

**NECROTIZING FASCIITIS & HYPERBARIC MEDICINE: A PLASTIC SURGEON'S
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ABSTRACT

Aim: To study the effectiveness of hyperbaric medicine in necrotizing fasciitis wounds and evolve a protocol for management with combined surgical modality. **Methods:** This study was carried out in the Plastic surgery department, from December 2016 to September 2018. A total of 11 patients with Necrotizing fasciitis subjected to hyperbaric oxygen therapy during the management were enrolled in the study. The results regarding the changes in wound and complications were noted. **Results:** Out of 11 patients, all patients were diabetic. 3 patients were Fournier's gangrene, eight patients were necrotizing fasciitis involving the lower extremity. Two patients did not require any surgical intervention while 9 required multiple debridement and soft tissue reconstruction in terms of skin grafting. **Conclusion:** Hyperbaric therapy is a useful adjunct for surgery in management of necrotizing fasciitis.

INTRODUCTION

Plastic surgeons specialize in the restoration of form and function of damaged or malformed areas of the body. Plastic surgery includes many types of reconstructive surgery, hand surgery, microsurgery, and the treatment of burns. Plastic surgery, as a specialty, evolved remarkably during the 20th century, with increasing importance to the treatment of complex wounds. The management of acute wounds has often been in the domain of a Plastic Surgeon since they can be healed with restored form and function. However, chronic, non healing wounds are altogether a challenge that demands the plastic surgeons not only augment the wound healing process with surgical techniques but also to reduce the recovery period of the wounds by understanding the pathophysiology and treating the wounds with the help of other modalities that are scientifically proven. Acceptance of new techniques often faces a stumbling block initially when only a few centers practice it. Over a period of time, it reaches a phase when such modalities get accepted and practiced widely. Hyperbaric medicine is a modality with which the horizon of innovations in surgery and medicine meet to complement each other to augment the result of treatment. Hyperbaric oxygen therapy has continued to gain attraction and invite controversy in Plastic surgery. Although several approved indications exist for the utilization of hyperbaric oxygen therapy, awareness towards successful adjunctive hyperbaric oxygen in practical situations of plastic surgery are yet lacking. The increasing experimental evidence proving the beneficial role of Hyperbaric Oxygen therapy in pathophysiology

of wound healing has generated interest among Plastic Surgeons who are now adopting to use it as an adjunct modality to their surgical procedures in wound management. The success of Hyperbaric Oxygen Therapy is in its timing and the completion of a proper dosage of treatment, which can be decided based on specific measured parameters documenting tissue hypoxia.

Keeping abreast of these decision making algorithms based on tissue hypoxia becomes the responsibility of the plastic surgeon so that he could identify the start, the required dosage and the endpoint when the wound should be no more be treated by conservative measures. Often surgical procedures are best sandwiched between periods of Hyperbaric Oxygen therapy to obtain the best treatment results within the shortest time.

Necrotizing fasciitis

NSTIs are characterized by rapidly progressive necrosis of the fascia and subcutaneous tissue with relative sparing of the underlying muscle.^[1] Necrotizing fasciitis may occur in a wide range of anatomical locations. The presentation of necrotizing fasciitis of perineal region is termed as Fournier's gangrene.^[2] Necrotizing soft tissue infection of the scrotum is a rapidly progressive, acute condition, which results due to imbalance between the host immunity and virulence of the causative microorganisms. Invasive Group A Streptococcus (iGAS) was found to be the most frequently isolated causative bacterium.^[3] About 20-70% of the patients may have diabetes mellitus with necrotizing infection of

scrotum.^[4] Other predisposing factors include alcoholism, intravenous drug use, low socioeconomic status, immune disorders, and cancerous conditions.^[5]

MATERIALS AND METHODS

The study was conducted in the department of Plastic surgery and burns. Eleven patients with Necrotizing fasciitis were screened for inclusion in the study. Patients requiring ICU/ ventilator support were not included in

the study. Informed consent was obtained from the patients undergoing the study. Wound care and surgical management was proceeded as per the standard protocol of the unit. After Initial assessment, patient was treated with hyperbaric oxygen therapy according to the protocol described in Table 1.

Table 1: HBO protocol for necrotizing fasciitis.

Day of treatment	Pressure	Duration of session	Number of sessions per day	Comments
Day 1	2.8 ATA - 3 ATA	120 minutes isopressure	3 sessions - 8 hours apart	
Day 2 onwards	2.8 ATA - 3 ATA	90 minutes isopressure	1 session	
Day 10- Assessed by the Plastic Surgeon and decide when to terminate the course				
10 - 15 sessions depending on clinical improvement				

RESULTS

Out of 11 patients, all patients were diabetic. 3 patients were fournier's gangrene, eight patients were necrotizing fasciitis involving the lower extremity. Two patients did not require any surgical intervention while 9 required multiple debridement and soft tissue reconstruction in terms of skin grafting. Patients who required ICU/ ventilator support were not included in the study due to limitations of monoplace hyperbaric chamber.

Clinical Applications

Case 1:

A 75-year-old Diabetic presented with Necrotizing fasciitis of the right leg [Figure 1a]. Patient was treated with iv antibiotics for 4 days and simultaneously with Hyperbaric Oxygen therapy at 2.4 ata initially twice a day for the first 4 days and then daily once for the next 10 days. Oral antibiotics followed intravenous antibiotics. Patient received a total of 18 sessions of HBOT. Patient recovered completely with no surgical procedures [Figure 1b].



Figure 1a: Diabetic patient with necrotizing fasciitis of the right leg.



Figure 1b: Recovery of the wound following 18 sessions HBO without surgical intervention.

Case 2:

A 57 yrs female was admitted with necrotizing fasciitis of the left leg, multiple incision and drainage [Figure 2a] was done in local hospital and referred for further management to plastic surgery department. Patient was started with debridement and HBO sessions simultaneously, incisions extended for adequate drainage [Figure 2b]. Wounds healed well following debridement and skin grafting [Figure 2c & 2d]. Patient underwent 32 sessions of HBO therapy.



Figure 2a: Necrotizing fasciitis of the left leg - status multiple incision and drainage done.



Figure 2b: Debridement and extension of incision done.



Figure 2c: Skin grafting done at later stage.



Figure 2d: Wound healed completely – 32 sessions of HBO was administered.

Case 3:

A Diabetic patient presented with Fournier's Gangrene [Figure 3a], which was treated with debridement [Figure 3b] and simultaneous HBO sessions. Wound was later covered with skin graft [Figure 3c & 3d]. Patient underwent 30 sessions of HBO therapy.



Figure 3a: Diabetic patient with Fournier's Gangrene.



Figure 3b: Post debridement Picture.



Figure 3c: Wound covered with skin grafting with simultaneous application of Hyperbaric oxygen therapy.



Figure 3d: Late postoperative appearance of the wound.

DISCUSSION

Fulminant tissue necrosis may be accompanied by generalized toxicity, progressing to shock and multi-organ failure. Without prompt recognition and immediate aggressive management, it is often rapidly fatal. The initial event is the entry of bacteria into the fascia, either trauma or surgery. Rapid bacterial proliferation in the fascia is followed by white cell infiltration and liquefactive necrosis of the tissue. The external manifestation of the disease in terms of skin necrosis many a times cannot be correlated to the fascial spread leading to inadequate debridement. Satellite lesions may be evident due to sub-cutaneous propagation. Perforating skin vessels are occluded due to progressive thrombosis of the blood vessels at fascial level, which results in secondary cutaneous ischaemia and gangrene [Figure 4].^[6,7]

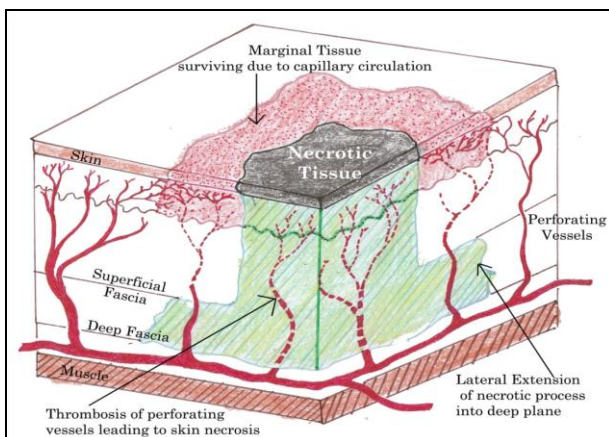


Figure 4: Progress of necrotic process in necrotizing fasciitis affecting nearby perforators.

Even with immediate and radical surgical debridement of all necrotic tissue, the prompt commencement of broad-spectrum antibiotics and appropriate high-dependency supportive care mortality rates are in the region of 30% to 40%.^[8,9,10]

Most patients require multiple frequent extensive debridement and are left with large soft tissue defects exposing the vital structures. Prolonged hospital stays and rehabilitation are often needed. Significant morbidity with early and late mortality are common with necrotizing soft tissue infection. To this day the surgical approach to these wounds remains inconsistent. Although the emergent need for surgery even though is widely accepted,^[11] errors of judgement remain troublesome. An overly aggressive approach with surgery in an early phase may result in extensive resections and even amputations that were not clinically indicated.

Nowadays, with the development of antibiotic and HBO therapies, the approach towards necrotizing fasciitis has changed, with surgery now utilized for eliminating necrotic tissue and reducing oedema-related compression. Array of cellulitis, disrupted vascularity and infected necrotic tissue results in tissue edema. Edematous tissue triggers the hypoxia to a vicious cycle. Edema also exacerbates spread of the infection by reducing microcirculation and reduces antibiotic penetration.^[12]

The rationale of utilizing HBO in necrotizing fasciitis is

- Hyperoxic effect - Salvaging critically ischaemic areas
- Anti bacterial effect - through a direct bacteriostatic or bacteriocidal effect and potentiates antibiotic efficiency in oxygenated environment
- Immunogenic effect - improves white cell killing efficacy and exhibits a complex balance between the generation of reactive oxygen species and the up-regulation of antioxidant defences.
- Anti-inflammatory effect - inhibition of the binding and subsequent activation of leucocytes to damaged vascular endothelium reduces ischaemia-reperfusion injury.
- Anti edema effect - Hyperoxic vasoconstriction and redistribution of circulation to deprived areas in a reverse steal phenomenon.
- Wound healing effects – enhancing fibroblast activity and collagen synthesis.

In our series, as we have a monoplace hyperbaric chamber, we were not able to include the patients of necrotizing fasciitis who require ICU/ventilator support. This limitation could be overcome if there is a multiplace chamber where a doctor/ technician can step inside the chamber for monitoring or controlling the parameters while hyperbaric oxygen is being administered. There was no complications related to hyperbaric therapy where noted during the study.

CONCLUSION

The acceptance of Hyperbaric Oxygen therapy can be strengthened only through evidence brought out from multicentre trials with the existing centers in India and thus helping to create a code of practice in India. The necessity of this is long felt as the same Hyperbaric Oxygen therapy has shown great result in some parts of the world and remains unacceptable for the same clinical condition in other parts of the world. In our observation, when Hyperbaric oxygen therapy combined with surgical expertise, complicated wounds like necrotizing fasciitis could be managed effectively.

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