The Utility of Transesophageal Echocardiography for Detecting Residual Shunt in a Patient Undergoing Atrial Septal Defect Repair

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A 22-yr-old woman with the diagnosis of ostium secundum type of atrial septal defect (ASD, 4.1 cm) was scheduled to undergo surgical closure of ASD. After an uneventful opioid-based induction of anesthesia, arterial blood gas analysis revealed arterial oxygen saturation (SaO₂) of 96.5% (arterial oxygen tension, PaO₂, 88.7 mm Hg) with fractional inspired oxygen concentration (FiO₂) of 0.5. The ASD was closed using a pericardial patch using standard cardiopulmonary bypass (CPB). The post-CPB arterial blood gas analysis showed SaO₂ of 80.9% at FiO₂ of 1.0. The SaO₂ continued to remain between 80% and 85%, even after manual ventilation and endotracheal suctioning.

Transesophageal echocardiography (TEE) was performed, which revealed that the lower end of the patch near the inferior vena cava (IVC) was improperly placed, leaving a defect of about 4 mm that allowed the IVC to partially drain in the left atrium (LA) (Fig. 1). Since color Doppler examination was inconclusive for diagnosing the shunt across the defect, it was confirmed at this stage by injecting agitated saline contrast through a 22-G cannula placed in the femoral vein. The contrast was seen to appear in right ventricle, LA, and left ventricle at the same time (please see video clip 1 available at www.anesthesia-analgesia.org). Agitated saline was also injected into the superior vena cava through the triple-lumen catheter in the internal jugular vein, which failed to appear in the LA.

CPB was reinstituted and ASD closure was revised using a fabric patch. After surgery, her SaO₂ improved to 98.1%. TEE now showed a properly placed patch (Fig. 2) allowing the IVC to drain in the right atrium (compare with Fig. 1). Injection of saline contrast through the femoral vein confirmed that there was no residual shunt (please see video clip 2 available at www.anesthesia-analgesia.org).

Ostium secundum defect is the most common ASD. This is a centrally placed defect within the atrial septum, which involves a partial or whole flap valve of the fossa ovalis. When more of the fossa ovalis tissue is absent, the inferior (posterior) rim of the ASD almost extends up to the IVC. The enlarged Eustachian valve of the IVC then overhangs the ASD and can be mistaken as the inferior edge of the ASD. It has been reported that it can be included in the repair, leading to diversion of caval blood into the LA (1,2). The faulty repair can lead to complete transposition of the IVC to the LA (1) or may create a funnel, which diverts blood flow from the IVC to the LA (3).

In our patient, it is apparent that the large ASD extended up to the IVC and the IVC opening was overriding the defect onto the LA causing some right-to-left shunting. The preoperative PaO₂ of 88.7 mm Hg at FiO₂ of 0.5 suggests the existence of this shunt. During the first repair, the Eustachian valve was mistaken as an inferior edge of the ASD and was sutured to the pericardial patch (Fig. 1). The “mass” seen between the solid and hollow arrows in Figure 1...
is the enlarged Eustachian valve to which the pericardial patch had been sutured. Figure 2 clearly demonstrates the enlarged Eustachian valve to which the patch was sutured earlier (compare Figs. 1 and 2). Figure 2 also shows that the patch (bright spot) now extends up to the defect seen in Figure 1. Thus proper placement of the patch has clearly delineated the anatomy of coronary sinus, IVC, and interatrial septum as demonstrated in Figure 2.

Although oxygen saturation of 80% in this patient strongly suggested the presence of intracardiac shunt, we believe that the confirmation and exact location of the shunt by a noninvasive technique such as TEE is most appropriate. With the current easy availability of TEE in operating room, it should be applied in all patients with obvious desaturation. If atrial level shunting is identified, a standard bicaval view should be obtained and the probe should then be inserted a little further to profile the IVC-right atrium junction. This may require some modification by way of probe manipulation and changing the angle to obtain the best view. The present case highlights the importance of diagnosing this rare but unfortunate surgical complication with the help of TEE.

REFERENCES