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## Complete Reconstruction of the Left Heart with Atriomegaly and Ventriculomegaly: Clinical Case

### Abstract

**Background.** Implementation of the principles of medical preparation, comprehensive reconstruction of the left heart in patients with atriomegaly and ventriculomegaly and combined mitral-tricuspid valve diseases leads to improvement of myocardial function and morphometric parameters of the left atrium (LA) and left ventricle (LV).

**Case description.** Patient R., male, 67 years old, underwent examination and treatment from April 22 to May 25, 2021 at the department of surgical treatment of acquired heart diseases of the National Amosov Institute of Cardiovascular Surgery of the National Academy of Medical Sciences of Ukraine with the diagnosis of stage IV mitral regurgitation, stage IV tricuspid insufficiency, high grade pulmonary hypertension, permanent atrial fibrillation (lasting 10 years since 2011), IIB heart failure with reduced left ventricular ejection fraction (LVEF), secondary hypothyroidism (state of drug subcompensation). Upon admission, the patient was in a state of circulatory decompensation, which required long-term medical preparation for the operation. After his condition was improved, the patient underwent surgery: mitral valve replacement with complete preservation of the valve apparatus, triangular plasty of LA, tricuspid valve plasty with the imposition of a support ring and resection of the right atrium. There were no complications during the intraoperative period. The postoperative period was characterized by symptoms of hyperbilirubinemia, increased exudation from drainages on the first day after surgery. After appropriate treatment, the patient's condition was stabilized. The patient was discharged on the 13th day after surgery with improvement.

**Conclusion.** Given the initial severe condition of the patient with advanced heart disease with reduced LVEF, left atriomegaly 9.5x12.3 cm, high grade pulmonary hypertension (peak systolic pressure = 70 mm Hg) and comorbidities, comprehensive reconstruction of the left heart with atriomegaly and ventriculomegaly leads to improvement of functional state of the myocardium and morphometric parameters of LA and LV.

**Keywords:** cardiac surgery, atrial fibrillation, left atriomegaly, right atriomegaly, high pulmonary hypertension, mitral regurgitation, left ventriculomegaly.

**Introduction.** Left atriomegaly is a clinically significant risk factor for surgical treatment of patients with mitral-tricuspid heart disease. Left atriomegaly often results in left ventricular (LV) compression which leads to

significant respiratory distress and heart failure. Left atrium (LA) dilation is a factor that prevents the restoration of sinus rhythm and increases the risk of thromboembolic complications [1, 2, 3].

Left ventriculomegaly combined with reduced LV contractility is an additional risk factor for surgery in the correction of combined mitral-tricuspid valve diseases [4, 5]. The combination of all factors determines the feasibility

of a comprehensive reconstruction of the left heart during surgical correction.

**Clinical case.** Male patient R., 67 years old, was treated from April 22 to May 25, 2021 at the department of surgical treatment of acquired heart defects of the National Amosov Institute of Cardiovascular Surgery of the National Academy of Medical Sciences of Ukraine with the diagnosis of stage IV mitral regurgitation, stage IV tricuspid insufficiency, high grade pulmonary hypertension (peak systolic pressure = 70 mm Hg), permanent atrial fibrillation (AF) (lasting 10 years since 2011), IIB heart failure with reduced left ventricular ejection fraction (LVEF), secondary hypothyroidism (state of drug subcompensation: thyroid-stimulating hormone 13.7 pg/ml, T3 free 2.17 pg/ml).

The patient was admitted with complaints of shortness of breath, edema of the lower extremities, and heart failure. According to the patient, he has lost 10 kg in the last year.

Echocardiographic examination before surgery revealed severe mitral regurgitation due to prolapse of both leaflets; severe tricuspid insufficiency; high grade pulmonary hypertension (systolic pulmonary artery pressure = 70 mm Hg); reduced LV contractility (LVEF = 0.38-0.39); left and right atriomegaly (diameter = 7.0 cm) (Table 1).

Upon radiography of the thoracic cavity, cardiomegaly and a small right-sided hydrothorax were detected.

According to the results of coronary angiography (4/27/2021), no significant atherosclerotic lesions of the coronary arteries were detected.

As the patient was in a state of circulatory decompensation, a 14 days preoperative medical preparation

was started. The drugs used included Yuperio, Digoxin, Sildenafil, Euthyrox, etc. After preparation, the patient's shortness of breath and edema decreased, vital capacity increased from 50% (at the time of admission) to 64% (at the time of surgery). LVEF increased to 0.41. Heart failure decreased to IIA.

The risk of surgery by the EuroSCORE II scale was 5.92%.

The operation was performed on 5/13/2021. The scope of the operation was as follows: mitral valve replacement with complete preservation of all valve apparatus + triangular plasty of LA + resection of LA auriculum + tricuspid valve plasty with the imposition of support ring + safe resection of the right atrium. Duration of the operation was 380 minutes; it was performed in conditions of artificial circulation (146 minutes) and general hypothermia (29.7 °C). The aortic cross-clamp time was 98 minutes. Intraoperative blood loss was 400 ml.

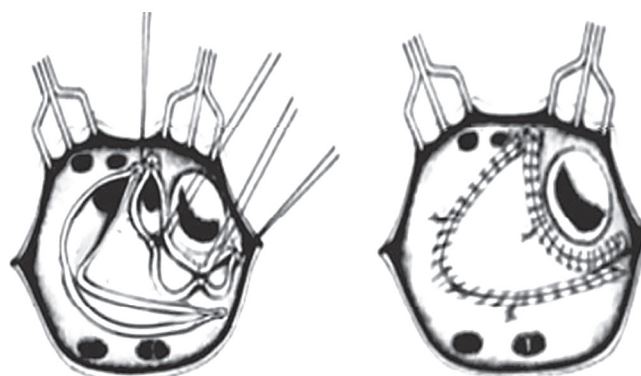
The operation was performed as follows (surgeon: Prof. Volodymyr V. Popov). Median sternotomy. Cannulation of aorta and both vena cava. Initiation of cardiopulmonary bypass. Antegrade cardioplegia at the aortic root with Custodiol solution 1000 ml + retrograde cardioplegia (Custodiol) through the coronary sinus with Custodiol solution 1800 ml. The electrical activity of heart disappeared on fourth minute. Both atria were opened. Revision of the mitral valve: mitral regurgitation with significant dilatation of the atrioventricular orifice (left ventricular end-diastolic volume = 399.0 ml). The anterior flap of the mitral valve was encapsulated, the valve and subvalvular structures were completely preserved. St. Jude Medical-31 mechanical valve was implanted (in the intermediate position) on U-shaped individual seams with gaskets in the amount of 13 pcs. The auricles of the left and right atria were cut off and sewn outside. The triangular plasty of the LA (through the method developed by Prof. Volodymyr Popov) was made using strips from its auricle for strengthening (Fig. 1.)

**Table 1**

*Echocardiographic parameters before surgery*

Parameters (units)	Values
Body surface area (m <sup>2</sup> )	1.8
EDVI (ml/m <sup>2</sup> )	221.7
LV EDV (ml)	399.0
ESVI (ml/m <sup>2</sup> )	86.7
LV ESV (ml)	156.0
LVEF	0.38-0.39
LA diameter (cm)	9.5 × 12.3
SPAP (mm Hg)	70.0
Mitral valve	Prolapse of both leaflets, partial break of chords of posterior leaflet, regurgitation ++++
Tricuspid valve	regurgitation ++ (+)
Aortic valve	Moderate fibrosis of leaflets, peak gradient 11 mm Hg, without backflow

EDVI, end-diastolic volume index; ESVI, end-systolic volume index; LV EDV, left ventricular end-diastolic volume; LV ESV, left ventricular end-systolic volume; SPAP, systolic pulmonary artery pressure.



**Fig. 1.** Scheme of triangular plasty of the left atrium (by Prof. Volodymyr V. Popov)

The plasty of the tricuspid valve with the imposition of Plancor-A support ring No. 34 was performed. Resection of the right atrium along the incision line (1x6 cm) was performed. The heart resumed its activity from the first depolarization. The general warming of the patient to 36.8 °C was provided. After stopping the cardiopulmonary bypass: central venous pressure = 40 mm H<sub>2</sub>O, pressure in LA = 140 mm H<sub>2</sub>O, blood pressure = 120/70 mm Hg. Inotropic support: norepinephrine 0.02 µg/kg/min, dobutamine 2.5 µg/kg/min.

The postoperative period at the intensive care unit lasted 91 hours. Inotropic support with dobutamine on day 1 after surgery was 2.3 µg/kg/min; on day 2 it was discontinued.

Values of creatine phosphokinase-MB: 189 µmol/l (5/14/2021) and 18 µmol/l (5/17/2021).

During the patient's stay in the intensive care unit, there was moderate hepatic insufficiency (total bilirubin up to 54 µmol/l), increased drainage exudation on day 1 after surgery, which required additional hemostatic therapy. On day 4, the patient was transferred to the department of surgical treatment of acquired heart defects. Medical therapy (Yuperio, Euthyrox, antibacterial, anticoagulant therapy, etc.) was successfully continued.

Table 2 shows the echocardiographic parameters before surgery and before discharge.

Postoperative period in the surgical department was unremarkable. The wound healed by primary intension.

Electrocardiography at discharge: AF with heart rate 89 bpm, blood test at discharge: hemoglobin 95 g/l; RBC  $3.3 \times 10^{12}$ /l; ESR 13 mm/h; WBC  $6.7 \times 10^9$ /l. Total bilirubin decreased to 24 µmol/l. Thyroid function test (5/17/2021): TSH 0.727 pg/ml, T3 free 1.25 pg/ml. UCP radiography showed a decrease in heart shadow (Fig. 2).

The patient was discharged on 5/25/2021 (13 days after surgery) in satisfactory condition for further treatment at the cardiac hospital at place of residence.

Six months after discharge, the patient was examined at the National Amosov Institute of Cardiovascu-

**Table 2**

*Comparison of echocardiographic parameters before and after surgery*

Indicators (units)	Before the operation	Before discharge
Mitral valve	Prolapse of both leaflets, partial break of chords of posterior leaflet, regurgitation ++++	Δ MVP 10 mm Hg
Tricuspid valve	regurgitation ++ (+)	Δ TV 10 mm Hg, no regurgitation
EDVI (ml/m <sup>2</sup> )	221.7	98.3
LV EDV (ml)	399.0	177.0
ESVI (ml/m <sup>2</sup> )	135.4	57.2
LV ESV (ml)	243.0	103.0
SVI (ml/m <sup>2</sup> )	86.7	41.1
LV SV (ml)	156.0	74.0
LVEF	0.38-0.39	0.42
LA diameter (cm)	9.5 x 12.3	4.6
SPAP (mm Hg)	70.0	40.0

EDVI, end-diastolic volume index; ESVI, end-systolic volume index; LV EDV, left ventricular end-diastolic volume; LV ESV, left ventricular end-systolic volume; LV SV, left ventricular stroke volume; MVP, mitral valve prolapse; SPAP, systolic pulmonary artery pressure; SVI, stroke volume index; TV, tricuspid valve.

lar Surgery. Echocardiographic results remained almost unchanged compared to those after surgery. The patient notes significant improvement compared to his preoperative condition.

**Discussion.** In the correction of combined mitral-tricuspid valve disease, the factor of left atriomegaly is clinically significant at the hospital stage, and even more so in the long term. The incidence of thromboembolic complications, as well as the level of cardiovascular insufficiency in patients without correction of left atriomegaly in the long term reaches a critical value, especially in combination with long-standing AF [1, 2, 3, 4]. Left atriomegaly in the



**Fig. 2.** Radiography of the thoracic cavity before (4/23/2021) and after the operation (5/18/2021)

presence of tachyform AF promotes the formation of blood clots in the left atrial cavity and contributes to thromboembolic complications. Dilated LA contributes to the progression of heart and respiratory failure due to compression of the bronchus, trachea and posterior wall of the left ventricle [1, 2, 3]. Therefore, we consider it necessary to reduce the dilated LA.

Complete preservation of valvular and subvalvular structures during mitral valve replacement allows to preserve the contractility of the left ventricle to a greater extent, and reduce its volume, especially in patients with ventriculomegaly [4, 5, 6].

**Conclusions.** Reduction of LA in the surgical treatment of combined mitral-tricuspid valve diseases is the preferred procedure in patients with left atriomegaly. This operation leads to a significant improvement in the morphometry of LA, which is accompanied by positive clinical effects, both in the hospital and in the remote periods after surgery.

In left ventriculomegaly combined with reduced contractility of the left ventricle, mitral valve replacement should be performed with the greatest possible preservation of the valvular structures of the mitral valve.

Thus, careful preoperative medical preparation and comprehensive reconstruction of the left heart with the correction of mitral-tricuspid defect can reduce the risk of complications at the hospital stage, even in extremely severe patients.

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## Комплексна реконструкція лівих відділів серця при атріомегалії та венікуломегалії (клінічний випадок)

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**Резюме.** Впровадження принципів медикаментозної підготовки, комплексної хірургічної реконструкції лівих відділів серця при лівій атріомегалії та венікуломегалії у пацієнтів з мітрально-трикуспідними вадами серця призводить до покращення показників функціонального стану міокарда та морфометричних показників лівого передсердя та лівого шлуночка.

**Опис випадку.** Пацієнт Р, чоловік, 67 років, пройшов обстеження та лікування з 22.04.2021 по 25.05.2021 р. у відділенні хірургічного лікування набутих вад серця ДУ «Національний інститут серцево-судинної хірургії імені М. М. Амосова НАМН України» з діагнозом: мітральна недостатність IV ст.; трикуспідальна недостатність IV ст.; висока легенева гіпертензія; постійна форма фібриляції передсердь (з 2011 року – 10 років); серцева недостатність ІІБ зі зниженою фракцією викиду лівого шлуночка; вторинний гіпотиреоз (стан медикаментозної субкомпенсації).

При поступленні пацієнт перебував у стані декомпенсації кровообігу, що потребувало достатньо тривалої медикаментозної підготовки до операції (10 днів). Після поліпшення стану пацієнту проведено оперативне втручання в об'ємі: протезування мітрального клапана з повним збереженням клапанного апарату + трикутна пластика лівого передсердя + пластика трикуспідального клапана з накладанням опорного кільця + резекція правого передсердя. В інтраопераційному періоді ускладнень не виникло. Післяопераційний період перебігав з явищами

гіпербілірубінемії, підвищеної ексудації по дренажах у першу добу після операції. Після відповідного лікування стан хворого стабілізувався та на 91-у годину після операції він був переведений з відділення інтенсивного догляду в загальну палату. Пацієнт був виписаний на 13-у добу після оперативного втручання з суттєвим покращенням стану.

**Висновок.** Враховуючи вихідний тяжкий стан хворого із запущеною вадою серця зі зниженою фракцією викиду лівого шлуночка (0,38–0,39), лівою критичною атріомегалією 9,5 × 12,3 см, високою легеневою гіпертензією (70 мм рт. ст.) та супутніми захворюваннями, комплексна реконструкція лівих відділів серця при атріомегалії та вентрикуломегалії призводить до суттєвого покращення функціонального стану міокарда та морфометричних показників лівого передсердя та лівого шлуночка вже на госпітальному етапі.

**Ключові слова:** кардіохірургічні втручання, фібриляція передсердь, ліва атріомегалія, права атріомегалія, висока легенева гіпертензія, мітральна вада, ліва вентрикуломегалія.

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