

Baromedical Nurses Association (BNA)

Guidelines of Nursing Care for the Patient Receiving Hyperbaric Oxygen Therapy (HBO₂)

Position Statement: These hyperbaric nursing guidelines reflect and promote actual knowledge and judgment to practice hyperbaric nursing safely. It is recommended that each facility develops guidelines based on, but not limited to, the hyperbaric nursing guidelines, the Policy and Procedure Guidelines for Hyperbaric Facilities, the National Fire Protection Association (NFPA 99) and their own facility guidelines.

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PROBLEM	GOAL	INTERVENTIONS
<p>1. Knowledge deficit related to hyperbaric oxygen therapy and treatment procedures</p>	<p>Patients and/or family will demonstrate learning using the teach back/return demonstration method</p>	<ul style="list-style-type: none"> • Assess and document patient and/or family’s understanding of purpose and goals of hyperbaric oxygen therapy, procedures involved, and potential hazards of hyperbaric oxygen therapy • Utilize teach back method to confirm patient understanding • Identify and address barriers to learning: <ul style="list-style-type: none"> ○ Involve interpreter if indicated ○ Apply age-specific teaching ○ Consider cultural/religious factors ○ Assess readiness to learn ○ Identify patient's expectations of treatment • Discuss sequence of treatment procedures and what to expect, e.g. pressure, temperature, noises, wound care • Provide orientation to the hyperbaric environment, including chamber orientation, middle ear equalization, fire hazards, safety policies and procedures, risk and benefits of hyperbaric oxygen therapy • Document patient/family teaching, their understanding of instructions and any return demonstrations • Allow continued opportunities for discussion, questions and instruction • Provide patient and/or family with written education on hyperbaric oxygen therapy • Discuss post treatment education: <ul style="list-style-type: none"> ○ Assess for knowledge deficits related to underlying pathology and provide appropriate information specific to the patient's disease process ○ Provide written discharge instructions appropriate to the patient’s age, developmental level and culture/language

PROBLEM	GOAL	INTERVENTIONS
<p>2. Potential for anxiety related to hyperbaric oxygen treatments or other medical procedures</p>	<p>Patients will tolerate hyperbaric oxygen treatment and other medical procedures with minimal anxiety</p>	<ul style="list-style-type: none"> • Assess patient for history of confinement anxiety • Implement preventative measures as appropriate: <ul style="list-style-type: none"> ○ Patient education (see guideline 1) ○ Reinforce to patient they will not be left alone and staff are trained for emergency procedures ○ Empower patient; he or she is in charge and may request to end treatment at any time ○ Collaborate with physician or practitioner to consider anxiolytic medication • Identify signs and symptoms of anxiety before and during HBO2 treatment: <ul style="list-style-type: none"> ○ Patient verbal admission of anxiety ○ Clenching of fists ○ Flushed face ○ Complaint of nausea or diarrhea ○ Sudden complaint of pain or discomfort ○ Feelings of being smothered or suffocated ○ Urgency to empty bladder ○ Defensive attitude ○ Hyperventilation ○ Profuse diaphoresis ○ Flat affect ○ Tachycardia / reports of heart palpitations (Note: this may also be a sign of oxygen toxicity) ○ Restlessness ○ Sudden complaint of feeling warm/hot during treatment • Follow the recommended interactions to reduce anxiety during hyperbaric oxygen treatments: <ul style="list-style-type: none"> ○ Stay in patient's visual field ○ Address patient calmly

PROBLEM	GOAL	INTERVENTIONS
		<ul style="list-style-type: none"> ○ Establish eye contact with the patient ○ Reassure patient that he/she is safe ○ Encourage relaxation techniques and offer diversional activities; TV, music, books on tape, family member at chamber side as appropriate per HIPAA standards as patient privacy and safety may be a concern ○ Assure patient of hyperbaric trained nurse presence throughout treatment ○ Notify provider of patient's response to the anti-anxiety measures and ability to tolerate confinement
PROBLEM	GOAL	INTERVENTIONS
<p>3. Potential for injury within the hyperbaric facility related to transferring patient in/out of chamber</p>	<p>Patients will not experience any injury</p>	<ul style="list-style-type: none"> ● Comply with facility fall risk/prevention policy; assess patient's potential risk for fall, discuss safety measures and apply precautions as appropriate ● Communicate plan with patient and staff involved prior to taking action ● Provide patient education regarding safety precautions ● Provide patient assistance with transfers according to patient needs and facility policy: <ul style="list-style-type: none"> ○ 1-2 person assist as necessary ○ Use of gait belt as necessary ○ Use of foot stool and/ or lower stretcher to load patient ○ Use of slide board, or other transfer equipment as necessary, ensuring all equipment is removed prior to HBO2 treatment ○ Use side rails on stretcher, as appropriate ● Use hospital approved mechanical lift equipment and transfer devices when indicated, assuring all material used is removed prior to HBO2 treatment

PROBLEM	GOAL	INTERVENTIONS
		<ul style="list-style-type: none"> • Follow Safety Time Out/Pause (STOP) procedure prior to beginning any HBO2 treatment • Equipment located in the hyperbaric room should only include items necessary to provide patient care • All patient care equipment in the facility should be in good working order at all times and inspected per facility policy • It is the responsibility of all staff operating hyperbaric equipment to be knowledgeable of any potential hazard
PROBLEM	GOAL	INTERVENTIONS
<p>4. Potential for injury related to fire within the hyperbaric chamber</p>	<p>Patients will receive safe care throughout their admission</p>	<ul style="list-style-type: none"> • Hyperbaric oxygen treatment involves a fuel source (the patient, linen, equipment, dressing's supplies, etc.) in an oxygen - enriched atmosphere in a hyperbaric chamber • The fire triad is made up of fuel, oxygen and an ignition source. To complete the fire triad in the hyperbaric environment, an ignition source is necessary. This can occur from a spark in the chamber • Follow fire prevention procedures per facility established policy and procedure for Class A and Class B Chambers: <ul style="list-style-type: none"> ○ Oxygen levels shall be continuously monitored in Class A chambers in accordance with NFPA guidelines; ensuring chamber oxygen concentration does not exceed 23.5% ○ Hyperbaric oxygen treatment teaching and consent of the patient will include the risks of fire in the hyperbaric environment ○ Provide the patient/family with written instructions that provides information concerning prohibited materials in the hyperbaric environment to reduce the potential for fire

PROBLEM	GOAL	INTERVENTIONS
		<ul style="list-style-type: none"> ○ Staff will conduct and document a safety check/time out prior to each treatment to ensure fire safety precautions are met ○ Prohibited items are not allowed in the chamber. The Safety Director, in collaboration with the Medical Director, will determine the medical necessity of normally prohibited items, complete a risk analysis and institute additional safety measures as indicated ○ Grounding will be checked in all types of chambers according to NFPA and facility guidelines before operating the HBO2 chambers ○ Each facility is encouraged to conduct fire safety drills on a monthly or at least quarterly basis. A timed worst-case scenario drill shall be completed at least annually ○ All staff will participate in timed fire drills at least annually, to ensure preparedness in accordance with NFPA and industry standards ○ Casts must be allowed to cure before going in any oxygen enriched atmosphere
PROBLEM	GOAL	INTERVENTIONS
<p>5. Potential for injury related to changes in atmospheric pressure inside the hyperbaric oxygen chamber</p>	<p>Patients and inside tenders will not experience barotrauma during HBO2 treatment</p>	<p>Ear Barotrauma</p> <ul style="list-style-type: none"> • Assess patient’s and inside attendant’s knowledge of ear clearing techniques and ability to equalize pressure • Collaborate with practitioner to assess tympanic membrane (TM) prior to first HBO2 treatment, after any suspected barotrauma and as needed • Collaborate with practitioner to describe and document observations including color and visibility of TM, presence of wax, blood/fluid/air and any hearing deficits • Provide patient education prior to HBO2 therapy including:

PROBLEM	GOAL	INTERVENTIONS
		<ul style="list-style-type: none"> ○ Methods to equalize pressure in middle ear during treatment e.g. yawning, swallowing, jaw thrust, head tilt, Valsalva, Toynbee, Roydhouse, Frenzel etc. ○ Demonstration of equalization techniques ○ Reinforce importance of notifying chamber operator immediately when pressure or fullness is felt in middle ear ● Chamber operator will stop compression when patient is unable to equalize pressure and should return to the point of no pain/pressure prior to asking patient to equalize ears ● Identify nonverbal signs patient may be unable to equalize pressure including pulling on ear or applying pressure to tragus ● May elevate head of bed (HOB) during HBO2 therapy to assist in equalization of middle ear, when appropriate ● Identify patients who may benefit from ENT referral for possible myringotomy or tympanostomy/PE tube placement ● Administer decongestants per physician orders, prior to HBO2 <ul style="list-style-type: none"> ○ Assess for adverse blood pressure elevation due to concomitant use of sympathomimetic medications and hyperbaric oxygen therapy <p>Sinus or tooth</p> <ul style="list-style-type: none"> ○ Provide patient education regarding potential for sinus or tooth squeeze ○ Observe symptoms of squeeze on compression and decompression ○ Hold chamber pressure, instruct patient to blow nose, drink water etc. ○ Tooth squeeze – instruct patient to rub affected area

PROBLEM	GOAL	INTERVENTIONS
		<ul style="list-style-type: none"> ○ Slow decompression <p>Gastrointestinal Barotrauma (GI)</p> <ul style="list-style-type: none"> ○ GI barotrauma may occur on decompression if a patient has a propensity toward production or retention of GI gas. Though rarely injurious, it can be uncomfortable ○ Symptoms include a feeling of pain, discomfort, fullness or bloating in the abdomen ○ Decompression should be slowed or halted to allow the patient time to expel the gas <p>Pneumothorax</p> <ul style="list-style-type: none"> • Identify patients at greater risk for development of a pneumothorax. e.g., recent invasive procedures in the chest, history of spontaneous pneumothorax, chronic obstructive pulmonary disease (COPD) or other bullous lung disease • Monitor for any sudden cardiopulmonary decompensation during decompression as this may indicate a tension pneumothorax • Specific symptoms of tension pneumothorax include: <ul style="list-style-type: none"> ○ Sudden, sharp chest pain ○ Difficult, rapid breathing, shortness of breath ○ Rapid heart rate ○ Cough ○ Tracheal shift ○ Abnormal chest movements on the affected side ○ Cyanosis • Notify physician or provider follow orders for patient management: <ul style="list-style-type: none"> ○ Ensure supplies for emergent needle decompression are available and ready ○ Chamber should not be decompressed until preparations are made for emergency management of pneumothorax and authorized

PROBLEM	GOAL	INTERVENTIONS
		<p>by attending physician or until chest decompression is performed at pressure in a multi-place chamber</p> <ul style="list-style-type: none"> • Document according to facility guidelines • Follow facility emergency procedures
PROBLEM	GOAL	INTERVENTIONS
<p>6. Potential for injury related to central nervous system oxygen toxicity or seizure secondary to 100% oxygen at increased atmospheric pressure</p>	<p>Signs and symptoms will be recognized and promptly addressed. Seizing patient will suffer no harm</p>	<ul style="list-style-type: none"> • Provide patient and/or family with education about oxygen toxicity risks, and the signs / symptoms of central nervous system oxygen toxicity • Assess patient prior to HBO₂ treatment for increased risk factors such as: <ul style="list-style-type: none"> ○ Elevated core temperature ○ History of seizures ○ History of brain injury/surgery ○ Acute carbon monoxide (CO) poisoning ○ Use of medications that may lower the seizure threshold ○ Recommend reviewing all patient medications for potential to lower seizure threshold ○ Metabolic acidosis ○ Dehydration ○ Hypoglycemia • Monitor patient during HBO₂ and document signs and symptoms of central nervous system oxygen toxicity including: <p>V-E-N-T-I-D-C-C or V-E-N-T-I-D-S-H-H</p> <ul style="list-style-type: none"> ○ V - Visual changes (acute): tunnel or blurred vision ○ E - Ears – auditory hallucinations, ringing or roaring in the ears

PROBLEM	GOAL	INTERVENTIONS
		<ul style="list-style-type: none"> ○ N – Nausea Numbness ○ T- Twitching of muscles (usually facial), Tingling in the extremities ○ I – Irritability, personality change or Restlessness ○ D - Dizziness - Vertigo ○ C- Convulsions – Seizure activity ○ C- Change in affect ○ S Shortness of breath ○ H - Hiccups ○ H - Heart rate increased <ul style="list-style-type: none"> ● Reinforce to the patient the importance of notifying the chamber operator if they feel different or funny in the chamber ● If any symptoms occur including a seizure, follow the facility emergency guidelines: <ul style="list-style-type: none"> ○ Remove BIBS masks/hood (Class A) ○ Instruct patient to apply air mask (Class B) or appropriate device ○ Follow seizure procedure, In Class B chamber do not decompress patient during seizure, wait for spontaneous respirations to return and then decompress ○ In a Class A chamber, collaborate with the practitioner to follow established guidelines, e.g. the U.S. Navy’s for treating CNS oxygen toxicity during treatment or follow practitioner orders for continuation or discontinuation of treatment

PROBLEM	GOAL	INTERVENTIONS
7. Potential for impaired gas exchange related to pulmonary oxygen toxicity	Signs and symptoms of pulmonary oxygen toxicity will be recognized and promptly addressed	<ul style="list-style-type: none"> • Provide patient and/or family with information about risks, signs and symptoms of pulmonary oxygen toxicity • Monitor patient for symptoms of pulmonary oxygen toxicity during HBO2 treatments: <ul style="list-style-type: none"> ○ Dry cough ○ Air hunger ○ Substernal irritation or burning ○ History of high FiO2 ○ Substernal irritation or burning ○ Tightness in the chest ○ Dry hacking cough ○ Shortness of breath (SOB) ○ Difficulty inhaling a full breath ○ Dyspnea on exertion ○ Notify the physician or practitioner if signs and symptoms of pulmonary oxygen toxicity appear ○ Add humidity to oxygen as needed to reduce chest discomfort (multi-place only)
PROBLEM	GOAL	INTERVENTIONS
8. Potential for adverse events related to hemodynamic changes secondary to HBO2 treatment	Signs and symptoms of physiologic distress will be recognized and promptly addressed	<ul style="list-style-type: none"> • Patients with severe congestive heart failure (CHF) and/or a history of CHF exacerbations may be at risk of worsening CHF in the hyperbaric environment due to the vasoconstrictive effects of hyperbaric oxygen. The hyperbaric physician or practitioner should evaluate individual risk, weigh that risk against the potential benefit of HBO2 therapy, and re-assess the patient throughout treatment • Nursing assessment of these patients should include evaluation for jugular vein distention, adventitious heart sounds, and signs and symptoms of fluid accumulation in the lungs and lower extremities:

PROBLEM	GOAL	INTERVENTIONS
		<ul style="list-style-type: none"> ○ Assess patient according to facility heart failure guidelines ○ Assess fluid and electrolyte balance per provider order ○ Assess patient’s vital signs as indicated including daily weights <p>Whelan and Kindwall (2017) states “baseline left ventricular ejection fraction (EJF) is not a predictor of CHF outcomes. The EJF percentage ought not to be used as a criterion for inclusion or exclusion from HBO.”</p>
PROBLEM	GOAL	INTERVENTIONS
<p>9. Potential for ineffective breathing gas delivery related to patients needs/limitations</p>	<p>Signs and symptoms of inadequate gas delivery will be recognized and corrected promptly</p>	<ul style="list-style-type: none"> ● Assess the patient’s condition, needs, and limitations for the best suited gas delivery systems ● Monitor the patient’s response to the oxygen delivery system, including their ability to tolerate chosen system ● Assist the hyperbaric technician with the delivery system, as appropriate ● Follow facility guidelines for infection control for all equipment <p>Oxygen Treatment Hood</p> <ul style="list-style-type: none"> ○ Assist patient with application and removal of neck seal and hood ○ Ensure that oxygen flow is sufficient to ventilate the treatment hood and maximize FiO₂ ○ After assembly, check for leaks ○ Observe patient for signs of inadequate treatment hood ventilation such as fogging, restlessness, anxiety and overt symptoms of CO₂ toxicity <p>Face mask/Mouth Piece</p>

PROBLEM	GOAL	INTERVENTIONS
		<ul style="list-style-type: none"> ○ Assist patient with mask application and removal, and reposition mask/mouth piece as needed (monoplace) ○ Check for leaks, continuity of seal against the patient's face, keep tight fit around mouth piece ○ If using a Built-In Breathing Systems (BIBS) mask, ensure that the straps are adjusted for patient comfort and a tight seal <p>T-Piece (Briggs adapter) (Multiplace)</p> <ul style="list-style-type: none"> ○ Set up equipment ○ Monitor patient's rate and depth of respirations, listen to breath sounds ○ Notify the hyperbaric physician if patient is experiencing difficulty breathing ○ Have intravenous (IV) access for medication administration if needed ○ Suction as needed <p>Ventilator</p> <ul style="list-style-type: none"> ○ Ensure that endotracheal tube (ET) or tracheostomy cuff is inflated with normal saline (NS) prior to pressurization and replace the saline with air after treatment ○ Keep suction equipment nearby and ready to use ○ Monitor and document patient's tidal volume per Wrights spirometer, respiratory rate and breath sounds prior to chamber pressurization, during and after chamber pressurization and then every 10-15 minutes, or as ordered ○ Monitor patient for respiratory distress and notify hyperbaric physician if apparent ○ Manually ventilate the patient with a bag valve device if necessary during pressurization and

PROBLEM	GOAL	INTERVENTIONS
		<p>depressurization of the chamber and as needed during treatment in a Class A chamber</p> <ul style="list-style-type: none"> ○ Monitor PtcO₂ levels per transcutaneous monitor in monoplace chamber ○ Monitor pulse oximetry or arterial blood gas (ABG) levels if possible and as ordered for multiplace chamber patients ○ Notify hyperbaric physician of abnormal findings
PROBLEM	GOAL	INTERVENTIONS
<p>10. Potential for pain related to hyperbaric oxygen treatment and patient's associated medical problems</p>	<p>Patients will state satisfaction with pain management</p>	<ul style="list-style-type: none"> ● Assess pain level and document according to facility guidelines ● Address patient's needs related to pain ● Assess patient's experience of pain and whether pain is increased during HBO₂ treatment ● Avoid intramuscular (IM) medications immediately prior to treatment due to vasoconstriction affect from HBO₂ treatments ● Provide non-pharmacological pain reducing interventions: <ul style="list-style-type: none"> ○ Relaxation techniques ○ Distraction ○ Repositioning ○ Family present at chamber side as appropriate
PROBLEM	GOAL	INTERVENTIONS
<p>11. Discomfort related to temperature and humidity changes inside hyperbaric chamber</p>	<p>Patients will tolerate the internal climate of the chamber</p>	<ul style="list-style-type: none"> ● Provide patient education related to temperature changes with compression and decompression ● Periodically assess patient's comfort with temperature changes

PROBLEM	GOAL	INTERVENTIONS
		<ul style="list-style-type: none"> • Offer patient comfort measures, such as blankets, increasing ventilation in the chambers or use of environmental control system (multiplace) • Monitor room temperatures according to NFPA guidelines
12. Potential for ineffective individual coping related to stresses of illness and/or poor psychosocial support systems	Patients will be able to verbalize and demonstrate effective coping during HBO2 treatment	<ul style="list-style-type: none"> • Assist patient/family to identify coping skills, available support systems, cultural and spiritual values • Provide emotional support, including active listening and acknowledgement of concerns • Offer other support services as needed and as available in the facility
PROBLEM	GOAL	INTERVENTIONS
13. Altered tissue perfusion related to carbon monoxide poisoning, decompression sickness, gas embolism and other neurological conditions.	Signs and symptoms of inadequate tissue perfusion will be recognized and promptly addressed	<ul style="list-style-type: none"> • Collaborate with the provider to perform baseline neurological assessment prior to treatment • Perform neurological checks per established protocol and provider order • Use a common metric, such as Glasgow Coma Score to facilitate communication and determination of altered level of consciousness • Assess and document patient's motor and sensory functioning as ordered • Monitor other signs of poor end organ perfusion per physician order: <ul style="list-style-type: none"> ○ Laboratory values, e.g. liver and kidney function ○ Shock ○ Respiratory failure/adult respiratory distress syndrome (ARDS) • Provide reorientation and emotional support as needed • Notify provider of changes • Discharge instructions for decompression sickness (DCS), carbon monoxide poisoning (CO) and arterial

PROBLEM	GOAL	INTERVENTIONS
		gas embolism (AGE) should include monitoring for cognitive or neurological sequelae
PROBLEM	GOAL	INTERVENTIONS
14. Impaired physical mobility related to disease pathology and medical ambulation or offloading devices	Patient's will not experience any injury related to ambulation or transfer	<ul style="list-style-type: none"> • All removable devices will be removed prior to HBO2 treatments per chamber safety policy • Prosthetics, diabetic shoes, orthotic boots and total contact casts all impact range of motion and mobility for a population that may already have balance and gait issues • If this is a new device for them, there may not be sufficient accommodation at home, in their car, or with their employment to maintain baseline activities of daily living or independent activities of daily living • Provide education/re-education regarding safe use of ambulation assistive device in reference to physical therapy guidelines • Provide education/re-education regarding safe use of offloading devices • Observe for statements indicating device non-compliance and/or unsafe use at home • Advise ordering physician of ineffective treatment, if indicated • Consider referral to psychosocial community resources as indicated • Consider referral to occupational therapy/physical therapy as indicated
PROBLEM	GOAL	INTERVENTIONS
15. Imbalanced nutrition/less than body requirements related to intake of nutrients insufficient to meet metabolic needs	Patient's nutrient intake will be sufficient to meet basal needs and improve healing.	<ul style="list-style-type: none"> • Wounds will not resolve without sufficient metabolic energy and nutrients no matter what intervention is applied • Assess baseline nutritional status before initiating adjunctive hyperbaric oxygen therapy

PROBLEM	GOAL	INTERVENTIONS
		<ul style="list-style-type: none"> • Advise coordinating hyperbaric physician of nutritional status • Coordinate nutritional supplementation with primary care physician and/or service referring to hyperbaric medicine • Provide nutritional education considering patient needs and dietary preferences • Consider referral to nutritionist and/or diabetes educator for further education and assistance developing nutritional plan • Monitor weight and nutrient intake in coordination with interdisciplinary team • Notify provider of ineffective treatment plan
PROBLEM	GOAL	INTERVENTIONS
16. Potential for vision changes related to hyperbaric oxygen treatments	Patients will recognize vision changes and report to the HBO2 staff	<ul style="list-style-type: none"> • Temporary myopic shift may occur during a normal course of hyperbaric oxygen therapy • Cataract growth is a rare side effect and is typically seen only after prolonged treatment outside accepted guidelines (>80 consecutive treatments without a break) • Encourage patients to report any vision changes • Assess vision pretreatment using a standard vision measurement tool, e.g. the Snellen eye chart: <ul style="list-style-type: none"> ○ Notify physician if patient has pre-existing acute angle glaucoma, cataracts or optic neuritis as more frequent visual assessments may be necessary ○ Reassure patients that myopic shift is usually temporary ○ Reinforce to patients they should not change prescription eye glasses for several weeks following HBO2 completion ○ Patients may need corrective glasses if driving ○ If available offer adjustable eyeglasses, e.g. the Adlens EmergenSee

PROBLEM	GOAL	INTERVENTIONS
17. Potential for unstable blood glucose level related to hyperbaric oxygen therapy and disease pathology	Patients will not experience symptomatic hypoglycemia during hyperbaric oxygen treatments	<ul style="list-style-type: none"> • Literature notes hyperbaric oxygen therapy carries its own mechanism for increased glucose usage through oxygen mediated transport of glucose into muscle cells and may also increase insulin sensitivity • Assess patient's knowledge level, recent hypoglycemic events and patient specific symptoms of hypoglycemia prior to HBO2 treatments • Adequate glucose control less than 200 mg/dL is vital for wound healing • Consider timing of short and long-acting glyemic control medications when scheduling HBO2 treatments to avoid peak action time while at depth in the chamber • Prevention of acute hypoglycemia in the hyperbaric chamber is vital for patient safety • Follow facility policy and procedure guidelines for pre- and post-treatment glucose control • Assess HgbA1c • Assess peripheral blood glucose prior to each HBO2 treatment to ensure level is at least 100 - 150 mg/dL or within facility guidelines (O'Neill, 2017; Stevens et al., 2016) • Recommend patients eat one hour prior to HBO2 treatment assuring complex carbohydrates have been eaten, e.g. vegetables and whole grains • Consider sending complex carbohydrate source, fruit juice, glucose tabs or tube of glucose gel into chamber with patient in the event of symptomatic hypoglycemia during treatment, depending in type of chamber used • Assist patient to use glucose gel, tabs or juice prior to HBO2 treatment if indicated

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