Versajet hydrosurgery system in the debridement of skin necrosis after Ca gluconate extravasation: report of 9 infantile cases

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Objective: The aim of the study was to evaluate the results of debridement with Versajet hydrosurgery system in patients with skin necrosis after ca gluconate extravasation.

Methods: We evaluated nine infants (mean age: 26 days; range: 1 day to 3 months) with calcium gluconate extravasation injury. Site of injury was the foot in 3 cases, the hand and wrist in 5 and the scalp in one. In all patients the skin necrosis was debrided with Versajet hydrosurgery system under general anesthesia without damaging the dermis layer.

Results: Following debridement all wounds healed spontaneously by re–epithelization and the mean time of full epithelization was fourteen days. No patient required a second debridement. At a minimum follow–up of 1 year minimal scar formation was noted and there was no hypertrophic scar.

Conclusion: Versajet hydrosurgery system appears to be effective in the debridement of skin necrosis due to ca gluconate extravasation in pediatric population.

Key words: Versaje hydrosurgery system; extravasation; Ca gluconate; infant.
sharp debridement hazards. To our knowledge, the use of Versajet™ Hydro surgery system has not been previously defined in the treatment of calcium extravasation. Published uses of the device include debridement of chronic wounds and burns, proposing accuracy and precision of excision.[9-13]

We examined whether this technique was an appropriate tool in the management of calcium extravasation. We describe here our experience in using the water jet debridement for the necrotic tissue excision of 9 infants affected by calcium extravasation.

**Patients and methods**

We evaluated nine infants (mean age: 26 days; range: 1 day to 3 months) with extravasation injury that was caused by calcium gluconate. The mean weight was 2.483 kg. Three of the infants were premature neonates. In 5 infants with a mean weight of 1.770 kg, the extravasation took place within 15 days after birth (mean: 7.6 days). In 3 cases the feet were affected. In 5 cases the back of the hand or the wrist were the site of the injury. In one case the scalp was affected (Table 1). Swelling, discoloration or erythema, induration, blistering or skin damage may all be observed following calcium gluconate infusion.

**Results**

In all cases, there was a good pulse and sufficient capillary refill distal to the infiltration site. All of the infants were consulted within 12 hours following extravasation. Extravasation site was flushed with saline and cold compress treatment was applied. After the usage of oily dressing, skin necrosis developed within 1 week. To debride the skin necrosis we used the Versajet hydrosurgery system (Fig. 1) under general anesthesia without damaging the dermis layer; subsequently, using oily dressing, the wounds healed spontaneously by reepithelialization. Only one debridement was performed in all cases. The mean time of full epithelization was 14 days. Minimum follow-up was 1 year. Minimal scar formation was noted and no hypertrophic scar was developed. Pre and postoperative photography of two illustrative cases are presented (Fig. 2a-d).

**Discussion**

Necrosis of skin and underlying soft tissue is a relatively common complication of peripheral intravenous infusions. The level of the soft tissue damage depends on the physiological and chemical characteristics of the agent. Millam recommended the clinical staging into I to IV for the extravasation injuries.[14] In stages I and II no signs

Table 1. Patient data.

<table>
<thead>
<tr>
<th>No</th>
<th>Weight (g)</th>
<th>Age</th>
<th>Site</th>
<th>Defect size after debridement (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1250</td>
<td>1 day</td>
<td>Foot</td>
<td>1x1.5</td>
</tr>
<tr>
<td>2</td>
<td>1650</td>
<td>3 days</td>
<td>Scalp</td>
<td>0.5x0.5</td>
</tr>
<tr>
<td>3</td>
<td>1850</td>
<td>5 days</td>
<td>Hand</td>
<td>3x2</td>
</tr>
<tr>
<td>4</td>
<td>1900</td>
<td>14 days</td>
<td>Foot</td>
<td>3x2</td>
</tr>
<tr>
<td>5</td>
<td>2000</td>
<td>18 days</td>
<td>Hand</td>
<td>1.5x1</td>
</tr>
<tr>
<td>6</td>
<td>3000</td>
<td>1 months</td>
<td>Foot</td>
<td>1x2</td>
</tr>
<tr>
<td>7</td>
<td>4000</td>
<td>2 months</td>
<td>Hand</td>
<td>3x2</td>
</tr>
<tr>
<td>8</td>
<td>4500</td>
<td>3 months</td>
<td>Hand</td>
<td>1.5x2</td>
</tr>
<tr>
<td>9</td>
<td>2200</td>
<td>13 days</td>
<td>Hand</td>
<td>3x2</td>
</tr>
</tbody>
</table>

Fig. 1. (a, b) Versajet device. [Color figure can be viewed in the online issue, which is available at www.aott.org.tr]
of skin damage and deficit are observed, and thus the recommended treatment is conservative, while in stages III and IV, the soft tissue damage is more extensive and may result in tissue loss (Table 2). The skin in these later stages is cold with inadequate capillary refill. In these situations, surgical management for debridement and coverage may be required. Treatment of skin and subcutaneous tissue necrosis requires basic plastic surgery procedures. The edematous extremity should be splinted and elevated. Devitalized tissue is allowed to demarcate, and then debrided surgically and/or with enzymes.\(^6\) Five debridement approaches are frequently used: autolytic, enzymatic, mechanical, biological and surgical. Autolytic, enzymatic and biological methods are natural and selective but are time consuming and may cause destruction to the adjacent tissues. The surgical method is fast but not selective and, in most cases, requires regional or general anesthesia. We described nine cases of infants with skin necrosis following extravasation of calcium gluconate that were debrided with versajet therapy. Tissue necrosis due to Ca extravasation and treatment methods has been well documented in the literature. In our knowledge using Versajet in such complication was not described. The Versajet device is based on the Venturi effect of fluid dynamics whereby the tip of the hand piece discharge a hair-thin stream of sterile saline parallel to the tissue. Hydrosurgery with the Versajet system enables the surgeon to hold, cut and remove injured tissue and contaminants at the same time without neighboring tissue damage associated with conventional surgery and without the risk of contaminating the environment.

The accurate and clean level of debridement achieved by this technology makes it easy to control the depth of debridement and the viability of the underlying tissue. Tissue protection and selectivity are superior compared to cold knife techniques. It is in these pediatric patients, with their thinner skin and increased risk of hypertrophic scarring, that the accuracy of debridement using the Versajet system is most important. Other potential uses of the device include the tangential debridement of chronic wounds and burns. Because of the precision offered there is reliability of debridement with reproducible results whereby soft tissue can be removed carefully and efficiently. Regarding to this, the objective of surgi-

Table 2. Staging of intravenous infiltrates.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Painful infiltration site, no erythema, no swelling</td>
</tr>
<tr>
<td>II</td>
<td>Painful infiltration site, slight swelling (0–20%), no blanching, good pulse below the infiltration site, brisk capillary refill below the infiltration site</td>
</tr>
<tr>
<td>III</td>
<td>Painful infiltration site, marked swelling (30–50%), blanching, skin cool to the touch, good pulse below the infiltration site, brisk capillary refill below the infiltration site</td>
</tr>
<tr>
<td>IV</td>
<td>Painful infiltration site, very marked swelling (30–50%), blanching, skin cool to the touch, decreased or absent pulse, capillary refill over 4 s*, skin breakdown or necrosis*</td>
</tr>
</tbody>
</table>

*The presence of any one of these characteristics constitutes a stage IV infiltrate.

![Fig. 2. This patient presented with extravasation injury to scalp. (a) Pre-operative image of scalp before debridement with the waterjet system. (b) Follow-up picture taken 12 months after the debridement; note dermal preservation; uneventful healing was observed. This patient presented with extravasation injury to hand. (c) Pre-operative image of hand before debridement with the water jet system. (d) Follow-up picture taken 12 months after the debridement; note dermal preservation; uneventful healing was observed. [Color figure can be viewed in the online issue, which is available at www.aott.org.tr]
cal treatment for extravasation is to get rid of necrotic skin and offer a flat dermal layer appropriate for reepithelialization. This requires removal of abnormal tissue whilst preserving adequate adnexal elements for reepithelialization.\textsuperscript{[4,14,15]} Full reepithelialization was complete by 3 weeks in all patients. The main console of the Versajet System was already in use at our department for debridement of burns and chronic wounds. We had no postoperative problems and hypothesized that this technique could easily be performed instead of a surgical procedure. We have found Versajet to be reliable, easy to learn and accurate in the surgical management of extravasation wounds. The Versajet system debrides irregular and complex contours which often can be quite difficult to debride with traditional methods. Debridement can be interrupted when punctuate bleeding is observed in superficial wounds. Our review confirms the advantages of hydrosurgery which are its tissue selectivity and its ability to use it in the thin skin of infants. Comfortable handling in complex contours such as extravasation injury sites and the preservation of the underlying adnexal, which is important for reepitelization, can easily be achieved. The retrospective design, the small number of cases and postoperative scar assessment between 10 weeks to 12 months are the limitations of our study.

Conflicts of Interest: No conflicts declared.

References