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THE KNOWLEDGE OF A SELECTED GROUP OF MEDICAL STUDENTS ON HYPERBARIC OXYGEN THERAPY

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ABSTRACT

During the last decades, there has been a rapid development in the research and use of hyperbaric oxygen therapy (HBO), and modern medicine is increasingly taking advantage of its beneficial effects. The aim of the study was to check the level of knowledge of future doctors (medical students) on hyperbaric oxygen therapy.
The survey was conducted among 240 students of the medical faculty (3rd and 5th year of study) of the Military and Medical Faculty of the Medical University of Lodz. The author's questionnaire with forced-choice questions was used as research tool.
The students' knowledge of hyperbaric oxygen therapy was varied and in some cases was not dependent on the year of study. It was observed that students' knowledge of the subject matter depends on the number of teaching hours allocated to it.
Keywords: hyperbaric oxygen therapy (HBO), the knowledge of medical students.

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INTRODUCTION

Hyperbaric oxygen therapy (HBO) is a treatment involving the use of oxygen at a pressure greater than 1 atm. in a hyperbaric chamber. In the currently available chamber the pressure applied during therapeutic procedures commonly amounts to 2.5 ATA [1,2]. Thanks to this, it is possible to repeatedly increase the amount of oxygen delivered to the body's cells, as in the course of the treatment patients breathe with 100% oxygen. Oxygen under hyperbaric conditions is supplied to the body's cells not only through haemoglobin oxygenation, but also in the dissolved form in blood plasma [3].

It has been shown that one litre of blood serum contains 3 ml of physically dissolved oxygen. It is known that by breathing 100% oxygen in normobaric conditions, the oxygen saturation of the blood serum increases to 20 ml/l. The full oxygen demand of an organism can be met by breathing 100% oxygen in hyperbaric conditions, which leads to an increase in the concentration of oxygen dissolved in the serum of up to 50 ml/l [1,2,3,4].

Indications for HBO include: decompression sickness, carbon monoxide poisoning, air or other gas embolism, gas gangrene, necrotic soft tissue infections, multi-organ injuries or thermal burns, wounds difficult to heal, states of an extremely high blood loss, intracranial abscesses, necrotising soft tissue infections, osteoarthritis resistant to treatment, late radiation injuries, skin grafts at risk of rejection, thermal burns, actinomycosis [5,6,7,8,9]. The list of indications and contraindications to the use of HBO, was established in 2013 by the European Committee of Hyperbaric Medicine (ECHM) and is regularly updated with the National Health Fund providing refunds on hyperbaric treatment.

Hyperbaric oxygen has been used in medical procedures for many years. The interest of researchers in looking for new possibilities of practical application of HBOT (Hyperbaric Oxygen Treatment) procedures is also unabated [15].

Individuals seeking to become medically proficient should acquire knowledge and practical skills in the field of prevention, diagnosis and treatment of medical conditions, these skills being necessary to function in the medical profession. Also, scholars of the Ministry of National Defence should additionally acquire the necessary knowledge to carry out the work of a doctor-officer. The specificity of the doctor's work is also constant education to best serve the patients. Taking the above into account, it seems essential to check the level of knowledge on hyperbaric oxygen therapy possessed by medical students - i.e. future doctors.

MATERIAL AND METHODS

The study covered 240 students of the medical faculty of the Military and Medical Department of the Medical University of Lodz. 120 students from both the 3rd and 5th years were randomly selected for the study, including 60 students studying within the framework of places limitation of the Ministry of National Defence (MON) from each analysed year.

The research tool was the authors' questionnaire containing 30 forced-choice questions concerned with hyperbaric oxygen therapy in the field of hyperbaric oxygen therapy and respondents' particulars.

A statistical analysis was performed using the STATISTICA 12 PL programme, and the significance level was assumed at $\alpha = 0.05$. For clear data illustration in the graphs, the results are presented numerically, indicating the number of correct and incorrect answers obtained in each group. In this work, WWL - MON - refers to students studying within the places limitation of the Ministry of National Defence, whereas the abbreviation WWL - means other ("civilian") students of the medical faculty.

RESULTS AND DISCUSSION

Hyperbaric oxygen therapy is carried out in hyperbaric chambers, which the NFPA (National Fire Protective Association) has divided into three classes: A - single seater, B - multi-seater and C - dedicated for animals [10,11]. The surveyed students who have already encountered the topic of hyperbaric oxygen therapy (the 5th year) easily indicated the types of hyperbaric chambers (90% of the answers given). They also possessed basic historical knowledge on hyperbaric chambers (75% correct answers). Unfortunately, the knowledge of third-year students in this field was insufficient (15% of correct answers).

The atmosphere rich in oxygen is defined as gas mixtures in which the oxygen content exceeds 23%. Unfortunately, in own study, a large part of the 3rd year students were unable to indicate the right answer (despite the already completed courses in biophysics or pathophysiology) (Fig. 1).

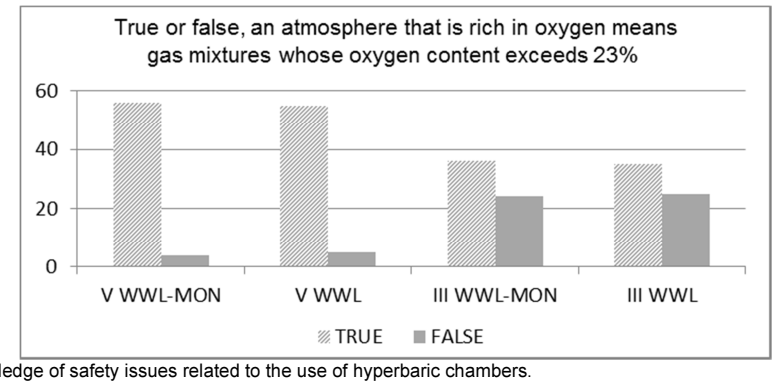

Fig. 1 The respondents' knowledge of safety issues related to the use of hyperbaric chambers.

For safety reasons, in multi-person hyperbaric chambers only air is used to generate the pressure. Oxygen is administered to patients through hoods with tight rubber collars or special face masks. The regulations allow [10,11] to use in them a breathing mixture with a maximum oxygen content of 23%, thanks to which it is possible to use monitoring equipment, respirators and infusion pumps.

Among the respondents, knowledge of these security regulations varied. The best results were obtained by the MON scholarship holders of the fifth year - 58 correct answers. Slightly fewer correct answers (55) were obtained by "civilian" students of this year. Among the students of the 3rd year, the correctness of answers oscillated around 50% - irrespective of the group. Regardless of the year of study, the respondents did not see that with elevated pressures and oxygen-rich atmospheres, the energy needed for an ignition was lower than in normal conditions. The number of correct answers in each group did not exceed 25.

Today, thanks to technical capabilities, patients with symptoms of respiratory failure are not deprived of the opportunity to use hyperbaric oxygen therapy. In fact, there are several types of respirators that are used in hyperbaric chambers [12]. It is surprising that a significant part of the 5th year students were unable to indicate the right answer in the survey (Fig. 2).

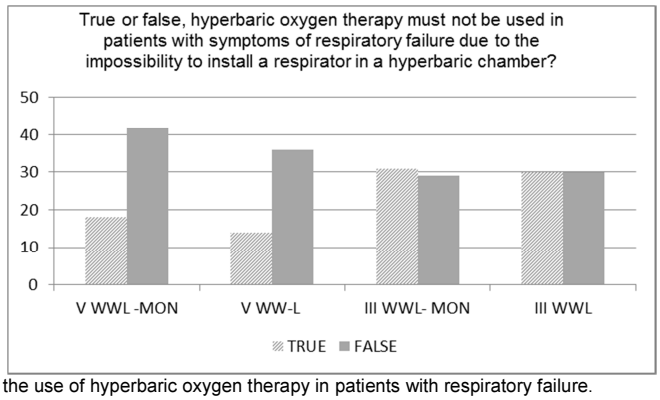

Fig. 2 Students' knowledge regarding the use of hyperbaric oxygen therapy in patients with respiratory failure.

It was difficult for the surveyed students to indicate other gases, apart from oxygen, used in hyperbaric oxygen therapy. Only students of the 5th year, studying within the framework of the places limitation programme of the Ministry of National Defence had no doubts indicating the right answers (Fig. 3). This may be due to the increased number of didactic hours allocated to the subject.

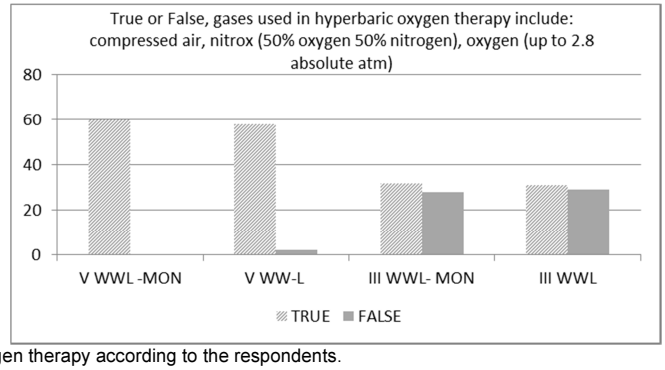

Fig. 3 Gases used in hyperbaric oxygen therapy according to the respondents.

A similar situation is concerned with the knowledge of legal and organisational regulations in the field of hyperbaric oxygen therapy. A significant proportion of third-year students did not know that hyperbaric oxygen therapy belongs to services contracted separately by the NHF (National Health Fund). They were also unaware of the NHF requirements regarding the composition of the medical staff of hyperbaric oxygen therapy centres (Fig. 4) [6].

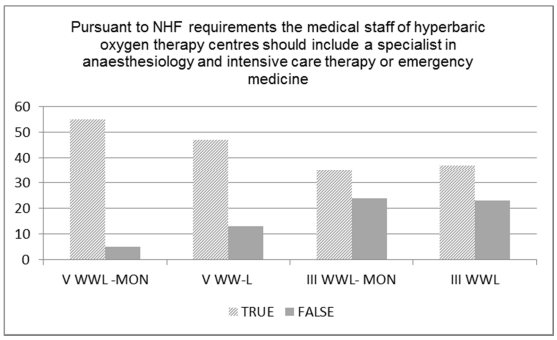

Fig. 4 Respondents' knowledge concerning the composition of the medical staff of a hyperbaric oxygen therapy centre.

Depending on the physical parameters used, hyperbaric oxygen shows both positive and negative effects on the human organism. Benefits include changes in the functioning of the circulatory system, respiratory system, and processes related to the healing of chronic wounds. Increased tissue oxygenation accelerates fibroblast proliferation, thus accelerating the regeneration of ischaemic skin fragments. In addition, it results in the acceleration of granulation and wound skinning processes, intensification of the angiogenesis process, as well as improvement of blood supply to the arterial and venous tissues [13,14].

The vast majority (63.75%) of students, both in the 3rd and 5th year of study, were able to name the benefits resulting from the applied increased oxygen partial pressure. The respondents pointed to the improvement of wound healing in the areas of hypoxia, as well as the reduction of oedema in burnt tissues.

Wound healing is a complex and dynamic process consisting of three phases: exudative inflammation (about 4 days from wound formation), granulation (4th to 7th day of healing) and scar formation. The entire uncomplicated wound healing process usually lasts about three weeks from its occurrence.

Among the external factors that significantly influence the healing process, one may distinguish the method of wound treatment. The important role of anaerobic bacteria in the development of wound infection has been demonstrated [16,17]. In the conditions of elevated pressure, oxygen exerts the toxic effect on anaerobic bacteria. At the pressure of 2-3 ata, a significant reduction in anaerobic growth has been observed [3,18]. Already in the 1960s studies by Winter et al. showed that the dressing of wounds with oxygen-permeable dressings significantly accelerates the repair processes as compared to wounds dressed in a standard manner [19].

Therefore, wounds difficult to heal should be mentioned among indications for hyperbaric oxygen therapy, including wounds resulting from diabetic foot syndrome, as well as infections and necrotic amputation stumps. Unfortunately, a significant number of third-years do not possess this knowledge yet (Fig. 5).

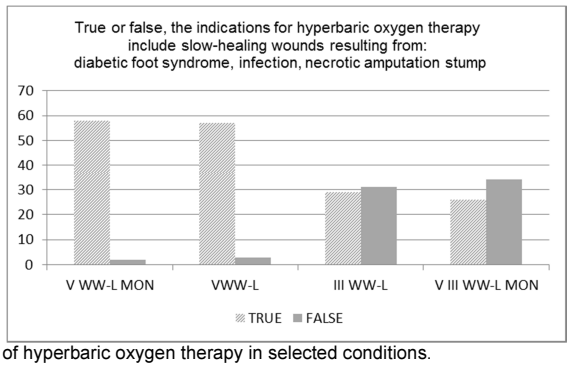

Fig. 5 Respondents' knowledge on the use of hyperbaric oxygen therapy in selected conditions.

The growing interest in the underwater world, the increasing availability of diving schools and the rapid development of diving techniques unfortunately result in a growing number of diving-related diseases and accidents. Decompression sickness (DSC) is caused by desaturation, or a sudden formation of gas bubbles in the body which had previously dissolved in the tissues during a dive. Half of the cases of decompression sickness are revealed 30 min after surfacing, 90% –up to 3 hours after, 99% – p to 12 hours after, 100% – up to 36 hours after [20]. DSC is treated as a condition of a sudden threat to human life. Accidents usually occur when the pressure drops too fast (for example as the result of an incorrectly performed ascent). The only effective method of treatment of decompression sickness is placing the patient in a hyperbaric chamber and subjecting him to recompression [3,21].

Hyperbaric oxygen therapy is also used as a basic method of treatment of carbon monoxide poisoning [8,21,22]. The poisoning usually occurs as the result of being in a smoke filled room during a fire, or as a result of leaks or inoperative gas installations, as well as leaks in ventilation ducts. The average half-life of HbCO in the blood when breathing with atmospheric oxygen is 5-6 hours. Oxygen therapy with 100% oxygen reduces the half-life of HbCO to 30-90 min. Whereas the application of hyperbaric oxygen therapy with 100% oxygen at 2.5 ATA, shortens this time to 15-20 min [22].

In the case of carbon monoxide poisoning in pregnant women, regardless of pregnancy duration, hyperbaric oxygen therapy with HbCO levels exceeding 10% should constitute the treatment of choice. The foetal carboxyhemoglobin concentration is 20-30% higher than in the mother, and foetal haemoglobin has a higher

affinity for CO. Therefore, it is important to use hyperbaric oxygen therapy and not merely passive oxygen therapy to reduce HbCO only in the mother, leaving foetal blood saturated with carbon monoxide [3,23,24].

In own research, almost all of the respondents (234 people) knew that hyperbaric oxygen therapy constitutes proper therapeutic treatment in decompression sickness or carbon monoxide poisoning. Unfortunately, 13-15 people from each study group were unable to indicate whether pregnant women could undergo hyperbaric oxygen therapy in the case of CO poisoning (Fig. 6).

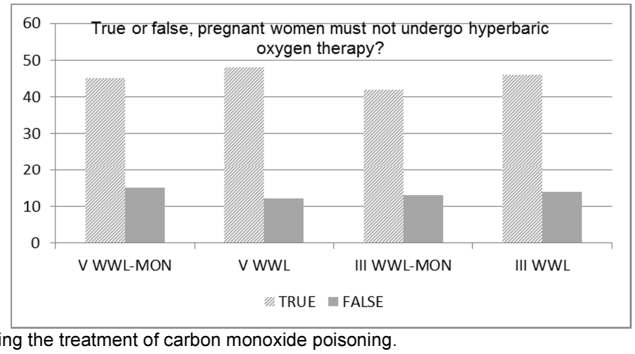

Fig. 6 Respondents' knowledge regarding the treatment of carbon monoxide poisoning.

Another indication for treatment with hyperbaric oxygen therapy is sudden deafness [25]. Its occurrence is usually noted between 30 and 50 years of age, and the incidence rate is estimated at 5 - 20 cases per population of 100,000. HBO causes a significant increase in oxygen partial pressure in tissues, in this case in the cochlea, which is very sensitive to hypoxia. Sensory cells of the inner ear depend on the oxygen uptake from endolymph by diffusion as they are not directly supplied with oxygen via blood vessels. Therefore, an increase of oxygen partial pressure in endolymph due to hyperbaric therapy may lead to oxygen deficiency in these cells [3,26,27]. Unfortunately, over 30% of the surveyed students of the 5th year and as much as 55% of the 3rd year did not know that the indication for hyperbaric oxygen treatment include sudden deafness and deafness as a result of an acoustic trauma.

One of the relative contraindications to HBO is inflammation of the paranasal sinuses. Unfortunately, less than half (n = 28) of the surveyed third year students and only 60% of the fifth year students indicated this answer. The majority of correct answers (n = 38) were obtained among the MON scholarship holders from the 5th year of study. Pressure trauma to the paranasal sinuses, mainly frontal sinuses, almost always involves an acute infection of the mucous membrane of the upper respiratory tract. In emergency situations it is possible to apply hyperbaric oxygen therapy, taking into account that each compression must be preceded by careful anemisation of the nasal mucosa and pharyngeal opening of the auditory tubes, and compression and decompression – which must to carried out very slowly [5,27,28].

The subjects also had difficulty in determining whether HBO is recommended for inflammation of bone and bone marrow. Only 20% of all respondents gave correct answers. The knowledge of the subjects concerning the use of hyperbaric oxygen therapy in radiation damage to tissues and organs was similar. It is surprising that the majority of surveyed students of both the third and fifth year (75% and 70% respectively) decided that individuals with pacemakers can freely use HBO.

CONCLUSIONS

The knowledge of students regarding hyperbaric oxygen therapy varies and depends on the number of hours of didactic classes devoted to this subject. The programme of studies as well as individual interests in hyperbaric medicine also have a great impact.

It is important to familiarise medical students with the physical basics of hyperbaric oxygen therapy, scientific research and clinical experience, by increasing the number of teaching hours of thematically related subjects, so that the knowledge they acquire could be better used in their future work.

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