Rapid fluid administration with the LifeFlow™ device and push-pull syringe

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abstract

Rapid fluid administration is central to intraoperative and trauma resuscitation. While a range of new devices may optimize delivery times, their impact on provider is not well documented. Our study evaluated administration time and provider experience using two unique methods. Providers administered fluid through an intravenous catheter with both a LifeFlow® and a push-pull device. Ten paired trials were conducted for three catheter gauges. Paired t-tests compared the groups. Subjective physical demand, effort, pain, and fatigue were recorded for each device using 21-point visual analog scales and were compared using sign-rank tests. Administration time was significantly decreased with the LifeFlow® compared to the push-pull device with all catheter gauges. No subjective measurement improved between the two methods. Provider experience did not differ between the two devices.

background

Regardless of the clinical scenario, the rapid administration of fluid may be indicated to restore intravascular volume, augment cardiac output, and reverse shock. If not rapidly and effectively treated, progressive decompensation will occur, resulting in death. Early and aggressive fluid therapy has been shown to decrease morbidity and mortality. Resuscitation guidelines from various organizations recommend the rapid intravascular administration of isotonic crystalloid as a key component of the initial resuscitation process. Various techniques and devices have been recommended for the rapid administration of fluid. A commonly used technique in pediatric resuscitation scenarios is a simple syringe, stopcock, and tubing set-up known as the "push-pull method" whereby fluids are intermittently drawn into a syringe from the infusion bag and then manually administered to the patient by turning the stopcock. The LifeFlow® Rapid Infuser is a single-use, hand-operated device that is designed to allow a healthcare provider to quickly and efficiently deliver recommended fluid volumes. The device has a 10 mL syringe with graduated markings that are visible through the transparent canopy of the device (Figure). It automatically recoils and refills with fluid when the trigger is released.

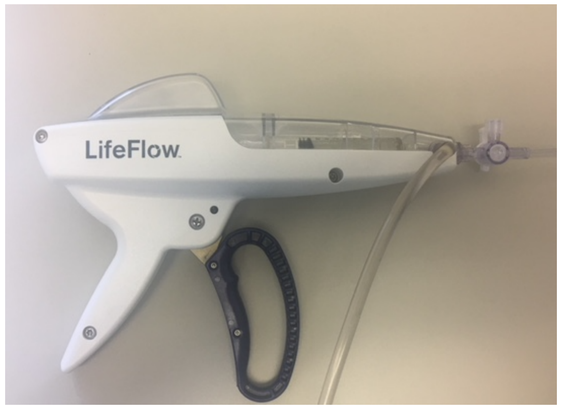
Our primary hypothesis was use of the LifeFlow® device would reduce the time needed to administer 500 mL of fluid, compared to the push-pull method. Our secondary aim was to determine whether use of the LifeFlow® device would reduce subjective effort or fatigue associated with rapid fluid administration.

methods

Thirty anesthesia providers emptied two 500 ml bags by push pull method and Life Flow device. Groups of 10 providers were recorded for three intravenous catheter sizes (18g, 20g, and 22g). Participants were timed and subsequently asked to rank their effort, physical demand, fatigue and pain using a 21 point visual analog scales where one is the lowest and 21 is the highest of each measure.

Fluid administration times were compared according to device type using paired t-tests and VAS responses were compared according to device type using non-parametric sign-rank tests. No adjustment for multiple comparisons was performed due to the exploratory nature of the study. Data analysis was completed in Stata/IC 14.2 (College Station, TX: StataCorp, LP), and two-tailed P<0.05 was considered statistically significant.

figure



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results

Catheter size and study outcome[a]	Push-pull system Mean (SD) or median (IQR)	LifeFlow® Mean (SD) or median (IQR)	P value
18 gauge			
Fluid administration time (min)[b]	3.8 (1.0)	2.5 (0.8)	<0.001
Physical demand[c]	10 (8, 12)	13 (10, 15)	0.048
Effort[c]	11 (8, 15)	15 (10, 18)	0.100
Fatigue[c]	8 (1, 10)	11 (5, 15)	0.035
Pain[c]	5 (1, 10)	9 (3, 17)	0.265
20 gauge			
Fluid administration time (min)[b]	3.8 (0.6)	2.8 (0.5)	<0.001
Physical demand[c]	14 (8, 18)	13 (12, 16)	0.798
Effort[c]	15 (7, 18)	14 (12, 17)	0.573
Fatigue[c]	6 (5, 14)	12 (8, 15)	0.082
Pain[c]	7 (5, 10)	8 (5, 15)	0.608
22 gauge			
Fluid administration time (min)[b]	5.3 (1.7)	3.3 (0.8)	<0.001
Physical demand[c]	12 (10, 17)	15 (15, 18)	0.006
Effort[c]	15 (8, 18)	16 (14, 18)	0.182
Fatigue[c]	9 (4, 12)	14 (5, 18)	0.081
Pain[c]	6 (4, 12)	11 (5, 12)	0.152

discussion

Limitations to our study include the use of an *in vitro* model. However, use of this model in a controlled setting allowed us to exclude the influence of other factors which impact fluid administration times. Despite the decreased administration time with the LifeFlow® device, we did not find subjective improvements in fatigue, physical demand, pain or fatigue when comparing the two devices. We postulate any improvement in these subjective parameters may be associated with increased administration time.

We found the LifeFlow® device allowed a significant reduction in fluid administration time when compared to a standard push-pull syringe system. It is a novel system that is easy to set-up and use which allows for the rapid administration of fluid. However, we did not note any improvement in subjective measures of fatigue and pain when using the device for rapid fluid administration. Whenever there is the rapid administration of fluid, there is also a concern regarding infiltration of administration sites with the extravasation of fluid. Ongoing observation of the administration site is needed to limit the potential morbidity related to such problems.