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EDITORIAL

Assisting the Surgeon with Transesophageal Echocardiography

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Transesophageal echocardiography is a versatile diagnostic and monitoring tool. While the diagnostic aspect has received much attention, the monitoring aspect is largely ignored. The literature on cost-benefit analyzes often include the benefits derived from the identification of new or residual lesions.[1] The benefit accrued from monitoring is often ignored as it is difficult to quantify. In this issue of Journal of Perioperative Echocardiography, Gourav et al. highlight the role played by intraoperative transesophageal echocardiography (TEE) in de-airing the heart after cardiac surgery.[2] The role of TEE in assisting the surgeon is only expected to increase with the advent of minimally invasive cardiac surgery. Thus, it is prudent upon the anesthesiologist to develop a systematic approach to monitoring with TEE.

In cardiac surgery through a median sternotomy, the first point of monitoring is at the time of aortic cannula placement. In adults, the usual region of cannula placement in the ascending aorta lies in the blind spot of TEE. However, in pediatric patients and when the surgeon places a straight cannula higher-up in the aorta, the position of the cannula can be confirmed with TEE.[3] Surgeon has to be informed when much distal placement of the cannula or abutment of the cannula against the aortic wall is visualized. This avoids selective arterial cannulation and aortic dissection respectively. After cannulation, aortic dissection is ruled out by visualizing the aortic arch and descending aorta; the regions which are not visualized by the surgeon.[4] On the corollary, TEE guides cannulation of branch arteries and confirms the flow in the true lumen in cases undergoing surgery for aortic dissection.[5]

The assistance of TEE in the placement of venous cannula in inferior vena cava (IVC)[6] and retrograde cardioplegia cannula in the coronary sinus are well established. Centers routinely monitor the position of the venous cannula in the IVC. The cannula in the IVC should adequately drain the hepatic veins also. The IVC and hepatic veins must have laminar flow and they should not be dilated. An obstruction in hepatic venous flow or partial obstruction to the venous return from the lower part of the body may not be apparent to the perfusionist. The difference in reservoir volume may be too small to be subjectively identified. This is more so in a pediatric cardiac surgical patient. Also, the venous return in a cannula with partial obstruction may resume normal level with higher venous pressure. The lower body venous pressure is seldom monitored routinely, and any such obstruction is missed in the absence of TEE. Renal and hepatic complications can occur frequently in such cases.

With the aortic cross-clamp in place, the TEE probe is placed in standby mode to avoid warming the heart. Intermittent momentary visualization of the left ventricle in trans-gastric view assists in identifying left ventricle distension. This can occur when the vent placed through the pulmonary vein has not crossed the mitral valve to reach the left ventricle. The myocardial energy consumption is increased in the distended left ventricle and this leads to myocardial dysfunction postoperatively. Again, the distension of the left ventricle may not be visually obvious on the field. Once detected, the LA vent is repositioned, or a vent is placed in the pulmonary artery.[7]

In open cardiac surgery, the chambers of the heart are filled with fluid before they are closed to remove any intracardiac air. This is further augmented by gentle ventilation by the anesthesiologist to expel the air from the pulmonary veins. This expelled air is removed from the vessels through a vent or a stab in the ascending aorta. The completeness of de-airing is assessed by TEE. Pockets of air have been shown to cause neurological injury in patients. While microbubbles may not cause clinically obvious injury, the higher embolic load can result in ventricle dysfunction as has been described in this case report.[2] The microbubbles can enter the right coronary artery and air bubbles are sometimes visually apparent on the field. The TEE at the time of de-airing should focus on the source of the air and the non-dependant regions of the heart.

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The pulmonary artery, left and right upper pulmonary veins, inter-atrial septum, left atrial appendage, the anteroseptal surface of the left ventricle and the right sinus of Valsalva are sequentially visualized. Apart from the long axis view on TEE, mid-esophageal four-chamber view to visualize the right ventricle and an eye on the right ventricle in the field can help in early detection. TEE is particularly helpful during de-airing in minimally invasive surgery and when the left-sided structures have not been mobilized.[8] In these cases, aspiration of air and manipulation of the left ventricle are not possible, and the aortic vent is left in place until there is no residual air.

Research utilizing TEE on de-airing is limited to comparing the various modalities of de-airing, which includes carbon-dioxide insufflations and Lund technique. A formal economic assessment of the utility of TEE in aortic and venous cannulations, identifying left ventricle distension and de-airing can allow updating of appropriate use criteria of TEE in cardiac surgery.

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