DUPUYTREN’S CONTRACTURE

HYPERBARIC OXYGEN FOR THE TREATMENT OF EARLY-PHASE DUPUYTREN’S CONTRACTURE

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Dupuytren’s disease (DD) is a proliferative disorder of autosomal-dominant inheritance, with variable penetrance of gene expression. The treatment of DD is challenging. Both operative and nonoperative approaches were reported for treatment of the disease, but no perfect approach has gained popularity as the best choice of treatment. Most of the emphasis has been placed on surgical techniques, but outcomes were reported to be dependent on some variables such as case selection, timing of surgery, and the surgeon’s training and experience. In this paper, we report on a hyperbaric oxygen (HBO) treatment for early-phase DD. HBO treatment was applied to a female aged 23 years who had a mild form of DD. Physical findings and complaints before and after HBO treatment were compared. Total relief of symptoms as well as physical findings were obtained with HBO treatment. HBO for the treatment of DD is a novel concept. Having treated only one case is not enough to conclude that HBO is the only effective mode of treatment for DD. HBO should also be tried to treat early-phase or mild contractures of DD. Unfortunately, HBO has a disadvantage, i.e., cost. But HBO is not invasive, and because of the nature of HBO treatment, most of the complications seen after surgeries, e.g., wound-healing problems, damage to the digital nerves and vessels, buttonholing of the skin, and tendon sheath opening, are not seen. © 2003 Wiley-Liss, Inc.

Dupuytren’s contracture was first reported by Felix Plater of Basel, Switzerland (1536–1614), but credit is given to Baron Guillaume Dupuytren, who described the treatment of this malady by operative demonstration of contracture release.1,2 Cleine and Cooper also described palmar fibromatosis prior to Dupuytren’s formal writings. Dupuytren’s disease is inherited as an autosomal-dominant trait. Certain populations show particularly high prevalence of the disease. Dupuytren’s disease (DD) is a condition of the hand characterized by the development of new tissue in the form of nodules and cords.3

The new tissue in the form of nodules and cords is of great biologic interest, inasmuch as it seems to have some features in common with benign neoplastic fibromatosis.4,5 The site of onset is the fibrofatty layer between the skin and deep structures of the palmar surface of the hand. The fibrofatty layer has a precisely ordered system of subcutaneous ligamentous fibers.

The description of Luck remains a didactic point for histopathologic understanding: the nodule was seen as the fundamental lesion.1,3,6 Nodules do not occur randomly but at precise positions, generally in the lines of the digital rays in the palm or digit; DD seems to follow certain anatomic pathways determined by longitudinal tension lines.

Luck’s classification of the disease into three phases has been widely accepted: a proliferative phase characterized by cell proliferation with no purposeful arrangement, an involutorial phase in which fibroblasts show alignment along tension lines, and a residual phase in which tissue is largely acellular and tendonlike.3 The current knowledge of pathogenetic mechanisms reduces Luck’s plan to two separate but overlapping processes:7 a proliferation process, and a mechanical process.

The first, i.e., the proliferation process, is characterized by immature fibroblasts, many of which are myofibroblasts in a characteristic whorl pattern.5,8 There is a close similarity between the proliferation phase of Dupuytren’s contracture and the proliferation process of wound-healing and fibrosis.8 At present, it is not clear what starts the proliferation phase. Rupture of fascial fibers and an inflammatory process with adhesions between ligamentous structures are two of the speculations.

The second, the mechanical process, demonstrates the phenomenon of mechanical transduction whereby the cellular tissue once formed responds to the mechanical environment, a process by which physical forces such as tension or compression, and cellular events such as gene expression, are linked.7

The high cellularity seen in Dupuytren’s tissue is assumed to be related to local ischemia at a microvascular level.10 Most of the abundant fibroblasts in Dupuytren’s tissue are clustered around partially or totally occluded microvessels. A similar pattern of fibroblast aggregation was identified in the local ischemia seen in diabetic patients.11

Hyperbaric oxygen (HBO) is a kind of therapy that has been used for the treatment of many diseases worldwide for 30 years. HBO therapy is carried out with breathing 100% oxygen via endotracheal tube, mask, or hood in a completely isolated pressure cham-
ber under pressures higher than 1 absolute atmosphere (ATA). Oxygen can increase from 0.3% up to 6.8% in proportion to applied environmental pressure. Both the increased concentration and the partial pressure of oxygen during HBO therapy ensure more oxygenation in the whole body. The increased tissue oxygen enhances the growth of fibroblasts, the formation of collagen, angiogenesis, and the phagocytic capabilities of the hypoxic leukocytes, so that it has beneficial effects on wound healing.12,13

In this study, we aimed to evaluate the role of local ischemia in Dupuytren’s contractures. If hypoxic conditions are reversed by high tissue oxygenation, fibroblast and myofibroblast production will cease. Hence, we chose a patient in early-phase Dupuytren’s contracture and applied a series of HBO treatments to her.

CASE REPORT

The patient is a 23-year-old female who works as a registered nurse in the main operating room of a hospital. She had been complaining of a cord development on the palmar aspect of her right hand for 2 years. There was no tenderness on the route of the cord. The tension in the palm caused difficulty when she needed to grasp and stretch her hand. The inability to fully extend her palm while passing surgical instruments to the surgeon during operations was her main concern.

Upon physical examination, a significant palmar cord was seen on the fourth metacarpal area. The cord extended from the proximal midpalmar crease to the MP joint of the ring finger. There were only 10° of extension deficit at the MP joint level. A forceful palmar extension elaborated a significant blanching along the cord line. No nodule was palpated.

We planned a series of HBO treatments for her. An incisional biopsy was performed to approve the histopathology of Dupuytren’s disease before the first session of HBO treatment. A 1 \times 1 \text{ cm} \text{ mini-Z-plasty} was planned at the junction of the fourth metacarp with a proximal midpalmar crease. After elevating the flaps of the Z-plasty, a 1 \times 0.5 \text{ cm} segment was harvested from the diseased cord. The cord was left intact after harvesting the specimen. The specimen was sent to our Department of Pathology for histological analysis.

HBO therapy was carried out at 2.5 ATA for 90-min sessions. Forty HBO therapy sessions were applied. Sessions were carried out 5 days a week, Monday through Friday.

The patient was evaluated in the first month, the sixth month, and 1 year after HBO treatment. In the first month, she complained of no tension while she fully extended her right hand. She stated that she was now easily handling surgical instruments during surgeries. Upon physical examination, no cord was seen on the palm of the right hand. She had a full active range of motion at the MP joint of the ring finger, without any extension deficit (Fig. 1). No blanching was observed when she fully extended her palm (Fig. 2). The area of previous cord formation had no tenderness upon tapping.
Postoperative 6-month and 1-year follow-up visits also took place. She did not complain of any tenderness or stretching in the palm of the right hand. She had a full range of motion of the MP joint in the ring finger.

The histological analysis with hematoxylin-eosin staining revealed findings related to “palmar fibromatosis.”

**DISCUSSION**

Dupuytren’s contracture is a proliferative disorder of autosomal-dominant inheritance. Factors such as age at presentation and severity of disease may be related to variable penetrance of gene expression. The greatest concentrations of patients with Dupuytren’s disease are located in Scandinavia and Great Britain. Viking heritage seems to be part of the original gene pool. There are also some areas in which the condition is virtually unknown, such as Greece, Turkey, the Middle East, and the Orient.

The aforementioned strong evidence dictates that Dupuytren’s disease is genetic. As the gene cannot be surgically removed, it is therefore wrong to contemplate a lasting cure. The patient can be helped by surgery, but there is equal potential to make the patient worse. Hence, careful analysis is advised before embarking on an operative treatment.

There is no perfect treatment for Dupuytren’s disease, or even one approach that is obviously better than another. Much emphasis has been placed on surgical techniques, but the outcome of treatment depends on case selection, timing of surgery, the patient’s expectations, the actual operation, postoperative rehabilitation, and the surgeon’s training and experience.

Nonoperative treatment reports on Dupuytren’s contracture vary, with a wide variety of nonoperative modalities including creams, lotions, corticosteroid injections, collagenase injection, physical therapy, and splinting, which are largely anecdotal. Even one consistently favorable response has not been documented in a series of patients with close follow-up.

It is well-known that some DD cases are associated with alcoholism and chronic liver disease, conditions frequently associated with deranged steroid hormone metabolism. The possible influence of sex steroid hormones on the development of DD was therefore studied, and no specific receptor was found in the palmar fascia.

In another study, the role of tamoxifen, a synthetic nonsteroidal antiestrogen, was investigated. Controversially, tamoxifen treatment was demonstrated to decrease the function of fibroblasts derived from Dupuytren’s affected fascia and downregulate tumor growth factor (TGF)-β2 production in these same fibroblasts in vitro. It was concluded that these data may be used to clarify the pathogenesis of DD.

Here, we reported on a nonoperative mode of treatment: HBO. The patient with early disease or mild...
contracture is presented. A series of HBO treatments was applied to this case successfully. It is really difficult to see patients in the early phase of Dupuytren’s disease, as most patients postpone their visit to their physician until joint motion has been seriously compromised.

What made us try HBO for treatment of Dupuytren’s disease? A high cellularity is seen in Dupuytren’s disease. Most of the abundant fibroblasts in Dupuytren’s tissue are clustered around partially or totally occluded microvessels. A similar pattern of fibroblast aggregation was identified in the local ischemia seen in diabetic patients. Besides, a study comparing lipid composition in affected hands with that in normal hands showed that the fascia in the former displayed a lipid profile consistent with mild local tissue hypoxia.

It is postulated that the pathogenesis of Dupuytren’s contracture is related to local tissue ischemia. The local ischemia probably stimulates increased production of fibroblasts and related cell types. The fibroblasts tend to organize themselves along lines of mechanical stress, eventually creating typical cord-type arrangements of palmar fascia. Having tried HBO for the treatment of only one case of Dupuytren’s contracture is not enough to conclude that HBO is the only effective mode of treatment for this disease. But HBO should at least be tried to treat early-phase or mild contractures of Dupuytren’s disease. Furthermore, HBO is not invasive, and has no deleterious effect on contracture formation. Therefore, after trying HBO for mild contracture treatment, other surgical approaches are still in the armamentarium. Because of the nature of HBO treatment, most complications seen after surgeries, e.g., wound-healing problems, damage to the digital nerves and vessels, buttonholing of the skin, and tendon sheath opening, will not emerge.

In conclusion, HBO treatment of the mild form of contractures in Dupuytren’s disease seems plausible. This mode of treatment is time-consuming but noninvasive, and therefore can be applied without hesitation about further deleterious effects on the prognosis of Dupuytren’s disease.

REFERENCES