

Certified Hyperbaric Technologist[®] Veterinary

Resource Manual



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SCOPE OF PRACTICE

Purpose

The purpose of certification in veterinary hyperbaric medicine (Certified Hyperbaric Technologist – Veterinary; CHVT) is to promote the safe and successful management of animals in the hyperbaric environment.

Goal

The goal is to develop a certification program in veterinary hyperbaric medical technology (CHVT) to assure that the discipline of hyperbaric medicine is supported by appropriately qualified veterinary technologists and/or veterinarians.

Objectives

1. To develop minimum core competencies in veterinary hyperbaric medicine technology.
2. To develop appropriate standards or guidelines for training course curricula and clinical internships.
3. To develop a process for certification in veterinary hyperbaric medicine.
 - a. Pre-requisites
 - 1) Qualifications, credentials
 - b. Examination
 - c. Continuous process evaluation
 - d. Post process professional development and continued certification

Competencies are defined as the ability to do something and usually require the application of complex and integrated knowledge and skill sets.

Competency Domains

1. Essential physics and physiology of gases and pressure, and their application.
2. Direct and indirect effects of pressure changes and their recognition and management in animals.
3. Basic animal behavior, animal management, normal physical parameters.
4. Basic anatomy and physiology of animal species.
5. Indications and contraindications for the use of hyperbaric oxygen therapy in animals and mechanism(s) of action in each indication.
6. Gas systems and animal hyperbaric chamber operation.
7. Hyperbaric chamber and facility safety.

Certification Process

1. Credentials

a. Qualifying vocations

- Veterinarian DVM
- Veterinary Technician
- Certified Veterinary Assistant
- Veterinary Technologists
- Animal Science Technician
- Medical Services Specialist
- Medical Doctor, MD
- EMT, EMT-I or Paramedic
- Registered Nurse or LPN
- CHT

b. Be at least 18 years of age with a high school diploma or equivalent

2. Qualifications

- a. The CHVT candidate must have completed a National Board of Diving and Hyperbaric Medical Technology (NBDHMT) approved hyperbaric medicine introductory course.
 - b. The CHVT candidate must meet a minimum clinical internship of 240 hours of undersea, hyperbaric medicine or aviation medicine technology which **must include at least 120 hrs. of training and experience in “veterinary” hyperbaric medicine.**
3. Successful completion of the CHVT certifying examination. The examination includes the appropriate evaluation of competencies related to veterinary and animal hyperbaric medicine. The examination will also assess those competencies common to both human and animal hyperbaric disciplines.

Certification Maintenance - Recertification

1. Maintain a minimum 16 continuing education credits every two years with at least eight of those specific to undersea hyperbaric medicine chamber safety.
2. The employer, administrator or medical director must provide a letter of recommendation and verification of 100 hours minimum of continued experience in undersea or hyperbaric medicine.

Clinical Internship

Clinical Internship – Guidelines for internship curricula and experiences.

Qualifications for Internship:

1. Be at least 18 years of age with a high school diploma or equivalent (international schooling will be recognized).
2. The CHT-V applicant must have completed a National Board of Diving and Hyperbaric Medical Technology (NBDHMT) approved hyperbaric medicine introductory course prior to enrolling in the internship.

Competencies:

- General Knowledge
- Facility Orientation
- Chamber Equipment
- Patient Assessment
- Patient Preparation and Hyperbaric Treatment
- Chamber Operations and Safety

GENERAL KNOWLEDGE COMPETENCIES

Competency Domains

- **Essential physics and physiology of gases and pressure and their application in hyperbaric medicine.** Proper application of hyperbaric oxygen therapy requires a thorough knowledge and understanding of the physics and physiology associated with increased pressure. The physical and physiologic concepts are important in understanding how hyperbaric oxygen therapy works, the problems that can develop in the body with increasing pressures and oxygen and the mechanisms by which hyperbaric oxygen therapy is beneficial in the management of disease.

Competencies

- Units of pressure used in diving and hyperbaric oxygen therapy and conversion of one unit to another.
- Terminology used in hyperbaric oxygen therapy.
- Knowledge of the important gas laws associated with pressure and their application in hyperbaric therapy.
- Boyle's Law (calculating air volumes and air consumption).
- Dalton's Law (partial pressure of gases at various depths, alveolar oxygen concentration).
- Charles' Law (the relationship between pressure changes and temperature changes).
- Henry's Law (the effect of partial pressures on the solubility of various gases in liquids and their corresponding effects on decompression).

- The principles of heat transfer by conduction, convection and radiation.
- Define conduction, convection and radiation.
- Explain how these concepts are related to hyperbaric therapy.
- **Barotrauma – direct and indirect effects of pressure change.** Barotrauma can result from the physical and physiologic effects of pressure applied during hyperbaric oxygen therapy. Identification, prevention and/or management of barotrauma events is an important aspect of the placing patients in a hyperbaric environment. Recognition and management of pressure related problems in animals.
- Define barotrauma (direct effects of changing ambient pressure).
- Explain the physical laws of gas behavior that contribute or are related to the development of barotrauma.
- List the most common sites for the occurrence of barotrauma.
- For each site of barotrauma be able to describe the following aspects:
 - Time of occurrence
 - Physiology and pathophysiology of the syndrome
 - Signs and symptoms in animals
 - Treatment
 - Prevention and treatment
- Indirect effects of pressure – list the most common indirect effects of pressure.
- For each effect describe the following aspects:
 - Physiology and pathophysiology of the syndrome
 - Signs and symptoms in animals
 - Patient management
 - Treatment
 - Prevention
- Possess the capability to provide clinical support and assist in the prevention and/or management of pressure related problems.
- Squeeze and other barotraumas.
- Carbon dioxide (CO₂) retention.
- Carbon monoxide (CO) poisoning.
- Hyperbaric chamber gas contamination.
- Anoxic and hypoxic events.
- Hypothermic and hyperthermic events.
- Effects of elevated partial pressures of oxygen.
- Review Dalton's Law.
- Know the signs of oxygen toxicity.
- Acute toxicity.
- Chronic toxicity.
- Possess the capability to provide clinical support and assist in the prevention and/or management of toxicity due to high oxygen partial pressure in various species.
- Relevant basic anatomy and physiology of animal species pertaining to the following systems. Knowledge of animal structure and function is key in understanding normal and

abnormal states and in managing disease. These basics are also important in monitoring and managing the effects of pressure and hyperoxia in the hyperbaric patient.

- Species:
 - Basic
 - Canine
 - Feline
 - Equine
 - Others (bovine, caprine, porcine, camelid, avian, reptile, other exotic)
- Systems:
 - Musculoskeletal
 - Neurological
 - Integumentary
 - Cardiovascular
 - Respiratory
- Indications and contraindications for the use of hyperbaric therapy in animals and the mechanism(s) of action in each indication. The hyperbaric technician should be able to list the indications for hyperbaric therapy and what effects of hyperbaric therapy are beneficial for these indications. Knowledge of the general mechanisms and affects of hyperbaric oxygen is necessary to discuss the efficacy in disease processes. The hyperbaric technician should be able to list and discuss the mechanisms associated with contraindications for use of hyperbaric therapy in animals.
- General mechanisms and physiologic effects of hyperbaric oxygen therapy.
- Cardiovascular effects.
- Pulmonary system.
- Immune system including effects on infectious agents.
- Wound healing and tissue salvage.
- Bone repair.
- Central nervous system effects.
- Oxygen radical production.
- Ophthalmic system.
- Indications for use of hyperbaric oxygen therapy in animals.
- Veterinarians and veterinary technicians should know the UHMS approved indications for humans (all apply to animals except maybe DCS).
- Animal related indications:

CNS	Musculoskeletal	Infectious	Cardiovascular
Cranial/Spinal Chord Trauma Cerebral Ischemia Compressive Chord Diseases Fibrocartilagenous emboli (FCE) Cerebral/Global Ischemia Cortical Blindness Tetraparesis Peripheral Nerve Injury Tetraparesis EPM Arterial Gas Embolism	Athletic Injuries Tendonitis Desmitis Periostitis Fracture Laminitis Myositis, compartment syndrome Crush injuries	Osteomyelitis Septic arthritis Septicemia Endotoxemia Blastomycosis Lymes disease Anaerobic infections Intracranial, abdominal abscesses	Hypotension Shock all causes Cardiac infarction Acute anemia Reperfusion diseases, peripheral ischemias Carbon monoxide/cyanide toxicity Lymphangitis Myocardial infarction Blood loss anemia
Respiratory	Cutaneous	GI	Genito-urinary
EIPH Pleuritis Sinusitis Pulmonary edema Smoke inhalation Rhodococcus pneumonia	Wounds Thermal burns Compromised grafts flaps Evenomation Snake bite Spider bite	Ileus Pancreatitis Peritonitis Ulcers Reperfusion	Infertility Radiation cystitis

- Discuss understanding of rationale for hyperbaric oxygen therapy treatment in these various conditions.
- List expected benefits for conditions and indications.
- Contraindications for the use of hyperbaric oxygen therapy in animals. Contraindications may be categorized as absolute or relative (based on human criteria).
- Absolute contraindications.
- Untreated pneumothorax.
- Untreated guttural pouch disease in equidae.
- Untreated middle and external ear diseases.
- Relative contraindications.
- High fever.
- Viral infections.
- Previous thoracic surgery.
- Previous spontaneous pneumothorax.
- Emphysema plus CO2 retention.
- Seizure disorders.
- Chronic sinusitis and other upper respiratory infections.
- Optic neuritis.
- Certain drugs – doxorubicin, bleomycin, disulfiram, cis-platinum, mafenide acetate.
- Gas systems and animal hyperbaric chamber operation. The certified hyperbaric technician should have a thorough knowledge of hyperbaric chambers and should be able to demonstrate basic chamber operation including patient evaluation and preparation.
- Classification of chambers and identification of the basic components of any hyperbaric chamber.
- Be familiar with NFPA classifications for hyperbaric chambers (A,B,C,) and how this applies to hyperbaric chambers used in veterinary medicine.

- Be able to describe the basic common components of a hyperbaric chamber, their purpose or use.
- Gases and gas quality.
- Oxygen purity and its importance.
- Methods for identifying gas impurities.
- Principles and use of gas analyzers.
- Calibrate gas analyzers.
- Gas line filtration.
- Be able to follow supply gas lines and describe components associated with them; trace supply gases from origin the patient.
- Understand and/or conduct procedures for chamber operations and life support systems.
- Elemental gas schematics and their interactions when mixed.
- Mathematical calculations of gas usage.
- Know how to prepare an animal patient for hyperbaric therapy including:
 - a review of the patient's history, medical/surgical condition as it might be affected by hyperbaric conditions.
 - evaluation of current treatments, medications etc. as they might be affected by or affect hyperbaric therapy.
 - be able to assure that they are not "no go" substances, materials etc. associated with the patient prior to therapy.
 - be able to conduct a pre therapy examination of the patients physical status (TPR), etc.

Chamber operations

- Appreciate the unique differences between monoplace and multiplace chambers.
- The various substances and materials, which are prohibited inside a chamber, such as medical preparations, combustible materials, etc.
- Pre and post dive checks of a hyperbaric chamber complex using specific checklists.
- The monitoring of internal chamber operations.
- Monitor the chamber for depth, temperature and humidity using available types of equipment.
- Rationale for gas stratification and its prevention.
- The principles of operation of various items of equipment used in a typical hyperbaric system, such as compressors, fire suppression systems, oxygen supply.
- How to carry out normal operations, and basic inspections of gas and air systems.
- Treatment protocols and procedures for multiple indications. Risks/benefits involved with emergency decompression.
- Proper identification of various gas cylinders; mandatory hospital grade gases and proper handling and storage of gas cylinders.
- The checks and user maintenance needed after using a hyperbaric chamber.
- Maintain a legible and accurate record of all aspects of a hyperbaric system.

- The characteristics of and maintenance requirements for acrylic viewpoints/cylinders.
- Emergency preparedness for fire, loss of oxygen, medical complications.
- The use of various types of fire suppression systems including routine maintenance and operational checks.
- Familiarity with the following regulatory agencies and other related organizations:
 - Food and Drug Administration (FDA)
 - Occupational, Safety and Health Administration (OSHA)
 - National Fire Protection Association (NFPA)
 - American Society of Mechanical Engineers (ASME)
 - American Society of Mechanical Engineers' Committee on Pressure Vessels for Human Occupancy (ASME PVHO)
 - Veterinary Hyperbaric Medicine Society (VHMS)
 - Undersea and Hyperbaric Medical Society (UHMS)
 - Other governing bodies in state of operation; including veterinary, racing and performance
- The certified hyperbaric technician should be able to demonstrate a thorough knowledge of chamber and facility safety.
- Basics of fire safety.
- Explain components of fire.
- Explain differences of fire in the hyperbaric oxygen environment.
- Define ignition temperature and flash point.
- Know possible sources of ignition in a hyperbaric chamber.
- Know basic methods for fire prevention in and outside the chamber.
- Basics of operational chamber safety.
- Vessel integrity.
- Handling of compressed gases.
- Electrical safety and grounding.
- HBOT staff training and qualifications.
- Safety standards.
- How to develop a "GO – NO - GO" list and apply risk assessment operational safety. The decision tree.
- Infection control.
- Know and demonstrate knowledge of standard universal precautions.
- Recognize patient and equipment risk factors for cross-contamination.
- Describe care and cleaning of hyperbaric chambers.
- State reasons for cleanliness in the hyperbaric facility.

INTERNSHIP GUIDELINES AND COMPETENCIES

Hyperbaric facility orientation

1. Reviews and understands the hyperbaric Safety Manual for the facility
2. Completes hyperbaric facility tour
3. Identifies location of emergency procedures guidelines
4. Identifies location of personal protective equipment
5. Identifies location of hyperbaric log and maintenance books
6. Identifies location of no smoking / oxygen in use signs
7. Identifies location of operator breathing source/mask for each chamber
8. Demonstrates how to access facility fire alarm system
9. Identify backup system for electrical failure
10. Identify bulk oxygen storage tank and surrounding area
11. Identify patient education for hyperbaric treatments
12. List items allowed/not allowed in hyperbaric chamber
13. State requirements for fire drills
14. Hyperbaric therapy facility policy review. The candidate should be familiar with and be able to state the policy for:
 - Hyperbaric physician and operator presence during hyperbaric treatment
 - Role and duties of the Safety Director
 - Policy on gas handling
 - Policy on gas storage
 - Policy on storage of hazardous materials
 - Policy for housekeeping in hyperbaric area
 - Policy for smoking in the chamber area
15. State requirements for ongoing safety education.

Generalized Clinical Knowledge

1. Have a basic understanding of the risks, side effects and hazards of certain medications in the hyperbaric chamber.
2. Describe the signs, symptoms and treatment of hyper- and hypothermia
3. Describe the effects of gases on the body and their limits under pressure
4. Describe the effects of pressure on the body and the principles of decompression and therapeutic procedures
5. Safe animal handling skills.
6. Have relevant knowledge to communicate with all levels of hyperbaric medical team (including techs, Dr's, etc).
7. Patient assessment

8. Basic medical terminology
9. Medical record keeping, including documentation such as photographs, videos, wound measurements, labeling, etc.

Chamber Equipment

1. Know and demonstrate knowledge of the routing of the compressed gas supply
2. Demonstrate emergency shut-off procedures on chamber
3. Demonstrate use of and the reason for adjusting the flow meter during HBO treatment
4. Show location of exhaust valve on outside wall
5. Demonstrate acrylic inspection and documentation; know the characteristics of and maintenance requirements for acrylic viewports/cylinders.
6. Identify stamp on HBO chamber per ANSI/ASME PVHO PVHO-1 standard
7. Identify oxygen level gauge
8. Verify integrity of chamber ground wire
9. Verify integrity of patient grounding strap
10. Gas handling:
 - a. Contents of compressed gas cylinders are legibly marked on the exterior of cylinder
 - b. High pressure gas cylinders are stored in assigned locations and accessible only to authorized personnel
 - c. Hi pressure gas cylinders are not stored near flammable materials
 - d. Large gas cylinders are stored in such a manner that they are restrained from being knocked over
 - e. Large gas cylinders are transported by the use of a hand truck that provides a means of restraining the cylinder
 - f. Valve protection valves are in place
 - g. Pressure reducing regulators are used to reduce the pressure from the cylinder to the supply line
 - h. PPE used when handling liquid oxygen cylinders
11. Demonstrates working knowledge of hyperbaric regulatory guidelines to include ASME-PVHO, ANSI, CGA CFR, NFPA, TJC, UHMS.
12. Demonstrate completion of daily, weekly, monthly, semiannual and annual maintenance logs.

Patient Assessment

1. Know and demonstrate knowledge of current appropriate referral conditions for hyperbaric oxygen treatment.
2. Demonstrate knowledge of treatment plan and know the duties of each staff member involved and discuss and understand the rationale for treatment plan.

3. Review patient's reason for referral.
4. Demonstrate knowledge of side-effects of hyperbaric therapy (see 2.0 under competencies). Knows species variations.
5. Have a basic understanding in the operation of biomedical devices within your facility.
6. Be able to carry out relevant diagnostic and clinical procedures such as:
 - a. Ability to report to supervising medical personal an accurate medical history
 - b. Blood glucose levels
 - c. Assess patient for pain and document
 - d. Obtain vital signs, pulse, respiratory rate, body temperature.
 - e. Observe for changes in neurological status
 - f. Know when to use appropriate clean or sterile techniques
 - g. Collection and removal of patient waste products
 - h. Assist in patient care procedures; dressing changes etc
 - i. Prepare patient for treatment:
 - Safe loading and unloading of patients
 - Ensure ONLY approved materials for inside chamber use
 - Provide comfort measures within approved safety constraints.
 - Comply with all facility quality control measures

Patient Preparation & Hyperbaric Treatment

1. Demonstrates knowledge of animal behavior that might indicate anxiety and fear of being placed in a chamber and behavior that might lead to potential for injury during placement or treatment in the chamber. Demonstrates knowledge of anxiety and fear related to feelings of confinement anxiety associated with hyperbaric chamber.
2. Demonstrates knowledge of potential for oxygen toxicity related to delivery of 100% oxygen at an increased atmospheric pressure
3. Demonstrates basic knowledge pain related to associated medical problems
4. Demonstrates knowledge of discomfort related to temperature and humidity changes inside hyperbaric chamber
5. Barotrauma Management
 - a. Know and demonstrate knowledge of the signs and symptoms of barotrauma in various species.
 - b. Know and demonstrate knowledge of the immediate management of barotrauma.
6. Oxygen Toxicity Management
 - a. Know and demonstrate knowledge of the signs and symptoms of central nervous system intolerance to hyperbaric doses oxygen.
 - b. Know and demonstrate knowledge of the signs and symptoms of pulmonary oxygen toxicity.

- c. Know and demonstrate knowledge of the various methods that serve to reduce the likelihood of immediate management of CNS toxicity.
 - d. List the complicating factors associated with the development of pulmonary oxygen toxicity.
7. Pulmonary Barotrauma
- a. Know and demonstrate knowledge of risk factors for pulmonary barotraumas on ascent.
 - b. Know and demonstrate knowledge of immediate management of suspected pulmonary barotrauma on ascent
 - c. State the differential diagnosis of:
 - cerebral arterial gas embolism
 - pneumothorax
 - tension pneumothorax
 - mediastinal emphysema
 - subcutaneous emphysema
8. Cardiopulmonary Complications
- a. Proficiency in obtaining vital signs
 - b. Knowledge of common clinical signs of severe, acute onset, cardiovascular distress.
 - c. Proficiency in basic CPR
9. Wound Care
- a. Appreciate the general principles of wound homeostasis, infection control and treatment and wound healing and non-surgical wound care.
 - b. Assist in the evaluation of wounds
 - c. Assist in the limited debridement of wounds, wound dressings and their respective applications.
10. Documentation
- a. Demonstrates understanding of documentation requirements
 - b. Know and demonstrate knowledge of all forms, electronic medical record, and paperwork used to document patient treatment.
 - c. Complete pre-treatment patient assessment and treatment protocol forms.
 - d. Complete ancillary patient chart notes and post treatment documentation.
 - e. Complete a record of a typical patient hyperbaric treatment.
 - f. Demonstrate completion of daily patient treatment logs per chamber.

Chamber Operations

1. Chamber Standard Operating Procedures
2. Demonstrate inspection and understanding of chamber console panel layout
3. Locate and operate automatic controls
4. Locate and operate manual controls

5. Demonstrate compression and decompression of the chamber
6. Checklists, Dive Tables and Treatment Protocols
 - a. Demonstrate knowledge of chamber checklists
 - b. Demonstrate knowledge of patient checklists
 - c. Demonstrate knowledge of decompression tables
 - d. Demonstrate knowledge of decompression protocols
 - e. Demonstrate knowledge of decompression table computations
7. Inspection of acrylic after each hyperbaric treatment for signs of drainage
- if present, clean chamber prior to next treatment.
8. State when chambers are to be cleaned.
9. Pressure Safety
 - a. Know and demonstrate knowledge of correct procedure for operating/securing door of chamber.
 - b. Know proper set-up and connection of all pass-throughs
 - c. List the potential pressure hazards in and around the chamber
 - d. Demonstrate operation of all pressure boundary doors.
10. Infection Control
 - a. Know and demonstrate knowledge of standard universal precautions.
 - Use of approved disinfectants for chamber and equipment; recognizing the risks associated with off gassing of chemicals in the chamber.
 - Hand washing
 - Personal protective equipment (PPE)
 - b. Recognize patient and equipment risk factors for cross-contamination
 - c. Demonstrate care and cleaning of hyperbaric chamber.
 - d. Demonstrate care and cleaning of hyperbaric stretcher
 - e. State reasons for cleanliness in hyperbaric area.
11. Chamber Standard Operating Procedures
 - a. Know console/panel layout as it pertains to emergency and override controls.
 - b. State reasons to use emergency decompression button.
 - c. State proper way to use emergency decompression button.
12. Fire Safety
 - a. Demonstrate knowledge of possible ignition sources
 - b. List items not allowed in hyperbaric chamber
 - c. Demonstrate knowledge for fire emergency
 - in chamber
 - in immediate area of chamber
 - in hyperbaric room
 - in facility
 - d. Fire Extinguishing System
 - Know location of fire extinguishers and fire alarms.
 - Demonstrate use of portable fire extinguisher