

optimal depth of its insertion into the DLT. The modified design needs only be produced in the small and medium sizes.

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## Transesophageal Echocardiography in Pediatric Cardiac Surgery

*To the Editor:*—The recent fine paper by Muhiudeen *et al.*<sup>1</sup> and the accompanying editorial by Weintraub and Sahn<sup>2</sup> admirably outline the complexities as well as the strengths and weaknesses of intraoperative transesophageal *versus* epicardial echocardiography used during surgical repair of congenital heart disease. They rightly point out that transesophageal echocardiography provides accurate assessment of surgical repairs of complex congenital heart defects, with the caveat that assessment of right ventricular outflow tract anatomy and valvular regurgitation is unreliable with currently available pediatric transesophageal echocardiography.

The degree of expertise and technical complexity evident in this report, the multidisciplinary authorship of the paper, and its appearance in an anesthesiology journal all beg the question: is it reasonable to expect that anesthesiologists can realistically do intraoperative transesophageal echocardiography assessments of complex congenital heart disease repairs? Furthermore, who watches the patient during the sometimes prolonged intraoperative transesophageal echocardiography assessment during the period of instability after bypass following a flawed surgical repair?

Intraoperative transesophageal echocardiography assessments that prompt surgical revision of complex congenital repairs during cardiopulmonary bypass should be at least as expert as the original preoperative decision for surgical repair itself. Anything less is unacceptable because the risk of reinstitution of bypass and revision of a complex repair may be substantial, particularly when the original bypass and aortic cross-clamp times have been prolonged. In our own institution, the pediatric cardiac anesthesia staff, who are also board certified in pediatric radiology, do not feel qualified to make such judgments with the degree of expertise necessary to justify such risks; when such decisions are made, full-time echocardiographers are involved. Given that the American Heart Association recognizes 35 forms of congenital heart defects and that there are a number of variants of each form,<sup>3</sup> one must ask: is it reasonable for an anesthesiologist who does not have

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2. DeLima L, Bishop M: Lung laceration after tracheal extubation over a plastic tube changer. *Anesth Analg* 73:350-351, 1991
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extensive formal training for and ongoing concentration in echocardiographic diagnosis of congenital heart defects to make such decisions?

While these questions may well be beyond the scope of the study,<sup>1</sup> such questions are important and arise because of the publication of such a paper. These questions were not addressed either by the authors<sup>1</sup> or by the writers of the accompanying editorial.<sup>2</sup> Although similar questions arise in the use of transesophageal echocardiography for assessment of valvular repairs and ventricular function during and after coronary artery bypass graft procedures, in the case of repair of congenital heart disease these issues are considerably more prominent and deserve comment.

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2. Weintraub RG, Sahn DJ: Pediatric transesophageal echocardiography. *ANESTHESIOLOGY* 76:159-160, 1992
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*In Reply:*—Hickey raises a number of important philosophical issues regarding the anesthesiologists' involvement in intraoperative transesophageal echocardiography. We affirm Hickey's contention that extensive formal training and ongoing involvement in echocardiography is necessary for independent evaluation of transesophageal echocar-

diagrams in patients with congenital heart disease. From our study, we learned that with appropriate training, an anesthesiologist can properly evaluate the repair. The learning curve has required 12 months of training in adult and pediatric transesophageal echocardiography and 2 yr of required full-time experience in echocardiography

of congenital heart disease. In our team, the anesthesiologist is not alone, and if there is a question that further surgical repair is required, then an echocardiographer, also skilled in perioperative monitoring, is called to assist the surgical team.

It may not be possible for every anesthesiologist to achieve this level of training, but a working association can be established between an echocardiographer and anesthesiologist that would allow the needed intraoperative services without such extensive and time-consuming training for the anesthesiologist. Therefore, we recommend that the guidelines proposed by the American Society of Echocardiography be followed. These are

that the anesthesiologist develop a close collaborative relationship with a cardiologist who has expertise in transesophageal echocardiography. A team that provides intraoperative transesophageal echocardiography must include physicians who have developed expertise in diagnostic echocardiography (including transesophageal echocardiography) who are available when needed to maximize the value of transesophageal echocardiography in surgical management decision.<sup>1</sup>

To reply to the question, "Who watches the patient during the . . . transesophageal echocardiography assessment?": obviously, if the patient is hemodynamically unstable, transesophageal echocardiography must wait until there is additional help available or until the patient is stable enough for the examination to be performed.

At our institution, the intraoperative transesophageal service evolved such that the anesthesiologist is primarily responsible for performing the intraoperative transesophageal echocardiography, and the pediatric transesophageal service has evolved as an extension of it.

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*In Reply:*—In his letter addressing the paper by Muhiudeen *et al.*<sup>1</sup> and our accompanying editorial,<sup>2</sup> Hickey raises an obvious point that I believe is well appreciated by those in institutions in which a large number of congenital heart disease operations are performed and where transesophageal echocardiography has found its deserved and pivotal role.

We agree completely that expertise involving judgments of surgeons, anesthesiologists, pediatric cardiologists, and experts in performing and interpreting color Doppler echocardiograms needs to be taken into account when decisions are made regarding adequacy or inadequacy of congenital heart disease repairs and the possibility of re-instituting bypass to revise them. As a simple example, the velocity dependence of most velocity variance color mapping techniques makes driving pressure a fundamental determinant of the jets arising from restrictive orifices, such as those in valvular regurgitation or those across ventricular septal defects, and intraoperative transesophageal echocardiographic findings must be interpreted in light of this interpretation.

In many instances in our own institution, all four teams (surgery, anesthesia, clinical pediatric cardiology, and echocardiographic imaging) collaborate on intraoperative decision-making. As such, we fully agree with Hickey's comments and are most appreciative that he took the time to send them to the Journal.

We believe that our study was an important matter to publish in ANESTHESIOLOGY because it brings to the forefront just the issues raised by Hickey regarding the anesthesiologist's ultimate responsibility for patient monitoring. We believe that the anesthesiologist should have the ability to interpret transesophageal echocardiograms, which will ultimately provide a standard of care in congenital heart surgery.

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