P49

MONITORING LOW-RATE INOTROPE DELIVERY INFUSION PRESSURES IN SYRINGE PUMPS USED IN PAEDIATRIC INTENSIVE CARE

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Background/Context

There are recognised clinical risks associated with delivery of potent drugs at very low infusion rates [1], for example inotrope infusion in the Paediatric Intensive Care Unit (PICU). Syringe based infusion pumps are, almost exclusively, the method of choice for delivery of inotropes to sick infants in the paediatric intensive care setting.

Problem

Variability in inotrope infusion rates, at the quite potent dilutions used, can have rapid and significant physiological effects, such as hypo- and hyper- tension, and interrelated heart rate and other vital sign variability [2]. Previously, our laboratory bench experiments have shown an error rate in the delivery of solutions of +30/-20% when infusion rate is set at 0.5 ml/h over 5 minute observation windows. Whereas, an increased rate of 1.0 ml/h resulted in an error rate of +5/-10%.

Strategy for change

By halving the potency of inotrope infusion concentrations it would allow clinicians to double the infusion rate when delivering the drug. This change has been implemented at the Newcastle Hospitals PICU; for example, the concentrations of adrenaline and noradrenaline have been reduced from 1.0 mg/50 mls to 0.5 mg/50 mls for < 5 kg patients.

By increasing infusion rate we may not only be able to reduce occlusion detection times and decrease the effects of start-up trend errors, lessening the effects of over- and under-delivery, but also, potentially reduce the number of occlusions that occur.

Measure of improvement

We have collected anecdotal evidence from our PICU nurses since this change was implemented which suggests that patients appear to be more stable, and that fewer occlusion alarms have occurred. Additionally, early clinical feasibility work also supports these findings. We have built a data logging device that can record data in real-time from these infusion pumps. This has been done, for the first time, in a clinical setting, allowing a more detailed analysis of their performance when running at very low infusion rates. This review found that 0 occlusion alarms occurred in over 275 hours of adrenaline infusions.

Lessons learnt

Early indications from clinical data support our previous bench work. Additionally, the development and first clinical use of our logging device gives us confidence that we have an attainable method to quantitatively collect novel clinical data, i.e. line pressure and infusion rates, from infusion pumps that will aid in future research.

Message for others

We advise clinical centres that deliver inotrope infusions to review their practice and consider whether reducing solution concentrations, increasing infusion rates, may be beneficial. More work is needed to assess the clinical significance of this change to practice, i.e. by collecting adjacent physiological data; moreover, this work should also aim to find an optimal balance between volume delivered and infusion rate.

References:

1. Baeckert M, Batliner M, Grass B, Buehler PK, Daners MS, Meboldt M, Weiss M. Performance of modern syringe infusion pump assemblies at low infusion rates in the perioperative setting. British Journal of Anaesthesia. 2020 Feb 1;124(2):173-82.

2. Patwardhan K. Inotropes in term neonates. Infant. 2009;5(1):12.