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Platelet-Rich Plasma (PRP) and Hyperbaric Oxygen Therapy (HBOT) As Effective Combination Therapy for Decubitus Ulcers

(PRP And HBOT Combined Treatment Of Decubitus Ulcers)

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***Abstract*—As an alternative and promising method for the treatment of chronic wounds and pressure ulcers is platelet-rich plasma (PRP) as an autologous therapy with very good results. In the last decade has also been shown that hyperbaric oxygen therapy (HBOT) can have a positive effect on the wound healing process. Here we describe the first case of combination therapy of PRP and HBOT in a patient with chronic pressure ulcer of larger dimensions. This combination therapy in the presented case significantly accelerated the wound healing process in comparison to the PRP or HBOT wound treatment alone, about which data are available in the literature. After the PRP and HBOT combined therapy, the decubitus ulcer of the patient was reduced by 48.7%, only 4 weeks after the treatment.**

Keywords—Decubitus ulcer; PRP; HBOT; PRP and HBOT combination therapy.

I. BACKGROUND

Pressure ulcers are a serious health problem that all medical institutions with patients with limited physical and motor function are dealing with. The mortality rate from this disease is up to six times higher compared to other diseases, and the highest incidence is in bedridden patients after a certain surgical procedures (1). The risk of developing pressure ulcers after surgery is increased 1.5 times in patients with diabetes (2). Chronic ulcers require special medical attention and care when cleaning the wound, dressing, and keeping it dry and free from microbial infections. Even with all the medical dedication, conventional methods of cleaning and bandaging ulcers often do not have a satisfactory result and the wound heals very slowly or not at all (3). The regenerative ability of platelet-rich plasma (PRP), which has been widely used in recent years for rejuvenation in various fields of medicine, has also found its application in the treatment of chronic wounds, including ulcers (4). Platelet-driven growth factors accelerate tissue regeneration and the healing process, especially when using PRP-gel (5), and can stimulate expression of anti-inflammatory cytokines as it was shown in some studies (6). This is a method that involves processing the patient's blood and isolating blood elements that have regenerative potential, with special protocols for centrifuging the patient's whole venous blood (7). Another method that has shown a positive effect in the treatment of chronic wounds by enabling a better supply of oxygen to the wound is hyperbaric oxygen therapy (HBOT) (8, 9). The benefit of HBOT is reflected in its ability to stimulate fibroblast cell replication and collagen deposition, as well as

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the creation of new blood vessels and the elimination of intracellular infections by helping leukocyte activity (10, 11). Although there are certain combination therapies for HBOT, for example with hemoglobin spray, there are no published studies or case reports of the combination of HBOT and PRP therapies (12). We present here for the first time a case of combination therapy with PRP and HBOT in a patient with decubitus ulcer with a positive outcome.

II. CASE DESCRIPTION

A 76-year-old male patient with decubitus ulcer on gluteus and sacral region in size of 11.5x10x2 cm, was admitted to the intensive care unit of the Familia Nursing Home in Sarajevo, Bosnia and Herzegovina, in October, 2021. He was previously hospitalized at the Clinical University Center in Sarajevo, at the abdominal surgery unit in September, 2021, when he underwent hemicolectomy surgery. Before this, the patient was operated 2009 for heart CABG I. baypas implantation, required due to infarct myocardii anteroseptalis. This was diabetic patient on therapy with insulin for the last two years. Upon admission to Familia intensive care unit, the patient was afebrile, conscious, communicative, oriented in time and space, with pale skin, without neurological laterilization. Auscultatory respiration bilaterally audible vesicular, and rhythmic heart rate RR 120/60 mmHg. F 75 in min. Abdomen covered with bandage material, placed colostoma functioning. Diuresis: spontaneously goes to the toilet. Lumbar vines of the patient were free, extremities mobile actively and passively, without neurological outbursts. The patient uses diapers, was vaccinated with two doses of Sinopharm vaccine, denies allergies to food and drugs. Immediately after admission, the cardiac therapy was recommended, antibiotic, Controloc, Aspirin 100 mg were included. 1x1. per os nutrition and hydration. The patient was self-propelled with the help of one person. Transfers in bed were performed independently with the help of a trapeze, transfer bed - wheelchair and with the help of one person. The balance of sitting was good, while the balance of standing was disturbed due to general weakness. Edema were present on both feet hanging to the right. Angular mobility in the joints of the extremities was within physiological limits. On the basis of physiotherapy assessment, a rehabilitation plan and program was made. From the personal anamnesis of the patient, it follows that the pressure ulcer of the mentioned size occurred within seven days after the hemicolectomy operation, and despite regular debridement and bandaging, the existing ulcer did not show any healing progress. Since the wound showed all the characteristics of a chronic wound that does not heal, even after four weeks, with the consent of the patient and his family, it was decided that the patient undergoes PRP treatment. The PRP was isolated from 27 ml of patient's whole blood due two centrifugation steps and isolation of buffy coat rich on platelets. After aseptic cleaning and re-debridement of the decubitus ulcer (Fig. 1), the wound was measured and photographed. The volume of the decubitus wound still was 11.5x10x2 cm, category III and with necrosis zone 6x7cm. 2.2 ml of isolated PRP substrate, at a platelet concentration 4.11 times higher than patient's whole blood (concentration of PRP substrate platelets: $802x10^9$/L and platelets concentration of the patient's blood before treatment: $195x10^9$/L) was applied as follows:

- 1.2 ml of PRP substrate was injected along the edge of the wound in 0.2 cm distance and 1 ml of the PRP substrate was applied on the surface of the wound (Fig. 2).
- The wound was then covered with a mixture of 8 ml of plasma with 10% Ca-gluconate, and with collagen dressing (Suprasorb C).

Fig.1: Cleaning and debridement of the wound.

Fig. 2: PRP application on the edge of the wound.

After PRP treatment, the patient underwent oxygen therapy in a hyperbaric chamber (12-seat chamber from manufacturer Baroxhbo, model Omega), for 15 treatments with 100% oxygen, 1.5 ATA (absolute pressure), in duration of 55 minutes for each individual treatment. Four weeks after the PRP treatment and fifteen HBOT treatments, new wound measurements were performed and photographed. It is important to point out that the pronounced granulation of the wound was visible on the fourth day after PRP application. The initial size of the wound of 11.5x10x2 cm (Fig. 3) was reduced by 47.8% after 4 weeks of PRP and HBOT combined treatment to a size of 8x7x2 cm, and was free from the necrotic tissue (Fig. 4A and 4B).

Fig. 3: Size of the decubitus ulcer before combined PRP and HBOT treatment in size of 11.5x10x2 cm (necrotic tissue zone 6x7cm).

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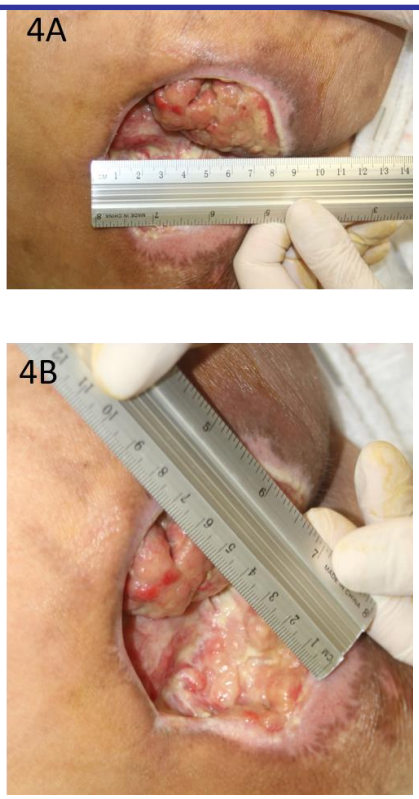

Fig. 4: A. Length of the wound after PRP and HBOT treatment. B. Width of the wound after PRP and HBOT treatment.

III. DISCUSSION

Wound healing is a natural response of the organism to tissue injury, which occurs with the activation of many cellular processes and signaling pathways through which cells communicate with each other in order to regenerate damaged tissue. The stages in which the wound heals are hemostasis, inflammation, proliferation and maturation. Each of these stages can be influenced by many internal or external factors, such as diabetes or microbial infections. Chronic wounds are characterized by a prolonged phase of inflammation due to increased concentration of proinflammatory cytokines. Such changes result in increased production of proteolytic enzymes that affect wound healing. In a negative sense, the increased activity of the metalloprotease enzyme also contributes to inhibition of wound healing process (13).

In recent years, several studies have been published that indicate a positive effect of PRP therapy as well as HBOT treatment when it comes to the treatment of chronic wounds. It has been shown that after PRP treatment there is a faster granulation of the wound, which was observed similar as for HBOT treatment alone, 7 days after the treatment (14, 15). With presented case report, where for the first time was combined PRP and HBOT treatment together for the chronic wound therapy, it was possible to see the wound granulation much earlier, on forth day after only one PRP treatment and two HBOT treatments. Reduction in decubitus ulcer size for 48,7% after four weeks after PRP treatment and at the end of 15 HBOT treatments, showed that combined therapy could be more effective in treatment of chronic wounds in comparison to PRP or HBOT treatment alone. We believe that the result of the PRP and HBOT combination therapy, which was achieved in this patient, is all the more significant because it is a patient with diabetes and in age of 76.

Overall, the presented case report opens the possibility of combined PRP and HBOT therapy as a better choice of treatment with a faster effect in the healing of chronic wounds such as pressure ulcers, even for the treatment of pressure ulcers of the third and fourth category. The potential of this combination therapy as a replacement therapy over the conventional treatment of chronic wounds, will be the subject of our future studies and research.

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