Extravasation Injury in Newborn Intensive Care Unit

Procedure Responsibilities and Authorisation

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Target Audience	Nurses, NNP/CNS, Registrars, SMO
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Procedure Review History

Version	Updated by	Date Updated	Summary of Changes
1	Leanne Baker	January 2012	First version
2	Joyce Mok	January 2017	Update
3	Aira Javier	May 2022	Update

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Contents

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1 Overview

1.1 Purpose

- To outline measures to prevent extravasation injury
- To provide guideline on interventions for intravenous infiltration injuries

1.2 Scope

Te Whatu Ora Waikato staff working in Newborn Intensive Care Unit (NICU)

1.3 Patient/client group

Babies and infants in Neonatal Intensive Care Unit.

1.4 Definitions

CNS	Clinical Nurse Specialists
CVAD	Central venous access device
Extravasation	The infiltration of a vesicant drug or solution into the surrounding tissue, results from a punctured vein or leakage around a venepuncture site. Extravasation differs from infiltration in that the latter occurs when a non-vesicant solution or medication escapes into surrounding tissue. Mechanical, physiologic and pharmacologic factors can increase the risk of extravasation.
Extravasation antidotes	When vesicant drugs extravasated, they cause tissue damage. Extravasation antidotes are used to decrease tissue damage and reduce chance of permanent disability or disfigurement. Hyaluronidase for extravasated agent such as dextrose, electrolytes (calcium, potassium, sodium bicarbonate), phenytoin, antibiotics (nafcillin, vancomycin), and plant alkaloids. Phentolamine for vasopressors, e.g. dobutamine, dopamine, epinephrine, norepinephrine, vasopressin.
Extravasation of intravenous fluids	Extravasation of intravenous (IV) fluids occurs with non-intentional leakage of infused fluid or medication into the surrounding tissue leading to tissue damage and skin necrosis. Preterm infants are at high risk due to long term exposure to IV therapy, immature skin and reduced venous integrity.
Irritant	Irritant is an agent that causes aching, tightness and phlebitis with or without inflammation, but does not typically cause tissue necrosis. Irritants can cause necrosis if the extravasation is severe or left untreated. Highly irritant solutions include: Solutions containing >10% dextrose, calcium, antibiotics (vancomycin, nafcillin), calcium salts, potassium salts, radio contrast media, hypertonic saline, blood, parenteral nutrition and sodium bicarbonate. These may all be treated with hyaluronidase.

IV	Intravenous
NNP	Neonatal Nurse Practitioners
Saline Irrigation	Used for severe hyperosmolar extravasations to assist with removal of extravasated material. Evidence for use is limited to case series reports which suggest that early treatment with saline irrigation +/- hyaluronidase results in good long-term functional and cosmetic outcomes.
SMO	Senior Medical Officers
Vesicant	Vesicant is an agent that has the potential to cause blistering, severe tissue injury, or tissue necrosis when extravasation occurs.

2 Clinical Management

2.1 Competency required

- Registrar, NNP, CNS, SMO
- Registered Nurse who completed Level 2 orientation and generic IV management certifications

2.2 Equipment

- Syringes, e.g. 1ml
- 0.9% sodium chloride
- Needles, e.g. 26G or smaller
- Alcohol/Chlorhexidine wipes
- Gauze pads
- Measuring tape
- Prescribed antidote, e.g. Hyaluronidase or Phentolamine as indicated
- Hydrocolloid dressing, e.g. duoderm
- Local anaesthetic
- IV cannula with side holes, e.g. large bore Angiocath™ (for saline flush-out technique)

2.3 Procedure

Identification of intravenous extravasation injury

- Monitor IV and CVAD sites closely: colour, skin integrity and patency. All sites should be monitored at least hourly and more often if medications/fluids known to be have potential to damage tissue is being infused.
- If extravasation does occur, skin sloughing and tissue necrosis may occur, as well as damage to deeper tissue, nerves and muscles. Plastic surgery may be necessary in extreme cases.
- It is vital that treatment is initiated immediately on recognising injury.

Prevention measures

- Avoid areas difficult to immobilize.
- Always expose the IV site if the baby is in a cot.
- Secure cannula so insertion site is clearly visible.
- Ensure CVAD / IV site dressing is not circumferential
- Tape splint loosely enough to maintain circulation.
- Limit IV glucose upper concentrations to 12.5%. Higher concentrations require a central line.
- Parenteral solution (Reg96) will be able to run together with SMOF Lipid.
- Dilute medications as per NICU (or approved drug protocol, e.g. Starship guidelines (see Appendix A)
- Assess catheter site and distal region hourly, and document on observation chart.
- Stop infusion immediately if signs of infiltration are present.

Signs and symptoms:

Swelling, pain, coolness of skin, blanching, bruising, leakage at site, erythema (redness), blistering, poor perfusion/paleness at site.

Table 1: Grading of Extravasation Injuries (Millam 1988)

Stage 1	Stage 2	Stage 3	Stage 4
Painful IV site	Painful IV site	Painful IV site	Painful IV site
No erythema	Erythema present	Blanching	Blanching
No swelling	Slight swelling	Marked swelling	Very marked swelling
Flushes with difficulty	No blanching	Cool to touch	Cool to touch
	Brisk capillary refill distal to infiltration site	Brisk capillary refill distal to infiltration site	Capillary refill > 4 sec*
	Good pulse distal to infiltration site	Good pulse distal to infiltration site	Decreased or absent pulse*
			Skin breakdown or necrosis*

** The presence of any of these constitutes a stage 4 infiltration*

When intravenous infiltration injuries occur

- Stop infusion.
- Do not remove IV cannula at this stage.
- IV cannula should be left in place to facilitate aspiration of fluid from the extravasated site and, if appropriate, administration of an antidote (Appendix B).
- Check with NNP/CNS/Registrar whether cannula can be removed.
- Remove any constricting bands that may act as tourniquets i.e. tapes, sleeves.
- Assess severity using Millam's Grading of Extravasation Injuries (refer to Table 1 above).
- Inform parents as soon as possible.

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Management of Extravasation Injury

Stage 1	Stage 2	Stage 3	Stage 4
• Stop infusion • Remove cannula and tapes • Elevate limb	• Stop infusion • Remove cannula and tapes • Elevate Limb	• Stop infusion • Report immediately to medical staff for assessment. • Remove constricting tapes • Leave cannula in situ until reviewed by medical staff (treating team) • Photograph injury if this will not delay treatment • Medical staff to commence irrigation procedure **within 1 hour** of extravasation by irrigating affected area using hyaluronidase and saline 0.9%, saline 0.9% irrigation alone or Phentolamine. Give appropriate pain relief prior to beginning procedure*. • Apply non-occlusive dressing as advised by treating medical team or plastics • Elevate limb • +/- Refer to plastics team *Minimum Paracetamol and sucrose (for infants) +/- Morphine	• Stop infusion • Report immediately to medical staff for assessment. • Remove constricting tape • Leave cannula in situ until reviewed by medical staff (treating team) • Photograph injury if this will not delay treatment • Medical staff to commence irrigation procedure **within 1 hour** of extravasation by irrigating affected area using hyaluronidase and saline 0.9% or saline 0.9% irrigation alone or Phentolamine. Give appropriate pain relief prior to beginning procedure* • Apply non-occlusive dressing as advised by treating medical team or plastics • Elevate limb • **Refer to plastics team**

- Evidence suggests hyaluronidase irrigation for parenteral nutrition and calcium chloride extravasation is beneficial. Irrigation of major grades of extravasation has been used to prevent extensive skin loss and need for plastic surgery. However, the evidence for the use of irrigation in preventing long-term injury is limited to case reports

- Hyaluronidase should be used within 1-2 hours of extravasation for the best results
- Hyaluronidase should NOT be used for extravasation of vasoconstrictive agents (dopamine, adrenaline, noradrenaline etc.)
- The decision to treat or not to treat with Hyaluronidase is the decision of the medical staff from the treating team and should be documented in the patient's medical record
- Compromise to the neurovascular status of the limb or suspected compartment syndrome is a surgical emergency

Hyaluronidase/Normal Saline Irrigation Procedure

1. Administer analgesia and wait 10 minutes before commending procedure.
2. Do not rupture formed blisters during the procedure.
3. Clean the affected limb with antiseptic solution.
4. Infiltrate the affected area in four quadrants with subcutaneous 1% lignocaine (max 0.15mL/kg).
5. **Hyaluronidase irrigation (followed by Saline 0.9% irrigation)**: Inject around and through the extravasation injury a total of 5 lots of 0.2mL aliquots of hyaluronidase 150 units/ml.
6. **Normal Saline Irrigation:** Irrigate the area using the four puncture marks already made from the hyaluronidase using 0.9% saline in 10-20mL aliquots. Suggested volumes for normal saline irrigation range from 50-500 mls (although in smaller infants 20mL may be sufficient).
7. If the cannula is still in situ, infiltrate 3-5mL 0.9% saline and then remove the cannula.
8. Massage out any oedema that develops in the direction of the puncture marks.
9. If the extravasation fluid includes lipid, irrigate the area until the effluent runs clear.
10. Large areas of extravasation may require additional infiltration of local anaesthetic during the procedure.
11. Once complete apply a non-occlusive dressing to the area as advised by the treating medical team or plastics team.
12. Elevate the affected limb.

Phentolamine

For extravasation injuries due to dopamine or other vasoconstrictors. Both low and high dosage dopamine have been reported to cause severe extravasation injuries.

- Phentolamine is injected into the IV cannula and or subcutaneously encircling the infiltrated site, 4-5 sites.
- For dosing refer to Appendix B
- Often within 15-30 seconds there will be an improvement in colour and perfusion.
- Hypotension is the most noted side-effect. Monitor BP continuously if possible, or 5 minutely for 1 hour after administration.

Other considerations for extravasation injuries:

- Do not apply hot or cold packs to the affected limb
- Administer antibiotics if signs of infection occur
- Nursing staff to continue to observe the site hourly for the first 24 hours to monitor for adverse effects
- Medical staff should review the site 1-2 hours post irrigation procedure to assess effectiveness. This should then be reviewed again in 24 hours by medical staff
- Consider plastic surgery consultation if extensive necrosis or tissue damage evident.
- Nurse/NNP/CNS/Registrar to complete Datix and ACC forms.
- Document injury in clinical notes and care plan. Take photographs of the infiltrated site (before & after treatment if applicable), include photos in clinical notes & attach in Datix report.
- ACC treatment injury

Ongoing assessment

- Continue to observe affected area post extravasation injury for 24 hours to ensure no signs of infection or further complications.
- If there are signs of infection/complications, the site should continue to be observed until the signs and symptoms resolve.
  Any signs of infection must be reported to the treating medical team to determine the need for antibiotic treatment.

2.4 Potential complications

Infiltration and extravasation may lead to tissue damage. If not recognized early, surgical resection and debridement may be required. Damage can be severe enough to result in physical deformity and functional deficits, such as loss of joint mobility, vascularity, and tendon function. Compartment syndrome can also occur. Severe permanent disability of the involved extremity can occur. Amputation may be necessary.

3 Audit

3.1 Indicators

- There is documented evidence to confirm the IV and central line have been assessed no less than hourly (to include but not limited to the catheter site and distal regions)
- All extravasation injuries are assessed for severity (using the Millam's Grading)
- Every extravasation injury is entered into Datix with evidence of an associated ACC lodgement.

4 Evidence base

4.1 References

- Auckland DHB (2020). Recognition and Prevention of IV Infiltration Injuries. Newborn Services Clinical Guideline. Retrieved on September 4, 2020 from http://www.adhb.govt.nz/newborn/guidelines/vascularcatheters/IVInfiltrationInjuries.htm#1
- Government of Western Australia Child and Adolescent Health Service Neonatology. (2020). Extravasation Injuries. Retrieved on April 4, 2022 from https://pch.health.wa.gov.au/~/media/HSPs/CAHS/Documents/Health-Professionals/Neonatology-guidelines/Extravasation-Injuries.pdf?thn=0
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- Taketomo, C., et al. (2014). Pediatric and neonatal dosage handbook (21st ed.). Lexicomp Drug References Handbooks.
- The Royal Children's Hospital Melbourne (2020). Extravasation injury management. Retrieved on April 4, 2022 from https://www.rch.org.au/rchcpg/hospital_clinical_guideline_index/Extravasation_injury_management/

4.2 Associated Te Whatu Ora Waikato Documents

- Wolters Kluwer (2020). Infiltration and extravasation management, pediatric. Lippincott Procedures.

Appendix A: High Risk Infusions and Medications (Vesicants)

Table 2: High Risk Infusions and Medications (Vesicants)

Adapted from Starship Guideline (2016). Extravasation and Infiltration Injuries - management in PICU

(Retrieved from starship.org.nz/guidelines/extravasation-and-infiltration-injuries-management-in-picu/)

Hyperosmolar Solutions	Non-Physiological pH Note: pH outside of 5-9 is painful and can be harmful	Vasopressors
Fluids: 10-50% Glucose, 3% Saline, TPN, Mannitol **Medications:** Aminophylline, Calcium solutions, Diazepam, Digoxin, Lorazepam, Glyceryl Tri-nitrate, Phenobarbitone, Phenytoin, Potassium, Radiographic Contrast, Sodium Bicarbonate	**Acidic:** Amiodarone, Amphotericin, Caffeine, Gentamicin, Metronidazole, Pentamidine, Vancomycin **Alkaline:** Aciclovir, Phenytoin, Thiopentone	Adrenaline Noradrenaline Dopamine Dobutamine Vasopressin Phenylephrine

Appendix B: Antidotes

Table 3: Antidotes

Source: Starship Guideline (2016). Extravasation and Infiltration Injuries - management in PICU

(Retrieved from starship.org.nz/guidelines/extravasation-and-infiltration-injuries-management-in-picu/)

Agent	Dose and Administration	Caution	Mechanism of Action
Hyaluronidase Note: Do not use for vasoconstrictive agents	150unit/ml solution - given as five 0.2ml subcutaneous injections into extravasation site via 25g needle. One injection may be administered via cannula if remains insitu. Total dose = 1ml = 150units[6]	Most effective if administered within 2hrs, reports of efficacy up to 12hrs post injury.* Effect lasts 24-48 hrs. Only to be used in conjunction with saline irrigation~	Breaks down connective tissue hyaluronic acid increasing the distribution and absorption of locally injected substances.
Phentolamine	5mg made up to 10ml with 0.9% Saline solution - given as subcutaneous injections into extravasation site and via cannula if remains insitu Dose = 0.1-0.2mg/kg, max dose 5mg.* ^	Effective up to 12 hrs post injury.* Systemic absorption may result in tachycardia and hypotension.	Competitive α-adrenergic blockade. Reverses the alpha mediated vasoconstriction properties of vasopressors.

Notes

* Reynolds PM, Maclaren R, Mueller SW, Fish DN, Kiser TH. Management of extravasation injuries: A focused evaluation of noncytotoxic medications. Pharmacotherapy 2014;34(6):617-632.

^ Le A, Patel S. Extravasation of noncytotoxic drugs: A review of the literature. Ann. Pharmacother. 2014;48(7):870-886.

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