CLINICAL EXPERIENCE IN USING THE WATER JET IN BURN WOUND DEBRIDEMENT

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SUMMARY. Water jets have been used in many areas of surgery. Recently a new surgical debridement device was launched onto the market - Versajet™. Versajet™ is a unique hydrosurgical device that uses a precise jet of water to simultaneously hold, cut, and remove devitalized or necrotic tissue. This paper describes our experience with ten patients comparing Weck knives with the newly designed hydrosurgical device when debriding burn wounds. The patients' age ranged from 27 to 60 yr (average, 37.8 yr) and the burn wounds treated were between 3 and 7% total body surface area, involving the face, abdomen, and limbs. The hydrosurgical system is a very useful tool for irregular and complex burn wound debridement. This paper represents the first written clinical experience utilizing hydrosurgery in the burn wound management in an Eastern country.

Introduction

After adequate resuscitation and stabilization of the victim, burn wounds should be meticulously cleaned and debrided. Achievement of wound healing is of major importance for the survival and clinical outcome of burn patients. Leaving dead tissue after debridement can not only slow down the wound healing process but also lead to patient infection.[1] Several reports have shown early surgical debridement or excision to be the most effective wound care strategy to improve survival, decrease blood loss, shorten the length of hospitalization, and decrease the risk of infection.[2-4]

The Weck knife has long been the preferred tool for burn excision. This handheld instrument works well for tangential burn excision on large flat areas, but has its limitations in small areas and areas with a three-dimensional structure. It is often time-consuming to use a Weck knife for large areas.

The Versajet™ system[5] is a specialized powered surgical tool designed to improve the outcome of patients undergoing wound debridement. This unique system reduces the number of procedures that some patients may have to undergo, and this reduction lowers the overall cost of patient treatment.

The Versajet™ system utilizes a reusable power console with ten power settings - the surgeon activates the console by means of a foot pedal. The surgical interface is a disposable handpiece and tubing assembly that connects it to the console. The system thus guarantees the safety of both patient and surgeons as the use of a water jet removes the risk of blood-borne pathogen infection due to sharp injuries.

In the first study of its kind in Taiwan, we compared use of the traditional Weck-knife-based burn wound debridement with the new Versajet™ hydrosurgical debridement device in ten patients.

Materials

Hydrosurgical system

The Versajet™ hydrosurgical system (Smith & Nephew, Hull, UK) pumps sterile saline at high pressure through a nozzle at the distal end of the handpiece. The Venturi effect creates a local negative pressure on the surface of the debriding parallel to the operating window. The saline jet crosses the operating window drawing with it the necrotic tissue into the evacuation tube, which is connected to a waste container. The system affords the surgeon control and precision by the possibility of adjusting the power settings for different tissue densities and angling the handpiece tip for precision. We used a standard handpiece with a 45° angled tip and a 14-mm operating window in this study.

Patients

We collected ten patients with thermal injuries of age ranging from 27 to 60 yr (mean, 37.8 yr). All patients were evaluated clinically for the indication of burn wound before surgical treatment.

The extent of the burn injuries ranged from 3 to 40% total body surface (TBSA). The burn wound areas treated ranged from 3 to 7% (mean, 4.95%). The area of distribution included the face, hand, leg, and foot. The depth ranged from deep-partial thickness to full-thickness burns. *Table I* presents information about the patients and the additional treatment with debridement using the water jet system.

Table I - Patient details

Case number	Age (yr)	Sex	Mechanism	Area involved	TBSA (%)	Depth of burn injury	Time interval between admission and operation (days)	Area treated (%)	Power setting	Other treatment
1	27	F	Flame	Face, chest, bilateral arm, left foot	10	II-III	2	4	3	Weck, curettage
2	33	M	Scald	Left lower leg and ankle	5	II-III	1	5	4	Weck
3	36	M	Flame	Bilateral upper limbs, right leg, face, abdomen	12	II-III	2	5.5	4	Weck
4	31	M	Flame	Face, neck, and four limbs	40	II-III	1	7	5	Weck
5	32	M	Chemical (strong alkali)	Face, neck chest, abdomen, right buttock and posterior thigh	20	II-III	8	7	5-6	Weck, curettage
6	27	M	Scald	Bilateral lower legs	3	II-III	1	3	3	Weck
7	50	F	Scald	Left lower leg and foot	3	II-III	1	3	5	Weck
8	60	M	Scald	Right arm and forearm	5	II-III	1	5	5	Weck
9	27	M	Chemical (acid)	Forehead	5	III	2	5	5	Weck
10	55	M	Chemical (acid)	Face, neck, upper limbs	11	II-III	25	5	3-8	Weck

Results

In our experience, the Versajet™ system needs a longer operative time to debride a given percentage of burn wound than the Weck knife. With the Versajet™ system, there is a reduction in the amount of blood lost compared with conventional tangential debridement - the need of Xylocaine gauze for haemostasis is also less. Because of the narrow operating window (14 mm), the possibility of injury to normal tissue is decreased. The closer the operating window is to parallel, the more powerful the tissue excision. The depth of debridement is equal between water jet at power 5 and Weck knife of 8/1000, in our experience (*Figs. 1,2*). The water jet system creates a local negative pressure and improves wound cleanness. Although there is still some splash, it is not necessary to wear eye protection for the procedure.

There is less post-operative bleeding using the Versajet™ system. This may be due to the Versajet™ system's capacity to "plane" down through the necrotic tissue, making it possible to switch to a different surgical site once oozing is noticed, indicating the presence of vascular or healthy tissue. The Versajet™ system gives the operator an excellent view of the surgical site. We can preserve more vital tissue and wound bed circulation with this surgical tool. With the Weck knife it is possible to perform a rapid

Fig. 1 - Deep second-degree burn wound marked in ten equal squares.

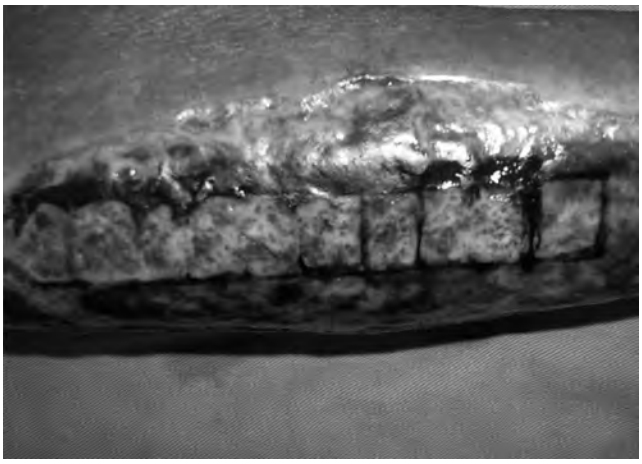

Fig. 2 - After debridement with different power settings from 1 to 10 (right to left) in each square.

Fig. 3 - Deep second- to third-degree burn wounds in right buttock and posterior thigh (about 7% TBSA).

Fig. 4 - Irregular wound edge well debrided with Versajet™ system.

Fig. 5 - Healthy and viable wound bed with active punctual bleeding.

Fig. 6 - Clean wound with good re-epithelialization on day 8 post-op.

Fig. 7 - Flame burn in both arms (about 4% TBSA) showing second-degree burns.

Fig. 8 - Necrotic dermis can be removed with the water jet system, sparing viable underlying dermis.

debridement, but it is less precise and leads to greater post-operative pain.

Case example 1

In our first case, a 32-yr-old male attempted suicide by drinking strong alkali, splashing himself with sulphuric acid at the same time. He had chemical burn injuries over the face, neck, chest, abdomen, right buttock, and posterior thigh (in total, about 20% TBSA). The depth of the burn injuries was generally second to third degree at admission. Owing to the presence of corrosive oesophagitis and diffuse ulceration in the entire whole gastric mucosa, an emergency operation of oesophagectomy, total gastrectomy, and jejunotomy was performed after initial resuscitation. The patient was then transferred to the intensive care unit for further post-operative care. However, the patient's right buttock and posterior thigh (about 7% TBSA) progressed to charred and black (*Fig. 3*). Tangential debridement was performed on day 8 after admission. The patient was placed in the supine position under general anaesthesia and the thermal injury wound was treated with strict adherence to the aseptic principle. Tangential excision was performed in all the eschar, and the Versajet™ system was mainly applied near the irregular wound edge (*Figs. 4,5*). The Versajet™ system preserved more vital tissue with its relatively small working window. This patient's full-thickness wound seemed to need higher power (5~6) and the wound was covered with Biobrane after all the procedures. The wound was clean, dry, and well epithelialized on day 8 after the operation (*Fig. 6*).

Case example 2

The second case was that of a 27-yr-old woman with flame burns in the face, chest, both arms, and left foot. The wound was about 10% TBSA and second to third degree in depth. We performed the operation on day 2 after admission, using the water jet to debride both arms (about 4% TBSA) (*Fig. 7*). Water jet system power setting 3 was sufficient for this level of debridement. The wound bed was clean at the level of viable tissue (*Fig. 8*). We used Acticoat to dress the wound, which healed successfully without any further complications.

Discussion

Water jet systems have been used with varying success in other clinical areas such as bone,[6] brain,[7] liver,[8] and lymph node.[9] There have however been few reports on the clinical application of the water jet systems in burn wounds in western countries.[10,11] The water jet system provides a considerable alternative in thermal wounds. The debridement of multiple small wounds, chronic wounds, and wounds with an uneven surface is achieved more precisely and easily. It also can spare more viable tissue and permits the healing process to progress naturally with successful re-epithelialization.

Studies have shown that wound irrigation is more effective in improving wound healing than conventional methods because it may exert more bacterial load reduction in the burn wound.[12-14] The localized vacuum in the Versajet™ system makes it possible to perform debridement and cleansing at the same time. It can make a cleaner wound bed with less bleeding than the Weck knife. The clean wound promotes more rapid wound healing and this reduces the number of debridement procedures required. However, as the endpoint of debridement is active bleeding from the healthy wound bed, the relatively lower amount of bleeding makes the endpoint with the Versajet™ system more difficult to determine.

The Versajet™ system is able to spare vital and viable

tissue precisely because its multiple power setting and enhanced visibility enable the surgeon to perform accurate debridement. For example, deep second- or third-degree wounds can be excised with higher power and higher pressure. In areas where the skin is of critical thickness, such as the hand and face, the water jet provides a relatively easy method for the excision of difficult aesthetic and functional areas. The ear is frequently associated with facial burns, especially when flame is the mechanism.[15] Severe thermal injuries to the external ear often lead to damage of the ear cartilage, which has limited vascularity and an uneven contour - much more precise debridement is therefore necessary.[16] Debridement of the ear cartilage was done by sterile scissors or curettage using the conventional method, except for the Weck knifes. We have also used the Versajet™ system in our burn centre to debride the ear cartilage, and the result of the wound was acceptable.

The conventional Weck knife works well for tangential excision on large flat areas only if there is adequate tension in them but does not work well in multiple small areas, uneven surfaces, areas without tension, and areas where the skin is of critical thickness (such as the hand and face). In clinical practice, the depth of debridement is determined by the thickness of the Weck knife, the angle of the Weck knife related to the wound surface, and the pressure applied on the wound by the operator. Owing to these factors related to use of the conventional instrument, a well-experienced surgeon is required, with a predictably longer learning course than with the Versajet™ system. To maintain tension, assistants are needed, as already said, or else inflation of the wound surface by injection of fluid into the subcutaneous tissue is necessary. However, the Versajet™ system is easy to operate and effort-saving compared with the Weck knife. It provides surgeons with a better instrument for wound debridement, with less strength.

Because of the danger of blood-borne pathogens such as hepatitis and AIDS, precautionary practices have been adopted, e.g. double gloving and the use of neutral zones for the passing of tools, in order to reduce the risk of sharp injuries.[17] The water jet system is much safer for operating room staff because of the reduced use of sharp cutting devices, as with conventional Weck knife exposure. When using a conventional Weck knife, surgeons often use their second hand or else enlist the help of an assistant to exert tension on the wound. The greater the number of people involved in this environment, the greater the risk of sharp injury. The Versajet™ system allows single-surgeon, single-handed, single-step debridement.

One potential disadvantage can be noted when debriding larger areas for the maximum cutting width of only 14 mm - increased operating time is inevitable. We found that the Versajet™ system used approximately 1 litre of sterile saline per 2% TBSA. Although this increased operating time and single operation expense, the potentially fewer further operations, coupled with the more effective debridement, indicate its overall benefit.

Conclusion

We publish our clinical experience in order to illustrate the practicability of the water jet system in burn wound debridement. As a result of the clinical experience we gained from use of the Versajet™ system, we have found it a more useful tool in irregular and complex burn wound debridement. It has the advantage of precise debridement but may take more time than the conventional Weck knife for the same surface area. We look forward to using this device more frequently in order to enhance wound debridement and improve patient outcome.

RÉSUMÉ. Les jets d'eau ont été utilisés dans plusieurs secteurs de la chirurgie. Récemment un nouvel appareil chirurgical pour le débridement a été lancé sur le marché - Versajet™. Versajet™ est un appareil hydrochirurgical unique qui emploie un jet précis d'eau pour tenir, couper et éliminer simultanément les tissus dévitalisés ou nécrotiques. Les Auteurs de cet article décrivent leur expérience avec dix patients et comparent les couteaux Weck avec cet appareil récemment conçu pour le débridement des brûlures. L'âge des patients variait entre 27 et 60 ans (moyen, 37,8 ans) et les brûlures couvraient entre 3 et 7% de la surface corporelle totale (visage, abdomen, membres). Le système hydrochirurgical constitue un instrument très utile pour le débridement des lésions irrégulières et complexes dues aux brûlures. Cet article présente la première étude clinique avec l'emploi de l'hydrochirurgie pour la gestion des brûlures à être publiée dans un pays oriental.

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