# Changes in the ADCI Medical Requirements


- Tony Alleman, MD MPH FACOEM UHM
- Chairman – Physicians Diving Advisory Committee


# Background

- PDAC medical committee was formed in 2012
- Focus of committee is to revise medical requirements
- Provide medical advice to ADCI
- Last revision of the medical requirements was in 2008

# Changes Effective 2016

- Examinations are to be performed by a physician qualified to perform these exams
  - Attended a fitness to dive course
- Examinations recommended annually
- Examination after some diving related incidents are required

# Changes Effective 2016

- Non-physicians are not approved to perform ADCI diving examinations
  - Physician assistants
  - Nurse practitioners

# Changes Effective 2016

- Diver is required to notify the medical examiner of any change in his/her medical condition
- Fitness for duty examination is required after
  - Any hospitalization due to diving related injury or illness

# Changes Effective 2016

- Fitness for duty examination is required after
  - Any hospitalization due to diving related injury or illness
  - Inner ear DCS
  - CNS dysfunction
  - Arterial gas embolus (AGE)

# Changes Effective 2016

- Fitness for duty examination is not required after
  - Type I DCS

# Changes Effective 2016

- Anyone exposed to hyperbaric conditions (divers, DMT's, inside attendants) will be required to have a medical evaluation for any change in injury or illness that requires prescription medication, surgery, or hospitalization
- Exams are to be done by ADC qualified doctors

# Components of the Exam

- Chest x-ray
  - In the past years PA only
  - Now PA and lateral
  - Every 3 years unless otherwise indicated
  - Looking for blebs/cysts
- Spirometry
  - Should use NHANES reference values
  - Include FEV1, FVC and FEF 25-75%

# Components of the Exam

- Visual acuity
  - Annual evaluation
  - Color vision
- Sickle screen
  - Optional
  - Once only
- TB screening
  - Optional
  - If done, annually

# Components of the Exam

- Cardiac risk based score (Framingham)
  - Done on divers 35 y/o and greater
  - Must do lipids
    - Total cholesterol
    - HDL cholesterol
  - Combination of cholesterol, smoking, age, blood pressure
  - Accumulate points
  - Determine risk

# Framingham Risk - Age

| Men | |
|---|---|
| **Age** | **Points** |
| **20-34** | -9 |
| **35-39** | -4 |
| **40-44** | 0 |
| **45-49** | 3 |
| **50-54** | 6 |
| **55-59** | 8 |
| **60-64** | 10 |
| **65-69** | 11 |

| Women | |
|---|---|
| **Age** | **Points** |
| **20-34** | -7 |
| **35-39** | -3 |
| **40-44** | 0 |
| **45-49** | 3 |
| **50-54** | 6 |
| **55-59** | 8 |
| **60-64** | 10 |
| **65-69** | 12 |

# Framingham Risk - Smoking

Men

| Age | Smoker | Non-smoker |
|---|---|---|
| 20-39 | 8 | 0 |
| 40-49 | 5 | 0 |
| 50-59 | 3 | 0 |
| 60-69 | 1 | 0 |
| 70-79 | 1 | 0 |

Women

| Age | Smoker | Non-smoker |
|---|---|---|
| 20-39 | 9 | 0 |
| 40-49 | 7 | 0 |
| 50-59 | 4 | 0 |
| 60-69 | 2 | 0 |
| 70-79 | 1 | 0 |

# Framingham Risk - Chol

Men

| Total Cholesterol | Age 20-39 | Age 40-49 | Age 50-59 | Age 60-69 | Age 70-79 |
|---|---|---|---|---|---|
| <160 | 0 | 0 | 0 | 0 | 0 |
| 160-199 | 4 | 3 | 2 | 1 | 0 |
| 200-239 | 7 | 5 | 3 | 1 | 0 |
| 240-279 | 9 | 6 | 4 | 2 | 1 |
| 280+ | 11 | 8 | 5 | 3 | 1 |

# Framingham Risk - Chol

Women

| Total Cholesterol | Age 20-39 | Age 40-49 | Age 50-59 | Age 60-69 | Age 70-79 |
|---|---|---|---|---|---|
| **<160** | 0 | 0 | 0 | 0 | 0 |
| **160-199** | 4 | 3 | 2 | 1 | 1 |
| **200-239** | 8 | 6 | 4 | 2 | 1 |
| **240-279** | 11 | 8 | 5 | 3 | 2 |
| **280+** | 13 | 10 | 7 | 4 | 2 |

# Framingham Risk - HDL

| Men | |
|---|---|
| **HDL** | **Points** |
| **60+** | -1 |
| **50-59** | 0 |
| **40-49** | 1 |
| **<40** | 2 |

| Women | |
|---|---|
| **HDL** | **Points** |
| **60+** | -1 |
| **50-59** | 0 |
| **40-49** | 1 |
| **<40** | 2 |

# Framingham Risk – B/P

## Men

| Systolic BP | If Untreated | If Treated |
|---|---|---|
| <120 | 0 | 0 |
| 120-129 | 0 | 1 |
| 130-139 | 1 | 2 |
| 140-159 | 1 | 2 |
| 160+ | 2 | 3 |

## Women

| Systolic BP | If Untreated | If Treated |
|---|---|---|
| <120 | 0 | 0 |
| 120-129 | 1 | 3 |
| 130-139 | 2 | 4 |
| 140-159 | 3 | 5 |
| 160+ | 4 | 6 |

# Example of Framingham Risk

- 40 y/o diver

| Age | Points |
|---|---|
| 20-34 | -9 |
| 35-39 | -4 |
| 40-44 | 0 |
| 45-49 | 3 |
| 50-54 | 6 |
| 55-59 | 8 |
| 60-64 | 10 |
| 65-69 | 11 |

| No of Points | |
|---|---|
| Age | 0 |
| Total Chol | |
| HDL Chol | |
| Sys B/P | |
| Smoking | |
| Total | 0 |

# Example of Framingham Risk

- 40 y/o diver
- Smoker

| Age | Smoker | Non-smoker |
|---|---|---|
| **20-39** | 8 | 0 |
| **40-49** | 5 | 0 |
| **50-59** | 3 | 0 |
| **60-69** | 1 | 0 |
| **70-79** | 1 | 0 |

| No of Points | |
|---|---|
| Age | 0 |
| Total Chol | |
| HDL Chol | |
| Sys B/P | |
| Smoking | 5 |
| Total | 5 |

# Example of Framingham Risk

- 40 y/o diver, smoker
- Total chol = 210

| Total Chol | Age 20-39 | Age 40-49 | Age 50-59 | Age 60-69 | Age 70-79 |
|---|---|---|---|---|---|
| <160 | 0 | 0 | 0 | 0 | 0 |
| 160-199 | 4 | 3 | 2 | 1 | 0 |
| 200-239 | 7 | 5 | 3 | 1 | 0 |
| 240-279 | 9 | 6 | 4 | 2 | 1 |
| 280+ | 11 | 8 | 5 | 3 | 1 |

| No of Points | |
|---|---|
| Age | 0 |
| Total Chol | 5 |
| HDL Chol | |
| Sys B/P | |
| Smoking | 5 |
| Total | 10 |

# Example of Framingham Risk

- 40 y/o diver, smoker
- HDL chol = 40

| HDL | Points |
|---|---|
| 60+ | -1 |
| 50-59 | 0 |
| 40-49 | 1 |
| <40 | 2 |

| No of Points | |
|---|---|
| Age | 0 |
| Total Chol | 5 |
| HDL Chol | 1 |
| Sys B/P | |
| Smoking | 5 |
| Total | 11 |

# Example of Framingham Risk

- 40 y/o diver, smoker, ↑ Total chol, ↑ HDL chol, B/P sys = 131

| Systolic BP | If Untreated | If Treated |
|---|---|---|
| <120 | 0 | 0 |
| 120-129 | 0 | 1 |
| 130-139 | 1 | 2 |
| 140-159 | 1 | 2 |
| 160+ | 2 | 3 |

| No of Points | |
|---|---|
| Age | 0 |
| Total Chol | 5 |
| HDL Chol | 1 |
| Sys B/P | 1 |
| Smoking | 5 |
| Total | 12 |

# Example of Framingham Risk

- 10% risk should have further evaluation

| No of Points | |
|---|---|
| Age | 0 |
| Total Chol | 5 |
| HDL Chol | 1 |
| Sys B/P | 1 |
| Smoking | 5 |
| Total | 12 |

| Point Total | 10-Year Risk |
|---|---|
| **<0** | <1% |
| **0** | 1% |
| **1** | 1% |
| **2** | 1% |
| **3** | 1% |
| **4** | 1% |
| **5** | 2% |
| **6** | 2% |
| **7** | 3% |
| **8** | 4% |
| **9** | 5% |
| **10** | 6% |
| **11** | 8% |
| **12** | 10% |
| **13** | 12% |
| **14** | 16% |
| **15** | 20% |
| **16** | 25% |
| **17 or more** | ≥30% |

# Disqualifying Conditions

- Lung – Cystic, *bullous*, or cavitary disease
- Lung – spontaneous pneumothorax
- Chronic Alcoholism, drug abuse *or dependence*
- Hemoglobinopathies associated with comorbidities

# Disqualifying Conditions

- Untreated or persistent / metastatic or other significant malignancies including those that require chemotherapy and/or radiation therapy unless five years after treatment with no evidence of recurrence

# Disqualifying Conditions

- Hearing impairment in the better ear should be at least 40 dB average in the 500, 1000, and 2000 Hz frequencies
- Justa-articular osteonecrosis is disqualifying
- Chronic conditions requiring continuous control by medication that increases risks in diving.

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- Chronic conditions requiring continuous control by medication that increases risks in diving.

# Changes Effective 2016

- Weight table is now ADC weight table
- Any diver over the ADC weight table can have body fat testing by impedance or hydrostatic methods.  Body fat of 23% or less would be acceptable
- Any diver over the ADC weight table and body fat >23% should be disqualified until weight is acceptable

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# Changes Effective 2016

- Arrhythmias and persistent tachycardia need to be evaluated.
- Vision – must be recorded with and without contacts if used.
- Ear changes –
  - Chronic perforation of TM
  - Active otitis media

# Changes Effective 2016

- Exercise stress testing when ordered must be to at least 10 METS.
- Antiplatelet agents and aspirin (except low dose) are disqualifying
- Ejection fractions must be at least 40%

# Changes Effective 2016

- Peptic ulcers that are healed must be documented (testing)
- Colostomies are disqualifying
- Active venereal disease is disqualifying
- History of kidney stones may be disqualifying
  - Periodic evaluation must be done to determine presence of stones

# Changes Effective 2016

- Neural impingement or nerve root displacement on MRI or CT scanning is disqualifying even if asymptomatic
- Pelvic exams are recommended to be performed by gynecologist or other physician who routinely performs those type of exams

# Changes Effective 2016

- Time of loss of consciousness should be documented.
- Any doubt about severity of head injury should get consultation.
- Asymmetric reflexes should be documented
- Two point discrimination testing in the thumb middle finger and little finger.

# Changes Effective 2016

- HIV testing has been removed
- Pulmonary function must measure FEV1, FVC and FEF25-75
- NHANES reference values should be used.
- Chest x-ray every three years instead of yearly
- Hemoglobin A1C required for any history of diabetes

# Changes Effective 2016

- Lipid panels required for all divers 35 years and older to be used in the Framingham Risk
- Drug screens are recommended

# Changes Effective 2016

- Medications are now listed that are disqualifying

# Medications

- Amphetamines
  - Lisdexamfetamine
  - Designer drugs (MDMA, MMDA, FLEA, EDMA, EFLEA, MDOH, MDEA, 5-methyl-MDA, and others)

# Medications That Potentiate Oxygen Toxicity

- Psychostimulants
  - Amphetamines
  - Cocaine
  - Methylphenidate
  - Phenylpropanolamine

Epilepsy and the elderly. In Schachter SC, Schomer DL, eds. The comprehensive evaluation and treatment of epilepsy. San Diego, CA: Academic Press; 1997. p. 233-254.

Oxygen toxicity. In Jain, KK, ed. Textbook of Hyperbaric Medicine. Cambridge, MA: Hogrefe & Huber; 2004, p. 48-58.

# Medications

- Marijuana and synthetic marijuana
- PCP
- Cocaine

# Medications

- Opioids, naturally occurring and synthetics
  - Morphine, codeine, hydrocodone, oxycodone, buprenorphine, many others

# Medications That Potentiate Oxygen Toxicity

- Narcotics
  - Fentanyl
  - Meperidine
  - Petazocine
  - Propoxyphene

Epilepsy and the elderly. In Schachter SC, Schomer DL, eds. The comprehensive evaluation and treatment of epilepsy. San Diego, CA: Academic Press; 1997. p. 233-254.

Oxygen toxicity. In Jain, KK, ed. Textbook of Hyperbaric Medicine. Cambridge, MA: Hogrefe & Huber; 2004, p. 48-58.

# Medications

- Phosphodiesterase inhibitors
  - Erective dysfunction medications

# Medications That May Promote Decompression Sickness

- Phosphodiesterase inhibitors
  - Sildenafil (Viagra)
  - Tadalafil (Cialis)
  - Vardenafil (Levitra)
  - Udenafil (Zydena)
  - Avanafil (Stendra, Spedra)
  - Dipyridamole (Persantine)

Blatteau J-E, Brubakk AO, Gempp E, Castagna O, Risso J-J, et al. (2013) Sidenafil Pre-Treatment Promotes Decompression Sickness in Rats. PLoS ONE 8(4): e60639. doi:10.1371/journal.pone.0060639

# Medications

- Immunosuppresants not recommended in saturation diving

# Medications

- Tramadol
  - Lowers seizure threshold
  - Risk for oxygen toxicity

# Medications

- Antidepressants
  - Except low dose sertraline used for mild depression
- All antipsychotic medications

# Medications That Potentiate Oxygen Toxicity

- Antidepressants
  - Tricyclics
  - Serotonin-specific agents
  - Bupropion

Epilepsy and the elderly. In Schachter SC, Schomer DL, eds. The comprehensive evaluation and treatment of epilepsy. San Diego, CA: Academic Press; 1997. p. 233-254.

Oxygen toxicity. In Jain, KK, ed. Textbook of Hyperbaric Medicine. Cambridge, MA: Hogrefe & Huber; 2004, p. 48-58.

# Medications That Potentiate Oxygen Toxicity

- Neuroleptics
  - Clozapine
  - Phenothiazines
  - Butyrophenones

Epilepsy and the elderly. In Schachter SC, Schomer DL, eds. The comprehensive evaluation and treatment of epilepsy. San Diego, CA: Academic Press; 1997. p. 233-254.

Oxygen toxicity. In Jain, KK, ed. Textbook of Hyperbaric Medicine. Cambridge, MA: Hogrefe & Huber; 2004, p. 48-58.

# Medications

- Muscle relaxants
- Benzodiazepines
  - Valium, Xanax, Ativan, Klonopin, many others
- Barbiturates
- Anxiolytic and/or hypnotic medications

# Medications That Affect CNS

- Depressants
  - Potential for increasing nitrogen narcosis
  - Opiates
  - Benzodiazepines
  - Barbiturates

# Medications

- All forms of insulin

# Medications That Potentiate Oxygen Toxicity

- Hormones
  - Insulin
  - Prednisone
  - Estrogen

Epilepsy and the elderly. In Schachter SC, Schomer DL, eds. The comprehensive evaluation and treatment of epilepsy. San Diego, CA: Academic Press; 1997. p. 233-254.

Oxygen toxicity. In Jain, KK, ed. Textbook of Hyperbaric Medicine. Cambridge, MA: Hogrefe & Huber; 2004, p. 48-58.

# Medications

- Nicotine patches must be removed when diving

# Medications

- Verenicline – Chantix
  - Variety of side effects including dizziness, drowsiness (up to 10%)
  - Seizures have been reported

# Medications

- Beta blockers
  - Propranolol, labetalol, many others


# Medications That Affect Cardiac Output

- Beta blockers
  - Reduced heart rate
  - May interfere with exercise tolerance
- Strong vasopressors (by increasing afterload)
  - Phenylephrine
  - Norepinephrine
  - Epinephrine

Understanding cardiac output. Crit Care. 2008;12(4):174.

# Medications

- Buproprion
  - Wellbutrin

# Medications That Potentiate Oxygen Toxicity

- Antidepressants
  - Tricyclics
  - Serotonin-specific agents
  - Bupropion

Epilepsy and the elderly. In Schachter SC, Schomer DL, eds. The comprehensive evaluation and treatment of epilepsy. San Diego, CA: Academic Press; 1997. p. 233-254.

Oxygen toxicity. In Jain, KK, ed. Textbook of Hyperbaric Medicine. Cambridge, MA: Hogrefe & Huber; 2004, p. 48-58.

# Weight Chart

| Maximum Allowable Weight Chart | | |
|---|---|---|
| Males Weight in Pounds | Height (inches) | Females Weight in Pounds |
| 170 | 60 | 170 |
| 176 | 61 | 174 |
| 182 | 62 | 179 |
| 188 | 63 | 182 |
| 194 | 64 | 187 |
| 200 | 65 | 192 |
| 206 | 66 | 196 |
| 212 | 67 | 200 |
| 218 | 68 | 204 |
| 225 | 69 | 209 |
| 230 | 70 | 212 |
| 235 | 71 | 217 |
| 241 | 72 | 222 |
| 247 | 73 | 225 |
| 253 | 74 | 230 |
| 259 | 75 | 234 |
| 265 | 76 | 239 |
| 271 | 77 | 243 |
| 277 | 78 | 248 |
| 283 | 79 | 252 |
| 289 | 80 | 255 |

# Return to Diving After Diving Related Incident

- Simple pain only – 24 to 72 hours
- Pain only needed >1 treatment table for complete resolution – 7 days
- Altered sensation in limbs resolved by one treatment table – 7 days

# Return to Diving After Diving Related Incident

- Motor or other neurological deficit resolved by one treatment table – 28 days
- Neurological injury needing several treatment tables to resolve – 4 to 6 months

# Return to Diving After Diving Related Incident

- Pulmonary barotrauma – 2 months
  - Includes mediastinal emphysema
- Pneumothorax resolved (other than spontaneous) – 2 months
- Vestibular decompression sickness – 4 to 6 months

# Return to Diving After Diving Related Incident

- Round window rupture – 6 months after repair
- Central nervous system oxygen toxicity after complete evaluation – 7 days
- Perforated TM – 6 weeks after healed
- Other ENT barotrauma – determined by examiner

# Return to Diving After Diving Related Incident

- All cases except simple pain only resolved by a single treatment table must be cleared by diving medical physician
- Persistent neurological deficits following diving related incidents are generally disqualifying

# Physicians Diving Advisory Committee (PDAC)

- Meets annually – next meeting at Underwater Intervention 2017
- Any questions or concerns
  - Phil Newsum
  - Tony Alleman, MD MPH

Any questions?