

Running head: INTRAVENOUS INFILTRATION

Recommendation of a Neonatal Intravenous Infiltration Pathway

Lysie E. Jones

Creighton University Graduate School of Nursing

March 21, 2014

INTRAVENOUS INFILTRATION

Abstract

Peripheral intravenous infiltration is a complication that can cause serious morbidities and adversely affect healthcare outcomes. Ideally, the best way to avoid peripheral intravenous infiltrations is to prevent them with astute nursing assessment and practices. However, infiltrations occur despite adequate prevention measures. Prompt identification and treatment utilizing appropriate tools and pathways is necessary to minimize complications. Neonates are specifically vulnerable to infiltrations, but many grading tools and interventions are not developmentally appropriate for all populations. By adopting a population-specific nursing protocol that addresses prevention, timely assessment and intervention, outcomes will be positively influenced in the neonatal intensive care unit.

INTRAVENOUS INFILTRATION

Recommendation of a Neonatal Intravenous Infiltration Pathway

Intravenous (IV) infiltration and extravasation are defined as fluid leaking from a blood vessel. When the fluid is a non-vesicant, it is an infiltration; when the fluid is a vesicant, it is an extravasation. Intravenous infiltration is the most common complication of peripheral intravenous therapy, with varying degrees of morbidity (Thigpen, 2007). Complications include pain, infection, disfigurement, prolonged hospitalization, increased hospital costs, and possible litigation (Thigpen, 2007). There are many different interventions and treatments practiced today, but no standardized pathway exists for bedside nurses to follow in my unit. The purpose of this project was to promote prevention of neonatal intravenous infiltrations and if infiltration occurs, to develop a pathway for bedside nurses to follow when identifying and starting treatment.

Background

It is estimated that 78% of pediatric peripheral intravenous (PIV) lines become infiltrated and 11% of neonatal intensive care unit (NICU) patients have IV extravasations (Beaulieu, 2012; Tofani et al, 2012; Amjad, Murphy, Nylander-Housholder, & Ranft, 2011; Thigpen, 2007) with a higher incidence in infants that are 26 weeks gestation and less (Beaulieu, 2012; Amjad et al, 2011; Thigpen, 2007). An estimated 43% of these infiltrations results in skin, muscle, or nerve damage and/or sloughing of tissue (Tofani et al, 2012; Thigpen, 2007). Intravenous extravasation is the most common problem requiring plastic surgery in the NICU (Sawatzky-Dickson & Bodnaryk, 2006) and 4% of infants leave NICU's with cosmetically or functionally significant scars from extravasation injuries (Wilkins & Emmerson, 2004).

There is demand for high quality and affordable care even with the rising cost of healthcare today. Health reform and changes in reimbursement have every institution looking to

INTRAVENOUS INFILTRATION

save dollars. Complications related to intravenous therapy can significantly impact the cost of care as well as affecting patient morbidity and mortality. The Centers for Medicare and Medicaid Services (CMS) considers intravenous infiltrates a reasonably preventable event (Beaulieu, 2012; Amjad et al, 2011). In April 2007, CMS discontinued reimbursement for infections resulting from intravenous catheters and in October 2008, reimbursement was discontinued for complications associated with procedures to repair injuries acquired while hospitalized (Amjad et al, 2011). Hospitals are now being held accountable for preventing these complications and decreasing length of stay. More than 2% of all injury claims from 1970-2001 were related to peripheral intravenous catheter infiltrates and increasingly, nurses are being named in malpractice suits involving administration of IV fluids and medications, at up to 10 million dollars per claim (Beaulieu, 2012). Pediatric intravenous infiltration has been identified as a nurse sensitive quality indicator by the National Database of Nursing Quality Indicators (NDNQI), and data is currently being collected (American Nurses Association, 2013).

Significance

IV infiltrations are typically graded on a scale. The first of these scales was created in 1988 by Millam; this tool has been used as a basis for many other existing scales (Beaulieu, 2012). In 2006, the Infusion Nurses Society (INS) developed a scale that measured edema in inches and recommended that vesicants (extravasations) be upgraded to the most severe grade of infiltration (Beaulieu, 2012). There have been many variations of grading tools proposed, however, few scales adequately account for patient size and are generalizable to the neonatal population.

Although most injuries will heal without intervention, there are a wide range of treatment options for intravenous infiltrations and extravasations that include: elevation, application of heat

INTRAVENOUS INFILTRATION

and/or cold, medications, dressings, debridement, and skin replacement (Treadwell, 2012).

Although many tools and treatments exist, management of infiltration and extravasation lacks evidence-based standards and many institutions do not have adequate procedures in place (Doellman et al, 2009). Intervention and treatment algorithms that contain specific actions designed to minimize complications are useful tools for bedside nurses. A combination of assessment and intervention tools that are tailored for pediatric patients may reduce morbidities, improve patient satisfaction and outcomes, and have financial benefits (Pop, 2012).

Many factors place neonates at the highest risk for injury by peripheral intravenous infiltration and extravasation injuries. Neonates cannot report pain nor advocate for themselves and neonates have more fragile skin, tissue, and smaller more fragile veins. Also, smaller intravenous catheters are routinely used and there can be difficulty in stabilizing and protecting the catheter (Beaulieu, 2012; Treadwell, 2012; Pop, 2012; Tofani et al, 2012; Amjad, 2011; & Doellman, 2009). The purpose of this project is to recommend a neonatal infiltration pathway for bedside nurses to reference in preventing, grading, and initiating treatment for peripheral intravenous infiltrations with the goal of improving care while decreasing costs, complications, and length of stay.

Review of Literature

A review of current literature for this project revealed an overall consensus that prevention is the best method of decreasing morbidity from peripheral intravenous infiltrations. However, it was also noted that even with diligent prevention strategies, infiltrations do occur. Use of models for rapid identification, appropriate assessment, and timely treatment can further improve outcomes for infiltration and extravasation events.

INTRAVENOUS INFILTRATION

Prevention and Early Recognition of Infiltration

Tofani et al. aimed to reduce peripheral intravenous infiltration rates by utilizing quality improvement methods. These methods included policy revision, hourly peripheral IV site assessment, staff education, and staff performance monitoring (Tofani et al., 2012). The TLC (touch, look, compare) method was created by the clinical director of Cincinnati Children's Hospital and Medical Center's Vascular Access Team. In addition to educating nursing staff about the importance of thorough PIV assessments, it provided information to parents about what to expect with PIV assessment. A significant decrease in infiltration events was initially seen after this education; however, due to difficulties in changing staff behaviors, the decrease was not sustained.

Prevention strategies suggested by Amjad et al. include a minimum of hourly assessments, appropriate taping techniques to allow adequate visibility of insertion site, and infusions run on automated pumps with pressure sensors (2011). It is a consensus that frequent and routine evaluation of the catheter site and early recognition of infiltration is important to minimize risk of tissue damage (Amjad et al., 2011; Doellman et al., 2009; Pop, 2012; Sawatzky-Dickson & Bodnaryk, 2006; Thigpen, 2007; Tofani et al., 2012; & Treadwell, 2012).

Assessment

Three articles used the same assessment scale adapted from Montgomery et al. (1999) and Ramasethu (2003). This scale's stages closely resemble the INS scale, and infiltration is graded numerically from one to four. The observation criteria are based on pain, crying with or difficulty while flushing, redness, capillary refill, swelling, blanching, skin temperature, and pulses (Beaulieu, 2012; Sawatzky-Dickson & Bodnaryk, 2006; & Thigpen, 2007). Tofani et al.

INTRAVENOUS INFILTRATION

utilized a scale adapted from the Infusion Nurses Society that graded infiltrations from zero to four based upon blanching, measured edema, skin temperature, pain, skin drainage or blistering, and circulatory impairment (2012). This scale adjusted for patient size by having different measurements for patients below 4 kilograms and above 4 kilograms. This study does not account for the difference in size between an extremely low birth weight (ELBW) infant who may be below one kilogram and a term infant who may be just less than four kilograms. By the end of this study, 12 of the 15 units had achieved 90% reliability with assessments utilizing this scale (Tofani et al., 2012).

In the article by Amjad et al., a revised grading scale was proposed. By referring to the number of joints involved in an infiltration instead of a number of inches, the scale represents the degree of severity relative to the size of the patient (Amjad et al., 2011). Utilizing an evidence based approach; a multidisciplinary team devised a treatment algorithm. A quantitative study of the decrease in morbidity after implementing this protocol is pending.

In the study by Pop, a tool was developed for pediatric patients utilizing a tool by the Infusion Nurses Society (2012). Some of the signs and symptoms were adjusted for the pediatric population, but most importantly, measurements for edema were changed from inches to percentage of affected extremities. This tool was well received by staff, considered easy to use, and did not lengthen assessment time. Data from 102 infiltrations, obtained from a convenience sample, was analyzed. This tool was shown to provide a better way to assess the infiltration and determine appropriate interventions. Results of statistical analysis suggest this is a valid and reliable method to assess infiltrations. A limitation of this tool is the lack of reference to scalp IV's. Another limitation was the grading of edema effecting the palm or foot.

INTRAVENOUS INFILTRATION

Intervention

Many studies recommend basic interventions for infiltration that include: aspiration from the cannula, removal of the cannula, elevation, and application of heat or cold. The use of heat or cold can be considered controversial in the neonatal population (Doellman et al., 2009; Treadwell, 2012).

Various medications are recommended for infiltrations. The most common is use of hyaluronidase to reduce tissue damage and necrosis in injuries caused from vesicants such as total parenteral nutrition (TPN), electrolytes, and antibiotics (Thigpen, 2007; Treadwell, 2012). The administration of hyaluronidase is controversial as it requires multiple puncture sites to fragile neonatal skin (Amjad et al, 2011). Phentolamine has been shown to reverse the ischemic effects of vasoactive drugs, such as epinephrine and dopamine (Thigpen, 2007; Treadwell, 2012).

Other treatment changes have been proposed based on the desire to limit additional puncture sites or trauma to fragile skin. One treatment pathway that is minimally invasive involves use of compression wraps and warm packs for first degree infiltrates, and topical bacitracin ointment and Vigilon and cast padding dressing for second and third degree infiltrations (Amjad et al., 2011). A quantitative study using this protocol is pending.

A review of prevention and management of infiltrations done by Doellman et al., suggests five steps at the first signs of infiltration: stop administration of fluids, disconnect IV tubing from catheter, attempt aspiration of residual drug from catheter site, administer nursing interventions, and notification of the physician or advanced practice nurse (2009). Nursing interventions included elevation and thermal application. This review is not based on pediatric or neonatal patients; however the five steps can be reasonably generalized to this population. An

INTRAVENOUS INFILTRATION

article by Beaulieu recommends a kit for infiltrations that contains specific protocols, management algorithms, documentation forms, antidotes with instructions, and tape measures or other necessary equipment (2012).

Quality of Research and Recommendations for Further Study

Overall, there are many studies about adult peripheral intravenous infiltration. Few studies were found that were based on pediatric assessment tools, that may be generalizable to infants, but few exist that are unique to the neonatal population. There are many articles that review practices, but a lack of primary research based resources. The goal of prevention and early identification, along with having tools available to bedside caregivers to initiate early and developmentally appropriate treatments is agreed upon as key to improving outcomes and decreasing costs. However, additional research is needed in determining the optimal treatment for these injuries.

My institution's Neonatal Intensive Care Unit policy for intravenous infiltration and extravasations refers to an adult policy. By providing education on preventative measures, and providing a pathway for nurses to provide timely assessment and intervention; my goal is to reduce peripheral intravenous infiltration rates and associated morbidities.

Middle Range Theory Application

The comfort theory, created by Katharine Kolcaba, provides a framework for research in settings where increasing comfort is a desirable outcome. According to the theory, enhanced comfort strengthens recipients to engage in activities necessary to achieve health or participate in health seeking behaviors. When patients engage in health seeking behaviors as a result of increased comfort, members of the healthcare team are more content and ultimately perform better (Peterson & Bredow, 2013). Kolcaba states that health seeking behaviors are further

INTRAVENOUS INFILTRATION

related to desirable institutional outcomes such as decreased cost, improved family and nurse satisfaction, and better outcomes for children/families including reduced lengths of stay and low readmission rates (Kolcaba & DiMarco, 2005).

Intravenous infiltration is a painful condition. By following a pathway that promotes prevention, early identification and treatment, discomfort can be minimized and health seeking behaviors improved. Some examples of health seeking behaviors in infants are adequate immune function, nursing or bottle feeding well, normal sleep cycles, and controlled pain. By including an assessment of an infant's comfort level, we are able to utilize the comfort theory in this research study.

Methods

Design, Sample, Setting

This was a retrospective review of infants with infiltrates in a 34 bed, level IV neonatal intensive care unit. A convenience sample of infants with intravenous infiltrations or extravasations within the past year were included in the quality improvement study. Excluded would be intravenous catheters that are centrally placed. The NICU staff nurses participated in the development of new prevention strategies and care pathway. A final re-evaluation of the infiltration rates and treatment strategies used will be done prospectively a year after implementation of the new guidelines.

Ethical Considerations

Approval from the Institutional Review Board at the Nebraska Medical Center was not necessary as this was a nursing practice change. Information was obtained from record review by management and no identification of subjects occurred.

INTRAVENOUS INFILTRATION

Measurement Methods & Data Collection

Educational materials were created to present to staff about the new procedures as well as quick reference guides for the bedside. Heightened awareness of infiltrations and prevention strategies are to be presented. The TLC (touch, look, compare) method that was created by Cincinnati Children's Hospital and Medical Center will be utilized to encourage appropriate hourly assessment of sites (Tofani et al., 2012). The five steps as described by Doellman will be initiated as a pathway for initial response to infiltration. A grading scale presented by Thigpen (2007), will be utilized for assessment and grading (see Appendix A). Development and implementation of a nursing protocol was completed with nursing input and recommendations from the unit medical director and nursing administration (see Appendix B).

Data Analysis

Analysis of the infiltration rate prior to and after the initiation of the new policy and pathway will be determined. A decreased number of infiltrations and less requiring use of treatment would be the goal of this project.

Limitations

Nursing administration was skeptical that nurses would accept the practice change, the implementation of the TLC method was questioned as being developmentally inappropriate for this population, many unspecified changes were requested to the project, and many delays were requested to consult with others about the implementation. Due to the delay in the implementation, comparison of the pre- and post-implementation rates of infiltrations will not be completed until 2015. It is still believed by the researcher and the unit medical director that by adopting a population specific nursing protocol that addresses prevention, timely assessment and intervention, outcomes will be positively influenced in the neonatal intensive care unit.

INTRAVENOUS INFILTRATION

References

- American Nurses Association. (2013). Nursing Sensitive Indicators. Retrieved from http://www.nursingworld.org/MainMenuCategories/ThePracticeofProfessionalNursing/PatientSafetyQuality/Research-Measurement/The-National-Database/Nursing-Sensitive-Indicators_1
- Amjad, I., Murphy, T., Nylander-Housholder, L., Ranft, A. (2011). A New Approach to Management of Intravenous Infiltration in Pediatric Patients. *The Art and Science of Infusion Nursing*, 34(4), 242-249.
- Beaulieu, M.J. (2012). Hyaluronidase for Extravasation Management. *Neonatal Network*, 31(6), 413-418.
- Doellman, D., Hadaway, L., Bowe-Geddes, L.A., Franklin, M., LeDonne, J., Papke-O'Donnell, L., Pettit, J., Schulmeister, L., Stranz, M. (2009). Infiltration and Extravasation. *The Art and Science of Infusion Nursing*, 32(4), 203-211.
- Kolcaba, K. & DiMarco, M. (2005). Comfort Theory and Its Application to Pediatric Nursing. *Pediatric Nursing*, 31(3), 187-194.
- Montgomery, L.A., Hanrahan, K., Kottman, K., Otoo, A., Barrett, T., & Hermiston, B. (1999). Guideline for IV infiltrations in pediatric patients. *Pediatric Nursing*, 25, 167-169, 173-180.
- Peterson, S.J., Bredow, T.S. (2013). Middle Range Theories: Application to Nursing Research. Philadelphia; Lippincott Williams & Wilkins.
- Pop, R.S. (2012). A Pediatric Peripheral Intravenous Infiltration Assessment Tool. *The Art and Science of Infusion Nursing*, 35(4), 243-248.
- Remasetu, J. (2003). Management of extravasation injuries. *Atlas of Procedures in Neonatology*. Philadelphia: Lippincott Williams & Wilkins.

INTRAVENOUS INFILTRATION

Sawatzky-Dickson, D., Bodnaryk, K. (2006). Neonatal Intravenous Extravasation Injuries:

Evaluation of a Wound Care Protocol. *Neonatal Network*, 25(1), 11-19.

Thigpen, J.L. (2007). Peripheral Intravenous Extravasation: Nursing Procedure for Initial

Treatment. *Neonatal Network*, 26(6)379-384.

Tofani, B.F., Rineair, S.A., Gosdin, C.H., Pilcher, P.M., McGee, S., Varadarajan, K.R,

Schoettker, P.J. (2012). Quality Improvement Project to Reduce Infiltration and

Extravasation Events in a Pediatric Hospital. *Journal of Pediatric Nursing*, 27, 682-689.

Treadwell, T. (2012). The Management of Intravenous Infiltration Injuries in Infants and

Children. *Ostomy Wound Management*, 58(7), 40-44.

Wilkins, C.E., Emmerson, A.J.B. (2004). Extravasation injuries on regional neonatal units.

Archives of Disease in Childhood Fetal and Neonatal Edition, 89, F274-F2754.

INTRAVENOUS INFILTRATION

Appendix A

Neonatal Intravenous Infiltration Pathway

1. Stop administration of IV fluids immediately.
2. Disconnect the IV tubing from the hub.
3. Gently attempt aspiration of the residual drug from the IV catheter.
4. Elevate the site if located in an extremity.
5. Notify the medical team.

Pathway adapted from Doellman et al. (2009).

Document infiltration score according to the following scale:

Thigpen Grading Scale of Intravenous Infiltrations
Stage: Observation
Stage 1: Pain at site, crying when intravenous cannula flushed, difficulty with cannula flushes, no redness or swelling
Stage 2: Pain at site, redness and slight swelling at site, brisk capillary refill
Stage 3: Pain at site, moderate swelling, blanching of area, skin cool to touch, brisk capillary refill below the site.
Stage 4: Pain, severe swelling around site, blanching of area, skin cool to touch, area of skin necrosis or blistering, prolonged capillary refill time (>4 seconds), decreased or absent pulses

INTRAVENOUS INFILTRATION

Appendix B

Policy and Procedure

Section: Clinical Protocol

Subject: Treatment of Extravasation in Neonates

Date Effective:

Purpose:

To provide a process for the immediate treatment of emergent situations where patients are experiencing extravasation of an intravenous medication/solution.

Definition:

Extravasation is the unplanned administration of an intravenous medication/solution into surrounding tissue usually as a result of catheter dislodgement.

Rationale:

Extravasation of many intravenous medications/solutions can result in significant patient morbidity. Appropriate and timely treatment measures have been shown to mitigate the sequelae associated with extravasation.

Policy:

1. Extravasation of an intravenous medication/solution can be an emergent clinical situation. Upon recognition of an emergent extravasation situation, as defined above, the nurse may immediately implement the appropriate protocol for treatment. Treatment will not be delayed to obtain physician's order.
2. Concurrently the medical team will be notified of the emergent situation.

General Information:

1. Signs and symptoms of extravasation can include swelling (most common), discomfort, pain at the site, leaking around the catheter, coolness of skin, induration, or blistering.

Procedure:

1. Perform the 5 steps of the neonatal intravenous infiltration pathway:
 - a. When extravasation is suspected, immediately stop the infusing intravenous medication/solution.

INTRAVENOUS INFILTRATION

- b. Disconnect the IV tubing from the hub.
 - c. Gently attempt aspiration of the residual drug from the IV catheter.
 - d. Elevate the site if located in an extremity.
 - e. Notify the medical team.
2. Assess the surrounding tissue and the IV site for:
- a. pain at the site
 - b. crying when cannula flushed
 - c. difficulty with cannula flush
 - d. redness
 - e. swelling
 - f. capillary refill
 - g. blanching
 - h. skin temperature
 - i. any necrosis or blistering
 - j. pulses
3. Administer antidote if ordered by the medical team.
4. Remove IV catheter and apply a dry, sterile dressing.

Documentation:

1. Once the patient is stabilized and the medical team has been notified, document in the patient's medical record:
 - a. Date/time of extravasation
 - b. The patient's presenting condition:
 - i. Experience during the extravasation
 - ii. IV catheter type
 - iii. insertion site location/appearance

INTRAVENOUS INFILTRATION

- iv. drug/solution being administered during extravasation
 - c. Treatment provided.
 - d. Medical team notification and orders received following notification.
 - e. Antidote administered, if indicated/ordered.
 - i. drug administered/dose
 - ii. technique utilized
 - iii. outcome/patient tolerance
2. Document infiltration grade into intravenous access flowsheet.
 3. Complete incident report.