Burn Injuries

A special section of plastic and reconstructive surgery is represented by burn injuries: injury to skin and other tissue caused by contact with dry heat (fire), moist heat (steam or hot liquids), chemicals, electricity, lightening, radiation. The depth of the injury is proportional to the intensity of the heat of the causative agent and the duration of exposure.

Burns are measured by layer of skin affected. According to this parameter, burns are classified in three groups:

- First degree burns involved the epidermis and are characterized by redness, pain and edema (such as in sunburn).
- Second degree burns involve the epidermis and dermis are characterized by intense pain, redness and blistering.
- Third degree burns destroy the entire skin, and expose the underlying organs. Skin is charred and numb and does not protect against fluid loss.

From a medical viewpoint, burns are classified as:

- Major or severe, involving more than 20 % of body surface and any deep burn of the hands, face, feet or perineum.
- Moderate – involving 5-20 % of body surface without any deep burns of hands, face, feet or perineum.
- Minor – involving less than 5 % of body surface, generally treated without hospitalization.

The immediate outcome of a burn is determined more by its extent (amount of body area affected) than by its depth (layers of skin affected). The depth of one burn is of importance when the question arises as to how much surgical treatment (including skin grafting) will be required.

General treatment of a burn injury includes pain relief, control of infection, maintenance of the balance of fluids and electrolytes in the system and a good diet, high-protein and vitamins to aid in the repair process.

In the cases of minor burns or scalds, cooling is one of the most effective ways of relieving pain. No ointment, oils or antiseptics are necessary for this stage.

In the cases of moderate burns or scalds, antiseptics are needed (chlorhexidine, bacitracin, neomycin). Treatment consists of using a dressing impregnated with a suitable antibiotic or of applying a cream containing antiseptic and pain-relieving agents and covering the burn with a dressing sealed at the end.

Severe burns are treated in specialized clinics. The process of healing is slow and tedious, including careful nursing, physiotherapy and occupational therapy. In some cases, depending on the extent of the burn, skin grafts may be considered.

Diapulse therapy has been proven to be a convenient therapeutic method for burn injuries. This particular therapy proved to decrease edema, relieve pain, and preclude local complications.

In 1969, Bornstein[1] introduced Diapulse to the burn units at the two leading hospitals immediately after Israel's Six-Day War. Using this method in tube pedicles and flaps procedures, he succeeded in reducing hospitalization by about 25%. By assessing when a tube can be transferable, he used Hynes' method to judge when the tube had enough blood supply to clamp the distal end of the tube. Atropine was inserted and they noted the results showed return circulation to the end of the tube and flap within ½ hour of injection. With the use of Diapulse he found they got positive atropine absorption results after 16 to 22 days thus shortening tube transfer time at each stage, from 6 to 12 days. If a patient required 10 operations they saved a week each time! Bornstein commented that some patients who would require a year's hospitalization (face and other major reconstructions) they saved three months.

In 1974, Ionescu[2] introduced Diapulse therapy for burn patients. Since Diapulse treatment proved particularly efficient in the treatment of traumatized hands – decrease and disappearance of œdema, relief of pain and uncomplicated local evolution, Ionescu[3] started a study on the effect of Diapulse on burned hands. He applied Diapulse therapy to over 2000 patients with:

- traumatic lesions; before and after surgery; with burns;
- different inflammatory diseases;
- severe evolutive necrotic lesions;
- radionecrosis.

The hand responds in a particular way to thermic injuries because of its anatomic peculiarities, its multiple fine structures which are differentiated for specific functions, its return circulation, which is situated mostly at the superficial level, where the occurrence of any injuries results in a rapid and progressive development of edema.

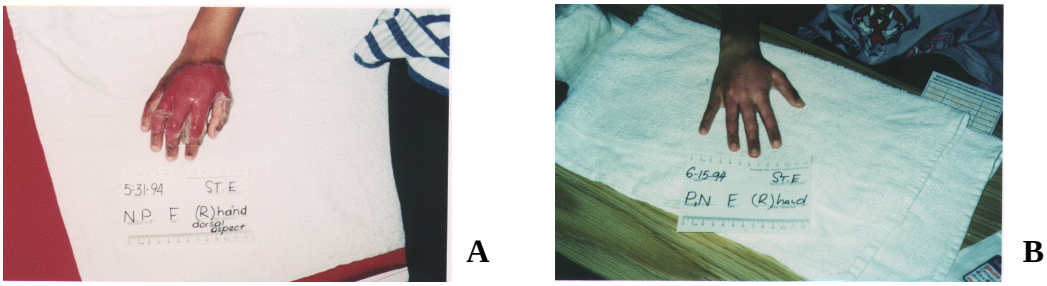
Diapulse therapy was applied on 43 patients, as soon as possible after their

admission, for 10 to 15 minutes on the areas most affected by burns for 3-5 days, at 600 pps and 6 peak power t.i.d.

The clinical observations recorded were:

- pain relieved after the first session;
- edema remarkably diminished;
- in the local evolution, aggravation of the wound, is no longer noticed;
- the debridement of burns is more rapid and the granular surface becomes suitable for grafting under improved conditions (Fig. **1**).

Positive results were also obtained using Diapulse therapy for the acceleration of the healing processes in first, second and third degree burns[4] (Fig. **2**).



A **B**

5-31-94
Prior to first Diapulse treatment

6-15-94
2 weeks

Fig. 1. Effect of Diapulse therapy on a 3rd degree burn hand.

Oct. 2 Front view Oct. 2 Side view

October 2nd, five days after her initial hospitalization, Diapulse therapy was instituted twice daily. Photographs taken prior to first Diapulse treatment

Oct. 3 Front view Oct. 3 Side view

Photographs taken October 3rd after two Diapulse treatments

Oct. 8 Front view Oct. 8 Side view

On October 4th she was discharged, after a total of five Diapulse treatments. She returned for final check-up October 8th, when final photographs were taken.

Fig. 2. Effect of Diapulse therapy, on a 1st & 2nd degree face burn.

Because the clinical results were significantly positive, Ionescu and staff tried to find objective proofs for them. Considering the local enzymic activity as an indicator of the viability, they checked the amount of total proteins and some significant enzymes in normal and burned tissue, before and after Diapulse therapy[5].

The study was performed on 20 burned patients admitted to the hospital as emergencies. Enzymic changes in epidermal cells were studied in 3 samples of skin, 100 to 300 mg in weight, taken from each patient:

- one sample was taken from the burned area before treatment;
- the second sample was taken from a nearby unburned area, considered to be the control;
- the third sample was taken from the burned area 24 hrs after the burn and after Diapulse therapy.

Patients were treated once daily for 3 – 5 days. Diapulse was applied through bandages and surgical dressing, over each burned area for 10 minutes at a setting of 600 pulses per second and 6 peak power. Enzymic activity determinations (LDH; GOT; GPT, alkaline phosphatase) and total protein concentration were performed from the skin samples' extracts. A summary of the results is presented in Table 1.

Table **1**. **Statistical analysis of enzyme determinations in burn tissues**

	NORMAL TISSUE	INJURED TISSUE	DIAPULSE TREATED

	1	2	1	2	1	2
PROTEINS	3.31	± .58	2.8	± .6	3.42	± 1.0
LDH	1657	± 241	1356	± 108	1788	± 310
GOT	80.7	± 19.9	73.75	± 18.6	90.87	± 26.7
GPT	16.2	± 2.6	16.8	± 3.0	19	± 5.7
ALK. PHOS.	16.8	± 4.8	15.3	± 5.1	17.8	± 5.8

1 = Average; 2 = Dispersion.

The laboratory data showed, in the case of Diapulse treated samples, an increase of total protein concentration and an increase of LDH and alkaline phosphatase activity. The GPT activity is slightly increased while GOT's activity decreased. This study provided a preliminary biological framework to discuss the beneficial effect of Diapulse therapy in the healing of wounds at subcellular level.

A study was performed by Ionescu, concerning Diapulse therapy on radionecrosis[6,7]. In this 40 patients were selected for Diapulse therapy. The etiology of these patients was represented by the therapeutic radiotherapy, applied for various types of malignancy: 15 epithelioma, 8 breast cancers, 7 hemangioma, 5 uterine cancers, 2 ependynom of distal spinal cord, 1 pituitary gland adenoma, 1 ovarian cancer and 1 syringomyelia.

Diapulse therapy was applied locally twice daily at maximum settings, penetration (6 peak power), 600 pulses per second, for 15 minutes, preoperative 7-30 days (average 14) as well as postoperative (in all cases, the surgical procedure consisted of excision of the integral radionecrotic tissue to healthy tissue).

Theoretical effects of radionecrosis are:

- the influence on local circulation, resulting in œdema and hematoma producing an increase of the distance between the cells and blood vessels, thus leading to cellular oxygen shortage;
- the damage of the transmembrane ion transport system (Na^+ / K^+ cellular pump) affecting cellular permeability, with a subsequent excess penetration of Na^+ ions into the cell; Ca^{2+} ions accumulate, inducing further damage; finally, the whole cell life is affected, including the nucleic acid synthesis.

Diapulse therapy indicated a positive effect on cellular processes: re-equilibration of membrane potential and regeneration of damaged membrane, followed by blood flow normalization. The immediate signs of restoration of cell polarity and of

improvement of the blood flow are the elimination of œdema, the reduction of hematoma and the relief of pain.

The results obtained using Diapulse therapy on radionecrosis were exceptional; in some cases, Diapulse was the only method of treatment leading to complete healing. It was also suggested that Diapulse therapy could induce tissue revitalization in the radionecrosis zone, which had been partially devitalized.

During the 17 years of using Diapulse in the hospital on traumas and burn injuries (4,000 cases), Ionescu et al found no contraindications despite its application to the most difficult cases.

References

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