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Warming Intravenous Fluids for Improved Patient Comfort in the Emergency Department: A Pilot Crossover Randomized Controlled Trial

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Introduction: The purpose of this study was to test if intravenous (IV) fluids warmed to body temperature are associated with greater patient comfort than room temperature IV fluids in adult emergency department (ED) patients.

Methods: This was a pilot double-blind, crossover, randomized controlled trial. Enrolled subjects sequentially received boluses of body temperature (36ºC) and room temperature (22 ºC) IV fluid, with the order of boluses randomized. Each subject's level of discomfort was assessed prior to and after each bolus, using a 10 cm visual analog scale (Discomfort VAS), with higher scores indicating greater discomfort. We calculated the change in Discomfort VAS score associated with body temperature IV fluid (ΔVASbody) and room temperature IV fluid (ΔVASroom) by subtracting the score reported before the bolus from the score reported after that bolus. We compared changes in Discomfort VAS score with body temperature and room temperature IV fluid using the Wilcoxon matched-pairs signed-rank test.

Results: Twenty-seven subjects were included. Treatment with body temperature IV fluid was associated with a significant decrease in discomfort (median ΔVASbody: -0.7 cm; interquartile range (IQR): -4.5 cm to +0.4 cm) compared to room temperature IV fluid (median ΔVASroom: +1.2 cm; interquartile range: -0.1 cm to + 3.6 cm) (P = 0.001).

Conclusion: In this small trial of adult ED patients, infusing IV fluids warmed to body temperature was associated with improved comfort compared to standard, room temperature IV fluids. [West J Emerg Med. 2013;14(5):542–546.]

INTRODUCTION

Nearly one-quarter of emergency department (ED) patients in the United States are treated with intravenous (IV) fluids. These fluids are typically stored at room temperature and infused into patients without prior warming. During infusion of room temperature IV fluids, some patients experience shivering, chills and discomfort. Small studies of patients undergoing surgery suggest that warming IV fluids to body temperature prior to infusion may reduce shivering and improve patient comfort in the perioperative period. However, the effect of warming IV fluids on patient comfort in the ED has not been evaluated. In this pilot study of adult ED patients, we compared the level of discomfort associated with infusion of IV fluids warmed to body temperature with those infused at room temperature.

METHODS

We conducted a double-blind, crossover, randomized controlled trial to test the impact of warming IV fluids to body...
ED, emergency department; IV, intravenous; mL, milliliter; VAS, visual analog scale.

**Figure 1.** Flow diagram of subject participation.
prior to and after each bolus, using a 10 cm visual analogue scale (Discomfort VAS), with 0 cm signifying no discomfort and 10 cm signifying the worst discomfort imaginable. The Discomfort VAS was modeled after the visual analog scale used for pain assessment.\(^8,9\) After finishing both boluses, subjects were also asked which treatment they preferred overall (bolus #1 or bolus #2).

**Statistical Analysis**

For each subject, we calculated the change in Discomfort VAS score associated with body temperature IV fluid \((\Delta VAS_{body})\) by subtracting the score reported before the body temperature bolus from the score reported after that bolus. Hence, a negative \(\Delta VAS_{body}\) indicated a decrease in discomfort associated with body temperature fluid treatment. Similarly, we calculated the change in Discomfort VAS score associated with the room temperature fluid \((\Delta VAS_{room})\) by subtracting the score reported before the room temperature bolus from the score reported after that bolus. The primary analysis involved comparing changes in Discomfort VAS associated with body temperature \((\Delta VAS_{body})\) and room temperature \((\Delta VAS_{room})\) fluid. We planned to perform this comparison with a paired t-test if the data were normally distributed or a Wilcoxon matched-pairs signed-rank test if the data were not normally distributed. We performed sample-size calculations using a paired t-test, type I error probability of 0.05, 80% power, and a standard deviation of 2 cm for the difference between \(\Delta VAS_{body}\) and \(\Delta VAS_{room}\). At least 21 subjects were needed to detect a 1.3 cm difference in \(\Delta VAS_{body}\) and \(\Delta VAS_{room}\). We based the goal of detectable difference of 1.3 cm on previous work showing that a 1.3 cm change on a visual analog scale for pain was clinically significant.\(^8,9\)

We also calculated the proportion of subjects who stated a preference for body temperature over room temperature IV fluids and used the one-sample z-test to compare this to the null (proportion of 0.5). We completed statistical analyses using Stata 11.1 (Stata Corp, College Station, Texas). Two-tailed \(P\)-values < 0.05 were considered statistically significant.

**RESULTS**

Thirty-one patients were approached for enrollment; 28 patients consented, and 27 completed the protocol (Figure 1). Distributions for \(\Delta VAS_{body}\) and \(\Delta VAS_{room}\) did not approximate normal distribution, and analyses were completed with nonparametric statistics. Treatment with body temperature IV fluid was associated with a significant decrease in discomfort (median \(\Delta VAS_{body}\): -0.7 cm; interquartile range (IQR): -4.5 cm to +0.4 cm) compared to room temperature IV fluid (median \(\Delta VAS_{room}\): +1.2 cm; IQR: -0.1 cm to +3.6 cm) \((P = 0.001)\) (Figure 2). After receiving both boluses, 20/27 (74%; 95% confidence interval: 57% to 91%) subjects reported a preference for body temperature over room temperature fluid \((P = 0.012)\).
DISCUSSION

This pilot study suggests that warming IV fluids to body temperature before infusion is associated with improved comfort for ED patients compared to room temperature fluids. IV fluid treatment is often initiated in the ED to increase intravascular volume in dehydrated patients. In addition to achieving physiologic endpoints, such as normalization of vital signs, an important secondary goal of IV fluid treatment is to improve patient comfort. As the practice of emergency medicine has evolved, the specialty has increasingly recognized the importance of patient-centered care and promoting patient satisfaction and comfort. When assessing the effectiveness of medical interventions, considering patient-centered outcomes in addition to physiologic endpoints is essential for meaningful evaluation. Warming IV fluids prior to infusion may be a simple technique to improve the effectiveness of a commonly used ED treatment from the patient perspective. Given the promising results of this study, future research is indicated to study warmed IV fluids in the ED.

The median change on the Discomfort VAS associated with body temperature fluid was -0.7 cm, compared to +1.2 cm for room temperature fluid; therefore, body temperature fluid was associated with a median change of 1.9 cm toward less discomfort compared to room temperature fluid. The Discomfort VAS was modeled after the pain visual analog scale, which has been well-validated and is commonly used in the ED. A change of 1.3 cm on the pain visual analog scale is considered clinically significant. Therefore, the magnitude of difference between VAS scores with body temperature and room temperature fluids suggests that the statistical difference we found in Discomfort VAS scores may correlate with an important clinical difference. Further suggesting the difference is clinically important is our finding that 74% of subjects reported an overall preference for body temperature fluids.

LIMITATIONS

Several limitations to our study should be highlighted. This was a small study conducted to help plan a larger trial by testing the methods of warming IV fluids and preliminarily evaluating the potential impact of warming fluids on patient comfort. While our results showed a statistically significant reduction in patient discomfort with warmed IV fluids, further research is needed evaluating larger samples sizes and other outcomes, including cost-effectiveness and ease of implementation. In this study, warmed IV fluids were administered to one patient at a time by a dedicated study nurse. Therefore, while we believe use of the device is simple and potentially feasible in the ED, we were unable to evaluate usability of the device by end-users in this study.

CONCLUSION

Warming IV fluids to body temperature prior to infusion was associated with improved comfort for adult ED patients compared to standard, room temperature IV fluids in this pilot study. Future research is warranted to further investigate the effect of warmed IV fluids on patient-centered outcomes and the feasibility of warming IV fluids in the ED setting.

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Conflicts of Interest: By the WestJEM article submission agreement, all authors are required to disclose all affiliations, funding sources and financial or management relationships that could be perceived as potential sources of bias. Safe & Warm, Inc. provided the warmers, but did not fund this research study.

REFERENCES