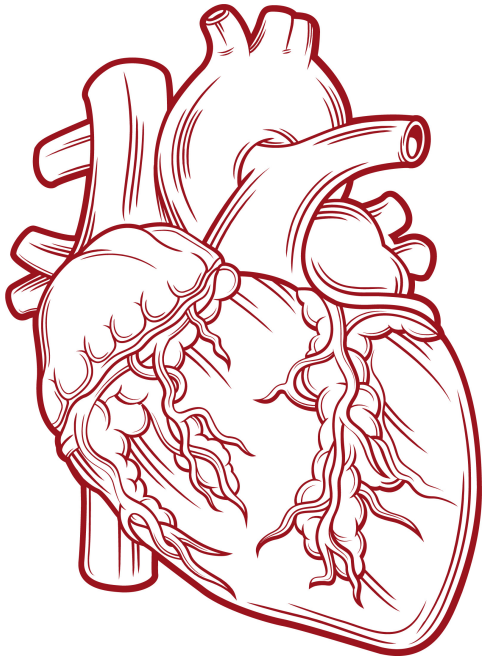

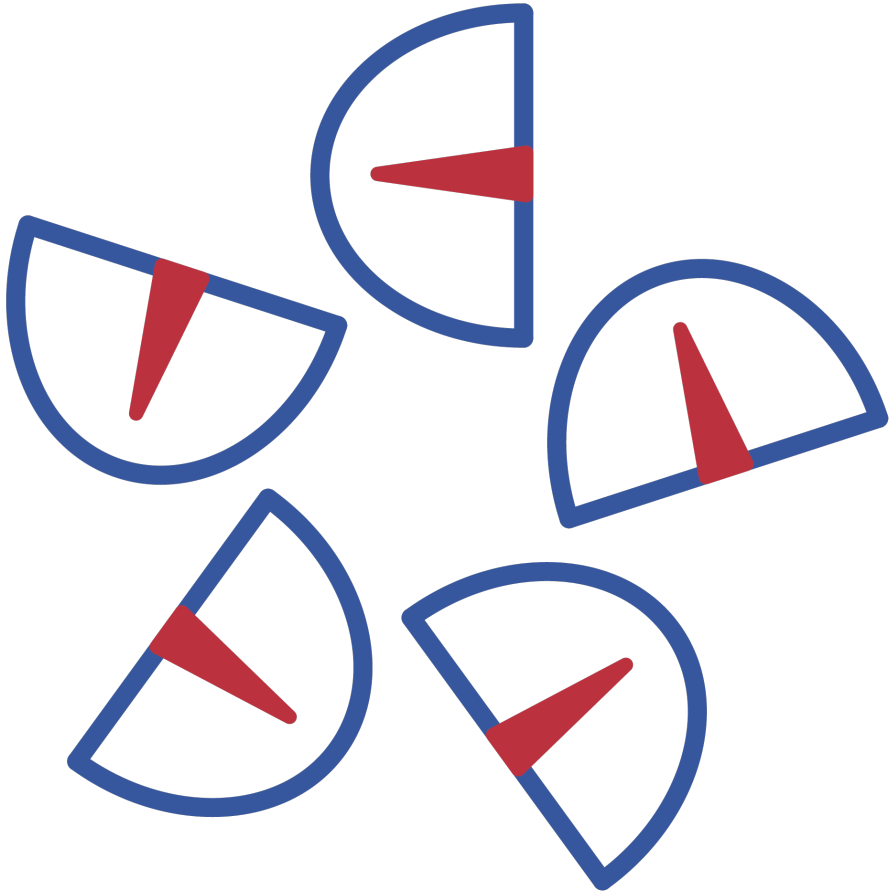

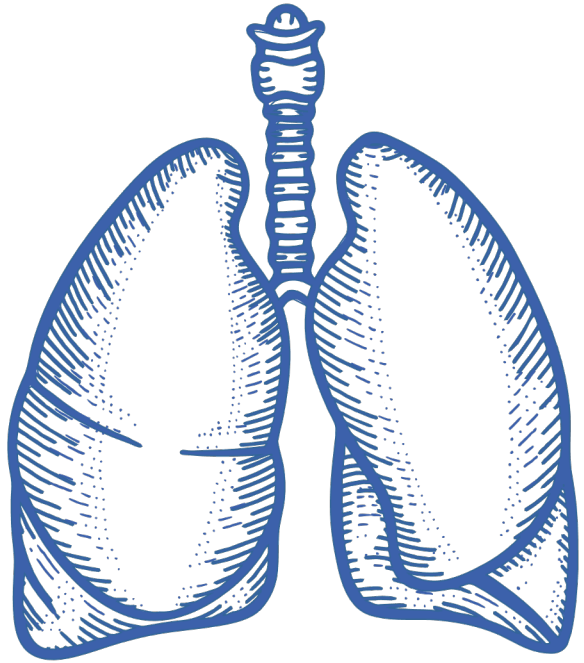

# CAP Snaps

5 Key Messages
Aortovascular Disease
Thursday 24th February 2022

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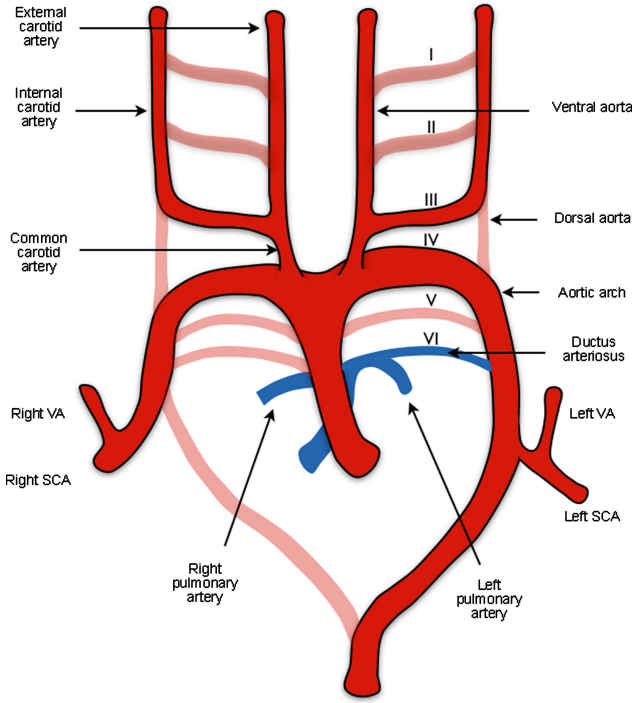
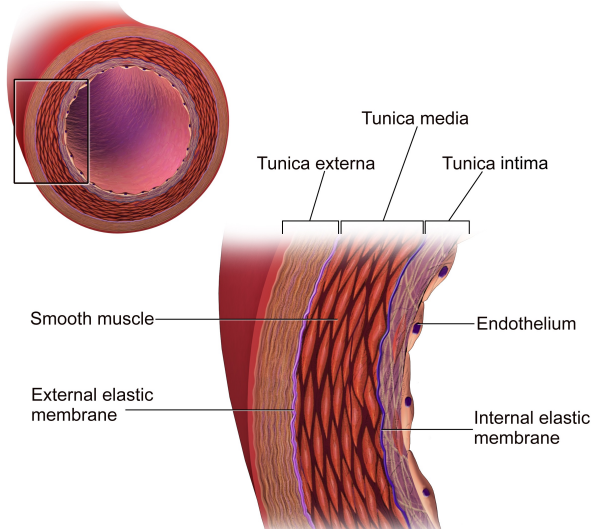
# Anatomy of the Aorta

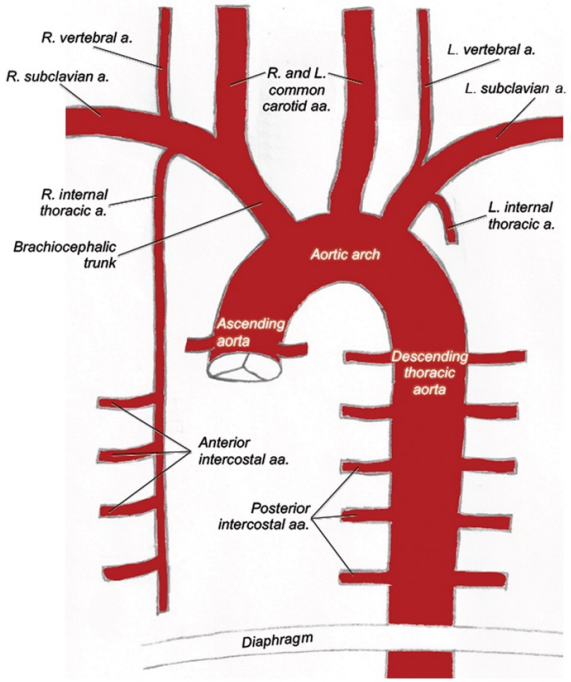
**Miss Katie O'Sullivan**
**Cardiothoracic Surgical Fellow**

- **Embryology**
  - Arises from the 4th pharyngeal arch artery on the LEFT
  - By week 8 of gestation a single aorta exists comprising ascending, arch and descending portions
  - Asymmetrical growth of 4th arch → asymmetrical location of rec. laryngeal nerve

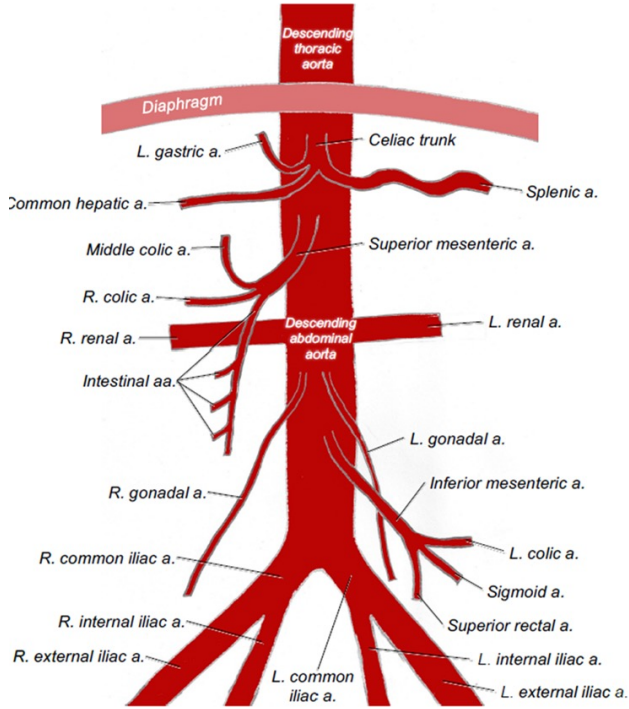



- **Histology**
  - Elastic artery comprising:
    - *Tunica adventitia (outer)*
    - *Tunica media (middle)*
    - *Tunica intima (inner)*




- **Branches of the aortic arch**
  - L and R coronary arteries
  - Brachiocephalic/inominate
  - L common carotid
  - L subclavian artery




- **Branches of the aorta**
  - Coeliac trunk (T12)
  - SMA (L1)
  - IMA (L3)
  - Bifurcation (L4)

# Pathphysiology of aortic disease

Dr. Caroline Bullen – Anaesthesia & ICU Fellow

## 1

**Types of disease**

1) **Aneurysms**

2) **Acute aortic syndromes:**

- Aortic dissection
- Intramural haematoma
- Ulcers

**3) Genetic syndromes:**
- Marfan syndrome
- Ehler's Danlos syndrome
- Loeys-Dietz syndrome

**4) Trauma/iatrogenic**

## 2

**Risk factors**

1) Hypertension
2) Hyperlipidaemia
3) Genetic predispositions
4) Inflammatory
5) Trauma
6) Other

- Pregnancy
- Drugs (cocaine)
- Steroids
- Body building/weight lifting

## 3

**Genetics**

Associated genes for TAD encode proteins involved in:

- Vascular sm. muscle
- TGF-β signalling
- Sm. mus. metabolism

TGF- increases collagen and degrades elastic fibres

## 4

**Forces acting on the aorta**

Aorta serves as a capacitor/reservoir:

**Systole**: kinetic energy of blood ejected from LV → to potential energy in aorta

**Diastole**: aorta recoils and potential energy propels blood into circulation

Elastic fibres & sm.mus cells highly interconnected

## 5

**Tunica media**

Degradation within this layer is key to pathogenesis of TAD

Thickest of 3 layers:
- confers elasticity & strength
- **elastin fibres** arranged in concentric layers
- **microfibril extensions** from elastic layer anchor to sm.mus cells
- Bounded by **internal/external elastic lamina**

# Neuroprotection during Aortic Surgery

Dr Mike Shaw
Consultant Anaesthetist

## Hypothermia

- DHCA is the mainstay of cerebral protection during cessation of cerebral blood flow for aortic surgery
- Hypothermia ↓ CMRO2 by 7% for every 1°C
- Dose-response curve for DHCA uration & neurological morbidity

## Therapeutics

- Options include::
  - **Thiopentone** 0.5 – 1g
  - **Steroids** (methylpred 1g)
  - **Actrapid** (if glucose >8)
  - Mannitol
  - $MgSO_4$

## Monitoring

- Cerebral NIRS
- pEEG (e.g. BIS)

## Technique

- Modern perfusion techniques (such as selective antegrade perfusion) prolong safe length of DHCA
- Selective perfusion techniques also allow less cooling (22-25°C)

## Summary

- Evidence of benefit for single treatment or intervention is poor
- Many centres in the world do nothing yet have equivalent outcomes

# 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 $H_2O$ dissociation
- Intracellular pH crucial for regulation of metabolism
- Maintained by
  - Buffering
  - [$CO_2$]

## ABG analysers

Warm patient's blood to 37 °C, so when sample from hypothermic pt. is analysed $CO_2$ is released → ↑ $PCO_2$

## pH stat

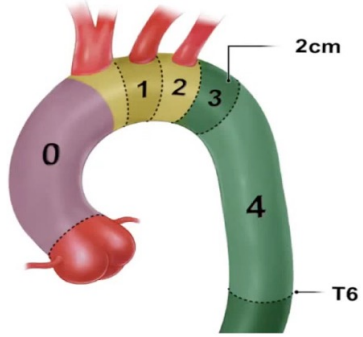
- ABG analyser measures at pt's actual temp (not corrected to 37°C)
- At this temp., perfusion goal is to maintain pH 7.4 & $PCO_2$ ~5.0
- $CO_2$ added to circuit so ↑ total $CO_2$ content during DHCA

## Summary

- $PaCO_2$ is a major determinant of CBF
- Cerebral autoregulation is preserved until 22°C
- Hypothermia produces a physiological alkalosis owing to:
  - ↑ solubility of $CO_2$
  - ↓ ionisation of $H_2O$

Dr Guiseppe Bozzetti
Consultant Anaesthetist

# 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 Monitoring requirements...**

- 2x arterial line (prox. & distal to clamp area)  - CVC  - ECG
- TOE  - NIRS  - 2x temp probe (naso & bladder)

**04 Considerations**

- Stroke
- Renal failure
- Coagulopathy

**05 How cold?**

Literature supports antegrade cerebral perfusion (8 – 12 mL/kg/min) & moderate hypothermia 24 – 28°C. Associated with lower neurological & renal complications and shorter ICU stays

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# Anaesthesia for Aortic Arch Surgery

Dr Carlos Corredor
Consultant
Anaesthetist

## 1

**Preoperative assessments:**

- Functional capacity (6MWT)
- Organ systems:
- CVS: echo (RV function & PAH)
- Lungs: spirometry
- Renal: U&Es
- Haem: optimise Hb

Frank conversation with pt. about associated morbidity

## 2

**Intraoperative monitoring:**

- 2x arterial line
- PA cathether
- CO monitoring
- TOE
- 2x temp probes
- Cerebral NIRS
- Paraspinal NIRS
- pEEG
- Spinal pressures & automated drain (LiquoGuard™)

## 3

**Issues coming off bypass:**

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

## 4

**Haemostasis/blood conservation**

- Preop' Fe studies & anaemia clinic
- Acute euvolaemic haemodilution (10 – 15ml/kg)
- TEG-guided transfusión
- Aprotinin
- Fractionated clotting factors (Octaplex 12.5U/kg & Riastap 4g)

## 5

**Neurological complications**

- 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