Learning From Others:

A Case Report From the Anesthesia Incident Reporting System

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Review of unusual patient care experiences is a cornerstone of medical education. Each month, the AQI-AIRS Steering Committee abstracts a patient history submitted to the Anesthesia Incident Reporting System (AIRS) and authors a discussion of the safety and human factors challenges involved. Real-life case histories often include multiple clinical decisions, only some of which can be discussed in the space available. Absence of commentary should not be construed as agreement with the clinical decisions described. Feedback regarding this article can be sent by email to **airs@asahq.org**. Report incidents or download the AIRS mobile app at **www.aqiairs.org**.

2020:3: To Wrap or Not to Wrap? Protecting Pediatric Patients from I.V.s While Protecting I.V.s from Pediatric Patients

Case #1: *A 4-month-old female with a history of failure to thrive due to poor feeding and severe gastroesophageal reflux presented for laparoscopic Nissen fundoplication. A mask induction was performed and a 22-gauge saphenous I.V. catheter was placed in the right foot. The catheter was taped onto the skin with Tegaderm and reinforced with tape. The surgery lasted four hours and was uneventful. At the end of the surgery, the I.V. site was checked and wrapped in soft Kling dressing by the O.R. nurse to prevent I.V. dislodgement or removal by the patient. Throughout the patient's hospitalization, there was nursing documentation that the I.V. site was checked every two hours for signs of infiltration. The patient's mother reported that the infant appeared to be bothered by the I.V. and pulled on the I.V. from time to time. On postoperative day four, the day of discharge, the I.V. was removed prior to discharge. A stage 3 pressure ulcer was noted in the skin underneath the region of the I.V. catheter hub (Figure 1).*

Case #2: *A 3-month-old male with congenital cystic adenomatoid malformation presented for thoracotomy for resection of pulmonary lesion. A 22-gauge saphenous I.V. catheter was placed in the left foot after induction of anesthesia. The catheter was secured in the same fashion as above. The surgery lasted five hours and was uneventful. The I.V. was wrapped in soft Kling dressing at the end of the surgery. Throughout the patient's hospitalization, there was nursing documentation that the I.V. site was checked every two hours for signs of infiltration. The I.V. was removed on postoperative day three, and a stage 2 pressure ulcer was noted underneath the region of the I.V. catheter hub.*

Case #3: *A 6-month-old male with a moderate-sized atrial septal defect presents for sternotomy and repair of defect. A 20-gauge saphenous I.V. catheter was placed in the left foot and was secured in standard fashion. The surgery, including cardiopulmonary bypass, lasted five hours and was uneventful. At the end of the surgery, the I.V. catheter was wrapped in Coban dressing by the O.R. nurse. On postoperative day one, the I.V. was checked by the inpatient nurse and noted to have caused a stage 1 pressure ulcer underneath the I.V. hub and tubing.*

All three cases above were reported from the same institution within a three-month time period. All three patients were infants younger than 6 months of age with I.V.s placed in the saphenous vein intraoperatively and wrapping of the I.V. postoperatively to avoid dislodgment. An I.V. safety initiative was started at this institution to address these issues.

Figure 1. Case 1: Stage 3 pressure ulcer with full-thickness tissue loss and exposure of subcutaneous fat due to I.V. hub, adapter and tubing pressure proximal to the insertion site at the left saphenous vein of a 4-month-old child.

Discussion

Peripheral I.V. catheters are widely used in both the ambulatory and hospital settings for short-term delivery of intravascular fluids and medications. They are among the most frequent invasive procedures performed in hospitals. I.V. therapy can be associated with many forms of injury. A prospective observational study suggested that the incidence of I.V. injury was at least 52.3 percent, with nonmechanical injuries more common than mechanical injuries.[1] The most frequent nonmechanical injuries were phlebitis (20.1 percent), hematoma (17.7 percent) and fluid/blood leakage (13.1 percent). The most common mechanical injury was obstruction/occlusion (12.4 percent). Other mechanical I.V. injuries include dislodgment, forgotten tourniquet and pressure ulcer formation.[1]

I.V. injuries can lead to substantial patient discomfort, increased costs and additional morbidity. An analysis of 6,894 claims in the ASA Closed Claims Database from 1997-2000 found that 1.8 percent of claims were related to complications of peripheral I.V. injuries.[2] I.V. injuries are more common in children due to their more sensitive and friable tissue as well as less overall tissue mass compared to adults. Case studies have shown that several factors are important in the potential development of an intravenous infusion injury in a pediatric patient.[3,4] First, the younger the patient, the more likely the injury is to occur. Injuries that result in tissue necrosis seem to be more prevalent in neonates and younger infants.[5,6] This is likely due to their immature skin, fragile veins, lack of subcutaneous tissue, limited ability to report pain, likelihood of needing longer periods of intravenous treatment, limited number of venous access sites, the small bore of catheters and the small drug volume.[6] Second, smaller catheter sizes used in pediatrics are associated with a greater chance of extravasation of fluid and medications. Third, according to several case studies, children and neonates, especially those with darker skin, are more likely to suffer from I.V. injuries due to difficulty in visualizing veins during insertion in this population.[3,5,6]

I.V. use in children is different than in adults in several ways. First, insertion sites are very different in the pediatric population. The most common insertion sites in adults include hand, forearm and antecubital fossa, while the most common insertion sites in children include the saphenous vein just anterior to the medial malleolus, superficial veins of the feet and hands as well as veins in the wrists.[7] This is due to the proportionally much smaller hand and forearm veins hidden under proportionally thicker amounts of fatty tissue in young children. Second, since it is difficult to palpate veins in neonates and infants, I.V. attempts can often be blind. Third, in younger infants and neonates, I.V. access is not only difficult to obtain initially but also difficult to maintain after it is placed. This patient population may not yet be able to understand and follow instructions, and their tendency to pull on attached wiring and tubing leads to dislodgement. There is also an element of fear of visualization of the I.V. in pediatric patients.

In the current reported cases, all three I.V. pressure injuries occurred at the saphenous site. There is less subcutaneous tissue above the bony prominence of the medial malleolus in this area, which begs the question of whether the location of the I.V. site contributed to the risk of pressure ulcer. The caliber and predictable course of the saphenous vein make it the most frequent to be blindly cannulated in a neonate or an infant,[8,9] especially when fluid therapy and volume resuscitation are anticipated. All three cases were relatively extensive operations in infants, requiring larger-bore I.V. access. It may not be feasible to cannulate a different vein intraoperatively. We suggest that neonatal and infant I.V.s inserted into the saphenous site should have extra padding underneath the hub of the I.V. prior to applying the Tegaderm so that the hub does not make direct contact against the skin. In some cases, a T-piece adapter can be used to connect the hub of the I.V. catheter to the infusion tubing to minimize the profile of the I.V. apparatus against the skin, and the potential for pressure on the skin (Figure 2).

Figure 2. Padding under the I.V. hub and use of a T-piece adaptor can minimize the profile of the I.V. tubing and pressure on the skin underneath against the bony prominence of the medial malleolus.

There are also several means to prevent premature I.V. removal. These include the use of extra tape and bandage reinforcement, use of a dressing to securely wrap and hide the I.V. and wrapping of padded hard boards around joints to prevent bending of joints. In two of the three cases, the I.V.s were wrapped securely with soft Kling dressing, and in the third case with elastic Coban dressing. This was needed due to the young age of the children, high risk of I.V. removal and importance of maintaining I.V. access for several days postoperatively. However, tight wrapping around the I.V. hub and tubing, against the vulnerable saphenous site, may increase the risk of pressure ulcer formation. We suggest

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avoidance of tightly wrapped I.V. catheters and of elastic dressings in the neonatal and infant population to help minimize formation of I.V. pressure ulcers.

Finally, since pediatric I.V.s can be difficult to obtain and there are limited available sites for cannulation, pediatric I.V.s are often kept for longer durations than adult I.V.s.[8] Because pediatric I.V.s are at higher risk of infiltration due to smaller bore catheters and more sensitive tissue, there is a standardized approach in many institutions to monitor for signs of I.V. injuries. In fact, for the current cases of I.V. injury, all three patients had documentation of hourly I.V. checks with no signs of infiltration and phlebitis, as well as an I.V. dressing that is clean, dry and intact. Hourly I.V. checks typically involve visually inspecting the catheter tip insertion site at the skin and palpating for swelling and may not involve unwrapping the entire I.V. tubing and looking at the skin near and under the hub of the I.V. Hourly unwrapping and rewrapping of an I.V. on an infant may overburden the daily workflow of nurses. We suggested at least once daily complete unwrapping of the I.V. to inspect the entire apparatus.

A summary of our suggestions to prevent I.V.-induced pressure ulcer formation are shown in Figure 3. Each member of the patient care team, including the anesthesiologist, surgeon and nurses in the O.R., post-anesthesia care unit and inpatient unit, has a role in preventing I.V. injures. By striving to prevent these common injuries, we can improve the safety of our patients.

Figure 3: Suggestions for I.V. Placement in Pediatric Patients

1	Insert I.V. in location of choice. The saphenous location is acceptable if needed for intraoperative fluid therapy
2	Consider using T-piece as adaptor between I.V. catheter hub and infusion tubing to reduce profile of apparatus pressed against the skin
3	Pad soft gauze underneath the hub of the I.V. catheter and T-piece
4	Check the skin around and underneath the I.V. hub and tubing at the end of the operation
5	Use of soft Kling dressing to loosely wrap and hide I.V. and tubing. Avoid elastic dressings
6	Consider rewrapping the I.V. once child fully emerges from anesthesia
7	Unwrap the I.V. completely every 24 hours to check the skin around and under the I.V. hub and tubing

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