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On-pump beating heart mitral valve replacement with protection of the mitral leaflets in poor ventricle patients with end stage severe mitral regurgitation

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Summary

Abstract: Mitral valve replacement (MVR) in patients with severe mitral regurgitation and poor ventricle has a high mortality and morbidity. For such patients if mitral valve repair is not possible MVR can be performed with partial or complete protection of the mitral leaflets. Herein we report 2 patients with severe mitral regurgitation and poor ventricle (EF 20%–25%). MVR was performed by complete protection of the both anterior and posterior mitral leaflets and using the on-pump beating heart technique. Levosimendan was administered to one of the patients on induction of anesthesia. Weaning from cardiopulmonary bypass was uneventful for the both patients. The postoperative course of the 2 patients was uneventful and they were discharged on the 5th and 6th days.

Keywords: Heart valve surgery, levosimendan, cardiopulmonary bypass.

Introduction

Mitral valve surgery by using CPB in the functioning heart provides advantages in protecting cardiac functions especially in patients with reduced ventricle function, and its use recently is increasing. In patients with limited cardiac reserves, substantial morbidity and mortality increase is seen in the operations performed with arrest. Cardiac functions might be better protected with CPB guidance in the functioning heart in patients with reduced ventricle function. As cardioplegia solution is not given in the mitral valve surgery performed with CPB guidance in the functioning heart, the patient

will be protected from myocardial reperfusion injury, and coronary perfusion continues. Thereby, normal cardiac physiology can be maintained with normothermic coronary perfusion.⁽¹⁾

Protection of functions and geometry of left ventricle by the performed cardiac surgery is highly important. In this regard, protection of subvalvular apparatus is also highly important. Protection of subvalvular apparatus has been reported to decrease early-period mortality-morbidity and to improve the long-term survival and functional capacity.^(2,3)

Levosimendan is a novel positive inotrope drug

which can increase contractility without increasing intracellular calcium level and oxygen consumption, and which can be used in postoperative patients who have difficulties in getting out of CPB with decompensated cardiac failure.⁽⁴⁾ We also used prophylactic Levosimendan to facilitate getting out of CPB in one of these patients.

Case Report 1

60-Year-old male patients admitted to our clinic with the complaints of shortness of breath, palpitation, getting tired quickly and chest pain. The patient had these complaints for nearly ten years, and as their severity increased recently; he undergone an echocardiography (EKO) in an external center, and grade 3-4 mitral regurgitation was detected. The patient had no known history, and he had inguinal hernia comorbidity. In the physical examination, blood pressure was 110/70mmHg, pulse was 80/min and arrhythmic. He had 5/6 systolic murmur in apex with auscultation. He had rales in the bilateral basal parts of the lungs with auscultation. The patient's NYHA functional capacity was III. Cardiac rhythm was in atrial fibrillation in electrocardiogram. In the telecardiogram, he had mild loading findings in basal zones of bilateral lungs, and cardiomegaly.

In EKO, he had grade 3-4 eccentric severe mitral regurgitation, ejection fraction: 25%, left ventricular end diastolic diameter: 7.0 cm, left ventricular end systolic diameter: 6.5 cm, left atrium: 6.7 cm, and diffuse hypokinetic areas were present in left and right ventricles. Also pulmonary arterial pressure of the patient with grade 2 tricuspid regurgitation was measured to be 50 mmHg. In the coronary angiography, coronary arteries were assessed to be normal. No pathology was detected in the patient's routine blood work-up.

When the patient was taken for operation with these findings, in addition to anesthesia induction, Levosimendan was initiated as 12 microgram/kg/min bolus, followed by 24-hour-infusion at 0.1 microgram/kg/min. Following median sternotomy, standard aorto-bicaval cannulation was performed. CPB was initiated, cooling was not performed and cross-clamp was not put. In the normothermic functioning heart, mitral valve was reached with left atriotomy when patient was in upside-down position and aortic vent was at maximum vent.

Anterior leaflet was thickened, fibrotic, and had prolapse, posterior leaflet was fibrotic and not suitable for repair. MVR was performed with 27 no St. Jude medical mechanical valve with individual pledgeted sutures by protecting the whole subvalvular apparatus (anterior and posterior leaflets were freed, and then fixed to annulus with pledgeted sutures to provide orifice, and ventricle geometry was preserved by protecting chordas).

Left atriotomy was closed, deairing was performed, cardiopulmonary bypass was ended without problems with 5 mcg dopamine and levosimendan infusion. Decannulation was completed without problems, and the patient's operation was completed without any complication. The patient's CPB duration was 80min, and operation duration was 160min. There was no problem during postoperative follow-up. He woke-up at the postoperative 3rd hour, no cerebrovascular event occurred, and he was extubated in the 15th hour. The patient was hemodynamically stable during intensive care follow-ups. He was taken into normal ward on postoperative day 1. As there was no problem in the routine work-up during postoperative period, and the patient was discharged with recovery at post-op. day 5.

Case Report 2

63-Year-old female patient was admitted with severe shortness of breath and palpitation on exertion. The patient's NYHA functional capacity was III. In the examination, blood pressure was 130/60mmHg, pulse was 92/min and arrhythmic. She had 4/6 systolic murmur in apex with auscultation. The patient's NYHA functional capacity was III. In the telecardiogram, he had mild loading findings in basal zones of bilateral lungs, and cardiomegaly. She had hypertension, and atrial fibrillation rhythm on electrocardiogram. When EKO findings were evaluated; 6.8 CM, LVESD: 5.8 CM, EF: 29%, 30 Mitral Regurgitation, CPAB: 34 mmHG, left atrium was dilated, posterior mitral valve systolic movement was limited, and it was in global hypokinesia form with more significance on inferior part.

Again, left atriotomy was performed in the functioning heart after standard procedure. Venous bleeding was observed. Subvalvular apparatus was prolonged, got thinner and not suitable for repair. 27 no ST. JUDE MEDICAL metal valve replacement and secundum

ASD primary repair was performed with protection of anterior and posterior leaflets. CPB was ended without problems. CPB duration was 91 min. The patient was extubated without problems at the 14th postoperative hour, and discharged with recovery on postoperative day 6.

Discussion

Levosimendan is a novel positive inotrope drug which can increase contractility without increasing intracellular calcium level and oxygen consumption, and which can be used in postoperative patients who have difficulties in getting out of CPB with decompensated cardiac failure. The primary mechanism of action of levosimendan in increasing contractility, is based on its effect of increasing the sensitivity of cardiac troponin-C to cytoplasmic calcium.⁽⁴⁾ During this inotropic effect, the most important aspect is the non-increasing intracellular calcium level; therefore the important side effects of adrenergic inotropes such as cardiac myositis dysfunction and arrhythmia due to increase in intracellular calcium. Diastolic relaxation is not impaired with levosimendan, and both preload and afterload of the heart are decreased as well. This process occurs by not increasing the oxygen consumption of the myocardium. Levosimendan also has an anti-ischemic effect due to its dilating effect on coronary arteries.^(4,5)

Cardiac functions might be better protected with CPB guidance in the functioning heart in patients with reduced ventricle function. As cardioplegia solution is not given in the mitral valve surgery performed with CPB guidance in the functioning heart, the patient will be protected from myocardial reperfusion injury, and coronary perfusion continues. Cardiac physiology is maintained thanks to normothermia.^(1,6) After the recognition of the favorable effect of preserving posterior leaflet on left ventricle functions in postoperative period, the applications for complete protection of mitral valve apparatus, continue to be performed.

The role of mitral valve apparatus is not only limited with valvular functions, it also has an important place in left ventricular functions. Results of the limited number of clinical trials performed, consistently show that protection of valve apparatus protects or improves the left ventricular functions even though different techniques are used.⁽⁷⁻¹¹⁾ In addition to the sudden afterload

increase occurring after mitral valve replacement, many authors reported that the continuity impairment in annular-chordal-papillary-muscular-left ventricle wall as a result of removal of chordal structures, contributes to left ventricle dysfunction in early postoperative period. These authors also associate the better hemodynamic outcomes and low mortality obtained after the application of repair techniques in mitral regurgitation with the preservation of annular-papillary-ventricular continuity with these techniques.⁽⁸⁻⁹⁾

In patients with chronic mitral regurgitation, the most important cause of left ventricle dysfunction after replacement is considered to be the tension on left ventricle wall as a result of sudden afterload increase which occurs after valve replacement with the elimination of low-impedance flow to left atrium in mitral regurgitation. Left ventricle has an absolute need for continuation of chordal tension and the supportive effects in the area on which the papillary muscles are holding on to resist this sudden development of afterload.

Left ventricle can protect its contractile functions by preserving especially its diastolic sizes and ideal geometry during contraction, and by preventing the increase in cavitory pressure.⁽⁹⁻¹¹⁾ In these cases, mitral orifice was extended by cutting the anterior leaflet from 2-3 mm distance and fixing it to annulus with pledged sutures without harm to chordal links. Extra valvular tissue was trimmed. Posterior leaflet kept as it was.

Here, especially preserving the anterior leaflet as complete may also cause obstruction in left ventricle outlet with the systolic forward movement of the anterior leaflet tissue. Therefore and ideal orifice should be provided. The second possible problem is the prosthetic valve dysfunction due to adverse interaction between the protected papillary muscle and its chordas and the prosthetic valve. In conclusion, we think that reconstructive surgery is appropriate for rheumatic mitral valve patients with pure mitral regurgitation or hemodynamically considerable mitral regurgitation, and in patients not suitable for reconstructive surgery, as an alternative mitral valve surgery with complete surgical protection of subvalvular apparatus is appropriate.

Mitral valve surgery by using cardiopulmonary bypass in the functioning heart is technically easy to use

and may have less complications compared to conventional methods.⁽¹⁾ For this patient, and in cases with low EF and high-risk of cardiac surgery, we obtained a good outcome by utilizing the effects of levosimendan

and thinking that we had better protection of cardiac functions in the functioning heart. Still, further experiences will contribute to our understanding on this subject.

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Conflicts of interest were not reported.

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