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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.

Calcium gluconate has been widely used in the management of neonatal hypocalcemia and extravasation of the solution into the surrounding tissues is a relatively common complication.[1] While this injury may appear irrelevant when compared with the primary problem, it can result with crucial morbidity.[2-5] The effusion due to leakage of the solution into the tissues may advance into secondary necrosis at the infusion area. This can cause further complications during the disease and may prolong the length of hospital stay.[6-7]

The back of the hand, the wrist and the back of the foot are the most commonly affected areas because these are the ideal infusion locations used in newborn infants. Tissue necrosis usually vanishes within a few weeks without a severe outcome, but it may also cause cosmetic and functional impairment. Debridement of superficial and intermediate depth partial thickness wounds with classical sharp instruments like the Goulianor Humby knife, or deep–faceted curettes, may easily cause the loss of skin layers critical for proper reepithelialization. Precise tissue protection as well as appropriate closure help to reduce scarring and deformity.[8]

Recently, waterjet debriding tools have been developed for wound debridement and wound bed preparation. The benefits include controlled and rapid debridement, removal of debris as well as the elimination of

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Table 1. Patient data.

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

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

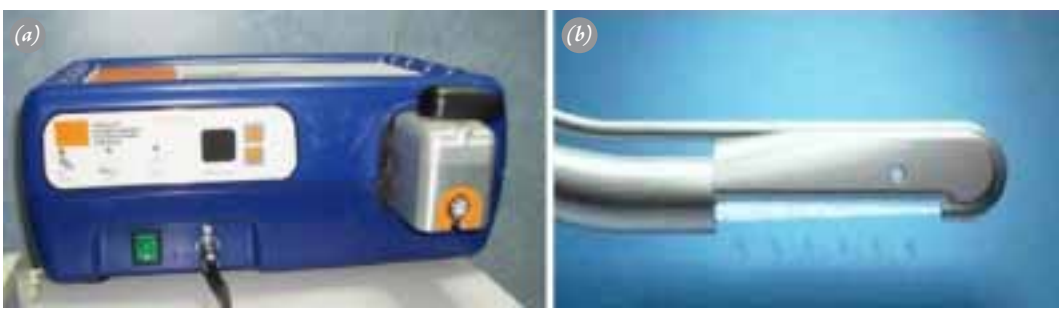

Fig. 1. **(a, b)** Versajet device. [Color figure can be viewed in the online issue, which is available at www.aott.org.tr]

Table 2. Staging of intravenous infiltrates.

Stage	Characteristics
I	Painful infiltration site, no erythema, no swelling
II	Painful infiltration site, slight swelling (0–20%), no blanching, good pulse below the infiltration site, brisk capillary refill below the infiltration site
III	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
IV	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*

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

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.[8,15-18] 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-

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.[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 adnexial, 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

1. Murphy PM, Gault DT. Treatment of extravasation injury. Anaesthesia 1990;45:600. CrossRef
2. Hannon MG, Lee SK. Extravasation injuries. J Hand Surg Am 2011;36:2060-6. CrossRef
3. Namazi H. Extravasation injuries: a practice pearl. [Letter to the Editor] J Hand Surg Am 2012;37:861. CrossRef
4. Heitmann C, Durmus C, Ingianni G. Surgical management after doxorubicin and epirubicin extravasation. J Hand Surg Br 1998;23:666-8. CrossRef
5. Wong FC, Kim, EE, Sparks, R, Wong W-H, Yang DJ, Podoloff DA. Three sphere dosimetry models (0.4 cc, 2cc and 10cc) of 12 commonly available radionuclides for locoregional therapy or extravasation. J Nucl Med 2001;42(5 Suppl):28.
6. Dionyssiou D, Chantes A, Gravvanis A, Demiri E. The wash-out technique in the management of delayed presentations of extravasation injuries. J Hand Surg Eur Vol 2011;36:66-9. CrossRef
7. Domínguez-Fernández I, Goíriz R, Pérez-Gala S, Fraga J, Fernández-Herrera J. Calcinosis cutis following extravasation of calcium salts. J Eur Acad Dermatol Venereol 2008;22:505-6. CrossRef
8. Cedidi C, Hierner R, Berger A. Plastic surgical management in tissue extravasation of cytotoxic agents in the upper extremity. Eur J Med Res 2001;6:309-14.
9. Fraccalvieri M, Serra R, Ruka E, Zingarelli E, Antoniotti U, Robbiano F, et al. Surgical debridement with VERSAJET: an analysis of bacteria load of the wound bed pre- and post-treatment and skin graft taken. A preliminary pilot study. Int Wound J 2011;8:155-61. CrossRef
10. Soong M, Schmidt S. Acute contaminated open forearm fractures treated with VersaJet Hydrosurgical Débridement. J Orthop Trauma 2010;24:66-8. CrossRef
11. Dillon CK, Lloyd MS, Dzeiwulski P. Accurate debridement of toxic epidermal necrolysis using Versajet. Burns 2010;36:581-4. CrossRef
12. Kimble RM, Mott J, Joethy J. Versajet hydrosurgery system for the debridement of paediatric burns. Burns 2008;34:297-9. CrossRef
13. Jeffery SL. Versajet hydrosurgery in burns wound debridement: a preliminary experience by Gravante G, Esposito G, Delogu D, Montone A. Burns 33;207:401-2. Burns 2007;33:800. CrossRef
14. Millam DA. Managing complications of i.v. therapy (continuing education credit). Nursing 1988;18:34-43. CrossRef
15. Lin CY, Hsieh KC, Yeh MC, Sheen-Chen SM, Chou FF. Skin necrosis after intravenous calcium chloride administration as a complication of parathyroidectomy for secondary hyperparathyroidism: report of four cases. Surg Today 2007;37:778-81. CrossRef
16. Lehnhardt M, Vu P, Kuhnen C, Steinstraesser L, Muehlberger T, Druecke D, et al. Serious complications of injections-retrospective analysis of incidences, complication-management, prophylaxis and economic aspects. [Article in German] Zentralbl Chir 2005;130:162-9. [Abstract]
17. Schummer W, Schummer C, Müller A, Karzai W. Extravasation: a rare complication of central venous cannulation? Case report of an imminent erosion of the common carotid artery. [Article in German] Anaesthesist 2003;52:711-7. [Abstract] CrossRef
18. Kumar RJ, Pegg SP, Kimble RM. Management of extravasation injuries. ANZ J Surg 2001;71:285-9. CrossRef