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Journal club critique

Protocolized resuscitation with esophageal Doppler monitoring may improve outcome in post-cardiac surgery patients

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Expanded Abstract

Citation

McKendry M, McGloin H, Saberi D, Caudwell L, Brady AR, Singer M: Randomised controlled trial assessing the impact of a nurse delivered, flow monitored protocol for optimisation of circulatory status after cardiac surgery. BMJ 2004, 329:258-261 [1].

Hypothesis

Four hours of nurse-led, flow-monitored protocolized resuscitation reduces complications and shortens stay in intensive care and hospital for post-operative cardiac surgery subjects compared to usual care.

Methods

Design: Randomized controlled trial.

Setting: Intensive care unit and cardiothoracic unit of a university teaching hospital between April 2000 and January 2003.

Subjects: 174 adults who had cardiac surgery with cardiopulmonary bypass. Subjects undergoing off-pump surgery, aged <18 years, or with relative contraindications to the use of the esophageal Doppler probe, such as esophageal disease, were excluded. Subjects were also excluded postoperatively if on admission to intensive care there was excessive bleeding, unstable arrhythmias, a need for intra-aortic balloon counterpulsation, or inotrope requirements $\geq$10 μg/kg/min of dopamine or dobutamine or $\geq$0.16 μg/kg/min of epinephrine or norepinephrine.

Intervention: Subjects were allocated to conventional hemodynamic management (control group) or to an algorithm guided by esophageal Doppler flowmetry (protocol group). An esophageal Doppler probe was inserted within 10 minutes of arrival in the intensive care unit in both groups. In the protocol group, the bedside nurse followed an algorithm that instructed repeated 200 ml colloid boluses until the stroke volume index no longer increased by >10% and was $\geq$35 ml/m^2. Thereafter, the algorithm provided additional instructions for vasoactive agents based on blood pressure and stroke volume index (refer to figure 1 in original article). The algorithm was run until 4 hours post-probe insertion or until extubation if <4h. In the control group, probe readings were obtained by a study nurse on insertion and at four hours or at extubation if <4h, but the clinical team was blinded to these readings. The control group received standard postoperative care, using markers of tissue perfusion such as urine output and arterial base deficit, and monitoring cardiac output if clinically indicated.

Outcomes: The primary outcomes were length of stay in intensive care and hospital. The secondary outcome was postoperative complications.

Results

There were 89 subjects in the protocol group and 85 in the control group with both groups well matched for age, sex, weight, Parsonnet cardiac risk score, APACHE II score, and type of surgery. After four hours, protocol subjects had received a greater volume of colloid (1667 ml vs. 1042 ml, P<0.001) than control subjects, but the volume of crystalloids did not differ (353 ml vs. 328 ml, P=0.09). Protocol subjects saw greater increases in stroke volume and cardiac output, but no difference in base excess. Median duration of hospital stay was significantly lower in the protocol group than the control group (7 days vs. 9 days, P=0.02), though ICU length of stay did not differ. There was a trend toward fewer postoperative complications in the protocol group (19.1% vs. 30.6%, P=0.08).

Conclusion

A nurse-delivered protocol to optimize circulatory status in the early postoperative period after cardiac surgery may significantly shorten hospital stay.

Commentary

Use of esophageal Doppler monitoring (EDM) during surgery has previously been shown to be associated with improved end-organ perfusion and/or reduced length of stay [2-5]. The current study by McKendry and colleagues differs in that none of the previous studies were performed in an ICU setting using a nurse-delivered protocol.

This study was a well-designed randomized controlled trial. The two groups were similar at baseline, suggesting randomization was successful, and the results seem to argue strongly in favor of the protocolized arm. The intervention is attractive for a number of reasons. First, in comparison to reliance on clinical markers alone, EDM offers an assessment of central hemodynamics. Second, compared to the traditional measure of central hemodynamics, the pulmonary artery catheter, EDM is less invasive, it provides continuous 'beat-to-beat' cardiac output monitoring, and it measures flow rather than pressure, which is probably a better indicator of tissue perfusion [6,7]. Third, the intervention is not just EDM. Rather, it is a protocol relying on information obtained from EDM. Although earlier studies of EDM have suggested benefit, it was not possible to delineate from these studies how the EDM should be used, and it is therefore unclear how others should apply EDM. The combined protocol plus EDM in the current study is more easily packaged for export to other users and settings. Use of EDM by nurses could reduce costs by minimizing the amount of physician oversight required.

There are, however, some limitations to this study. First, the study was a single-center trial performed in a major university hospital where physician and nursing staff were familiar with the technique and likely enthusiastic about its use. The benefits may be less apparent when applied across a wider cross-section of hospitals by clinicians less familiar with either the protocol or EDM. Second, it is not clear if the benefits were due to EDM or the act of protocolizing resuscitation. It could be that using a protocolized resuscitation algorithm with other monitoring techniques (perhaps even clinical examination) could yield similar benefits. Third, the standard care provided in the control arm is difficult to quantify. Care might have been less intense with respect to routine care than in other institutions. Alternatively, there could be contamination bias between arms, resulting in more aggressive monitoring and intervention in the control arm, and an underestimation of treatment effect. All these limitations can be addressed in a larger multicenter evaluation. In this respect, this study could be considered analogous to a very promising phase II study of a potential new drug, meriting a subsequent phase III follow-up study.

Finally, it remains tantalizing to speculate on why this approach improved outcome. Although it seems intuitive that aggressive monitoring and resuscitation in situations of occult shock and hypoperfusion should be beneficial, studies have yielded inconsistent results. It would be interesting to know in what ways the intervention arm in this study affected the pathophysiology of shock and hypoperfusion. For example, was there less ischemia, oxidative stress, inflammation, or activation of coagulation and thrombosis pathways? Ultimately, it seems we still need to understand how our therapies manipulate the basic pathways implicated in critical illness in the clinical setting if we are to develop optimal titrated care.

Recommendation

Until more information is available, we cannot recommend widespread adoption of EDM outside the clinical research arena. Nevertheless, the results strongly merit the conduct of a confirmatory trial, along with evaluation of the impact of this intervention on other endpoints. Furthermore, protocolized resuscitation with EDM may have benefits in other conditions where there is significant risk of under-resuscitation, such as other postoperative groups and subjects with sepsis, burns, or trauma.

Competing interests

The authors declare that they have no competing interests.

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