Low Gradient Severe Aortic Stenosis

Amr Ahmed Youssef
Associate professor of Cardiology
Assiut University

My Agenda

- Assessment of aortic stenosis severity.
- Definition of low gradient severe aortic stenosis and its importance.
- Assessment of low gradient severe aortic stenosis.
- Treatment .

Assessment of aortic stenosis severity

- The accurate diagnosis of aortic stenosis (AS) and its severity is one of the major feats of echocardiography.
- The diagnosis of severe aortic stenosis in the presence of symptoms is usually an indication for aortic valve replacement. (Vahanian A et al 2007)
- echocardiographic assessment, which is often the definitive test of severity, represents a decisive step in the management of these patients.

- European and American guidelines both recommend an aortic valve area (AVA) cut-off of <1 cm^2, or, indexed for body surface area, <0.6 cm^2/m^2 for severe aortic stenosis. (Minners J et al., 2007& Vahanian A et al., 2007)
- The European Society of Cardiology (ESC) guidelines further state that 'Severe aortic stenosis is unlikely if cardiac output is normal, and there is a mean pressure gradient <50 mmHg'.

- The American guidelines, slightly differently, set the threshold at a peak transvalvular velocity of 4 m/s (corresponding to a peak gradient of 64 mmHg, usually with a mean gradient slightly higher than half the peak gradient) or a mean gradient >40 mmHg in the presence of a 'normal' cardiac output.

2008 Focused Update Incorporated Into the ACC/AHA 2006 Guidelines

Grading the Degree of Stenosis

- • Mild (area 1.5 cm^2, mean gradient less than 25 mm Hg, or jet velocity less than 3.0 m / s)
- • Moderate (area 1.0 to 1.5 cm^2, mean gradient 25 to 40 mm Hg, or jet velocity 3.0 to 4.0 m /s)
- • Severe (area less than 1.0 cm^2, mean gradient greater than 40 mm Hg, or jet velocity greater than 4.0 m /s).

- Impaired left ventricular systolic function leads to a decrease in stroke volume.
- In such a scenario, the severity of aortic stenosis cannot be judged by transvalvular velocity or gradient, and the valve area—measured by the continuity equation or by direct planimetry in a short axis view—must be used to evaluate severity.

- In aortic stenosis, systolic flow first passes through the left ventricular outflow tract at one velocity (V_1) and then is rapidly accelerated to a higher velocity (V_2) through the narrowed area of the stenotic orifice.
- The area of the outflow tract (A_1)
- Aortic valve area (A2)
- $A2 = A1 \times V1/V2$

- Alternate measures of AS severity have been proposed as being less flow dependent than gradients or valve area. These include valve resistance and stroke work loss.
- However, these measures have not been shown to predict clinical outcome, and have not gained widespread clinical use.

- Valve resistance was calculated as (*Ho PP et al., 1994*)

  Resistance = $(\Delta P_{mean}/Q_{mean})\times 1333$

  Δp_{mean} = Mean transvalvular pressure gradient

  Q_{mean} = Mean transvalvular flow rate was derived by dividing stroke volume by the systolic ejection time,
- % LV stroke work loss = $(\Delta P_{mean}/LVP_{mean})\times 100\%$

  where LVP_{mean} is the mean systolic left ventricular pressure, calculated by adding the SBP and ΔP_{mean}. (*Bermejo J et al., 2003*)

Definition of low gradient severe aortic stenosis

- Low gradient aortic stenosis is defined as severe aortic stenosis (valve area <1.0 cm2) with a transvalvular mean pressure gradient of less than 30 mmHg [Bonow, RO, et al., 2008].
- Low gradient aortic stenosis most often occurs in the setting of left ventricular (LV) systolic dysfunction with a low left ventricular ejection fraction (LVEF), which results in a low flow rate across the aortic valve.

Importance

Severe AS have a low gradient across the aortic valve that can reflect one of two different abnormalities:

1- True stenosis with secondary left ventricular dysfunction induced by a severe stenotic lesion that reduces the transvalvular gradient.

2-Pseudostenosis in which there is both moderate AS and a low cardiac output due to myocardial disease that is unrelated to the valvular lesion.

Accurate assessment of AVA in such patients is difficult because :

Calculated AVA is directly proportional to forward stroke volume.

Some patients with low-flow, low-gradient AS have a reduced AVA as a result of inadequate forward stroke volume rather than anatomic stenosis,

- Obviously, surgical therapy is unlikely to benefit patients with pseudostenosis because their primary pathology is a cardiomyopathy.
- On the other hand, patients with severe anatomic AS may benefit from valve replacement despite the increased operative risk associated with a low-flow, low-gradient hemodynamic state.

Assessment of low gradient severe aortic stenosis

- In this situation it is important to answer two important questions:

1. Is it severe AS?
2. If severe AS, is it afterload mismatch or decrease myocardial reserve(myocardial damage)?.

- ACC/AHA guidelines for managing valvular heart disease recommends hemodynamic evaluation of low-flow, low-gradient AS using dobutamine echocardiography to distinguish patients with fixed anatomic AS from those with flow-dependent (" relative") AS in patients with LV dysfunction and low-transvalvular gradients.

The Role of Dobutamine Echocardiography

- Three basic patterns of dobutamine responsiveness were observed: fixed AS, relative AS, and absence of contractile reserve.
- Fixed AS was characterized by dobutamine-induced increases in peak velocity and mean gradient with no change in AVA. All patients with contractile reserve and fixed AS had an increase of 0.6 m/s in peak velocity and 10 mm Hg in mean gradient.

- In contrast, relative AS was characterized by a significant increase in calculated AVA (0.3 cm^2) without a significant change in peak velocity or mean gradient.
- No hemodynamic variable changed significantly in the patients without contractile reserve. (DeFilippi et al., 1995)

- Monin et al., (2001) studied 45 patients with low-flow, low-gradient AS by dobutamine echocardiography. Operative mortality at 30 days was only 8% in patients with contractile reserve compared with 50% in those without contractile reserve. LV ejection fraction and NYHA functional class improved significantly in patients with contractile reserve who survived valve replacement.

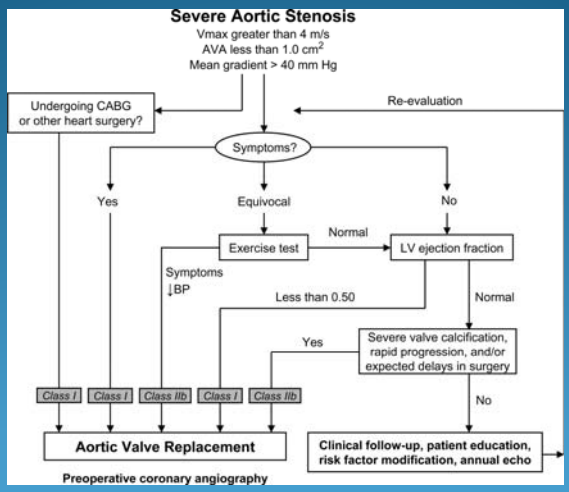
Dobutamine Challenge in the Catheterization Laboratory

- Nishimura et al., (2002) report for the first time the use of dobutamine infusion during cardiac catheterization to evaluate the hemodynamics of low-flow, low-gradient AS.
- They concluded that dobutamine infusion in the catheterization laboratory may be helpful in identifying which patients with low-flow, low-gradient AS have a truly fixed anatomical stenosis that may benefit from valve replacement. The findings also confirm that contractile reserve is an important prognostic indicator in these patients.

Treatment

- **Indications for Aortic Valve Replacement (AVR)**
  Class I
- 1. AVR is indicated for symptomatic patients with severe AS.* *(Level of Evidence: B)*
- 2. AVR is indicated for patients with severe AS* undergoing coronary artery bypass graft surgery(CABG) , undergoing surgery on the aorta or other heart valves. *(Level of Evidence: C)*

- 3. AVR is recommended for patients with severe AS* and LV systolic dysfunction (ejection fraction less than 0.50). *(Level of Evidence: C)*
- **Class IIa**
- 1. AVR is reasonable for patients with moderate AS* undergoing CABG or surgery on the aorta or other heart valves on combined multiple valve disease and on AVR in patients undergoing CABG). *(Level of Evidence: B)*



Bonow, R. O. et al. J Am Coll Cardiol 2008;52:e1-e142

Conclusions

- Low gradient aortic stenosis making some clinical dilemma
- In this condition, we should differentiate between true severe aortic stenosis and pseodostenosis.
- True stenosis with impaired LV systolic function we should differentiate between afterload mismatch with better prognosis after AVR and patients with myocardial damage.
- Dobutamine stress echo is recommended for these differentiation.


Thank you