HYPERBARIC OXYGEN THERAPY

March 2025

Introduction

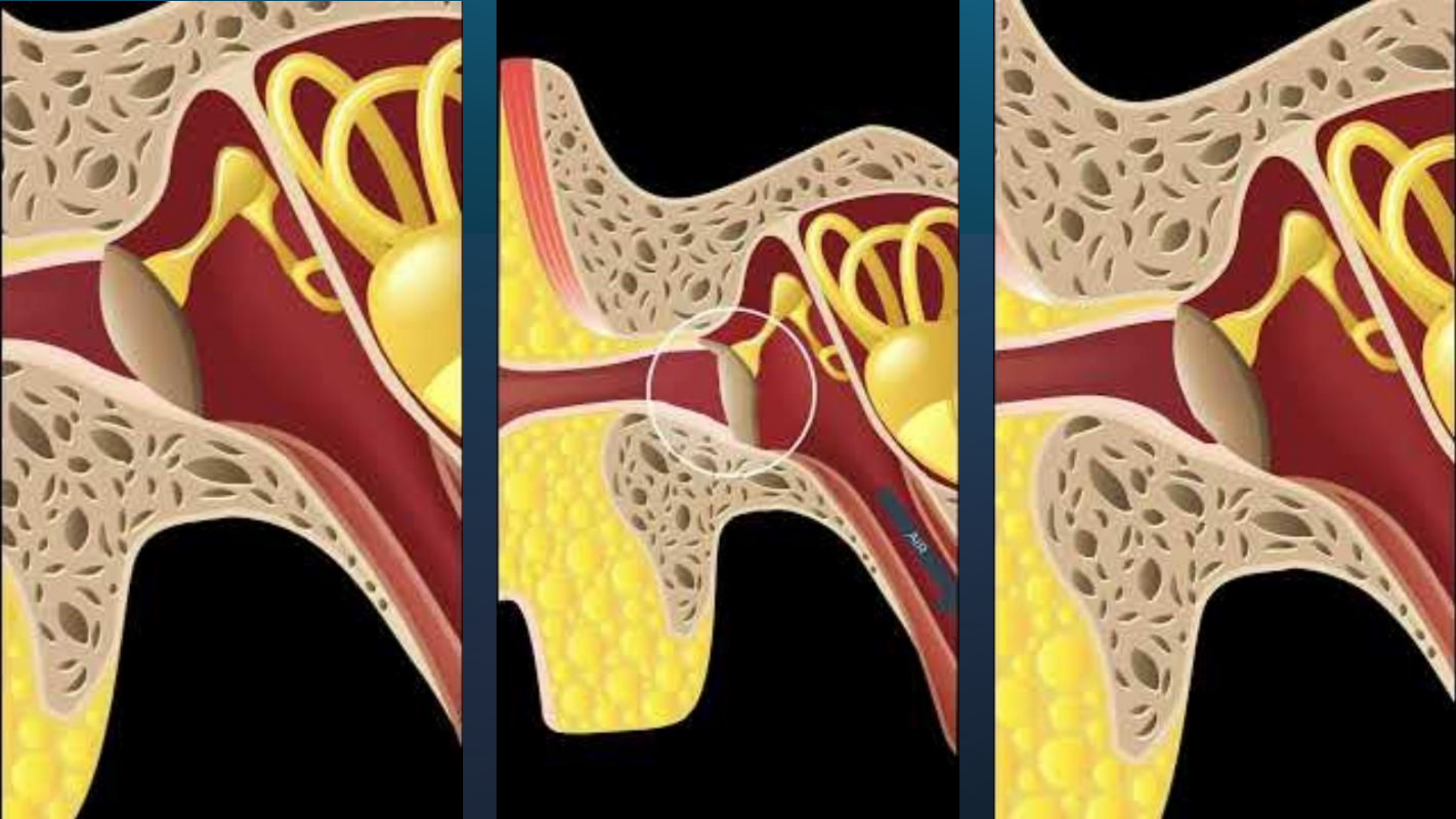
- Presenter: Janell Brookes
- Role: HBO Safety Technician/Safety Director
- Location: Cleveland Clinic Akron General Medical Center
- Time in the field: 5 Months in Hyperbaric Medicine
- 11 Years as A Registered Respiratory Therapist

This month's topic: Barotrauma

Overview: Barotrauma

Middle ear Barotrauma is the most common complication of Hyperbaric Therapy. During compression clearing the ears, auto inflation, 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. Auto inflation 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 using an auto inflation maneuver or yawning, swallowing, or taking a drink, may experience severe pain and potentially damage the tympanic membrane. Middle ear damage from pressure is called barotrauma. The underlying causes of barotrauma include an inability to auto inflate, artificial airways and damage to the eustachian tubes.


Air

Ear Clearing

TECHNIQUES FOR EQUALIZING

1.) VALSALVA MANEUVER- PINCH YOUR NOSTRILS AND BLOW THROUGH YOUR NOSE.

2.) TONYBEE MANEUVER – WITH YOUR NOSTRILS PINCHED, SWALLOW. THIS WILL PULL OPEN YOUR EUSTACHIAN TUBES WHILE THE MOVEMENT OF THE TONGUE WITH YOUR NOSE CLOSED, COMPRESSES AIR AGAINST THEM.

3.) LOWRY TECHNIQUE- WHILE CLOSING YOUR NOSTRILS, BLOW AND SWALLOW AT THE SAME TIME.

4.) EDMONDS TECHNIQUE- WHILE TENSING THE SOFT PALATE AND THROAT MUSCLES, PUSH THE JAW FORWARD AND DOWN.

5.) FRENZAL MANEUVER- CLOSE YOUR NOSTRILS AND CLOSE THE BACK OF YOUR THROAT AS IF STRAINING TO LIFT WEIGHT. THEN MAKE THE SOUND OF THE LETTER "K" FORCING THE BACK OF YOUR TONGUE UPWARD, COMPRESSING AIR AGAINST THE OPENING OF THE EUSTACHIAN TUBES.

6.) VOLUNTARY TUBAL OPENING – TENSE THE MUSCLES OF THE SOFT PALATE AND THROAT WHILE PUSHING THE JAW FORWARD AND DOWN, AS IF STARTING TO YAWN. THESE MUSCLES PULL THE EUSTACHIAN TUBES DOWN.

IN THE CHAMBER

- 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 auto inflate while the chamber is decompressing.
- Once a stable pressure has been reached, have the patient perform several auto inflation maneuvers.
- Once the patient and technician are satisfied, pressurization can recommence.
- If the 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."

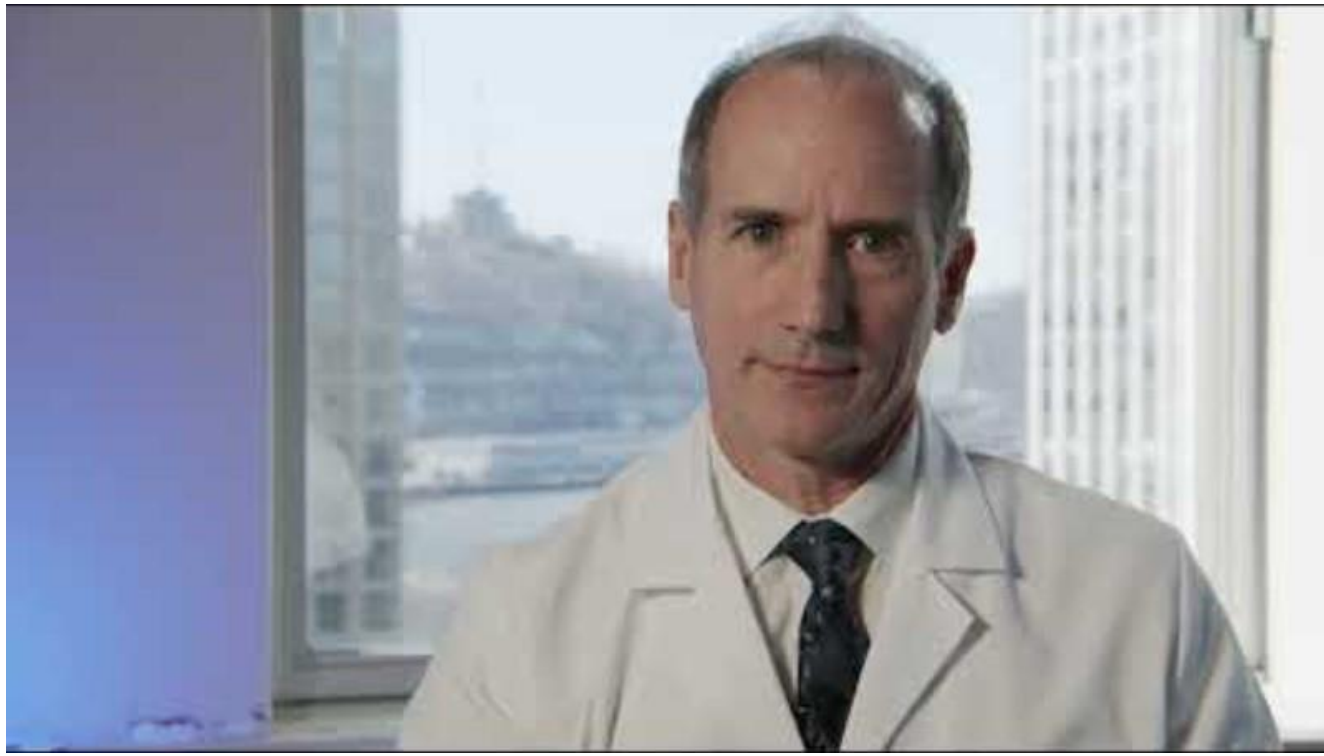
Ear Exam

- 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.
- TEED 0- Symptoms, such as pain or stiffness, with no physical findings
- TEED 1- Erythema or injection around the handle of the malleus, congestion around the umbo
- TEED 2- Erythema, injection, or congestion 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

A patient's ears are looked at before and after treatment by the provider.

TEED Scale

- Various grades of injury of TM
  - 1 – Capilary dilation
  - 2 – Mucosal edema
  - 3 – Hemorrhage into TM
  - 4 – Hemorrhage or serrous exudate
  - 5 – TM rupture
- Treat conservatively



Other Barotrauma Concerns

- Middle Ear barotrauma is not the only concern as any air-trapped space is subject to barotrauma. Although rarer than ear barotrauma, blocked sinuses or an air pocket in the tooth are also at risk for squeezing as the pressure changes in the chamber. Barotrauma can be extremely painful and will usually occur upon descent.
- Pulmonary barotrauma refers to the spontaneous rupture of alveoli and the subsequent release or dissection of air into the various extra alveolar spaces resulting in pneumothorax, pneumomediastinum, pulmonary interstitial emphysema, pneumatocele or air cyst formation, subcutaneous emphysema, pneumopericardium, and or pneumoperitoneum. We use a pre-treatment chest x-ray to rule out risk factors for pulmonary barotrauma.

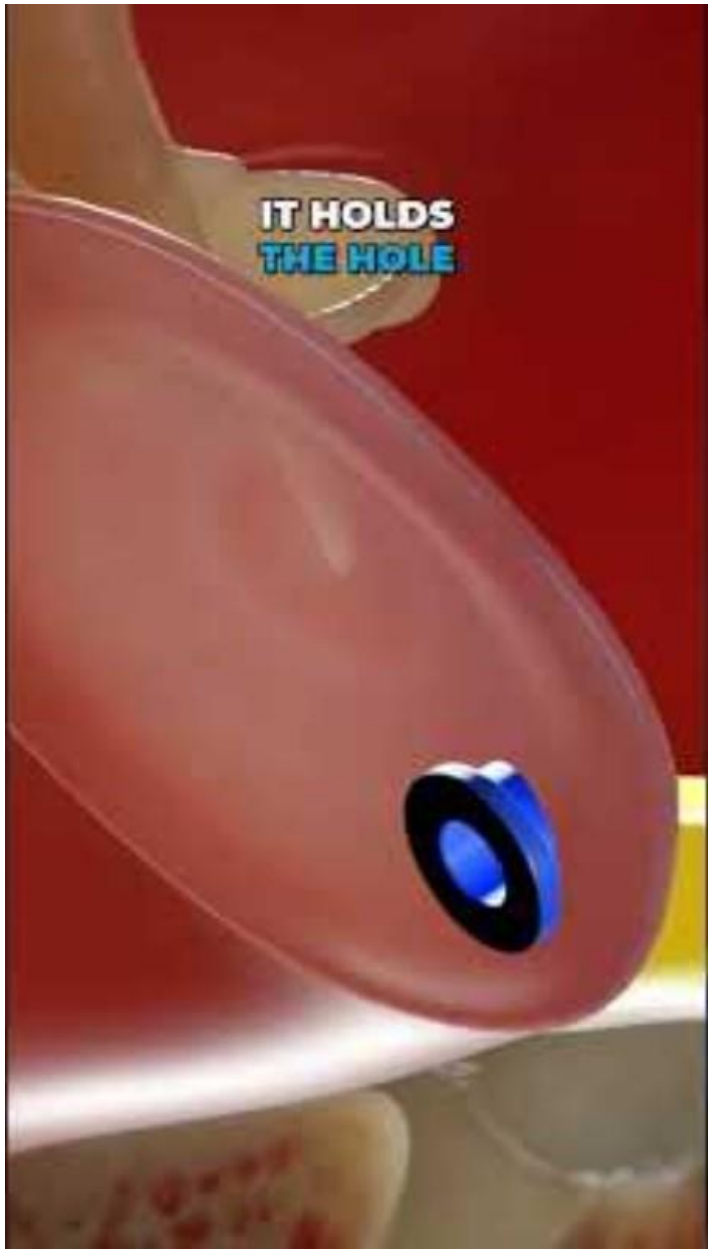
Preventing Barotrauma

- Obtain pre-treatment chest x-ray to rule out pneumothorax and identify increased risks for pulmonary barotrauma
- Teach patients what to expect with pressure changes in the chamber
- Train patients on ear clearing techniques
- Pay close attention for signs that a patient is struggling to clear their ears
- Discuss orders with the provider. Ask them to consider writing the order to reduce rate set prophylactically in new patients
- Educate patients during consultation to contact the office if they are having congestion symptoms. These symptoms put patients at a higher risk for barotrauma. If a patient calls to report these symptoms discuss with the provider if a decongestant recommendation can be made.

Ear Barotrauma Treatment

- **Myringotomy** is a surgical procedure that involves creating a small incision in the eardrum to relieve pressure or drain pus from the middle ear.

- **Tympanostomy** is the actual placement of ear tubes into the eardrum. It is often performed in conjunction with myringotomy to allow fluid to pass through the ear canal into the middle ear.



Quiz

Question 1

What is the most common complication of hyperbaric oxygen therapy?

Answer 1

Middle Ear Barotrauma

Question 2

Name 3 Areas that can be affected by Barotrauma

Answer 2

Blocked Sinuses, Airpocket in Tooth, Pulmonary Barotrauma

Question 3

Hemorrhage in the Tympanic Membrane is classified as a TEED 3.

True or False?

Answer 3

True

Question 4

How many times is considered reasonable to attempt to compress a patient during a single dive?

Answer 4

Reasonable to attempt to compress a patient up to 3 times.

Question 5

Boyle's Law: as pressure is increased, air-filled spaces will do what in volume?

Answer 5

As pressure is increased, air-filled spaces will decrease in volume.

Extra Credit Question

Have you ever put an inflated glove into the chamber during a test cycle? What occurs?

Round Table

- Welcome Merriann
- Radiation Cystitis Questionnaire
- No updates on the Troy, MI chamber fire
- HBO annual competency- are you up to date?
- Newly distributed medical necessity checklists- follow up
- Air break regulator settings (Perry 70 psig, Sechrist 50-70 psig and 30-40 LPM)
- NEW Daily and Weekly Checklists!!!!!
- NEW Chamber Emergency Cards!!!!!

Daily Chamber Checklist (Perry-Pneumatic)

Use a separate checklist for each chamber. Put a check on each line as completed unless otherwise indicated to enter a value or mark N/A if not applicable.

Week Of (MM/DD/YYYY):	MON	TUE	WED	THU	FRI
Initials of person completing checklist					
Chamber Serial #_____					
Oxygen supply pressure reading at alarm panel (50-90 psi) **Enter value →**					
Oxygen supply pressure reading at chamber console (50-90 psi) **Enter value →**					
Air tank level checked (change below 500 psi) **Enter value →**					
Air tank regulator gauge set to 70 psig					
Air break equipment ready & disinfected (Demand System ONLY)					
Chamber covers completely removed and stored in a professional manner					
Chamber grounds are connected and without damage (back of chamber and patient grounding strap), check continuity with multimeter (less than 1 ohm Ω) **Enter value →**					
Chamber supply/vent hoses without obvious leaks, kinks, or damage					
Inspect acrylic chamber hull for scratches and/or crazing					
Inspect both the green oxygen supply and red exhaust bypass indicators to ensure that the lenses are in place and undamaged					
Turn the communication switch to the on-position, green light should be on					
Turn on entertainment					
Switch communications panel to Test, ensure system works properly					
Inspect chamber door gasket for damage					
Inspect chamber controls for damage or loose knobs					
Inspect chamber interior and exterior for cleanliness					
SHUTDOWN CHECKLIST:					
Initials of person completing checklist					
Turn oxygen and air supply to chamber off (change air tank if below 500psi) **Enter value →**					
Ensure System ON/OFF switch is OFF. Confirm that indicator eye is NOT showing green					
Turn off entertainment					
Ensure communication switch is **OFF,** (green light will go out)					
Clean chamber interior/exterior and cover					

Person Completing: _____ Initials _____ Person Completing: _____ Initials _____

Daily Chamber Checklist (Sechrist)

Use a separate checklist for each chamber. Put a check on each line as completed unless otherwise indicated to enter a value or mark N/A if not applicable.

Week Of (MM/DD/YYYY):	MON	TUE	WED	THU	FRI
Initials of person completing checklist					
Chamber Serial #_____					
Oxygen supply pressure reading at alarm panel (50-90 psi) **Enter value →**					
Oxygen supply pressure reading at chamber (50-90 psi) **Enter value →**					
Air tank level (change below 500 psi) **Enter value →**					
Air tank regulator gauge set between 50-70 psi					
Air break equipment disinfected (demand valve only)					
Chamber covers completely removed and stored in a professional manner					
Chamber grounds are connected and without damage (back of chamber and patient grounding strap), check continuity with multimeter (less than 1 ohm Ω) **Enter value →**					
Chamber supply/vent hoses without kinks or damage					
Inspect acrylic chamber hull for scratches and/or crazing					
AC power connected and green LED lit					
Turn on entertainment					
With door open, rotate swing arm lever to closed position and turn master valve on. Check air flow and function of intercom (volume up and pick up handset)					
Inspect chamber door gasket for damage					
Inspect chamber controls for damage or loose knobs					
Inspect chamber interior and exterior for cleanliness					
SHUTDOWN CHECKLIST					
Initials of person completing checklist					
Turn off entertainment					
Turn the master valve to the OFF position					
Turn oxygen and air supply to chamber off (change air tank if below 500psi) **Enter value→**					
Clean chamber interior, exterior and cover					

Person Completing: _____ Initials _____ Person Completing: _____ Initials _____

Weekly Checklists

SECHRIST WEEKLY CHAMBER CHECKLIST

Please use a separate checklist for each chamber. Initial each line as completed or enter a value where indicated.

MONTH/YEAR: _____	1	2	3	4	5
Week:					
Chamber #: _____					
Clean gurneys thoroughly with approved disinfectant					
Deep clean chamber interior and exterior					
Inspect acrylic for cracks, nicks, discoloration, scratches, or crazing					
Inspect chamber door latching mechanism for ease of operation and positive latching					
Inspect door cam, clean if necessary and lightly lubricate with halocarbon grease					
Close and lock chamber, turn Master Valve to **On**					
Pressurize the chamber to approximately 3.0 ATA and set the ventilation control to minimum					
Adjust the ventilation control to maximum. Chamber Pressure gauge may drop slightly, ensure pressure is not being lost significantly					
Turn the Master Valve **Off** and Emergency Vent/Emergency toggle the chamber to 0.5 PSI (alternate weekly to test both methods)					
Time decompression (≤ 2 minutes, unless chamber installed prior to 2002, then decompress in ≤ 3 minutes) **Enter value →**					
Ensure locking pin disengages after emergency vent by opening chamber door					
Smoke hoods located in center, check expiration dates					
Check grounding bracelets and plug for tightness and damage. Using a voltmeter on the Ω setting, check ground continuity, reading should be less than 1 Ω. **Enter value →**					

Signature _____ Initial _____

PERRY WEEKLY CHAMBER CHECKLIST

Please use a separate checklist for each chamber. Initial each line as completed or enter a value where indicated.

MONTH/YEAR: _____	1	2	3	4	5
Week					
Chamber Serial #_____					
Clean gurneys thoroughly with approved disinfectant					
Clean chamber interior & exterior, including muffler & air break					
Inspect acrylic for cracks, nicks, discoloration, scratches, or crazing					
Inspect chamber door latching mechanism for ease of operation and positive latching					
Inspect door cam, clean if necessary and lightly lubricate with halocarbon grease					
Close and lock chamber, turn system switch to **On**					
Pressurize the chamber to approximately 3.0 ATA and set the ventilation control to minimum (if chamber has ventilation control)					
Adjust the ventilation control to maximum. Chamber Pressure gauge may drop slightly, ensure pressure is not being lost significantly					
Turn the system **Off** and emergency vent the chamber to 0.5 PSI using the Exhaust Bypass button					
Time decompression (≤ 2 minutes, unless chamber installed prior to 2002, then decompress in ≤ 3 minutes) **Enter value→**					
Ensure locking pin disengages after emergency vent by opening chamber door					
Smoke hoods located in center, check expiration dates					
Check grounding bracelets and plug for tightness and damage. Using a voltmeter on the Ω setting, check the patient grounding strap, reading should be less than 1 Ω. **Enter value→**					

Signature _____ Initial _____

Attendance: February

In Attendance:

- Henry Ford
- Chambersburg
- Fairview
- Inspira
- Monroeville
- Jackson
- Akron
- MGMC

Absent:

- Woodlands
- ACMH

Topic: Seizures

April 1st, 2025
At 12:15pm eastern time

Has Presented In 2025…

-Ally
-ACMH
-Akron

Has NOT Presented In 2025…

-Chambersburg
-Fairview
-Henry Ford
-Inspira
-Jackson
-MGMC
-Monroeville
-Woodlands

Contact Us

QUESTIONS/PROBLEMS

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THANK YOU !!!