

Systems Focus:  
Cardiology

# CVS & Diving

- ↑cardiac demand
  - Heat generation, exercise, vascular redistribution due to immersion
- Cold/stress can induce coronary spasm
- CVS D/O in diving:
  - Sudden death – underwater usually due to CVD, arrhythmia
  - Acute MI
  - Stroke
  - Syncope
  - Arrhythmias
  - Pulmonary edema
  - Paroxysmal dyspnea
  - Vascular rupture/occlusion
  - Gas embolism
- CAF RF Screening
  - Hx – CVD, smoker, DM, lipids, FHx, HTN, exercise tolerance
  - Anthropometrics
  - Labs – lipids, fasting gluc, A1C > FRS
  - ECG q4yrs to 40, then q2yrs >40 y.o.
  - +/- EST, stress echo, nuclear perfusion, CT Coronary Ca if indicated
- Why screen Asx?
  - Most ACS due to plaque rupture, often without flow limitation pre-ACS event
  - Up to 50% initial presentation CVD is sudden cardiac death

# CHD

- Septal defects
  - VSD most common upper septum
  - Small deficits gen no significant R to L shunt (unlikely to ↑risk AGE)
- Aortic stenosis
  - Exercise syncope, sudden death
- Patent ductus arteriosus
  - HF if severe
- Cardiomyopathy
  - Hypertrophic often asx, may hear murmur on exam if valve abN
  - Dilated – ↓LV fx may = exercise intolerance
  - \* Any FHx of sudden death needs investigation to r/o cardiomyopathy!
  - CI's to diving
    - AbN LV Fx – EF <50% (risk arrhythmia)
    - Hx ICD, arrhythmias, syncope
    - Hx of HF (lose cardiac reserve to prevent syncope)
- PFO & Diving
  - Controversial- significant opinion (based on epi, animal models, path exam, pathophys reasoning) that shunt likely does not contribute to isolated spinal DCS
  - Relative risk DCS in significant shunt vs. no shunt ~5-25
    - Includes incidence of isolated spinal DCS, thus likely overestimate shunt-attributable risk
  - Consider underlying condition
  - CAF Screening – CDs, unexplained DCS/AGE hit
    - Echo with bubble contrast & Valsalva

# Valvular Disease

- Stenotic valves
  - ↓exercise tolerance (worse with immersion)
  - Lead to circulatory obstruction
- Regurgitant valves
  - Tolerated if mild
  - HF, pulm congestion if severe -> ↑dyspnea (exercise, immersion)
- Volume overload -> hypertrophy
  - ↑muscle mass demands requires ↑blood flow (risk underperfusion of endocardium)
- Bicuspid aorta (\*requires cardiology W/U)
  - Assoc with abnormal coronary arteries, aortic root dilation, PDA, Turner syndrome, aortic stenosis, aortic insufficiency
- Aortic stenosis – exercise syncope, sudden death
  - Low risk if no LVH on ECG, HF, arrhythmias, syncope or angina
- Aortic insufficiency – HF if severe
- Mitral stenosis – exercise induced pulmonary edema
- Mitral insufficiency – HF if severe
- Mitral prolapse - +/- arrhythmia
  - Assoc with palpitations, tachy, extra beats, CP, regurg
- Pulmonic stenosis – reduced exercise tolerance if severe
- Tricuspid stenosis – reduced exercise tolerance if severe
- Prosthetic valves
  - What is fx status
  - ?anticoagulation required (increase hemorrh risk in BT)
  - Likely low stress warm water diving only

# Arrhythmias

- Supraventricular
  - Episodic SVT, Afib can be N variant in young population
  - R/O Mitral sten, TSH, HTN, nicotine, stress, EtOH, caffeine, supplements etc.
    - Gen ok to dive if no organic heart disease, resolves with stim remove
    - CDSM review if requires BB/CCB
- Ventricular
  - PVC may be N variant – assess with exercise
  - No go diving if multifocal, R-on-T, freq coupling, ICD, LV dysfx (increase risk sudden death)
- Long-QT syndrome
  - QT > 440 msec
  - Assoc with sudden death/VF, syncope
    - Ppt by stress, exercise, lyte abN, drugs, meds etc.
    - Increase risk combo of exercise & immersion
  - Unfit dive
- Increased vagal tone
  - Bradycardia may be N variant in well conditioned applicants
  - Fit dive if asx
  - If palpitations (Afib), severe brady while diving – can increase risk syncope

# Conduction Abnormalities

- Often underlying cardiac disease
- 1° AV
  - May be due to excess vagal tone
  - Asx generally ok
- Fixed 2° AV block
  - Often lead to complete block = CI
- LBBB
  - Often due to cardiomyopathy or coronary dz
  - Requires workup
- RBBB
  - Incomplete
    - If stable, usually N variant, benign
  - Complete
    - May be N variant or congenital HD
    - Requires workup to r/o anatomic cardiac abnormality
- Pacemaker
  - If no other heart disease, pacemaker tested to pressure and good exercise tolerance
    - May be ok for sport diving
    - Unfit CF diving
  - ICD – unfit diving

# Conduction Abnormalities

- Brugada Syndrome

- Mutation Na channel
- Type 1 – ST elevation >2mm in >1 of V1-V3 followed by a negative T Wave
- Type 2 - >2mm saddleback shaped ST elevation
- Type 3 – morphology of Type1/2 but <2mm
- Accompanied by documented VF/VT, FHx of sudden cardiac death <45, similar ECG in family mbrs, syncope, nocturnal agonal respiration, inducibility of VT with electrical stimulation
- Tx = ICD, CI to diving

- Pre-excitation syndromes

- Short PR not in itself CI
  - Asx, low risk arrhythmia may be ok sport diving
  - Recurrent paroxysmal or exercise-induced tachy requires w/u
- WPW
  - Risk exercise induced tachy, palpitations, SOB, syncope, sudden cardiac death
  - If successful ablation – ok to dive
  - If sx – Unfit Diving