

**August
2024**

HYPERBARIC MONTHLY MEETING



TOPIC:

August – To Dive or NOT To Dive

PRESENTED BY:

Ashley
Henry Ford



Overview

Comorbidities can add additional complications to a patient undergoing hyperbaric oxygen therapy. It is important to know when it is safe to treat a patient and how the risk can be reduced to protect them. Pre-treatment testing can rule out contraindications before the patient begins HBOT. Working with your overseeing hyperbaric physician to create the safest treatment protocol for a complex patient, can produce better outcomes.

Be on the lookout for red, yellow, and green traffic lights indicating when to stop, go, and slowly proceed with caution.

Comorbidities That May Pose A Risk

**Congestive
Heart
Failure**

**Chronic
Obstructive
Pulmonary
Disorder**

**Dialysis
Patients**

**Pneumo-
thorax**

**Congenital
Spherocytosis**

**Seizure
Disorder/
History**

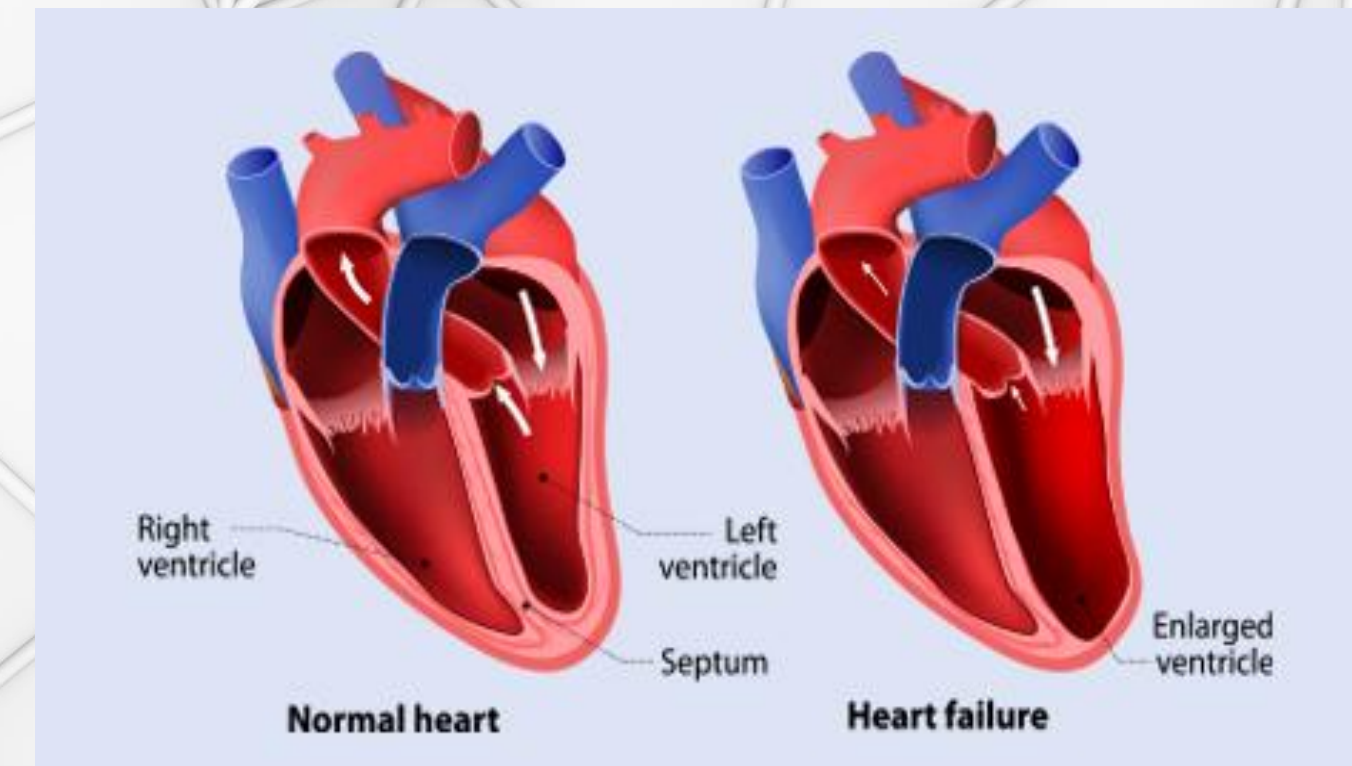
**Trapped
Air Space
Concerns**

Congestive Heart Failure (CHF)



all patients with a history of CHF should be maximally medically managed prior to HBOT. One could also consider treating at a lower pressure to potentially lessen the increase in left ventricular afterload. Theoretically, air breaks may be of benefit in reducing the oxygen-induced vasoconstriction and resulting increased afterload. Consider LOWER AND SLOWER!

- CHF is a condition in which the heart does not pump blood well enough to supply the body. This weakened heart condition leads to fluid buildup in the lower extremities, upper extremities, lungs, and other organs. Patients with CHF, especially those with ejection fractions less than 30%, are at a higher risk for CHF exacerbation and acute pulmonary edema during HBOT. This occurs when hyperbaric increases pressure that shifts the retained fluid and causes pulmonary edema. Patients should not be fluid overloaded and a pretreatment, baseline echocardiogram may be considered.



Chronic Obstructive Pulmonary Disorder (COPD)



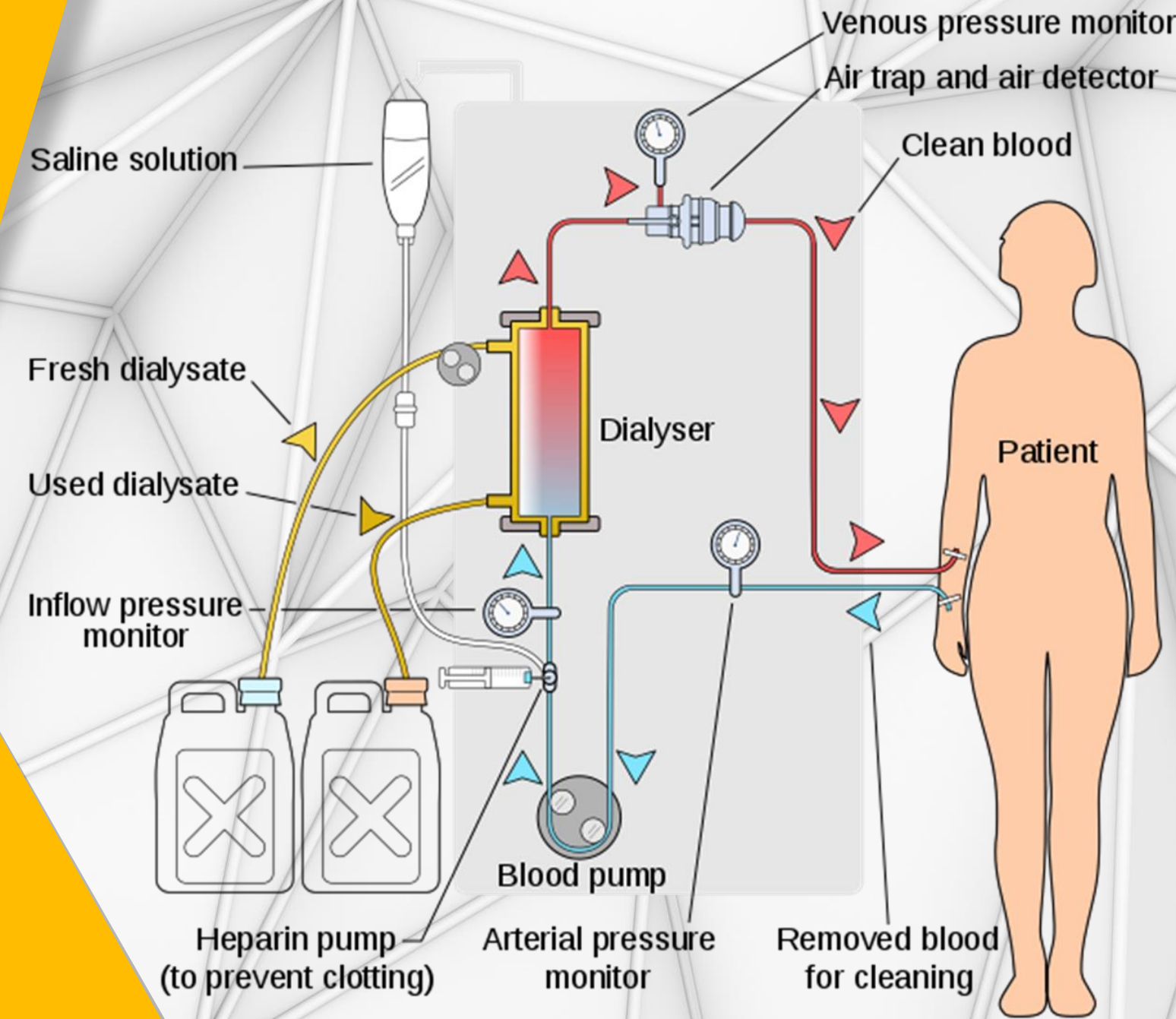
- COPD is a respiratory condition involving constriction of the airways and difficulty or discomfort in breathing. Pulmonary barotrauma from overinflation is a rare, but potential side effect of HBOT especially in COPD patients that are at an increased risk for air trapping during decompression with active bronchospasm, mucous plugging, and bullous lung disease. COPD is a relative contraindication to HBOT due to the risk of hypercarbia (increased carbon dioxide in the bloodstream.) The high oxygen fraction increasing blood oxygen saturation levels can lead to oxygen-induced hypoventilation and increased ventilation/perfusion mismatch. COPD and/or Asthma can result in air trapping and the development of pulmonary barotrauma. Similarly, asymptomatic pulmonary blebs and bullae found on chest x-rays also serve as a relative contraindication due to the potential air trapping progressing to a pneumothorax.

Patients with COPD should be medically managed with their primary or pulmonary care provider. Patients that are showing signs of respiratory distress, may require the HBOT attending physician to order additional testing or cancel treatment that day. These patients are at an increased risk of developing a pneumothorax. It has also been theorized that HBOT could lead to pulmonary oxygen toxicity in higher risk patients such as those with COPD, however this has been found to be unsubstantiated.

Dialysis



- Patients receiving dialysis are at a higher risk of complications during hyperbaric treatment due to sudden fluid shifts from volume overload, causing acute pulmonary edema, similar to Congestive Heart Failure (CHF).
- To make HBOT safer for dialysis patients we should
 - Weigh patients to ensure they are not fluid overloaded on a daily basis
 - Consider canceling treatment on days where there is concern for fluid overload
 - HBOT appointments should be scheduled for after dialysis, if possible
 - If a patient misses dialysis for any reason, consider canceling HBOT until dialysis can take place if there is any concern of fluid overload
 - The provider may consider orders to treat dialysis patients lower and slower depending on each patient





Congenital Spherocytosis

Congenital or hereditary spherocytosis occurs because of a genetic mutation with the red blood cells (RBCs). Instead of being shaped like a disk, the cells are round like a sphere. These red blood cells (called spherocytes) are more fragile than disk-shaped RBCs. They break down faster and more easily than normal RBCs. This breakdown leads to anemia and other medical problems.

Congenital spherocytosis has been considered dangerous with use of HBOT, as the increased partial pressure of oxygen could cause hemolysis. However, there have been reports of patients being treated without issue.

Long-Term Use of High-Flow Oxygen**



- It had previously been theorized that patients that utilize High-Flow Oxygen regularly, are at an increased risk of Pulmonary Oxygen Toxicity which could burn the lungs.
- This theory has been disproven. During the Covid-19 outbreak, we learned that patients that had been surviving on high-flow Oxygen did not develop pulmonary oxygen toxicity. So our concerns are no longer valid.



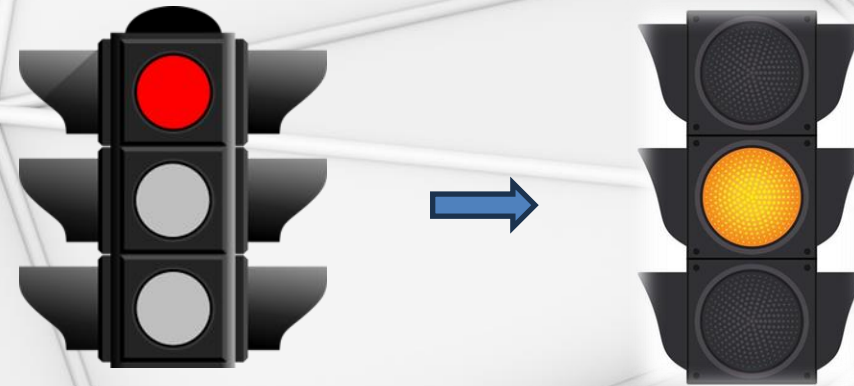


Seizure Disorders

High fever or epilepsy can decrease the seizure threshold, making oxygen toxicity more likely. The risk of HBOT-induced oxygen toxicity resulting in seizures in patients at increased risk of seizures due to history or recent brain surgery is unknown.

How can we make HBOT safer? Antiepileptics and fever control can help alleviate this risk. Take temperatures as part of daily vital signs to rule out high fevers. Ensure any patient with a seizure history is medically-managed. Always ask patients if they took their medication prior to treatment.

Trapped Air Spaces



- The body can have several air spaces that could trap air, leading to barotrauma in hyperbaric. The inability to equalize ear or sinus pressure, perhaps from previous surgery, radiation, or acute upper respiratory tract infection, could cause pain or barotrauma. A history of certain ear conditions requiring surgery, such as otosclerosis, can be problematic. Acutely congested patients or those with minor difficulty clearing their ears can be treated with decongestants and nasal spray. If ineffective or if the specific history of ear disease indicates, tympanostomy tubes should be placed before the initiation of HBOT.
- Eustachian tube dysfunction can increase the risk of barotrauma to the tympanic membrane. Therefore, it may be recommended that patients receive tympanostomy tubes before HBOT.
- A history of eye surgery may be a contraindication to HBOT if any air or gas is trapped in the eye, as expansion or contraction of gas could damage the eye.
- A history of thoracic surgery can increase the risk of atelectasis and pneumothorax in the setting of HBOT. A thorough assessment should be performed before proceeding.
- A history of spontaneous pneumothorax is a relative contraindication and may require further evaluation before starting HBOT.
- Do we need pulmonology clearance on every COPD patient or any one who has ever had a pulmonary concern? No.

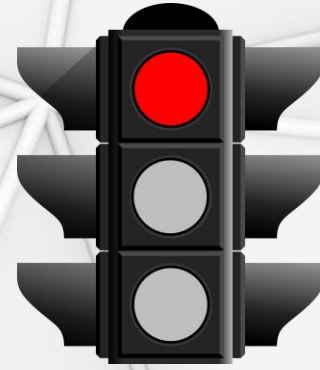
Cancer



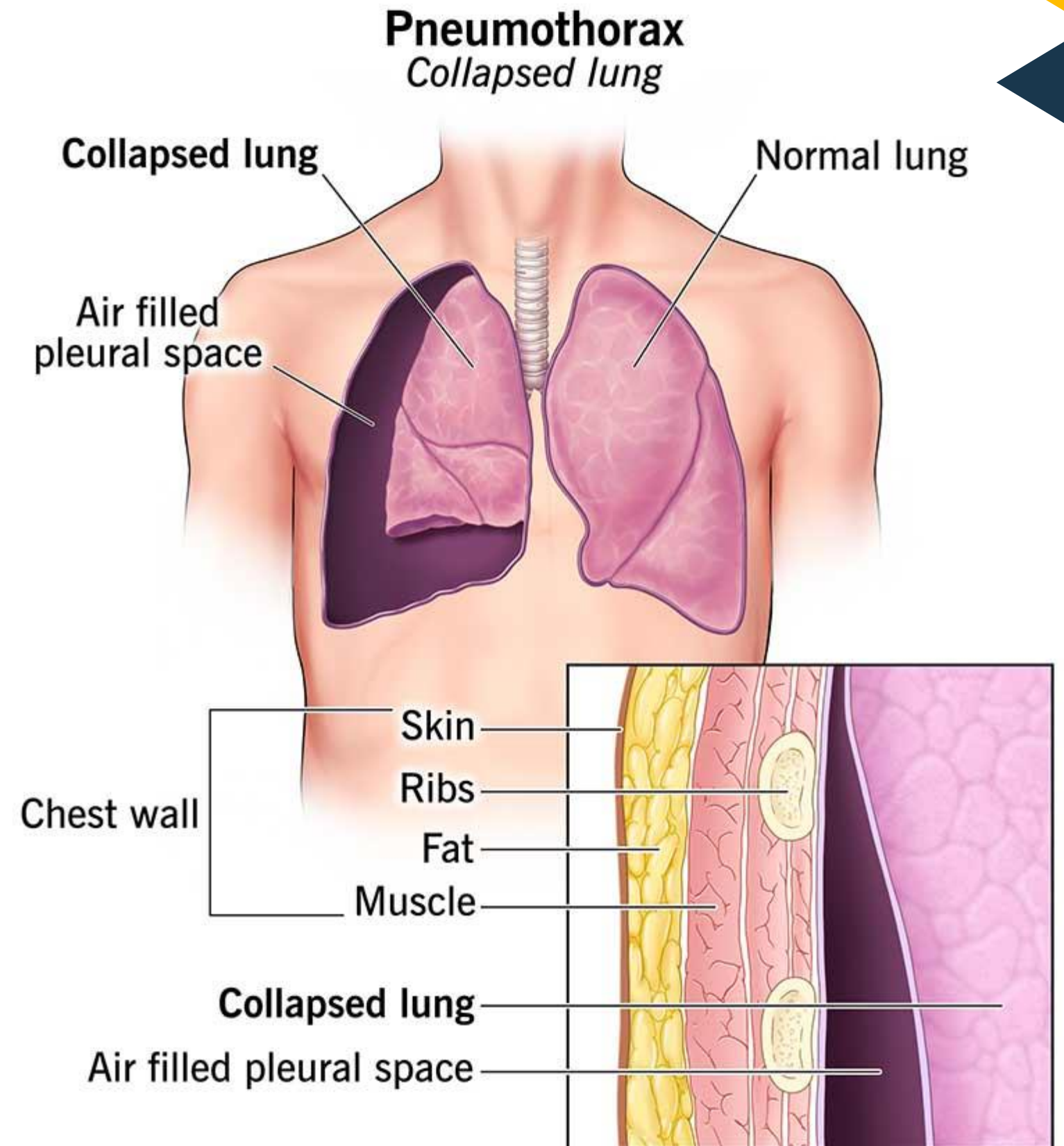
- At one point it had been hypothesized that active cancer would be a contraindication to HBOT. The proposed mechanism was that hyperbaric oxygen causes the release of vascular endothelial growth factor (VEGF) and could cause increased tumor growth. “If hyperbaric could reproduce other cells, it could reproduce cancer cells.” However, given the difference in tumor growth cycles versus wound healing, review has shown that the evidence reflects a neutral effect on gene expression related to tumor growth. Conclusively, it has been proven that hyperbaric oxygen therapy does not grow/spread cancer. It is safe for active cancer patients to receive HBOT.



Pneumothorax



- A pneumothorax occurs when air leaks into the space between your lung and chest wall. This air pushes on the outside of your lung and makes it collapse.
- An untreated pneumothorax is the only absolute contraindication for hyperbaric oxygen therapy.

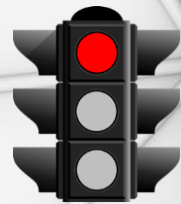


Conclusion



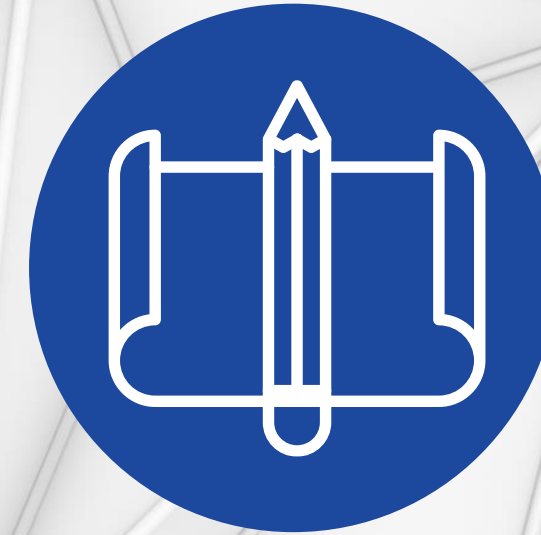
Absolute Contraindication

- Untreated Pneumothorax



Relative Contraindication

- CHF
- COPD
- Dialysis
- Seizures
- Spherocytosis
- Air Spaces



No Contraindication

- Active Cancer
- Long-Term High-Flow O2



Procedure

- Complete hyperbaric consultation as normal but ensure the physician clearing the patient is aware of the patient's comorbidities.
- Discuss the treatment protocol with the physician, such as treating at 2.0 ATA.
- Make sure the pre-treatment testing that was ordered, has been carefully reviewed and signed off by the physician.
- Obtain additional clearances if the hyperbaric physician has requested this be obtained from the patient's specialist, i.e., cardiac clearance from the patient's cardiologist, pulmonology clearance from the patient's pulmonologist, etc.
- Watch the patient closely during treatment. Do not hesitate to abort the treatment if the patient exhibits any sign of respiratory distress. Address any concerns with the overseeing physician, whether it is in pre-treatment vital signs, after the treatment, or anything in between.

Safe Treatment Protocols

- The clearing HBO physician will determine the treatment protocol. Dr. Serena and Matt Schweyer, Serena Group's National Hyperbaric Safety Director, can work with the physician to answer any questions. The general recommendation from Serena Group for patients that are not deemed “at-risk” is 2.4 ATA for 90 minutes with two 5-minute air breaks, with a rate set of 1.5 psi/min.
- Why do we treat patients at 2.4 ATA? The deeper you go; the more Oxygen is driven into the body's compartments.
- If a patient is deemed “at-risk” their treatment protocol should be modified. 2.0 ATA is a therapeutic treatment pressure and does not require air breaks. Why should we treat “at-risk” patients at a lower pressure? We lower the treatment pressure to decrease the likelihood of HBOT side effects.
- When should you lower the rate set? Rate set should be lowered when patients are new to treatment and are still adjusting to pressure differentials, as well as when patients have potential air-trapping diseases.

SOURCES

Hyperbaric Contraindications

[Hyperbaric Contraindications - StatPearls - NCBI Bookshelf \(nih.gov\)](#)

Congestive Heart Failure

[Hyperbaric Oxygen Therapy And Congestive Heart Failure \(woundreference.com\)](#)

Pulmonary Function After HBOT

[Pulmonary function following hyperbaric oxygen therapy: A longitudinal observational study - PMC \(nih.gov\)](#)





QUESTIONS?

A graphic for a quiz. The word "QUIZ" is written in large, bold, yellow letters with a blue outline and a white drop shadow. Above the word are three blue speech bubble icons with yellow outlines: the first contains an exclamation mark, the second contains a checkmark, and the third contains a question mark. The background is a white geometric pattern of interconnected lines. A large yellow diagonal stripe runs from the top right towards the bottom left. On the right side, there is a blurred photograph of a person standing in front of a group of people, some of whom have their hands raised.

QUIZ

QUESTION 1

A patient with a history of CHF comes in and the physician cleared them for treatment. You take their blood pressure, and it is 220/108. Their BP at every other treatment has been between 112-140 systolic and 70-90 diastolic. What should you do, primarily?

- a. Dive the patient but keep a watchful eye.
- b. Chart the BP and make sure the physician signs off on it when he/she completes the note.
- c. Notify the physician for further instruction before diving the patient.
- d. Wait 15 minutes and retake the BP.
- e. Do not treat the patient that day.

Answer

- a. Dive the patient but keep a watchful eye.
- b. Chart the BP and make sure the physician signs off on it when he/she completes the note.
- c. **Notify the physician for further instruction before diving the patient. (FIRST)**
- d. Wait 15 minutes and retake the BP.
- e. Do not treat the patient that day.

QUESTION 2

“High-Risk” patients may need to be treated at ____? ____ ATA unless otherwise determined by the clearing physician.



Answer

2.0 ATA

2.0 ATA is a therapeutic treatment pressure and does not necessarily require air breaks.

QUESTION 3

Which patients may require clearance by a cardiologist?



Answer

Congestive Heart Failure.

Important Note Not every CHF patient requires cardiac clearance. This is why we obtain pre-dive testing. Our HBO physicians are capable of clearing patients for HBOT.

QUESTION 4

A patient with COPD and CHF, that has an Ejection Fraction of 40% can **NOT** receive HBOT.

TRUE or FALSE?

EJECTION FRACTION

What the Numbers Mean



 Penn Medicine

Answer

FALSE

CHF patients with ejection fractions less than **30%** may need to be treated at 2.0 ATA and monitored closely throughout treatments. They're at higher risk for CHF exacerbation/acute pulmonary edema during HBOT.

HOUSEKEEPING



MEETING ATTENDANCE



July Attendance



Attended

- Mary Greeley Medical Center
- Wellspan Chambersburg
- Henry Ford
- Fairview

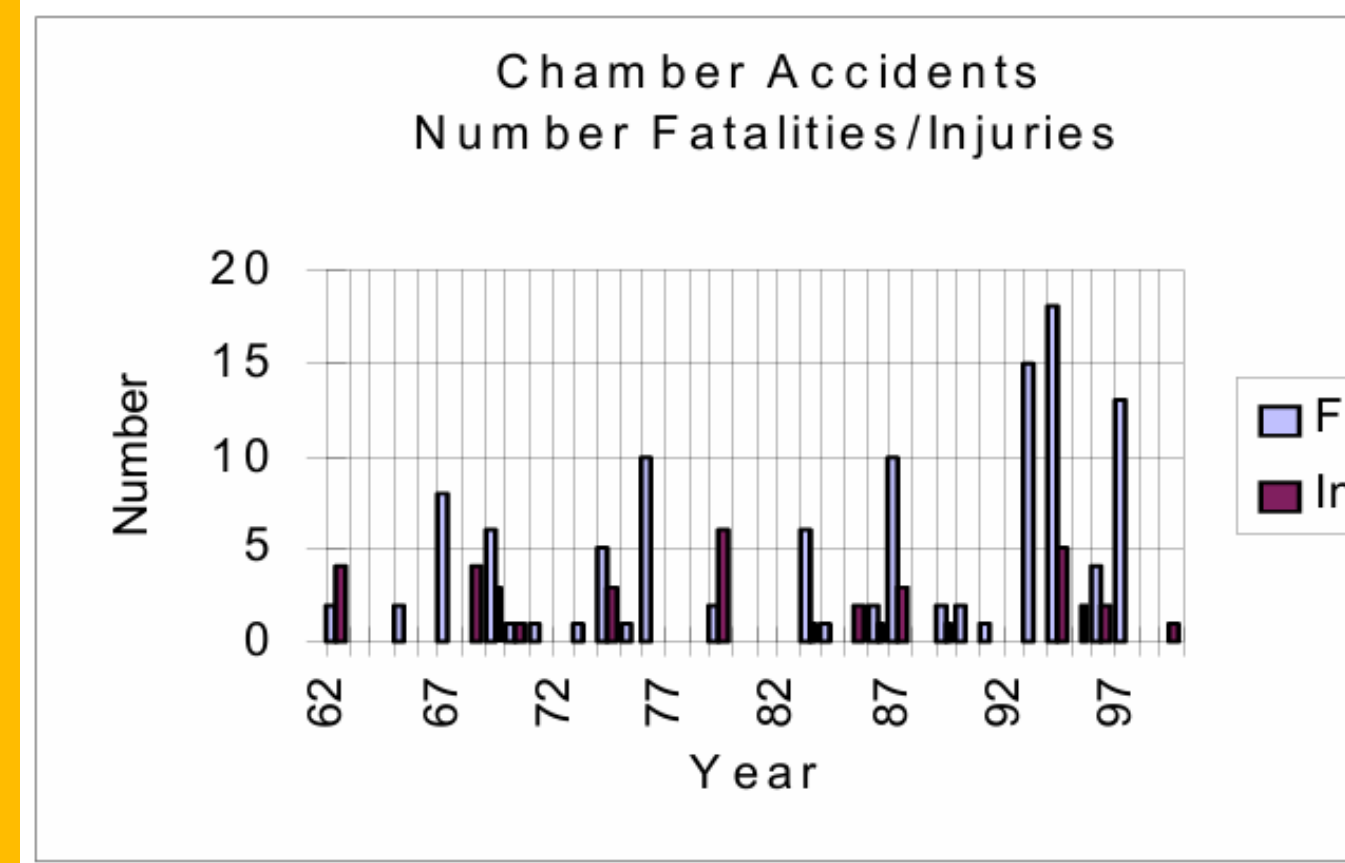
Unattended

- Berkshire
- Monroeville
- Inspira Health
- The Woodlands
- Cleveland Clinic Akron General
- Jackson Hospital
- Via Christi

If you were unable to be present at the meeting, please send a copy or picture of your completed quiz in the safety manual to ageorge@serenagroups.com or 609-202-6152.

ROUND TABLE?

- Follow up from last month: *“The first recorded accident in the Chamber Experience and Mishap Database is that from a Cunningham chamber dated from 1923, that accident did not result in either death or injury. Used outside the hospital in the cold environment of Kansas City, gas burners were placed under the chamber to heat the chamber. The heat rose enough one day to start smoldering and smoking. The occupants were escorted out without incident, however, it was recorded as the first hyperbaric chamber accident. Since that accident, there have been a total of 113 incidents which resulted in 135 deaths and 50 injuries over 75 years. In the first 44 years, 1923 to 1967, there were 15 incidents, a rate of 0.34 incidents per year. After 1967 that rate increased to an average of 3.2 incidents per year. This includes hyperbaric chambers, hypobaric chambers, diving bells, and space craft. Concomitant increases in the number of injuries and deaths followed the increase in incidents. It should be pointed out that the number of deaths has far out paced the number of injuries during this period. In the United States, the National Fire Protection Association (NFPA) published in 1969 a Manual on Fire Hazards in Oxygen-Enriched Atmospheres and later in 1970 a Standard for Hyperbaric Facilities. These manuals, which are updated and reviewed regularly, are primarily responsible for there never being a fire related death in a clinical hyperbaric chamber in the United States.”*



COMING UP NEXT MONTH

**Topic: Clean Chambers are Safe
Chambers!**

Presenter: Jackson Hospital

 **Date: September 3, 2024 at
12 pm eastern time**



HYPERBARIC CONTACTS

THANK YOU!



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