Our Surgical and Anesthetic Technique for A Complex Cardiac Intervention Performed On a Case with Severe Pulmonary Hypertension
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Citation

Abstract
Patients referred to a hospital with mitral stenosis and severe pulmonary hypertension often have other associated cardiac diseases and comorbid conditions. We describe our surgical and anesthetic technique for a complex cardiac intervention performed on a case with severe pulmonary hypertension.

INTRODUCTION
Pulmonary hypertension increases perioperative risk in patients having mitral valve replacement[1]. Coronary artery bypass surgery in patients with primary pulmonary hypertension is extremely rare. Persistent elevation of pulmonary pressure is the most important complication in the postoperative period[2].

CASE PRESENTATION
Our case was a 60-year-old male. He was suffering from chest pain and shortness of breath for 6 months. Our patient was in NYHA functional class III. Preoperative hemodynamics demonstrated a mitral valve area of 0.9 cm², pulmonary artery systolic pressure of 85-90 mm Hg. Other characteristics included coronary artery disease (stenosis of obtuse marginal branch of circumflex artery), and mild tricuspid regurgitation. His ejection fraction was 40%.

He was operated on under endotracheal general anesthesia and in supine position. Following a median sternotomy, pericardium was opened longitudinally. After heparinization, extra-corporeal circulation was established between the venae cavae and the ascending aorta. A cross clamp was placed on aorta and by antegrade intermittent isothermic blood cardioplegia from aortic root, cardiac arrest was established. Hypothermia was moderate (28°C). A vent was placed via the right superior pulmonary vein. Distal anastomosis to the first obtuse marginal branch of circumflex artery was carried out with autologous saphenous graft (Figure 1).

Figure 1

Standard left atriotomy was made from interatrial junction. An organized mass of thrombus within the left atrial auricle, which was not identified preoperatively, was extirpated (Figure 2&3).
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Left auricle was ligated primarily from inside the left atrium (Figure 4).

Native mitral valve was severely calcified and there were some fused areas with fibrous annulus. This valve was then excised since it was assumed to be inappropriate for repair (Figure 5).

31 mm St. Jude mechanical valve was inserted by using pledgeted Ti-cron® horizontal mattress sutures (Figure 6).
After right atriotomy, it was identified that coaptation of the tricuspid valve was optimal by using saline test. No further intervention to this valve was planned (Figure 7).

In our perioperative anesthesia protocol, following the induction, pulmonary artery catheter was inserted. Initial pulmonary arterial pressures were measured as 79/39 (mean=54) mm Hg. After the induction of anesthesia, infusion of levosimendan was started with a loading dose of 0.6 µg/kg within 10 minutes. Then, an infusion rate of 0.1 µg/kg/minute was continued for 24 hours. After weaning from cardiopulmonary bypass (CPB), pulmonary arterial pressures were measured as 36/27 (mean=31) mm Hg. Inhalation of nitric oxide was initiated during weaning from CPB and continued for almost 13 hours until extubation. During weaning from CPB, dopamine and dobutamine infusions of 10 µg/kg/minute and adrenaline infusion of 2 mg per hour were initiated. During CPB, total amount of diuresis was 850 ml whereas it was 1200, 2140 and 4030 ml within 6, 12 and 24 hours; respectively. Pulmonary arterial pressure was measured as 40/10 (mean=24) mm Hg in the 24th postoperative hour.

**DISCUSSION**

The calcium sensitizer levosimendan improves myocardial contractility by stabilizing troponin C and enhancing calcium sensitivity of cardiac myofilaments, however, it has no effect on myocardial oxygen demand and does not induce arrhythmias \[^{[3-6]}\]. One advantage of levosimendan over catecholamine would be to increase the force of contraction without enhancing the influx of Ca\(^{2+}\) into the cytosol and thus without increasing the risk of arrhythmias related to this ionic alteration \[^{[3]}\]. Previous studies have demonstrated that levosimendan improves hemodynamic performance more effectively than β-adrenergic agonist in patients with severe heart failure, and it has been associated with improved long-term survival \[^{[3]}\].

Pulmonary hypertension increases morbidity and mortality in patients undergoing heart surgery. Mitral valve stenosis is frequently associated with an increase in pulmonary vascular resistance. Cardiopulmonary bypass exacerbates pulmonary hypertension in patients undergoing cardiac surgery\[^{[8]}\]. Pulmonary hypertension may be encountered in the intensive care unit in patients with critical illnesses such as acute respiratory distress syndrome, left ventricular dysfunction, and pulmonary embolism, as well as after cardiothoracic surgery\[^{[4]}\]. The intensive care unit management of patients can prove extremely challenging, particularly when they become hemodynamically unstable\[^{[4]}\]. Patients with decompensated pulmonary hypertension, including those with pulmonary hypertension associated with cardiothoracic surgery, require therapy for right ventricular failure\[^{[4]}\].

Inhaled nitric oxide are effective in the treatment of postoperative pulmonary hypertension in patients with mitral valve stenosis undergoing mitral valve surgery. This drug improve cardiac output and reduce mean pulmonary arterial pressure, pulmonary vascular resistance, and trans-pulmonary gradient\[^{[4]}\].

Controversy surrounding the use or misuse of the pulmonary artery catheter (PAC) remains one of the most frequently debated issues in anesthesia, critical care, and cardiology. It has been argued that the cardiovascular data it provides, its
ease of insertion, and the low incidence of associated complications mandate its use in all patients undergoing cardiac surgery. Conversely, it has been suggested that clinical experience, combined with information derived from the central venous pressure and noninvasive monitors, is adequate to diagnose and treat hemodynamic abnormalities in the perioperative period\[10\]. Current indications of PAC is for patients with pulmonary hypertension and low cardiac output, as well as those who are predicted to be difficult for postoperative management. Routine use of PAC for cardiac surgery should be reconsidered\[11\].

For mitral valve surgery in patients with severe pulmonary hypertension, cardiac surgery can be successfully performed with an acceptable mortality, and risk factors for poor perioperative outcome can be identified by preoperative clinical characteristics. Younger patients have the best long-term survival, and most survivors experienced long-term improvement in functional status\[1\]. The results of the study of Cámara et al. indicate that, in patients with mitral valve lesions and severe pulmonary hypertension, i- surgical procedures can be performed with an acceptable operative mortality; ii- excellent long-term survival and functional results can be obtained; and iii- pulmonary hypertension decreases significantly after operation\[13\].

References
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