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Summer 2020

### Aortic Stenosis

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#### Recommended Citation

Lower, Christina, "Aortic Stenosis" (2020). *Nursing Student Class Projects (Formerly MSN)*. 452.  
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# Aortic Stenosis

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## Aortic Stenosis

### Overview

- The aortic valve is a three leaflet, one-way valve located between the left ventricle and the aorta (Stoelting & Hiller, 2015).
- Aortic stenosis is the irreversible narrowing of the aortic valve (Stoelting & Hiller, 2015).
- Sclerosis (lipid build-up on valve) usually precedes stenosis, and no symptoms are present until valve becomes severely stenosed (Stoelting & Hiller, 2015).
- Most common valvular heart disease in adults age 60 years and older (Bavishi et al., 2018).
- Only successful treatment is to replace the aortic valve via open heart surgery or transcatheter approach (Hijazi et al., 2019).
- Without valve replacement, death occurs primarily due to heart failure within one to two years (Joseph et al., 2017).

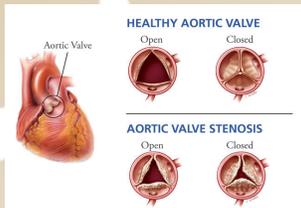


Figure 1. Comparison of healthy aortic valve and stenosed aortic valve. Retrieved from umcvc.org

### Risk Factors

- Male
- Age >60 years
- Smoking
- Obesity
- Congenital bicuspid valve (Lindman et al., 2020)
- Childhood Rheumatic fever (Lindman et al., 2020)
- Systemic Hypertension (Stoelting & Hiller, 2015)
- Hypertrophic cardiomyopathy (Stoelting & Hiller, 2015)

## Signs and Symptoms

- Most patients are asymptomatic until stenosis is severe with valve area <1.0 cm<sup>2</sup> (Griese et al., 2017)
- Characteristics of low-flow aortic stenosis are a valve area <1cm<sup>2</sup>, a mean gradient <40mmHg and ejection fraction <50% (Bavishi et al., 2018).
- Aortic Stenosis mimics heart failure symptoms:
  - Activity intolerance
  - Shortness of breath (exertional)
  - Syncope episodes caused by dilation of arteries to accommodate for restricted stroke volume
  - Anginal chest pain
  - Symptoms improve after a period of rest (Hijazi et al., 2019)
- Systolic Murmur auscultated best at right second intercostal space (McCance & Huether, 2018)
- When aortic stenosis causes heart failure:
  - Multi-organ system failure
  - Cardiogenic shock
  - Fluid volume overload → edema
  - Respiratory distress (Hijazi et al., 2019)

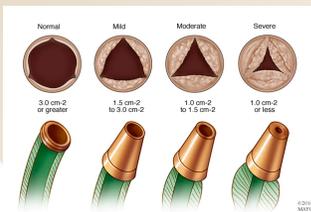


Figure 2. Representation of progressive occlusion caused by stenosis of valve. Retrieved from mayoclinic.org

## Why Aortic Stenosis

I have cared for many patients with aortic stenosis of varying severity and witnessed how complex patient conditions can become. It can be very difficult to manage hemodynamic stability once aortic stenosis effects multiple organ systems. Caring for these patients intrigued me to learn more about the pathophysiology of aortic stenosis to better understand what causes the significant complications and hemodynamic instability.

## Pathophysiology of Aortic Stenosis

- Results from inflammatory response caused by endothelial damage, stress, lipid penetration and calcification. (Joseph et al., 2017)
- Progressive thickening of the valve leaflets leading to calcification and fibrosis which minimizes leaflet mobility (Bavishi et al., 2018).
- Typically progresses slowly over decades until severe, then rapid deterioration follows (Joseph et al., 2017).
- Sclerosis proceeds stenosis of valve and affects >40% of adults by age 75 (McCance & Huether, 2018).
- Initially, the pressure gradient is compensated by hypertrophy of the left ventricle to accommodate for increased ventricular wall stress (Bavishi et al., 2018).
- Biomarkers such as B-naturetic peptide are released in response to cardiac wall stretch (Bavishi et al., 2018).
- Diagnosis and monitoring via non-invasive echocardiogram or invasive cardiac catheterization (Joseph et al., 2017)
- Severity of stenosis determined by flow rate across valve, size of valve opening and symptoms (Bavishi et al., 2018).
- Peak aortic jet velocity (Vmax) determines prognosis (Lindman et al., 2020)
- Aortic stenosis can cause other valvular abnormalities such as aortic, mitral and tricuspid valve regurgitation (Bavishi et al., 2018).

Table 1. Classification of Aortic Stenosis Severity

Classification	Transaortic velocity (m per second)	Mean pressure gradient (mm Hg)	Aortic valve area (cm <sup>2</sup> )
Normal	< 2.0	< 10	3.0 to 4.0
Mild	2.0 to 2.9	10 to 19	1.5 to 2.9
Moderate	3.0 to 3.9	20 to 39	1.0 to 1.4
Severe	≥ 4.0	≥ 40	< 1.0

Figure 3. Classifications of Aortic Stenosis. Retrieved from aafp.org

## Significance of Pathophysiology

- As the valve narrows, it begins to obstruct forward flow into the aorta, thus, impairing major organ perfusion (McCance & Huether, 2018).
- Once patients develop symptoms, stenosis is likely severe and risk of mortality is high (Joseph et al., 2017).
- Treatment is often delayed because of lack of symptoms, delaying diagnosis (Hijazi et al., 2019).
- Heart failure affects all major organ systems as ejection fraction (EF) reduces and leads to death (Joseph et al., 2017).
- Mortality rates reach 50% after two years of severe symptomatic aortic stenosis (Bavishi et al., 2018).
- No pharmacological treatments have proven to be effective in aortic stenosis (Joseph et al., 2017)
- Patients who have multiple valvular abnormalities have a 1.5-fold increase in mortality and 1.3-fold increase in 1-year mortality (Bavishi et al., 2018).

## Implications for Nursing Care

- Hemodynamic monitoring
  - Encourage medication compliance for blood pressure and lipid control
  - Treat heart failure symptoms promptly
  - Pay close attention to heart rhythm and watch for arrhythmias
- Post SAVR
  - Monitor for: bleeding, stroke symptoms, hemodynamic instability, rhythm changes
  - Keep incision clean and dry
  - Adequate pain management
- Post TAVR
  - Monitor for bleeding from access site and hematomas
  - Monitor for hemodynamic instability, rhythm changes, stroke symptoms
  - Promptly treat heart failure symptoms (Stoelting & Hiller, 2015; Wang et al., 2018)

## Treatment

- Balloon valvuloplasty is a temporary (lasting up to 6months) method to open the valve and typically used as a bridge to surgery (Joseph et al., 2017).
- SAVR
  - Surgical aortic valve replacement (SAVR) requires open sternotomy (Hijazi et al., 2019).
  - Candidacy for SAVR is determined by a Mortality Risk Score that looks at 3 additional cardiac surgery factors: fragility, major organ damage unable to be improved by surgery, obstacles related to surgery (Wang et al., 2018)
- TAVR
  - Transcatheter aortic valve replacement (TAVR) is used to avoid open heart surgery as a less invasive method to replace the valve (Hijazi et al., 2019).
  - Post-op mortality rates are similar due to TAVR patients being in poorer health prior to valve replacement (Bavishi et al., 2018).

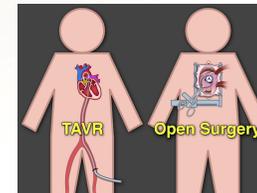


Figure 4. Different approaches to aortic valve replacement. Retrieved from drashchiheart.com

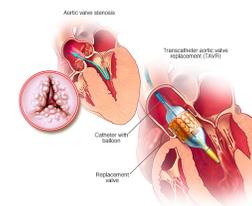


Figure 5. Replacing valve via TAVR method. Retrieved from mayoclinic.org

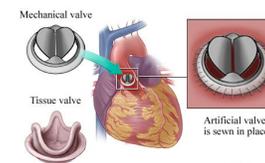


Figure 6. Representation of different valves that can be sewn in via the SAVR method. Retrieved from webmd.com

## Case Study

- 97-year-old male presents to clinic with impending doom following recent emergency room visit for fluid overload requiring diuretics
- Deemed not a SAVR candidate for his age
- In addition to severe aortic stenosis, Pt had tricuspid regurgitation, hypertension, chronic obstructive pulmonary disease (COPD) and stage III chronic renal failure.
- Admitted and emergently worked up for TAVI ( carotid imaging, TAVR cat scan (CT) to assess vasculature of chest and abdomen, diagnostic heart catheterization
- TAVI performed under general anesthesia → right and left femoral arteries accessed and a temporary pacemaker placed
- Bioprosthetic aortic valve deployed via the catheter without complications
- Postoperative echocardiogram showed properly seated valve and no regurgitation. Pacemaker removed the next day.
- One month later, Pt had bradycardic arrest during follow-up appointment, and it was discovered Pt was accidentally taking metoprolol succinate at home, which likely precipitated bradycardic event.
- At 6-month follow-up, patient reported improved symptoms and EF improved to 65%.

(Zegrean, 2017)

## Conclusion

- Aortic stenosis is progressive narrowing of the aortic valve → left ventricular hypertrophy → heart failure.
- Major risk factor is older age
- Valve replacement is the gold standard treatment as no pharmacological treatments proven to be effective.
- Hemodynamic stability becomes an issue in managing patients as aortic stenosis affects many body systems.
- Early valve replacement may become standard in reducing mortality rates as longevity increases (Kang et al., 2020)
- As people live longer, aortic stenosis is likely to increase in prevalence. (Zelis et al., 2020)
- TAVR procedures are growing in popularity for older adults with severe aortic stenosis, however, more research must be completed to evaluate effectiveness of urgent and emergent TAVRs on patients with poor prognosis. (Bavishi et al., 2018).

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## Additional References

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- Pawade, T. A., Newby, D. E., & Dweck, M. R. (2015). Calcification in aortic stenosis: The skeleton key. *Journal of the American College of Cardiology (JACC)*, 66(5), pp. 561-577. <https://doi.org/10.1016/j.jacc.2015.05.066>

