Aortic Stenosis and Transcatheter Aortic Valve Replacement (TAVR) “Saving lives one TAVR at a time”

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Mr. Murphy is an 81 y/o gentleman admitted to the hospital with complaints of shortness of breath, syncope, and critical aortic stenosis. He was admitted earlier this evening in relatively stable condition but a rapid response was called when he became acutely tachycardic. Upon arrival to his room you see that he is in obvious distress. His bedside monitor reads a HR of 162, and his BP is 86/41.
You get the above rhythm strip and diagnose atrial fibrillation with RVR. The next best thing to do is

A) Give Magnesium Sulfate IV
B) IV Bolus of amioderone
C) Get a stat potassium level and replace if low
D) Emergent cardioversion
After cardioversion Mr. Murphy converts to sinus tachycardia with a HR of 117. You admit him to the ICU as he is still dyspnic and sats are 95% on a 100% non rebreather. You gather more history and find that he has a known hx of CAD s/p CABG 5 years ago, COPD, DM II, CKD stage II and aortic stenosis that is being monitored by his PCP. His BP after cardioversion is 117/46. Upon auscultation of his heart and lungs you hear bilateral coarse crackles and a harsh systolic murmur that radiates to both carotids.
After placing him on bipap and administering IV diuretics you get a stat EKG which shows sinus tachycardia without any ST changes and a stat bedside echo which reveals a reduced EF of 25-30%, LVH, diastolic dysfunction, pulmonary hypertension and severe aortic stenosis. You decide the next best step in treating Mr. Murphy is to

A) Start IV nitroprusside
B) Consult Interventional cardiology to consider Balloon Valve Angioplasty as a bridge to further therapy
C) Pray
D) Start IV beta blockade
The correct answer is C! (it’s always C)
Balloon Aortic Valvuloplasty (BAV)

• Initially developed in 1986 as a treatment for Aortic Stenosis (AS)

• Studies showed that it was not a very effective form of treatment for AS and it has mainly been used as a palliative measure in patients considered non operative candidates for surgical aortic valve replacement (sAVR)

• With the invention of TAVR, there has been a rise in the number of BAVs performed as a means to bridge to TAVR\(^1\) or sAVR
Mr. Murphy undergoes BAV and within a couple of days he is greatly improved! He is down to 2 L NC with sats of 95%, has no dyspnea at rest, and his HR is 87 with BP of 117/47.

NOW WHAT?
Over the next couple of days Mr. Murphy undergoes further work up for possible AVR.

- The formal reading of his echo revealed a peak velocity across the AV of 4.4m/s, a mean gradient of 52mmHg and a valve area of 0.7cm$^2$.

- Left heart catheterization demonstrated significant blockages of his native coronary arteries but a patent LIMA to LAD, and patent vein grafts to the LCx and RCA.

- Spirometry revealed severe COPD with an FEV1 of 1.3 L, 46% of predicted.

- Carotid ultrasound revealed Rt ICA < 50% and Lt ICA 50-70%.
A bit about Aortic Stenosis

- Most commonly acquired type of valvular disease in developed countries, affecting approx. 7% of the population age 65 or older
- Generally diagnosed by echocardiogram
- Criteria for severe AS is max velocity of >4m/s, mean gradient >40mmHg, and AVA < 1cm²
- Generally due to progressive calcification of the trileaflet valve
- Long asymptomatic period during which the LV is able to compensate by undergoing concentric hypertrophy
- Once symptoms develop the risk of mortality increases dramatically
A- normal valve    B- Stenotic bicuspid valve    C- Stenotic Aortic valve
Given Mr. Murphy has severe symptomatic aortic stenosis, what are Mr. Murphy’s chances of surviving another two years?
A) < 10%
B) < 50%
C) >60%
D) >75%
The natural history of aortic stenosis, emphasizing a long pre-symptomatic period and the dismal outcome once symptoms begin.
Management strategy for patients with severe aortic stenosis.

Severe Aortic Stenosis
Vmax greater than 4 m/s
AVA less than 1.0 cm²
Mean gradient > 40 mm Hg

Undergoing CABG or other heart surgery?

Symptoms?
Yes
Equivocal
No

Exercise test
Normal
Less than 0.50

LV ejection fraction
Normal

Severe valve calcification, rapid progression, and/or expected delays in surgery

Aortic Valve Replacement
Preoperative coronary angiography

Clinical follow-up, patient education, risk factor modification, annual echo

Class I
Class I
Class IIb
Class I
Class IIb

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So, back to Mr. Murphy....

His echo demonstrates severe AS, and we know that he’s symptomatic and time is of the essence so what’s the hold up?

(He only has severe COPD, has had a previous sternotomy, has DM, a reduced EF with NYHA class III symptoms, CKD and is 81 y/o... what’s not to love?)
Calculating Surgical Risk

There are two widely used risk calculators with regards to cardiac surgery.

- Society of Thoracic surgery (STS).
  http://riskcalc.sts.org/stswebriskcalc/#/calculate
  Mr. Murphy’s score was 12.4%

- EUROSCORE II
  http://www.euroscore.org/calc.html
  Mr. Murphy’s score was 12.2%
• While sAVR has been and still is the gold standard for treatment of patients with severe symptomatic AS, approx. 40% of patients diagnosed with severe AS do not undergo sAVR, most often due to comorbidities that deem them to be at high or extreme surgical risk

• Thankfully for Mr. Murphy 2002 brought about the invention of the TAVR
The Invention of the TAVR

• First TAVR procedure was performed in 2002 in France, with the first performed in the US in 2005

• Clinical Trials were started in 2007, with the first published data available in 2010

• The FDA approved the use of the Sapien Valve for inoperable patients in 2011 and for high risk surgical patients in 2012.
TAVR, What It Is and How It Works

- Trileaflet either porcine or bovine pericardial valve that is attached to a metal frame and inserted via a femoral artery in a retrograde fashion in the aortic valve position. Other insertion options are transaortic or transapical.
- Does not require open heart surgery or cardiopulmonary bypass
- The valve attaches at the annulus but functions supra-annular
Two types of valves available for TAVR

The Sapien Valve (pictured on the left) is a trileaflet bovine pericardial valve attached to a balloon-expandable stainless-steel support frame.

The CoreValve (pictured on the right) is a self-expandable nitinol frame with a porcine trileaflet pericardial valve attached.
Criteria for TAVR

• Must be evaluated by a multidisciplinary team at a recognized TAVR center
• Evaluated by two cardiac surgeons and deemed either high risk or prohibitive risk for sAVR
• Undergo CTA chest/abd/pelvis to evaluate aortic valve circumference and diameter as well as the coronary anatomy and vasculature for possible access issues
Contraindications

• Absolute- sensitivity/inability to take antiplatelet medications (aspirin and Plavix), ongoing sepsis including active endocarditis, mechanical AV already in place

• Relative- ascending aortic aneurysm, femoral Artery < 6mm (non calcified) and <7mm (if calcified), aortic annular diameter (as determined by CTA) < 18mm or >29mm, mod or severe MR, stroke within past 6 months, bicuspid valve, untreated significant CAD, LV thrombus, HOCM with or without LVOT obstruction

• There is a new CoreValve, the CoreValve Evolut R that is approved to treat those with a failed bioprosthesis “Valve in Valve”
Mr. Murphy does qualify for TAVR and undergoes the procedure 2 weeks later. He arrives in the CVICU post procedure in stable condition without having had any intraoperative complications of note. He is intubated and sedated. He has a pacing pulmonary artery catheter in place with a calculated cardiac index of 2.4 on no inotropes. He is on propofol, insulin and norepinephrine (2-5 mcg/min) infusions. HR is in sinus rhythm with a HR of 82 and his BP is 115/54 on his arterial line. Approximately 75 minutes after arrival you look up and see the following on his telemetry.
What is the most likely diagnosis?

A) LBBB
B) Sinus bradycardia
C) Complete Heart Block
D) Mobitz Type II
Complications Following TAVR

- Death - varies between high risk and extreme/prohibitive risk groups but ranges from 14-30% (and is statistically lower than that of medical treatment)
- Bleeding - 11% in high risk groups, 17-24% in extreme risk
- Vascular complications (17-30%)
- Heart Block - at increased risk if a pre-op RBBB is present and more common with CoreValve (20-40%) vs Sapien (3-8%)
- Stroke (2-5%)
- Paravavular aortic regurgitation - common but generally mild
- Uncommon complications - coronary obstruction, annular rupture, and MI
Mr. Murphy lives to see another day!
(after getting his PPM implanted for CHB)
In Conclusion...

• Aortic stenosis is the most common valvular disease in those over 65 years of age
• Once a patient becomes symptomatic, time is of the essence for AVR (whether sAVR or TAVR) due to risk of sudden death
• With the invention of TAVR there is now an option for those previously denied surgery and a less invasive and equal if not more favorable alternative for those that are at high risk
• STAY TUNED- There is ongoing research regarding the effectiveness of TAVR in lower risk populations. They are also continuing to improve the design of the prosthetic valves to ensure safer and more effective outcomes.
References


