

Innovating Applications with Trans-Thoracic Echocardiography in Goal Directed Fluid and Hemodynamic Therapy in Children

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Abstract

Background: Recent trial protocols with trans-thoracic echocardiography have been elaborated in children to guide fluid and hemodynamic therapy. This Editorial describes the development and perspectives of these trials.

Objectives: Objectives of this Editorial is to update the latest development of new trials with trans-thoracic echocardiography for goal directed fluid and hemodynamic therapy in children.

Methods: Mini-review and summary of the studies in development.

Results and Conclusion: These trials will enlight and clarify the impact of goal directed fluid and hemodynamic therapy with echocardiographic indices on postoperative outcome in the pediatric surgical population.

Keywords: *Trans-thoracic Echocardiography; Pediatric Surgery; Pediatric Anesthesia and Critical Care; Postoperative Outcome*

Study protocols have been elaborated and conceptualized where trans-thoracic echocardiography has been integrated in goal directed fluid and hemodynamic therapy (GDFHT) to guide fluid administration and vasopressor inotropic therapy in pediatric surgical settings. The aim of these protocols is to improve postoperative outcome in children. It has been evidenced earlier that postoperative adverse outcome is multifactorial in children [1]. One of these multiple factors is the general state of the patient, namely the ASA status (American Society of Anesthesiologists status) which grades the patient's general healthy condition and scores from I to V with increasing severity state. The higher the ASA status the higher risk the patient presents to have adverse postoperative outcome. The interest of implementing GDFHT in these patients appears intuitively evident as it has been demonstrated in adults [2]. In children, evidence concerning this issue is not that intuitive. Thus, these protocols where echocardiographic hemodynamic parameters will help to guide fluid therapy and hemodynamics could be a solution to improve postoperative outcome in high risk patients. Which hemodynamic echocardiographic parameters should be used? In children an indice like aortic peak velocity variation (ΔV_{peak}) has been validated for fluid responsiveness in pediatric surgical patients under anesthesia and mechanical ventilation [3-6]. To assess the effectiveness of fluid therapy one has to have

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a reproducible parameter. Cardiac output (CO) is an indice which is important to monitor. The ideal monitor for CO should be one that is non-invasive and easily reproducible. CO can be assessed with trans thoracic echocardiography by measuring aortic velocity time integral (VTI) in the apical five chamber view [7]. Cardiac output can be calculated with the following formula: $CO = SV \times HR = VTI \times D^2 \times \pi / 4 \times HR$ [5,7], where SV is stroke volume, HR heart rate, D the diameter of the aortic annulus (assessed in the parasternal longitudinal view).

In children to assess CO, it is recommended to use distance minute (DM) instead of VTI because CO is heart rate dependent [8]. DM is calculated as follows $VTI \times HR$. DM Percentile values for age have been established [8].

As precised here above, 6 studies have been conceptualized where trans-thoracic echocardiographic parameters will be integrated in GDFHT protocols with the objective to clarify the impact of these parameters on postoperative outcome in terms of morbidity, length of stay in the intensive care unit (LOSICU), length of mechanical ventilation (LMV), length of hospital stay (LOS), fluid therapy and vasopressor-inotropic therapy [9-14]. Since not all parameters have been validated in children, these protocols will also determine indices which are predictive of adverse postoperative outcome [9-11]. Once these are clarified they will be integrated in randomized controlled trials (RCT) where GDFHT protocols with trans-thoracic echocardiography will be compared to standard care [12-14].

All these trials are part of the Thesis entitled "Do goal directed therapies improve postoperative outcome in children? (Perioperative Goal Directed Fluid and Hemodynamic Therapy; Transfusion goal directed therapy using viscoelastic methods and enhanced recovery after surgery and Postoperative outcome)" [15-18]. This Thesis is registered at <http://www.theses.fr/s232762>.

Conclusion

Six trials are in development: Three are observational non interventional pilot studies [9-11] which will determine trans thoracic echocardiographic hemodynamic parameters predictive of adverse postoperative outcome in children; three others are RCT [12-14] where these validated echocardiographic parameters will be integrated in GDFHT protocols which will be compared to standard care. These goal directed fluid and hemodynamic therapy RCT will determine the impact of trans thoracic echocardiography on postoperative outcome in pediatric surgical patients.

Conflict of Interest

The author declared no conflict of interest.

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