Diving Medical Responder

Approved Training Course Outline

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DMR Training Course Content

The DMR training course is designed to prepare dive team medics, fire department dive teams, law enforcement dive teams, scientific dive teams, and recreational scuba divers to be effective when dealing with diving related accidents and injuries. DMR personnel are expected to work within their respective scope of practice, consistent with company policy and under the supervision of a medical control physician or as basic aid providers under Good Samaritan legislative provisions.

SECTION 1: **Introductions; Setting the Stage**

i. Attendance Requirements; Course Completion Testing

ii. Preview of Course Content, Knowledge and Skills Expectations
~emphasize in-chamber clinical/invasive skills requirements

iii. Roles and Responsibilities of the Diver Medic
~company policies; medical control physician; standing orders
~constant updating of medical evacuation/transfer processes
~medical kits; record keeping; local and regional resources
~maintain proficiency; encourage dive team health and fitness

SECTION 2: **Physics and Physiology Review; International Issues**

i. Defining, Measuring and Converting Pressure
~absolute and gauge
~standard and metric
~absolute, gauge and metric

ii. Converting Temperature
~ Fahrenheit and Celsius

iii. Key Gas Laws
~Boyle's: Dalton's; Henry's; Guy-Lussac's

iv. Emergency Gases
~definition
~computing for patient/diver depth

v. Treatment Gases
~definition
~computing for patient/diver depth

vi. Converting Weight and Drug/Fluid Dosage
~pounds to kilograms
~cc's to ml's and liters

vii. Cylinder Gas Color Coding; International Differences
~air; *oxygen-nitrogen mixtures (nitrox); medical oxygen; nitrogen; helium, oxygen-helium mixtures (heliox/oxyhelium); oxygen-helium-nitrogen mixtures*

SECTION 3: **Decompression Sickness & Cerebral Arterial Gas Embolism**

A. Decompression Sickness

i. Basic Pathophysiology
~evolution of a gas phase
~intravascular and extravascular gas
~direct and indirect bubble effects

ii. Predisposing/Risk Factors
~dehydration; increasing age; poor physical conditioning; exercise during/post decompression; ambient temperatures; inert gas switching

iii. Surface Orientated, Bell Bounce and Saturation Diving Aspects

iv. Symptom Presentation and Clinical Findings: Type 1 (‘minor’) DCS
~non-radiating joint pain
~minor skin irritation

v. Signs and Symptoms and Clinical Findings; Type 2 (’serious’) DCS
~radiating and other sensory-related musculoskeletal discomfort
~significant cutaneous changes (cutis marmorata; “marbling”)
~slowed lymphatic drainage; abdominal/thoracic pain; cardiopulmonary changes (‘chokes’); cranial nerve involvement; sensory/ motor impairment

vi. Differential Diagnosis; Type I vs. Type II DCS
~to optimize therapy
~determine need for subsequent diagnostic testing
~guide fitness to return to diving decisions

vii. Immediate Management & Evacuation Issues; No On-site Chamber

viii. Treatment Table Selection Criteria and Application
~U.S. Navy treatment tables 5, 6, 6A, 7, 8, 9
~Comex Cx 30
~gas bounce decompression sickness
~saturation decompression sickness (U.S. Navy protocol)

ix. Adjunctive Therapies
~oral & intravenous fluids
~pharmacology; guided by evidence-based position statement

x. *~in-water recompression risk-benefit controversy*

xi. Management of Incomplete Resolution and Relapse

xii. Differential Diagnosis; Pulmonary DCS vs. Immersion Pulmonary Edema

B. Cerebral Arterial Gas Embolism

i. Basic Pathophysiology
~pulmonary over pressure during ascent; structural lung failure
~right (venous) to left (arterial) passage of decompression-induced bubbles
~gas bubbles become gas columns as arterial vascular bed narrows
~ischemic brain insult; vascular reactivity and vasoconstriction

ii. Predisposing/Risk Factors
~accelerated/uncontrolled/breath-holding ascents
~underling pulmonary diseases
~breach of pulmonary filtration system
~cardiac abnormality; anatomic or functionally patent foramen (PFO)

iii. Clinical Presentation
~typical rapid onset, within 10 minutes of surfacing for pulmonary barotrauma
~delayed onset in paradoxical (venous bubbles to arterial circulation) cases
~dramatic, obvious neurological impairment
~loss of consciousness; stroke-like clinical picture; abnormal behavior, speech, vision; impaired motor function/weakness usually affecting one side of the body

iv. Differential Diagnosis
~CAGE vs. Type I (cerebral) DCS

v. Immediate Management & Evacuation Issues; No On-site Chamber

vi. Treatment Table Selection Criteria
~U.S. Navy treatment tables 6, 6A, 7, 8
~Comex Cx 30

vii. Adjunctive Therapies
~as per decompression sickness

viii. Management of Incomplete Resolution and Relapse

ix. Potential for Concurrent Pneumothorax, Mediastinal and Subcutaneous Emphysema

SECTION 4: **Patient Assessment**

i. Vital Signs

ii. Physical Examination Fundamentals

iii. Neurological Examination Fundamentals
~brief and detailed versions

iv. Diagnostic Equipment
~BP cuff; stethoscope; penlight; 'neurological' reflex hammer; tuning fork; otoscope

v. Evaluation of Hearing
~Weber; Rinne; Schwabach; diver self test

vi. Evaluation of External Ear, Middle Ear, Ear Drum

vii. Anticipated Findings; DCS, CAGE, Ear, Lung and Other Barotraumas

SECTION 5: **Barotrauma**

i. Air containing anatomic locations

~mediastinum; subcutaneous sites; middle ear; external ear; paranasal sinus spaces; teeth; GI tract;

ii. Pathophysiology

i. lungs: per cerebral arterial gas embolism, Section 3 above

ii. mediastinum and subcutaneous: air tracking from lung over-pressure

iii. middle ear: pressure imbalance between naso-pharynx and middle ear

iv. external ear: material (wax, bony in-growth) occluding the external canal

v. paranasal sinus spaces: pressure imbalance between these spaces and the oro-pharynx

vi. teeth: gas spaces existing within diseased or incompletely filled cavities, or failure of the dental cementum

vii. G.I. tract: expansion gas formed secondary to dietary intake or underlying disease

iii. Predisposing/Risk Factors

~pulmonary pathologies; upper respiratory infections; polyps; poor equalization technique; rapid and poorly compensated changes in pressure; poor dental health; smoking

iv. Symptom Presentation and Clinical Findings

~pneumothorax; tension pneumothorax; subcutaneous emphysema; mediastinal emphysema; ear pain; sinus pain; dental pain, abdominal discomfort

v. Management

~pneumothorax; varies from observation and high partial pressure oxyxgen breathing to surgical intervention

~tension pneumothorax; surgical intervention vs. inherent unsaturation with treatment gases while under pressure vs. recompression to depth of distinct improvement in cases occurring under pressure

~subsutaneous and mediastinal emphysema; observation, rest, oxygen delivery, medical transfer

~ear and sinus spaces, symptomatic relief including decongestants; ENT referral for all inner ear and severe middle ear injuries

~teeth; symptomatic relief and dental referral

~G.I. tract; symptomatic relief

vi. Differential Diagnosis: Inner Ear Barotrauma vs. Inner Ear DCS

SECTION 6: **Recompression Treatment Procedures**

i. Recompression Decisions Based Upon Symptom Presentation, Symptom Classification, Initial Treatment Response
ii. U.S. Navy Treatment Protocols
iii. Operational Issues and Complications
~treatment table extensions; incomplete resolution; relapse; residual symptoms; tender/medic decompression; medical evacuation/transfer
iv. Omitted Decompression
v. Decompression of the Medic/Tender

SECTION 7: **Invasive Procedures**

Emergent management of pneumothorax/tension pneumothorax; routes of fluid and medication administration and rate calculations; nasogastric tubes; wound closure; sterile technique; Foley catheter; airway control; transfer of vials and ampoules into the chamber.

See Appendix I: 'Essential and Valuable Invasive Skills' listing

SECTION 8: **Other Diving Related Injuries, Side Effects, and Complications**

i. CNS Oxygen Toxicity
ii. Pulmonary Oxygen Toxicity
iii. Marine Life Injuries
iv. Thermal Imbalance; Hyperthermia, Hypothermia

APPENDIX I

ESSENTIAL INVASIVE TRAINING SKILLS

1. Intravenous access
    a. Fluid infusions
    b. Drug administration
    c. Blood draws
2. Intramuscular injection
3. Subcutaneous injection
4. Insertion of urinary catheter
5. Insertion of nasogastric/orogastric tube
6. Manual or battery powered oropharynx/orogastric suction
7. Airway control; one or more of the following:
    a. Double lumen tube
    b. Pharyngeal-tracheal lumen
    c. Endotracheal intubation
    d. Needle cricothyroidotomy
8. Chest decompression capability; one or both of the following:
    a. Pneumothorax needle
    b. Chest tube

VALUABLE ADDITIONAL SKILLS

1. Ability to use the 'Easy IO Drill'
2. Simple suture repairs or alternate of wound closure option, eg;
    a. Dermagel / Dermabond
    b. Quickclot
    c. Celox gauze
3. Splinting of simple dislocations and fractures
4. Basic Life Support
5. Advanced Cardiac Life Support
6. CO2 scrubber installation for chamber under pressure
7. Operation of a CO2 analyzer

APPENDIX II

Water Skills

Missing Diver Skills

1. Determine last sighting of missing diver, and then conduct a straightline search to last know location, followed by search patterns (circle, grid, etc.).

Buddy Assist Skills

2. Emergency Options Drill:
    a. Instructor allows divers to become separated by a short distance. Then have the stopped diver swim to the unstopped diver and communicate a need for gas, followed by gas sharing on alternate second stage.
    b. Then repeat the same drill, except that this time you will instruct the buddies do a gas sharing ascent.
    c. At a depth no greater than 20 fsw (6 msw), separate buddy pair(s) from each other by a distance slightly greater than water depth, and inform one of the divers that he or she is out of gas. Allow this diver to choose the safer way to deal with the problem. If the diver decides that the surface is closer and more realistic, and performs an ESA, terminate the drill and get the divers together again.

3. Assist an exhausted diver underwater.
4. Assist a disoriented diver.
5. Assist a tired buddy on surface, using fin pushes and diver tows.

Diver and Buddy Rescue skills

6. Use of extensions, surface floats, ring buoys, etc. from boat or dock.
7. In-water use of extensions and buoys.
8. Blocks and parries from panicky diver.
9. Cross equipment/chest carry and control carry.
10. Swimming rescue of struggling victim.
11. Rescue of an injured or unconscious diver from bottom.
12. Rescue breathing and “dosie-doe”, and other carries enabling ease of mouth to mouth rescue breathing.
13. Equipment removal and transporting diver to a stable platform and/or beach.
14. Simulate CPR and EMS activation.