Aortic Stenosis
In Non-Cardiac Surgery

Matthew McFarling MD FRCPC
Assistant Clinical Professor
Department of Anesthesia
McMaster University &
Hamilton Health Sciences
Disclosure

No conflicts of interest to declare.
Objectives

- Review incidence, prevalence and progression of aortic valve disease
- Identification of patients with significant valvular disease
- Pre-operative evaluation and optimization *
- Suggestions/reminders about peri-operative management [of potentially challenging physiologic conditions]
Historical Perspective

- Skinner & Pearce identified aortic valve disease as a risk for non-cardiac surgery (1964)

- Goldman shows aortic stenosis is an independent risk factor for cardiac complications in non-cardiac surgery (1977)


# Incidence

Incidence of Aortic Stenosis in Ontario (2002 - 2015) per 100,000 person years

*Yan et al (2017)*

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overall</strong></td>
<td>144.2 (142.2-146.1)</td>
<td>168.7 (165.5-172)</td>
<td>127.4 (125.0-129.7)</td>
</tr>
<tr>
<td><strong>1 Risk Factor</strong></td>
<td>154.7 (151.7-157.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2 Risk Factors</strong></td>
<td>200.2 (194.9-205.4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>3 Risk Factors</strong></td>
<td>234.2 (218.7-249.6)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Aortic valve stenosis (AS) is the most common valvular disease in Western countries; primarily presenting as calcific stenosis.

- 2-7% of those over 65 yrs of age are affected.
- Moderate or severe AS affects 13% of those > 75 years of age.
- Severe AS affects 8% of those over 85 years of age.


Bi-Modal Prevalence

• 35-55 yrs
  • bicuspid valve calcifies prematurely; possibly associated with dilation of ascending aorta

• > 65 yrs
  • atherosclerotic degenerative changes of a tricuspid aortic valve
Progression of Disease

- Progressive, and unrelenting
- Inevitably leads to severe stenosis of the valve
- Rate of progression is not accurately predictable, but typically quoted as:
  - 3 - 19 mmHg / year
  - 0.1 - 0.3 cm² / yr


Pathophysiology

- increased afterload causing increase wall stress
- wall stress induces concentric hypertrophy
- hypertrophy results in reduced ventricular compliance
- muscular hypertrophy
- collagen deposition

Aortic Stenosis:
Mechanical Obstruction to forward flow

Pressure Overload

Increased LV wall stress
Concentric Hypertrophy

Compensation
N wall tension; N afterload
N contractility
decreased LV compliance
decreased early filling
increased late filling
Stroke Volume: Normal

Decompensation
Fibrosis
Inc. Wall tens: afterload excess
decreased Contractility
decreased LV Compliance
LV Dilation
Stroke Volume: Decreased

Subendocardial Ischemia  

Pulmonary Congestion  

LV Dilation  

Angina  Breathlessness  Syncope  Sudden Death
Cardinal Symptoms

- Angina (35%)
- Heart Failure (50%)
- Syncope (15%)

Life Expectancy

- 5 Years
- 2 Years
- 3 Years

Mortality

- Annual mortality rate is 25% with severe AS
- Average survival is 2 to 3 years if no intervention occurs


But my patient anticipates ‘non-cardiac’ surgery.
Summary

- Little objective data is published to guide the management of these patients
- moreover, the evidence is conflicting
- general principles - anatomic, physiologic, ethical, and moral apply.

*Hip Hemiarthroplasty in Two Patients with Severe Aortic Stenosis: Ethical Questions from an Anesthesiologist’s Perspective. 2015 Dec 15;5(12):213–5.*
## Essential Assessments

<table>
<thead>
<tr>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is valvular heart disease severe?</td>
</tr>
<tr>
<td>Does the patient have symptoms?</td>
</tr>
<tr>
<td>Are symptoms related to valvular disease?</td>
</tr>
<tr>
<td>What is the life expectancy and expected quality of life?</td>
</tr>
<tr>
<td>Do the expected benefits of the intervention (vs. spontaneous outcome) outweighs its risks?</td>
</tr>
<tr>
<td>What are the patient’s wishes?</td>
</tr>
<tr>
<td>Are local resources optimal for the planned intervention?</td>
</tr>
</tbody>
</table>
Examination Findings

- Crescendo-decrescendo murmur, radiates to carotids *
- Paradoxically split S2
- +/- S3, S4
- Valvusalva manoeuvre and sustained handgrip decrease intensity
- Pulsus parvus et tardus
Approximately half of patients with severe AS are asymptomatic.

Exercise testing may identify whether patients are truly asymptomatic; traditional treadmill exercise testing or bicycle ergometer are safe.

Patients with AS and an abnormal EST have a worse prognosis unless AVR is performed.

Exercise echocardiography and cardiopulmonary exercise testing can complement the traditional symptom-based exercise test.

Cardiac Assessment for Patients Undergoing Noncardiac Surgery
A Multifactorial Clinical Risk Index

A NEW METHOD OF CLASSIFYING PROGNOSTIC COMORBIDITY IN LONGITUDINAL STUDIES:
DEVELOPMENT AND VALIDATION

Derivation and Prospective Validation of a Simple Index for Prediction of Cardiac Risk of Major Noncardiac Surgery
Thomas H. Lee, MD, SM; Edward R. Marcantonio, MD, SM; Carol M. Mangione, MD, SM;
Eric J. Thompson, MD, SM; and Daniel F. Gelijns, MD

Usefulness of the Charlson Co-Morbidity Index to Predict Outcomes in Patients >60 Years Old With Aortic Stenosis During 18 Years of Follow-Up
George K. Shin, MD; Khaled D. El Ghoul, MD; Emily M. Johnson, MS; et al.

Prognostic Usefulness of Cardiopulmonary Exercise Testing for Managing Patients With Severe Aortic Stenosis
Van D. Le, PhD, Gunnar V. Jensen, PhD, and Lars Kjøller-Hansen, DMSc*
Risk Indices

- “… estimates of post-test risk should not be taken literally if one's subjective clinical judgment suggests a revision.”

- “… risk estimates should not be quoted blindly in the face of clinical information that is not adequately considered by the index.”

Prognostic Factors

• High-risk surgery
• Symptomatic severe AS
• Co-existing mitral regurgitation
• Co-existing coronary disease
Echocardiography

- Echocardiography is the key to confirm the diagnosis, assess its severity and prognosis.

- It is indicated in any patient with a murmur

- Should be performed and interpreted by properly trained personnel.

- Flow-dependent indices add further information and have a prognostic value.
Non-Surgical Management

- AS patients electively undergoing non-cardiac surgery may not be optimized with aortic valve replacement for a variety of reasons:
  
  - multiple co-morbidities (51% of cases)
  - urgent surgery (29%)
  - advanced age (27%)
  - tolerated recent surgery (20%)
  - low risk surgery (15%)
  - cancer surgery (12%)
  - safer anesthetic management (8%)
  - patient refusal (3%)

Should I Postpone?

- When time allows; elective v. urgent v. emergent

- Severe & critical AS patients should not undergo elective surgery without further consultation

- When resources are potentially or probably inadequate for intra- and post-operative care
When Do I Refer Out?

• When time allows; elective v. urgent v. emergent

• When resources are potentially or probably inadequate for intra- and post-operative care

• When the risk of delay for transport is assessed as less than the risk of immediate intervention
It must be done.
• 5646 patients in Danish registry
• MACE 3.7% with AS and 2.9% of controls (P = 0.19)
• Mortality 3.8% with AS and 2.9% controls (P = 0.13)

• MACE 15.5% AS patients and 11.4% controls
• Mortality 21.4% AS vs 17.0% (P = 0.01).

• Meta-analysis of 29,327 participants
• Mortality and cardiovascular events (composite)
• Patients with and without AS, undergoing elective and emergent non-cardiac surgery
• No significant difference in mortality
• Increase in composite outcome and myocardial infarct

“Patients with AS undergoing non-cardiac surgery have not been shown to be at increased risk of mortality, but have significantly higher rates of adverse cardiovascular events compared to patients without AS.”
Recommendations

- Unfortunately, little objective guidance for all-comers
- Invasive monitoring and access (IV, arterial & central venous access, echocardiography, arrhythmia management/defib)
- Vasopressor, inotrope, and rhythm control readiness
# Anesthetic Goals

<table>
<thead>
<tr>
<th>LV Pre-Load</th>
<th>Heart Rate/ Rhythm</th>
<th>Contractile State</th>
<th>Systemic Vascular Resistance</th>
<th>Pulmonary Vascular Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>↑</strong></td>
<td><strong>↓</strong></td>
<td>Maintain</td>
<td><strong>↑</strong></td>
<td>Maintain</td>
</tr>
<tr>
<td>(Maintain)</td>
<td>(Sinus)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: The table indicates the goals for anesthetic management.*
Pre-Operative Considerations

- Surgical severity; urgency, fluid and blood loss, disability
- Valve disease severity, complications, and co-morbidities
- Invasive monitoring and access (IV, arterial & central venous access, echocardiography, arrhythmia management/defib)
- EKG can be challenging; suggest multi-lead (5) at a minimum
Recommendations

- Disposition to ICU or other high-acuity area for monitoring and early recognition/management of complications

- consider possibility of acquired von Willebrand syndrome and increased risk of bleeding
Thank you