

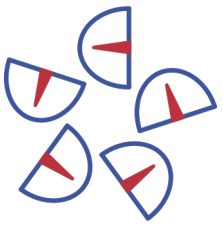
CAP Snaps

5 Key Messages

Aortovascular Disease

Thursday 24th February 2022

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Anatomy of the Aorta

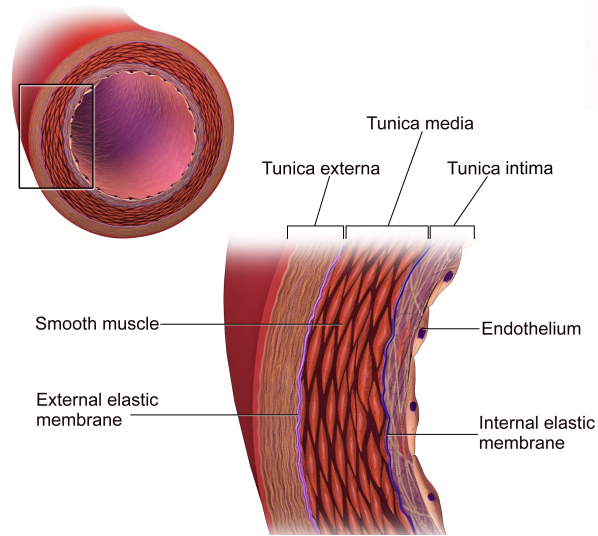
Miss Katie O'Sullivan
Cardiothoracic Surgical Fellow

1. Embryology

- Arises from the 4th pharyngeal arch artery on the LEFT
- By week 8 a single aorta exists
- Asymmetric growth of 4th arch → asymmetrical location of rec. laryngeal nerve

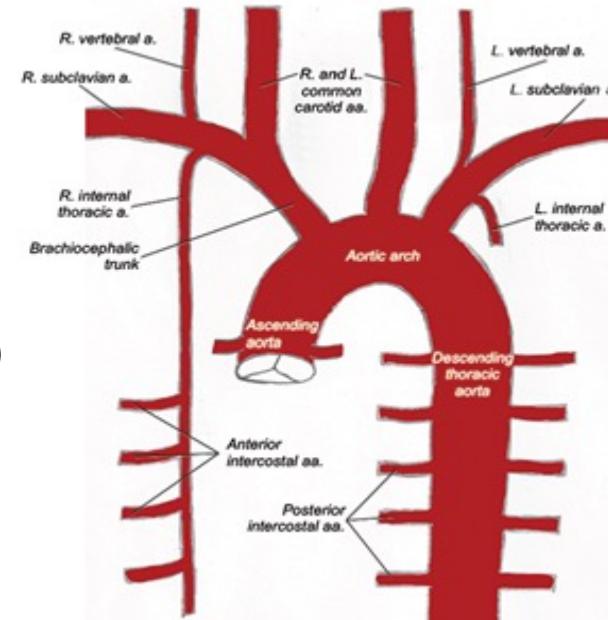
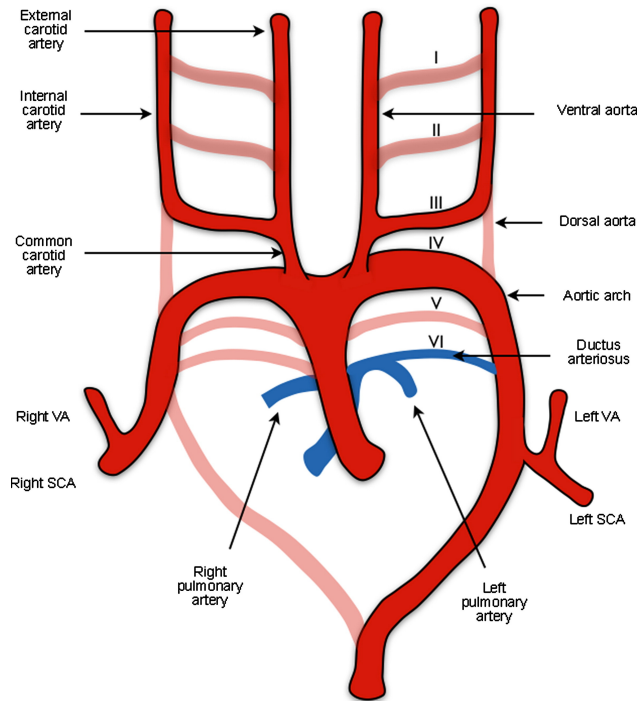
2. Histology

- Elastic artery comprising:
 - *Tunica adventitia* (outer)
 - *Tunica media* (middle)
 - *Tunica intima* (inner)



3. Anatomy of the approach

- Know your Femoral & Axillary anatomy
- How are you getting onto bypass?

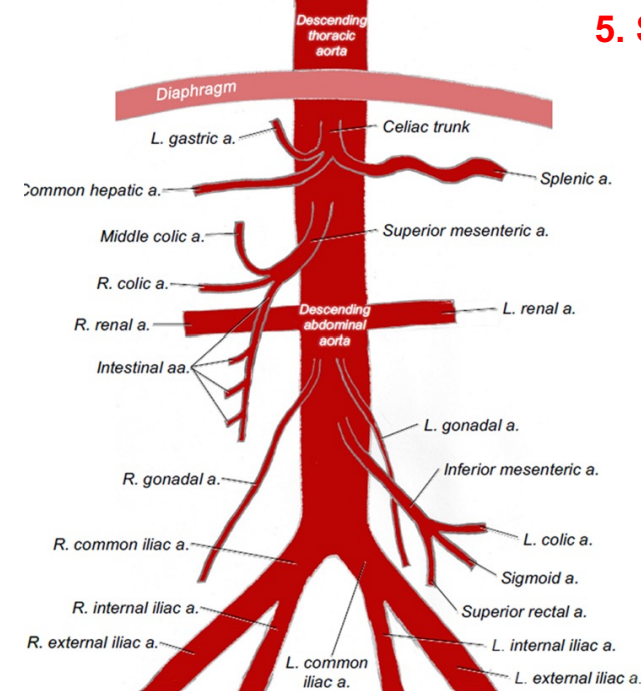


4. Branches of the aortic arch

- L and R coronaries
- Brachiocephalic
- L common carotid
- L subclavian
- Beware anatomical variants

5. Spinal cord blood supply

- Vertebral arteries
- Artery of Adamkiewicz
- Intercostals
- Lumbar



Pathophysiology of aortic disease

Dr. Caroline Bullen – Anaesthesia & ICU Fellow



1

Risk factors

- 1) Hypertension – 80%
- 2) Connective tissue disease
- 3) Genetic basis even without specific syndrome
- 4) Any increase in aortic wall stress:
 - Pregnancy
 - Drugs (cocaine)
 - Steroids
 - Weightlifting

2

Aneurysms

- Loss of smooth muscle cells
- Hypoplastic remodelling
- Inflammation & oxidative stress
- TAA and AAA have different pathophysiology

3

Dissections

- Intimal tear
- Intima and media exposed to pulsatile blood flow
- Intramural haematoma may form
- False lumen may thrombose

Ulcers

- Atherosclerotic plaque rupture – may precede to dissection

4

Forces

Aorta serves as a capacitor and a reservoir:

Systole:

kinetic energy of blood ejected from LV → to potential energy in aortic wall

Diastole:

aorta recoils and potential energy propels blood into circulation

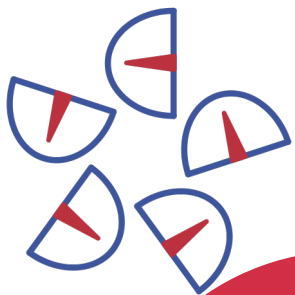
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Tunica media

Degradation within this layer is key to pathogenesis of aortic disease.

Thickest of 3 layers:

- confers elasticity & strength
- **elastin fibres** arranged in concentric layers
- **microfibril extensions** from elastic layer anchor to smooth muscle cells
- Bounded by **internal/external elastic lamina**



Neuroprotection during Aortic Surgery

Dr Mike Shaw
Consultant Anaesthetist



Hypothermia

- Hypothermia has the best, and only good evidence for neuroprotection.
- Hypothermia ↓ CMRO₂ by 7% for every 1°C
- ↑↑ DHCA duration results in neurological morbidity



Steroids

- Methylprednisolone 1g – traditional approach
- Long history of use in paediatric cardiac
- Potential for harm – CRASH trial, hyperglycaemia, etc



Thiopentone

- Old DHCA evidence for 40-50mg/kg!!
- Most give 500mg
- Big doses delay extubation and may be neurotoxic!



What can we do?

Minimise harm

- 1-off dose Thiopentone is probably OK
- Avoid hyperglycaemia – insulin
- Steroids may be harmful



Summary

- Evidence of benefit for single treatment or intervention is poor
- It is reasonable to give nothing!
- Perfusion techniques have moved on
- Many non-anaesthesia factors affect neurological outcomes

TOE of the Ascending Aorta and Arch

Dr Giuseppe Bozzetti
Consultant Anaesthetist

01 Aorta zones

- Know the zones
- Beware the blindspot – common site of surgical manipulation

02 'Basic' views

- ME AV LAX = Asc Ao $\sim 120-140^\circ$ - ME AV SAX = 40°
- UE AV SAX = 0°
- Aortic arch views are also pulmonary artery views

03 Underrated views

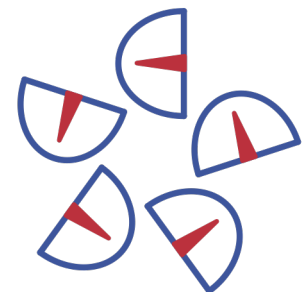
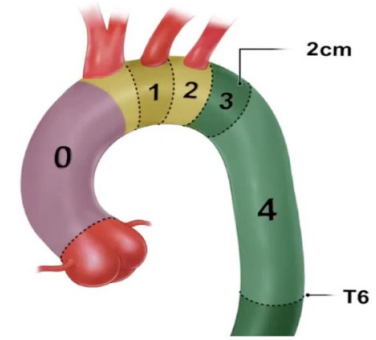
- UE Ao Arch SAX 80°
- Deep transgastric views – avoids the tracheal blind spot but structures of interest are in the far field

04 When to measure

- AV annulus – mid systole
- Asc Ao – diastole – indexed values are most useful
- 5.5cm needs repair (4.5cm if Marfans, or AV surgery)

05 Use X-plane & 3D

- Multi-plane imaging allows for SAX Asc Ao and arch views.
- Helps in diagnosis of aortic syndromes – Beware artefact & azygous
- Consider epi-aortic scanning for atheroma



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Deep Hypothermic Circulatory Arrest

Joanna Metcalfe
Senior Perfusionist



Hypothermia

- Mild (32 – 35°C)
- Moderate (28 – 32°C)
- Deep (<28°C)
- DHCA = complete cessation of the circulation at temperature <28 °C to preserve organ function during complex aortic surgery



pH

- Changes with temp. due to H₂O dissociation
- Intracellular pH crucial for regulation of metabolism
- Maintained by
 - Buffering
 - [CO₂]



Cerebral perfusion

Antegrade – 10 to 20ml/kg/min
Allows for less severe cooling

Retrograde – less embolic events, but adequacy of perfusion unknown



pH stat

- ABG measured at pt's actual temp (not corrected)
- At this temp., perfusion goal is to maintain pH 7.4 & PCO₂ ~5.0
- CO₂ added to circuit so ↑ total CO₂ content during DHCA



Summary

- PaCO₂ is a major determinant of CBF
- Cerebral autoregulation is preserved until 22°C
- Hypothermia produces a physiological alkalosis owing to:
 - ↑ solubility of CO₂
 - ↓ ionisation of H₂O
- Perfusion & cooling are key

The 'hemi-arch' procedure

01 Aorta zones

0: Asc. aorta – innominate artery 1: innominate to L common carotid
2: LCC - L SCA 3: 2cm distal to L SCA 4: Z3 – mid-descending (T6)

02 'Hemi-arch' meaning...

- Leaves the supra-aortic trunks intact
- Resects lesser curve of arch
- Mandates circulatory arrest & use of cerebral protection techniques
- Allows inspection of aortic arch & more extensive aortic replacement

03 Surgeons like...

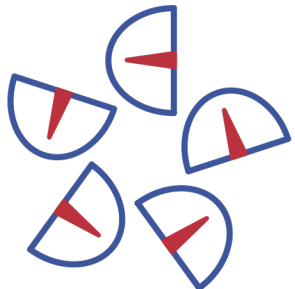
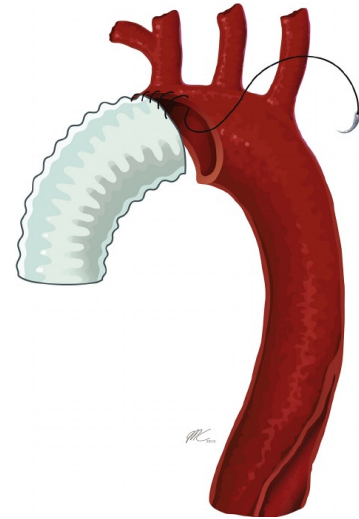
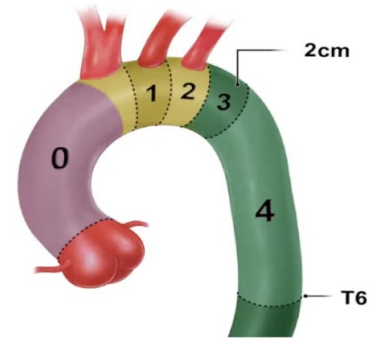
- 2x arterial line (prox. & distal to clamp area)
- CVC +/- PAC
- TOE
- NIRS -> drop in value means check anastomoses & adjust your cannulae
- 2x temp probe (nasopharynx & bladder)
- neuroprotective drugs!

04 Considerations

- Stroke
- Circle of Willis competence unknown – bilateral cerebral perfusion
- Renal failure
- Coagulopathy

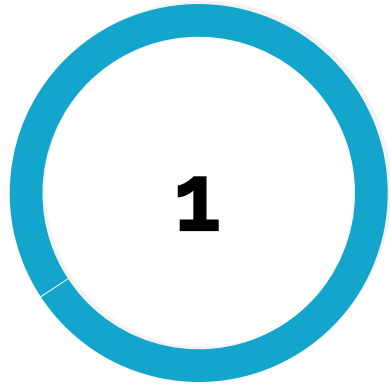
05 How cold?

Antegrade cerebral perfusion (8 – 12 mL/kg/min)
+ moderate hypothermia 24 – 28°C
= lower neurological & renal complications and shorter ICU stays



Anaesthesia for Aortic Arch Surgery

Dr Carlos Corredor
Consultant
Anaesthetist



Preoperative assessments:

- Functional capacity - 6 min walk, frailty
- CVS: echo (RV function & PAH)
- Lungs: spirometry
- Renal: U&Es
- Haem: optimise Hb
- Frank conversations with pt. about associated morbidity



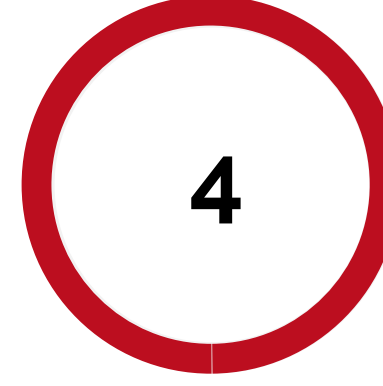
Induction:

- 2x arterial line – right radial essential
- Beware BP surges!
- Airway may be distorted by aneurysm
- Careful monitoring of heart and brain
(TOE, Cerebral NIRS, Paraspinal NIRS, pEEG, Spinal pressures & CSF drainage)



Issues coming off bypass:

- Hypoxia & Hypercapnia
- ↑ PVR
- Fluid loading
- **RV strain**
- **Vasoplegia**
- Metabolic acidosis
- Myocardial injury
- Air embolism



Coagulation

- Pre-op Iron studies & anaemia clinic
- Acute normovolaemic haemodilution (10 – 15ml/kg)
- TEG-guided transfusion
- Aprotinin vs TXA ?? The debate continues...
- Fractionated clotting factors avoid haemodilution but may be prothrombotic



Post-op

- Early sedation hold (<2hrs following ICU arrival)
- Aim RASS 0 to -1
- Dexmedetomidine & fentanyl to facilitate
- Maintain MAP 85 – 90mmHg for spinal cord perfusion
- Early assessment lower limb power and post-op stroke