Anaesthesia for non-cardiac surgery in patients left ventricular outflow tract obstruction (LVOTO)

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- RBH largest congenital cardiac unit worldwide (2 sites)
- > 20% UK workload
- Surgery at Brompton
LVOTO & Anaesthesia

• Why does it matter?
• What is it?
  – Fixed / Dynamic
• Anaesthetic management
  – Pre-op
  – Per-op
Why does LVOTO matter?

- Common
- ↑ed LV afterload → LV hypertrophy
- Untreated results in LV dilatation & failure
- High risk infective endocarditis

- Anaesthesia → ↑ed risk
- ∴ recognise prior to anaesthesia
Range of disease

- Supra-valvular (F)
- Valvular (F)
- Sub-valvular
  - Fibro-muscular ridge or tunnel (F)
  - Hypertrophic cardiomyopathy (D)
Supra-valvular obstruction

• +/- Obstruction in multiple vessels
  – Including pulmonary vessels
• Particular risk in:
  – Williams syndrome
  – Rubella syndrome
• AV adhesion to sino-tubular junction $\rightarrow$ restricted coronary filling (esp. LCA)
Valvular obstruction

• Congenital
  – Bicuspid valve
  – 1-2% population
  – ♂ : ♀ (4:1)
  – Autosomal dominant, variable penetrance
  – +/- CoA Ao

• Acquired
  – Most common valvular disease in elderly
Effects of fixed obstruction

- Concentric hypertrophy
- CO heavily rate dependent
- (LV dilatation)
- Inadequate systemic perfusion
- Pulmonary oedema
  - Exacerbated with MV regurgitation
- 1-2% mortality with non-cardiac surgery (if severe)
Anaesthesia with fixed obstruction

• Ensure effective LV pre-load – avoid:
  – Dehydration $\rightarrow$ ↓filing vol.
  – Tachycardia / arrhythmia $\rightarrow$ ↓filing time
  – (Excess ↑LAP $\rightarrow$ pulmonary oedema)

• Maintain coronary perfusion – avoid:
  – Tachycardia / arrhythmia $\rightarrow$ ↓coronary flow time
  – ↓SVR (systemic vascular resistance) $\rightarrow$ ↓Ao root P

• Remember prophylaxis for endocarditis

Arterial & central venous lines may be helpful
Sub-valvular obstruction

**Fixed**
- Associated with other congenital conditions
  - ~40% have VSD
- Progressive, with ↑ing:
  - Obstruction
  - Regurgitation
- Discrete ridge (~90%)
- Fibromuscular tunnel

**Dynamic**
- Hypertrophic cardiomyopathy (HCM)
- Degree of obstruction varies acutely
  - Exercise
  - Emotion
  - Catecholamines
  - Unknown
Hypertrophic Cardiomyopathy

- Genetic condition (multiple genes involved)
  - ~90% inherited (autosomal dominant)
  - Most common inherited heart defect (1:500)
- LV hypertrophy disproportionate to the load
  - Stiff LV wall with impaired filling
  - ~40% have LVOTO at rest
  - In a further 33% LVOTO can be provoked

Maron, M.S. et al Circulation 2006, 114 (21), 2232-9
Clinical symptoms of HCM

- Nil
- May only be provoked by exercise:
  - Dyspnoea
  - Syncope
  - Angina
  - Arrhythmias
- Sudden death most common in young
- Hypertrophic Cardiomyopathy Association (HCMA)
  - Provides information for medical staff & families
  - [http://www.4hcm.org/](http://www.4hcm.org/)
Obstruction in HCM

- Not affect all individuals
- Mainly sub-aortic
  - Systolic anterior motion of mitral valve (SAM)
  - Mid-systolic contact between mitral valve & septum

- Diagnose with gradient $\geq 30$mmHg
  - Obstructive at rest
  - With provocation

Maron, B.J. et al JACC 2009, 54 (3), 191-200
Risk of sudden death in HCM

Major risk factors:
- Previous cardiac arrest
- Spontaneous, sustained runs of VT
- Family history
- Unexplained syncope
- LV thickness > 30mm
- AbN BP with exercise

Potential risk factors:
- AF
- Ischaemia
- LVOTO
- High risk mutations
- (Intense exercise)
Avoiding sudden death in HCM

- Institute pre-emptive treatment if ≥ 2 major risks
  - FH HCM
  - Previous arrest
  - VT
  - Unexplained syncope
  - LV thickness ≥ 30mm
  - AbN BP response

More risk factors → greater likelihood death
Clinical signs of HCM

- Nil
- Rapid up- & down-stroke of arterial pulse
- Prominent jugular vein
- Systolic murmur at left sternal edge
  - ↑s with ↓blood in LV (e.g. Valsalva)
- ↓ (or no ↑) BP with exercise
Optimum treatment of HCM

**Drug Treatment:**
- Symptoms of failure:
  - \( \beta \)-blockers
  - \( Ca^{2+} \) channel blockers
  - Disopyramide
- Arrhythmia prevention:
  - \( \beta \)-blockers
  - Amiodarone
  - \( \omega \) ? need anti-coagulation

**Interventions:**
- Myomectomy
  - Surgical
  - Alcohol septal ablation
- Consider AICD

ACC/ESC consensus document 2003 (JACC)
Anaesthesia & dynamic obstruction

Avoid:
- ↑ dynamic obstruction
  - Dehydration (empty LV cavity)
  - +ve inotropes
- ↓ ΔP coronary perfusion
  - ↓ diastolic pressure
  - ↑ LV wall pressure (+ve inotropes)
- ↓ coronary perfusion time
  - +ve chronotropes
- Arrhythmias
  - Metabolic derangement (K⁺, Mg²⁺)
  - Excess LA dilatation
Anaesthesia with LVOTO

Summary

• LVOTO may be congenital or acquired
  – Always take a family history

• Obstruction may be fixed or dynamic

• If fixed, avoid:
  – Dehydration, tachycardia & ↓SVR

• If dynamic, avoid:
  – Dehydration, tachycardia, ↓SVR & +ve inotropes