Survivability of Existing Peripheral Intravenous Access Following Blood Sampling in a Pediatric Population

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A B S T R A C T

Purpose: Although pediatric patients report venipuncture as their most feared experience during hospitalization, blood sampling from peripheral intravenous accesses (PIVs) is not standard of care. Blood sampling from PIVs has long been considered by healthcare personnel to harm the access. In an effort to minimize painful procedures, pediatric nursing staff conducted a prospective, observational study to determine if blood sampling using existing PIVs resulted in the loss of the access. The ability to obtain the sample from the PIV was measured along with patient and PIV characteristics.

Design and Methods: Specimen collection using 100 existing PIVs was attempted on pediatric inpatients. Each PIV was observed for functionality, infiltration, occlusion, and dislodgement following collection and again in 4 h. Frequencies of PIV loss and successful blood sampling were calculated. Patient age, PIV gauge, access site, and PIV age were evaluated for associations with successful sampling using chi-square tests, Fisher’s exact tests, and logistic regression.

Results: PIV survivability was reported at 99%. The ability to obtain a complete specimen was reported at 76% and found to be significantly related to PIV age and site. Size of PIV and patient’s age were not significantly related to successful sampling.

Conclusions: Encouraging rates of PIV survivability and collectability suggest blood sampling from PIVs to be a valuable technique to minimize painful and distressful procedures.

Practice Implications: Nursing practice was changed in this pediatric department. Patients and families are saved the pain and distress of venipuncture. Nurses reported saving time and personal distress by avoiding the venipuncture procedure.

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Background

Child and Family Psychosocial Impacts

Five out of every one hundred American children are hospitalized for an illness, injury or disability every year (Center for Pediatric Traumatic Stress Resources, n.d., para. 1). For some of these children and their families, a stay in the hospital is a planned event. For many children, it is sudden and the result of a traumatic event. Whether planned or unplanned, a one-time experience or one in a series of encounters with the health care system, each hospitalization impacts the child and family in a profound way.

When children are hospitalized, they report pain, especially needle pain, as their most feared experience (Broome & Huth, 2003). According to Carlson, Broome, and Vessey (2000), venipuncture and peripheral intravenous access (PIV) insertion are two painful and distressful procedures often occurring in acute care. Kotzer, Coy, and LeClaire (1998) reported that pain is a very stressful experience, for both child and parent, even when caused by a therapeutic treatment. Prior to venipuncture and PIV insertion, the application of ‘numbing creams’ to the needle site is the standard of care in pediatric settings. Child Life Specialists provide distraction, a non-pharmacologic, cognitive intervention, which significantly decreases acute procedural pain. However; the success of this intervention is dependent upon the age and experience of the patient, and the availability of the Child Life Specialist (Karakaya & Gozen, 2016). Despite expert Child Life intervention and preparatory pharmacologic applications, toddlers, preadolescents, adolescents and their families experience anticipatory anxiety and distress, as well as physical and emotional pain during venipuncture (Carlson et al., 2000). Kennedy, Luhmann, and Zempsky (2008) also found that despite

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offering physical and emotional support by professionals specifically trained in distraction techniques, PIV insertion and venipuncture remain the most common sources of pain in hospitalized children.

Children with chronic illnesses experience an even greater number of painful and distressful procedures (Kazak et al., 2006). These frequent painful procedures challenge the child’s beliefs about the world as a safe place, and may result in lasting negative emotional and psychological responses. These responses are symptoms of pediatric medical traumatic stress, which is defined as “a set of psychological and physiological responses of children and their families to pain, injury, serious illness, medical procedures, and invasive or frightening treatment experiences” (National Child Traumatic Stress Network, n.d., para.1). Professionals knowledgeable about the prevention of these lasting maladaptive responses encourage health care personnel to pay attention to the impact of treatment-related events, and reduce anxiety and pain whenever possible.

Peripheral Intravenous (PIV) Sampling Practice

Most hospitalized children require a PIV as part of their therapeutic regimen. However, despite the presence of a functioning PIV, blood sampling from the existing PIV is not the standard of care in pediatric departments (Berger-Achituv, Budde-Schwartzman, Ellis, Shenkman, & Erez, 2010). According to Seemann and Reinhardt (2000), “the use of peripheral intravenous access or saline lock devices for blood collections is often not recognized or sanctioned by policy” (p. 290). Blood sampling from indwelling PIVs has long been considered by healthcare professionals knowledgeable about the prevention of these lasting negative emotional and psychological responses. These responses are symptoms of pediatric medical traumatic stress, which is defined as “a set of psychological and physiological responses of children and their families to pain, injury, serious illness, medical procedures, and invasive or frightening treatment experiences” (National Child Traumatic Stress Network, n.d., para.1). Professionals knowledgeable about the prevention of these lasting maladaptive responses encourage health care personnel to pay attention to the impact of treatment-related events, and reduce anxiety and pain whenever possible.

Reliability of the PIV Sample

The reliability of serum samples obtained by PIV is well documented in the medical and nursing literature (Alexander, 2011; Arrants et al., 1999; Berger-Achituv et al., 2010; Hambleton, Gomez, & Andreu, 2014). While the majority of sample reliability studies have been conducted on the adult population, Berger-Achituv et al., conducted a repeated measure clinical trial comparing specimens taken from both PIVs and venipuncture in samples of 40 children. Paired t-test revealed blood counts and serum chemistry interchangeable with significance set at p < 0.05. In similar comparisons, Seemann and Reinhardt (2000) reported no significant statistical differences between PIV and venipuncture samples in 17 comparison groups of adults when examining serum chemistry (p < 0.05). Comparison of glucose levels from both PIVs and venipuncture were found to be statistically different; however, the difference was not clinically significant, i.e., the raw differences did not result in different clinical treatments (Berger-Achituv et al., 2010).

In a study to determine the reliability of coagulation values obtained from PIVs, Arrants et al. (1999) compared samples of 11 adults requiring a series of diagnostic blood draws. Samples obtained via venipuncture and PIV were compared on three consecutive days. When prothrombin time (PT) and partial thromboplastin time (PTT) values were compared, analyses of variance revealed no evidence of reliable differences between the venipuncture and PIV specimens (p > 0.05). Zengin and Enc (2008) compared PIV and venipuncture samples concurrently for PT and activated partial thromboplastin time (APTT) values in a group of 120 adults. No clinically significant differences were observed in PT, and aPTT results (p > 0.05).

Lindley et al. (1994) examined pairs of samples from six Hemophilia A adults, under non-bleeding conditions, at eight intervals and found no statistically significant differences in PT, PTT and factor VII values (p > 0.05).

When comparing 259 pairs of venipuncture and PIV samples from adults in an emergency department, Hambleton et al. (2014) reported venous blood gases and pH as the only comparisons to exceed three SDs of the laboratories accepted error. These findings disqualify venous blood gases and pH as acceptable tests for PIV sampling.

Quebbeman, Busman, Hamid, Caballero, and Hoffman (1984) found that therapeutic medication samples, specifically anti-tumor medications, drawn from catheters which have been used for medication administration to show “seven to 80 times greater concentrations of the medication in the blood sample” (p. 712). Despite flushing of the catheter and the lack of a recent administration of the medication, high levels persisted. Quebbeman et al. (1984) concluded that the medication remained in the catheter, therefore yielding a falsely high result. Although the use of an existing catheter for blood sampling saves the patient the pain and distress of venipuncture, PIV blood sampling cannot be considered reliable to measure therapeutic medication levels.

False positive results are frequently associated with blood culture collection from central venous catheters (Halm, Hickson, Stein, Tanner, & VandeGraaf, 2011). Unless the source of infection is believed to be the catheter itself, venipuncture is recommended for blood culture sample collection (Alexander, 2011; Center for Disease Control and Prevention, 2017). While research supports similarities in venipuncture and PIV samples for many laboratory tests such as complete blood count, chemistry and coagulation studies, there is no support for extending the PIV sampling technique to the collection of venous blood gases, therapeutic medication levels, or blood cultures.

Compassionate Care and Patient Experience

The Inpatient Pediatric Department is increasingly aware of its patients’ well-being during hospital procedures, and works diligently to develop measures to increase their comfort. The importance of decreasing suffering and providing compassionate care is a priority in the provision of patient centered, safe, quality care (Dempsey, Wojciechowski, McConville, & Drain, 2014). In an attempt to minimize painful procedures, decrease anxiety and demonstrate compassion for their patients and families and in congruence with the Infusion Nursing Standards (Alexander, 2011), the department’s Unit Practice Council (UPC) implemented the PIV blood sampling technique in 2014. As part of this department’s ongoing evaluation of the patient experience, Press Ganey Associates routinely surveys patients following discharge. Specifically, the Press Ganey Performance Score: Concern for Comfort During Tests and Treatments (2014–2017) (Press Ganey Associates, Inc., 2014) was utilized to determine the impact of the implementation of the technique in the pediatric department. Survey scores were compared pre and post implementation. After the implementation of the PIV blood sampling technique in the pediatric department, a significant improvement in their Press Ganey Performance Score: Concern for Comfort During Tests and Treatments was observed. In the quarter prior to utilizing the PIV blood sampling technique, the third quarter of 2014, the performance score question by discharge date and percentile ranking, was in the 31st percentile. In the quarter following the implementation of the PIV blood sampling technique, the score reached the 95th percentile ranking and remains in the 90th percentile to the most current quarter, the third quarter of 2017 (See Fig. 1).

The blood sampling technique is the result of the nurses’ effort to avoid suffering and improve the patient experience. Concern and
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