

## THE ROLE OF NURSE IN HYPERBARIC OXYGEN THERAPY

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### Abstract

The speciality of hyperbaric nursing has evolved since the 1950s along with the practice of hyperbaric medicine. Nurses, qualified by education, experience, and professional licensure, provide care for patients in the altered environment of the hyperbaric chamber. The art and science of nursing are uniquely combined in this setting as nurses not only deal with the technology of the hyperbaric chamber, the physiological monitoring and life support equipment, but also with the art of psychologically adapting the patient, and providing emotional support and patient and family education. The role of the nurse in oxygen treatment: working at a hyperbaric oxygen clinic offers the nurse a variety of satisfaction and challenges.

**Keywords:** Hyperbaric oxygen therapy. Nurse. Hyperbaric nurse. The role.

### 1 Introduction

Hyperbaric oxygen therapy (HBOT) is defined as systemic treatment in which the entire patient is placed inside a pressurized chamber and breathes 100 % oxygen under a pressure greater than 1 atmosphere (atm). It is used to treat certain diseases and conditions that may improve when an increased partial pressure of oxygen is present in perfused tissues.

The literature states that HBOT should not be a replacement for other standard successful therapeutic measures. Depending on the response of the individual patient and the severity of the original problem, treatment may range from less than 1 week to several months' duration, the average being 2 to 4 weeks. Hyperbaric oxygen therapy for more than 2 months is usually not necessary.

Hyperbaric nursing is available for nurses who work with patients requiring hyperbaric oxygen therapy. This nursing role is beyond the traditional nursing role; it is often referred to as baromedical nursing. Discussions will include working with complex patients and the multidisciplinary team, scope of practice, roles and extent of practice including patient education, wound management including debridement, pain management, and patient counselling.

Hyperbaric nursing was defined by the BNA as “the diagnosis and treatment of human responses to actual or potential health problems in the altered environment of the hyperbaric chamber” [1]. This further expands the American Nurses Association’s definition of nursing which is “the protection, promotion, and optimization of health and abilities, prevention of illness and injury, alleviation of suffering through the diagnosis and treatment of human response, and advocacy in the care of individuals, families, communities and populations [2].

The hyperbaric nurse has a multifunctional role – that of clinician, educator, and researcher. The goal of hyperbaric nursing is to provide safe, cost-effective, quality patient care, according to established standards [3].

Hyperbaric nursing had its origins in the 1950’s, in Europe. Nurses were called to support treatment in multiplace chambers as the practice of hyperbaric medicine developed from the treatment of divers to more traditional illnesses and diseases afflicting patient populations. At the beginning, nurses learnt their roles via on-the-job training from experienced colleagues. First in the 1960’s, in USA the formal training became available and was soon an essential prerequisite. This period coincided with the introduction of monoplace hyperbaric chambers.

Hyperbaric nurses were skilled in other treatment branches and experienced in critical care, emergency room, and medical areas, which reflected the nature of the early referable indications. The additional cross-competency in hyperbaric oxygen therapy was developed.

The European Code of Good Practice (ECGP) for Hyperbaric Oxygen Therapy, as an intended reference document for European countries, defines guidelines, regulations, and standards in hyperbaric medicine and relates to hyperbaric treatment as a procedure affecting patients, staff and any third parties involved in the therapeutic process [4].

A hyperbaric centre must guarantee the best use of its equipment, and services. A hospital hyperbaric centre must guarantee its assistance 24 hours a day, and must be able to offer adequate treatment for all kinds of diseases, including those requiring critical care inside the chamber. Staff requirements affecting different types of facilities should comply with the aforementioned conditions of availability and system of work. This work aims to review the type of staff needed in the hyperbaric centre, to define their behaviour and providing some general rules to be applied in each situation, depending on the conditions of each centre. In order to develop its functions correctly, a hyperbaric centre needs different professional qualifications. These ECGP document summarises as follows: the medical director and physicians/medical doctors, nurses, attendants, chamber operators, technicians, and others. Characteristics, functions and background which should be followed by the whole staff must be defined and reviewed. In each category the following items will be described in detail: definition of functions, background, specific educational profile, academic requirements and degrees, continuous education, and dedication.

Every HBOT staff member has his own, specific role. Respiratory technicians trained in HBO therapy or hyperbaric nurses operate the hyperbaric chamber and supporting equipment, monitor the patient during its use and are responsible for practical implementation of patient care during hyperbaric treatment. Additionally, staff nurses are responsible for the patient both before and after treatment. Nevertheless, each staff member should be also familiar with his functions and responsibilities.

Similarly to other fields of medicine, nurses complete medical treatment and are responsible for the practical implementation of patient treatment [5, 9]. All hospital based hyperbaric centres should have a permanent team of nurses, with partial or full-time dedication depending on the needs of each centre. One or two people cannot guarantee a 24-hour-a-day service, because the long stays inside the multiplace chamber that they must often pass, renders them incapable of decompression in the following hours. Condition to work in shifts would be therefore necessary for the whole team of nurses.

For example, the ECGP document defines the activities that hyperbaric nurses perform, that are the usual functions of their profession, but with some differences due to the characteristics of the hyperbaric treatment:

- 1) Nursing measures belonging to the common pathologies of the hyperbaric therapeutics to be applied to the patients in a self-standing chamber,
- 2) Nursing assistance of patients located inside the hyperbaric chamber and taking special care in the specific conditions of the hyperbaric environment.
- 3) Adaptation of conventional medical techniques and specific treatments of each illness to the hyperbaric environment, so the other treatments that the patient is habitually receiving have not to be interrupted while in the chamber.
- 4) In some cases, operating the external controls of a monoplace hyperbaric chamber according to the compression and decompression schedules established.

Basic education and a nursing degree are required. Special courses for hyperbaric nurses are highly recommended but they will not be strictly required.

In order to obtain special competences, the hyperbaric nurse must have the corresponding degree of her profession. Specific education in critical care nursing will be very useful.

Knowledge of other specialisation like angiology, traumatology, and wound care will also be suitable. Special courses on diving and hyperbaric medicine are essential. Necessary training may be given in the same institution by the medical director.

Hyperbaric nurses should also receive a complementary specific education according to the achieved professional level, in the following areas:

- 1) General principles of decompression theory, diving technique, and pneumatics.
- 2) Hyperbaric technique.
- 3) Safety and preventive measures.
- 4) Operation of monoplace hyperbaric chambers.
- 5) Intensive critical care of patients.
- 6) Other aspects inherent in both diving and hyperbaric medicine, concerning the nurse's profession.

As in all fields of health and medicine, hyperbaric nurses must complete and continue their education by theoretical self-training by reading specialised texts, and attending specialised courses and congresses. Their membership in specialised professional societies at national or international level like EBAss (European Baromedical Association for nurses, operators and technicians) or newly created would be suitable. Maintenance of nurses' skills and competences by training and continuous education should be documented as a condition for compliance with good practice regulations in medical treatment.

## **2 The Hyperbaric Nurse Clinician**

Approach in the nursing process in hyperbaric treatment is similar to the approach in all medical areas. Nursing process should be precisely tracked in complete medical records. This process is divided into five basic phases: assessment, nursing diagnosis, planning, intervention, and evaluation. Planning of patient care that is followed by assessment and nursing diagnosis must reflect the standards of practice and care, which are established or identified by the company as to be implemented in patient care. These standards can be developed as standardized plans of care or reflected within ordinary plans of care, utilized by the hospital. To assist with developing of care plans, the national or international standards of nursing practise and guidelines should be reviewed. The available sources were elaborated by the American Nurses Association, Baromedical Nurses Association – BNA (Standards of Care for Patient Receiving Hyperbaric Oxygen Therapy), British Hyperbaric Association, European Committee for Hyperbaric Medicine (ECHM) [5]. The standards of clinical nursing practice should contain also criteria for evaluation of quality of nursing care.

Standards of care can be divided into several phases of nursing process. Within the assessment, the nurse collects data about patient's health. The nurse uses appropriate assessment techniques and systematically documents the continuously collected data. During nursing diagnosis, the nurse analyses the assessment data in order to determine the nursing diagnosis. The diagnosis is validated with the client or significant others, if necessary. Diagnoses should be documented to facilitate the determination of expected outcomes and care plan. Expected outcomes are identified and individualized in the outcome identification standard. The outcomes must be mutually formulated with the patient and documented as measurable goals. Planning standard describes the process for establishment of plan of care that is agreed with patient, reflects to the current nursing practice, documented, and provides for continuity for care. In the implementation standard, the nurse consistently and safely implements the interventions identified in the plan of care. The interventions must be documented in the same manner like all previous standard activities.

The professional standards include guidelines to evaluate the nursing performance. These standards can be generally grouped in these subjects of activities: quality of care, performance appraisal, education, collegiality, ethics, cooperation, research, and resource utilization.

Some example of the specifics of care for patient receiving hyperbaric oxygen therapy are elaborated and implemented in the BNA guidelines [5, 6]. This document describes desired outcomes and nursing interventions for different nursing diagnoses/problems. Table 1 represent examples which are generic to all patients receiving HBO [6, 7].

**Table 1** Care of the patient receiving hyperbaric oxygen therapy

<p><b>I.</b></p> <p><b>A. Nursing diagnosis/problem</b>  Anxiety related to knowledge deficit of hyperbaric oxygen therapy and treatment procedures  <i>Definition:</i>  Anxiety is a practical risk with hyperbaric oxygen treatments. It can occur before, during or after the treatment.  <i>Identify signs and symptoms of anxiety</i></p> <ul style="list-style-type: none"> <li>• Patient verbal admission of anxiety</li> <li>• Clenching of fists</li> <li>• Flushed face</li> <li>• Complaint of nausea or diarrhea</li> <li>• Sudden complaint of pain or discomfort</li> <li>• Feelings of being smothered or suffocated</li> <li>• Urgency to empty bladder</li> <li>• Defensive attitude</li> <li>• Hyperventilation</li> <li>• Profuse diaphoresis</li> <li>• Flat Affect</li> <li>• Tachycardia</li> <li>• Restlessness</li> </ul> <p><b>B. Desired Outcomes</b>  Patient and /or family will state:</p> <ol style="list-style-type: none"> <li>1. Rationale for hyperbaric oxygen therapy.</li> <li>2. Goals of therapy.</li> <li>3. Procedures involved with hyperbaric oxygen therapy.</li> <li>4. Potential hazards of hyperbaric oxygen therapy.</li> </ol> <p><i>Purpose:</i>  Familiarize the patient with the procedure, potential beneficial effects and safety precautions relating to his/her treatments to ensure patient's emotional comfort.</p> <p><b>C. Nursing Interventions</b></p> <ol style="list-style-type: none"> <li>1. Asses a document patient and/or family's understanding of rationale for and goals of hyperbaric oxygen therapy, and procedures involved with and potential hazards of hyperbaric oxygen therapy.</li> <li>2. Identify barriers of learning <ul style="list-style-type: none"> <li>• Involve Interpreter if indicated,</li> <li>• Apply age-specific teaching,</li> <li>• Consider cultural/religious factors,</li> <li>• Assess readiness to learn.</li> </ul> </li> <li>3. Include information on the following when identified as a learning need: <ul style="list-style-type: none"> <li>• Purpose and expected outcomes of hyperbaric oxygen therapy,</li> <li>• Sequence of treatment procedures and what to expect (e.g. pressure, temperature, noises, wound care),</li> <li>• Oxygen delivery systems,</li> <li>• Ear clearing techniques,</li> <li>• Pulmonary barotraumas, and</li> <li>• Prevention of oxygen toxicity.</li> </ul> </li> <li>4. Provide continued opportunities for discussion and instruction.</li> <li>5. Provide patient and/or family with information brochure on hyperbaric oxygen therapy.</li> <li>6. Keep patient and/or family informed of all procedures.</li> <li>7. Document patient/family instruction, using the confirmation of instruction form and the general patient instruction form.</li> </ol>
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**Table 1 (Continued) Care of the patient receiving hyperbaric oxygen therapy**

<p>II.</p> <p><b>A. Nursing diagnosis/problem</b>  Potential for injury related to transferring patient in/out of chamber and within hyperbaric facility  <i>Identification:</i>  <i>Equipment located in the hyperbaric facility should only items necessary to provide patient care. Excess items like personal belongings or other medical equipment unrelated to the function of HBO treatment contribute to potential injury hazards and therefore should be removed. All necessary equipment in the facility should be in good working order at all times. Only those personnel trained to operate the equipment should do so.</i></p> <p><b>D. Desired Outcomes</b>  Patient will not experience any injury.  <i>Purpose:</i>  <i>The patient has the right to expect safe care delivery throughout the admission</i></p> <p><b>B. Nursing interventions</b></p> <ol style="list-style-type: none"> <li>1. It is the responsibility of all staff, lead by the Safety Director to inspect the facility and identify equipment with the potential of causing harm to a patient in any state.</li> <li>2. Comply with the local Fall Risk Policy; assess patient's potential risk for fall and apply precautions as appropriate.</li> <li>3. All equipment with the potential for injury will be secured to prevent harm.</li> <li>4. Assist patient in and out of the chamber appropriately. <ul style="list-style-type: none"> <li>• 1-2 person assist as necessary</li> <li>• Use of gait belt, as necessary</li> <li>• Use of foot stool and/ or lower gurney to load patient</li> <li>• Use of slide board, as necessary</li> <li>• Use side rails on stretcher, as appropriate</li> </ul> </li> <li>5. Communicate transfer plan with patient and staff involved prior to taking action.</li> </ol>
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**Other nursing diagnosis/problems:**

- Potential for barotrauma to ears, sinuses, teeth, and lungs, or cerebral gas embolism related to changes in atmospheric pressure inside hyperbaric oxygen chamber
- Potential for oxygen toxicity related to delivery of 100% oxygen at an increased atmospheric pressure.
- Potential for inadequate therapeutic gas delivery related to delivery system and patient's needs/limitations.
- Anxiety and fear related to feeling of confinement anxiety associated with hyperbaric oxygen chamber.
- Pain related to associated medical problems.
- Potential for ineffective individual coping related to stresses of illness and/or poor psychosocial support systems.
- Potential for dysrhythmia related to disease pathology.
- Potential for fluid volume deficit related to dehydration or fluid shifts.
- Altered cerebral tissue perfusion related to:
  - Carbon monoxide poisoning
  - Decompression sickness
  - Acute necrotizing infection
  - Gas embolism
  - Other
- Potential for alteration in comfort, fluid, and electrolyte balance related to nausea and vomiting.
- Altered health maintenance related to knowledge deficit for:
  - Management of chronic wound

- Restrictions following decompressions sickness
- Symptoms to report after carbon monoxide poisoning

According to the European Code of Good Practice for Hyperbaric Oxygen Therapy the whole nursing process must be systematically and continuously documented. The active role of the nurse in each phase of this process is irreplaceable. Nevertheless, the important role of nurse is in developing, implementing, and improving of the documentation system for hyperbaric treatment. Nurses should be involved in process of preparation and implementation of standard operation procedures as well as in creation of templates for records/documentation formats.

### **3 The Nurse as Educator**

Facilitating the educational process of patients and families is an accountability of the hyperbaric nurse. Patient education helps maximize the integration of the benefit therapy into the total health care delivery system, and helps improve cost-effectiveness, and maintain patient safety and facilitate care. The principles of teaching/learning are utilized as the nurse assesses for readiness to learn, and adapts the teaching process for the individual patient and family [3, 5].

### **4 The Nurse as Researcher**

Nurses are frequently involved in the area of medical research, in cooperation with the hyperbaric physicians, administering HBO treatments according to investigational protocols, developing research protocol and their implementation, and reporting and publishing results. Nurses working in hyperbaric departments located at academic institutions will find opportunities to be involved in research projects at the basic laboratory stage. Working in this type of conditions requires the professional nurse to draw upon her scientific background and experience [3,5,8].

### **5 The Nurse as Manager**

The responsibility for management of resources in the hyperbaric department is often in the realm of the hyperbaric nurse whose function is management position. Accountabilities may include management of resources – staffing, supplies and services, and supervision of patient care. Responsibilities may include coordination of clinical and educational activities and research within department. In the multiplace setting, this may be a shared responsibility with facilities manager [3,5].

### **6 Conclusion**

Demand for hyperbaric nurses is growing as the number of hyperbaric facilities and the number of patient receiving hyperbaric treatment has grown. Hyperbaric nursing continues to be responsive to the changing health care needs of our patients and the health environment. In the beginning the 21<sup>st</sup> century, maintaining patient's safety and quality of care while ensuring adequate reimbursement is challenging the hyperbaric nurse.

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