Pre-dicting post-ligation syndrome

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Transthoracic echocardiogram showing a large patent ductus arteriosus with left-to-right shunting.

Central Message

Do novel preoperative echocardiographic indices help identify hemodynamic instability after ligation of a patent ductus arteriosus?

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Management of a patent ductus arteriosus (PDA; [Figure 1](#)) in the preterm infant has become increasingly controversial during the last decade, largely due to the lack of randomized trials prospectively evaluating various treatment options. The growing uncertainty regarding the beneficial effects of medical treatment and percutaneous or surgical closure of PDA, combined with the potential side effects, has resulted in the adaptation of a more selective approach by most neonatologists.¹ There is an urgent need to identify patients with hemodynamically significant PDA who are most likely to benefit from PDA closure that can be accomplished with a favorable morbidity profile.

About 10% to 45% of preterm infants undergoing surgical ligation of the PDA have postligation hemodynamic instability, which could potentially affect the long-term outcome of this vulnerable population. The mechanisms of postligation hemodynamic instability are complex and likely involve both myocardial dysfunction and vascular tone dysregulation.²⁻⁴ Information on preoperative factors that can predict postligation cardiovascular compromise, however, is scarce. In this issue of the *Journal*, Gray and colleagues⁵ used novel echocardiographic indices obtained before PDA ligation to predict which preterm infants would have postligation syndrome, as defined by a vasoactive inotropic score (VIS) of at least 20. They used left ventricular end-systolic elastance (E_{es}) and arterial elastance (E_a) as measures of cardiac contractility and afterload. Although E_{es} and E_a were not different between patients with VIS less than 20 and 20 or greater, in multiple regression analyses higher E_{es} and lower E_a were associated with VIS of 20 or greater. Gray and colleagues⁵ speculate that higher contractility in the setting of lower afterload represents inappropriate ventriculoarterial coupling that does not respond favorably to acute changes in loading conditions such as those imposed by surgical duct ligation. They further suggest that by using a cutoff of E_a/E_{es} greater than 0.78, one can safely identify patients at low risk for cardiovascular compromise after duct ligation. It is interesting that in their

analysis, E_a/E_{es} (calculated as end-systolic volume/stroke volume) was a better predictor of postligation syndrome, whereas the mathematically closely related ejection fraction (stroke volume/end-diastolic volume), which is easily measured and better understood, was not.

The search for noninvasive preoperative predictors of postligation syndrome is a valid exercise. Although the study by Gray and colleagues⁵ makes inroads by using these novel echocardiographic measures, it is premature to conclude that these data would change practice and drive the decision regarding which patients should undergo surgical PDA ligation. The echocardiographic data were obtained as long as 2 weeks before ligation and used single-beat estimations and single-time point noninvasive systolic blood pressure measurements without attention to concomitant inotropic support. The use of a VIS cutoff of 20, which has not been evaluated in preterm infants undergoing nonbypass cardiac surgery, as a surrogate for postligation syndrome is entirely arbitrary. The receiver operator characteristic curves to predict VIS of 20 or greater with E_a and E_{es} are not discriminatory. In addition, in light of the absolute lack of difference in E_{es} and E_a between patients with VIS of less than 20 versus 20 or greater ($P > .7$), their significance in predicting VIS of 20 or greater in a multiple regression analysis is cause for ponder.

It is unlikely that one more complex mathematical measurement is going to supplant the intelligence of bedside clinical acumen in PDA management. It is incremental knowledge gained from novel approaches such as that undertaken by Gray and colleagues,⁵ however, that allows us

FIGURE 1. Transthoracic echocardiogram showing a large patent ductus arteriosus (PDA) with left-to-right shunting. LPA, Left pulmonary artery; RPA, right pulmonary artery.

to arm ourselves with data that can be more predictive and discriminatory. If we are to achieve our goal of rationally balancing risks and benefits, we have to learn how better

to use available data and technology to our benefit. The ultimate destination still lies ahead, but studies such as the one by Gray and colleagues⁵ suggest that we are well on our way.

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