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Neonatal Extravasation Injuries Associated with Intravenous Infusions



In this Issue...

Neonatal extravasation associated with peripheral intravenous infusion is a complication that may lead to serious injuries in an already vulnerable patient, including the loss of a limb, sepsis, and contractures. Currently, there are no randomized controlled trials demonstrating the effectiveness of available modes of post-extravasation intervention in reducing injury or scarring, and the information in the literature regarding management in these cases is primarily limited to case reports.

In this issue, we discuss these case reports, review the current methods utilized in wound management and, most importantly, highlight the necessity of educating clinicians in the best defense against peripheral intravenous complications — decreasing the incidence of extravasation injury.

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1.0 hours Physicians
1 contact hour Nurses

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July 17, 2008

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Edward E. Lawson, MD

Professor
Department of Pediatrics
Division of Neonatology
The Johns Hopkins University
School of Medicine

Christoph U. Lehmann, MD

Associate Professor
Department of Pediatrics
Division of Neonatology
The Johns Hopkins University
School of Medicine

Lawrence M. Noguee, MD

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Department of Pediatrics
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GUEST AUTHORS OF THE MONTH



Reviews & Commentary:
Kim L. McCullen, MSN, RN, CNNP
Nurse Practitioner
St. John Hospital and Medical Center
Detroit, MI

Guest Faculty Disclosure

Ms. McCullen has no relevant financial relationships to disclose.

Dr. Pieper has no relevant financial relationships to disclose.

Unlabeled/Unapproved Uses

The author has indicated that there will be no reference to unlabeled or unapproved uses of drugs or products in the presentation.

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Reviews:
Barbara Pieper, PhD, RN, APCNS-BC, CWO, FAAN
Professor/Nurse Practitioner
Wayne State University
College of Nursing
Detroit, MI

LEARNING OBJECTIVES

At the conclusion of this activity, participants should be able to:

- Discuss with colleagues pertinent factors associated with extravasation in the neonate
- Identify for colleagues treatment options for extravasation
- Describe for colleagues considerations for wound dressings used in the neonate

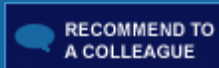
COMMENTARY

It is almost a certainty that an infant admitted to a Neonatal Intensive Care Unit (NICU) will undergo the insertion of an intravascular catheter. While peripheral intravenous therapy is routine, it has become apparent to clinicians that intravenous extravasation, a complication of peripheral intravenous therapy, can cause significant and long-lasting sequelae in an already compromised infant. Common injuries observed in the NICU include cellulitis, infection, necrosis, scarring, nerve damage, and permanent contractures. A 2004 United Kingdom study, examining extravasation injuries in regional neonatal units, reported the incidence of extravasation injury resulting in skin necrosis to be approximately 4%, with 70% of such injuries occurring in infants \leq 26 weeks gestation.¹

Guidelines should be developed and utilized for the prompt treatment of intravenous extravasation. There is limited research and no standard treatment of extravasation in the neonatal population; treatment has been based on results from case reports and is unit or hospital specific. Intervention with a medication following infiltration is based on the physiochemical characteristics of the infusate, stage of extravasation, and availability of specific medications utilized as antidotes, with the primary goal being minimization of tissue damage around the site. The site where infiltration has occurred should be assessed and staged (staging criteria charts have been developed by Milliam² and Flemmer & Chan³); this approach will assist in determining the appropriate treatment approach, providing data for process improvement, and for developing a standardized mode of documenting clinical and research notes.

Local Treatment

In 1986, Chandavas described a multiple puncture technique to be used when acidic or hyperosmolar solutions have infiltrated: multiple perforations are made with a sterile needle over the area of greatest swelling, and the extravasated fluid is manually squeezed out.⁴ A case report from Casanova, Bardot, and Magalon evaluated the use of three medications: hyaluronidase, phentolamine, and glyceryl trinitrate, all of which have been



determined to be effective when injected or used topically to treat an area where infiltration has occurred.⁵ Infiltrations caused by solutions containing high concentrations of dextrose (10% or greater), calcium, nafcillin, calcium salts, potassium salts, radiocontrast media, hypertonic saline, blood, parenteral nutrition, and sodium bicarbonate can be treated with local injection of hyaluronidase. Hyaluronidase acts to modify the permeability of connective tissue through hydrolysis of hyaluronic acid, improving the circulation of water in the infiltrated area and enhancing the distribution and re-absorption of extravasated fluids through tissues, thereby acting to increase tissue permeability and dilute the infiltrated fluid in the surrounding tissue. Hyaluronidase should not be used if the infiltration is caused by catecholamines (dopamine) or alpha agonists: if a catecholamine were to become extravasated, this vasoconstrictive agent, hyaluronidase, would disperse it to the surrounding tissue, possibly causing damage to a larger area.

A case report by Subahni, Sridhar, and DeCristofaro examined the subcutaneous administration of phentolamine injected within 12 hours to reverse the vasoconstrictive effects caused by catecholamines such as dopamine.⁶ Phentolamine appeared to be effective, as evidenced by improvement in color and perfusion after injection into the blanched area of infiltration.⁶ Glyceryl trinitrate (topical form of nitroglycerin) is a potent vasodilator that acts to reduce ischemia due to dopamine infiltration.⁷ Only a small number of neonates have been evaluated after use of nitroglycerin ointment. However, nitroglycerin may have effects on blood pressure and heart rate, and there is the possibility of over dosage or toxicity owing to absorption through immature skin in a neonate. Its use, therefore, should be limited until more controlled trials can be conducted.⁷

Each of the studies discussed herein utilized the Gault technique first described in 1993, which consists of an injection of hyaluronidase, saline flush out, and liposuction under local or general anesthesia within 3 to 12 hours of infiltration. The Gault technique was reviewed favorably by the authors, who demonstrated a reduction in necrosis injury.^{5,8,9} However, guidelines need to be in place in order for the antidote or intervention to be carried out quickly – necessary because effectiveness of such treatment is dependent upon timely administration.

Wound Care

Wound care management after extravasation seeks to promote wound healing and prevent complications such as infection, scarring, and contractures. A retrospective study by McCullen and Pieper (reviewed herein) noted that knowledge of a guideline about skin care and wound management after extravasation is essential to provide proper clinical practice and to promote process improvement.¹⁰ Currently, neonatal skin care guidelines recommend maintaining a moist wound environment through the use of topicals (bacitracin, silver sulfadiazine, Aquaphor™, amorphous hydrogels, hydrogel in gel or sheet dressing form), alone or in conjunction with dressings (hydrocolloids [Duoderm®], semipermeable [Opsite™, Tegaderm™], hydrofiber [Aquacel®]). Use of dry dressings, skin cleansers, soaps or antiseptics (Dakins solution, hydrogen peroxide, providine-iodine) should be avoided because these solutions will cause a cytotoxic response and possibly delay wound healing.¹¹ Several studies describing wound care management utilizing topicals and dressings as detailed above reported improved wound healing, prevention of infection, and prevention of early contracture.^{12,13,14,15} Consultation with plastic surgery and wound debridement (surgical, chemical, autolytic) may be necessary if necrotic tissue impairs wound healing. The retrospective review conducted by Kumar and colleagues (discussed herein), with a small sample size of 9 cases, compared a non-operative conservative approach (daily cleansing, silver sulfadiazine, 0.2% chlorhexidine cream) to early debridement and grafting and demonstrated satisfactory results in both groups.⁸

Prevention Of Injury

Aware of the severity of complications from an extravasation injury, clinicians currently focus their practice on the treatment of the infiltration and management of the potential wound; however, seeking to prevent the incidence of infiltration and subsequent extravasation may be the better mode of treatment. Prevention may be facilitated by developing standards or guidelines regarding the initiation and maintenance of peripheral intravenous access. In 2006, The Infusion Nurses Society (INS) published standards based on empirical scientific research reflecting current knowledge and practices in infusion therapy, and defined the accountability of nursing in the participation and delivery of infusion therapy.¹⁶ While the INS standards of practice are not specific to the neonatal population, they can provide a framework from which infusion based policies and practices may be developed for the NICU. Policies regarding placement of a peripheral intravenous catheter would further help advise healthcare professionals on how to reduce the

incidence of complications related to peripheral intravenous therapy. Methodology would include knowledge of factors pertinent to initiation of peripheral vascular access (site selection, device selection, equipment utilized) and maintenance of the patent line (type of infusates appropriate for peripheral lines, assessment of site, and early infiltration detection). Such guidelines would educate clinicians about the importance of maintaining a solid knowledge-base founded on an understanding of basic anatomy, the physiology of vessel wall structure, and the neonatal integumentary system.

Cannulation

Cannulation of a vessel should be based on adequate perfusion of the limb and access to vasculature that is able to accommodate cannula size while persevering blood flow around the cannula; areas of flexion should be avoided as a possible site of cannulation.¹⁶ Initiation of a peripheral intravenous (PIV) should be avoided in the following situations: where an intravenous access currently exists in same extremity; in tortuous veins; in an extremity with paralysis, orthopedic, or neurologic problems; and where there is a Blalock-Taussing shunt in the same arm.¹⁶

Infusate

The 2006 INS Standards of Practice listed fluids and medications not appropriate for peripheral intravenous infusion, which included infusates with a pH less than 5 or greater than 9 and an osmolality greater than 600 mOsm/L.¹⁶ Avoiding the use of infusates considered inappropriate for peripheral intravenous administration is essential because the severity of cellular injury is directly related to the agents infused: more specifically, the infusate volume and physiochemical properties (pH, osmolality, degree of dissociability pKa).¹⁷ Infusates considered caustic such as sodium bicarbonate are monitored closely, whereas hyperalimentation solutions are typically monitored less vigilantly – when in fact most contain calcium and can cause severe tissue necrosis when infiltrated. All calcium-containing fluids infused should be vigilantly monitored by the Nurse.

Maintenance

A vigilant assessment of peripheral intravenous sites requires frequent visible inspection of the site with a clear dressing, clinician attentiveness to any changes, and early detection of infiltration. Stabilization of the site should employ a method that provides the best possible site visualization with minimal constriction of the limb, to avoid obstructing vascular circulation. Use of an armboard should be limited to intravenous lines inserted near a joint; in most cases, however, it is unnecessary and it decreases mobility, leading to muscle weakness and contractures.¹⁶ Infusion devices have been recommended for use in the neonatal population, and they are designed with an adjustable occlusion pressure alarm which aids in the early detection of infiltration. However, in a recent study conducted by Phelps and Helms, the authors questioned the effectiveness of these tools after demonstrating that infusion device occlusion alarms registered increased pressure readings in only 19% of the cases.¹⁸

The development of guidelines for the insertion of peripheral intravenous lines, interventions for infiltration, and wound care management after extravasation are necessary to properly address an issue now recognized for its importance to the neonatal population and for the serious risks associated with peripheral intravenous therapy. The adherence to appropriate guidelines would expedite the use of proper procedures, the effectiveness of which are dependent on a timely response. Future research investigating neonatal tissue extravasation is needed to determine immediate treatment approaches, a protocol for wound care management, and guidelines for best practice in initiation of peripheral intravenous lines. Existing case reports can serve as an excellent foundation from which future studies can expand on issues still left unaddressed.

References

1. Wilkens CE, Emmerson AJ. [Extravasation injuries on regional neonatal units](#). *Arch. Dis. Child. Fetal Neonatal Ed.* 2004;89(3):F274-275.
2. Millam DA. [Managing complications of IV therapy](#). *Nursing*. 1988;(18):34-43.
3. Flemmer L, Chan JSL. [A pediatric protocol for management of extravasation injuries](#). *Pediatric Nursing*. 1993;19(4):355-358, 424.
4. Chandavas O, Garrow E, Valda V, Alsheikh S, Vega SD. [A new method for the prevention of skin sloughs and necrosis secondary to intravenous infiltration](#). *Am J Perinatology*. 1986;3(1):4-5.
5. Casanova D, Bardot J, Magalon G. [Emergency treatment of accidental infusion leakage in the newborn: report of 14 cases](#). *Br J Plast Surg*. 2001;54(5):396-399.

6. Subhani M, Sridhar S, DeCristofaro JD. [Phentolamine use in a neonate for the prevention of dermal necrosis caused by dopamine: a case report.](#) *J Perinatology*. 2001;21(5):324-326.
7. Ramasethu J. [Prevention and management of extravasation injuries in neonates.](#) *Neoreviews*. 2004;5(11):e491-497.
8. Kumar RJ, Pegg SP, Kimble RK. [Management of extravasation injuries.](#) *ANZ Surgery*. 2001;71(5):285-289.
9. Davies J, Gault D, Buchdahl R. [Preventing the scars of neonatal intensive care.](#) *Arch. Dis. Child*. 1994;70(1):F50-F51.
10. McCullen KL, Pieper B. [A Retrospective chart review of risk factors for extravasation among neonates receiving peripheral fluids.](#) *J Wound Ostomy Continence Nurs*. 2006;33(2):133-139.
11. Clifton-Koeppel R. [Wound care after peripheral intravenous extravasation: what is the evidence?](#) *Newborn Infant Nursing Reviews*. 2006;6(4):202-211.
12. The management of extravasation injuries in neonates. World Wide Wounds [Available online](#). Accessed 2008.
13. Lehr V, Lulic-Botica M, Lindbald W, Kazzi N, Aranda J. [Management of infiltration injury in neonates using DuoDerm Hydroactive Gel.](#) *Am J Perinatology*. 2004;21(7):409-414.
14. Sawatzky-Dickson D, Bodnaryk K. [Neonatal intravenous extravasation injuries: evaluation of a wound care protocol.](#) *Neonatal Network*. 2006;25(1):13-19.
15. Cisler-Cahill L. [A protocol for the use of amorphorous hydrogel to support wound healing in neonatal patients: an adjunct to nursing skin care.](#) *Neonatal Network*. 2006;25(4):267-273.
16. Beauman SS, Swanson A. [Neonatal infusion therapy: preventing complications and improving outcomes.](#) *Newborn and Infant Nursing Reviews*. 2006;6(4):193-201.
17. Ramasethu J. [Complications of vascular catheters in the neonatal intensive care unit.](#) *Clin Perinatol*. 2008;35(1):199-222.
18. Phelps SJ, Helms RA. [Risk factors affecting infiltration of peripheral venous lines in infants.](#) *J Pediatr*. 1987;111(3):384-389.

NEONATAL RISK FACTORS FOR EXTRAVASATION STUDIED BY CHART REVIEW

McCullen KL, Pieper B. **A retrospective chart review of risk factors for extravasation among neonates receiving peripheral intravenous fluids.** *J Wound Ostomy Continence Nurs*. 2006;33(2):133-139.

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The goal of the study by McCullen and Pieper was to identify variables associated with extravasation and resulting tissue damage in neonates with peripheral intravascular therapy. Intravascular therapy is essential for the administration of nutrition, medications, fluids, and electrolytes; extravasation is the unplanned administration of fluid or medications into the surrounding tissue outside the vein. A retrospective chart review was completed on neonates who experienced peripheral extravascular infiltration in the neonatal intensive care unit. The researchers developed a novel data collection tool and rated the tissue damage from extravasation with the scale from the Task Force of Pediatric Nursing Research Committee, 1994.

The sample (n = 25), including 15 female (60%) and 13 (52%) white infants, had a gestational age at birth ranging from 24 to 39.6 weeks. Their most common diagnoses were sepsis, respiratory distress syndrome, and hyperbilirubinemia. The most common solutions/medications given to them were total parenteral nutrition (containing calcium) and calcium. Peripheral intravenous catheters were secured with tape. The sites of infiltration were the arm (64%), foot/leg (20%), scalp (12%), and 1 site not recorded. Eleven neonates (45.8%) had an absence of redness, warmth, pain, swelling, blanching, mottling, tenderness, or drainage (magnitude of infiltration Stage 0) at the infiltration site. In contrast, 6 (25%) had some aspects of Stage 4 magnitude of infiltration, ie, severe swelling above and below the site, blanching, pain at site, decreased or absent pulse, capillary refill greater than 4 seconds, skin cool to touch, and skin breakdown or necrosis. Because infants received a mean of 1.96 (SD = 0.79) medications, the impact of a specific medication on extravasation could not be analyzed. Severity of infiltrate was not significantly affected by post-conceptual age or infant weight. Only 9 neonates had the area size and treatment of the infiltrated site documented. Methods of care to the extravasation sites were Radicare™ by (Carrington Labs), bacitracin, and normal saline.



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While the solutions causing the skin and tissue damage from extravasation were similar to those in other studies, the lack of documentation regarding the extent of the extravasation wound and its treatment was concerning. Without adequate documentation, the clinician is hampered in making clinical decisions about wound care progress. As a result of this study, in this institution intravenous lines were subsequently secured with a transparent dressing so the insertion site was visible. Although research is needed, the transparent dressing appears to aid in the early detection of extravasation. Limitations of this study include its retrospective design, deficiencies in the medical record, and the small sample size.

In their general conclusions, the authors recommend more detailed documentation of the wound site and its treatment. They also suggest wound care clinicians collaborate with neonatal practitioners to develop wound care protocols for extravasation.

INITIATING AND MAINTAINING PERIPHERAL INFUSION THERAPY

Beauman SS, Swanson A. **Neonatal infusion therapy: preventing complications and improving outcomes.** *Newborn Infant Nurs Rev.* 2006;6(4):193-201.

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Infusion therapy through peripheral venous access is the most common procedure performed in the NICU. Infusion therapy's quality and rate of complications are dependent upon knowledge and skill of the clinicians, selection of appropriate infusion equipment and site, proper skin preparation before insertion, proper needle/catheter stabilization, and appropriate infusion monitoring. This 2006 review paper discusses resources available to clinicians who manage neonatal infusion therapy, overviews the basic skills and knowledge needed for safe and effective infusion therapy, and provides guidelines for appropriate procedures in the initiation of intravenous access.

The authors note that guidelines on the management of intravenous access and extravasation are needed, and should be developed, in every Neonatal Intensive Care Unit (NICU). In 2006, the Infusion Nurses Society (INS) revised and published the *INS Standards of Practice*, reflecting evidenced-based standards founded on empirical scientific research for infusion therapy. These standards contain a section devoted to the neonatal and pediatric population, and may be accessed at [Journal of Infusion Nursing, 2006;29\(Suppl\):S1-S92](#).

In 2002, a working group representing 13 organizations led by the Society of Critical Care Medicine (SCCM) developed guidelines for practitioners who insert intravascular catheters and for persons responsible for surveillance and control of infections in hospitals, outpatient sites, and home care settings for adults and children. *Guidelines for the Prevention of Intravascular Catheter-Related Infections* include recommendations about the importance of education of health care workers, sterile barrier precautions during central venous catheter insertion, using 2% chlorhexidine for skin antisepsis, avoiding routine placement of central venous catheters, and using antiseptic/antibiotic impregnated central venous catheters if the rate of infections is high despite adherence to other strategies. This document may be accessed here: [O'Grady et al. Guidelines for the prevention of intravascular catheter-related infections. Clin Infectious Dis. 2002;35:1281-1307](#).

An understanding of skin and blood vessel physiology and conditions associated with reduced infusion therapy complications is critical. Knowledge of vessel wall structure, the anatomy of the neonatal integumentary system, and pain and stress of the venipuncture procedure are important for all neonatal providers. Venipuncture for infusion therapy should be initiated by a skilled clinician familiar with proper equipment and site selection, preparation, and stabilization. Pressure settings on infusion pumps and associated supplies are also important to comprehend. Since extravasation is the most common complication of neonatal infusion therapy, assessment of the site is critical. The authors discuss in great length the current understanding of physiology and the required skills and knowledge necessary for state of the art infusion therapy.

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COMPARISON OF PERIPHERALLY INSERTED CENTRAL VENOUS CATHETERS AND PERIPHERAL INTRAVENOUS CATHETERS

Janes M, Kalyn A, Pinelli J, Paes B. **A randomized trial comparing peripherally inserted central catheters and peripheral intravenous catheters in infants with very low birth weight.** *J Pediatr Surg.* 2000;35(7):1040-1044.

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Total parenteral nutrition and intravenous antibiotic therapy are often needed long-term for critically ill, very low birth weight infants (VLBW). Factors that determine the failure of the initiation of intravenous catheters include the immature muscular integrity of the vascular system, reduced vessel diameter, blood stagnating/pooling at the injection site, lack of appropriate vessels due to gestational age, and severity of illness of the neonate. These may increase the risk of endothelial damage secondary to poor perfusion or friable veins. The purpose of this study was to determine if percutaneously inserted central catheters (PICC) and peripheral intravenous catheters (PIV) in VLBW infants differed in incidence of sepsis, number of insertion attempts and catheters required, number of courses of antibiotics administered, and total duration of all intravenous lines.

Using a randomized comparative design, 63 VLBW infants who required intravenous therapy were assigned to the PICC group (n = 32) or the PIV group (n = 31). Exclusion criteria included: neonates expected to be on full enteral feeding within 48 hours, suspected or proven chromosomal anomalies, investigation/treatment of sepsis within the previous 24 hours, skin breakdown or contractures at the insertion site, or a platelet count of less than $50,000 \times 10^9/L$. Data were collected prospectively.

The two groups did not differ significantly by gestational age, birth weight, sex, total hours of intravenous use, episodes of suspected or proven sepsis, having received more than one course of antibiotic therapy, and death. Major outcomes by groups showed the PIV group had significantly more insertion attempts and more catheters used. The most common organism for infections was coagulase-negative Staphylococcus, with 8 in the PICC group and 10 in the PIV group. The top two reasons for removal of the PICC were: 1) it was no longer needed (n = 31), and 2) mechanical complications (n = 27) including leaking, blocking, kinking, extravasation, and cracked catheter hubs. The authors did not present information about the most frequent reasons to remove a PIV.

In conclusion, the PIV and PICC groups did not differ in sepsis or other complications. The lack of significance for some variables may have been due to the small sample size that under-powered the study. The use of PICC lines decreased the number of painful procedures for these infants. Although mechanical problems were stated, information about extravasation was not presented. Future research should examine the effects of a standardized management plan on the incidence of complications and outcomes for PICC. A more aggressive use of PICC lines may result in fewer traumas experienced by infants in the neonatal intensive care units.

WOUND CARE AFTER PERIPHERAL INTRAVENOUS EXTRAVASATION

Clifton-Koeppel R. **Wound care after peripheral intravenous extravasation: what is the evidence?** *Newborn Infant Nurs Rev.* 2006;6(4):202-211.

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Reviewing the literature related to the pathophysiology of intravenous extravasation and wounding, assessment of extravasation, immediate treatment, and wound care, the author reported intravenous extravasation for newborns ranged from 23% to 63%, and the

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prevalence of skin necrosis as 38 per 1000 infants, with the majority being in newborns less than 26 weeks gestation.

The mechanisms for extravasation include: a) the catheter tip piercing the vessel wall; b) the catheter tip remaining in the vessel, with vasoconstriction and back pressure causing leakage through the initial catheter placement site; and c) characteristics of the infusate (ie, high osmolality, high pH, or chemical composition of the fluids and medications) causing irritation to the vessel wall. Calcium supplements are frequently given to the neonate to prevent neonatal hypocalcemia; however, calcium gluconate may cause coagulation necrosis of the tissue and clotting within the blood vessel.

Staging systems, used to assess the severity of the intravenous extravasation, included factors such as pain, skin color, swelling, pulses, capillary refill below the extravasation, skin temperature, and skin breakdown/wounding.

Since research is lacking regarding treatment, protocols may vary. In the immediate phase, the primary goal is to neutralize the substance. This may be accomplished with a normal saline washout, hyaluronidase, phentolamine, and glycerol trinitrate. The use of heat and cold is controversial. Wound care to promote a moist wound environment is recommended, whereas dry gauze, soaps or antiseptics are discouraged. Since newborns can topically absorb substances from dressings, dressing must be selected carefully. Dressing categories used in extravasation injuries included hydrogels, hydrocolloids, transparent dressings, hydrofibers, and silver sulfadiazine.

In conclusion, prevention of extravasation is critical. Prevention methods include: hourly or more frequent (especially in calcium-containing fluids) assessments of peripheral intravenous sites; visible insertion sites; intravenous catheters secured to limit movement but not so tight as to limit fluid dispersal; and limited osmolality of solutions. Multi-center research studies need to be implemented to examine wound care for intravenous extravasation in the neonate.

TREATMENT OF EXTRAVASATION INJURIES

Kumar RJ, Pegg SP, Kimble RM. **Management of extravasation injuries.** *ANZ J Surg.* 2001;71(5):285-289.

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Tissue necrosis may develop after intravenous fluid extravasation because of the solution osmolality, tissue toxicity, vasoconstriction properties of the solution, and infusion pressure on the tissue. The authors report on 9 patients with extravasation injuries identified in 3 Australian hospitals. The patients ranged in age from 17 days to 60 years. Six of the injuries were in children less than 2 years of age; 2 were neonates. The injury sites included dorsum of the foot (n = 6; 66.7%), dorsum of the hand (n = 2; 22.2%), and groin (n = 1; 11.1%). None of the 9 patients had the same causative factor. The causes of the neonatal injuries were flucloxacillin and sodium bicarbonate. Two patients had injuries from essentially isotonic fluids (5% dextrose and 4% dextrose/0.18% saline).

The non-operative treatment usually involved daily cleansing and a topical antiseptic cream. The 2 neonates received topical silver sulfadiazine with 0.2% chlorhexidine. Debridement of eschar occurred in 5-7 days and the wounds re-epithelialized within 3-4 weeks with excellent results. For the other 4 children, 3 had the surgical debridement and split skin grafting of the site, which resulted in the moderate scarring for 2 and a fair outcome for one. Seven of the 9 patients required prolonged scar management.

In conclusion, in the event of necrosis, the authors recommended conservative therapy with delayed debridement and split skin grafts. The involved area requires time to demarcate to determine the extensiveness of the required procedure. Surgery may involve multiple procedures, including the release of scar/contractures. The primary aim is prevention of these injuries through education of the health care team. Limitations of this study include the small sample size, retrospective design, and the limited information about the treatment. Statistical comparisons were not done.

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GAULT'S PROCEDURE TO TREAT EXTRAVASATION

Casanova D, Bardot J, Magalon G. **Emergency treatment of accidental infusion leakage in the newborn: report of 14 cases.** *Br J Plast Surg.* 2001;54(5):396-399.

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The authors reviewed the Gault's procedure on newborns that experienced accidental leakage of an intravenous infusion into surrounding tissue. Gault's procedure, first described in 1993, involves injection of a few milliliters (mL) of hyaluronidase or saline through 4 micro-incisions into the affected area under general anesthesia. Aspiration is then performed through the micro-incisions with a 2mm microcannula using a liposuction technique. Saline is used to rinse the affected area after each liposuction procedure. Gault's procedure is repeated several times and then a dressing is applied.

The 14 newborns had a mean age 20.3 days (range: 1 day to 6 months). Their average weight was 2.490 kg; 6 of the infants were premature. The extravasation infusion solutions were dopamine (8 cases), beta-blocker (1 case), caffeine and calcium salts (5 cases). The sites affected by infiltration were foot and ankle (9 cases), hand or wrist (3 cases), elbow (1 case), forehead (1 case). Good pulses and capillary refill were present below the infusion site in all of the newborns. One or more of the following signs were present in all: swelling, discoloration/erythema, indurations, blistering, and/or skin damage. Gault's procedure used in this study was hyaluronidase for 11 newborns and saline only for 3 cases. Eleven (78.6%) of the 14 cases had good results after Gault's procedure. In 3 of the 14 cases, skin necrosis developed after the procedure. Gault's technique was most effective when it was performed within 6 hours of the infiltration (4-6 hours with an infiltrate due to a vasopressor agent).

The solution that was used prior to the infiltrate determined the extent of skin or tissue damage present before the Gault's technique was performed. As in other publications, the solutions considered toxic to the skin were intensive nutrition solutions, hypertonic glucose, calcium salts, potassium chloride, sodium bicarbonate, vasoactive drugs, contrast dyes, and antibiotics. A critical issue was the severity of tissue damage present prior to the procedure. Gault's technique was effective in a majority of cases examined. The approach is considered aggressive, requires initiation within a short timeline (4-6 hours), and requires general anesthesia.

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Respiratory Therapists

Respiratory therapists should [visit this page](#) to confirm that *AMA PRA Category 1 Credit(s)TM* is accepted toward fulfillment of RT requirements.

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Step 1.

Click on the appropriate link below. This will take you to the post-test.

Step 2.

If you have participated in a Johns Hopkins on-line course, login. Otherwise, please register.

Step 3.

Complete the post-test and course evaluation.

Step 4.

Print out your certificate.

PHYSICIAN
POST-TEST

NURSE
POST-TEST

Respiratory Therapists
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Credit Designations — [back to top](#)

Physicians

eNewsletter: The Johns Hopkins University School of Medicine designates this educational activity for a maximum of 1.0 *AMA PRA Category 1 Credit(s)*TM. Physicians should only claim credit commensurate with the extent of their participation in the activity.

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Nurses

eNewsletter: This 1.0 contact hour Educational Activity (Provider Directed) is provided by The Institute for Johns Hopkins Nursing. Each newsletter carries a maximum of 1.0 contact hours.

Podcast: This 0.5 contact hour Educational Activity (Provider Directed) is provided by The Institute for Johns Hopkins Nursing. Each podcast carries a maximum of 0.5 contact hours.

Respiratory Therapists

For United States: [Visit this page](#) to confirm that your state will accept the CE Credits gained through this program.

For Canada: [Visit this page](#) to confirm that your province will accept the CE Credits gained through this program.

Post-Test — [back to top](#)

To take the post-test for eNeonatal Review you will need to visit [The Johns Hopkins University School of Medicine's CME website](#) or [The Institute for Johns Hopkins Nursing](#). If you have already registered for another Hopkins CME program at these sites, simply enter the requested information when prompted. Otherwise, complete the registration form to begin the testing process. A passing grade of 70% or higher on the post-test/evaluation is required to receive CME/CNE credit.

Statement of Responsibility — [back to top](#)

The Johns Hopkins University School of Medicine and The Institute for Johns Hopkins Nursing take responsibility for the content, quality, and scientific integrity of this CME/CNE activity.

Intended Audience — [back to top](#)

This activity has been developed for neonatologists, NICU nurses and respiratory therapists working with neonatal patients. There are no fees or prerequisites for this activity.

Learning Objectives — [back to top](#)

At the conclusion of this activity, participants should be able to:

- Discuss with colleagues pertinent factors associated with extravasation in the neonate
- Identify for colleagues treatment options for extravasation
- Describe for colleagues considerations for wound dressings used in the neonate

Internet CME/CNE Policy — [back to top](#)

The Office of Continuing Medical Education (CME) at The Johns Hopkins University School of Medicine (SOM) is committed to protecting the privacy of its members and customers. The Johns Hopkins University SOM CME maintains its Internet site as an information resource and service for physicians, other health professionals and the public.

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that your state will accept the CE Credits gained through this program or click on the link below to go directly to the post-test.

RESPIRATORY
THERAPIST
POST-TEST

Faculty Disclosure — [back to top](#)

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- **Mary Terhaar, DNSc, RN** has indicated no financial relationship with commercial supporters.

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