Aortic Dissection: The Great Masquerader

Calgary Emergency Physicians Grand Rounds
June 11, 2015

Eric Herget & Jehangir Appoo
Aortic Dissection: The Great Masquerader

Calgary Emergency Physicians Grand Rounds
June 11, 2015

Eric Herget & Jehangir Appoo
Who are we?

CALGARY THORACIC AORTIC PROGRAM

The Calgary Thoracic Aortic Program website is designed for patient education on a variety of aortic diagnoses in the chest including aortic aneurysms and dissections. The Thoracic Aortic Program was established and is led by Dr. Jahangir Appoo, and co-director Dr. Eric Herget. The Program is built on a multidisciplinary platform for diagnosis, screening, and therapeutic management of thoracic aortic disease. Through an integrative approach involving clinical excellence, teaching, and research we aim to provide state of the art therapy for our patients and contribute to a lifelong learning process to help improve patient outcomes.

WHAT IS THE AORTA?
WHAT IS THORACIC AORTIC DISEASE?
HOW IS IT TREATED?
**Aortic Dissection**

<table>
<thead>
<tr>
<th>Variable presentation</th>
<th>“Great Masquerader”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable acuity</td>
<td>1%/hr</td>
</tr>
</tbody>
</table>
Pt. #1 – recent OR

48 y.o female

Previously well
Hx of Cig smoking

Sudden onset of CP radiating to back Thursday April 30, 2015 -called EMS but refused to come in to hospital

GP visit & CXR next day – Trop neg; R hilar opacity

CXR results back after weekend, repeat study requested
Pt. #1

Ongoing retrosternal discomfort, feeling restless, unwell

Does not go in for repeat investigation

6 days post pain presents for repeat CXR → bilat pleural effusions, increased atelectasis, increased heart size → CT PE → CTA
Distal entry tear with retrograde extension
• 1427 patients
  • 954 male
  • mean age 61.7 years
Immediate surgery
Hybrid Ascending, Arch and Descending Ao Reconstruction

Intraop: massive amt of hematoma in ascending aorta, innominate artery and left carotid artery – thrombosed FL causing compression of true lumen
Pt. # 2 – recent M&M Rounds

54y.o male

Presented to PLC at 03:00 with CP
Trop T slightly positive – lateral T wave changes

Positive D-Dimer

CCU consult
  ACS Diagnosis
  ASA & Ticagralor, admitted to CCU
Pt. # 2

CXR @ 06:30; CT PE @ 08:20; CTA @ 08:28

Vasc Surg consult completed on chart

Cardiac Surg phone consult

Emergent Transfer to FMC organized

Arrives at FMC at 10:00 – codes upon arrival
Aortic Dissection has variable urgency and variable presentation

Difficult to distinguish between Acute Coronary Syndrome and Dissection

In one study out of China:

14% of patients with diagnosis of Ao Dissection are initially misdiagnosed

ACS represents 47% of misdiagnosis

Don’t know how many patients had aortic dissection and didn’t receive confirmatory diagnosis

Presenting symptoms of Aortic Dissection

How to attempt to distinguish from ACS:

PAIN:

Abrupt onset of CP
Maximal intensity at time of onset
CP more often “sharp” than “tearing”
CP radiating to back or abdomen
Can be painless!
Great Masquerader

Signs and symptoms of Aortic Dissection other than chest pain

- Cerebral Ischaemia
- Arm Ischaemia
- Spinal Cord Ischaemia
- Tamponade (intrapericardial rupture)
- Myocardial Infarction
- Intestinal Ischaemia
- Renal Ischaemia
- Leg Ischaemia

SBP difference >20mmHg

RCA more commonly involved
In one study looking at patients with acute chest or back pain, >90% of aortic dissections could be identified with some combination of following 3 findings:

1) Abrupt onset of thoracic or abdominal pain with a sharp, tearing and/or ripping character
2) Mediastinal and/or aortic widening on chest radiograph
3) A variation in pulse (absence of a proximal extremity or carotid pulse) and/or blood pressure (>20 mmHg difference between the right and left arm)

Probability of having an aortic dissection with none of above: 7%

Probability of having an aortic dissection with all 3 of above: >83%

Lab Tests

D-Dimer

v. sensitive for ao dissection; not specific
if d-dimer not elevated, pt. does not have ao dissection

Biomarkers currently under development....may be coming soon
Aortic Dissection
Aortic Aneurysm – Ascending, Descending
Goals of Acute Medical Management:

↓ BP

↓ dp/dt – LV ejection force
invitro models of artificial aortas
Strength of pulsation led to progression of dissection
Never validated in humans

B Blockers before vasodilators
Medical Treatment of Ao Dissection

Anti-impulse therapy
60/100 rule: Suggest IV B-blockers and Nipride to drop:
   HR to 60bpm
   SBP to 100mmHg

Pain control
Arterial line in arm with higher blood pressure

For Type B dissections: close observation for complications secondary to branch vessel involvement
If Hypotensive:

role of pericardiocentesis?

in OR?

Fluid Resuscitation
<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Detailed medical history and complete physical examination (whenever possible)</td>
<td>I</td>
</tr>
<tr>
<td>2. Intravenous line, blood sample (CK, troponin I, myoglobin, WBC, D-dimer, hematocrit, LDH)</td>
<td>I</td>
</tr>
<tr>
<td>3. ECG: documentation of ischemia</td>
<td>I</td>
</tr>
<tr>
<td>4. Heart rate and blood pressure (BP) monitoring</td>
<td>I</td>
</tr>
<tr>
<td>5. Pain relief (morphine sulphate)</td>
<td>I</td>
</tr>
<tr>
<td>6. Reduction of systolic blood pressure using beta blockers (IV propranolol, metoprolol, esmolol, or labetalol)</td>
<td>I</td>
</tr>
<tr>
<td>7. Transfer to intensive care unit</td>
<td>I</td>
</tr>
<tr>
<td>8. In patients with severe hypertension additional vasodilator (IV sodium nitroprusside to titrate BP to 100-120 mmHg)</td>
<td>I</td>
</tr>
<tr>
<td>9. In patients with obstructive pulmonary disease, blood pressure lowering with calcium channel blockers</td>
<td>II</td>
</tr>
<tr>
<td>10. Imaging in patients with ECG signs of ischemia before thrombolysis if aortic pathology is suspected</td>
<td>II</td>
</tr>
<tr>
<td>11. Chest x-ray</td>
<td>III</td>
</tr>
</tbody>
</table>

**Classification**

**Class I:** Conditions for which there is evidence and/or general agreement that a given procedure or treatment is useful and effective.

**Class II:** Conditions for which there is conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of a procedure or treatment.

  - **Class IIa:** Weight of evidence/opinion is in favor of usefulness/efficacy.
  - **Class IIb:** Usefulness/efficacy less well established by evidence/opinion.

**Class III:** Conditions for which there is evidence and/or general agreement that the procedure/treatment is not useful and in some cases may be harmful.

8.6.1.5. RECOMMENDATIONS FOR INITIAL MANAGEMENT

CLASS I

1. Initial management of thoracic aortic dissection should be directed at decreasing aortic wall stress by controlling heart rate and blood pressure as follows:

   a. In the absence of contraindications, intravenous beta blockade should be initiated and titrated to a target heart rate of 60 beats per minute or less. *(Level of Evidence: C)*

   b. In patients with clear contraindications to beta blockade, nondihydropyridine calcium channel-blocking agents should be used as an alternative for rate control. *(Level of Evidence: C)*

   c. If systolic blood pressures remain greater than 120 mm Hg after adequate heart rate control has been obtained, then angiotensin-converting enzyme inhibitors and/or other vasodilators should be administered intravenously to further reduce blood pressure that maintains adequate end-organ perfusion. *(Level of Evidence: C)*

   d. Beta blockers should be used cautiously in the setting of acute aortic regurgitation because they will block the compensatory tachycardia. *(5) (Level of Evidence: C)*

CLASS III

1. Vasodilator therapy should not be initiated prior to rate control so as to avoid associated reflex tachycardia that may increase aortic wall stress, leading to propagation or expansion of a thoracic aortic dissection. *(Level of Evidence: C)*
Contemporary results of surgery in acute type A aortic dissection: The International Registry of Acute Aortic Dissection experience

Santo Trimarco, MD
Christoph A. Niemeyer, MD
Vincenzo Rampoldi, MD
Truls Myrmel, MD
Toru Sasaki, MD
Xandrea H. Mento, MD
Eduardo Boissone, MD
Jeanna V. Cooper, MS
Dennis E. Smith, PhD
Lorenzo Menicanti, MD
Alessandro Riggio, MD
Joe K. Oh, MD
Michael G. Deeb, MD
Eric M. Isselbacher, MD
Kim A. Eagle, MD

On behalf of the International Registry of Acute Aortic Dissection Investigators

Background: Surgical mortality for acute type A aortic dissection reported in different experiences from single centers or surgeons varies from 7% to 30%. The International Registry of Acute Aortic Dissection, collecting patients from 18 referral centers worldwide, identifies a preoperative risk stratification scheme and a real average surgical mortality for acute type A aortic dissection in the current era.

Methods: A comprehensive analysis was completed of 200 clinical variables and their relationship to surgical outcomes in 526 of 1022 patients enrolled in the International Registry of Acute Aortic Dissection from 1996 through 2001. Extracted cases, categorized according to risk profile, were defined as unstable (group I), in the presence of cardiac tamponade; shock; congestive heart failure; cerebrovascular accident; stroke; com. myocardial ischemia, infarction, or both; electrocardiograms with new Q waves or ST elevation; acute renal failure; or mesenteric ischemia-infarction at the time of the operation. Outside of an unstable condition, patients were categorized as stable (group II).

Results: The overall in-hospital mortality was 25.1%. Mortality in group I was 31.4% compared with 16.7% in group II (P < .001). Independent preoperative predictors of operative mortality were history of aortic valve replacement (odds ratio = 3.12), migrating chest pain (odds ratio = 2.77), hypotension as sign of acute type A aortic dissection (odds ratio = 1.93), shock or tamponade (odds ratio = 2.69), preoperative cardiac tamponade (odds ratio = 2.22), and preoperative limb ischemia (odds ratio = 2.10).

Conclusions: The International Registry of Acute Aortic Dissection experience confirms that patient selection plays an important role in determining surgical outcomes in patients with acute type A aortic dissection. Knowledge of significant risk factors for operative mortality can contribute to better management and a more defined risk assessment in patients affected by acute type A aortic dissection.

526 pts 1996 – 2001
Operative Mortality 25%
GERAADA Results

2137 pts 2006 - 2010

Mortality 17% (10-35% based on age quartile)

Post op Neurodeficits 17% (includes 7% with preop deficit)
Canadian Thoracic Aortic Collaborative – CTAC

Unpublished data

2007-2013  17.9%
Natural History of Type A Dissection has a High Mortality

Traditional Thinking

Modern ICU Rx & Anti-impulse therapy
IRAD

>4000 Dissection Patients

Foothills Medical Centre, Calgary – Aug 2009

40% survival with medical therapy of Type A Dissection
>85y.o

Hemorrhagic Transformation

Previous sternotomy
Rupture
Shock
Surgery for Type A Dissection

Standard of care – surgical replacement ascending aorta

Operative mortality ~20%

Often with a residual Type B dissection

Persistent post-op malperfusion in 50%
Type A Dissection

Goals of surgical repair

- Resect 1º intimal tear (PIT)
- Replace ascending aorta
- Restore aortic valve competence
- Occlude false lumen
- Limit distal dissection
Type A Dissection

Outcomes for survivors of surgery for Type A dissection

Long term survival ~50% at 10 years (often young population)

Patent false lumen up to 80% of patients

Need for distal operation 20-50% at 10 years

Mortality from distal operation ~20-30%
Current “standard of care” for acute Type A Dissection

Very good operation
Saves many lives in distressful times

Tear specific operation
  Resect Intimal Entry Site
  Proximal arch reconstruction
  Circulatory arrest with cerebral perfusion
  Ascending aortic replacement

Proximal Complications
  Root/Valve/Coronary
  Pericardial effusions
Current “standard of care” for acute Type A Dissection

Very good operation
Saves many lives in distressful times

But, is it enough in all cases?

Does it satisfactorily treat the aorta and side branches at risk?
Complicated Type A
Case Example: 46y.o male flown in from OSH – May 2014

Hemodynamic shock

Abdomen distended, tender
Case Example: 46y.o male flown in from OSH – May 2014

Compromised visceral flow

Renal infarct/malperfusion
Case Example: 46y.o male flown in from OSH – May 2014

Both legs:
- Paralyzed
- Cold
- Mottled
- Pulseless
Our 46y.o patient

Is standard “hemiarch” surgery the right operation?

Will visceral, renal, & peripheral malperfusion be resolve?

Will he survive?
Post CPB on table Angio after FET, HemiArch, Asc Ao Replacement, Ao valve repair

Thoracic Ao TL expansion seen on angio & TEE

Good perfusion of celiac, SMA & nephrograms visible
Complicated Type A
Results of type II hybrid arch repair with zone 0 stent graft deployment for complex aortic arch pathology

William D. T. Kent, MD, MSc, Jehangir J. Appoo, MDCM, Joseph E. Bavaria, MD, Eric J. Herget, MD, Patrick Moeller, MS, Alberto Pochettino, MD, and Jason K. Wong, MD

Objective: To review the early results of a less invasive, single-stage hybrid arch procedure involving replacement of the ascending aorta, arch debranching, and zone 0 antegrade stent graft deployment.

Methods: Between May 2007 and January 2012, 20 patients with both acute and chronic aortic pathology were managed at 2 institutions with a type 2 hybrid arch procedure. Indications included diffuse atherosclerotic aneurysm, false lumen expansion of chronic aortic dissections, penetrating atherosclerotic ulcer, and acute type A dissection. Mean age was 67 ± 16.8 years with a mean European System for Cardiac Operative Risk Evaluation II score of 29.5 ± 19.4. Postoperative clinical and imaging follow-up was complete to a mean 18.5 ± 15.3 months.

Results: Successful zone 0 stent graft deployment was achieved in all cases. There was 1 in-hospital mortality (5%). A second death occurred at 40 days postoperation. Other complications included a permanent neurologic deficit in 1 patient (5%), transient paraplegia in 4 patients (20%), and 3 patients had respiratory complications (15%). There were no cases of renal failure requiring dialysis. Stent-related complications were identified in 4 patients (20%), including 3 type 1 endoleaks, none of which were at zone 0. There was 1 type II endoleak and a case of stent inolding. Two patients required a second successful endografting procedure.

Conclusions: This single-stage hybrid arch procedure offers an alternative approach to complex diffuse aortic pathology involving the arch. Replacement of the ascending aorta provides a safe location for zone 0 stent graft deployment, eliminating complications of proximal deployment in a native diseased aorta. (J Thorac Cardiovasc Surg 2014;148:2951-5)

Early experience 20 patients, 2007-2012, Calgary and Penn
Mean age 67
Combination Acute & Chronic Cases
Mean Euroscore II 29.5 ± 19.4

5% hospital mortality
5% permanent stroke
20% transient paraplegia
Indication #1 – distal malperfusion
54 y.o male acute Type A tranferred from OSH

Arch Tear
Left carotid dissection
Effaced TL in thoraco-abdominal segment

Clinically, unwell
On going abdominal pain
Oliguric
Weak femoral pulses
Clinical and Radiological suspicion of visceral malperfusion in young male

Is standard “hemiarch” surgery the right operation?

Will visceral malperfusion resolve?

Is Type II Hybrid Arch an optimal option?
- Ascending aorta replaced
- Arch debranched
- After coming off CPB, on table angiogram done to re-assess distal malperfusion

Pigtail catheter placed in true lumen from antegrade access
Single 37mm x 20cm endograft inserted from mid ascending aorta to descending aorta.

Obliteration of false lumen in arch & prox descending aorta.
Type B dissection

Evolving controversy surrounding mgmt of “uncomplicated” vs. “complicated” type B
Complicated Type B Dissection
Endovascular Treatment of Type B dissection
Complicated Acute Type B Dissection

56yo male
Seen 12 hrs post presentation
Severe Malperfusion:
  Ischemic leg
  Ischemic gut
  Renal failure
Rt. Iliac

SMA

Rt. Renal Artery
Management

– Emergent OR
– Multidisciplinary team
– Right groin access
– 42mm x 216mm Cook Zenith TX2 Proform device from left CCA to mid descending aorta (Prox LZ=36mm)
– Device unsheathed distal to ostium of Left Carotid Artery
Lower extremity, visceral & renal malperfusion resolved
Hospital Survival with Acute Type B Dissection

In Hospital Mortality:

Medical Rx - 10%

TEVAR - 10%

Open surgery - 34%

Recent Evolution of Thoracic Endovascular Repair

- Descending Thoracic Aortic Aneurysms
- Complicated Type B Aortic Dissections
- Aortic Coarctation

Current/Future Evolution of Thoracic Endovascular Repair

- Aortic Arch
- Ascending Aorta

Infrastructure

Research
Ongoing/Future Evolution
“Takumi Principle”

Perceptive, Thoughtful surgeons in new era of skill
Why Zone 0 TEVAR?
How did we get started?

11 yrs post Type A dissection repair
Why Zone 0 TEVAR?

- Complex Patients
- Diffuse aortic disease
- Generally need 2 stage procedures with total arch replacement and elephant trunk
- Often redo setting
<table>
<thead>
<tr>
<th>Surgeon</th>
<th>Year</th>
<th>ET1 Mortality</th>
<th>ET2 Mortality</th>
<th>Interval Mortality</th>
<th>Rx Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Svensson</td>
<td>2004</td>
<td>2%</td>
<td>8.5%</td>
<td>14%</td>
<td>18%</td>
</tr>
<tr>
<td>Safi</td>
<td>2007</td>
<td>6.3%</td>
<td>9.6%</td>
<td>10%</td>
<td>13.3%</td>
</tr>
<tr>
<td>Lemaire/Coselli</td>
<td>2006</td>
<td>12%</td>
<td>4%</td>
<td>25%</td>
<td>36%</td>
</tr>
<tr>
<td>Kouchoukos</td>
<td>2007</td>
<td>7.2%</td>
<td>--</td>
<td>--</td>
<td>7.2%</td>
</tr>
<tr>
<td>Grieppe</td>
<td>2008</td>
<td>6%</td>
<td>7%</td>
<td>12%</td>
<td>24.5%</td>
</tr>
</tbody>
</table>

Even in centres of experience, operative mortality with 2 stage elephant trunk technique is high
An Alternative Approach to Diffuse Thoracic Aortomegaly: On-Pump Hybrid Total Arch Repair Without Circulatory Arrest

William D. T. Kent, MD, MS, Jason K. Wong, MD, Eric J. Herget, MD, Joseph E. Bavaria, MD, and Jehangir J. Appoo, MD, MCM

Diffuse thoracic aortomegaly has conventionally been managed with a two-stage elephant trunk procedure, requiring prolonged circulatory arrest, with an inherent risk of major morbidity and mortality. Recently, to improve outcomes, several hybrid arch procedures have been proposed using off-pump techniques. We have adopted an alternative, single-stage hybrid strategy using cardiopulmonary bypass without circulatory arrest to replace the ascending aorta and perform arch debranching and antegrade endovascular stent graft deployment. Unlike off-pump procedures, pathology of the aortic valve, root, and ascending aorta is addressed while avoiding the complications of stent graft placement in the native ascending aorta.

2010- Zone 0 Novel Approach

Follow up at 2 years
Zone 0:
Is there a role for endovascular therapy of acute type A aortic dissection?
Obliteration of false lumen in arch & prox descending aorta

Pigtail catheter in true lumen
In the future:

What % of pts would be eligible for isolated endovascular repair of acute type A dissection?

Which patients benefit from conventional surgery vs. hybrid surgery vs. endovascular?

Strategies

- Surgical asc ao replacement followed by branch grafts?
Is it safe to place an endograft in the ascending aorta?

Clinical & Radiologic Follow up Zone 0
Thoracic Endovascular Aortic Repair

Jehangir Appoo, Eric Herget, William Kent, & Jason Wong
University of Calgary

Canadian Cardiovascular Congress
October 28th, 2012
64 y.o male
Type A repair 2009
Complicated course
Aorta growing at rate of 1cm/year
Arch dissected
Large residual primary intimal tear in arch
True lumen effaced
Total endo arch
Custom built branched arch graft
2013- VR image 3 months post op
Evolution of Zone 0
Future Evolution of closed chest zone 0
-new devices on horizon
Closed Chest Total Arch

Modular branch graft

Off the shelf device

FDA trial: 10 cases done at 4 sites in US – Oct 2014
Closed Chest Arch

Chimney Technique

Off the shelf conventional devices

Concern with gutter endoleaks & branch compression

Main indication: emergencies when customized devices unavailable but being used electively in parts of world
Closed Chest Total Arch

Najuta graft

Precurved fenestrated arch graft in various configurations off the shelf

Used in over 300 aneurysm cases in Japan

Concern re: risk of stroke
Evolution of Endovascular MultiLayer Aortic Stent Grafts
Closed chest total arch

Flow Modulating devices

Paradigm change:
Not about “aneurysm exclusion”

Scaffold to allow thrombus deposition, flow pattern modulation while maintaining side branch patency

Laminar vs. turbulent flow
Recent Evolution of Thoracic Endovascular Repair

- Descending Thoracic Aortic Aneurysms
- Complicated Type B Aortic Dissections
- Aortic Coarctation

Current/Future Evolution of Thoracic Endovascular Repair

- Aortic Arch
- Ascending Aorta

Infrastructure/Research
TEAM
Surgeons
Interventional Radiologists
CV Anesthetists
Nursing & DI staff
CV ICU
Advanced NP
Biomedical Engineering
Pathology
Neurology
Research Nurse Clinician
Cardiac Hybrid Operating Suite - a State of the Art Centre

Conventional operating theatre & Diagnostic suite

Multimodality
Multidisciplinary team
Avoid patient transfer
Improved results
Minimally invasive Aortic therapy is:

- Safer
- More effective
- More efficient
- Less invasive/better tolerated
- Innovative
Research Interests:

Assessing efficacy of innovation
Decreasing morbidity and mortality of aortic interventions
Understanding Aortic Dissections

Risk stratification of Aortic Aneurysms – *Indolent but Catastrophic*

Why do Aneurysms Rupture?

Size & growth rate not great predictors of rupture/dissection

Need more science
Aneurysms rupture/dissect when wall stress > wall strength

Collaboration with Biomedical Engineering, Histo-Pathology & Imaging colleagues
3D Growth
Multidimensional growth estimation

Non linear growth measure

\[ g_d^i = \frac{1}{t} \log \left( \frac{D_{i \text{ follow-up}}}{D_{i \text{ post operation}}} \right) \]

100 observations
3D Growth

Results

Growth rate (mm/y)

Maximum diameter

Maximum growth

Outer diameter (mm)
Recent Evolution of Thoracic Endovascular Repair

Descending Thoracic Aortic Aneurysms

Complicated Type B Aortic Dissections

Aortic Coarctation

Future Evolution of Thoracic Endovascular Repair

Aortic Arch

Ascending Aorta

Infrastructure/Research Paradigm

Today:

Few Tools for Primary Care Physicians
Position Statement

Canadian Cardiovascular Society Position Statement on the Management of Thoracic Aortic Disease

Primary Panel: Munir Boodhwani, MD, MMSc (Co-Chair),a Gregor Andelfinger, MD, PhD,b Jonathon Leipsic, MD,c Thomas Lindsay, MD, MSc,d M. Sean McMurtry, MD, PhD,e Judith Therrien, MD,f and Samuel C. Siu, MD, SM (Co-Chair)g

aDivision of Cardiac Surgery, University of Ottawa Heart Institute, Ottawa, Ontario, Canada
bDepartment of Pediatrics, University of Montreal, Montreal, Quèbec, Canada
cDepartment of Radiology, University of British Columbia, Vancouver, British Columbia, Canada
dDivision of Vascular Surgery, University Health Network, Toronto, Ontario, Canada
eDivision of Cardiology, University of Alberta, Edmonton, Alberta, Canada
fDivision of Cardiology, McGill University, Montreal, Quèbec, Canada
gDivision of Cardiology, Western University, London, Ontario, Canada
Increased risk of Aortic complications:

- large size (≈5cm)
- rapid growth (>0.5cm/yr)
- concomitant aortic valve disease
- uncontrolled hypertension
- smoking history
Position Statement

Canadian Cardiovascular Society Position Statement on the Management of Thoracic Aortic Disease

RECOMMENDATION

3. We recommend that patients with complex TAD who stand to benefit from these emerging techniques and technologies be referred to teams experienced in these approaches (Conditional Recommendation, Low-Quality Evidence).
**Canadian Cardiovascular Society Position Statement on the Management of Thoracic Aortic Disease**

*Reasonable to screen first degree relatives of patients with acute aortic syndrome, thoracic aortic aneurysm, and bicuspid aortic valves*

*Screening tool:*

- Echo
- ±CTA/MRA chest

...Indolent but Catastrophic...
15. We suggest that patients with TAD be precluded from private driving if the ascending aorta diameter is > 6.0 cm or the descending aorta diameter is > 6.5 cm, and restricted from commercial driving if the ascending thoracic aorta diameter is > 5.5 cm or the descending thoracic aorta is > 6.0 cm.\textsuperscript{83} (Conditional Recommendation, Very Low-Quality Evidence).

Values and preferences. These thresholds are based on the methodology of the CMA and Canadian Cardiovascular Society Consensus Conference on the assessment of the cardiac patient for fitness to drive and fly,\textsuperscript{82} and the best available observational evidence. Risk thresholds can be reached at different aortic diameters for different aorticopathies. Further studies are required to provide reliable estimates of rupture risk.

* If thoracic aorta is \approx 6\text{cm} worth having a conversation about driving
Come a long way....journey continues