

In Shortly about Hyperbaric Oxygen Therapy

Franjić S*

Independent Researcher, Croatia

***Corresponding author:**

Siniša Franjić,
Independent Researcher, Croatia

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1. Abstract

The human body depends on oxygen for survival. Organic tissues need an ideal oxygen supply for proper functioning. Lack of oxygen can reduce blood flow, damage tissue, cause premature aging, thin hair and even affect memory. Injured tissue needs more oxygen to survive. Most diseases and injuries occur and persist at the tissue level, within the cells. In cases of non-healing wounds, strokes or blood circulation problems, insufficient oxygen reaches the affected area, so natural healing does not occur. Hyperbaric oxygen therapy solves this problem by naturally increasing oxygen, and when cells are supplied with enough oxygen, they are healthy and vital.

2. Introduction

Hyperbaric Oxygen Treatment (HBOT)—the medical use of oxygen at environmental pressure more prominent than one environment absolute—is a really compelling treatment for a few endorsed clinical circumstances, such as carbon monoxide intoxication, incurable diabetes or radiation-injury wounds, and smoke inhalation [1]. In recent years, it has also been used to move forward cognition, neurowellness, and quality of life taking after brain injury and stroke. This opens unused roads for the elderly, counting the treatment of neurological and neurodegenerative diseases and enhancement of cognition and brain digestion system in cases of gentle cognitive disability. Nearby its integration into clinics, essential investigate thinks about have elucidated HBOT's components of activity and its impacts on cellular forms, translation variables, mitochondrial function, oxidative stress, and irritation. In this manner, HBOT is getting to be a major player in 21st century inquire about and clinical medications. The following audit will talk about the essential components of HBOT, and its

impacts on cellular forms, cognition, and brain disorders.

HBOT happens in two distinctive sorts of chambers: monoplace and multiplace [2]. Monoplace chambers are pressurized with oxygen, treat a single understanding at one time, and are generally little in estimate and portable. Multiplace chambers are pressurized with discuss (whereas the patients get oxygen through confront mask, endotracheal tube, or hood); treat numerous patients (or fundamentally harmed patients requiring ventilation or intravenous solutions through implantation pumps); and are generally huge in measure and nonmobile. Eminently, an interior delicate called a hyperbaric specialist, or healthcare supplier prepared in hyperbaric pharmaceutical, goes with patients into multiplace chambers, whereas no delicate is interior a monoplace chamber. Hence, in case a quiet requires new therapeutic consideration, the treatment session in a monoplace chamber must be prematurely ended, whereas a treatment session in a multiplace chamber may proceed depending on the judgment of the overseeing physician. Medicines can change from 2 hours to more than 6 hours depending on the treatment indication.

3. Indications

There are 14 indications for HBOT bolstered by the Undersea and Hyperbaric Medicine Society (UHMS) and repaid by the Centers for Medicare and Medicaid Services (CMS) [2]. The foremost commonly experienced signs that will require the help of an anesthesiologist are serious decompression sickness, arterial gas embolism (AGE), carbon monoxide harming, intracranial boil, and serious iron deficiency. The 14 conditions are as takes after:

1. Acute traumatic peripheral ischemia
2. Crush wounds and suturing of severed limbs (acute)

3. Acute peripheral arterial insufficiency
4. Compromised skin grafts (acute)
5. Osteoradionecrosis
6. Soft tissue radionecrosis
7. Gas gangrene (acute)
8. Progressive necrotizing contaminations
9. Chronic refractory osteomyelitis
10. Chronic nonhealing wounds (diabetic and nondiabetic ulcers)
11. Carbon monoxide poisoning
12. Decompression sickness
13. Gas embolism
14. Idiopathic sudden sensorineural hearing loss

4. Patient

When treating a mechanically ventilated patient, it is basic to consider the volume of the endotracheal sleeve [2]. In agreement with Boyle's law, as pressure increments, volume diminishes. In this way, on pressurization of the chamber (moreover known as the plunge stage), gas must be included to the endotracheal tube sleeve to preserve an satisfactory seal on the tracheal mucosa. On depressurization (or the rising stage), gas must be expelled from the endotracheal tube sleeve to avoid over the top development and harm to the trachea. The utilize of a manometer whereas including or evacuating gas from the endotracheal tube encourages the upkeep of appropriate sleeve volume and ensuing seal. Boyle's law moreover clarifies the etiology of ear torment secondary to insufficient center ear equalization and pressure on the tympanic layer from surrounding pressure exposure.

Arterial gas embolisms happen in aquatic situations; commercial development zones, such as tunneling ventures; and sometimes as therapeutic complications at normobaric pressure. Iatrogenic AGEs may stem from neurological surgeries, such as sitting craniotomies or spinal surgeries that can compromise bridging veins during surgical dissections, laparoscopic surgeries, and endoscopies. They can moreover happen amid the organization of intravenous fluids or blood items, particularly when managed with pressure bags. These patients may create fast, serious neurologic signs and ought to be treated with HBOT as before long as conceivable. In spite of the fact that HBOT was customarily thought of as "shrinking" the estimate of these gas bubbles and minimizing downstream blood stream obstacle, more later prove recommends that the larger part of gasses are quickly evacuated from the circulatory system. Ensuing HBOT minimizes the aggravation secondary to vascular endothelial disturbance and edema.

In case fundamentally harmed patients require HBOT, it is basic that ventilators, syringe pumps, and all other restorative gadgets are secure for hyperbaric oxygen. Regularly, these gadgets include brushless engines to decrease the hazard of start; the producer has

certified them as secure for hyperbarics [3].

Boyle's law states that at a consistent temperature, the pressure and volume of a gas are inversely corresponding. Usually the premise for numerous angles of hyperbaric treatment, counting a slight increment in chamber temperature during treatment; and the phenomenon known as 'squeeze', happening when blocked eustachian tubes prevent equalization of gas pressure, coming about in excruciating compression of gas within the center ear. In patients who cannot autonomously accomplish pressure equalization, the situation of tympanostomy tubes ought to be considered to supply a channel between the inward and external ear discuss spaces. Additionally, caught gas can broaden hazardously amid decompression, such as within the uncommon illustration of a pneumothorax happening at pressure.

HBOT benefits patients by forces the oxygen pressure within the alveoli [4]. Thus, the dissemination rate and the dissemination occurrence of oxygen will increment compared to standard oxygen treatment (e.g., confront cover, obtrusive ventilation, non-invasive ventilation, nasal cannula, and ECMO). HBOT gives tissue perfusion trade capacity due to the expanded dissemination occurrence of oxygen, recognizing HBOT from all other oxygen treatment strategies. Patients treated with HBOT appeared enhancements in their clinical variables and files as follows: (1) arterial blood gas examination, (2) liver function tests, (3) complete blood count (CBC, diff), and (4) improvement of lung structure clearance based on computed tomography (CT-scan).

5. Neurological Disorders

Hyperbaric oxygen therapy (HBOT) could be a methodology of treatment in which patients breathe in 100% oxygen through a head tent, mask or endotracheal tube interior a hyperbaric chamber that has been pressurized to more noteworthy than 1 supreme environment (ATA) [5]. HBOT is regularly managed at more than one and less than three ATA and actuates a state of expanded weight and hyperoxia that cause mechanical and physiologic impacts.

HBOT has been suggested for different conditions for more than 40 years. At first, it was utilized to treat decompression affliction in jumpers. In any case, over a long time its far-reaching potential has been perceived, and it has been affirmed for a assortment of purposes, counting carbon monoxide (CO) harming, decompression ailment and gas embolism, tricky wound mending, deferred radiation wounds, sudden deafness and other conditions as shown by evidence-based medication. In spite of the fact that controlled clinical trials are restricted, the judicious premise of HBOT as well as great clinical comes about have slowly expanded the utilize of HBOT for neurological clutters connected with cognitive unsettling influences. Neurological disarranges as well as conditions related to central nervous system (CNS) harm may display with a assortment of neuropsychological indications, such as disability of memory and learning forms, consideration and visuo-spatial ca-

capacities, dialect forms and official dysfunctions.

The neuroprotective and helpful impacts of neuropsychological shortfalls given by HBOT have been built up in exploratory creature and human models, although they remain questionable. In this survey, we are going outline the existing comes about of HBOT utilization in several neurological states, its current understanding and opinions for future ponders. To the finest of our information usually the primary state of the craftsmanship, precise audit in this point.

To get it the part of HBOT in neurological disorders, a fundamental information of cerebral digestion system, cerebral blood stream and the neurophysiology of the brain is basic. The physiological premise of HBOT is the gas laws. Whereas breathing discuss at barometrical pressure, most of the oxygen is bound to hemoglobin. In this circumstance, blood hemoglobin is immersed with oxygen (at approximately 97%) and working at close greatest capacity with a little sum of oxygen broken down within the blood plasma compartment. In case the percent of breathed in oxygen – or the pressure at which oxygen is breathed – is expanded, more oxygen will break up into the blood plasma. In HBOT conditions, the division of motivated oxygen and halfway weight of oxygen increments, supersaturating the blood with oxygen. Breathing in 100% oxygen at 3 ATA increments mean arterial oxygen pressure from around 100 mmHg in normobaric conditions to 2000 mmHg and the sum of oxygen conveyance to the tissues from 3 to 60 mL of oxygen per liter of blood. Supersaturation of the blood to this degree underpins resting tissue oxygen necessities without a fundamental commitment from hemoglobin carriage. Consequently, HBOT is valuable in illnesses in which hemoglobin work is restricted, such as CO harming or ischaemia. The abundance oxygen is carried in arrangement and it can diffuse to zones where red blood cellscannot reach. This height in the partial pressure of oxygen in tissue intervenes the helpful benefits of HBOT.

Upgraded oxygen supply and expanded pressure result in a wide assortment of pathophysiological components. Hence, HBOT is accepted to decrease neuroinflammatory reactions, blood–brain boundary porousness and apoptosis whereas emphatically affecting neurogenesis, neuronal and axonal integrity and synaptogenesis. All of these impacts may possibly impact patients' cognitive working. In any case, coordinate links are very troublesome to set up. Later propels in radiology and restorative imaging, in specific diffusion tensor imaging (DTI) and progressed perfusion models, may possibly fill the hole and give superior understanding of the interdependency among white matter structure, cerebral blood stream and cognition.

6. O₂

O₂ (oxygen) is a frequently disregarded supplement since of its specific get to interior the human body, through the lungs rather than the gastrointestinal tract, typical of all other supplements [6].

O₂ is key for human cells to perform so-called high-impact breath, which takes places within the mitochondria. Here, O₂ acts as an electron acceptor at last driving to ATP blend in a prepare known as oxidative phosphorylation. From a developmental viewpoint, the take-up of O₂ was the root of eukaryotic cells, rising as a result of an endosymbiotic relationship between prokaryotic cells (archaea and eubacteria) which were competent of utilizing this supplement. This reality spoken to an adaptative advantage with respect to those cells incapable to utilize it, complex living beings were coevolving with O₂, thus becoming a basic supplement for our cells.

In a basic way, O₂ is presented in our body by two recognized processes: ventilation, in which gasses are transported from the environment to the bronchial tree and dissemination, where a balance within the conveyance of O₂ between alveoli space and blood is come to. Given that the halfway weight of O₂ (PO₂) here is low, and wealthy in carbon dioxide (CO₂), gas exchange occurs. Simultaneously, the contrast within the pressure and volume within the chest divider and lungs are fundamental to allow the oxygen stream, as barometrical pressure does not shift at all. Once within the circulation system, O₂ is generally bound to hemoglobin (Hb) within the erythrocytes, and to a small degree in a broken-up shape, being systemically dispersed. At that point, oxygen trade is delivered between the microcirculatory vessels—Not as it were capillaries, but too arterioles and venules—and the rest of the tissues, due to the distinctive halfway pressure of O₂ and the Hb oxygen immersion (SO₂), which is additionally dependant on other factors like temperature, PCO₂ and pH, among others. On the off chance that, be that as it may there's a need of oxygen within the tissue it may show up a condition outlined as hypoxia. This may be due to low O₂ substance within the blood (Hypoxemia), which may be a consequence of either a disturbance within the blood stream to the lungs (Perfusion), wind stream to the alveoli (Ventilation) or issues within the gas dissemination within the haemato-alveolar boundary. Besides, low blood supply (ischaemia) or troubles within the O₂ conveyance, may too be responsible for tissue hypoxia. Subsequently, inside cells there are particular sensors named as Hypoxia-inducible factors (HIF) that beneath hypoxic conditions will tie to the hypoxia response element (HRE), in this manner controlling a wide assortment of cellular forms. Once in a while, hypoxia might give ideal suggestions for health, for occurrence amid early formative stages or within the case of discontinuous exposures. In any case, hypoxia for the most part actuate a neurotic stretch for cells that's closely related with the appearance and advance of a wide range of diseases. As a result, oxygen has been proposed as a potential restorative operator for patients experiencing distinctive intense or chronic conditions. As focusing on cellular hypoxia could be a promising, but still an rising approach, clinical administration of hypoxia is coordinated to balance worldwide hypoxemia and oxygen conveyance inside the tissues. In this

setting, HBOT emerges as an uncommon back within the dealing with of hypoxia and other hypoxia-related wonders by expanding blood and tissue levels of oxygen. Hereunder, we are going to portray the standards and instruments of activity of HBOT, with respect to its therapeutical basis and particular contemplations of this treatment.

7. Procedure

HBOT comprise of the supply of immaculate oxygen beneath increased pressure [6]. This strategy is conducted in a monoplace or multiplace chamber in the event that there are as it were one or different patients experiencing this method, separately. Within the to begin with case, the chambers are more often than not compressed with O₂ though within the moment, individuals' breath oxygen independently through a confront cover, hood, or an endotracheal tube. Within the case of fundamentally sick patients, it appears that multiplace chambers permit a much better monitoring of the imperative capacities in comparison to monoplace chambers, in spite of the fact that the utilize of the last mentioned are moreover secure and well endured by patients. Depending on the convention, the evaluated length of session changes from 1.5 to 2 h and may be performed from one to three times daily, being given among 20 to 60 therapeutical measurements depending on the condition. Habitually, this strategy utilizes between 2 to 3 atms of pressure. By the by, it has also been gotten promising comes about in a few thinks about from <2 atms (1.5 atms) for certain conditions, in spite of the fact that concurring to all UHMS right now endorsed signs it is required a chamber pressurized to a least of 2 ATA. In spite of a few conventions acknowledge the utilize of 6 atms (i.e., treatment of gas embolism), small benefits are as a rule detailed from >3 atms because it may be related with a plenty of antagonistic impacts. Besides, it is not possible to breath immaculate O₂ at higher weights than 2.8 atm, and in those cases it is went with with other gasses like helium, nitrogen or ozone. The elective, normobaric oxygen therapy (NBOT), utilizes oxygen at 1 atm of pressure. In comparison with HBOT, NBOT is cheaper and less demanding to apply, and it could be found in almost all healing centers, because it does not require hyperbaric chambers. Be that as it may, a few ponders have detailed a decreased adequacy of NBOT in comparison with HBOT, in this manner appearing the pertinence of HBOT for certain conditions. On the other hand, the utilize of NBOT can be basic for patients enduring from a few illnesses in nonappearance of HBOT facilities.

The therapeutical premise of hyperbaric oxygenation are result of three primary variables: (1) By breathing 100% O₂, a positive gradient is made, thus favoring dissemination for hyperoxygenated lungs to hypoxic tissues; (2) due to the tall weight, O₂ concentration within the blood raises concurring to Henry's Law (the sum of broken up gas inside a liquid is specifically relative to its fractional weight) and (3) it diminishes the estimate of gas bubbles within the blood taking after Boyle-Mariotte Law and Henry's Law. In

other words, the creation of a hyperbaric environment with pure oxygen grants a noteworthy increase of the oxygen supply to blood (Hyperoxemia) and to the tissues (Hyperoxia) indeed without the commitment from Hb. In this way, HBOT gives numerous impacts within the living being, and it can be utilized to adjust tissue hypoxia, inveterate hypoxemia and to help in the clinical administration of distinctive neurotic forms counting wound mending, corruption, or reperfusion wounds.

Opposite to hypoxia, the human body has not created any particular adjustment to hyperoxia. Interests, the presentation to irregular hyperoxia, share numerous of the go between and cellular components which are initiated by hypoxia. Typically called the hyperoxic-hypoxic conundrum. Critically, it does not got to be considered a negative property. As happening with irregular hypoxia, the submitting of short-term hyperoxia may give positive results within the cell. The clarification dwells in a vital concept in biology, the hormesis, which relates the type of reaction gotten with the measurements gotten. From a atomic viewpoint, tall PO₂ within the tissues may have vital implications within the cellular signaling, especially through expanding the generation of reactive oxygen species (ROS) and responsive nitrogen species (RNS). These changes initiate numerous impacts within the organism, including the blend of distinctive development components, progressing neovascularization or appearing immunomodulatory properties, among others, in this manner applying its clinical adequacy. Additionally, HBOT upregulates HIF, by ROS/RNS and Extracellular Regulated Kinases (ERK1/ERK2) pathway. Within the same way, an intemperate generation of ROS and RNS due to hyperoxia may lead to the appearance of oxidative stretch, DNA harm, metabolic unsettling influences, endothelial dysfunction, acute aspiratory damage and neurotoxicity. As hyperbaric O₂ may give both useful and antagonistic impacts, it is fundamental to adjust the different factors to clinically suggest or reject HBOT. Due to the material science of HBOT, it isn't simple to plan satisfactory considers and clinical trials to completely underwrite its utilize. In spite of this, there are a few prescient models which will be an extra apparatus to assess what patients may advantage the foremost from getting this treatment, considering unmistakable therapeutical approaches in the event that necessary.

8. Conclusion

Hyperbaric oxygen therapy (HBOT) is a procedure in which pure oxygen is inhaled inside a chamber with increased atmospheric pressure to enhance the natural healing powers of the human body. Hyperbaric oxygen therapy will increase the amount of oxygen carried by the blood to restore proper blood gas levels and tissue function to promote healing and fight infection. Hyperbaric oxygen therapy treatments are pleasant and relaxing, and all you have to do is to inhale pure oxygen in a chamber under elevated atmospheric pressure, which improves the distribution of oxygen through blood capillaries to tissues and organs. The treatment is

non-invasive and suits almost everyone, with rare exceptions. Oxygen therapy is one of the most powerful and 100% natural ways to reduce inflammation, heal wounds faster and optimize both physical and mental abilities.

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