SerenaGroup

Building the Nation's Leading Wound Care Team

2021 SerenaGroup Hyperbaric Safety Manual

SerenaGroup Monthly Safety Awareness Program

Section One: The Fire Safety Plan

1. Purpose

A Fire Safety plan provides hyperbaric personnel with an emergency plan in the event of a fire in the hyperbaric area. A predetermined plan is expected to reduce injury and potentially catastrophic outcomes. Hyperbaric centers must develop their own fire safety plan. This document will guide the development of the plan.

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.

NFPA 99 Health Care Facilities, 2018 edition, (page 118):

"14-3.1.3.2 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/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. The plan is a collaborative effort developed between SerenaGroup® and hospital representatives responsible for fire safety in accordance with NFPA standards.

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

2.5. The area will be kept meticulously clean and free of fire hazards in accordance with the National Fire Protection Association (NFPA) guidelines for Hyperbaric health care facilities.

2.6. The chamber(s) must be kept free of lint and dust particles. These are hazardous when inside the chamber during operation.

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

2.8. Items listed as unsafe in the chamber safety policy manual, are NOT allowed in the chamber.

3. Scope

This manual applies to all Hyperbaric Medicine Center staff, overseeing physicians, and patients.

4. Responsibility

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

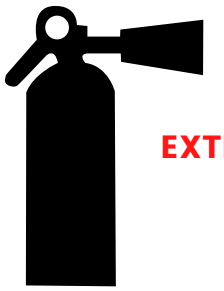
5. Elements of the Fire Safety Plan

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 at a minimum:
5.2.1. Identification of signage locations
5.2.2. Extinguishing (sprinklers, smoke detectors, fire extinguishers, etc.) methods, equipment and location
5.2.3 The Rescue, Alarm, Contain, Extinguish (RACE) protocol:

RESCUE = **Assist anyone who is in immediate danger.**

ALARM = **Activate the nearest fire alarm. Immediately after activating the alarm, go to the nearest phone and call 911. Let the operator know there is a fire and give the exact location.**

CONTAIN = **Attempt to contain the fire by closing all doors and windows in the area where the fire is located. If smoke is observed coming from underneath any of the doors that were closed, dampen towels and place them at the door base.**



EXTINGUISH = **Try to extinguish the fire. Retrieve the nearest fire extinguisher and use it on the fire. Note: if the fire is out of control, do not attempt to extinguish it. Close the door immediately!**

5.2.4. Emergency phone numbers: who to contact, when and where
5.2.5. Oxygen leak testing-frequency and procedure
5.2.6. Electrical equipment-location, preventive maintenance schedule
5.2.7. Specific fire prevention requirements for hyperbaric suite
5.2.8. Mock Drill-frequency
5.2.9. General response to fire-code announcement door and window handling

5.3. All SerenaGroup® personnel and hospital employees working in the hyperbaric suite will be knowledgeable of the fire safety plan. They will be fully prepared to prevent a fire or in the case of a fire, extinguish it immediately.
5.4. Assure appropriate signage in the center prohibiting smoking (readable from a distance of 5 feet).
5.5. Ensure patients, staff and visitors do not smoke. There should never be an open flame within the center.
5.6. Ensure the patient has changed into 100% cotton clothing prior to the therapy.
5.7. Ensure all linens are 100% cotton. This includes pillowcases, blankets, and sheets.
5.8. No clothing is permitted in the chamber except that provided by the hyperbaric staff in accordance with safety policies and procedures. This includes but is not limited to undergarments even if they are 100% cotton, street clothes, hospital gowns, and scrubs.
5.9. All patients are searched prior to every hyperbaric treatment for prohibited items.
5.10. Patients must remove any petroleum-based products including but not limited to make-up, hair spray, nail polish, perfume, after shave lotion, oil-based creams or ointments with a petroleum base.
5.11. Allow only items necessary for patient care during therapy such as nasogastric tubes, external fixation devices, wound dressings, soft contact lenses, Foley catheters, vented drains, monitoring leads and cables for cardiac monitoring as long as they have been tested for hyperbaric safety.
5.12. Cover dressings with 100% cotton linens. If patient has a post-op skin graft and physician does not want the dressing removed, cover existing dressing with 100% damp cotton towel. Do not expose a wound covered with an ointment in the chamber.
5.13. Devices with a power source are not permitted in the chamber such as external pacemakers, holter monitors, external TENS units or insulin pumps.

5.14. Turn off the main oxygen supply to the chambers at the end of operations each day to prevent oxygen leakage into the hyperbaric suite.
5.15. According to policy, 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.
5.16. Complete and sign the pretreatment checklist before every Hyperbaric treatment.

6. Action depending on the location of the fire

6.1. Fire inside the building housing the hyperbaric unit.
6.1.1. In the case of a fire inside the building but outside of the chamber area follow the hospital fire plan.
6.1.2. Only remove patients from the chamber or chamber room if the fire threatens the suite.
6.2. Fire in the hyperbaric unit but outside of the chamber(s)
6.2.1. Pull the fire alarm and activate hospital fire plan informing fire station of the fire location.
6.2.2. If chamber is directly threatened, inform the patients in the hyperbaric chamber that rapid emergency decompression is necessary and they should try to stay calm, breath normal and do not hold their breath.
6.2.3. Follow the procedure to emergency vent the chamber(s) (see SerenaGroup® 2020 Policy 401. Emergency Procedures for Monoplace Chamber).
6.2.4. Remove the patients from the chamber(s).
6.2.5. Turn off the oxygen supply located outside chamber room.
6.2.6. Assist in the evacuation of the area per hospital evacuation plan.

6.3. Fire inside the a Monoplace Hyperbaric Chamber
6.3.1. A fire inside a monoplace hyperbaric chamber pressurized with 100% oxygen during operation is a fatal event. The patient inside the chamber in which a fire has occurred has no chance of survival; therefore, no attempt to save this patient by emergency decompression is warranted.
6.3.2. Pull the fire alarm.
6.3.3. Immediately follow the procedure to emergency vent the unaffected chamber(s).

6.3.4. When assistance arrives have them activate the hospital fire plan informing fire fighting personnel of location of the fire.
6.3.5. Inform the patient that emergency decompression is required.
6.3.6. Have the patient breathe from the air break mask during emergency decompression.
6.3.7. Evacuate the patient(s).
6.3.8. Turn off oxygen supply to the chamber(s).

Section Two: Emergency Preparedness

1. Purpose

The purpose of this section is to establish an Emergency Preparedness plan specific to the hyperbaric center.

2. Policy

2.1. To provide optimal patient care and support in the event of an emergency or natural disaster such as a flood, hurricane, ice storm, earthquake, or tornado.
2.2. Patients are informed of alternative care options in the case of a disaster that may impact the hyperbaric center.
2.3. Hyperbaric unit sand supporting staff will receive education on emergency preparedness plan to promote safety during a disaster.
2.4. The Hyperbaric Medicine Center Emergency Preparedness plan compliments the hospital's plan; it does not supersede the hospital emergency preparedness.

3. Scope and Responsibility

This policy applies to all members of the Hyperbaric Medicine staff, physicians and patients.

4. Procedure

4.1. In the case of a disaster, it may become necessary to remove patients from the hyperbaric chambers. The following steps should be taken:
4.1.1. Explain to the patients why the reason for ending the treatment early.
4.1.2. Decompress chambers at a normal rate. **DO NOT EMERGENCY VENT THE CHAMBERS.**

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

4.1.3.1. Close the doors on the chambers.

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

4.1.3.3. Disconnect the transformer from the electrical outlet at the wall interrupting the power supply to the battery charger.

4.1.3.4. Cover the chambers with the cloth chamber cover.

Section Three: 2021 Safety Program Schedule

January - Featured in the 2020 Safety Manual

February – Strategies to promote patient adherence. Save a Treatment (Results from Task Force)

March – COVID-19 Infection Control

April– Complacency in the Practice of Hyperbaric Medicine

May– Choosing a Safe Dressing for Patients Receiving HBOT

June – Pneumothorax Under Pressure

July – Static Electricity

August – Meeting "Medical Necessity" for Diabetic Foot Ulcers

September – Confinement Anxiety/Claustrophobia

October – Middle Ear Barotrauma

November – Patient Education

December – Seizures in the Hyperbaric Chamber

February: Patient Adherence

Overview: Hyperbaric oxygen therapy (HBOT) requires the patient to commit to daily visits to the center for 8 weeks or more. Patients must make travel arrangements and lifestyle changes that drastically effect their life and the lives of their family members. The majority of patients have multiple comorbidities and see multiple physicians further complicating their schedules. Adherence to a daily hyperbaric oxygen regimen challenges the most committed patient.

The hyperbaric staff plays an integral role in patient adherence. Most importantly, the hyperbaric staff and physicians must repeatedly communicate the importance of the therapy to the patient. In the case of a diabetic foot ulcer, for example, the staff can explain to the patient that HBOT decreases the risk of limb loss.

Education is crucial and it begins with the staff. Prior to educating patients the team members must fully understand the indications for HBOT and how to communicate the risks and benefits to the patient and family. In speaking with the patient choose words that persons without medical training will understand. First explain the procedure to the patient in detail. Leave time for questions. Take every opportunity to reassure the patient that the hyperbaric technician is always attentive to their needs. Make an effort to get to know the patient. What other techniques may be valuable?

Thought Experiment. After paying an outrageous sum of money for you and your family to go to a Disney park for 10 hours, 5 of which you spent in line, you begin the hunt for your car. You were sure it was in the Goofy, but your spouse remembers mouse ears on the light pole. Your skin is sticky from a day of sweating in the Florida heat and you are still nauseous from the unidentifiable meat Daffy served you at lunch. The kids have fallen off the edge of exhaustion into uncontrollable irritability. You finally locate the car and secure all the seatbelts. But as you head down the Disney thoroughfare everyone agrees you will be back next year. Please explain the Disney experience. How does it relate to patients visiting the hyperbaric suite?

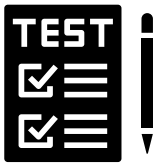
Ten tips from Tim Mayhugh, National Safety Director, to help improve patient adherence:

1. Smile. Say please and thank you. Think Disney.
2. Use simple nonmedical language.
3. Become acquainted with your patients and their family.
4. Never stop educating. Education is not a onetime event before beginning therapy. It is daily teaching and reinforcing. Keep up to date on various wellness programs available to your patients.
5. Share your knowledge about the chamber and the treatment.
6. Stress the importance of HBOT and the proven benefits.
7. Don't be afraid to use humor in a socially acceptable manner.
8. Follow up on missed appointments. A phone call on the same day may bring them back sooner; try to be creative in ways to help them make it--sometimes it just a matter of changing the time of their treatment. It also shows that they are important to you as well as the importance of coming for treatment each day and that you are concerned with their well-being.
9. When scheduling their time slot, take into account their needs. Do they have other previous appointments? Do they work? Do they babysit grandkids that they need to see off to school or be home when they get home? Do they use transportation that has limited time availability? This can be a difficult task but becoming an expert scheduler goes with the territory.
10. Think Disney

Save a Treatment (SAT) (Results from Task Force)

Reference:

https://www.uspharmacist.com/article/patient-compliance-and-health-behavior-models
The challenge of patient adherence
Leslie R Martin,1 Summer L Williams,2 Kelly B Haskard,2 and M Robin DiMatteo2
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2503662



Name: _____

Date: _____

Post-Test: Patient Adherence

1. Your daily treatment schedule should be rigid, and it is the patient's responsibility to "make it work".

True False

2. Which of the following will improve adherence:
   a. Scheduling the patient at a time that is convenient for the physician
   b. Getting to know the patient and his or her family
   c. Using medical terms in explaining the procedure
   d. Gathering with other staff in the hyperbaric room to chat

3. The key to adherence is patient _____ .

4. It is a good practice to keep up to date on various wellness programs available to your patients?

True False

5. Name two local resources that your patients may benefit from.
   1. _____
   2. _____

6. It is best if only one person in your center provides patient education?

True False

7. Site at least two reasons why the Disney approach is successful.
   1. _____
   2. _____

March: Infection Control in HBOT

Background
COVID-19 has brought the issue of infection control to the forefront and heightened awareness of infection control: good hand hygiene, social distancing and the proper mask donning, doffing, and wearing (covering the nose and mouth). Person-to-person spread of COVID-19 occurs primarily indoors between people less than 6 feet apart. When an infected person coughs, sneezes, or talks droplets from their mouth or nose are released into the air. The droplets can come into contact with mucous membranes of the nose and mouth of persons close by or inhaled into their lungs. Although most of the viral infections are transmitted by symptomatic patients, recent studies suggest that asymptomatic individuals with COVID-19 may also play a role in the spread of the disease. Health care workers, therefore, must take universal precautions to avoid contracting or transmitting the disease.

Monoplace chambers require the use of specific antiseptics to avoid damaging the acrylic shell. Most commercial biohazard-cleaning agents used to kill COVID-19 contain alcohol which degrades acrylic. SerenaGroup® recommends cleaning the chamber with sodium hypochlorite solution to prevent the spread of COVID-19.

Propose
This policy describes disinfection of an acrylic monoplace chamber to prevent the transmission of COVID-19 and other infectious agents.

Procedure
- Wear appropriate personal protection equipment (PPE) (mask and eye protection).
- Place a fan near the open door of the chamber to ventilate the chamber throughout the duration of the cleansing.
- Clean all gross material with water with a 100 percent cotton towel. (water temperature must not exceed 100 degrees Fahrenheit). Place all contaminated material in a biohazard bag.
- Using a clean 100 percent-cotton cloth, wipe area with disinfectant.
- Keep the surface moist for recommended time for product used, then let it air dry.
- After the area is dry, use a clean 100 percent-cotton towel moistened with water to rinse the treated area. Allow it to air-dry again.
- Examine the internal surface of the chamber and buff dry.

- With the door open, continue to introduce air through the chamber until there is no detectable odor of cleaner or disinfectant or pressurize the chamber to 3 ATA and emergency decompress to surface to 'flash' the chamber.
- Once there are no detectable odors or visible contaminants, return the chamber to service.
- Wash hands

Before Patients Arrive

Prepare the clinic/HBO Room.

- Use universal precautions to prevent the transmission of COVID-19.
- Keep health department contact information readily available.
- Follow COVID-19 incidence in the community.
- Assess and restock supplies now and on a regular schedule.

Communicate with patients.

- Ask patients about COVID-19 symptoms during reminder calls.
- Post signs at entrances and in waiting areas about prevention actions.

Prepare the waiting area and patient rooms.

- Provide supplies—tissues, alcohol-based hand rub, soap at sinks, and trash cans.
- Place chairs 6 feet apart. Use barriers (like screens), if possible.
- If your office has toys, reading materials, or other communal objects, remove them or clean them regularly.

After Patients Arrive

Ask patients about COVID-19 symptoms.

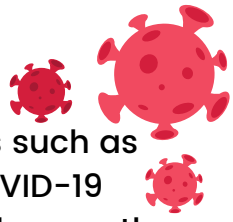
- Provide patients with facemasks to cover mouth and nose.
- Educate patients on proper facemask use.
- Limit non-patient visitors.
- Ask patents and visitors to wash their hands.

Separate sick patients with symptoms.

- Wear all appropriate personal protection equipment (PPE).
  - gown, gloves, mask (n95 if available), face shield or eye protection
- Allow patients to wait outside or in the car if they are medically able.
- Create separate spaces in waiting areas for sick and well patients.
- Place sick patients in a private room as quickly as possible.
- Wash hands often.

Before Patients Leave

- Provide at-home care instructions to patients with respiratory or other symptoms. Consider telehealth options for follow up.
- After patients leave, clean frequently touched surfaces using EPA-registered disinfectants—all dressing room counters, beds, seating.
- Ask patient to wash hands.
- Wash hand after every patient contact.



COVID-19 can live for hours or days on a surface, depending on factors such as sunlight, humidity, and the type of surface. It is possible to contract COVID-19 after touching an infected surface virus and transmitting the virus to the mouth or eyes.

Know the Systems of COVID-19

COVID-19 infected patients may exhibit a wide range of symptoms ranging from mild symptoms to severe illness. Symptoms may appear 2-14 days after exposure to the virus. Symptoms include,

- Fever or chills
- Cough
- Shortness of breath or difficulty breathing
- Fatigue
- Muscle or body aches
- Headache
- New loss of taste or smell
- Sore throat
- Congestion or runny nose
- Nausea or vomiting
- Diarrhea

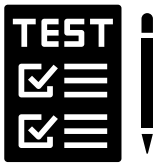
(This list does not include all possible symptoms)

References:

William Rutala, Ph.D., M.P.H, David Weber, , M.D., M.P.H. and the Healthcare Infection Control Practices Advisory Committee (HICPAC) Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008”

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

https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinic-preparedness.html



Name: _____

Date: _____

Post-Test: Infection Control in HBOT

1. All disinfectants are safe to use on the chamber acrylic?

True False

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

.

3. While alcohol is adequate to kill many pathogens, but causes damage to the _____ of hyperbaric chambers.

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

True False

5. COVID-19 can live for hours or days on a surface?

True False

6. It may be possible that a person can get COVID-19 by touching a surface or object?

True False

7. The minimum time to wash your hands is _____ seconds.

April: Complacency in the Practice of Hyperbaric Medicine

Definition of complacency

- Webster defines complacency as, "self-satisfaction especially when accompanied by unawareness of actual dangers or deficiencies." When it comes to safety, complacency is dangerous. https://www.merriam-webster.com/dictionary/complacency

Background

Situations leading to complacency in the hyperbaric suite:

- When technicians perform repetitive functions without incident or complication.
- When the center prioritizes time over safety.
- When there are no repercussions or remedial education for unsafe behaviors.
- When daily check lists take too long to complete.
- When there are too many check lists.

In 1997 P.J. Sheffield and D.A. Desautels undertook a retrospective study: Hyperbaric and hypobaric fires, a 73-year analysis, which clearly demonstrated that since 1980, the primary source of Chamber fires has been prohibited items taken into the HBO chamber by the patient. This phenomenon has not changed in the years since the initial study.

Every time a patient enters the hyperbaric chamber the potential for a catastrophic event exists.

Everyone working in the hyperbaric center from technician to physician, assumes the role of risk manager. Resources detailing the safe operation of hyperbaric chambers are provided along with SerenaGroup® policies and procedures. A simple adage summarizes these texts, "Control everything that enters the chamber". Tim Mayhugh often exclaims, "If I didn't give it to you and God didn't give it to you, then it doesn't go in the chamber." Each item placed into the chamber from the patient to the linens, dressings, comfort items such as pillows, and extra blankets must be evaluated before they are allowed in the chamber. Fire can result from the combination of three factors:

1. The abundance of oxygen.
2. The increased flammability of all fuel sources.
3. Energy sources including possible sources of static electricity.

In the case study presented below, the participants are careful, well trained, well-educated and experienced technicians. They possess all of the tools needed to avoid this "near miss", but something went awry.

Case Study Facts:
Jane, the technician, retrieves inpatient, Ms. Smith, from the floor and prepares her for HBOT. A half-an-hour earlier technician Joe had taken inpatient, Mr. Jones, from the floor to the HBO suite. After loading Ms. Smith into the chamber, Jane tells Joe that she must leave immediately to attend to a family emergency. She informs him that she has completed the checklist for Mr. Jones, and he is ready for treatment. As she rushes from the unit, she reiterates that Mr. Jones is all set. Joe acknowledges receipt of the information with a nod and wave. Joe is also in a hurry. The physician stuck his head in the center earlier in the day and stressed that he had to leave on time that day. Joe observes that Mr. Jones is still in a floor gown with a T-shirt underneath. He examines the gown. The tag reads 100% cotton. Similarly, the T-shirt is 100% cotton. He recalls that 100% cotton is safe in a hyperbaric environment. He concludes that the patient's current attire is safe. To be sure, he asks Mr. Jones if he has any prohibited items. Mr. Jones, experienced with hyperbaric treatments, denies having anything might explode. The technician, satisfied with the response, put the check list aside and loaded him into the chamber. After pressurizing the chamber to 2.4 ATA, Joe completes the pre-treatment check list. The treatment is uneventful.

Joe removes Mr. Jones from the chamber. Immediately he notices a tube of denture glue in the breast pocket of his gown. On further investigation Joe finds tissue paper and coins in Mr. Jones' pockets. He then discovers a powered up smart phone in transmit mode.

This is a near miss. The cell phone could have ignited a fire in the chamber leading to Mr. Jones certain death and destruction of the hyperbaric suite.

Errors caused by complacency

- The patient received treatment in a floor gown and T shirt rather than the approved hyperbaric attire. This was a flagrant violation of the center's policy on garments permissible in the high oxygen environment of the monoplace chamber.
- Both technicians failed to complete the pre-treatment check list
- The technician signed the statement "Operator is satisfied that 1). Chamber is operating correctly and in safe condition and 2). All safety policies and procedures have been followed and any exceptions were listed in chamber log statement."

- The technician failed to control the items that went into the chamber.
- The technician failed to follow several of the hyperbaric center's policies and procedures.
- Technician Jane was untruthful.
- The medicated patient was not a reliable source of information critical to the safe operation of the chamber.

Outside Factors

- The overseeing physician had an important engagement and pressured the technicians finish on time.
- A family emergency required Jane to leave clinic ahead of schedule.

Root Cause Analysis

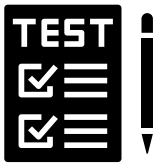
Root cause analysis uncovers the primary reason for an adverse event. In this case, there were several violations of policy, but the underlying cause for this potentially lethal incident was complacency. Complacency occurs when individuals perform repetitive tasks with infrequent complications. Check lists, first popularized by the airline industry, reduce the risk of errors due to complacency. Pre-treatment check lists save lives. They are not optional. In addition, policies and procedures provide further protection against complacency.

The last item on the "chamber side check list" is a time out, the intent of which is to reflect on the immediate previous activity involved in the preparation of the patient. Take this time to do one last mental check list and be sure that you, the patient, and the chamber are as prepared as humanly possible to provide a safe treatment.

The technician must always control what enters the chamber. There are no exceptions.

Lessons Learned

What lessons can this real-life scenario teach us? Burned into your auditory memory is Tim's gruff exclamation, "If God didn't give it to you and I didn't give it to you, it doesn't go in the chamber." If Joe, the technician, had recalled this admonition he would never have allowed Mr. Jones in the chamber with a hospital gown or T-shirt. While changing the gown Joe would have found the contraband. In addition, had the pre-treatment check lists had been completed as designed, the contraband would have been discovered. HBOT is safe. It is safe when check lists are completed and policies and procedures followed. The technician holds the life of the patient in his or her hands. Dr. Serena frequently repeats the surgeon's mantra, "the same way every time."



Name:_____

Date: _____

Post-Test: Complacency in the Practice of Hyperbaric Medicine

1. List at least 2 reasons why individuals become complacent:
   1_ _
   2 _

2. List at least 2 results of complacency:
   1_ _
   2 _

3. It is not necessary to ask all pre-treatment checklist questions after a patient has had 10 treatments?

   True False

4. Policy are just guidelines and as such are optional?

   True False

5) When following all regulations and all policies and procedures:
   A. We are guaranteed that we will have a safe treatment.
   B. We can be reasonably sure of a safe treatment.
   C. We can be absolutely sure of a safe treatment.
   D. We can be sure not to have an intendent.
   E. We will probably still have an issue.

May: Choosing a Safe Dressing for the Patients Receiving HBOT

Background
What dressings are safe in the hyperbaric chamber?

This question can confound HBO techs on a daily basis, some have gone to the extreme 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 as well as denying the patent a treatment that a physician has deemed necessary.

"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

(NFPA 14.3.5.4.3)

The answer lies in the balance between the risks associated with the dressing and its potential benefits in treating the wound. First ask, "is the dressing necessary?" If the answer is no, the dressing is removed prior to treatment. If the answer is yes, decide whether to cancel the treatment or mitigate the risk.

When evaluating a dressing it is important to first understand the roll of fuel in the chemical reaction know as fire. Normally this reaction is between oxygen in the atmosphere and some sort of fuel (wood or gasoline, for example). Of course, wood and gasoline do not spontaneously catch on fire just because they are surrounded by oxygen. Fuel must be heated to its ignition temperature for combustion to occur. The reaction will keep going as long as there is enough heat, fuel, and oxygen. This is known as the fire triangle.

Fuels can be solids, liquids or gases. During the chemical reaction that produces fire, fuel is heated to such an extent that (if not already a gas) it releases gases from its surface. Only gas can be used as fuel. Gas is made up of molecules (groups of atoms). When these gases are hot enough heated molecules are loosened, moving apart to form a gas. The gas molecules

combine with oxygen in the air resulting in fire. This is important to us for two reasons: first the hyperbaric environment is 100% oxygen under pressure. There are 15 times more molecules of oxygen available to 'mix' with molecules of fuel. This lowers the heat required for combustion, or flash point. The second factor is the need to convert fuel to gas, meaning that any product that evaporates or 'off gases' at room temperature becomes exceptionally rich fuel as no heat is required to convert the solid or liquid to gas. An example of this can be found in the oily rags left in the attic that on a hot summer day spontaneously combust. This happens at temperatures as low as 120 degrees Fahrenheit in room air (21% oxygen).

Most skin and wound care products have petroleum alcohol or benzine base. These are all rich fuels and according to our prohibited items list should not enter the chamber. Let's examine this a little closer. These highly flammable products are used in most all cases as 'carriers' in others words they keep the product moist or pliable for storage and once exposed to air they evaporate. Once the evaporate, they are no longer a 'rich fuel' and no longer pose an unacceptable fire risk.

Fuel is not the only consideration in deciding on whether an item can enter the chamber. We must consider the amount of fuel, potential energy sources, interactions with high dose oxygen, ability to produce a static charge, and potential damage to the chamber acrylic.

When developing a "go" or "no go" list it is also important consider ways to mitigate risk minimizing the likelihood of an incident. Mitigating risk can include covering a dressing with a damp cloth, increasing the vent rate, padding over a device, and substitution with a compatible product.

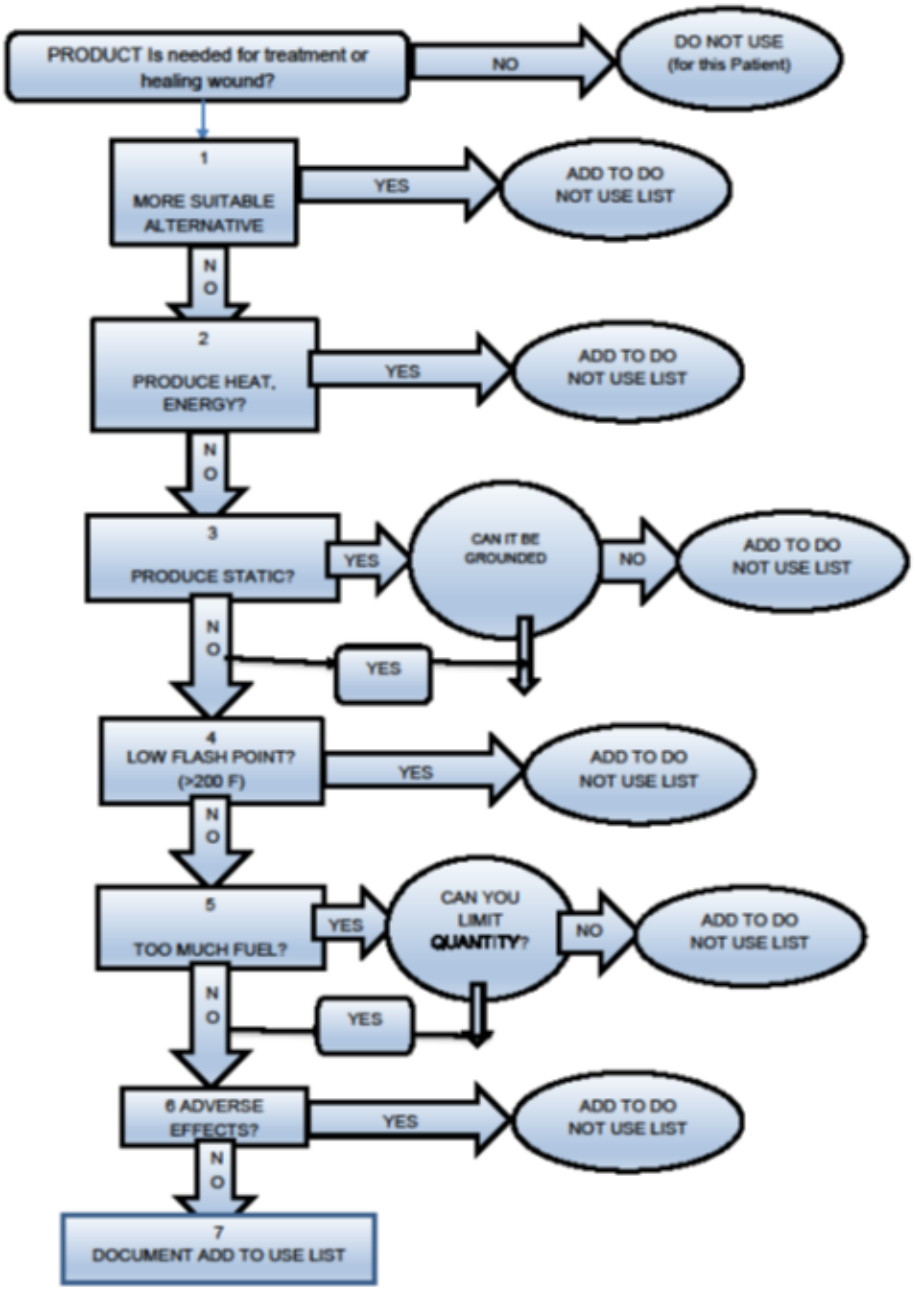
Utilizing the decision tree below let's walk-through a go-no-go list.

Go - NO Go? **Concerns? Can it be mitigated?**

Go - NO Go? **Concerns? Can it be mitigated?**

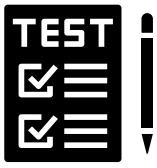
Go - NO Go? **Concerns? Can it be mitigated?**

Go - NO Go? **Concerns? Can it be mitigated?**



Procedure:
When evaluating a dressing for use in HBOT, employ a logical method and document the reasoning underpinning the decision. Please to lesser extent consider the psychosocial results when considering low risk personal items, however never compromise safety, when in doubt leave it out.

References:
**"Hyperbaric Medicine Practice" 2nd edition by Dr. Kindwall (pp. 417).
NFPA 99, 2012 addition chapter 14 SerenaGroup policy and procedure.2020



Name:_____

Date:_____

Post-Test: Choosing a Safe Dressing for the Patients Receiving HBOT

1. A 2 x 2 Vaseline gauze dressings may be permitted in the monoplace chamber?

True False

2. The first question to ask is _____.

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: (list two)

- _____
- _____

4. If the doctor orders a dressing, then it is safe to go in the chamber without further investigation.

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.

True False

June - Pneumothorax Under Pressure

Overview:
A rare potential complication of HBOT, a collapsed lung or pneumothorax, can lead to life-threatening complications if unrecognized or mismanaged. The symptoms of pneumothorax include sudden shortness of breath, stabbing chest pain, a shift in the position of the trachea, asymmetric chest movement, and increased respiratory distress. Boyle's Law states that as pressure decreases the volume of air-filled spaces will increase; therefore, a patient with a pneumothorax will experience symptoms during decompression of the chamber. Once the patient is removed from the chamber physical examination will provide further evidence of a pneumothorax: asymmetric or absent breath sounds on one side, hypotension, and tachycardia. For the symptomatic patient immediate needle thoracostomy by a trained physician is the treatment of choice. Patients with minimal symptoms can be transferred to the emergency room.

Procedure:
If patient exhibits symptoms of a pneumothorax:

- Stop decompression.
- Notify Hyperbaric Physician stat.
- If it is determined that the patient has a tension pneumothorax, prepare for needle thoracostomy or emergent transfer to the emergency room.
- Slowly decompress the patient at a rate of 1 psi or at a rate prescribed by the physician.
- Following initial stabilization, transfer the patient for further work-up and management.

References:
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

Name:_____

Date: _____

Post Test - Pneumothorax Under Pressure

1. Patients with a pneumothorax may experience the following symptoms during decompression _____ and _____.

2. During the decompression, the pneumothorax expands.
   True False

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

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

5. What gas law explains the mechanism of action resulting in a Pneumothorax in HBOT?

   _____

July – Static Electricity

Overview:
The fire triangle is a simple way to understand the ingredients needed to cause a fire. Three components make up the triangle: heat (ignition source), fuel, and an oxidizing agent such as oxygen. As oxygen concentration increases, the risk of fire increases. Sparks caused by the discharge of static electricity act as ignition sources in fires. Fire prevention rests on removing or reducing the impact of one or more of the sides of the triangle. In the high oxygen hyperbaric environment, the focus is on reducing the amount of available fuel and eliminating ignition sources. Most fires in a hyperbaric chamber are caused by the introduction of an ignition source (e.g. hand warmers, cigarette lighters). Static electricity is ubiquitous. Anyone who has touched a doorknob after walking across a carpeted floor has experienced static electricity. In a monoplace chamber a static discharge will lead to disaster.

Briefly, electrons accumulate on the surfaces of objects including the human body. The result is a difference in voltage between objects such as your finger and the doorknob. A spark is created when electrons flow from one object to another. Grounding reduces the potential for sparks by providing a pathway for electrons to flow to the earth. For this reason, the patient in the hyperbaric chamber always wears a ground. In addition, it is recommended that the relative humidity levels in the hyperbaric suite exceed 40%. This further reduces the risk of static discharge.

The grounding requirements for hyperbaric chambers and occupants are found in the National Fire Prevention Agency Manual (NFPA) Chapter 19, NFPA 99 or Chapter 20, NFPA 02. In summary, a grounding system must be in contact with the patient's skin and provide a conductive pathway. Grounding straps used in hyperbaric chambers are usually attached to the patient's wrist. If the patient is properly grounded a static discharge or spark is exceedingly rare. Grounding the patient eliminates a potential ignition source.

Procedure:
Daily inspection of the hyperbaric chamber includes inspection of the grounding wire attached to the rear of the chamber. All patients must wear a grounding wrist band before entering the chamber. Inspect the following grounding areas:

- Daily inspect the cable running from the chamber to grounding plate
- Ensure the patient is wearing the grounding wrist band prior to and during treatment.
- Daily check that the chain at bottom of gurney is making contact with the floor.
- The humidity in the hyperbaric suite should range between 30- 40%.

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

Name: _____

Date: _____

Post-Test: Static Electricity

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

2. Give two examples of grounding used in the HBO suite:
   _____
   _____

3. To decrease static electricity you may need to lower the humidity in the chamber room.
   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.
   True False

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

August – Meeting "Medical Necessity" for Diabetic Foot Ulcers

Overview:
The phrase "medical necessity" when used by Medicare is a specific term that means the service provided to a patient is necessary and appropriate as judged by current medical standards. Accurate documentation is necessary to meet the medical necessity criteria established by Medicare. Medicare and their contractors publish these criteria in the form of national (NCD) and local (LCD) coverage determinations. Failure to meet medical necessity criteria can result in repayments and fines.

Check lists and documentation templates which contain the elements of medical necessity safeguard against fines and penalties. In this exercise, we will review the documentation template for a patient with a Wagner 3 or 4 diabetic foot ulcer under consideration for HBOT.

Template:
Patient is a Type I/Type II Diabetic and he/she has a Wagner Grade 3/4/5 ulcer of the _____, as proven by (MRI/bone scan/x-ray/ Abscess/ gangrene/ etc). The patient has had 30 days of standard wound care without measurable signs of healing. Maintenance of clean, moist wound bed of granulation has been performed with serial debridements on (dates) and applying (dressings). Proper offloading has been provided by (offloading device). Debridement of infected bone has been performed on (date). Vascular assessment including (Spell out all testing done and results, TCOM, ultrasound, CT angio, ABI) and no revascularization is required and/or revascularization has been provided by Dr. _____ on (date) and optimized and/or patients is not a candidate for revascularization. Pre-albumin and Albumin levels are within normal ranges (or skin turgor, multi-vitamins, Ensure, etc) indicating that the patient's nutritional status is optimized. Recent Hemoglobin A1C is _____. Glucose levels controlled/being followed by_____ and any changes/modifications to insulin/medications will be followed by this physician. Patient has been treated and/or is being treated with _____ to resolve any infection. Patient education regarding smoking cessation was provided (if smoker).

Review of Systems: physician to dictate full review of systems here

Review of Contraindications: The relative contraindications for hyperbaric oxygen therapy have been reviewed and the patient risk vs benefit considered regarding the following:

Untreated pneumothorax, history of spontaneous pneumothorax.

SerenaGroup® Hyperbaric Oxygen Therapy Checklist

- Any history of the following medications: Bleomycin, Doxyrubicin (Adriamycin), Disulfiram (Antabuse), Cis-Platinum and Mafenide Acetate (Sulfamylon).
- Upper respiratory infections and chronic sinusitis.
- Retinal surgery in the preceding 6 weeks with use of intraocular gas.
- Seizure disorders
- Patient receiving anti-seizure medications should have drug levels addressed prior to initial treatment and as determined by the physician during the course of HBO therapy. Benzodiazepines (Diazepam or Lorazepam) may be administered to reduce the risk of oxygen seizures.
- Emphysema with CO2 retention.
- High fever >100.
- Pregnancy
- Medications: Steroids as they may decrease the threshold for oxygen seizures; Narcotics may lead to decreased respiratory drive and Phenergan predisposes to oxygen toxicity (utilize different antiemetic).

The potential risks associated with treatment were reviewed with the patient including but not limited to fire, barotrauma, seizure and confinement anxiety as well as visual changes. Patient acknowledges risk, benefits and common complications and acknowledges by signing informed consent. Patient wishes to proceed with hyperbaric oxygen treatment.

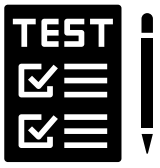
Plan:
Patient is candidate for hyperbaric oxygen therapy for the diabetic ulcer of the _ _ _ _ _ _ _ _.
Treatment will consist of 2.0-2.5 ATA for 90-120 minutes once a day as an adjunct to the appropriate standard of care.

Procedure:
By utilizing the SerenaGroup Hyperbaric Oxygen Therapy Checklist when reviewing a chart for HBOT, you can assure that the provider has met all elements of medical necessities.

References:
CMS pub 100.3, manual section number 20.29 2016 NCD Hyperbaric oxygen Therapy, Novitas WC LCD (L32125) 11-9-2017, Matt Schweyer "Diabetic lower extremities ulcer HBO H&P.

The SerenaGroup Hyperbaric Oxygen Therapy Checklist can be printed off the SerenaGroup Member's Portal at www.serenagroupinc.com. If you do not have access to the Member's Portal, please contact your Program Director immediately for assistance.

All staff and providers that work in a SerenaGroup Managed Advanced Wound Care Center are allowed access to the Member's Portal.



Name: _____

Date: _____

Post-Test: Meeting Medical Necessity for a DFU for HBOT

1. Diabetic foot ulcers should always be staged?
   True False

2. If the patient has a bounding pedal pulse there is no need for any vascular studies?
   True False

3. The Patient who is a documented diabetic who you have been treating for a Wagner II ulcer on his left foot, just arrived at your center. He/she has a new Wagner III foot ulcer on their right foot. Can you put him/her in HBO immediately?
   Yes or No If no, why not?

_____

_____

4. Your patient has received 31 treatments in the Hyperbaric Chamber for his DFU Wagner III. The wound has made progress toward healing; it would be medically necessary to order another 30 treatments?
   True False

5. Vascular assessment testing can be done utilizing,
_ _ _ _ _ _ _ _ _ _, _ _ _ _ _ _ _ _ _ _ _ _, _ _ _ _ _ _ _ _ _ _ _ _, or _ _ _ _ _ _ _ _ _ _.

6. Are Diabetic foot ulcers ever downgraded (until fully closed)?
   Yes or No

7. Bonus: What are the elements of a Wagner Grade III Diabetic foot Ulcer?

_____

_____

_____

September: Confinement Anxiety/Claustrophobia

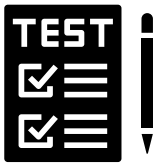
Overview:
Assessment for confinement anxiety or claustrophobia is indicated for all HBOT candidates. In patients with confinement anxiety consider premedication with a benzodiazepine (e.g. Lorazepam) or distraction techniques (e.g. television shows). Claustrophobic patients may require additional interventions such as biofeedback. It is important to reassure the patient that the technician is immediately available at all times during a treatment. Inform the patient that if he or she wants out of the chamber, they will be taken out.

Signs/Symptoms:
Observe the patient for signs and symptoms of confinement anxiety such as clenching of fists, facial flushing, diaphoresis, defensive attitude, urgency to empty bladder, feeling of being smothered or suffocated, a sudden complaint of pain or discomfort, and frequent complaints of nausea or diarrhea.

Procedure:
An estimated 8% of the population has claustrophobia as defined by Diagnostic and Statistical Manual of Mental Disorders (DSM-5)1. In contrast, confinement anxiety is common. On initial assessment avoid the use of the word claustrophobia. It is too often confused with mild to moderate anxiety experienced by most individuals in closed spaces. Ask the patient about experiences in confined spaces. If a patient has tolerated an MRI, for example, they will not meet the DSM-5 criteria for claustrophobia. Patients with confinement anxiety should tour the center prior to coming on for their first treatment. In moderate to severe cases the physician may prescribe a benzodiazepine such as Lorazepam. The patient takes the medication 30 minutes prior to treatment. Other techniques such as distraction and Lamaze have successfully treated patients with severe confinement anxiety. The treatment for claustrophobia is cognitive behavioral therapy under the direction of a psychiatrist or psychologist2.

References:

1. Wardenaar KJ, et. al , The cross-national epidemiology of specific phobia in the World Mental Health Surveys. Psychological medicine. 2017 Jul; [PubMed PMID: 28222820]
2. Thorpe S,Salkovskis PM,Dittner A, Claustrophobia in MRI: the role of cognitions. Magnetic resonance imaging. 2008 Oct;[PubMed PMID: 18524527]
3. Hyperbaric Nursing, Larson-Lohr pp. 137-138, 141-142, Hyperbaric, Medicine Practice, Kindwall, pp.54



Name:_____

Date: _____

Post-Test: **Confinement Anxiety/Claustrophobia**

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

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

3. _____ may be given prior to the treatment for confinement anxiety.

4. If the patient states they want out of the chamber, force them to finish the treatment.
   True False

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

October: Ear Barotrauma

Overview:
Middle ear barotrauma is the most common complication of hyperbaric therapy. During compression clearing the ears, autoinflation, equalizes the pressure between the middle ear and the pressure in the chamber. Recall from Boyle's Law that as pressure is increased air-filled spaces will decrease in volume. Autoinflation maneuvers open the eustachian tubes in the nasopharynx permitting communication between the middle ear space and the atmosphere. A patient that cannot equalize the pressure between the middle ear and the chamber by swallowing, yawning or performing a Valsalva maneuver, will experience severe pain and potentially damage the tympanic membrane. Middle ear damage is called barotrauma. The underlying causes of barotrauma include an inability to autoinflate, artificial airways and damage to the eustachian tubes.

Procedure:
If the patient experiences mild to moderate pain during compression, stop the pressurization and decrease the pressure until the patient no longer experiences pain. Advise the patient not to autoinflate while the chamber is decompressing. Once reaching a stable pressure have the patient perform several autoinflation maneuvers. Once patient and technician are satisfied, pressurization can recommence. If patient experiences severe pain that is not relieved by stopping the pressurization or decompressing, remove patient from the chamber and notify the Hyperbaric Physician. It is reasonable to attempt to compress a patient up to three times. If the patient experiences pain on the third attempt at compression the treatment is aborted. Remember the adage "three strikes and you're out."

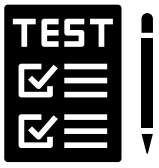
Ear Exam:
The classification system used to grade the appearance of the tympanic membrane following HBOT is called the Teed Scale. It is named for Wallace Teed, a United States Navy Submarine Medical Officer during World War II, who first described middle ear barotrauma related to changes in pressure.
https://www.ncbi.nlm.nih.gov/books/NBK499851/

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 :
https://www.ncbi.nlm.nih.gov/books/NBK499851/



Name:_____

Date:_____

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.

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. Hemorrhage in the tympanic membrane is classified as a TEED 1.

True False

November: Patient Education

Overview:
The internet abounds with sites professing miraculous benefits from hyperbaric oxygen therapy. Unfortunately, most of the claims are unfounded and many of the sensational treatments fail to qualify as HBOT. The primary source for patient education on HBOT is google. As a result, patients often present to the hyperbaric suite misinformed. Patient education plays a vital role in HBOT.

Education also involves the patient in their care. A robust body of evidence suggests that educated and engaged patients have better outcomes and are more compliant. In addition, education engenders trust. The patient must trust the technician. The fastest way to gain trust is to educate.

Patients receiving HBOT have multiple co-morbidities. Each new diagnosis adds the burden of illness requiring lifestyle modifications, specialist visits and frequent monitoring. Daily HBOT increases the patient's burden. The patient must understand and believe that the treatment has value. HBOT education focused on the benefits of HBOT will encourage the patient to make the commitment to come to the hyperbaric suite daily for up to 3 hours.

One of the advantages of providing education during HBOT is that the patient is seen daily. The physician and technician can assist the patient in making lifestyle changes such as weight loss, smoking cessation, and improved glycemic control. The HBOT technician becomes the life coach.

Procedure:
Teach. Use simple language, draw pictures, and distribute hand-outs. Engage the patient. Document all teaching.

The following may assist in patient education efforts.

HBOT Frequently Asked Questions

What is Hyperbaric Oxygen Therapy?
Hyperbaric oxygen therapy (HBOT) is a proven medical treatment. It enhances the body's natural healing process. Patients breath 100% oxygen in a pressurized chamber. The pressure promotes the body's uptake of oxygen.

How long are the treatments?
HBOT takes 120 minutes each day. This does not include the time needed to arrive at the facility, change into appropriate clothing and then change back into street clothes after the treatment. A typical Hyperbaric treatment will take two and a half hours from arrival to departure.

How many treatments are required?
The number of treatments and duration of each treatment will be determined by the physician. This is based on your diagnosis and your response to treatment. Typically patients require 4 to 8 weeks of daily treatment (Monday through Friday)with the exception of holidays and weekends.

Is Hyperbaric Oxygen Therapy safe?
Yes. Serious complications are rare. Hyperbaric Oxygen Therapy is prescribed by a specially trained physician. Patients are under constant medical supervision by a trained hyperbaric technologist who is in the treatment room at all times.

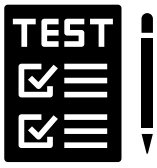
Are there any side effects?
The most common side effect pain in the ears and sinuses caused by pressure changes. To minimize this risk, patients learn techniques to promote adequate clearing of the ears during compression or in cases when patients have problems with pressure equalization, tubes may be inserted into the ears. In some cases patient may experience 'popping and or cracking 'the evening following the first 2-3 treatments. This is temporary and will not adversely affect the patient's health. In addition 1 in 5 patients may experience changes in vision, near-sightedness, during the course of treatment. These changes are usually minor and temporary. Rare side effects include seizures, lung collapse and difficulty breathing. If any of these side effects develop the patient is sent to the emergency room for further evaluation and treatment.

How should patients prepare for their hyperbaric treatments?
Patients should arrive 15 minutes prior to their scheduled treatment time. Only special hyperbaric gowns provided by the center are allowed into the hyperbaric chamber. No cosmetics, perfumes, hair products, deodorants, wigs, under clothing, eyeglass's or jewelry are allowed into the chamber. Patients are also advised not to drink carbonated beverages or alcohol for four hours prior to their treatment. Additionally, patients should give up smoking and nicotine products while receiving hyperbaric treatments as they interfere with the body's ability to transport oxygen. Patients with diabetes may experience hypoglycemia (low blood sugar) in the hyperbaric chamber. Technicians will

record patient's symptoms and look for signs and symptoms of hypoglycemia. Patients experiencing hypoglycemia are encouraged to notify the technician immediately. Diabetics receiving HBOT will have their glucose level checked before and after each treatment. If the blood sugar is below 120 the patient is given carbohydrates and the blood sugar levels are retested. If they fail to increase after the carbohydrates the treatment is canceled for that day.

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.



Name:_____

Date:_____

Post-Test: Patient Education

1. A robust body of evidence suggests that educated and engaged patients have better _____ and are more _____.

2. It is important that the patient understand and believe that the treatment has value.

True False

3. The most common side effect in hyperbaric is pain in the ears and sinuses caused by _____ _____.

4. Is important to only use medical language so that the patient will know how well educated you are as this will help them feel safer?

True False

5. Patent education should only be done as part of the pre-HBOT intake process?

True False

December: Oxygen Toxicity Seizures

Introduction:
Initially described by Paul Bart in the late 19th century, exposure to high levels of oxygen can lead to acute oxygen toxicity. The manifestations of which are neurologic in nature. The early signs are nonspecific such as twitching of the lip, changes in vision, tinnitus, or a sudden change in behavior. Left untreated the toxicity will progress to seizures. Oxygen toxicity seizures are uncommon, occurring only 0.52 times per 10,000 hyperbaric treatments. Air breaks reduce the potential for acute oxygen toxicity. If a patient undergoing HBOT exhibits the early signs of oxygen toxicity give him or her an air break and consider lowering the pressure in the chamber. Alternatively, the physician can choose to end the treatment. In addition, eliminating fluorescent lighting in the chamber room decreases the risk of seizure.

Signs/Symptoms:
Oxygen toxicity can lead to mild symptoms or progress rapidly to a seizure without prodromal symptoms. Careful attention to the patient throughout the treatment is key to identifying oxygen toxicity and intervening in a timely fashion. The acronym VENTID identifies the early signs of oxygen toxicity (V= changes in vision, E= ears including symptoms such as tinnitus, N=nausea, T=twitching, I=irritability, and D=dizziness).

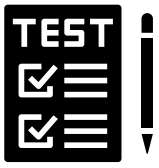
Differential Diagnosis:
Most Seizures in a hyperbaric environment are not due to oxygen toxicity. The differential diagnosis includes hypoglycemia, fever, new seizure disorder, medications that lower the seizure threshold, electrolyte abnormalities and chemical or alcohol abuse.

Procedure:
If the patient is observed or complains of any unusual neurologic symptoms have the patient take an air break. Immediately notify the physician supervising the treatment. Under the direction of the physician consider decreasing the pressure in the chamber or discontinuing the treatment. In the case of a seizure do not decompress the patient until seizure activity ceases.

In diabetic patients check a blood glucose level to rule out hypoglycemia as the source of the seizure. The patient is sent to the emergency room for a seizure work up. If the seizure is secondary to oxygen toxicity the patient can resume HBOT. Prior to the next treatment incorporate an air break in the treatment protocol.

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, Seizure incidence by treatment pressure in patients undergoing hyperbaric oxygen therapy, Marvin Heyboer 3rd et al. UHMS
https://pubmed.ncbi.nlm.nih.gov/25558546/



Name:_____

Date: _____

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.

True False

2. Initially described by _____ in the late 19th century, exposure to high levels of oxygen can lead to acute oxygen toxicity.

A. Dan Kelly
B. Antonine Lavoisier
C. Paul Bert
D. Ida Boerema

3. Immediately decompress the patient if they actively seizing.

True False

4. Most seizures in a hyperbaric environment are not due to oxygen toxicity?

True False

5. Name 3 causes of seizures other than oxygen toxicity:

_____ _____
_____.

Quality Assurance of Emergency Procedures

Required: 2 Fire Safety Drills per year, one drill needs to be timed
Recommended: Fire drill performed quarterly on the below recommended topics.

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

Safety Director _____

Medical Director _____

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
6. Air Embolism
7. Seizure - Oxygen Related, Other
8. Confinement Anxiety
9. Diabetic Reaction
10. Other - Please specify

Medical Record #	Adverse Events	Intervention	Comments

Safety Director _____

Medical Director _____

SerenaGroup
Building the Nation's Leading Wound Care Team

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