

Wound Treatment after Congenital Syndactyly Separation with 100% Oxygen Therapy: A Case Report

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Abstract

Contemporary procedures concerning wound treatment should comprise not only pharmacological treatment, surgical procedures, or special dressings, but also physical medicine procedures. The complex manner of proceeding in many cases reduces treatment time, patients' suffering, as well as the incidence of complications; it also cuts down the risk of repeated hospitalizations. The paper presents therapeutic effects of hyperbaric oxygen therapy in the treatment of a wound that was hard to heal, after surgical procedure of syndactyly of 2nd/3rd toe in the left foot, in a three-year-old patient. After two months, complete healing of the wound was achieved, with reduction of inflammatory reaction and skin hyperaemia. The results obtained indicate that treatment applying hyperbaric oxygen therapy is a useful adjuvant method the treatment of patients with wounds that are hard to heal, after surgical procedures.

Keywords:Hyperbaric oxygen therapy; Congenital syndactyly; Physical medicine; Wound

Introduction

The treatment of wounds that are hard to heal still poses a serious interdisciplinary medical problem. The above does not mean, however, that wounds which heal badly are impossible to heal. Yet, only a well educated team of physicians, nurses, and physiotherapists can stand to such a difficult challenge. It should be remembered that such a team has to be additionally provided with modern diagnostics equipment, proper dressing materials, as well as equipment for carrying out physiotherapeutic procedures [1,2].

In Poland, the problem of chronic wounds concerns some 500 thousand people, who suffer for months, not only because of the pain they have to endure, but also because of social dysfunction [1]. The process of healing of a non-infected skin wound which has similar wound margins is a dynamic phenomenon, and its specific healing stages closely related to each other. The first stage: the exudative one (acute inflammatory response in trauma) lasts for some 5-6 days. The second stage – the productive (anabolic) stage takes some 3-14 days, whereas the third stage is the scar modeling stage, which lasts some 6-18 months. In the topical wound treatment, proper selection of treatment method is important, being adequate to the healing process phase, the wound advancement stage, and well as the amount of exudates produced [3,4].

The wound healing problem has been known since the dawn of history, as early as in the antiquity various forms of dressings had been in use, as well as topically applied preparations, the aim of which had been the external protection of the wound, as well as stimulation of the healing process. Despite marked progress made in finding out the processes responsible for wound healing, results of treatment in case of chronic wounds are still not completely satisfactory. The predisposition to recurrence calls for frequent hospitalization and makes prolonged medical care inevitable. Due to the physical suffering caused to patients by wounds, mood changes often occur, which lead to isolation from the surroundings and substantial reduction of the patients' life quality. The efficacy of pharmacological treatment differs in such cases. In many instances, this is a long term treatment, inconvenient for patients; it is also connected with much discomfort, oftentimes not giving the expected therapeutic effect. In numerous cases, chronic wounds lead

to systemic inflammations, disability, and even death. That is why a methodical search for new therapeutic methods has been going on, comprising also physical medicine, which may result in improved treatment efficiency [5,6].

Hyperbaric oxygen therapy (HBO) is a method of treatment, in which the therapeutic action of 100% oxygen is used, or that of a mixture of gases with high oxygen content, close to 100%, having the pressure exceeding 1 atmosphere [7]. In hyperbaric oxygen therapy, oxygen pressure in alveolar air is increased; the atrio-capillary gradient of oxygen increases, and thus – in accordance with Henry's law, the diffusion force increases, so does oxygen solubility in plasma. Breathing pure oxygen, having the atmospheric pressure equal to one (1) atmosphere absolute (ATA) causes a triple increase of oxygen solubility in plasma, in comparison with breathing atmospheric air. In case of pressure amounting to 2-3 ATA (usually used in oxygen hyperbarism), oxygen solubility in plasma increases as many as 14 times. In such conditions, hemoglobin gets practically completely saturated with oxygen apart from a small amount of physiologically inactive hemoglobin), thanks to which the healing processes accelerate significantly. Proliferation of fibroblasts is accelerated in skin, along with acceleration of regeneration of ischaemic parts of tissue, and speeding up the process of granulation and epidermisation of wounds. Moreover, HBO procedures intensify the processes of angiogenesis, enhance blood flow in veins and arteries, as well as improve tissue perfusion. Taking the above into consideration, studies have been conducted for many years now, concerning the possibilities of clinical use of physiotherapeutic methods, including also the hyperbaric oxygen therapy, in complex treatment of chronic

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Received July 03, 2015; **Accepted** August 31, 2015; **Published** September 06, 2015

Citation: Pasek J, Majda D, Cieślak G, Sieroń A (2015) Wound Treatment after Congenital Syndactyly Separation with 100% Oxygen Therapy: A Case Report. *Surgery Curr Res* 5: 245. doi:10.4172/2161-1076.1000245

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wounds, of various etiology [7-9].

The aim of the paper is to present the effects of treatment by means of hyperbaric oxygen therapy, applied to a wound, resulting from the procedure of separating a congenital syndactyly of 2nd/3rd toe in the left foot, in a three-year-old patient.

Case Presentation

The three-year-old patient was admitted to the School of Medicine with the Division of Dentistry in Zabrze University of Silesia in Katowice Chair and Department of Internal Diseases, Angiology and Physical Medicine in Bytom, Poland, due to a hard – to – heal wound remaining after surgical procedure of separating a congenital syndactyly of 2nd/3rd toe in the left foot. Previously, the patient was hospitalized at the Pediatric Surgery Ward of the Specialist Hospital No. 2 in Bytom, where the above procedure had been performed. Despite treatment conducted for two months at the Pediatric Surgery Ward, the wound in the foot failed to heal, as a result of its infection (which was bacteriologically confirmed) and its partial dehiscence occurred.

Physical examination on admission revealed, on the frontal surface of the left foot, a wound located at the base of 2nd and 3rd toe, having the diameter of about 1.5cm. Inflammatory erythema condition with visible purulent infiltration remained around the wound (Figure 1).

On palpation the lesion was tender. The patient was not able to bend the surgically treated 2nd and 3rd toe in the left foot, nor was he able to load the surgically treated extremity and move about on his own. As there were no indications for surgical debridement of the wound, after angiological consultation the patient was qualified for conservative treatment, with the use of hyperbaric oxygen therapy. The procedures were performed with the use of OXY-KOM, a device for local hyperbaric oxygen therapy, (manufactured by FASER S.A., Poland) (Figure 2).

The time of each procedure was 30 minutes, while the pressure of oxygen applied amounted to 2.5 ATA. The procedures that were performed affected the wound area, in such a way that the extremity with the lesion was placed inside the aluminum coil of the device. After each procedure, dressing was applied to the wound, for protective purposes. The procedures were performed in two series; each consisted of 15 daily procedures, with weekend (Saturday-Sunday) break. The intermission between the series was 4 weeks long. Throughout the therapy, the patient remained under proper care, applied in case of wound treatment.

During the first therapeutic series, one could notice a significant reduction of the oedema, in terms of size, as well as reduction of intensity of the exudates, and increased granulation of the wound.

During the 3-week intermission after completion of the first series of hyperbaric oxygen therapy, one could have noticed purgation of the ulceration, with evacuation of purulent secretion.

In the second therapeutic series, the physical parameters for procedures were identical to those in the first series. During the second series of procedures, the following were observed: gradual formation of new granulation tissue, followed by intense epidermization, both from the wound lips, and from the surviving epidermal islets at the bottom of the lesion. Finally, after 10 weeks, the wound healed completely, also the intensity of inflammatory reaction, as well as skin congestion around the scar, diminished significantly. Additionally, the patient was able to fully bend the toes after treatment completion. The wound condition, after completing the entire therapeutic cycle (30 procedures in total) has been presented on Figure 3.



Figure 1: Postoperative wounds of 2nd 3rd toe of the left foot - local state before beginning of the HBO therapy.



Figure 2: The device OXY-KOM for local hyperbaric oxygen therapy (manufactured by FASER S.A., Poland).



Figure 3: The local state after the end of the second session of the HBO therapy.

Discussion of the Results

Treatment of chronic wounds in basic health care provision is often insufficient and fails to provide fully satisfying results [6]. Due to the complex etiology and pathogenesis of those wounds, the most advantageous therapeutic effects are achieved by means of a complex, multi-directional treatment model, taking into account the synergies between individual therapeutic methods, including also physical medicine methods [10-12]. At present, the recognized methods of physical treatment of chronic wounds comprise: therapy with the use of low-energy lasers and magneto-lasers, high voltage electro-stimulation, sonotherapy using the therapeutic action of ultrasound waves and alternate current with pulsating changes, as well as magnetotherapy [10,12-16]. The above contemporary physical medicine methods, due to the advantageous biological action of physical factors, stimulate the regeneration and repair processes, and are a precious supplement to main wound treatment procedures.

The results of the study presented here, as well as numerous literature data indicate that hyperbaric oxygen therapy, demonstrating strong biostimulation activity, may be yet another method adjunctive to classical wound treatment. The mechanism of therapeutic action of oxygen therapy - in such cases - consists of stimulation of restoration of the destroyed microcirculation blood vessel network, enhancing topical blood supply in tissues, as well as improvement of blood rheological properties, increased production of collagen by fibroblasts, and acceleration of mitosis in cells of the epidermis germinative layer [7,8]. The uses of the device for topical HBO therapy allow avoiding possible side effects, which may sometimes occur during systemic HBO procedures [17].

Conclusions

1. Hyperbaric oxygen therapy can be a useful method which supplements the treatment of patients with post-operative wounds, which makes it easier for the wound to heal completely, while manifestations of a secondary inflammation subside.

Consent

“Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal”

Competing Interest's

The author's declare no conflict of interests.

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