

# TREATMENT OF SOFT TISSUE INFECTIONS WITH HYPERBARIC OXYGEN (HBO) THERAPY

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## = Abstract =

Breathing oxygen under high pressure increases the concentration of oxygen in the blood and reduces hypoxia. Hyperbaric oxygen(HBO) is useful in treating many diseases. It is used orthopedics, for example, to treat anaerobic gas gangrene. At our hospital good results were obtained using it adjunctively to the surgical and antibiotic treatment of soft tissue infections (including aerobic infections).

## I. INTRODUCTION

Soft tissue infections are usually treated by surgical procedures such as debridement and irrigation, or by antibiotics therapy. In this paper three cases of soft tissue infection treated by surgery, antibiotic and HBO therapy are discussed. The results were good in all cases.

## II. CASE REPORTS

Case 1. seventy-four year old, male. The patient fell down on a bamboo stick and was stuck in the hip. Five hour post traumatic Xrays indicated gas in the wound. The hip was crepitated and slightly inflamed. Psuedomonas

maltophilia was detected (Table 1). The general condition of the patient was good. Debridment and irrigation were performed with the administration of antibiotics and HBO. The spotty gas formation observed on admission (Fig. 1) disappeared by the seventh day of treatment (Fig. 2).

Case 2. Sixty-two year old, male. The patient noticed swelling in his left foot after walking around some hills one day. Swelling and redness spread to the upper thigh the following day, and severe pain continued. The patient felt drowsy. Severe inflammation was seen. Streptococcus pyogenes and Pseudomonas paniculatis were detected (Table 2). Antibiotics and

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HBO were administered. The dorsal side of the ankle began to necrotise, necessitating a necrectomy.

Granulation tissue formed after the operation, necessitating a skin grafting. This case was very serious, and was diagnosed as necrotizing fascitis.

Case 3. thirty-two year old, male. In June 1984 the right leg began to swell. The leg was cut open, revealing a pus discharge. Blood test was normal. *Staphylococcus aureus* was detected. Fistelography showed a shadow-like network(Fig. 3). In October the focus was removed and closed irrigation suction performed. Antibiotics and HBO were administered postoperatively, with good results.

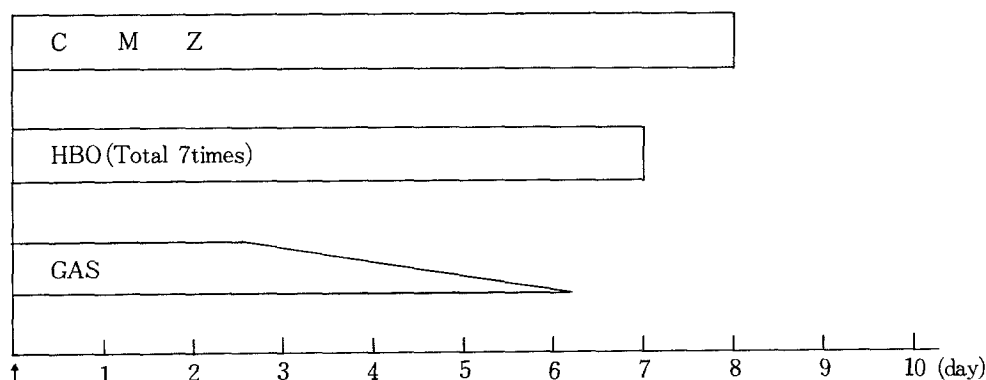
### III. DISCUSSION

Hyperbaric oxygen therapy was first used in treating gas gangrene by Borema and Brummelkamp in 1960. It has since come into wide use

very rapidly. Breathing oxygen under high pressure increases the concentration of oxygen in the blood and reduces hypoxia. Table 3 shows the indications for HBO. The hyperbaric chamber at our hospital can accommodate up to eight people, and doctors and nurses can enter with patients, when necessary. Pure(100%) oxygen is administered at 2.0 to 2.8 ATA one hour per day. In treating soft tissue infections. HBO should be used in cases like case 1 when gas is present, unless the gas is non-bacterial. When gas is not present, surgery and antibiotic treatment are usually performed. HBO acts bacteriostatically against anaerobic bacteria which cause gas gangrene. McAllister T.A. reports that HBO is bacteriostatic for aerobic bacteria in vitro as well. Sugimoto, however, claims it is ineffective against aerobic bacteria. D.J. Bakker suggests using HBO adjunctively in treating aerobic infections.

In case 2 edema was severe and necrotic changes were seen with the infection. HBO

Table 1. Case 1.



Debridement Wound cleaning(FOM·AMK)

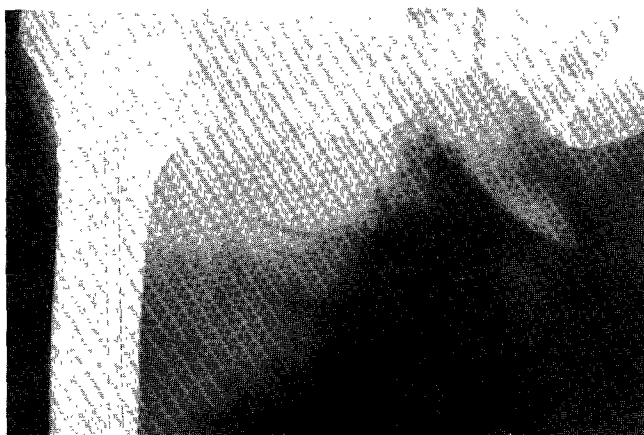
WBC 7700

ESR(mm/hr) 6

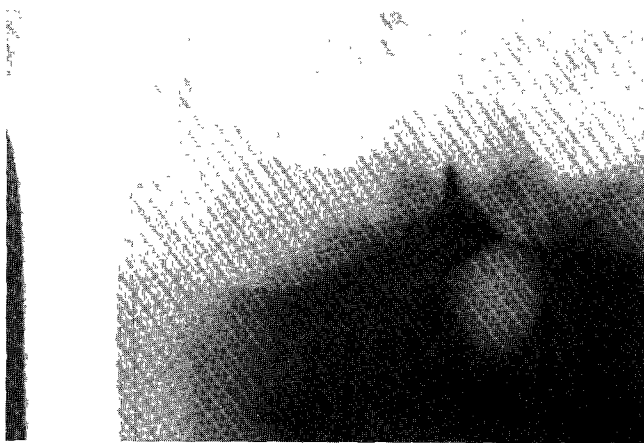
CRP 2 +

ASLO 12

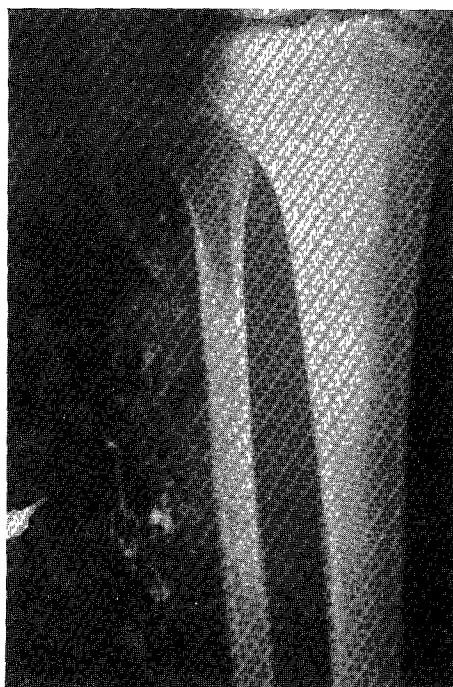
Bacteria: *Pseudomonas maltophilia*



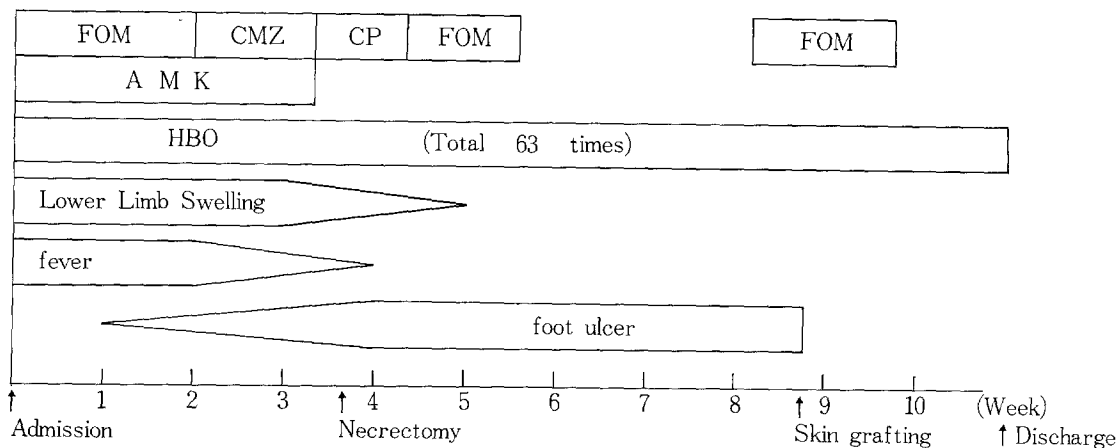
**Fig. 1.** Roentgenogram showing spotty gas formation of right hip in Case 1.



**Fig. 2.** gas disappeared on the 7th day.



**Fig. 3.** Fistelography showing a shadow-like network in Case 3.

**Table 2.** Case 2.

WBC	9000	16100	13400	7200		6800		5300
ESR (mm/hr)	68	115	145	80	32	22	50	14
CRP	6 +	6 +	4 +	2 +	1 +	—		

ASLO 50

Bacteria: *Streptococcus pyogenes**Pseudomonas paucimobilis***Table 3.** Indication for HBO

## 1. Emergency Cases

- 1) Acute carbon monoxide poisoning
- 2) Gas gangrene
- 3) Air embolism, Decompression sickness
- 4) Acute peripheral vascular disturbance
- 5) Shock
- 6) Myocardial infarction
- 7) Cerebral embolism
- 8) Intestinal obstruction
- 9) Retinal arterial occlusion
- 10) Sudden deafness etc.

## 2. Non-emergency Cases

- 1) Malignant tumors treated by radiation or anticancer chemotherapy
- 2) Peripheral vascular diseases with refractory ulcers
- 3) Skin grafting
- 4) SMON
- 5) Osteomyelitis, Radiation necrosis etc.

alleviated the edema by increasing oxygen pressure in the organs, countering acidosis and producing vasoconstriction. It similarly ameliorated the necrosis by reducing ischemia and helping granulation tissue formation.

We cannot state conclusively that HBO is effective against aerobic infection objectively. However, in reducing edema, and stimulating neovascularization and wound repair, it may be effective synthetically. Surgery and antibiotic therapy remain the principles treatment for soft tissue infection, with hyperbaric oxygen therapy to be used adjunctively.

## REFERENCES

1. D.J. Bakker: Pure and mixed aerobic and an aerobic soft tissue infections. Hyperbaric Oxygen Reviews, 6:No 2, 1985
2. Dellinger, E.P : Sever Necrotizing Soft Tissue Infections J A M A, 246 : 1717~1721, 1981
3. Mahito Kawashima : Hyperbaric oxygen therapy in orthopedics. Orthopaedic and Traumatic Surgery, 23 : No 2, 1980
4. Shigeaki Kawashima : Two cases of necrotizing fascitis Orthopedics & Traumatology. 28 : No 4, 1980
5. Tsuyoshi Sugimoto : Hyperbaric oxygen therapy against bacterial infection, Surgical treatment, 30 : No 2
6. Hisashi Sugimoto : Hyperbaric oxygen therapy against an aerobic infections (Gas gangrene) Orthopaedic and Traumatic Surgery, 23 : No 2, 1980
7. McAllister, T A et al : Hyperbaric oxygen and aerobic micro-organisms. In Hyperbaric Oxygenation, Ledingham, I McA (Ed), E & S Livingstone, Edinburgh and London. 1964 P250
8. Kinsaku Sakakibara : Hyperbaric oxygen therapy. Orthopedic and Traumatic Surgery, 23 : No 2, 1980
9. Motoaki Uchiyama, et al : Review of 24 cases of Gas gangrene. Japanese Journal of Traumatology and Occupational Medicine, 33 : No 6, 1985