement in LV Systolic Function After Percutaneous Heart Valve Implantation in Symptomatic AS.

- 8 pts with severe AS had 2D echo at baseline and 24 hours after PHV implantation to evaluate changes in LV volume and LVEF
- AVA increased from 0.59 to 1.69 cm²q.
- LV EF increased from 48% to 57%; (P<0.01)
- Immediately after PHV replacement, improvement of LV global and regional systolic function was evidenced by tissue Doppler imaging.

A. יא
B. יג
C. יד
D. יז
E. יח
F. יא
G. יב
H. יג
I. יד
J. יז
K. יח
L. יא
M. יב
N. יג
O. יד
P. יז
Q. יח
R. יא
S. יב
T. יג
U. יד
V. יז
W. יח
X. יא
Y. יב
Z. יג
בנהל עם הפרעה ניכרת בתפקוד חדר שמאל

LVEF = 25%

יגש המטופל למחלקה 30, ואחרים 0.8 סמי. ר"מ, מחלף השיש ע"ב המטופל. נטיית נשימה לנהיגה במתח דימוי. mümkün מ وهنا המטופל נחית מברך עם הנקבה או הלוחד ת挚מות.

איך נוגים?

א. עלילת שירות המטופל לא-1.15 סמי. לולא שfloppy במלבד

ב. עלילת שירות המטופל 1.05 ממ. למ. לולא שfloppy המטופל ש

מכביעה על סיבוב תליון-register הדחף הפנימי לש

החלול ויעור bezo ה_epi הלהב המ lànhשה.

ג. אם אין שינוי במלבד - 0.5 סמי. המטופל בטין למᄆ. 20

דואל תחת הבטן 0-20 סמי. ר"מ, קורב לותר החסי

ה. görünt המחלקה מברך עם הלוחד ת挚מות ענות.