Efficacy of Hyperbaric Oxygen Therapy in the Treatment of Pyoderma Gangrenous

ABSTRACT

Pyoderma gangrenosum (PG) is a rare and severe neutrophilic dermatosis characterized by the formation of painful and often debilitating skin ulcers. The causes of PG are not yet fully understood, but it is believed to be related to dysfunctions of the immune system and can be associated with other systemic conditions. Hyperbaric oxygen therapy (HBOT) has been used as an adjuvant treatment in various chronic conditions, including PG.

The retrospective, observational, and descriptive study presented here aims to evaluate the effectiveness of HBOT in treating patients with PG seen at the Centro Mineiro de MedicinaHiperbárica. Additionally, the study seeks to identify treatment response patterns, considering factors such as patient age, the number of HBOT sessions required, and the total duration of treatment.

The sample included 10 patients diagnosed with PG who underwent HBOT between January 2000 and December 2022. The majority of patients were female, aged between 43 and 72 years. A significant reduction in the area of skin lesions was observed in several patients, indicating a positive response to the treatment. However, the definitive effectiveness of HBOT in managing PG still requires additional studies with a larger number of patients and more robust methodological designs.

Keywords: Pyoderma Gangrenosum; Hyperbaric Oxygen Therapy; Neutrophilic Dermatosis; Adjuvant Treatment; Therapeutic Efficacy.

INTRODUCTION

Pyoderma gangrenosum is a rare neutrophilic dermatosis characterized by the presence of painful, rapidly progressing skin ulcers. Although the exact etiology of pyoderma gangrenosum is still not fully understood, it is believed to involve an immune dysfunction, often associated with inflammatory bowel diseases, rheumatoid arthritis and other autoimmune conditions.(1,2,3)

Hyperbaric oxygen therapy (HBOT) is a therapeutic modality that involves the administration of pure oxygen in a high-pressure environment, usually two to three times normal atmospheric pressure. This therapy has been widely used in the treatment of various conditions, including chronic wounds, osteomyelitis and carbon monoxide poisoning.(4,5) In the context of pyoderma gangrenosum, HBOT has been considered an adjuvant therapeutic option, especially in cases refractory to conventional therapies.4

Recent studies suggest that HBOT can promote ulcer healing by improving tissue oxygenation, reducing edema and modulating the inflammatory response.(4,5) Vieira et al.4 reported a case of successful use of HBOT as an adjuvant treatment for pyoderma gangrenosum, highlighting the effectiveness of this therapy in accelerating the healing process. In addition, a review by Maronese et al. (5) highlighted the

emerging evidence on the benefits of HBOT in the management of pyoderma gangrenosum, underlining the need for further clinical studies to validate these findings.

The incidence of pyoderma gangrenosum varies globally, and the condition presents significant challenges in both diagnosis and treatment. Monari et al. (6) conducted a prospective study, emphasizing the need for innovative and personalized therapeutic approaches to manage this complex condition.(6)

METHOD

This study was characterized as a retrospective, observational and descriptive study, conducted at the Centro Mineiro de MedicinaHiperbárica, located at Avenida do Contorno, 9495, Bairro Prado, Belo Horizonte, Minas Gerais, CEP: 30.110-043. Covering the period from January 2000 to December 2022, the study focused on patients diagnosed with pyoderma gangrenosum (PG) who had undergone treatment with hyperbaric oxygen therapy (HBOT). The sample consisted of data from all patients with PG seen at the clinic and who underwent HBOT treatment during the research period, making it a convenience sample.

The inclusion criteria included patients of any age or gender with pyoderma gangrenosum referred to the Centro Mineiro de MedicinaHiperbárica for HBOT treatment. Exclusion criteria included pregnant women, the presence of an untreated pneumothorax or hemothorax, recent pulmonary thromboembolism, the use of specific chemotherapy drugs such as doxorubicin and bleomycin, the use of the drug Sulfamylon and patients who had undergone ophthalmic surgery less than 30 days previously.

In the methodology applied at the clinic, patients signed an informed consent form after being referred to the Minas Gerais Hyperbaric Oxygen Therapy Center. Treatment took place from Monday to Saturday, in monoplace or multiplace chambers, allowing up to seven patients to be present simultaneously, with sessions lasting between 90 and 120 minutes. Every week, a nurse counted and measured the lesions, while a doctor reassessed the patient every 15 days.

The data collection procedures involved the analysis of medical records by the researcher and two medical students. The information collected was recorded in an Excel database, including variables such as age, gender, time since diagnosis, size and number of lesions, diseases associated with PG, medication used, number of relapses and HBOT sessions.

With regard to ethical aspects, data collection began only after approval by the CEP/Conep system.CAAE approval: 72841823.2.0000.5134.

RESULTS

The data obtained from the Centro Mineiro de MedicinaHiperbárica, covering the period from January 2000 to December 2022, provides a detailed overview of the effectiveness of hyperbaric oxygen therapy (HBOT) in the treatment of pyoderma gangrenosum (PG). Table 1 shows information on 10 patients treated with HBOT, highlighting variables such as gender, age, number of sessions, presence of necrosis, initial and final total areas of the lesions, presence of serous exudate, closure of the lesions and treatment time.

The patients analyzed ranged in age from 43 to 72 years, with a predominance of females. The number of HBOT sessions varied significantly between patients, with a minimum of 20 sessions and a maximum of 702 sessions. The diversity in the number

of sessions reflects the need for individualized treatment, based on each patient's specific response and the severity of their lesions.

The presence of necrosis was observed in 70% of patients, while serous exudate was present in 90% of cases. These indicators are critical for assessing the severity of the lesions and the inflammatory response associated with PG. The total area of the lesions varied widely, with some initial lesions as small as 3.6 cm^2 and others reaching 240 cm^2. After treatment, the areas of the lesions also varied significantly, with some lesions reducing substantially in size.

Table 1: Hyperbaric Oxygen Therapy Treatment Data for Pyoderma Gangrenosum

Gender	Age	Number of sessions	Presence Of necrosis	Inicial total area	Final total area	Presence of serous exudate	Did the lesions close?	Treatment time
Female	43	69	No	240cm	91cm	Yes	No	4 months
Male	63	287	Yes	30cm	20,25cm	No	No	9 years
Female	55	702	No	3,6cm	3cm	Yes	Yes	2years
Male	58	20	Yes	10cm	24cm	Yes	Not reported	1 month
Female	62	82	Yes	35cm	1cm	Yes	Not reported	3 month
Male	64	460	Yes	48cm	28cm	Yes	Not reported	3 months
Female	72	160	Yes	45cm	60cm	Yes	Not reported	18 years
Female	69	30	Yes	12,5cm	42cm	Yes	Not reported	Not reported
Female	68	67	Yes	48cm	42cm	Yes	Not reported	3 months

Female	44	150	Yes	165cm	130cm	Yes	Not reported	1 year

DISCUSSION

A retrospective analysis of data from patients treated with hyperbaric oxygen therapy (HBOT) at the Centro Mineiro de MedicinaHiperbárica demonstrates that HBOT can be a valuable therapeutic option for the management of pyoderma gangrenosum (PG). Although the response to treatment varied significantly between patients, many showed a reduction in the total area of the lesions and an improvement in the clinical signs of inflammation, such as the presence of serous exudate. According to Xavier et al, 2024, The use of hyperbaric oxygen therapy in the treatment of pyoderma gangrenosum promoted complete healing of the lesions in 64.3% of patients and improvement of the lesions in another 19.6% of cases.

The variability in the number of sessions and treatment time required to achieve improvement suggests that PG requires highly individualized treatment approaches. Factors such as the presence of necrosis, the initial area of the lesions and the inflammatory response should be considered when planning treatment with OHB. The wide range of treatment times, which varied from one month to 18 years, emphasizes the chronic and complex nature of PG and the need for continuous monitoring and therapeutic adjustments. There is no gold standard of treatment for PG (7,8,9), the aim of which is to close the wound, reduce inflammation, manage pain and prevent infection (10).

Despite the limitations of this study, such as the small sample size and the retrospective nature of the data collection, the results are promising and indicate that HBOT can be an effective addition to the arsenal of treatments for PG. Future studies, with larger samples and a prospective design, are needed to confirm these findings and develop more standardized treatment protocols. The clinical variants of pyoderma gangrenosum are: classic ulcerative, bullous, vegetative, pustular, periostomal and post-operative (11,12). Thus, the difference in clinical types can affect wound closure.

Although only one patient reported complete closure of the lesions, most patients showed some form of improvement, indicating that HBOT can be effective in reducing the area and severity of PG lesions. Treatment times ranged from one month to 18 years, suggesting the need for prolonged treatments to achieve significant results in some cases. Hyperbaric medicine provides plasma and tissue oxygen, accelerating the healing process, increasing angiogenesis, reducing pain and infection rates (13,14).

These results highlight the importance of a personalized approach to treating pyoderma gangrenosum with hyperbaric oxygen therapy. The variability in treatment responses and treatment times reinforces the need for further research to optimize therapeutic protocols and improve clinical outcomes forpatients.

CONCLUSION

Hyperbaric oxygen therapy has been shown to be effective in several cases of pyoderma gangrenosum, providing a viable treatment option for patients who do not respond adequately to conventional therapies. Personalization of treatment and continuous

follow-up are crucial to maximizing the benefits of HBOT and improving the quality of life of patients with PG.

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