THE EFFICIENCY OF BURN WOUNDS DEBRIDEMENT WITH USE OF HYDROSURGERY – OUR EXPERIENCES

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The aim of the study was to present experience of doctors from the Center for Burns Treatment in Siemianowice Śląskie who use a Versajet system.

Material and methods. Debridement with the use of a water jet was applied in 70 patients with IIbº /IIIº thermal burns in the period between 2009-2013. The corresponding evaluation involved duration of operation, locations, wound surfaces and technique of debridement after operation. Microbiological tests were also performed before and after debridement.

Results and conclusions. In the paper, its authors draw attention to the short time of debridement. The application of a water jet allows precise debridement, particularly in hardly accessible places, preparation of wounds to be covered with autologous split thickness skin graft, protection of healthy tissues.

Key words: debridement, hydrosurgery, water jet

Standard treatment of burn wounds involves early removal of necrotic tissue and wound closure in order to protect human body against loss of liquids, electrolytes and – first of all – to prevent infections (1, 2). Proper wound debridement improves survival rate, decreases number of micro-organisms in the wound, makes it possible to prepare the wound for possible skin graft, and thus shortens a period of hospitalization (2, 3). Depending on the surface and depth of a given wound, surgical debridement methods with the use of surgical tools are applied or enzymatic, biological and autolytic methods, with the use of specialistic dressings. The method of surgical removal of necrotic tissue involves resection and/or tangent cutting, which may cause heavy loss of blood and other complications, such as imprecise cut-outs in anatomically difficult areas of the body.

The Versajet system was designed for wound debridement (cutting, cut-outs, removal of necrotic tissues) with the use of a stream of liquid released under pressure from the nozzle.

The flow of liquid through the nozzle generates a vacuum, which cuts and sucks the removed tissues in. An operator can control the depth and power of tissue aspiration, changing power settings / depending on location, type of debrided surface/tissue/, pressure of the nozzle on the tissue and nozzle direction against a wound surface.

When a nozzle is placed perpendicularly to the surface of debrided wound, the tissues can be cut and sucked. When it is placed diagno-
nally, it allows to rinse the surface, smooth wound bottom and edges (fig. 1).

Wound debridement with the use of a water jet has the following advantages: supports epidermization, allows precise debridement of hardly accessible places, such as, e.g. face, fingers, neck, improving results of operations and healing following ski graft, makes it possible to avoid damage of healthy tissues thanks to the possibility to control the depth of cutting, removes biofilm, reduces a risk of infection, prevents infection (1, 3, 4, 5).

Versajet® (by Smith & Nephew) is used in the Center for Burns Treatment in Siemianowice Śląskie since 2009 for debridement of wound surfaces: burns, varicose crural ulcerations, ulcers in the course of a diabetic foot, bedsores (fig. 2).

The paper is based on an analysis of results involving the use of a water jet applied in patients with IIB°/III° thermal burns, in order to debride wounds, based on experience from the Center for Burns Treatment in Siemianowice Śląskie.

MATERIAL AND METHODS

This paper is of observational character and presents experience of doctors from the Center for Burns Treatment in Siemianowice Śląskie who used hydrosurgery in wound debridement in 70 patients (12 women and 58 men) with IIB°/III° thermal burns during the period from 2009 to 2013. The age of women fell between 19 and 84 years (average: 61 years). The age of men fell between 19 and 75 years (average: 48 years). The reasons underlying burns are showed in fig. 3. The quantitative distribution of burns locations in hospitalized patients is shown in fig. 4.

Burn wounds were debrided in 13 (19%) patients with thermal burns of IIB° and in 57 (81%) patients with thermal burns of III°. The area of burns in patients with IIB degree fell between 6% of the body surface and 70% of the body surface (on average, 27% of the body surface).
The efficiency of burn wounds debridement with use of hydrosurgery – our experiences

The area of burns in patients with III degree fell between 2% of the body surface and 70% of the body surface (on average, 26% of the body surface). Wounds were debrided with the use of the Versajet II Plus system with nozzle type 45/14 mm, on average on the 23th day following the injury (5-78 days). Device power was set according to the corresponding manual, while taking into account the type of debrided surface. Each time photographic documentation was made and smears were taken for microbiological tests before and after wound surface debridement. The material was transferred onto a Stuart-type transportation medium and then seeded onto relevant culture media. Isolated micro-organisms were determined in terms of quality and half-quantity, i.e. determining their growth as scarce (+), abundant (+++) and very abundant (+++). Having identified a bacterial strain, drug susceptibility was assessed, using a diffusion-disk method. Both before and after operation, each patient was subject to venous thromboembolism prophylaxis (low-molecular-weight heparin) and analgesics (tramadol) as well as to focused or empiric antibiotic therapy, according to treatment standards applied in CLO in Siemianowice Śląskie.

RESULTS

Following hydrosurgical wound debridement, the following were applied during one operation: silver dressing in 24 patients, autologous split thickness skin graft was performed in 42 patients, in 2 patients at the time of autologous split thickness skin graft, autologic cultured keratinocytes were applied and in 2 patients Suprathel dressing was applied. Treatment results are presented in fig. 5.

In 31 (44%) patients the hydrosurgical debridement of wound was the last operation performed with the use of autologous split thickness skin graft. Among 70 patients, during their hospitalization, wound debridement was – on average – the 2nd operation performed (1-6 operations). On average, an operation of wound surface debridement with the use of Versajet water jet lasted 55 minutes. In order to demonstrate the effectiveness of hydrosurgery in eliminating bacteria that settled in the wound, microbiological tests were performed. In the studied group, the number of Acinetobacter baumannii strains were reduced in 9 patients, Staphylococcus aureus in 12 patients, Pseudomonas aeruginosa in 18 patients, Proteus mirabilis in 1 case, Streptococcus pyogenes in 2 cases, Escherichia coli in 5 patients, Streptococcus agalactiae in 1 patient, Klebsiella pneumoniae in 8 cases.

DISCUSSION

The results of Versajet water jet used in the Center for Burns Treatment in Siemianowice Śląskie confirm the thesis assumed by the other authors stating that hydrosurgical debridement allows precise wound debridement and makes it possible to protect healthy tissues (4, 6, 7, 8). Wound therapy should result in wound healing, closure within the shortest time span. It is possible with the use of autologic and allogeneic skin grafts.

Proper wound debridement constitutes a prerequisite for a graft to be taken. In 42 cases following relevant wound preparation with the use of Versajet system, skin grafts were performed during one operation. In their work, Vanwijck and others describe similar results, underlining the role of hydrosurgery as a method that makes it possible to prepare the wound, which conditions graft bonding. Autologous split thickness skin graft are the most frequently performed. Full thickness skin grafts and cultured keratinocyte grafts (in 2

![Fig. 5. Wounds were completely healed in 33 patients (47 %), healed wounds with single residual areas were observed in 28 patients (40%), 4 patients (5.7%) were sent to another centre in order to have coexisting diseases treated, 2 patients (2.8%) were sent to Intensive Care Units following exacerbation of their general condition, 3 patients died (4.3%)](image-url)
patients in the work) are also carried out. The wounds healed in 93% of patients.

Local treatment of chronic wounds should be compliant with TIME strategy, consisting of the following elements: T – tissue debridement, I – infection and inflammation control, M – moisture balance, E – epidermization stimulation. TIME procedure assumes that the following aspects favourably affect healing: tissue debridement, infection and inflammation control, selection of relevant dressing preserving adequate moisture balance and epidermization stimulation. The method of debridement with the use of the Versajet system ensures preservation of the TIME strategy elements, the very fact being underlined by authors of many publications (8, 9, 10). Necrotic tissues on the surface of burn wounds hinder proliferation and correct epidermization, thus constituting an obstacle that hinders healing. The extent of injury, degree of wound contamination, patient’s overall condition, as well as an optimum time for necrosis removal, colonizing microorganisms and biofilm, presence/absence of infection constitute factors that determine a choice of the tissue debridement method. A wound may be debrided with the use of dressings, preparations containing enzymes that dissolve necrotic tissue and with the use of biological methods, such as larval therapy. These methods require discipline and determination on part of both medical staff and patients, as well as proper financial outlays (3, 8, 10, 11).

Apart from surgical methods of wound debridement, the supporting therapies involve, among others, Hyperbaric Oxygen Therapy (HBO) which improves blood supply, reduces oedema and hiders multiplication of bacteria (12, 13). Good effects of non-invasive supporting therapy were described with the use of physical methods (ultrasound, magnetic therapy, laser therapy, electrotherapy) (14). Local vacuum therapy that removes wound exsudat and stimulates growth of granulation by means of vacuum also favourably affects the course of wound healing and debridement (11).

Kawecki and others also describe favourable effects of supporting therapy by means of ozone used externally onto wound surface in the form of a mixture with air (15). During the work, the hydrosurgical wound debridement with the use of Versajet was not applied in case of dry, hard necrosis debridement. The most favourable method in such cases was surgical resection, which was also confirmed by authors of other papers (5, 8, 9, 16). Many authors describe good effects gained with the use of a hydrosurgical wound debridement system, indicating such advantages as reduction of the number of bacteria and cleanliness of an operating area resulting from simultaneous removal and aspiration of necrotic tissue together with bacteria present in wound secretion (8, 9).

The frequent reason underlying therapeutic failures is neglect of the unfavourable role of biofilm in a wound. Biofilm generated by bacteria, which consists of destructive enzymes, consumption of oxygen and nutrients, necessary for wound healing, hinders the correct healing process (8, 9, 17). In their papers, Gurunluoglu and Matsumura underline reduction of the number of procedures, as well as limitation of operation time when compared with classic methods of wound bed debridement (5, 16). Matsumura performed skin grafts in 72 % cases during one operation, while Gurunluoglu – in 67% cases – these results are similar to those presented in this paper (5, 16). In 44% cases in the presented paper, the operation during which hydrosurgical debridement was performed was the last procedure. Less procedures involves also less costs, which is referred to in papers by Mosti et al. and Granick et al. (17, 18). In the performed study, complete wound healing appeared in 87% patients, with similar results stated by other authors (4, 5, 16). The average time of operation in our study was 55 minutes for the debridement of – on average – 26% area of II/III degree burns and it is comparable with the time stated by Gravante, who describes hydrosurgical debridement operation as lasting 40 minutes for 15% of the area (2).

On the basis of results obtained in our study, we state that the Versajet system allows precise debridement, particularly in hardly accessible places, such as: face area, neck, rib area. We observed a particular role of the hydrosurgical system used for wound debridement on face – in 7 patients, neck – in 8 patients, hands – in 11 patients. Multitude of delicate anatomic structures, numerous prominences, uneven surface and cosmetic effects condition methods of hydrosurgical debridement, allowing protection of healthy tissues. The work of Duteille and Perrot, describing favourable results of treatment of face burns with the use of Versajet system confirms our results (7).
Taking into account the subjective character of an assessment of effects obtained with the use of Versajet system for hydrosurgical wound debridement presented in the paper and the fact that there was not any control group covered by the study, the authors are planning to elaborate studies that will include the aforementioned elements, as well as to evaluate hydrosurgical debridement of the other types wounds.

CONCLUSIONS

The water jest system allows precise debridement, particularly in hardly accessible places (face and neck areas), ensures protection of healthy tissues, allows preparation of wounds to be covered with autologous split thickness skin graft. At the same time, reduction in the number of bacteria strains in the wound was observed, which contributed to the shortening of hospitalization time, thus decreased the costs of treatment. Minimum risk of hemorrhage, good visibility of operating area make it possible to reduce the time of wound debridement. Proper classification of patients with burn wounds for wound debridement with the use of Versajet system constitutes the basis of therapeutic successes. In case of deeper, extensive burn wounds, surgical debridement with the use of traditional methods still remains a method of choice.

REFERENCES


Received: 30.10.2014 r.
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