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Randomized Prospective Clinical Trial Comparing Room Temperature and Warmed Intravenous Fluid Boluses on Pediatric Patients' Comfort

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A common complaint among pediatric patients receiving an intravenous (IV) fluid bolus is that their arm feels cold and uncomfortable. The purpose of this study is to test if administering warmed IV fluids, as compared to room temperature IV fluids, results in increased comfort among pediatric patients seeking care in an emergency department. A blinded randomized controlled trial was conducted and 126 pediatric patients were enrolled. Each patient's overall comfort, arm comfort, and arm temperature were measured prior to IV fluid administration, 15 minutes after the beginning of the infusion, and at the end of the 60-minute infusion. After the first 15 minutes of IV fluid administration, the patients who received warmed IV fluids reported higher comfort than the patients who received room temperature IV fluids, $t(118) = 2.04$, $p = 0.04$. Additionally, patients who received the room temperature IV fluids reported that their arms felt cooler than patients who received the warmed fluids, $t(118) = 3.25$, $p = 0.0015$. Warming IV fluids has the potential to improve the experience of IV bolus administration for pediatric patients.

COMFORT IS AN optimal outcome of care for patients and their families (Kolcaba & DiMarco, 2005). Pediatric nurses often face a challenge when promoting comfort among young patients who may not be able to distinguish between causes of discomfort. A common complaint among pediatric patients receiving an intravenous (IV) fluid bolus is that their arm feels cold and uncomfortable. Anecdotally, pediatric nurses report that patients frequently complain of discomfort during the first 5–10 minutes of their IV fluid bolus administration. One contributing factor to discomfort during the beginning of the infusion could be that the room temperature fluids feel cold relative to patients' body temperature. To examine whether this clinical suspicion is supported, literature was reviewed to evaluate whether administering warmed IV fluids would decrease discomfort among patients. Warming IV fluids before administration was found as an intervention studied in adult populations to decrease hypothermia and shivering. However, to date, no study has rigorously examined warmed IV fluid administration among pediatric patients or as an intervention to increase patient comfort during an IV fluid bolus. The present study

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seeks to address these gaps in the literature by studying the question: In pediatric patients receiving an IV bolus, does administering warmed IV fluids, as compared to room temperature IV fluids, affect patient comfort?

Several investigators have studied the effects of administering warmed IV fluids compared to room temperature IV fluids on a variety of patient outcomes. The majority of these studies focused on the administration of warmed IV fluids in the adult perioperative setting. Investigators have demonstrated that warmed IV fluids result in less need for intraoperative analgesia (Lista, Doherty, Backstein, & Ahmad, 2012), less occurrence of hypothermia (Smith et al., 1998), fewer patient complaints of feeling cold (Okeke, 2007; Woolnough, Allam, Hemingway, Cox, & Yentis, 2009), shorter time in the recovery room (Hasankhani, Mohammadi, Moazzami, Mokhtari, & Naghgizadh, 2007; Lista et al., 2012; Okeke, 2007) and less postoperative shivering (Hasankhani et al., 2007; Workhoven, 1986).

In addition to these studies that demonstrate positive patient outcomes in the perioperative setting, to date, two studies examined the effect of administration of warmed IV fluids on patient comfort (Cassidy, Adkins, Rayl, & Wipfler, 2001; Self et al., 2013). Cassidy et al. (2001) conducted a controlled, nonblinded, prospective study of 20 adult patients who received IV fluids in a pre-hospital EMS setting; however, only 10 of the 20 patients were able to complete the outcome tool. The investigators reported a trend in favor of increased comfort when warmed IV fluids were administered; however the sample size was too small to report generalizable findings, effect size was not published, and statistical significance was not tested. Self et al. (2013) performed a pilot double-blind crossover randomized study in which 27 adult subjects sequentially received room temperature IV fluids and warmed IV fluids and completed comfort visual analog scales. Warmed IV fluids were associated with a statistically significant decrease in discomfort (median ΔVAS: −0.7 cm; IQR: −4.5 cm to +0.4 cm) compared to those who received room temperature IV fluids (median ΔVAS: +1.2 cm; IQR: −0.1 cm to +3.6 cm), $p = 0.001$.

While there is preliminary evidence supporting warming IV fluids to improve patient comfort among a small sample of adult subjects, no study has rigorously examined the effect of administering warmed IV fluids compared to room temperature IV fluids on patients' comfort. In addition, no study has examined this intervention among pediatric patients. The current study seeks to address these gaps in the literature by addressing the effect of warmed IV fluids compared to room temperature IV fluids on patient comfort among a large sample of pediatric patients.

Methods

A prospective double-blinded randomized controlled study was conducted to examine the effect of administration of warmed IV fluids compared to administration of room temperature IV fluids on patient comfort during a 60-minute IV fluid bolus. The study took place in a 35-bed level I pediatric trauma center. On average, 181 patients are provided care in this setting each day with an average of 26 IV fluid boluses administered daily. Due to the large number of IV fluid boluses administered, the emergency department setting was an ideal location to assess an intervention aimed at improving pediatric patients' experience during IV fluid administration. Study approval was obtained from the hospital's institutional review board. All study staff were educated on the ethical treatment of human subjects through CITI training.

Sample

A convenience sample of patients, 6–21 years old, who presented to a pediatric emergency department for care and were receiving an IV fluid bolus of 20 mL/kg over 60 minutes was enrolled. Patients were excluded for complaints of burns, heat injuries, hyperthermia (temperature in triage >38 °C), hypothermia (temperature in triage <35.5 °C), or a mental status or cognitive disability that rendered them incapable of responding to the patient surveys. Patients were excluded if they received their IV fluid bolus through a central line or if they were non-English speaking. Based on physician and clinical nurse judgment, if a patient was unstable or needed fluid resuscitation immediately, they were not recruited for the study.

Variables and Measurement

The independent variable was whether the patient received warmed IV fluids or room temperature IV fluids. Patients were randomized using a computer-generated random number list. Only the patient's clinical nurse, who obtained the fluids and attached them to the patient's IV, was aware of which fluid the patient received. Study staff, patients, and their parents were blinded to which temperature of fluids the patient received.

The primary outcome variable was patient-reported arm comfort, which was measured at baseline, 15 minutes after the beginning of the IV fluid bolus, and at the end of the 60-minute IV fluid bolus. At each of these time points, patients were asked to rate the comfort of their arm using an investigator-developed visual analog scale (VAS) ranging from 0 (very bad) to 10 (very good). In addition to the primary outcome variable, various other outcome data were collected at baseline, 15 minutes after the beginning of the IV fluid bolus, and at the end of the 60-minute IV fluid bolus, including patient-reported overall comfort using the Comfort Daisies scale (Kolcaba & DiMarco, 2005) and patient-reported arm temperature using an investigator-developed VAS ranging from 0 (very cold) to 10 (very hot).

In addition to the patient-reported measures, at each of the three time points, parents answered one question about their child's overall comfort using an investigator-developed VAS ranging from 0 (very comfortable) to 10 (very uncomfortable).