HYPERBARIC OXYGEN THERAPY FOR WOUND COMPLICATIONS AFTER SURGERY IN THE IRRADIATED HEAD AND NECK: A REVIEW OF THE LITERATURE AND A REPORT OF 15 CONSECUTIVE PATIENTS

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Received 7 December 1995; accepted 20 January 1997

Abstract: *Background.* Radiotherapy, which is often used for cancer in the head and neck, leads to damage of tissue cells and vasculature. Surgery in such tissues has an increased complication rate, because wound healing requires angiogenesis and fibroplasia as well as white blood cell activity, all of which are jeopardized. Hyperbaric oxygen therapy (HBO) raises oxygen levels in hypoxic tissue, stimulates angiogenesis and fibroplasia, and has antibacterial effects.

Methods. In this consecutive retrospective study, 15 patients with soft-tissue wounds without signs of healing after surgery in full-dose (64 Gy) irradiated head and neck regions were treated with HBO and adjuvant therapy. The patients in this study were also compared with patients examined in an earlier study, with corresponding wounds treated without HBO.

Results. The healing processes seemed to be initiated and accelerated by HBO. In the HBO group, 12 of 15 patients healed completely, 2 patients healed partially, and only 1 patient did not heal at all. There were no life-threatening complications. In the reference group, only 7 of 15 patients with corresponding wounds without signs of healing eventually healed without surgical intervention, and 2 patients had severe postoperative hemorrhage, which in one case was fatal.

Conclusion. Evaluation of obtained results supports the hypothesis that HBO therapy has a clinically significant effect on initiation and acceleration of healing processes in irradiated soft tissues. © 1997 John Wiley & Sons, Inc. *Head Neck* **19:** 315–322, 1997.

Keywords: radiotherapy; hypoxia; surgery; wound complications; hyperbaric oxygen therapy

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CCC 0148-6403/97/040315–08

Radiotherapy, which is often used for cancer in the head and neck, leads to damage of tissue cells and vasculature.[1–3] Surgery in such compromised tissues has an increased complication rate, because wound healing, with angiogenesis and fibroplasia, requires normal cell growth conditions, including normal oxygen tensions; the minimal level has been suggested to be 2.7 kPa (20 mmHg).[2] The preoperative radiation dosage is probably important even though no difference in complication rate was found after radiation with 50 Gy and 64 Gy in a series of 100 consecutive microvascular free flap reconstructions.[4] The time lapse between the last dose of radiation and surgery is important. The complication rate in-

creases with time elapsed from the last radiotherapy session.[4] The complication rate is increased even if a free or pedicled flap is used, as the flap, despite its own good circulation, requires a well-perfused tissue to grow into.[3,5] There is also a higher risk of infections, because low oxygen tensions (1) promote the growth of anaerobic bacteria; (2) may diminish the activity of antimetabolites, inhibitors of protein synthesis and redox-cycling agents; and (3) inhibit oxygen-dependent phagocytic killing.[6]

Hyperbaric oxygen therapy (HBO) greatly increases the tissue oxygen levels and thus enhances the wound healing rate in hypoxic, irradiated tissues.[2,3] Hyperbaric oxygen is given at a raised pressure of 2.0–3.0 bar (200–300 kPa, equivalent to 10–20 m H_2O) with the patient breathing 100% oxygen for approximately 75 minutes. Hyperbaric oxygen at 3.0 bar will double the diffusion distance in the venous and quadruple it in the arterial end of the capillary.[7] The raised oxygen levels stimulate fibroplasia and angiogenesis in hypoxic, irradiated tissues,[2,3,5,8] whereas normoxic tissues are not affected.[3] Treatment with 100% oxygen in normobaric conditions has no apparent effect on fibroplasia and angiogenesis.[8] Hyperbaric oxygen also inhibits infections through direct bactericidal effects on anaerobes due to increased production of free radicals and other toxic products.[6,9] Some authors claim that phagocytic killing by white blood cells is enhanced by HBO,[9] whereas others claim that HBO in routine clinical use does not affect white blood cell function.[6] The activity of some antibiotics is potentiated by HBO.[6]

The complications that can be attributed to HBO are minor and include possible seizures caused by oxygen toxicity, pulmonary irritation, claustrophobia, temporary myopia, and problems with pressure equalization.[2,10]

The vast majority of published reports have shown that HBO has no cancer-causing effects and does not enhance the growth of existing cancers.[11]

It is well-known that HBO stimulates the healing of osteoradionecrosis in the mandible.[3] Earlier studies also indicate that HBO given prophylactically reduces the complication rate following surgery in irradiated soft tissue in the head and neck.[3] Furthermore, HBO therapy seems to stimulate soft-tissue wound healing after surgical complications in irradiated soft tissue[12] and stimulate wound healing in soft-tissue radionecrosis[13–17] in the head and neck. In this report, we have reviewed pertinent literature and evaluated the possible clinical value of HBO for major wounds that show no signs of healing or for chronic fistulas after surgery in patients treated with full-dose (64 Gy) irradiation of the head and neck regions. We have also compared these patients with earlier patients with corresponding wounds or fistulas treated without HBO.[4]

REVIEW OF THE LITERATURE (TABLE 1)

Greenwood and Gilchrist[12] were the first to report the beneficial effects of HBO on wound healing in postirradiation head and neck surgery. Their study is the only one that can be compared to ours. The four patients in their study had received a radiation dose between 45 and 115 Gy. Three patients had fistulas, and one had a wound infection, and all four were treated with HBO 2.0 or 3.0 bar, with a total treatment time between 46 and 54 hours over 12–16 days, and adjuvant therapy. All patients were healed, even though one patient with a fistula needed an excision and further HBO treatments.

Marx's study[3] is the only one with controls, and it is also the only study where HBO is used prophylactically. One hundred sixty patients irradiated with at least 64 Gy were scheduled for major surgery, with or without a flap. Eighty patients were treated with HBO, 2.4 bar 90 minutes daily, 20 treatments preoperatively, 10 treatments postoperatively (so-called 20/10 protocol); whereas 80 patients served as controls without HBO. Surgery was performed by the same surgeons. This study showed significantly fewer and/or less severe complications in the HBO group, which had wound dehiscence in 11% compared with 48% in the non-HBO group ($p = .001$). Six percent in the HBO group had wound infections, 24% in the non-HBO group ($p = .001$). Prolonged hospital stay due to delayed healing occurred in 11% of the patients in the HBO group, 55% in the non-HBO group ($p = .005$). The methods in this study are not described in detail, and further information has been requested from the author.

Hart and Mainous[13] showed good results with HBO, surgery, and antibiotics in five patients with laryngeal radionecrosis. The patients had received a radiation dose between 31.5 and 120 Gy, and all had therapy-resistant fistulas and sloughing cartilage. Two of the patients had remaining tumor and necrotizing process involving a carotid artery. With HBO 2.0 bar 2 hours daily, usually 60 treatments, and adjuvant therapy, the fistulae closed and the ulcers were covered with epithe-

Table 1. Studies on therapeutic and prophylactic effects of hyperbaric oxygen therapy (HBO) for surgical complications in the irradiated head and neck and in various soft-tissue radionecroses in the head and neck.

Study	No. of patients	Complications	Treatment	Results
Greenwood and Gilchrist, 1973[12] (therapeutic; surgical complications)	4	Fistula and wound infection	2.0 or 3.0 bar, various times	All patients healed
Marx, 1993[3] (prophylactic; surgical complications)	160 (80 HBO, 80 control)	Wound dehiscence, infection, and delayed wound healing after surgery in irradiated patients	2.4 bar 90 min/day	Significantly fewer complications in the group treated with HBO pre- and postoperatively
Hart and Mainous, 1976[13] (therapeutic; radionecrosis)	5	Radionecrosis larynx	2.0 bar 120 min/day	4 improved, 1 died from aspiration unrelated to HBO
Farmer et al, 1978[14] (therapeutic; radionecrosis)	3	Radionecrosis nose, floor of the mouth, and larynx	2.0 bar 120 min/day	Nose: slight improvement; floor of mouth: marked improvement; larynx: moderate improvement
Davis et al, 1979[15] (therapeutic; radionecrosis)	16	Radionecrosis soft tissue	2.4 bar 90 min/day	15 of 16 improved
Fergusson et al, 1987[16] (therapeutic; radionecrosis)	8	Radionecrosis larynx	2.0 bar 120 min/day	All patients improved, 1 laryngectomy
Feldmeier et al, 1993[17] (therapeutic; radionecrosis)	9	Radionecrosis larynx	2.4 bar 90 min/day	3 patients decannulated; 4 patients fistulas closed; functional voices in all patients and no laryngectomy

lium in three patients, one patient was grafted successfully, and one patient died precipitously from aspiration unrelated to HBO.

Farmer et al[14] treated three patients with soft-tissue radionecrosis with HBO, 2.0 bar 2 hours daily, 40 or 80 treatments. The patients had received at least 45 Gy and had radionecrosis for at least 3 months without improvement. None had remaining tumor. One patient showed marked and one patient, moderate improvement after 40 treatments, whereas one patient was only slightly improved despite 80 treatments.

Davis et al[15] showed improvement in 15 of 16 patients with soft-tissue radionecrosis of the head and neck after treatment with HBO, 2.4 bar, 90 minutes daily, in an average of 45 (29–90) treatments, as an adjunct to surgery and antibiotics. The patients are not described in any detail, except for four case histories, and irradiation doses are not specified.

Ferguson et al[16] treated eight patients with advanced (grades III and IV, Chandler's classification) radionecrosis of the larynx with HBO, 2.0 bar 2 hours daily, usually 40 treatments, supplemented with antibiotics and humidity. The radiation doses were 60–70 Gy, and the time between radiotherapy and radionecrosis ranged from 3 to 15 months. Seven of eight patients improved dramatically, and only one patient eventually required laryngectomy. These results were better than earlier studies without HBO. Follow-up was at least 14 months.

Feldmeier et al[17] also treated patients with advanced (grades III and IV, Chandler's classification) radionecrosis of the larynx with HBO. The radiation doses were 45–70 Gy, and the time between radiotherapy and radionecrosis was 3 months to 2 years. The nine patients in this study received 8–45 HBO treatments, 2.4 bar 90 minutes daily. Three patients with tracheostomy could eventually be decannulated, four had their fistulas closed, and all had functional voices. No patient required laryngectomy.

MATERIALS AND METHODS

Group I: HBO. The time period for this consecutive retrospective study was between October 1993 and August 1995. Ten men and five women, age 45–92 years, with oral, pharyngeal or laryngeal cancer classified as T2–T4 and treated with a

Table 2. Group I: HBO.

No.	Age (yr)	Sex	Diagnosis	TNM	Time between end of irradiation and surgery
1	71	M	Supraglottic laryngeal Ca	T2N0M0	10 yr
2	47	M	Hypopharyngeal Ca	T4N2aM0	3 mo
3	46	M	Laryngeal Ca	T3N0M0	1 mo
4	45	M	Tonsillar Ca	T2N2cM0	2 mo
5	68	M	Gingival Ca	T4N1M0	2 mo
6	59	M	Tonsillar Ca	T3N0M0	2 mo
7	71	M	Ca floor of the mouth	T3N3M0	1 mo
8	77	M	Supraglottic laryngeal ca	T2N0M0	13 mo
9	58	M	Tonsillar Ca	T3N0M0	1 mo
10	52	F	Ca floor of the mouth	T4N0M0	2 mo
11	60	F	Lingual Ca	T4N0M0	5 yr
12	68	F	Lingual Ca	T4N0M0	2.5 yr
13	68	F	Gingival Ca	T4N1M0	1 mo
14	65	F	Buccal Ca	T2N1M0	3 wk
15	92	M	Laryngeal Ca	T2N0M0	1 yr

preoperative irradiation dose of 64 Gy (52 Gy in patient number 11) were included in group 1: HBO (Table 2). Six of these patients had neck metastases (N1–N3). All had major infected wounds or chronic fistulas with no signs of healing at 3 weeks or longer after surgery. Six patients had fistulas. In six patients the wounds were caused by partial or total necrosis of a free or a pedicled flap. Four patients had abscesses. Five patients had the mandible bone exposed in the wound, two had the carotid sheath exposed, and one had tracheal cartilage exposed.

One man, age 34 years, was not included. He had been treated for a lingual cancer with full-dose radiation (64 Gy) and total glossectomy 3 years earlier and during the period in question had a regional recurrence close to the carotid artery. After neck dissection, there was a non-healing wound; HBO was started, but after two treatments, the patient refused further therapy. He later died when the cancer growth caused a carotid blow-out.

All 15 patients were treated with HBO and adjuvant therapies (antibiotics, minor surgery, wound dressing, etc). Hyperbaric oxygen was given in a Sechrist monoplace chamber in which the patient was breathing 100% oxygen except during two pauses, 5 or 10 minutes, breathing air. The chamber was pressurized with 100% oxygen, allowing the patient to breathe oxygen without a mask or a hood. All patients were treated at a pressure of 2.5 bar, except five patients who were initially treated with 2.8 bar (Table 2). Treatment time schedule was usually 75 minutes oxygen time once a day. Five patients (nos. 8, 9, 10, 12, and 13) were initially given two treatments daily because of the severity of their infections. The patients were scheduled for 30 treatments. If the wound was not healed by then, another 10 treatments were given (Table 2).

Table 2. *(continued)* Group I: HBO.

Complications	Time between surgery and HBO	Treatment	Results*
Hypopharyngeal fistula after biopsy	11 mo	2.5 bar 75 min × 30	Not healed, remaining fistula.
Wound necrosis after neck dissection	5 wk	2.5 bar 75 min × 30 (treatment 1–2, 2.8 bar)	Healed after 4.5 mo
Fistula and wound dihiscence after laryngectomy and neck dissection	5 wk	2.5 bar 75 min × 21	Healed after 1.5 mo
Partial necrosis of pedicled flap	11 wk	2.5 bar 75 min × 30	Healed after 2.5 mo; decannulated; good swallowing function
Necrotic wound in the mouth, exposed mandible, trismus	16 wk	2.5 bar 90 min × 40	Healed after 4.5 mo; remaining trismus
Free flap necrosis, exposed mandible and carotid sheath, trismus	7 wk	2.5 bar 90 min × 30	Healed after 3.5 mo; less trismus
Wound dehiscence in the floor of the mouth, exposed mandible	14 wk	2.5 bar 75 min × 40	Healed after 6 mo
Abscess, free flap necrosis	10 days	2.8 bar 75 min × 12 (2/day) 2.5 bar 75 min × 16	Healed after 1 mo
Abscess, necrotic neck wound after debridement	6 wk	2.8 bar 75 min × 6 (2/day) 2.5 bar 75 min × 20	Healed after 4 mo
Partial necrosis of pedicled flap, fistula	7 wk	2.8 bar 75 min × 10 (2/day) 2.5 bar 75 min × 32	Healed after 4.5 mo
Wound dehiscence in the floor of the mouth, exposed mandible with titanium plate	3 wk	2.5 bar 75 min × 30	Healed after 2.5 mo
Partial necrosis of pedicled flap, abscess, large fistula	3 days	2.5 bar 75 min × 14 (2/day) 2.5 bar 75 min × 26 (treatment 20–25, 2.8 bar)	Not healed, fistula markedly reduced in size
Fistula through the palate, abscess, wound dehiscence neck, exposed carotid sheath	6 wk	2.8 bar 75 min × 6 (2/day) 2.8 bar 75 min × 5 2.5 bar 75 min × 19	Healed after 5.5 mo
Free flap necrosis, exposed mandible	5 wk	2.5 bar 75 min × 20	Healed after 1.5 mo
Fistula between tracheostoma and neck, exposed tracheal cartilage	5 wk	2.5 bar 75 min × 28	Not healed, remaining exposed tracheal cartilage, fistula healed after 1.5 mo

**Healing time = time between complication and complete healing.*

The results were evaluated from clinical examinations of the healing status of the wounds and fistulas, the infection status, and the softness and pliability of the tissues.

Group II: Reference. Fifteen patients described in an earlier report[4] who had corresponding wounds, necrotic flaps, or fistulas treated without HBO constituted the reference group. There were 10 men and five women, age 30–66 years, in this group. All had oral or pharyngeal cancer classified as T1–T4 treated with a preoperative irradiation dose of 50 Gy ($n = 5$) or 64 Gy ($n = 10$). Eleven of these patients had neck metastases (N1–N3). Ten patients had fistulas. In six patients the non-healing wound was caused by a partial or total necrosis of a free microvascular flap. Four patients had abscesses. Seven patients had the mandible bone exposed in the wound (Table 3).

RESULTS

In the HBO group 12 of 15 patients healed completely, 2 patients healed partially within 1–5 months after introduction of treatment with HBO, and 1 patient did not heal. Because the treatment usually did not start directly after a complication, complete healing occurred at between 1 and 6 months after diagnosis of the complication (Table 2). Three patients (nos. 3, 9, and 14) had fewer treatments than planned, because of early healing. Clinical observation revealed fast growth of highly vascularized granulation tissue, which filled the tissue defect and was eventually replaced by a comparatively smooth and pliable fibrous tissue covered by normal mucosa or skin. The initial signs of chronic wound infection and inflammation disappeared, and the healed neck and mouth tissues were clinically evaluated as astonishingly soft and pliable de-

Table 3. Group II: Reference.

No.	Age (yr)	Sex	Diagnosis	TNM	Time between end of irradiation and surgery	Complications	Results*
1	48	M	Hypopharyngeal Ca	T1N2M0	7 yr	Abscess, fistula, free flap necrosis, rupture internal jugular vein	Suture internal jugular vein, removal of free flap, pedicled flap
2	50	M	Oropharyngeal Ca	T3N1M0	1 mo	Free flap necrosis	Healed after 1.5 mo
3	52	M	Lingual Ca	T2N1M0	1 mo	Free flap necrosis, abscess, fistula	Healed after 3 mo
4	52	M	Tonsillar Ca	T3N3M0	2 mo	Free flap necrosis, trombosis internal jugular vein	Massive bleeding, patient died
5	62	F	Tonsillar Ca	T2N0M0	3 wk	Partial necrosis of free flap	Healed after 2 mo
6	65	M	Lingual Ca	T4N0M0	2 mo	Partial necrosis of free flap, fistula	Not healed; died from recurrent cancer causing massive bleeding 4 mo postop
7	66	M	Oropharyngeal Ca	T3N0M0	1.5 mo	Exposed mandible, fistula	Healed after 4 mo
8	65	M	Ca floor of the mouth	T1N1M0	1 mo	Exposed mandible	Healed after 5 mo
9	61	F	Oropharyngeal Ca	T2N0M0	1 mo	Exposed mandible	Healed after 5 mo
10	54	M	Ca floor of the mouth	T2N1M0	1 mo	Abscess, fistula	Not healed after 3 mo, extirpation of fistula
11	54	F	Tonsillar Ca	T4N1M0	2.5 mo	Exposed mandible, fistula	Not healed after 1.5 mo, extirpation of fistula, closure of exposed mandible
12	30	M	Lingual Ca	T3N1M0	1 mo	Abscess, fistula, exposed mandible	Not healed after 4 mo, extirpation of fistula, closure of exposed mandible
13	65	F	Ca floor of the mouth	T4N1M0	1 mo	Exposed mandible, fistula	Not healed after 1.5 mo, local flap (Bakamjan)
14	55	F	Gingival Ca	T4N1M0	1.5 mo	Skin necrosis, exposed mandible, fistula	Not healed after 2.5 mo, closure of exposed mandible, local flap
15	65	M	Lingual Ca	T2N1M0	3 wk	Fistula	Healed after 3 mo

**Healing time = time between complication and complete healing.*

spite full-dose irradiation and surgery followed by an infected non-healing wound.

Patient no. 1 had been irradiated 10 years earlier and had a small fistula caused by a deep and large biopsy on suspicion of cancer recurrence. No recurrence was found, but the fistula did not heal despite 30 HBO treatments. Ten further treatments were planned, but the patient did not wish to submit to further treatment. Patient no. 12 had a large lingual cancer resected and replaced with a pedicled pectoral flap. Postoperatively, there was a partial necrosis of the flap, and later on an abscess developed under the flap which led to a large fistula between the mouth and the neck. Hyperbaric oxygen therapy healed the infection and stopped further necrosis. The fistula was markedly reduced in size but did not heal completely despite 40 treatments. Patient no. 15 had a fistula and exposed tracheal cartilage after a laryngectomy. The fistula healed after 28 HBO treatments, but the tracheal cartilage remained exposed.

No severe complications of HBO were noted. One patient (no. 2) had oxygen seizures during the second treatment. He was treated with fenytoin, and the following 28 treatments were uneventful. Two patients expressed psychologic discomfort during treatment, and one had some problems with equalizing the pressure in the middle ears but managed to carry through all 30 treatments.

The patients' compliance was high: all 15 patients completed the basic 30 treatments. One patient with advanced recurrent cancer refused fur-

Table 4. Comparison between the hyperbaric oxygen (HBO) and the reference group.

Pretreatment data

	N	Mean age (yr)	Preop radiation dose		T1	T2	T3	T4	N0	N1	N2	N3
			64 Gy	50/52 Gy								
HBO	15	63.1	14	1	0	5	4	6	9	3	2	1
Reference	15	56.3	10	5	2	5	4	4	4	9	1	1

Treatment complications

	N	Flap necrosis		Exposed mandible	Exposed carotid sheath	Exposed tracheal cartilage	Abscess and/or fistula
		Total	Partial				
HBO	15	3	3	5	2	1	8
Reference	15	4	2	7	0	0	10

Results of HBO

	N	Massive acute bleeding	Death from massive acute bleeding	Healed without surgical intervention
HBO	15	0	0	12
Reference	15	2	1	7

ther HBO after two treatments and was not included in this study. Five patients were recommended 10 further treatments, and only 1 of these (no. 1) declined further treatment.

In the reference group, 7 of 15 patients healed. One patient died from a massive bleeding at night from the internal jugular vein. One patient had a similar hemorrhage but was saved by ligature of the internal jugular vein. Five patients later needed surgery because of exposed mandible or a fistula.

DISCUSSION

In this study, the intention was to use HBO to initiate and/or accelerate healing of wounds in full-dose irradiated tissues with no signs of normal healing after major surgery. It was found that wounds that did not show any signs of healing prior to treatment demonstrated abundant amounts of well-vascularized granulation tissue after 1–6 weeks of HBO treatment. Eventually, in 12 of 15 patients, a complete healing was seen after 1–5 months, and with fewer and less severe sequelae than expected from a chronic wound in fully irradiated tissues. Two patients had a partial healing, but the wound was in one case unaffected by the HBO treatment. The initiation of wound healing may be due to stimulation of angiogenesis and/or stimulation of the cell-replication processes. The antibacterial effects of HBO, especially on anaerobic infections, may also be important, especially to prevent the formation of hard scar tissues and fibrotization of the neck.

Patient no. 6 in group 1: HBO had a necrosis of a free microvascular skin transplant, and the carotid artery and jugular vein were exposed to the pharyngeal cavity. The risk of a fatal carotid blow-out bleeding was evident. Treatment with HBO initiated fast growth of highly vascularized granulation tissue, which covered the vessels within a few days, and all signs of infection disappeared. The wound healed nicely, and the final result, with almost-normal mucosa covering the wound region, was functionally even better than what would be expected after successful transplantation of a free vascularized volar forearm flap.

The healing failure in patient no. 1 in group 1: HBO may be due to the 10-year duration of his fistula. The two patients with partial healing during HBO nonetheless benefited from the HBO treatment, because the wound area was definitely reduced.

Some of the wounds might have healed without HBO; however, the HBO group seemed to do better than the reference group, in which only 7 of 15 patients healed without surgical intervention and in which 2 patients had massive postoperative hemorrhage, which in 1 case was fatal. Retrospective analysis of non-randomized small groups of patients never permits conclusions, but the obtained results suggest clinical usefulness of

HBO in treatment of wounds with no signs of healing in irradiated tissues. This is in accordance with the sparse reports in the literature on HBO effects on soft-tissue wound healing in irradiated tissues.

The study group included 15 consecutive irradiated ear, nose, and throat patients at Karolinska Hospital treated with HBO to induce and accelerate soft-tissue healing. None of these patients were treated for osteoradionecrosis. It should be kept in mind that this study was retrospective and included several subjective parameters (epithelialization, infection signs, tissue softness, and pliability) and only two objective parameters (wound healing or not, healing time). Efforts were made to measure oxygen tensions, but as yet, we do not have a reliable technique. Periwound transcutaneous oxygen levels were measured when possible, and in two patients, one with wound necrosis after neck dissection (patient no. 2) and one with a necrotic wound after debridement of an abscess (patient no. 9), the levels during normobaric air breathing improved from pathologic (0.5 kPa) before HBO to normal (4.0 kPa) after 4–5 weeks of HBO therapy.

Evaluation of obtained results supports the hypothesis that initiation and acceleration of the healing processes in irradiated soft tissues by treatment with HBO is of clinical significance. The biologic background mechanisms as well as the clinical usefulness of HBO in head and neck cancer surgery should be further examined.

CONCLUSION

Radiotherapy leads to damage of tissue cells and vasculature. Surgery in such tissues has an increased complication rate, because wound healing requires angiogenesis and fibroplasia as well as white blood cell activity, all of which are jeopardized. Hyperbaric oxygen therapy raises oxygen levels in hypoxic tissue, stimulates angiogenesis and fibroplasia, and has antibacterial effects. In this consecutive retrospective study, 15 patients with soft-tissue wounds without signs of healing after surgery in full-dose (64 Gy) irradiated head and neck regions were treated with HBO and adjuvant therapy. The patients in this study were also compared with patients examined in an earlier study, with corresponding wounds treated without HBO. The healing processes seemed to be initiated and accelerated by HBO. In the HBO group 12 of 15 patients healed completely, 2 patients healed partially, and only 1 patient did not heal at all. There were no life-threatening complications. In the reference group, only 7 of 15 patients with corresponding wounds and without signs of healing eventually healed without surgical intervention, and 2 patients had severe postoperative hemorrhage, which in 1 case was fatal.

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