2015

Safety Manual/Monthly Safety Awareness Program

SerenaGroup Hyperbaric Medical Center
2015

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Fire Safety Plan

1. Purpose

To provide hyperbaric personnel a predetermined plan in the event of a fire in the hyperbaric area in order to reduce injury and/or catastrophic outcomes.

2. Policy

2.1. In the event of an emergency, the Hyperbaric Medicine Center personnel will be prepared to respond.

2.2. The Safety Director shall be designated by the Program Director / Manager or designee.

NOTE: NFPA 99 Health Care Facilities, 1999 edition, (page 131)

"19-3.1.3.2 A safety director shall be designated in charge of all hyperbaric equipment. The safety director shall work closely with facility management personnel and the hyperbaric physician(s) to establish procedures for safe operation and maintenance of the hyperbaric facility. He or she shall make necessary recommendations for departmental safety policies and procedures. The safety director shall have the authority to restrict or remove any potentially hazardous supply or equipment items from the chamber."

2.3. Each plan shall be collaboratively developed with the hospital fire safety policy in conjunction with NFPA standards.

2.4. There will be no smoking or open flames in the hyperbaric area.

2.5. The area will be kept exceptionally clean and free of fire hazards according to the NGPA for Hyperbaric health care facilities.

2.6. The chamber itself will be kept exceptionally clean of lint and dust particles as these are hazardous when inside the chamber.

2.7. Each hyperbaric patient will be searched and questioned about possession of an ignition source before entering the chamber.

2.8. All items listed in the chamber safety policy will not be allowed in the chamber.

3. Scope

Applies to all Hyperbaric Medicine Center staff and patients.

4. Responsibility

It is the responsibility of the Safety Director for the center to implement and ensure that fire safety practices are followed within the department.

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5. Procedure

5.1 The Program Director/Manager shall obtain the hospital fire safety plan.

5.2 A comprehensive plan will be developed and incorporated into the overall emergency plan for the center. It shall include the following at a minimum:

5.4.1 Signage locations

5.4.2 Extinguishing (sprinklers, smoke detectors, fire extinguishers, etc.) methods, equipment and location.

5.4.3 R.A.C.E. protocol or similar standard guideline for response in the event.

5.4.4 Emergency phone numbers-who to contact, when and where.

5.4.5 Oxygen leak testing-frequency and procedure.

5.4.6 Electrical equipment-location, preventive maintenance schedule

5.4.7 HBO requirements for fire prevention

5.4.8 Mock drill-frequency

5.4.9 General response to fire-code announcement, door and window handling

5.3 All Oxygen-8 Hyperbaric Medicine Centers personnel will be knowledgeable of the fire safety plan and be prepared to proactively prevent fire and in the case of a fire, extinguish it immediately.

5.4 Assure appropriate signage (readable from a distance of 5 feet) in the center prohibiting smoking.

5.4.1 Ensure patients, staff and visitors do not smoke or have any open flames within the center.

5.5 Ensure the patient has changed into 100% cotton clothing prior to the therapy. **CLOTHING DISALLOWED IN THE CHAMBER INCLUDE THE FOLLOWING:**

5.5.1 Underwear (bra, panties, briefs)

5.5.2 Street clothes (even if tag states 100% cotton)

NOTE: These items are potential sources of ignition as well as a place for concealment of lighters or matches.

5.6 Ensure all linens are 100% cotton. This includes pillow cases, blankets, and sheets.

5.7 Search all patients prior to initiation of every treatment to secure that no lighters or matches, jewelry etc. are being placed in the oxygen enriched environment. (Wedding bands may be taped if patient refuses to remove).

5.8 Cleanse or allow the patient to cleanse off the following petroleum based products:

- Make-up
- Hair spray
- Nail polish

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- Perfume
- After shave lotion
- Oil-based creams/ointments (petroleum jelly), or cover wound or skin area with 100% cotton linen.

5.9 Allow only the items necessary for patient care during therapy such as:

- NG tubes (vented)
- External fixation devices covered with cotton towels
- Wound Dressings
- Soft contacts
- Foley catheters, auto vented
- Other drains or catheters, vented
- Monitoring leads and cables compatible with the chamber such as pass through lines for EKG or TCOM monitoring
- Intrinsically safe transducers

NOTE: Cover all dressings with 100% cotton linens.

NOTE: If patient has a post-op skin graft and physician does not want the dressing removed, cover existing dressing with 100% damp cotton towel. NEVER expose a wound covered with an ointment in the chamber.

5.10 Disallow the following items in the chamber:

- External pacemakers
- Holter monitors
- External TENS or similar product
- External insulin pump

5.11 Turn off the main oxygen supply to the chambers at the end of each day to ensure no leakage of oxygen into the room.

5.12 Analyze the oxygen concentration in the room around the gaskets of the chamber and various sites in the room to ensure no leakage of oxygen is occurring, according to policy.

5.13 Sign off on the pretreatment checklist before every HBO therapy.

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5.14 FIRE OUTSIDE OF CHAMBER AREA BUT INSIDE THE BUIDLING

5.14.1 Follow hospital fire plan

5.15 FIRE IN THE HYPERBARIC UNIT BUT OUSIDE OF THE CHAMBER

5.15.1 Pull fire alarm and activate hospital fire plan informing of location of the fire

5.15.2 Notify patients of need for rapid decompression.

5.15.3 “Emergency vent” the chambers and remove patients from chambers.

5.15.4 Turn off oxygen.

5.15.5 Assist in the evacuation of the area per hosptial evacuation plan

5.16 FIRE INSIDE OF THE HYPERBARIC CHAMBER

5.16.1 Notify other staff members to pull fire alarm and activate hospital fire plan informing of location of the fire

5.16.2 “Emergency vent” the chambers and remove patients from chambers.

5.16.3 Have patient breathe from the air break mask during emergency ventilation.

5.16.4 Turn off oxygen.

5.16.5 Prepare to extinguish fire.

5.16.6 Assist in the evacuation of the area per hosptial evacuation plan

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Emergency Preparedness

1. Purpose

To establish an Emergency Preparedness plan specific for the hyperbaric center.

2. Policy

2.1. To provide optimal patient care and support in the event of an emergency such as fire, flood, hurricane, ice storm, earthquake, tornado, etc.

2.2. All patients will be oriented in alternative care options

2.3. All staff will be oriented and updated to the emergency preparedness plan with safety as a primary focus

2.4. The Hyperbaric Medicine Center Emergency Preparedness plan compliments the hospital's plan; it does not supersede the hospital emergency preparedness plan.

3. Scope and Responsibility

Applies to all members of the Hyperbaric Medicine Center.

4. Procedure

4.1. Should it become necessary to remove patients from the chambers, the following actions should be taken:

4.1.1. Explain to the patients why they are being decompressed.

4.1.2. Decompress chambers at a normal rate. **DO NOT EMERGENCY VENT THE CHAMBERS**.

4.1.3. Provide alternative care information to the patient on admission that instructs the patient on the plan for care in the event of a natural disaster.

4.1.4. Once chambers are empty and all of the patients have exited the center, secure the chambers in the following manner:

4.1.4.1. Close the doors on the chambers

4.1.4.2. Switch off both the Oxygen and Air supply to the chambers at the wall source.

4.1.4.3. Disconnect the transformer from the electrical outlet at the wall. The will interrupt the supply power to the battery charger.

4.1.4.4. Cover the chambers with the cloth chamber cover.

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2015 Safety Program Schedule

January – Infection Control

in HBOT February –

Dressings in HBOT March –

Static Electricity

April – Treating the Dialyzes

patient May – The pretreatment

checklist June –

Pneumothorax under Pressure

July – Emergency

Decompression August –

Chamber inspection

September – Confinement

Anxiety/Claustrophobia October – Ear

Barotrauma

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November – Fire Safety

December – Seizures in the Hyperbaric Chamber Call in Number: See monthly email

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Infection Control in HBOT

Background

The disinfection of acrylic monoplace chambers can be problematic because many commercial biohazard-cleaning agents contain alcohol. While alcohol is adequate to kill many pathogens, it is destructive to acrylic. The procedure recommended by SG uses sodium hypochlorite (bleach) for high-level disinfection. The Centers for Disease Control and Prevention recommend[1] the use of sodium hypochlorite for durable surfaces contaminated with clostridium difficile (C-Dif) because no commercial Environmental Protection Agency-registered products exist at this time. Sodium hypochlorite in a concentration of 10 percent free chlorine was also chosen because it shows no damage to acrylic[2].

Purpose

To apply a procedure for high-level disinfection of the acrylic monoplace hyperbaric chamber for gross contamination or infectious biohazard body fluids or material.

Procedure

- Wear appropriate personal protection equipment (PPE) for biohazards.
- Place a fan near the open door of the chamber to ventilate the chamber with fresh air throughout the duration of the procedure.
- With the door open, clean all gross material with water (water temperature must not exceed 100) and a 100 percent cotton towel. Place all contaminated material in a biohazard, leak proof, red bag.
- Prepare a 1:10 solution of sodium hypochlorite (bleach) in water. Ensure that the water temperature does not exceed 100°F (38°C).
- Using a clean 100 percent-cotton cloth, wipe area with bleach solution.
- Keep the area wet with the solution for 10 minutes, then let it air dry.
- After the area is dry, use a clean 100 percent-cotton towel and clean water to rinse the treated area. Allow it to air-dry.
- Examine the internal surface of the chamber and buff any surface scratches with Novis® #2 fine scratch remover.
- Polish the acrylic with Brillianize® or other acrylic polish.
- With the door open, continue to introduce air through the chamber until there is no detectable odor of cleaner or disinfectant.
- Once there are no detectable odors or visible contaminants, return the chamber to service.

References: [1]William Rutala, Ph.D., M.P.H, David Weber, , M.D., M.P.H. and the Healthcare Infection Control Practices Advisory Committee (HICPAC) Guidline for Disinfection and Sterilization in Healthcare Facilities, 2008"

[2]Jerry D. Stachiw, Handbook of Acrylics for Submersibles, Hyperbaric Chambers, and Aquaria, Pg 976, Best Publishing, 2003.

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Date:_____

Name:_____

Post-Test
Infection Control in HBOT

1. Sodium hypochlorite in a concentration of 20 percent free chlorine was also chosen because it shows no damage to acrylic.

   (circle) True False

2. The Centers for Disease Control and Prevention recommend[1] the use of sodium hypochlorite for durable surfaces contaminated with _____.

3. While alcohol is adequate to kill many pathogens, it is._____ to_____.

4. Appropriate personal protection equipment (PPE) should be donned before cleaning interior of chamber.

   (circle) True False

5. A 1:10 solution of sodium hypochlorite (bleach) in water should be wiped off chamber immediately.

   (circle) True False

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Dressing in Chamber

Background

This is a question that plagues new and inexperienced HBO techs on a daily basis and immediately after the Florida accident some have gone to extremes of removing all medical related dressings and skin barriers prior to HBOT, of course you cannot be too safe right? Well, not really. You do run the risk of making the patient's wounds worse by drying it out and exposing it to the atmosphere**.**

"Traditional practices of excluding certain types of dressings should be revisited. Vaseline gauze dressings are permitted in the monoplace chamber and have been used for many years without incident. A good practice is simply to cover them during treatment. If a patient with severe psoriasis, for example, requires a lotion or cream with a petroleum base to control the skin eruption, it is counter-productive and harmful to the patient to scrub away all the medicament on a daily basis prior to HBO."**

NFPA 14.3..5.4.3

"The physician or surgeon in charge, with the concurrence of the safety director, shall be permitted to use prohibited items in the chamber that are one of the following"

1. Suture material
2. Alloplastic devices
3. Bacterial barriers
4. Surgical dressings
5. Biological interfaces

Procedure:
When evaluating a dressing for Hyperbaric we must use a logical fact based method that we can then document. It is at all times of the upmost importance that balance the overriding safety concerns with the need to provide good wound care. You should then document your decision.

See chart below:

References: **"Hyperbaric Medicine Practice" 2nd edition by Dr. Kindwall (pp. 417).
NFPA 99, 2012 addition chapter 14 SerenaGroup policy and procedure.

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PRODUCT Is needed for treatment or healing wound?

NO

DO NOT USE
(for this Patient)

1
MORE
SUITABLE
ALTERNATIVE

YES

ADD TO DO
NOT USE LIST

N
O

2
PRODUCE HEAT,
ENERGY?

YES

ADD TO DO
NOT USE LIST

N
O

3
PRODUCE STATIC?

YES

CAN IT BE
GROUNDED

NO

ADD TO DO
NOT USE LIST

N
O

YES

4
LOW FLASH
POINT? (>200 F)

YE

ADD TO DO
NOT USE LIST

N
O

5

TOO MUCH FUEL?

YES

CAN YOU

LIMIT
QUANTITY
?

NO

ADD TO DO
NOT USE LIST

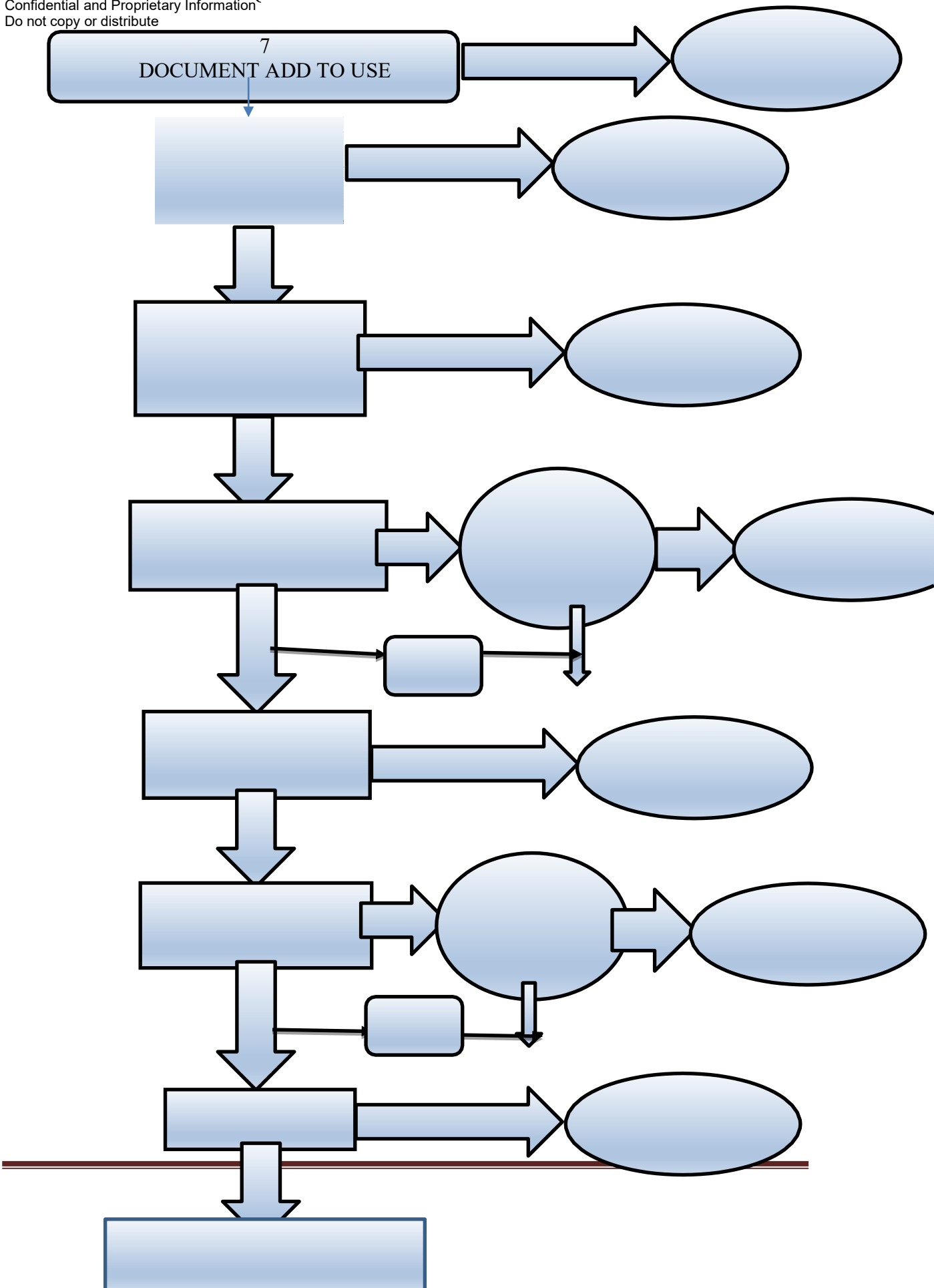
N
O

YES

YE

N

6 ADVERSE
EFFECTS?


7
DOCUMENT ADD TO USE

Date:_____

Name:_____

Post-Test
Dressing in Chamber

1. Vaseline gauze dressings are permitted in the monoplace chamber

   (circle) True False

2. The first test be place a dressing the chamber is to determine if the patient _____for an effect wound healing treatment.

3. The physician or surgeon in charge, with the concurrence of the safety director, shall be permitted to use prohibited items in the chamber that are one of the following: (pick two)

   ._____,_____.

4. If you are not sure that a product is safe to go into a chamber, if the doctor ordered it then it is ok to go in the chamber with no further investigation needed.

   (circle) True False

5. If a product contains a small amount of a questionable ingredient, such as a petroleum base, a good practice is simply to cover it during treatment.

   (circle) True False

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Static Electricity/Grounding

Overview:
When oxygen concentration increases in an atmosphere, the risk of fire increases. Sparks caused by discharges of static electricity have been implicated as ignition sources in fires and explosions. To prevent fires in any environment the 3 legs of the fire triangle must be considered, fuel, ignition source and oxygen. Fire prevention in hyperbaric environments focuses on reducing the amount of available fuel and eliminating the source ignition. The majority of fires in Hyperbarics have been caused by the introduction of an ignition source (hand warmers, cigarette lighters, etc.) Static electricity is a routine part of our lives. We have all experienced a snap or pop of static when you reach for a doorknob, particularly after walking across a carpeted floor. In certain situations a static discharge can lead to disaster. Electrons accumulate on the surfaces of objects (including our body) and can result in significant voltage potentials under certain conditions. These voltages usually flow unnoticed from object to object through conductive pathways. To reduce the potential for sparks, static charges must have conductive pathways to flow through and these are called grounds. Ground examples are: conductive footwear, cables, chains or elevated relative humidity levels (>40-50%) can provide an appropriate path to ground in order to dissipate the accumulated charge. There are specific grounding requirements for Hyperbaric Chambers and occupants defined in the National Fire Prevention Agency Manual (NFPA) Chapter 19, NFPA 99 or Chapter 20, NFPA 02. Requirements state that a grounding system must provide a high impedance conductive pathway in contact with the patient's skin. Grounding straps used in hyperbaric chambers are usually attached to the patient's wrist or to an adhesive ECG monitoring pad. The Hyperbaric environment poses an increased fire hazard primarily due to elevated oxygen concentration. It would be extremely rare to see the discharge of more than a single spark especially if the patient was properly grounded.

Procedure:
Daily inspection of your hyperbaric chamber includes the inspection of the grounding wire attached at the rear of your chamber. All patients are required to wear a grounding wrist band or ECG patch before entering the chamber. Grounding Areas: chamber (cable is attached to grounding plate upon daily inspection) patient (wrist band or ECG patch attached) gurney (chain at bottom of gurney making contact with the floor). To safely treat patients in an increased oxygen environment we must pay close attention to static control by increasing relative humidity and providing adequate conductive pathways as listed above.

References: NFPA 99, Chapter 19 Section 2.7.4, 3.1.5.3, NFPA 03, Chapter 20 Section 20.2.7.4, 20.3.1.5.3.2, Wilbur T. Workman, Hyperbaric Facility Safety: A Practical Guide, Chapter 3, pp 523-533

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Date:_____

Name:_____

Post-Test
Static Electricity/Grounding

1. A static spark does not generate enough charge to be dangerous in an oxygen enriched environment. (circle) True False

2. Give two examples grounding used in the HBO department_____ and_____.

3. To decrease static electricity you may need lower your humidity in the chamber room. (circle) True False

4. This_____grounding area is inspected prior to treating your first patient of the day.

5. The_____Manual gives you specific grounding requirements.

6. If your patient is grounded it is extremely rare to have a static spark. (circle) True False

7. The human body is capable of producing significant voltage potential under the certain conditions. (circle) True False

8. The majority of fires in HBO chambers have been caused by _____ source.

9. The 3 legs of the fire triangle are:_____,_____ and_____.

10. When the concentration of oxygen is increased so does the risk of fire. (circle) True False

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Treating the Dialyzes patient

Background

Hyperbaric oxygen exposure can produce significant hemodynamic changes. An increase in systemic afterload due to hyperoxic vasoconstriction in well perfused tissues can lead to a decrease in left ventricular function and a decrease in ejection fraction in some patients. When this decrease in left ventricular function occurs in the setting of pulmonary arterial vasodilatation due to improved alveolar oxygenation with increased left atrial and left ventricular filling, acute left ventricular dysfunction and pulmonary edema can result. Cases have been reported in patients with a history of pulmonary edema or low left ventricular ejection fractions or in patients with sudden fluid shifts from volume overload. Acute pulmonary edema appears to be more common in monoplace than multiplace treatment settings, perhaps because of the requirement for patients to be in a more supine position in the monoplace chamber rather than the sitting position with legs dependent available in the multiplace chamber.

Procedure

Many patients receiving hyperbaric oxygen treatment have severe peripheral arterial disease or diabetes mellitus. These patients are at increased risk for coronary artery disease and occult left ventricular dysfunction. Have a high index of suspicion for prior episodes which could represent congestive heart failure, especially in patients with renal failure, on dialysis, who may be prone to rapid changes in fluid volume. Obtain an echocardiogram in any patient with a history of congestive heart failure, and when abnormal, refer these patients for evaluation and optimization by a cardiologist. While an absolute safe cutoff for left ventricular ejection fraction cannot be defined, patients with ejection fractions of less than 30% should be considered at very high risk for HBOT induced acute pulmonary edema. Weigh renal failure patients daily before HBOT to determine if excessive fluid retention is present. Monitor these patients observationally closely, and have a low threshold to abort treatment at the first sign of respiratory distress.

Reference: Larson-Lohr V, Norvell H, Josefsen L, Wilcox J et al. Hyperbaric Nursing and Wound Care. Flagstaff, AZ: Best Publishing Company; 2010.

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Date:_____

Name:_____

Post-Test
Treating the Dialyzes patient

1. Acute pulmonary edema appears to be more common in monoplace than multiplace treatment settings.

   (circle) True False

2. The may be due to the requirement for patients to be in a more _____position in the monoplace chamber rather than the _____position with legs dependent available in the multiplace chamber.

3. You should weigh renal failure patients daily before HBOT to determine if excessive fluid retention is present.

   (circle) True False

4. Hyperbaric oxygen exposure will not produce significant hemodynamic changes.

   (circle) True False

5. Patients who have severe peripheral arterial disease or diabetes mellitus are at_____risk for coronary artery disease.

6. List two special precautions that should be taken with the dialyzes patient. _____and_____.

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The pretreatment checklist

Dive Procedure

- A. Preparation of Patient
  - 1. Clothing
  - 2. Wound Care
- B. Checklist
- C. Descent - pressure being put into the chamber
  - 1. Time to clear ears 2. Hot and humid
- D. 90 total minutes of 02
- E. Oxygen is a medication - possible side effect - lung irritation or convulsion (very rare)

Appropriate Material In The Chamber

- A. Not Allowed
  - 1. Synthetics - nylon, rayon, etc.
  - 2. Vaseline or Oil Based Products - lipstick, hair oil, make-up, skin lotions, and glycerin
  - 3. Hair Spray
  - 4. Watches
  - 5. Hearing Aids
  - 6. Hard Contact Lens
  - 7. Glasses
  - 8. Prosthetic Devices
  - 9. Smoking Materials
  - 9. Newspaper or Loose Leaf Paper
  - 10. Gum or Candy

.

Safety In The Chamber

- A. Fire Proof Materials - Only 100% cotton clothing including undergarments
- B. Importance of patient assistance in keeping the chamber safe

Scope of the Problem: This 73-yr analysis of clinical vigilance to exclude ignition sources from being carried into the chamber. Ignition sources: Ignition sources of principal concern in oxygen-enriched environments are defined by NFPA 53-94 and are placed in four categories: electrostatic and break (arc) sparks, exothermic chemical reactions, heated gases, and hot surfaces. One might successfully argue that electrostatic sparks and electrical arcs should be separate categories since they are different ignition sources with regard to cause and level of risk. Electrostatic spark is considerably less fire risk than electrical arc and is currently a source of controversy. HBO2 experience has revealed no fatalities in clinical hyperbaric chamber fires in North America. Two fires without fatalities occurred in North American clinical hyperbaric chambers in 1976 and 1989, European clinical hyperbaric facilities reported two fatalities in three fires. Nineteen of the 25 clinical hyperbaric chamber fires occurred in Asia, resulting in 58 fatalities.

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Fire Prevention: This review confirms previous reports that fatal hyperbaric chamber fires were caused by a combination of factors; abundance of bumables (fuel), elevated oxygen concentration, faulty electrical components, inadequate extinguishment, and lack of vigilance to exclude ignition sources from being carried into the chamber

References: P J. SHEFFIELD and D A. DESAUTELS 73 year analysis of hyperbaric chamber fires, SerenaGroup policy and procedure.

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Date:_____

Name:_____

Post Test
The pretreatment checklist

1. When the patient is well known to you the pretreatment check list is optional.

   (circle) True False

2. Name 3 personal care products not permitted in chamber.

   _____,_____and _____

3. The patient may wear only 100% cotton that has been_____by the _____.

4. Most chamber fires before 1989 were due to prohibited items taken into the chambers by patients. .

   (circle) True False

5. A pretreatment checklist is an important part of any hyperbaric program.

   (circle) True False

6. When your patient complains that they do not want to be asked the same question every day your best response would be:

   A. If you promise me to be sure not to take anything into the chamber I will not ask you.
   B. I only do this because they make me.
   C. I know it's silly but I have to do it.
   D. I am sorry but I must ask you each day as I want you to be 100% safe it is much to easy to forget something.

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Pneumothorax under Pressure

Overview: A pneumothorax in the chamber is extremely serious. Symptoms suggesting pneumothorax include sudden shortness of breath, stabbing chest pain, tracheal shift, asymmetric chest movement, and increased respiratory distress during decompression. If a pneumothorax is suspected, a 14-16 gauge needle should be readily available prior to decompression. Upon exiting the chamber, additional findings may be present on physical exam. These include asymmetric breath sounds, hypotension and tachycardia. Perform an immediate needle decompression if the patient appears to have a "tension" pneumothorax as evidenced by significant tachycardia, hypotension, or respiratory distress. Decompression is performed by inserting a 14 or 16 gauge needle over the top of the 2nd rib at the midclavicular line.

Procedure: If patient exhibits any of the above symptoms, do the following:

- Stop decompression
- Notify Hyperbaric Physician
- If it is determined that the patient does have a tension pneumothorax, gather your equipment and staff to immediately insert a 14-16 gauge needle upon opening the chamber door
- Once physician has arrived, bring patient up at a rate of 5 psig or as ordered by the physician
- Following this initial stabilization, make arrangements for appropriate transfer and further management

Reference: Clinical Procedures in Emergency Medicine, 3rd Edition, Ed Roberts & Hedges, W.B. Saunders. Hyperbaric Medicine Practices, 2nd Edition 1995, Eric P. Kindwall, M.D. pp. 291-292

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Date: _____

Name:_____

Post Test
Pneumothorax

1. Patients may experience the following symptoms during decompression _____and_____.

2. During the decompression the pneumothorax expands. (circle) True False

3. A patient suffering a pneumothorax in the Hyperbaric Chamber is not serious. (circle) True False

4. The patient may exhibit signs of cyanosis in the chamber. (circle) True False

5. Patients with any kind of pulmonary lesions on x-ray should have a _____ descent rate.

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Emergency Decompression

Introduction: Use Emergency Vent or Exhaust By-Pass only in extreme emergency situations. Rapid loss of chamber pressure may result in barotrauma.

Procedure: **Sechrist -** Turn the Master Valve to the Emergency Vent position and then press the Emergency Vent Button. The chamber will decompress at a rate pf 0.5 psi to 1.0 psi per second.

Sechrist H - Turn the Master Valve to the Emergency Vent position and then press the Emergency Vent Button or remover cover toggle emergency switch. The chamber will decompress at a rate pf 0.5 psi to 1.0 psi per second.

Sigma 34/Sigma Plus - Turn the system On/Off switch to the off position. Press and hold the Exhaust By-Pass button. The chamber will depressurize in approximately 110 seconds from 30psig to 0psig.

ETC Bara-Med
Place chamber into Manual Mode Press and hold the Exhaust By-Pass (RED) button. The chamber will depressurize in approximately 110 seconds from 30psig to 0psig.

To slow the rate of decompression, the Emergency Vent/Exhaust By-Pass may be pushed intermittently instead of being held down constantly.

Reference: Perry Sigma 34 Manual, pp.30; Perry Sigma Plus Manual, pp. 27
Sechrist Manual 4.9, ETC BARA-Med manual chapter 7 pp 8

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Date:_____

Name:_____

Post Test
Emergency Decompression

1. A patient that is suffering from anxiety should be emergency vented out of the chamber. (circle) True False

2. _____to the lungs may occur during emergency ventilation.

3. Patients can be removed from the chamber in 30 seconds or less. (circle) True False

4. The emergency vent button may be depressed _____ to avoid trauma to the lungs.

5. Under what condition would you use the Emergency Vent?
   _____

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Chamber Inspection

Background

The following is inspection requirements, they apply to both Class A and Class B as appropriate, it is for information to add to your knowledge base.

Procedure

2.3.6.7 INSPECTION OF PRESSURE VESSELS FOR HUMAN OCCUPANCY (PVHO's)

A pressure vessel for human occupancy (PVHO), as defined by ASME PVHO-1 is a pressure vessel that encloses a human being or animal within its pressure boundary while it is subject to internal or external pressure that exceeds a 2 psi differential pressure. PVHO's include, but are not limited to submersibles, diving bells, personal transfer capsules, decompression chambers, recompression chambers, hyperbaric chambers, high altitude chambers and medical hyperbaric oxygenation facilities.

This section provides guidelines for inspection of PVHO's. Due to the many different designs and applications of PVHO's, potential failures of components or safety concerns that are not specifically covered, such as rapid decompression or Fire/sparking issues should be considered.

General / Operational

1) PVHO's must be constructed in accordance with ASME PVHO-1 and PVHO-2. These codes adopt Section VIII and therefore the vessels should bear a "U" or "U2" ASME stamping.
2) Cast and ductile iron fittings are not allowed.
3) Due to the human occupancy element, a person should be in attendance to monitor the PVHO, when in operation, in the event there is an accident.
4) Because of the human occupancy element, these vessels should have a depressurization rate less than 145 PSI/sec.
5) The installation should be such that there is adequate clearance to inspect it properly. In some applications, such as underground tunneling, it may be impossible to perform a complete external inspection.

Internal Inspection

1) Where existing openings permit, perform a visual internal inspection of the vessel. Look for any obvious cracks and note areas that are subject to high stress such as welds, welded repairs, head-to-shell transitions, sharp interior corners, and interior surfaces opposite external attachments or supports.
2) The vessel should be free of corrosion, damage, dents, gouges or other damage.

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3) All openings leading to external fittings or controls should be free from obstruction.
4) All exhaust inlets should be checked to prevent a chamber occupant from inadvertently blocking the opening.

External Inspection
1) The Inspector should closely examine the external condition of the pressure vessel for corrosion, damage, dents, gouges or other damage.
2) The lower half and the bottom portions of insulated vessels should receive special focus, as condensation or moisture may gravitate down the vessel shell and soak into the insulation, keeping it moist for long periods of time. Penetration locations in the insulation or fireproofing such as saddle supports, sphere support legs, nozzles, or fittings should be examined closely for potential moisture ingress paths. When moisture penetrates the insulation, the insulation may actually work in reverse, holding moisture in the insulation and/or near the vessel shell.
3) Insulated vessels that are run on an intermittent basis or that have been out of service require close scrutiny. In general, a visual inspection of the vessel's insulated surfaces should be conducted once per year.
4) The most common and superior method to inspect for suspected corrosion under insulation (GUI) damage is to completely or partially remove the insulation for visual inspection. The method most commonly utilized to inspect for GUI without insulation removal is by x-ray and isotope radiography (film or digital) or by real time radiography, utilizing imaging scopes and surface profilers. The real time imaging tools will work well if the vessel geometry and insulation thickness allows. Other less common methods to detect GUI include specialized electromagnetic methods (pulsed eddy current and electromagnetic waves) and long range ultrasonic techniques (guided waves).
5) There are also several methods to detect moisture soaked insulation, which is often the beginning for potential GUI damage. Moisture probe detectors, neutron backscatter, and thermography are tools that can be used for GUI moisture screening.
6) Proper surface treatment (coating) of the vessel external shell and maintaining weather tight external insulation are the keys to prevention of GUI damage.

Inspection of Parts and Appurtenances (piping systems, pressure gage, bottom drain)
1) As stated above, cast iron is not allowed on PVHO's and shall be replaced with parts fabricated with other suitable materials, in accordance with ASME Code Section II,
2) If valves or fittings are in place, check to ensure that these are complete and functional.
3) The Inspector shall note the pressure indicated by the gage and compare it with other gages on the same system. If the pressure gage is not mounted on the vessel itself, it should be ascertained that the gage is installed on the system in such a manner that It correctly indicates actual pressure in the vessel.
4) The Inspector shall verify that the vessel is provided with a drain opening.

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5) The system should have a pressure gage designed for at least the most severe condition of coincident pressure in normal operation. This gage should be clearly visible to the person adjusting the setting of the pressure control valve. The graduation on the pressure gauge shall be graduated to not less than 1.5 times the MAWP of the vessel.
6) Provisions should be made to calibrate pressure gages or to have them checked against a standard test gage.
7) Any vents and exhausts should be piped at least 10 feet from any air intake.
8) Venting should be provided at all high points of the piping system.

Inspection of Viewports / Window

1) Each window should be individually identified and be marked in accordance with PVHO-1
2) If there are any penetrations through windows, they must be circular.
3) Windows must be free of crazing, cracks and scratches.
4) Windows and viewports have a maximum interval for seat/seal inspection and refurbishment. Documentation should be checked to ensure compliance with PVHO-2, Table 7.1.3.

Inspection of Pressure Relief Devices

1) Pressure relief devices must have a quick opening manual shutoff valve installed between the chamber and the pressure relief device, with a frangible seal in place, within easy access to the operator.
2) The pressure relief device shall be constructed in accordance with ASME Gode Section VIII.
3) The discharge from the pressure relief device must be piped outside to a safe point of discharge.
4) Rupture disks may be used only if they are in series with a pressure relief valve, or when there is less than 2 cubic feet of water volume.
5) Verify that the safety valve is periodically tested either manually by raising the disk from the seat or by removing and testing the valve on a test stand.

Acceptance Criteria (PVHO certified technician only)

The following forms are required to be completed:

1) Form PVHO-1 Manufacturer's Data Report for Pressure Vessels for Human Occupancy
2) Form PVHO-2 Fabrication Certification for Acrylic Windows

h) All PVHO's under the jurisdiction of the U.S. Coast Guard must also comply with 46 CFR Part 197.

References: PVHO-1, PVHO – 2, AMSE website

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Date:_____

Name:_____

Post Test
Chamber Inspection

1. Because of the human occupancy element, these vessels should have a depressurization rate less than 145 PSI/sec

. (circle) True False

2. The Inspector should closely examine the_____condition of the pressure vessel for corrosion, damage, dents, gouges or other damage

3. In general, a visual inspection of the vessel's insulated surfaces should be conducted once per year.

   (circle) True False

4. If a patient is at 2 ATA and you decompress the chamber at a rate of 5.0 psi/min how long will it take the patient to decompress?

   _____

5. Pressure relief devices must have a quick opening manual shutoff valve installed between the chamber and the pressure relief device, with a frangible seal in place, within easy access to the operator.

   (circle) True False

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Confinement Anxiety/Claustrophobia

Overview: All patients prior to their first treatment should be assessed for possible confinement anxiety or claustrophobia. To prevent or decrease the effects of confinement anxiety use pre-medication or distraction (TV, movies). Assure the patient that there will be someone present at all times. Reinforce that if the patient wants out of the chamber they will be taken out.

Signs/Symptoms: Clenching of fists, flushed face, profuse diaphoresis, and defensive attitude, urgency to empty bladder, feeling of being smothered or suffocated, sudden complaint of pain or discomfort, complaint of nausea or diarrhea.

Procedure: On your initial assessment if patient states that they suffer from claustrophobia you may want to order an anxiolytic drug. This medication can be given 30 minutes prior to treatment. Some patients may not realize they are claustrophobic until they go into the chamber. Should the patient request to come out of the chamber this must be done immediately. Pre-medication can be ordered prior to their next treatment.

References: Hyperbaric Nursing, Larson-Lohr pp. 137-138, 141-142, Hyperbaric Medicine Practice, Kindwall, pp.54

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Date:_____

Name:_____

Post-Test
Confinement Anxiety/Claustrophobia

1. Name three symptoms that your patient may exhibit if they are showing signs of confinement anxiety._____, _____ and_____.

2. Pre-treatment assessment will help identify patients that may suffer from claustrophobia. (circle) True False

3. _____may be given prior to the treatment if the patient needs it.

4. If the patient states they want out of the chamber try to keep the patient in so they can complete their treatment. (circle) True False

5. Assure the patient that you are always present in the room should they need anything. (circle) True False

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Ear Barotrauma

Overview: Barotrauma to the ear is the most common complication of hyperbaric therapy. It is more difficult to inflate the middle ear because the inner ends of the Eustachian tubes have slit like openings. These openings tend to close tighter if not opened actively by swallowing, yawning or doing the Valsalva maneuver.

Procedure: If the patient experiences mild to moderate pain, stop the pressurization and decrease to the point of no pain. Make sure the patient does not try to clear while the chamber is decompressing. Reinforce equalization techniques and continue to pressurize when patient states they have no more discomfort. If patient experiences severe pain and it is not relieved by stopping the pressurization or decompressing, remove patient from the chamber and notify the Hyperbaric Physician.

Ear Exam: Classification system for the degree of ear squeeze is based on the appearance of the ear drum. It was devised by Wallace Teed, a United States Navy Submarine Medical Officer during World War II.

TEED SCALE
TEED 0 - Symptoms with no physical findings
TEED 1 - Erythema or injection around the handle of the malleus
TEED 2 - Erythema or injection of the entire tympanic membrane
TEED 3 - Hemorrhage into the tympanic membrane appearing as bright red patches
TEED 4 - Deep blue/black appearance of the tympanic membrane due to blood filling the middle ear with the possibility of rupture present.
TEED 5 - Perforated ear drum

References: Eric P. Kindwall, Hyperbaric Medicine Practice, Chapter 4 pp. 51
Larson-Lohr, Norvell, Hyperbaric Nursing, pp. 87,127,140

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Date:_____

Name:_____

Post-test
Ear Barotrauma

1. What is the most common complication of Hyperbaric Therapy_____.

2. The TEED Scale was developed to assess patients for potential oxygen seizures.
   (circle) True False

3. Patients should be instructed not to try to equalize during_____.

4. Equalizing techniques include all of the following except: Valsalva, Yawning, Blinking, Swallowing_____.

5. Hemorrage in the tympanic membrane is classified as a TEED 1.
   (circle) True False

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Fire Safety/On Site

Overview: The flammability of materials will increase as the partial pressure of oxygen increases to the point where normally non-combustible materials may become flammable or combustible. Materials, generally not considered fuel sources, will burn vigorously in an oxygen-enriched environment (23.5%) such as:

- Human tissue, body hair, oils and fats
- Loose cotton garments
- Oil-based products, facial cream, body oils, hair spray, etc.

Before the patient's treatment, a safety check needs to be completed and documented in the chart. The safety checklist states that the Hyperbaric Technologist or Nurse treating the patient has gone through a checklist of safety procedures.

◊ FIRE OUTSIDE THE HYPERBARIC UNIT, BUT INSIDE THE BUILDING

- Follow hospital fire plan

◊ FIRE IN THE HYPERBARIC UNIT, BUT OUTSIDE THE CHAMBER

PROCEDURE:

Office Staff or Designee

- Pull fire alarm and call_____informing them of location of the fire
- Assist in the evacuation of the area per hospital evacuation plan

Nursing Staff

- Evacuate the area per hospital evacuation plan

Director

- Report to the Hyperbaric Unit and stand by to turn off main oxygen as soon as emergency decompression is complete
- After turning off oxygen assist in the evacuation of the Hyperbaric Unit per hospital evacuation plan

Nurse Manager

- Report to the Hyperbaric Unit and prepare to extinguish the fire
- Assist the Hyperbaric Technologist in the emergency decompression of the patient using the emergency vent button (Sechrist) or bypass/exhaust button (Perry)
- Remove patient from the chamber and follow hospital evacuation plan

Hyperbaric Technologist

- Decompress all chambers as quickly and safely as possible using the emergency vent button (Sechrist) or bypass/exhaust button (Perry)
- Notify personnel who is standing by to turn off main oxygen valve
- Remove patients from the chamber and follow hospital evacuation plan

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◊ FIRE INSIDE THE HYPERBARIC CHAMBER ON SITE

PROCEDURE:

Office Staff or Designee

- Pull fire alarm and call_____informing them of location of fire
- Assist in the evacuation of the area

Nursing Staff

- Evacuate the area per hospital evacuation plan

Director

- Report to the Hyperbaric Unit and stand by to turn off main oxygen as soon as emergency decompression is complete
- After turning off the oxygen assist in the evacuation of the Hyperbaric Unit per hospital evacuation plan

Nurse Manager

- Report to the Hyperbaric Unit and place the fire extinguisher next to the chamber on fire
- Assist the Hyperbaric Technologist in the emergency decompression of the patient in the unaffected chambers, emergency vent button (Sechrist) or bypass/exhaust button (Perry)
- Remove patients from the chambers and follow hospital evacuation plan

Hyperbaric Technologist

- Have patient breathe off the air mask and emergency decompress the chamber, emergency vent button (Sechrist) or bypass/exhaust button (Perry)
- Notify personnel standing by to turn off the main oxygen valve
- Prepare to extinguish the fire before removing the patient from the chamber and evacuate the building per hospital evacuation plan

◊ STAFF READINESS FOR FIRE SAFETY MANAGEMENT

PROCEDURE:

All Staff will participate in the hospital's fire drills per the hospital's policy.

1. In order to ensure proper management of the hyperbaric patient's therapy, the hyperbaric unit will be notified in advance of a fire drill.
2. The hyperbaric unit will conduct quarterly department fire drills as part of the Center's safety preparedness.

References: Wilbur T. Workman, Hyperbaric Facility Safety pp. 670-671, Francois Burman, Risk Assessment Guide pp.1.7-1.8
Written documentation from Sechrist and Perry Manufacturer regarding sequence main oxygen cut off valve

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Date:_____

Name:_____

Post – Test
Fire Safety/Onsite

1. What percentage is considered an oxygen-enriched environment._____?

2. The flammability of materials decreases as the partial pressure of oxygen increases. (circle) True False

3. List three items that generally are not fuel sources_____,_____ and_____.

4. Normal non-combustible materials may become flammable or combustible when the partial pressure of oxygen increases. (circle) True False

5. 100% cotton is non-flammable in an oxygen-enriched environment. (circle) True False

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Subject: Fire Safety/Off Site

Overview: The flammability of materials increases as the partial pressure of oxygen increases to the point where normally non-combustible materials may become flammable or combustible. Materials generally not considered fuel sources will burn vigorously in an oxygen-enriched environment (23.5%) such as:

- Human tissue, body hair, oils and fats
- Loose cotton garments
- Oil-based products, facial cream, body oils, hair spray, etc.

Before the patient's treatment, a safety check needs to be completed and documented in the chart. The safety checklist states that the Hyperbaric Technologist or Nurse treating the patient has gone through a checklist of safety procedures.

◊ **FIRE OUTSIDE THE HYPERBARIC UNIT, BUT INSIDE THE BUILDING**

- Follow hospital fire plan

◊ **FIRE IN THE HYPERBARIC UNIT, BUT OUTSIDE THE CHAMBER**

PROCEDURE:

Office Staff or Designee

- Call "911" informing the emergency operator of the exact location of the fire
- Pull fire alarm
- Assist in the evacuation of the area per hospital evacuation plan

Nursing Staff

- Evacuate the area per hospital evacuation plan

Director

- Report to Hyperbaric Unit and stand by to turn off main oxygen as soon as emergency decompression is complete
- After turning off the oxygen assist in the evacuation of the Hyperbaric Unit per hospital evacuation plan

Nurse Manager

- Report to the Hyperbaric Unit and prepare to extinguish the fire
- Assist the Hyperbaric Technologist in the emergency decompression of the patients, emergency vent button (Sechrist) or bypass/exhaust button (Perry)
- Remove patients from the chamber and follow hospital evacuation plan

Hyperbaric Technologist

- Decompress all chambers as quickly and safely as possible using the emergency vent button (Sechrist) or bypass/exhaust button (Perry)
- Notify personnel standing by to turn off main oxygen valve
- Remove patients from the chamber and follow hospital evacuation plan

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◊ FIRE INSIDE THE HYPERBARIC CHAMBER OFF SITE

PROCEDURE:

Office Staff or Designee

- Call "911" informing the emergency operator of the exact location of the fire
- Pull fire alarm
- Assist in the evacuation of the area per hospital evacuation plan

Nursing Staff

- Evacuate area per hospital evacuation plan

Director

- Report to the Hyperbaric Unit and stand by to turn off main oxygen as soon as emergency decompression is complete
- After turning off the oxygen assist in the evacuation of the Hyperbaric Unit per hospital evacuation plan

Nurse Manager

- Report to the Hyperbaric Unit place fire extinguisher next to the chamber on fire
- Assist the Hyperbaric Technologist in the emergency decompression of the patients in the unaffected chambers, emergency vent button (Sechrist) or bypass/exhaust button (Perry)
- Remove patients from the chambers and follow hospital evacuation plan

Hyperbaric Technologist

- Have patient breathe off the air mask and emergency decompress the chamber, emergency vent button (Sechrist) or bypass/exhaust button (Perry)
- Notify personnel standing by to turn off the main oxygen valve
- Prepare to extinguish the fire before removing the patient from the chamber and evacuate the building per hospital evacuation plan

◊ STAFF READINESS FOR FIRE SAFETY MANAGEMENT

PROCEDURE:

All Staff will participate in the hospital's fire drills per the hospital's policy.

1. In order to ensure proper management of the hyperbaric patient's therapy, the hyperbaric unit will be notified in advance of a fire drill.
2. The hyperbaric unit will conduct quarterly department fire drills as part of the Center's safety preparedness.

References: Wilbur T. Workman, Hyperbaric Facility Safety pp. 670-671, Francois Burman, Risk Assessment Guide pp.1.7-1.8
Written documentation from Sechrist and Perry Manufacturer regarding sequence main oxygen cut off valve.

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Date:_____

Name:_____

Post – Test
Fire Safety/Offsite

6. What percentage is considered an oxygen-enriched environment._____?

7. The flammability of materials decreases as the partial pressure of oxygen increases. (circle) True False

8. List three items that generally are not fuel sources_____,_____ and_____.

9. Normal non-combustible materials may become flammable or combustible when the partial pressure of oxygen increases. (circle) True False

10. 100% cotton is non-flammable in an oxygen-enriched environment. (circle) True False

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Seizures in the Hyperbaric Chamber

Introduction: Oxygen toxicity occurs in approximately 1.3 times in 10,000 exposures. Pre-treatment assessment is one of the major tools in preventing oxygen toxicity. Air breaks can be used to decrease the potential for oxygen toxicity in patients that are on high doses of steroids, narcotics (narcotics decreases the respiratory drive that can lead to increased oxygen levels) or febrile. The room environment plays a role decreasing the chance of a seizure by eliminating fluorescent lighting in the chamber room.

Signs/Symptoms: Patients may exhibit one or more of the symptoms, however the seizure may happen without warning. Careful monitoring of your patient at all times is essential. Signs of oxygen toxicity begin with: sweating, nausea, vomiting, apprehension, shortness of breath, tunnel vision, tinnitus and muscle twitching.

Other Considerations: Seizures may also be caused by hypoglycemia, high doses of steroids, hyperthermia, and chemical/alcohol abuse.

Procedure: If patient is observed or complains of any of the above symptoms have the patient breathe off their air break system, this will lower their oxygen level. Notify the Hyperbaric Physician supervising the treatment. Continue air breathing for 5-10 minutes until patient states they feel better. Discontinue patient's treatment and decompress the patient at a normal rate. ***If patient is a Diabetic immediately check blood sugar, episode could be hypoglycemia.*** Prior to the next treatment incorporate an air break in the patient's treatment protocol. If patient has a seizure it will consist of a tonic phase where the patient may hold their breath. ***Never decompress at this phase.*** When the patient begins a jerking motion this is the clonic phase. Patient should be observed for breathing, chamber can be decompressed at a rate tolerated by patient. Patient should have a complete assessment done post treatment. The Hyperbaric Physician will determine the course of action for the patient.

References: Hyperbaric Nursing. 2002, Larson-Lohr., Norvell, pp. 143-144 pp. 250-251; Hyperbaric Medicine Practices, 2nd Edition 1995, Eric P. Kindwall, M.D. pp. 80, pp. 290-291

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Date:_____

Name:_____

Post Test
Seizures in the Hyperbaric Chamber

1. Patients will always exhibit one or more signs/symptoms prior to having a seizure in the chamber. (circle) True False

2. The seizure will consist of two phases:_____and _____.

3. You can only decompress the patient during the clonic phase. (circle) True False

4. _____is the major tool used to help you prevent oxygen toxicity.

5. During your pre-treatment assessment what at some of the factors that would determine if the patient should get an air break incorporated in the their treatment protocol. _____,_____, _____.

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Insert your chambers yearly Service / Maintenance Report(s) Here

(See attached sample)

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QUARTERLY QUALITY ASSURANCE OF EMERGENCY PROCEDURES

REQUIREMENTS: One Fire Safety Drill each quarter. Choose one of the other three topics each quarter.

TOPICS	DATE	MET	NOT MET	COMMENTS
Fire Safety				
Cardiac/Respiratory Arrest				
Pneumothorax Under Pressure				
Seizures in the Hyperbaric Chamber				

SAFETY DIRECTOR_____MEDICAL DIRECTOR_____

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DEPARTMENT OF HYPERBARIC MEDICINE

II. HYPERBARIC ADVERSE EVENTS

ADVERSE EVENTS

1. Ear Squeeze
2. Sinus Squeeze
3. Oxygen Toxicity – *CNS & Pulmonary*
4. Nausea / Vomiting
5. Pneumothorax

ADVERSE EVENTS

6. Air Embolism
7. Seizure – *Oxygen Related, Diabetic Related , Other*
8. Confinement Anxiety
9. Diabetic Reaction
10. Other – *Please Specify*

MONTH: _____

Medical Record #	Adverse Events	Intervention	Comments

SAFETY DIRECTOR_____MEDICAL DIRECTOR_____

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Notes:

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