

# COMPARATIVE ASSESSMENT OF THE TIME OF PATIENTS' STAY IN THE INTENSIVE CARE UNIT AFTER MITRAL VALVE REPLACEMENT WITH PRESERVATION OF THE POSTERIOR LEAFLET AND COMPLETE REMOVAL OF SUBVALVULAR STRUCTURES

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## Abstract

**The aim** is to evaluate the effectiveness of time spent in the intensive care unit and the use of inotropic drugs after mitral valve replacement surgery with preservation of the posterior leaflet with comparison of complete removal of subvalvular structures.

**Material and methods.** The study included 60 patients, including 28 patients after surgery with preservation of the posterior mitral valve leaflet and 32 patients after surgery with complete removal of subvalvular structures. The average age of the patients was  $45.9 \pm 12.0$  years. Inclusion criteria were the time spent in the intensive care unit after surgery, the use of inotropic drugs, and the duration of use of the ventilator.

**Results.** In comparison, the control group in the intensive care unit received more inotropic drugs. In the main group of renal doses - 21 (75%) patients received dopamine -  $2.38 \pm 0.21$  micrograms per kilogram minute, adrenaline -  $0.021 \pm 0.003$  micrograms per kilogram minute. Cardiotonics were not received at therapeutic doses. Above therapeutic doses - 2 (7.14%) patients received (dopamine) -  $8 \pm 0.01$  micrograms per kilogram minute. In the second group of renal doses - 23 (71.87%) patients received dopamine  $2.24 \pm 0.54$  micrograms per kilogram minute, adrenaline -  $0.021 \pm 0.001$  micrograms per kilogram minute. Therapeutic doses of 5 (15.6%) patients dopamine -  $5.2 \pm 0.4$  micrograms per kilogram minute, adrenaline -  $0.04 \pm 0.001$  micrograms per kilogram minute. Above therapeutic doses of 2 (6.25%) patients, dopamine is  $8.2 \pm 0.02$  micrograms per kilogram minute, adrenaline is  $0.07 \pm 0.003$  micrograms per kilogram minute.

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**Conflict of interest**  
The authors declare that they have no  
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**Keywords**  
mitral valve replacement, subvalvular structure, posterior cusp, cardiotonic drugs

Артқы жарманы сақтай отырып, митральды қақпақшаны протездеуден және клапан асты құрылымдарын толық алып тастағаннан кейін науқастардың қарқынды терапия бөлімшесінде болу уақытын салыстырмалы бағалау

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Қырғыз Республикасы Денсаулық сақтау министрлігінің Жүрек-қан тамырлары хирургиясы және ағзаларды трансплантациялау ғылыми-зерттеу институты, Бішкек қ., Қырғыз Республикасы

## Аңдатпа

**Жұмыстың мақсаты** - митральды қақпақшаны ауыстыру отасынан кейін артқы жарманы сақтай отырып, клапан асты құрылымдарының толық жойылуын салыстыра отырып, қарқынды терапия бөлімінде өткізілген уақыттың және инотропты препараттарды қолданудың тиімділігін бағалау.

**Материал және әдістер.** Зерттеуге 60 науқас қатысты, олардың 28-і митральді қақпақшаның артқы жармасын сақтай отырып жасалған отадан кейінгі науқастар және 32-сі клапан асты құрылымдарын толығымен алып тастаған отадан кейінгі науқастар. Науқастардың орташа жасы  $45,9 \pm 12,0$  жасты құрады. Қосу критерийлері отадан кейін жан сақтау бөлімінде болған уақыт, инотропты препараттарды қолдану және өкпенің жасанды вентиляция құрылғысын пайдалану ұзақтығы болды.

**Нәтижелер.** Салыстырмалы түрде, жан сақтау бөліміндегі бақылау тобы инотропты препараттарды көбірек қабылдаған. Негізгі топ емдік дозаларда кардиотониктерді қабылдамады. Екінші топта емдік дозаларда 5 науқас (15,6%), дофамин - килограмм минутына  $5,2 \pm 0,4$  микрограмм, адреналин - килограмм минутына  $0,04 \pm 0,001$  микрограмм қабылдады. Емдік дозадан жоғары 2 науқас (6,25%), дофамин - килограмм минутына  $8,2 \pm 0,02$  микрограмм, адреналин - килограмм минутына  $0,07 \pm 0,003$  микрограмм қабылдады.

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митральды қақпақшаны протездеу, клапан асты құрылым, артқы түтік, кардиотоникалық препараттар

## Сравнительная оценка время пребывания больных в отделение интенсивной терапии после протезирования митрального клапана с сохранением задней створки и полного удаление подклапанных структур

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**Конфликт интересов**  
Авторы заявляют об отсутствии конфликта интересов

### Аннотация

**Цель работы** - оценить эффективность пребывания времени в отделении интенсивной терапии и использование инотропных препаратов после операции протезирования митрального клапана с сохранением задней створки со сравнением полным удалением подклапанных структур.

**Материал и методы.** В исследование включены 60 больных из них 28 пациентов после операции с сохранением задней створки митрального клапана и 32 пациентов после операции с полным удалением подклапанных структур. Средний возраст больных составил  $45,9 \pm 12,0$  лет. Критериями включения были время пребывания в отделение интенсивной терапии после операции, использование инотропных препаратов и длительность использования аппарата ИВЛ.

**Результаты.** По сравнению контрольная группа в отделении интенсивной терапии получали инотропные препараты больше. В основной группе терапевтических дозах не получали кардиотоники. Во второй группе терапевтических дозах 5 (15,6%) пациентов дофамин –  $5,2 \pm 0,4$  микрограмм на килограмм минуту, адреналин –  $0,04 \pm 0,001$  микрограмм на килограмм минуту. Выше терапевтических дозах 2 (6,25%) пациентов дофамин –  $8,2 \pm 0,02$  микрограмм на килограмм минуту, адреналин –  $0,07 \pm 0,003$  микрограмм на килограмм минуту.

**Ключевые слова**  
протезирование митрального клапана, подклапанная структура, задний ствол, кардиотонические препараты

### Relevance

In many ways, in the studies, a parallel was drawn between the dependence of the functioning of the left ventricle and the safety of the mitral valve. However, there were no quantitative criteria by which it would be possible to compare the functional capabilities of the heart during reconstruction and prosthetics of the mitral valve, to assess the compensatory and reserve capabilities of the left ventricular myocardium after these two types of operations. In 1990, N.A. Chigogidze, I.I. Skopin, P.A. Borsh in their studies determined the effect of reconstructive operations on the mitral valve and its prosthetics on the regional and general function of the left ventricle [1]. Using left ventriculography, it was proved that a decrease in the integral function of the left ventricle in patients after mitral valve replacement is mainly associated with impaired contractility of the posterior-basal and diaphragmatic segments directly related to the surgical intervention zone. This, according to the authors, was due to the removal of the chord-papillary apparatus and rigid fixation of the annulus fibrosus to the prosthesis. In addition, the change in the geometric shape and redistribution within the ventricular volume, along with the hyperfunction of the intact myocardium, served as a compensatory mechanism for maintaining the function of the left ventricle during mitral valve replacement. According to the calculations of the intragastric volume by segments, it was determined that the geometric shape of the left ventricle in patients after mitral valve replacement approached the spherical shape,

the most unfavorable from the point of view of the energy expenditure of the myocardium. In these conditions, hyperfunctional compensation mechanisms cannot be fully realized. During reconstructive operations on the mitral valve, regional disorders were also observed in the form of a decrease in the segmental ejection fraction. However, both in number and in severity, these segmental disorders were significantly less in comparison with patients who underwent mitral valve replacement. It is also important to note that after reconstructive operations on the mitral valve, the most favorable ellipsoid shape of the left ventricle was preserved. Thus, based on the analysis of the segmental and general function of the left ventricular myocardium in patients after reconstruction of the mitral valve and its prosthetics, it was determined that the mitral valve apparatus is actively involved in the reorganization of the left ventricular cavity, contributing to the most rational distribution of vectorial forces of contraction in the process of translational-rotational movement performed by the heart muscle [1, 2].

The analysis of indicators of invasive monitoring of central hemodynamics made it possible to establish that in the case of complete preservation of the subvalvular structures, there was a more significant decrease in pressure in the pulmonary circulation and the greatest increase in SI and SV, with the possibility of preserving only the posterior valve of the MV observed changes were less distinct, while in the group of people operated on with a routine method, the worst immediate re-

sults of prosthetics were demonstrated. Thus, the need for maximum preservation of the native mitral complex is quite obvious. The result of the implementation of the presented surgical approach, in addition to restoring the closure function of the MV, is the provision of the isovolumic contraction phase, which, according to the results of a number of studies, leads to an improvement or complete normalization of regional and general LV contractility [3,4]. Leaving subvalvular structures will further improve the immediate and long-term results [5]. An uncomplicated early postoperative period was observed in 69 (66.3%) patients. After being transferred to the intensive care unit, they had stable hemodynamics supported by therapeutic doses of cardiotonics, as well as an average mechanical ventilation time of  $16 \pm 3.8$  hours, on the second day they were transferred to the unit [6]. The results on the preservation of the geometry and functional state of the LV are in the group with complete preservation of the subvalvular structures and the anterior and posterior cusps. The time and need for receiving cardiotoxic drugs in the postoperative period in the intensive care unit clearly correlates with the preservation or excision of subvalvular structures [7].

The preservation of subvalvular structures is not a new concept, however, some surgical techniques for the treatment of left atrioventricular defect, depending on the nature of the lesion of the leaflets and subvalvular structures, must be adopted to achieve the best immediate and immediate clinical results, are not definitively defined, and are controversial. Therefore, the need for complete removal or preservation of the valves, subvalvular structures of the MV, their role in changing the functional state of the left ventricular myocardium is still being discussed [8].

The aim of the study is to show the feasibility of preserving the posterior leaflet with CPA in patients with mitral valve replacement (MVR).

Complete preservation of the subvalvular structure prevailed of all the types of operations with the preservation of the posterior leaflet in 89 (94.7%) cases. Due to the sharp thickening and shortening of the chords in 5 (5.3%) cases, we had to remove the first-order chords. The amount of chord removal depended on the degree of thickening and shortening of the chordal-papillary apparatus. Of these, in 1 case two were deleted and in 4 - one first-order chord. Nevertheless, being of the opinion that the preserved chordal-papillary apparatus of MV leads to an improvement in myocardial function, it is necessary to completely save the leaflet with subvalvular apparatus [8-9].

As far back as the 1960–70s, it was shown that the preservation of the chord-papillary apparatus

of mitral valve (MV) and annulopapillary continuity plays a crucial role in the functioning of the LV. Many surgeons believe that the preserved chord-papillary apparatus of MV allows to leave the sequence of physiological contraction of the left ventricular wall unchanged, improves contractility of the LV myocardium in the near and long-term postoperative period, especially in patients with increased LV and mitral insufficiency [10].

## Material and methods

At the Research Institute of Heart Surgery and Organ Transplantation, retrospective analyzes after mitral valve surgery with and without preservation of the posterior cusp of the chordal-papillary apparatus (CPA) of the mitral valve in patients with a defect were selected.

The analysis includes the following parameters: total duration of treatment, intraoperative duration during cardiopulmonary bypass, duration of treatment in the intensive care unit and intensive care, drugs received (inotropic drugs: dopamine, adrenaline).

Divided into 2 groups for comparison. The average age of the patients was  $47.4 \pm 10.2$  years. Of the total number of patients, 40 (66.6%) were female and 20 (33.3%) were male. All patients had heart failure of varying severity, namely, in functional class 2 (FC) there were 2 (3.33%), in 3 FC - 53 (88.3%) and in 4 FC - 5 (8.33%) patients. In 32 (53.33%) cases, there was atrial fibrillation before surgery.

In the overwhelming majority, rheumatism was the cause of MV defect (59 (98.3%) patients), 1 (1.66%) had infective endocarditis. Mitral stenosis or its predominance was diagnosed in 44 (73.33%) patients, insufficiency or its predominance was noted in 11 (18.33%) (Table 1).

## Results

When analyzing the study group by the type of mitral defect in patients with insufficiency, the technique of preserving the posterior leaflet and CPA was more often used. Thickened chords together with papillary muscles can obstruct blood flow to the left atrium and create a large gradient between the left atrium and ventricle during diastole; therefore, in patients with severe stenosis, the MV in some cases had to remove completely subvalvular structures (Table 2).

Of all types of operations with preservation of the posterior valve, in 28 (46.66%) cases, complete preservation of GL prevailed. Due to the sharp thickening and shortening of the chords in 5 (5.3%) cases, we had to remove the chords of the first order. The amount of chord removal depended on the degree of thickening and shortening of the CPA. Of these, in 1 case, two were removed and in 4 - one

**Table 1.**  
Clinical characteristics of patients

| Indicators                                    | Absol. Number | %     |
|---|---------------|-------|
| <b>Average age, years</b>                     | 47,4±10,2     |       |
| <b>Floor:</b>                                 |               |       |
| men   | 20            | 33,3  |
| women   | 40            | 66,6  |
| <b>Functional class:</b>                      |               |       |
| II  | 2             | 3,33  |
| III   | 53            | 88,3  |
| IV  | 5             | 8,33  |
| <b>The reason for the defect:</b>             |               |       |
| rheumatism                                    | 59            | 98,3  |
| congenital defect                             | 0             | 0     |
| infective endocarditis                        | 1             | 1,66  |
| <b>Heart rhythm:</b>                          |               |       |
| sinus rhythm                                  | 28            | 46,6  |
| fibrillation                                  | 32            | 53,33 |
| <b>The nature of the mitral valve defect:</b> |               |       |
| stenosis                                      | 44            | 73,33 |
| failure                                       | 11            | 18,33 |

**Table 2.**  
Preservation of subvalve structures

| Nº | Preservation of subvalve structures                             | Abs. number | %     |
|----|---|-------------|-------|
| 1  | Preservation of the back leaf and chordo-papillary apparatus    | 28          | 46,66 |
| 2  | Complete removal of the leaflet and chordal-papillary apparatus | 32          | 53,33 |

first order chord. Nevertheless, holding the opinion that preserved CPA MK leads to an improvement in the work of the myocardium [1,2,3]. In the second group, 32 patients were removed under the MV valve structure.

The duration of cardiopulmonary bypass in the main group averaged 85.89±29 minutes, the time of aortic clamping was 59±26 minutes, the control group averaged 88.15±36.6 minutes, the time of aortic clamping was 63.81±31.08 minutes Cold hyperpotassium blood cardioplegia was used to protect the myocardium.

According to the restoration of cardiac activity in the main group, independent recovery of 17 patients (60.71%), as well as in the second group 26 (81.25%). Through fibrillation 11 (39.28%) in the first group, 6 (18.7%) in the second group (Table 3).

**Table 3.**  
Operating indicators

| Operating indicators                            | 1 <sup>st</sup> group |        | 2 <sup>nd</sup> group |        |
|---|-----------------------|--------|-----------------------|--------|
| Average time of extracorporeal circulation, min | 85,89±29              |        | 88,15±36,6            |        |
| Average time of aortic clamping, min            | 59±26                 |        | 63,81±31,08           |        |
| Recovery of cardiac activity: %                 |                       |        |                       |        |
| Independent                                     | 17                    | 60,71% | 26                    | 81,25% |
| Through fibrillation                            | 11                    | 39,28% | 6                     | 18,7%  |

**Table 4.**  
Postoperative complications

| Types of complications          | 1 <sup>st</sup> group |       | 2 <sup>nd</sup> group |       |
|---------------------------------|-----------------------|-------|-----------------------|-------|
|                                 | Absolute              | %     | Absolute              | %     |
| <b>Non-fatal complications:</b> | 28                    | 46,66 | 32                    | 53,33 |
| a) heart failure                | 1                     | 3,57  | 7                     | 21,87 |
| b) respiratory failure          | 0                     | 0     | 1                     | 3,12  |
| c) diastasis of the sternum     | 0                     | 0     | 1                     | 3,12  |
| <b>Fatal complications</b>      | 0                     |       | 0                     |       |

In the postoperative period, out of 60 patients, 10 (16.66%) patients had various types of complications (Table 4).

In 10 cases, non-fatal postoperative complications were noted. In patients with heart failure, cardiotonics have been used in therapeutic doses. In 4 cases, higher therapeutic doses and prolonged artificial ventilation were used. One patient developed sternal diastasis after surgery. Conducted osteosynthesis of the sternum, discharged on the 12th day after osteosynthesis (table 4). In the main group of renal doses, 21 (75%) patients received dopamine - 2.38±0.21 µg / kg / min, adrenaline - 0.021 ± 0.003 µg / kg / min. Cardiotonics have not been received at therapeutic doses. Above therapeutic doses - 2 (7.14%) patients received (dopamine) - 8 ± 0.01 µg / kg / min.

| Cardiotonics (inotropic drugs): (dopamine, adrenaline) | 1 <sup>st</sup> group (n-26) (µg / kg / min) | № п | %     | 2 <sup>nd</sup> group (n-32) (µg / kg / min) | № п | %      | p    |
|--|--|-----|-------|--|-----|--------|------|
| No inotropic support                                   |  | 4   | 14,28 |  | 2   | 6,25   | <005 |
| Renal  | д-2,38±0,21<br>а-0,021±0,003                 | 21  | 75    | д -2,24±0,54<br>а-0,021±0,001                | 23  | 71,875 | <005 |
| Therapeutic  | 0  |     | 0     | д-5,2±0,4<br>а-0,04±0,001                    | 5   | 15,6   | <005 |
| Higher therapeutic                                     | д-8±0,01<br>а- 0                             | 2   | 7,14  | д-8,2±0,02<br>а-0,07±0,003                   | 2   | 6,25   | <005 |

**Table 5.**  
Use of inotropic drugs

| Stay before and after surgery                 | 1 group No. 28 | 2 group No. 32 |
|---|----------------|----------------|
| 1) general, day                               | 22,07±7,41     | 20,1±7,6       |
| 2) before surgery, day                        | 9,85±5,11      | 8,18±4,44      |
| 3) after surgery, day                         | 12,2±4,5       | 12±6,3         |
| Hours spent in the intensive care unit, hours | 42±22          | 48,75±41,11    |

**Table 6.**  
Hospital stay

In the control group with renal doses, 23 (71.87%) patients received dopamine  $2.24 \pm 0.54 \mu\text{g} / \text{kg} / \text{min}$ , adrenaline -  $0.021 \pm 0.001 \mu\text{g} / \text{kg} / \text{min}$ . Therapeutic doses of 5 (15.6%) patients dopamine -  $5.2 \pm 0.4 \mu\text{g} / \text{kg} / \text{min}$ , adrenaline -  $0.04 \pm 0.001 \mu\text{g} / \text{kg} / \text{min}$ . Above therapeutic doses in 2 (6.25%) patients, dopamine -  $8.2 \pm 0.02 \mu\text{g} / \text{kg} / \text{min}$ , adrenaline -  $0.07 \pm 0.003 \mu\text{g} / \text{kg} / \text{min}$  (Table 5).

The table shows that in the postoperative period the indicators changed significantly. However, there was a decrease in the use of cardiotonics in the first group, mainly at renal doses.

Hospital stay in the first group spent days  $22.07 \pm 7.41$ , before surgery  $9.85 \pm 5.11$  days, after surgery  $12.2 \pm 4.5$  days and in the second group  $20.1 \pm 7.6$  days, before surgery  $9,85 \pm 5.11$  days, after surgery  $12.2 \pm 4.5$  days (Table 6).

Extubation after surgery in the 1st group on the first day, 25 (89.28%) patients were extubated. There were 26 (84.37%) patients in the control group (table 7).

## Conclusions

Thus, according to the data obtained as a result of the analysis of the immediate postoperative results of MVR with the preservation of GL compared to the complete removal of CPA, the use of inotropic drugs decreases, the time spent in the A&R department decreases. And also immediately after the operating room heart failure is significantly reduced (Table 4). The operative technique of preserving the posterior cusp with its subvalvular structure is easy to perform surgically and does not lengthen the time of artificial circulation (Table 3).

| Day       | 1 group No. 28 | 2 group No. 32 |
|-----------|----------------|----------------|
| the first | 89,28%         | 84,37%         |
| second    | 10,71%         | 12,5%          |
| third     | 0              | 0              |
| fourth    | 0              | 3,25%          |

**Table 7.**  
Extubation after surgery

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