Hemodynamics of Percutaneous Structural Procedures

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Within the past 12 months, I have no financial relationships to disclose.
Aortic Stenosis
Tri/MV valves open

Pa/Ao valves are closed

Pa/Ao valves close

Tri/MV valves open

systole

Left ventricle

Left atrium

ECG

TIME (sec)
Techniques for Aortic Valve Gradient Measurement

- Single Catheter LV-Ao pullback
- LV and Femoral Sheath
- LV and Long aortic sheath
- Bilateral femoral access
- Double-lumen pigtail catheter
- Transeptal LV access with ascending Ao
- Pressure Guidewire with ascending Ao
- Multi-transducer micromanometer catheters

Fusberg and Feldman T, Cath and CV Int 53:553;2001
Pullback Method
Simultaneous Methods

Hemodynamic Technique

Peak instantaneous vs P-P

LV

Unshifted = larger Grad

Fusberg and Feldman T, Cath and CV Int 53:553;2001
Calculating Aortic Valve Area

• AVA: Gorlin equation

\[
\text{Valve Area (cm}^2) = \frac{\text{Cardiac Output (ml/min)}}{\text{Heart rate (beats/min)} \times \text{Systolic ejection period (s)} \times 44.3 \times \sqrt{\text{mean Gradient (mmHg)}}}
\]

• AVA: Hakke formula (“poor man’s Gorlin”)
  – Assumes HR*SEP*44.3 = 1000 in most patients
  – Valid for HR ~65-100

AVA = cardiac output (L/min)/√(Peak-Peak Pressures)
Aortic Valvuloplasty

- 80 year old male with critical aortic stenosis, trace AR, COPD, pneumonia admitted to the MICU with septic shock

- Infection treated, but unable to wean patient from pressors/ventilator

- Patient is Full Code, undergoing TAVR workup as an outpatient
Aortic Valvuloplasty: Hemodynamics
TAVR (Transcatheter Aortic Valve Replacement)

- 85 year old female with critical AS.
- Frail, COPD, ESRD, AS, DM2, chronic steroids from RA
- STS score 12
- CT Angio: Bilateral femoral, iliac arteries mild calcium, nontortuous
Transcatheter pre-TAVR

Post TAVR

Decreased but residual gradient

Rise in LV EDP
TAVR: Paravalvular leak

Oval shaped aortic valve orifice
Aortic Regurgitation Index

$$= \left(\frac{\text{AoP}_{\text{dia}} - \text{LVEDP}}{\text{AoP}_{\text{sys}}}\right) \times 100$$

$$= \left(\frac{40 - 20}{120}\right) \times 100 = 16.7$$
Pre AVP: ARI=26

Post AVP: ARI=33
Mitral Stenosis

Normal LA and LV diastolic pressures

LA - LV Diastolic Gradient

Mitral Stenosis
Mitral Valvuloplasty

1. Highly mobile with only leaflet tips restricted
2. Leaflet mid portions and base portions have normal mobility
3. Valve continues to move forward in diastole, mainly from the base
4. No or minimal forward movement of the leaflets in diastole

Leaflets near normal in thickness (4-5 mm)
Midleaflets normal, considerable thickening of margins (5-8 mm)
Thickening extending through the entire leaflets (5-8 mm)
Considerable thickening of all leaflet tissue (>8-10 mm)
Minimal thickening just below the mitral leaflets
Scattered areas of brightness confined to leaflet margins
Brightness extending into the mid portions of the leaflets
Extensive brightness throughout much of the leaflet tissue

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**PREDILATATION**

ECG

![Graph showing pressure vs. time with annotations: LV, LA, mean mitral gradient 15 mmHg, cardiac output 3.0 L/min, mitral valve area 0.6 cm².]

**POSTDILATATION**

ECG

![Graph showing pressure vs. time with annotations: LV, LA, mean mitral gradient 3 mmHg, cardiac output 3.8 L/min, mitral valve area 1.8 cm².]

Mean mitral gradient 15 mmHg
Cardiac output 3.0 L/min
Mitral valve area 0.6 cm²

Mean mitral gradient 3 mmHg
Cardiac output 3.8 L/min
Mitral valve area 1.8 cm²
Severe MR Post Valvuloplasty
Mitral Regurgitation
Edge to Edge MV repair

Alfieri surgical repair (1992)

MitraClip percutaneous repair (1998)
Catheter-Based Mitral Valve Repair

*MitraClip System*

- Clip toward MV
- Clip across MV
- Leaflets grasped

*Slide: Ted Feldman, MD*
Evolution of MitraClip

Percutaneous Therapies for Mitral Regurgitation

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Abstract: Percutaneous therapies for the treatment of mitral regurgitation have emerged rapidly over the past several years. Most of the percutaneous approaches are modifications of existing surgical approaches to mitral annuloplasty or leaflet repair. Most of the percutaneous devices are based on surgical approaches. Catheter-based leaflet repair with the MitraClip is accomplished using an implantable clip to mimic the surgical edge-to-edge technique. Percutaneous annuloplasty can be achieved indirectly via the coronary sinus, or directly from retrograde left ventricular access. Several of these percutaneous approaches have been successfully used in trials or are in the early stages of use in practice. (Curr Probl Cardiol 2012;37:42-68.)
Case Study

- 75 year old man with multiple comorbidities (ESRD, DM, severe PAD with known porcelain aorta), dilated CMY with EF 20% and functional MR with multiple hospitalizations for CHF exacerbations
Hemodynamic effects of MitraClip

Pre

Post
NO PARKING
CARDIOLOGIST PARKING ONLY
ALL OTHERS WILL BE TOWED