Underwriting Impact of New Advances in Valvular Heart Disease

NEHOUA 2012

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Agenda – Impact of new advances in valvular heart disease

- Mitral regurgitation
  - Mitral valve repair
  - Percutaneous mitral valve repair
- Aortic regurgitation
  - Aortic valve repair
  - Ross procedure update
- Aortic stenosis
  - Trans-catheter aortic valve replacement (TAVR)
The heart – "basically"
Case 1 - mitral regurgitation

- 42 y.o. female
- reports atypical chest pain x 6 months

INDICATION: Mitral valve prolapse and mitral regurgitation follow-up.

Images were adequate for interpretation.

No previous echoes are on record.

DIMENSIONS:........(NORMAL)....VALVES:.........FUNCTION:...........

AoR:.............32(<40mm).........AV:...Sclerotic
LA:.............43(<41mm).........MV:.........MVP
LVID:.............51(<57mm).........TV:......Normal
LVIS:...........29
IVS:.............10(<12mm)
PWLV:...........10(<12mm)
RV:.............36(<41mm)
EF:.............60(60+-10%)
LV MASS INDEX:........89
E/A RATIO:........1.7
DT:...............255
LA VOL INDEX:........32 cc/m2

FINDINGS:

The left ventricle is of normal size and has normal systolic function.
The right ventricle is normal. The right atrium is normal. There is mild left atrial enlargement.

The aortic valve is sclerotic, without significant flow abnormalities.
There is bileaflet mitral valve prolapse. There is regurgitation that appears at least moderate in severity. The overall appearance is consistent with moderate mitral regurgitation.

The tricuspid valve is normal, with mild regurgitation. Estimated pulmonary arterial systolic pressure is 24 mmHg.

The pericardium is normal. There are no intracardiac masses or thrombi.
Diastolic function is normal. The IVC varies normally with respiration, implying normal right atrial pressure.

CONCLUSION:

Bileaflet mitral valve prolapse with moderate mitral regurgitation.

No other significant abnormality is seen.
Case 2 – mitral valve repair

39 y.o. male
- severe bileaflet prolapse

Before repair

VALVES: Mitral valve appears myxomatous. It is prolapsing both the anterior and the posterior leaflet with the posterior leaflet prolapsing more deeply into the left atrium than the anterior leaflet. With this prolapse there is severe eccentric mitral regurgitation. Mitral stenosis is not seen. Aortic valve is grossly normal. There is no aortic stenosis or aortic insufficiency. Tricuspid valve is grossly normal. There is mild tricuspid regurgitation. Based on the regurgitant jet, the RV systolic pressure is estimated to be 20 mmHg assuming 10 mmHg for the CVP. Pulmonic valve was not well visualized. Pulmonic insufficiency was not seen.

CHAMBERS: Left ventricle is mildly enlarged measuring 6.2 cm at end diastole, function is well preserved. Ejection fraction is estimated to be 62%. The right ventricle is normal in size and in function. Left atrium is normal in size measuring at 4.0 cm. Right atrium is normal in size. Pericardium is within normal limits.

2 years after repair

Mitral valve shows thickening of the posterior annulus. There is trace mitral regurgitation.

CONCLUSION:
1. Normal LV size and function.
2. Status post mitral valve repair.
3. Aortic valve sclerosis with trace aortic insufficiency.
4. Compared to the patient’s last echo from August 2008, no significant changes are noted.
Mitral regurgitation – etiology and prevalence

- Etiology
  - Mitral valve prolapse - also termed "degenerative"
  - Congenital – valve clefts, a feature of tetralogy of Fallot and certain ASDs and VSDs
  - Traumatic – ruptured chordae tendinae; flail leaflet
  - Infective – endocarditis
  - Inflammatory – rheumatic heart disease
  - Ischemic – CAD
  - Cardiomyopathy

- Prevalence
  - Over 70% of healthy adults are found to have trivial ("trace") MR
  - 19% of the Framingham cohort were found to have "mild or greater" MR
  - "Moderate" or "Severe" MR: 1.9% and 0.2%
Variability in mitral regurgitation determination

There is a significant overlap in severity assessment, leading to broad interpretation on echo reports: "mild/moderate" "moderate/severe"

Source: CIRC (Avierinos) 2002, Otto Textbook of Echocardiography
Mitral regurgitation – what about "moderate" regurgitation

What I look for:

- Progressive left ventricular and, particularly, left atrial enlargement
- Fall in ejection fraction (should be normal or above normal)
- New onset atrial arrhythmias, particularly atrial fibrillation
Mitral regurgitation - stages

■ Compensated
  - Left ventricular enlargement – "eccentric hypertrophy"
    - LV end-diastolic dimension <60 mm; end-systolic dimension <40 mm
  - Left atrial enlargement
  - Normal ejection fraction (50-55%)
  - Reduced functional capacity and reserve while still "asymptomatic"

■ Decompensated
  - Symptoms – fatigue, shortness of breath
  - Progressive left ventricular and left atrial enlargement
  - Fall in ejection fraction (below 50%)
Mitral regurgitation – impact of left atrial size

Left atrial diameter >55 mm or volume >40 ml/m² identifies a higher risk
Mitral regurgitation – treatment options

- Medical – vasodilators, Ca++ inhibitors, ACE inhibitors, anti-coagulation
  - no evidence to indicate that prognosis is improved
  - usually reserved for symptomatic patients who are not surgical candidates

- Indications for surgery
  - Symptoms
  - Severe regurgitation on echo
    - must be associated with both left ventricular (LVESD >40 mm) and left atrial dilatation > 40 mm or 40 ml/m² (exception: acute mitral regurgitation due to flail leaflet)
      - Question the severity if LV <60 mm!
  - Ejection fraction <60%
Mitral regurgitation – surgical options

- Mitral valve replacement
  - mechanical valves – more durable but require anti-coagulation
  - bioprosthetic valves – durability limited particularly in younger patients

- Surgical valve repair – advantages over valve replacement
  - lower operative mortality (2.6% vs 10.3%)
  - better survival at 5 years (82% vs 72%) and 10 years (68% vs 52%)
  - Recurrent regurgitation incidence
    - 17% at 5 years
    - 32% at 7 years
Mitral regurgitation – percutaneous options

- 75% procedure success rate
- 30% require surgery within 3 years
Case 1 - mitral regurgitation

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- echocardiogram:

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Mitral regurgitation and repair - summary

- Echocardiographic assessment
  - Very important to look at the chamber dimensions and ejection fraction as part of the total picture
  - The Doppler reading of regurgitation severity is subject to considerable variability

- Treatment options
  - We will be seeing more "repairs" and less "replacements"
  - We will be seeing more "reoperations" and it's too early to tell the long-term outlook on these
  - A successful mitral valve repair may result in excellent long-term survival
Agenda – Impact of new advances in valvular heart disease

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  - Ross procedure update
- Aortic stenosis
  - Trans-catheter aortic valve replacement (TAVR)
Case 3 – aortic regurgitation

66 y.o. male

2D & M-MODE FINDINGS:
The right atrium is mildly enlarged. The right ventricle is of normal size and dimension. The left atrium is mildly enlarged with a diameter of 4.7 cm. The left ventricle is of normal size and dimension with an end-diastolic diameter of 4.7 cm and end systolic diameter of 2.9 cm. The left ventricular wall thickness was within normal limits at 0.9 cm. The overall left ventricle systolic function is normal with an estimated ejection fraction of 65%.

There is what appears to be a bicuspid aortic valve with mild aortic valve sclerosis. There is appears to be adequate excursion of the bicuspid aortic valve leaflets on 2-D imaging. The mitral and tricuspid valves appear structurally normal. The pulmonic valve is structurally normal.

There is no evidence of pericardial effusion.

DOPPLER AND COLOR FLOW MAPPING:
Color Doppler study reveals a peak velocity across the aortic valve of 2.1 m/sec, consistent with a peak transvalvular gradient of 19 mmHg. This is consistent with minimal aortic stenosis. There is an eccentric jet of moderate aortic insufficiency. There is mild mitral insufficiency, mild tricuspid insufficiency, and trace pulmonic insufficiency. The estimated RV systolic pressure is 34 mm mercury consistent with borderline pulmonary hypertension.

CONCLUSIONS:
Normal left ventricular systolic function.
Bicuspid aortic valve with an eccentric jet of moderate aortic insufficiency. There is minimal aortic stenosis.
Mild mitral and tricuspid insufficiency with borderline mild pulmonary hypertension.
Trace pulmonic insufficiency.
Aortic regurgitation – etiology and prevalence

- Etiology
  - Aortic root dilatation
  - Hypertension
  - Marfan's syndrome
  - Bicuspid aortic valve
  - Infective – endocarditis

- Prevalence
  - Aortic regurgitation of any severity is rare before age 50 but is increasingly found over age 50
    - Mild regurgitation can be found in up to 2% of elderly men and 14% of elderly women
    - Moderate to severe regurgitation is more common in elderly men (12%) than in elderly women
Aortic regurgitation – echocardiographic accuracy

- The Doppler determination of aortic regurgitation severity is considerably more accurate than that of mitral regurgitation.
- Measurement of the aortic root and the ascending aorta are more challenging and subject to wider variability.
- Serial CT scanning is probably more reliable for analyzing changes in aortic root size.
Aortic regurgitation – stages

- Compensated
  - Asymptomatic
  - Left ventricular end-diastolic dimension (LVEDD) < 65 mm
  - Left ventricular ejection fraction (EF) > 55%

- Decompensated
  - Left ventricular end-systolic dimension (LVESD) > 50 mm
  - Left ventricular ejection fraction (EF) < 50%
Aortic regurgitation – the importance of symptoms

- High risk patients
  - Patients with LV systolic dysfunction
  - Patients with any symptoms!
    - palpitations
    - atypical chest pain
    - dyspnea on exertion
    - shortness of breath at rest

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**Natural history of chronic aortic regurgitation mostly based upon data from nine series with a total of 593 patients followed for a mean of 6.6 years**

| Asymptomatic patients with normal left ventricular (LV) systolic function | 
|-----------------------------|-----------------|
| Progression to symptoms and/or LV dysfunction | Less than 6 percent/year |
| Progression to symptoms, LV dysfunction, or death | 
| According to LV end-systolic dimension* | 
| > 50 mm | 19 percent/year |
| 40 to 50 mm | 6 percent/year |
| < 40 mm | 0 percent/year |
| Progression to asymptomatic LV dysfunction | Less than 3.5 percent/year |
| Sudden death | Less than 0.2 percent/year |

**Asymptomatic patients with LV systolic dysfunction**

| Progression to cardiac symptoms | More than 25 percent/year |

**Symptomatic patients**

| Mortality rate | More than 10 percent/year |

Aortic regurgitation – treatment options

- **Medical therapy**
  - Unlike mitral regurgitation, vasodilators (calcium channel blockers, ACE inhibitors) have been shown to slow the progression of aortic regurgitation

- **Valve replacement**
  - Mechanical valves have greater durability in this valve position as well
  - Bioprosthetic valves are used in those who cannot tolerate anti-coagulants
  - Bioprosthetic valves are also commonly used past age 65 where durability is less of a concern
  - Mortality: 2.5% per year
    - Mortality is much higher in "too late" surgery
      - Severe symptoms, dilated left ventricle, reduced ejection fraction
Aortic regurgitation – newer approaches

- Aortic valve repair
  - used when the only real issue is dilatation of the aortic root
  - Any scarring or calcium on the valve cusps or root are reasons to go to valve replacement
  - Need for subsequent valve replacement: 15-20%
  - Mortality: in-hospital mortality rare: long-term results are early but may be close to standard population after a suitable "wait" period
Aortic regurgitation – the Ross procedure

- The problem is the aortic valve
- The solution
  - Move the pulmonic valve into the aortic valve position!
  - Put a prosthetic valve into the pulmonic position (lower pressure, less complications)!
Aortic regurgitation – the Ross procedure

**Advantages**
- The valve is native – very durable long-term
- The valve is sized exactly right! Best hemodynamics of all the surgical options
- The valve requires no anticoagulation

**Disadvantages**
- The surgery is technically complex
- Reoperations (15%)
  - Patch or replacement of the aortic root most common
  - Rare issues with the "autograft" (the new aortic valve) or "allograft" (the new pulmonic valve)

**Mortality**
- 96% - 98% survival (about ½ of that of aortic valve replacement) at 15 years: close to standard population in a very selected population of young adults
Case 3 – aortic regurgitation

66 y.o. male

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Trace pulmonic insufficiency.
Aortic regurgitation and the Ross procedure - summary

- Patients with mild/moderate aortic regurgitation may remain stable for considerable periods of time

- Keys to monitoring in aortic regurgitation
  - Left ventricular chamber size (LVEDD and LVESD)
    - use the LV mass calculator if available!
  - Aortic root size

- Aortic repair
  - Very selected group usually do well after repair

- Aortic valve replacement
  - Survival best in those operated before it's "too late"

- Ross procedure
  - Promising survival data but continues to be "at a cross-roads"
Agenda – Impact of new advances in valvular heart disease

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  - Trans-catheter aortic valve replacement (TAVR)
Aortic stenosis case

25 y.o. female

The rhythm is sinus. The aortic valve is bicuspid and the cusps are mildly thickened. Left and right ventricular size are normal. Global left and right ventricular systolic function are normal (visually estimated LVEF = 65%). Left ventricular mass index is estimated to be 69 g/m² (upper normal = 100 g/m²). Atrial size is normal.

The estimated mean transaortic pressure gradient is 26 mmHg. The aortic valve orifice is estimated to be 0.9 cm² (consistent with moderate to severe aortic stenosis) by continuity equation. Aortic regurgitation is graded 2+ by regurgitant pressure half-time. Mitral and tricuspid regurgitation are each graded trivial by colour flow mapping.

The left ventricular outflow tract diameter is estimated to be 21 mm. Mild to moderate aortic regurgitation.
Aortic stenosis: etiology and prevalence

- The etiology of aortic stenosis is age-related
  - Under age 70: bicuspid aortic valve
  - Over age 70: calcific disease (also called "degenerative") in a normal tricuspid valve
    - Plaque deposits on the valve are similar to atherosclerotic plaques
    - Similar risk factors as for coronary artery disease
    - Associated with diabetes and metabolic syndrome
  - There is a genetic predisposition in a subset of families with AS

- Prevalence
  - Bicuspid aortic valve: 2% of the U.S. population
  - Aortic sclerosis: up to 25% of people over age 65
  - Aortic stenosis: 2%-3% of people over age 75

Source: clevelandclinicmeded.com; uptodate.com
Aortic stenosis – echocardiographic accuracy

- The Doppler measurement of aortic valve area is so accurate that patients are currently taken to surgery without needing cardiac catheterization.

- Other echocardiographic features that are helpful:
  - The presence of a bicuspid valve
  - The extent of valve and root calcification
  - Aortic root dilatation ("post-stenotic")
  - Left ventricular hypertrophy
Aortic stenosis - stages

- **Mild AS**
  - mean gradient <25 mmHg; valve area <1.5 cm²

- **Moderate AS**
  - mean gradient 25-40 mmHg; valve area 1.0 – 1.5 cm²

- **Severe AS**
  - mean gradient >40 mmHg; valve area < 1.0 cm²
  - onset of symptoms may not occur until this degree of severity if left ventricular function is normal
    - dyspnea
    - dizziness/syncope
    - chest pain
Aortic stenosis – complications

- Sudden death
  - up to 35% of symptomatic AS
  - up to 5% of asymptomatic AS!
- Atrial fibrillation
- Ventricular arrhythmias
- Embolism
- Concurrent CAD
Aortic stenosis – treatment options

- No medical therapy has been proven to delay progression
  - Statins have been suggested – controversial
  - ACE inhibitors – hypothetical

- Aortic valve repair – not available for most AS cases

- Indications for aortic valve replacement
  - Any significant symptom – syncope, chest pain, dyspnea
    - Very high risk of sudden death or heart failure
  - Very severe stenosis
    - Valve area < 0.75 cm$^2$
  - Symptoms with exercise testing
  - Very high B-natriuretic peptide?
Aortic stenosis – aortic valve replacement

- Re-operations are much more likely with bioprosthetic valve
- Long-term mortality: ~ 2.5% per year
  - With CAD revascularization: operative mortality is higher but long-term mortality is similar
Aortic stenosis – percutaneous (trans-catheter) valve replacement - TAVR

young aortas

old aortas
Indications

- Severe aortic stenosis
- Significant symptoms indicating poor prognosis
- Consensus decision by cardiologists and surgeons that patient is a poor risk for surgery

Contra-indications

- Aortic insufficiency
- Small aorta size
- Root/valve not heavily calcified
Aortic valve replacement age >80

U.S. population 1-year death rate = 6%

Source: NEJM (Smith) 2011
Aortic stenosis case

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Aortic stenosis and TAVR - summary

- Aortic stenosis is usually a disease of older people but can present much earlier in those with bicuspid valves
- Surgical management is the only option once severe AS is present
- Aortic valve replacement and CAD = similar mortality to aortic valve replacement alone
  - Caveat: complete revascularization!
  - Caveat: no peri-operative complications
- TAVR: very promising for the poor-risk elderly
  - Insurable?
Newer approaches to valvular disease - 2012

- Mitral disease
  - Mitral repair is the procedure of choice

- Aortic regurgitation
  - Ross procedure is promising but remains controversial

- Aortic stenosis
  - TAVR will evolve quickly and needs to be reviewed periodically
Thank you
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