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Hyperbaric Oxygen Therapy as an Adjuvant in Maxillofacial Surgery

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Hyperbaric oxygen has been reported to play an important role in the prevention and in the treatment of radioosteonecrosis. Its use in the treatment of specific soft tissue infections and delayed wound healing also has been discussed in the literature. The results reported concerning the use of hyperbaric oxygen therapy in the treatment of osteomyelitis are more controversial.
At the University of Zurich, a group of 118 patients from the Department of Oral and Maxillofacial Surgery underwent adjunctive hyperbaric oxygen therapy in the Centre for Hyperbaric / Hypobaric Medicine and Related Studies. The indications for hyperbaric oxygen therapy in this group of patients are presented. Our first results suggest that hyperbaric oxygen therapy is a considerable support in most cases of delayed wound healing due to hypoxic tisssue conditions.

Keywords: Hyperbaric oxygen therapy, maxillofacial surgery, osteomyelitis, radioosteonecrosis

INTRODUCTION

The rationale for the application of hyperbaric oxygen (HBO) therapy is based on its capacity to stimulate wound healing and leucocyte activity in hypoxic tissues. Repeated hyperoxygenation stimulates fibroblast proliferation and collagen synthesis. This results in neocellularity and angiogenesis. Consequently, a correction of the oxygen tension occurs. HBO also is reported to provoke a higher local concentration of leucocytes and to repair their killing capacity which is impaired by hypoxia. Furthermore, it has a direct lethal effect on anaerobes. The application of HBO in similar conditions has therefore also been advocated in the field of maxillofacial surgery.

METHODS AND MATERIAL

Between January 1987 and December 1991, 118 patients received 132 series of adjuvant hyperbaric therapy. This number constitutes 76% of all hyperbaric treatment series (Fig. 1). In 102 cases, all data necessary to be included in a retrospective study were available. Seventy-two patients underwent between 10 and 60 or more hyperbaric sessions. The installation for hyperbaric medecine contains 4 pressure chambers (one wet chamber), each individually functioning and designed for deep diving simulation to a depth of 100 msw and altitude simulation up to 10,000 meters. Six patients can take place in the largest pressure chamber. Depending on the general condition and the tolerance of the patients, the simulated diving depth usually varies between 8 and 15 meters, providing 1.8 to 2.5 atmospheres absolute pressure. Specially trained volunteers always accompany the patients inside the pressure chamber.
Mask breathing is made comfortable by using a plastic hood allowing for better communication. Fifteen liter 100% oxygen per minute is administered via a device which is attached to the patient's head during twice 45 minutes with a 5 minute break. A plastic bag covers head and shoulders of the patient. Continuous analysis assures a gas composition of 98% O_2, 1% CO_2 and 1% H_2O and N_2 inside this bag. Five days a week, the patients have 1 daily session of 90 minutes effective hyperbaric oxygen therapy.

INDICATIONS FOR HYPERBARIC OXYGEN THERAPY

The indications for adjunctive HBO therapy in the group of 72 patients whom received between 10 and 60 hyperbaric sessions were osteomyelitis (31), irradiated tissues (21), soft tissue infections (7) and healing problems (7) (Fig. 2).

Table 1 Indications for adjunctive HBO

healing problems		radioosteonecrosis
graft exposure		irradiated tissue
graft infection		actinomycosis
	in → HBO	
pseudarthrosis		infection
late graft resorption		gunshot injuries
pathological fracture		systemic deseases

Osteomyelitis

The osteomyelitis group (N=31) was subdivided in primary osteomyelitis (n=4) and secondary osteomyelitis (n=27). Two patients with primary osteomyelitis and 22 patients with secondary osteomyelitis underwent a combined therapy consisting in decortication, antibiotics and HBO. These patients went diving 18 times on average, with a minimum of 10 and a maximum of 52 sessions. The remaining patients had a less radical treatment consisting in local rinsing, antibiotics and HBO.

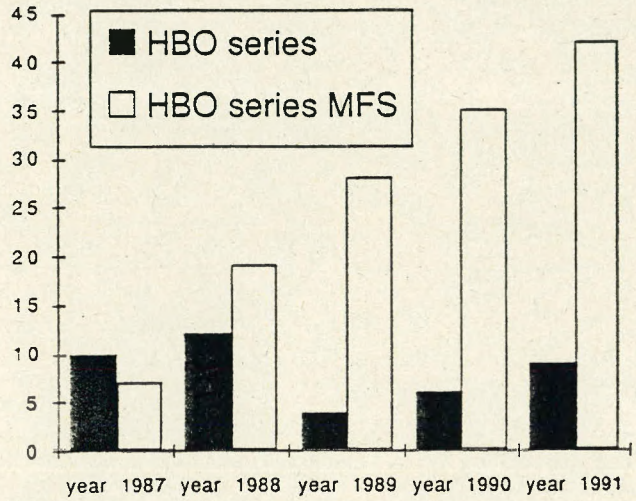


Figure 1

Irradiated tissue

Twenty-one patients underwent HBO following radiotherapy for the folllowing reasons: wound dehiscency (1), reconstructive procedures in an irradiated receptor area (6), radioosteonecrosis (14).

Soft tissue infections

This group of 7 patients is composed of 4 patients in whom actinomycosis was proved and 3 in whom this was highly suspected.

Healing problems

HBO was indicated in this group of 7 patients for various reasons, such as wound dehiscency in diabetes, wound dehiscency in severely scarred oral mucosa, reconstructive procedures after gun shot blast and pseudarthrosis.

In the group of primary osteomyelitis, the influence of adjunctive HBO on the healing process was unclear. In 2 cases, one in the lower jaw and one in the zygoma, there was no improvement of symptoms nor was there any radiological evidence of changes in the bone structure following HBO (22/24 sessions) combined with antibiotics. In 2 other cases of primary osteomyelitis in the lower jaw treated by decortication, antibiotics and HBO (50/52 sessions), a relapse of the clinical symptoms occurred.

In the group of secondary osteomyelitis, which underwent decortication combined with antibiotics and HBO (n= 22), the period of ongoing clinical symptoms and local care was limited to less than 3 to 4 weeks in 18 out of 22 patients (75%). In none of these relapse occurred nor was further surgery needed. In one case sequestration occurred 2 months after finishing HBO therapy (18 sesions). Surgery was needed to obtain healing 7 months after osteomyelitis had been diagnosed. The 3 remaining cases belong to the group of refractory osteomyelitis (n=5). In 4 cases, HBO was started when relapse following decortication occurred. In 2 of these, HBO (13/14 sessions) and antibiotics without surgical revision resulted in arrest of the clinical symptoms within 4 weeks. In 2 other cases, both HBO and surgery were needed to obtain healing, respectively 6 and 9 months later. Another patient suffering from osteomyelitis in the lower jaw developed infiltration and abcedation 6 weeks following decortication. Microbiological analysis revealed the presence of actinomyces and HBO treatment was immediately initiated. Thirteen weeks after the onset of HBO therapy (52 sessions), the clinical situation had returned to normal.

Finally, in the 6 patients with secondary osteomyelitis treated by local rinsing, antibiotics and HBO but without decortication, the clinical symptoms disappeared in 5 of them within 7 weeks. Only in 1 case (10 sessions)an additional decortication was needed to obtain healing.

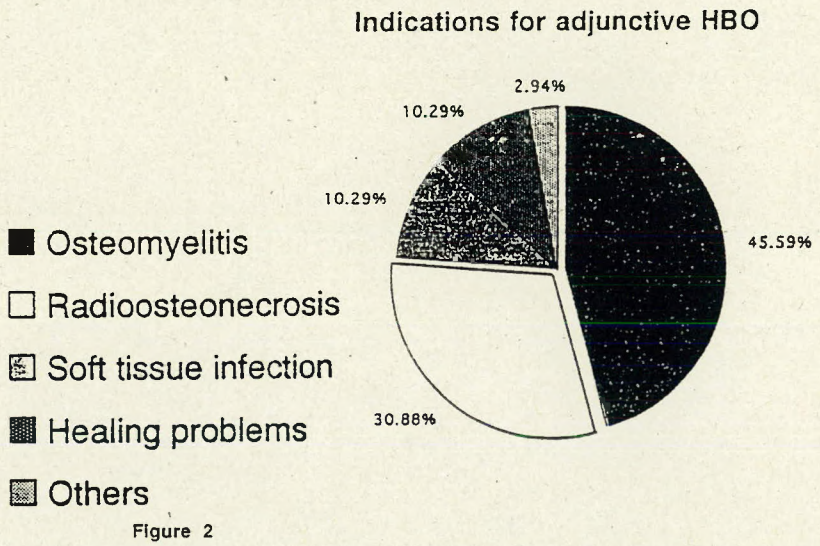


Figure 2

RESULTS

Osteomyelitis

Irradiated tissue

Healing was achieved in all reconstructive procedures in irradiated

tissue within less than 2 months time, with one exception (fistula till 5 months postoperatively). Among the 14 patients with radioosteonecrosis, 10 underwent a resection followed by reconstruction. HBO was applied both pre- and postoperatively. In 7 patients wound healing was noted, while in 3 of them, the process was not arrested by the combined treatment. The 4 other patients were treated by antibiotics, local revision and HBO. Although healing was obtained in 2 of them after respectively 4 and 5 months, no improvement was seen in the others.

Soft tissue infections

In all cases, incision and drainage was carried out, combined with HBO and highly dosed antibiotics for several weeks, which resulted in restitutio ad integrum without further surgery.

Though there clearly was a beneficial influence when applying adjunctive HBO in the group of **healing problems**, an analysis in this group is difficult because of its heterogenous composition.

DISCUSSION

Thirty out of 102 fully documented patients had less than 10 HBO sessions, mostly because the hospitalisation period could not be prolonged and daily outpatient therapy could not be realized. Unfortunately, up till now it was impossible for technical reasons to organize HBO sessions twice a day. Complications due to hyperbaric oxygen therapy did not occur. The care for the patient's comfort within the pressure chamber makes that there is a good compliance.

The few reports about the use of hyperbaric oxygen treatment in osteomyelitis of the jaws are controversial (Mainous & Boyne, 1973; Marx & Johnson, 1988; Van Merkenstein et al., 1984). Marx (1988) reports that the two types of osteomyelitis that have responded to adjunctive HBO are refractory chronic suppurative osteomyelitis and chronic diffuse sclerosing osteomyelitis. The cases mentioned here under secondary osteomyelitis correspond to chronic secondary osteomyelitis with suppuration and/or sequestration. Radiologically, osteolysis, sequestration and/or perisosteal bone formation can be seen.

The results in the treatment of primary osteomyelitis coincide with these reported by Van Merkenstein (1984).

In the group of secondary osteomyelitis, all symptoms related to infection and wound problems disappeared in less than 4 weeks time in 75% of them, after 18 HBO sessions on average. According to Sailer, the introduction of HBO allows for less radical surgery. Localised secondary osteomyelitis proves to respond to non-surgical therapy in 5 out of 6 cases. Hyperbaric oxygen therapy also was improving the healing process in refractory osteomyelitis. Moreover, it seems that less cases of refractory osteomyelitis developed in the group treated from the beginning by decortication, HBO and antibiotics. A tendency towards less frequent indication of intra-oral partial mandibular resection simultaneous reconstruction is seen (Obwegeser & Sailer, 1978). However, conclusions cannot be made before more precise prospective clinical and radiological studies are carried out.

In the field of maxillofacial surgery, the use of adjunctive HBO in the prevention and therapy of radioosteonecrosis was already mentioned by Hart & Mainous in 1976 and has especially been studied and promoted by Marx (1983, 1985, 1988). For this purpose, more HBO sessions are needed. The results in our patients tend to confirm the importance of correcting the hypocellularity, hypovascularity and hypoxia of irradiated tissues prior to any (surgical) trauma, as has been stated by Marx in 1988. It is worth noticing that in 2 patients massive relapse of squamous cell carcinoma occurred some months after HBO therapy, although a direct relationship neither can be excluded nor confirmed. The same coincidence has already been reported (Teixeira et al., 1991).

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