



# Epidemiological profile of patients treated with the aid of hyperbaric oxygen in the State of Mato Grosso do Sul from May 2007 to October 2012

*Perfil epidemiológico dos pacientes tratados com auxílio da oxigenioterapia hiperbárica no estado de mato grosso do sul de maio de 2007 a outubro de 2012*

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## ABSTRACT

**Background:** The Hyperbaric Oxygen Therapy-HOT, is a non-invasive therapeutic method in which patient breaths 100% oxygen (pure oxygen) through masks, while remain in a pressurized chamber to a pressure higher than atmospheric. Its act as an accelerator of recovery process, by increasing the oxygen saturation in the body that allows to speed up cicatrization and engagement to infection. The aim of this study was to determine the epidemiological profile of hyperbaric oxygen therapy patient of Mato Grosso do Sul state. **Objective:** To demonstrate the Epidemiological Profile of patients treated with the aid of hyperbaric oxygen in the State of Mato Grosso do Sul May 2007 to October 2012. **Methods:** We conducted a retrospective study of HOT patients admitted to Santa Casa de Campo Grande Hospital from May 2007 to October 2012. **Results:** Among 600 patients who underwent HOT, there was a predominance for males (71% - 425 patients); Plastic surgery is the medical speciality which most request HOT associated with conventional treatment for their patients (71% of the total patients), and most of these are due to burn injury (82%). Most of the patients were aged between 31 and 60 years old. (the range with highest prevalence were 31 to 60 years). The mean number of hyperbaric sessions among the burn patients was between 6 and 10 sessions (66.19% of burn patients). **Conclusions:** The majority of our service to patients requiring hyperbaric oxygen therapy was male because of moderate to severe burns, and the Plastic Surgery specialty that most used this tool as adjuvant treatment.

**Keywords:** Hyperbaric Oxigenation. Therapeutics. Wound Healing.

This study was carried out in Santa Casa de Campo Grande, Campo Grande, MS, Brazil.

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## RESUMO

**Introdução:** A oxigenoterapia hiperbárica – OHB é uma modalidade terapêutica não invasiva em que o paciente respira oxigênio a 100% (oxigênio puro), com o uso de máscaras, enquanto permanece em uma câmara pressurizada a uma pressão superior à atmosférica. Seu papel é atuar como um acelerador do processo de recuperação, por meio do aumento da saturação de oxigênio no organismo, que permite a aceleração nas cicatrizações e no combate a diversas infecções. **Objetivo:** Demonstrar o perfil epidemiológico dos pacientes tratados com auxílio da oxigenoterapia hiperbárica no Estado de Mato Grosso do Sul, de maio 2007 a outubro 2012. **Método:** Realizou-se estudo retrospectivo dos pacientes admitidos na Santa Casa de Campo Grande, que utilizaram oxigenoterapia hiperbárica, de maio de 2007 a outubro de 2012. **Resultados:** Dos 600 pacientes que se submeteram à OHB, predominou o sexo masculino (71% - 425 pacientes); A cirurgia plástica foi a especialidade que mais solicitou OHB associada ao tratamento convencional de seus pacientes (71% do total de pacientes), sendo destes a maioria devido à lesão por queimadura (82%). O intervalo de idade de maior prevalência foi dos 31 aos 60 anos. A média do número de sessões de hiperbárica, dentre os pacientes com queimadura, foi entre 6 e 10 (66,19% do total de queimados). **Conclusões:** A maioria dos pacientes que necessitavam de oxigenoterapia hiperbárica era do sexo masculino devido a queimaduras moderadas a graves, sendo a Cirurgia Plástica a especialidade que mais utilizou esta ferramenta como tratamento adjuvante.

**Descritores:** Oxigenação Hiperbárica. Tratamento. Cicatrização.

## INTRODUCTION

Hyperbaric medicine involves treating patients with hyperbaric oxygen (HBO) therapy, a non-invasive therapy in which patients breathe 100% oxygen, while remaining in a pressurized chamber at a pressure greater than atmospheric pressure<sup>1</sup>.

HBO therapy has been used for inflammatory, infectious, and ischemic conditions for over 50 years worldwide, and is recognized by the Brazilian Federal Council of Medicine. It is employed as a treatment in diverse clinical situations, including the treatment of burns. However, there has been controversy about how this technique is to be used and which patients it can benefit<sup>2</sup>. The purpose of HBO therapy is to accelerate the recovery process, by increasing oxygen saturation in the organs, which speeds up healing and helps combat diverse infections.

Hyperbaric chambers gradually increase ambient pressure and maintain it without variations in the hyperbaric pressure for the duration of the intended period (Figures 1 and 2). There are two types of hyperbaric chambers used in medicine. The first is a multipatient chamber, which involves several patients simultaneously. These are pressurized with air until it reaches the pre-fixed pressure level, and the patients then breathe pure

oxygen through well-adapted masks or sealed hoods. The second type is a monopatient chamber, which treats only one patient at a time. These are directly pressurized with oxygen and the patient breathes freely, without the need for masks or other devices<sup>1</sup>.

Hyperbaric medicine was developed in Europe in 1662, following observations by Henshaw, an Englishman who practiced medicine. He found that people living in mountainous regions showed a marked improvement in wounds when they underwent treatment in coastal regions, and formed the hypothesis that this improvement was due to the difference in atmospheric pressure. To prove such observations, he built a “*domicilium*”—a pressure vessel—in which he began to apply “baths of compressed air” to people with acute conditions. The results obtained by Henshaw for these “pressure baths” at pressures higher than atmospheric pressure were positive, thus giving rise to hyperbaric medicine<sup>3,4</sup>.

During the 1930s, studies suggested that oxygen could play an important role in the treatment of decompression illnesses associated with diving. However, since oxygen is highly combustive, it took three decades for the development of equipment that would allow its safe administration. Studies then arose confirming the advantages of HBO ther-

apy and it was found that inhaling pure oxygen, inside hyperbaric chambers, increased the oxygenation rate of blood in all body tissues. Hence, it was concluded that such an increase could help fight infections, accelerate healing processes, and enhance antibiotic therapy.



**Figure 1** - Hyperbaric chamber gradually increases ambient pressure and maintains it without variation at the hyperbaric level during the duration of the treatment.



**Figure 2** -- Frontal view of the hyperbaric chamber.

## OBJECTIVE

To demonstrate the epidemiological profile of patients treated HBO therapy in Mato Grosso do Sul, Brazil between May 2007 and October 2012.

## METHOD

A retrospective study was carried out at Santa Casa Misericórdia de Campo Grande through

review of patient medical records from between May 2007 and October 2012, from which it was determined that 600 patients underwent HBO therapy in the state of Mato Grosso do Sul. The departments requesting HBO therapy for patients were orthopedics, plastic surgery, vascular surgery, cardiac surgery, thoracic surgery, general surgery, and clinical medicine. All patients who underwent HBO therapy completed a minimum number of hyperbaric chamber sessions, e.g., 10 sessions, increasing the number of sessions as requested by the assistant doctor. Patients did not undergo HBO therapy if there were signs of hemodynamic involvement.

## RESULTS

Out of the 600 patients who underwent HBO therapy between 2007 and 2012, the majority was male (approximately 71% or 425 patients) ( *Figure 3* ). The plastic surgery department most frequently requested HBO therapy as a conventional treatment for patients, corresponding to 71% of all patients in the current study, followed by vascular surgery, which accounted for 17% of patients; orthopedics, with 5.3%; cardiac surgery, with 3%; thoracic surgery, with 2%; clinical medicine, with 1%; and general surgery, with 0.7% (*Figure 4*). The total and mean number of HBO therapy sessions performed during the study period were 5,712 and 9.52 sessions, respectively. The total number of HBO therapy sessions per discipline was as follows: plastic surgery, 3,977 sessions; vascular surgery, 911 sessions; orthopedics, 468 sessions; cardiac surgery, 190 sessions; thoracic surgery, 82 sessions; clinical medicine, 45 sessions; and general surgery, 39 sessions (*Figure 5*). Burns to the skin were the leading condition requiring HBO as a treatment in addition to the other conditions; out of the 428 patients from the plastic surgery department who underwent HBO therapy, 349 had burns.

## DISCUSSION

HBO is a complementary treatment, used as a coadjuvant treatment for various conditions, both acute and chronic, whether they are of an ischemic nature, infectious, traumatic, or inflammatory. In general, it is applied in serious cases and where there is resistance to conventional treatment; most conditions in which it is employed involve an unpleasant prognosis and high costs to the physical integrity of the patient. The use of HBO is increasing throughout the world as it provides two of the major benefits of contemporary medicine: lower costs and high efficiency. De-

creasing the response time improves the results of the scarring process, thereby decreasing the incidence of relapse, surgery, mutilation, graft rejection, deformed burn scars, administration of medicines, and long hospital stays.

HBO therapy has the following benefits:

- Vasoconstriction – favorable in cases of edema;
- Antimicrobial and antibacterial effect – facilitating the action of leukocytes and decreasing the production of toxic substances;
- Enhancing the effects of various medicines;
- Increase in the oxygenation of blood – by increasing the amount of oxygen dissolved in the plasma;
- Growth of new capillary beds or neovascularization;
- Re-establishing the oxygenation of tissues – in the case of intoxication by carbon monoxide;
- Elimination of gaseous embolisms – in the case of diving accidents.

The number and frequency of sessions are always indicated by the hyperbaric or assistant doctor, depending on the condition with which the patient presents, but it can be said that, in most cases, the treatment is performed on a daily basis. The sessions last between 90 and 120 minutes and are monitored by a responsible professional, who remains with the patients throughout the duration of a session. In case of the need for venous infusions, transfusions, or the draining of wounds or cavities during the session, the responsible professional will perform the necessary procedure.

In Brazil, the Federal Medical Council, in accordance with the indications of the Brazilian Society of Hyperbaric Medicine and the *Undersea & Hyperbaric Medical Society* (EUA), amended in 1995, the Resolution nº 1457, regulating the application of this treatment.

Main indications:

- Gaseous embolism;
- Decompressive illness;
- Traumatic air embolism;
- Carbon monoxide poisoning or smoke inhalation;
- Cyanide poisoning or cyanide derivatives;
- Gas gangrene;
- Fournier's syndrome;
- Necrotizing soft tissue infections: cellulite, fasciitis, myositis;
- Traumatic acute ischemia: crush injury, compartment syndrome, reimplantation of amputated limbs, and others;

- Acute vasculitis of an allergic etiology, due to medicines or biological toxins (arachnids, snakes, and insects);
- Thermal or electric burns;
- Refractory lesions: skin ulcers, diabetic foot lesions, bedsores, ulcers due to autoimmune vasculitis, dehiscence of sutures.

Many comparative studies have systematically shown that the increasing use of HBO therapy as the conventional treatment reduces the final cost of treatment, since it reduces the length of hospital stay, as well as the number of dressings and surgeries and the use of medicines<sup>5</sup>. When there is a real need for mutilating surgeries, their amount and the extent to which they are used are reduced. Besides cost, the esthetics of the final result must be taken into account. The use of conventional treatment only is accompanied by the loss of tissue due to necrosis and resections, as well as scarring with deformations, with both esthetic and functional damage<sup>6</sup>.

Treatment with HBO has two principles: the mechanical action exerted by pressure usually above 2 atm, and hyperoxygenation due to the use of 100% oxygen, which increases the partial pressure of oxygen in the tissues. With the use of HBO as an adjuvant treatment, a reduction in the healing time is observed, as well as more esthetically pleasing wound healing; microvascular integrity is maintained, edema is minimized, and essential substrates required for tissue vitality are promoted.

When HBO is not used in the early stages of the treatment of burns, it could still be used at a later stage in patients who demonstrate poor recovery. In these cases, the most frequent use is in the treatment of secondary infections, both on burns and in painful regions, or even on grafted tissue. The desired effects are infection control and tissue restoration, as with other types of infections<sup>8</sup>.

However, HBO therapy must be reserved for use in cases in which some benefit may be expected; also, it should never be viewed as a substitute for some or all of the care that is advocated in the proper treatment of burns.

Certain concepts have already been established regarding the use of HBO therapy: (1) normal adequately oxygenated tissues do not become "more normal" with HBO therapy; (2) HBO therapy does not promote the reversal of definitive lesions (necrosis, degeneration); (3) HBO therapy can and must be accompanied by conventional treatments; (4) the conventional treatments applied together with HBO therapy will need to be modified in quantity and intensity<sup>8</sup>.

## CONCLUSION

We conclude that, in our institution, the majority of patients who required HBO therapy were male, with moderate to serious burns, and the plastic surgery department most frequently used this modality as an adjuvant treatment. The benefits of HBO therapy as a co-adjuvant therapy, when appropriately indicated, have been demonstrated.

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