Long-term Effects of Diving

Noise-Induced Hearing Loss

- Risk Factors (RF)
  - Noise in environment – topside
    - Ship/boat noise, equipment/tools
    - Gas into chamber
  - Noise in environment – underwater
    - No hearing protection
    - Helmet, reg, ship/boat noise, tools, underwater explosions
  - Barotrauma
  - Inner ear DCS
- ↓Sound localization under water
  - ↑sound velocity in water vs air = reaches both ears at same time
- CAF screening
  - Audiogram qYear & on clinical indication
  - Occupational med (effect of diving on person) – audiogram
  - Fitness to dive considerations (whisper test, word discrimination, audiology)
- New studies show no difference between divers and those exposed to similar levels of surface noise

DON

- Type of avascular necrosis due to hyperbaric exposures; in long bones with fatty marrow
  - Relatively ↓blood flow = prolonged wash-out
  - N_2 is 5x more soluble in marrow fat than in blood
- Location: prox humerus, prox/distal femur, prox tibia
  - "wet" (divers) – femur, shoulders, rarely hip
  - "dry" (caisson) – hip most common
- Juxta-articular (A) or shaft (B) lesions
  - A lesions often become sx – pain, ↓ROM
  - B lesions often remain asx
- RF
  - Depth exposures >30msw, or >4hrs at <30msw, hx of DCS (any depth), significant omitted deco
  - Submariner escape – DON risk after single provocative deco exposure even if no DCS
  - >40, obesity, EtOH, fatty liver, dyslipidemia
  - Hx of DON
- Dx based on imaging studies
  - Long-Bone Survey (LBS)
    - B/L upper humeri (including rotational view of shoulder), AP & lat knees (upper tibia & lower femur) & b/l hip
    - Xray changes may not be observed for months/years after lesions devo
  - MRI preferred – more sensitive & specific
    - Able to detect DON as early as 2 weeks post onset, and by 2 months virtually all lesions are demonstrable
  - Bone scan
    - High sens but low specificity, not diagnostic
- Prevention
  - Timely Tx of DCS with HBOT likely to reduce incidence of DON
  - Avoid RFs

DON Classification

UK MRC

- Juxta-articular A Lesions:
  - A1 – Dense areas with intact articular cortex
  - A2 – Spherical opacities
  - A3 – Linear opacities
  - A4 – Structural failures: translucent cortical bands, collapse of articular cortex, sequestration of cortex
  - A5 – Secondary degenerative arthritis
- Shaft B Lesions:
  - B1 – Dense areas
  - B2 – Irregular calcified areas
  - B3 – Translucent and cystic areas

- Ficat 0
  - Ischemia, intravascular coag
  - Asx, no radiographic changes
- Ficat 1
  - Dead bone without repair, asx
  - Xray N, MR shows marrow edema by ~ 4weeks
- Ficat 2
  - Dead bone with repair, no collapse, asx until late
  - XR: sclerosis with irreg margins, spherical opaque areas (“snowcap”) and linear opacities
  - MRI: rings of low intensity surrounding necrotic center
- Ficat 3
  - Dead bone with repair & collapse
  - Sx – pain with joint motion or weight-bearing
  - Xray: subchondral # - radiolucent “crescent” line
  - MRI: necrotic centre, collapse of articular surface
- Ficat 4
  - Secondary degenerative arthropathy
  - May progress to complete destruction of joint

DON (see CFHS 4000-24)

- Screening
  - ALL divers complete DON questionnaire @ PHA
    - LBS only if at risk
  - Student divers
    - DWD candidates LBS at end of course
    - SWD only if Q shows ↑risk = LBS within 1 month completing course
  - Divers with ongoing exposure to DON RFs (all DWD, SWD with increased risk) = LBS q5yrs
  - Any diver with DCS, significant violation deco or sub escape = LBS within one week of event, followed by MR (hips, knees, shoulders) @ 2 months post-event
  - All DWD, and any SWD who have required LBS = LBS at termination of diving career

- Management
  - All DCS, significant omitted-D, sub escape, or DON lesions require CDSM review
  - If ID DON – R/O lesions at other sites
  - Juxta-articular A lesion
    - Shall be further characterized by MRI, staged
    - MRI of b/l shoulders, hip and knees
    - Followed by XRq6 months x 2 years, then annually until no further interval change
    - Referred to ortho
    - Declared “unfit CF diving or hyperbaric env”
    - Strongly advised to d/c civi diving >30msw, avoid load-bearing activities on involved joint
  - Shaft lesion
    - MR of b/l shoulders, hip and knees
    - LBS q5years until end of diving career, exit LBS
    - F/U required if dev sx
    - May be able to continue diving as per their quals vs. <30msw – requires CDSM review