Hypoxemia in the post-cardiopulmonary bypass period: TEE to the rescue!

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Introduction
Successful management of hypoxemia in cardiac surgery requires finding the correct diagnosis and implementing appropriate interventions. We describe a patient who developed acute hypoxemia due to a right-to-left interatrial shunt discovered by transesophageal echocardiography (TEE) in the postcardiopulmonary bypass (CPB) period.

Case report
A 66 year old presented for combined aortic valve replacement (AVR) and coronary artery bypass grafting (CABG). An intraoperative TEE exam showed normal biventricular function, a high transvalvular gradient across the aortic valve, moderate tricuspid regurgitation, and an intact interatrial septum (IAS) with no evidence of shunting by color-flow Doppler (CFD). Pulmonary hypertension was also noted (45/25 mmHg) after placement of a Swan Ganz catheter.

While weaning from CPB, mild LV systolic dysfunction (EF 40%) and normal RV systolic function was seen on TEE. Within minutes, acute hypoxemia ensued as oxygen saturation decreased to 71% and was confirmed with a PaO2 of 48.9 mmHg on ABG. There were also high right atrial (RA) (30 mmHg) and PA pressures (60/45 mmHg). Bronchospasm, mucus plugging, endobronchial intubation, and poor lung compliance were ruled out as causes of hypoxemia. Subsequent TEE exam revealed a 5 mm IAS communication with a right-to-left shunt by CFD. Maneuvers performed to reduce the shunt included increasing doses of vasopressor support and milrinone infusion for inotropic support. After 20 minutes, right-sided pressures decreased as oxygenation improved to 100% (PaO2 was 205 mmHg). TEE documented flow reversal of shunt to a left-to-right direction. Hypoxemia did not occur postoperatively and a follow up echocardiogram showed no evidence of an IAS defect.

Discussion
Many factors can contribute to hypoxemia after CPB, including atelectasis, bronchospasm, protamine reactions¹, and inflammatory lung injury². In our case, clinical hypoxemia developed when high right-sided pressures promoted a right-to-left shunting of blood through a new septal defect. This defect may have been undetected prior to CPB. Alternatively, a septal communication may occur from inadvertent cannulae manipulation or suture placement while seating the aortic valve. Regardless, the combination of elevated RA pressures and the defect resulted in right-to-left shunting and acute hypoxemia. Aggressive pharmacologic support to treat pulmonary hypertension reversed shunt flow and eliminated further episodes of hypoxemia. If hypoxemia persisted from right-to-left shunting, surgical repair of the defect may have been warranted.

Our case demonstrates how TEE provided essential information for intraoperative diagnosis of hypoxemia. A potential intracardiac communication with a right-to-left shunt should be considered if clinically significant hypoxemia occurs during cardiac surgery.

References
1) Anesth Analg 2002; 94:1402-1408
2) Chest 2002; 121:1269-1277