MINI-INVASIVE TRANSMITRAL MYECTOMY AND MITRAL VALVE REPLACEMENT IN OBSTRUCTIVE HYPERTROPHIC CARDIOMYOPATHY CASE

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Primary hypertrophic cardiomyopathy is an isolated genetic heart disease characterized by thickening of the myocardium in the absence of an apparent hemodynamic cause. There are two patterns of the obstruction: static, with a muscle band narrowing the outflow tract of the left ventricle, and dynamic, which implies elongation of the anterior mitral valve leaflet. The key to correct treatment of the condition is understanding of the mechanism behind the obstruction. Myectomy is the gold standard of invasive treatment of obstructive hypertrophic cardiomyopathy; it aims to remove the static component of the obstruction. Another common adidition is the mitral valve surgery, aimed at elimination of the obstruction's dynamic component. This article presents a successful mini-invasive transmitral myectomy and mitral valve replacement in a case of obstructive hypertrophic cardiomyopathy with a damaged mitral valve.

Keywords: minimally invasive surgery, obstructive hypertrophic cardiomyopathy, mitral valve replacement

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ТРАНСМИТРАЛЬНАЯ МИОЭКТОМИЯ И ПРОТЕЗИРОВАНИЕ МИТРАЛЬНОГО КЛАПАНА ИЗ МИНИДОСТУПА ПРИ ОБСТРУКТИВНОЙ ГИПЕРТРОФИЧЕСКОЙ КАРДИОМИОПАТИИ

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Гипертрофическая кардиомиопатия (первичная) — это изолированное генетическое заболевание сердца, выражающееся в утолщении миокарда без явной гемодинамической причины. Существует два механизма обструкции: статический — мышечный валик, стенозирующий выносящий тракт левого желудочка, и динамический — удлиненная передняя створка митрального клапана. Понимание механизма обструкции является ключом к правильному лечению. Золотым стандартом инвазивного лечения обструктивной гипертрофической кардиомиопатии является миоэктомия, устраняющая статический компонент обструкции. Ее дополняют вмешательствами на митральном клапане, которые помогают устранить динамический компонент обструкции. В статье представлен клинический случай успешной трансмитральной миоэктомии и протезирования митрального клапана из мини-торакотомии при обструктивной гипертрофической кардиомиопатии с поражением митрального клапана.

Ключевые слова: миниинвазивная хирургия, обструктивная гипертрофическая кардиомиопатия, протезирование митрального клапана

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Соблюдение этических стандартов: от пациента получено добровольное информированное согласие на оперативное лечение.

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Primary hypertrophic cardiomyopathy is an isolated genetic heart disease characterized by thickening of the myocardium in the absence of an apparent hemodynamic cause. There are over 1400 mutations in more than 11 genes encoding the cardiac sarcomere proteins that can cause the disorder [1]. In some nosologies, like the Noonan syndrome, the MELAS syndrome, the Sengers syndrome etc., heart damage is secondary.

The degree of obstruction of the left ventricular outflow tract (LVOT) defines the severity of hypertrophic cardiomyopathy. There are two patterns of the obstruction, one involving a muscle bundle narrowing the LVOT and another is the elongation of the anterior mitral valve (MV) leaflet. The key to correct treatment of the condition is understanding of the mechanism behind the obstruction. Although myectomy is the gold standard of invasive treatment of obstructive hypertrophic cardiomyopathy (OHC), MV surgery, which aims at elimination of the obstruction's dynamic component, should also be considered.

It is very important to make the myectomy sufficiently complete. The classical transaortic access, however, imposes limitations on manipulations deeper in the left ventricle. Moreover, even following all the rules of myectomy, there is still a risk of damage of the tracts. Transmitral access, on the other hand, involves partial amputation of the MV's anterior leaflet (which gives direct access to the interventricular septum (IVS)), followed by myectomy, reduction of the posterior leaflet's height (if it is more than 20 mm), and remodeling annuloplasty

with a support ring. The operation is finished with restoring the integrity of the MV's anterior leaflet by suturing in an oval autopericardium patch.

However, the question of advisability of the above-described plastic reconstruction of MV is still an open one. If the patient suffers from a pronounced SAM syndrome, there is a risk of recurrence of the dynamic obstruction.

This sort of intervention can be minimally invasive, but this approach to the matter has not yet been properly developed. In Russia, the share of surgeries through mini-access in isolated pathologies is very low, and the number of combined interventions is single-digit. Only the successful technique application cases are described in the published papers, which prevents accumulation of objective data thereon. However, it is possible that the negative consequences linked to mini-invasive access are mainly associated with the complexity of the incision itself and not with the procedures made through such access. In addition to the obvious advantages, minimally invasive procedures deliver results comparable to those attained through the classical access. This is convincing point in favor of the promise of development of the short-scar incision cardiac surgery.

This article presents a successful transmitral myectomy and mitral valve replacement through a mini access in a case of hypertrophic obstructive cardiomyopathy (HOCM) with a damaged mitral valve.

Case description

A 65-year-old female patient was admitted to the Department of Cardiac Surgery of the I.V. Davydovsky City Clinical Hospital. Case history: for 15 years she has been suffering from shortness of breath and dizziness during physical exertion (climbing the stairs from one floor to the next one). Since December 2020, even minimal exertion, like climbing 2 or 3 steps, brought shortness of breath. The described condition was the reason for an outpatient examination. Echocardiography (EchoCG; June 16) revealed the EF to be at 70% and the IVS asymmetrically hypertrophied (up to 17 mm in the basal regions). Other findings included obstruction of the LVOT (HPmax in LVOT > 100 mm Hg), violation of myocardial relaxation, retraction of the MV's posterior leaflet in the left atrial (LA) up to 10 mm, severe mitral insufficiency (4th degree, type II by Carpentier classification). Transesophageal echocardiography (TEE; June 16) showed a significant deflection of the posterior leaflet in the area of P3 and P2 (caused by chordal detachment), several regurgitant jets, vena contracta — 0.45 cm^2, SAM. Coronary angiography revealed no lesions. The main diagnosis: severe mitral insufficiency caused by the detachment of chords of MV's posterior leaflet. Obstructive hypertrophic cardiomyopathy (asymmetric, IVS / LVOT > 1.6/1; HP > 100 mm Hg). Complications: chronic heart failure 2A (CHF 2A), FC 2 according to NYHA.

The patient underwent mitral valve replacement with a mechanical prosthesis and transmitral myoectomy through a short-scar thoracotomy with pharmaceutical and cold blood cardioplegia and cardiopulmonary bypass (femoral vein-femoral artery) (surgeon O.Yu. Pidanov). MV reconstruction was not undertaken because mini access makes anterior leaflet reduction and neochord reconstruction difficult, and there is a high risk of development of the SAM syndrome: the obstruction was not only static but also dynamic. This patient had a subaortic obstruction that could not be remedied after MV replacement, which is an indication for myectomy, the golden standard treatment for HOCM.

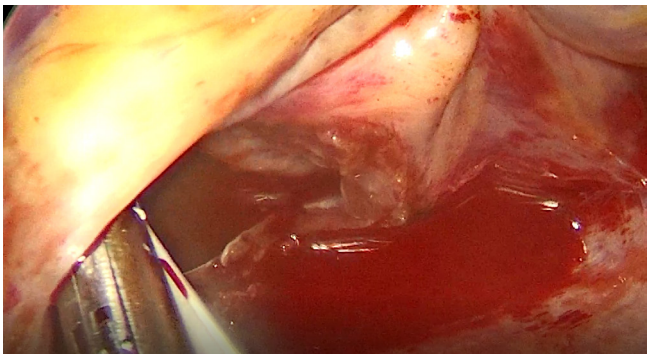

Fig. 1. Left atticotomy behind the interatrial sulcus

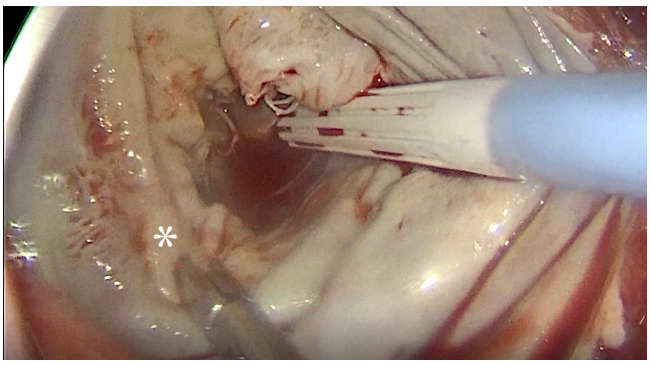

Fig. 2. Intraoperative view of the MV from the LA side. * — excessive mobility of the posterior leaflet in the P3 and P2 regions due to detachment of the chords

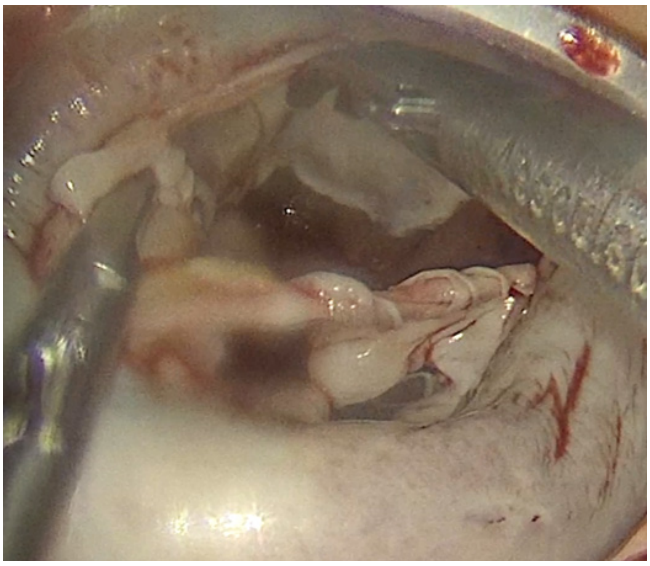

Fig. 3. MV excision, exposure of the LVOT obturation

Once the aorta was clamped, we placed a root aortic cannula to enable antegrade crystalloid cardioplegia (2000 ml). Carbonization was also part of the process. The MV was accessed from the left atrium through an incision behind the interatrial sulcus (Fig. 1).

To expose the MV and to move further into the left ventricle, an atrial retractor was placed. Intraoperative view of the MV: detachment of the chord in the P2 segment, severe insufficiency (Fig. 2).

The muscle bundle obturating the LVOT becomes visible as the MV is excised (Fig. 3).

Myectomy began immediately below the MV annulus (navigation lines indicate excision volume) (Fig. 4) and continued to the base of the papillary muscles (Fig. 5). The

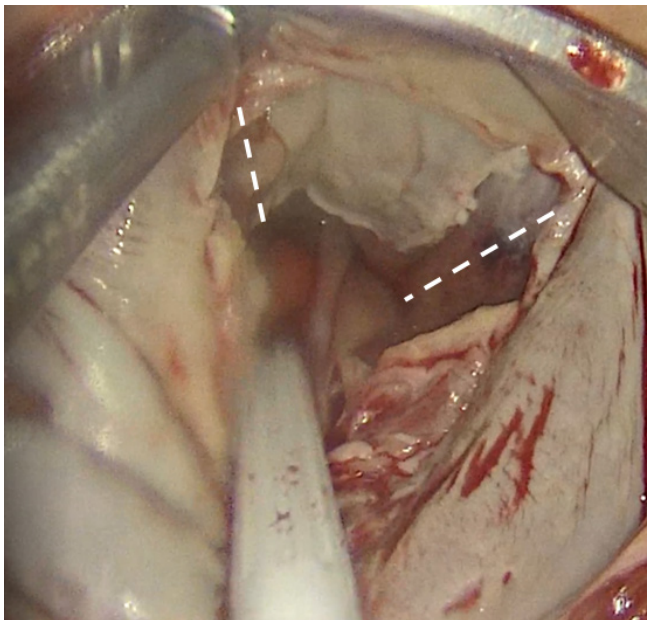

Fig. 4. Muscle bundle obtruding the LVOT. Navigation lines indicate the extent of the excision

excised fragment of the muscle measured 3 × 3 × 0.7 cm.

Excision of the MV with partial excision of the subvalvular structures was a myectomy (Fig. 6).

Final view after myectomy: excised MV and muscle bundle; LV cavity became larger, especially near the LVOT; the papillary muscles were intact (Fig. 7).

A mechanical MV was placed with 17 single matrass sutures (Fig. 8).

The function of the prosthesis was reviewed and assessed. The atriotomy was closed with a double-row suture; after careful deaeration, the aortic clamp was removed. Cardiac activity restored without external assistance, HR = 85. Bypass was stopped with stable hemodynamics. Decannulation was performed from the femoral vein and artery, wound in the femoral region was closed with layered sutures. The pleural cavity was drained with a silicone drain tube, the thoracotomy wound was closed layered sutured. The patient was on bypass for 123 minutes; the aorta was clamped for 68 minutes. The patient was transported to the cardiac intensive care unit.

The result of the operation: HPmax in LVOT — 8 mm Hg, mean pressure gradient in the MV prosthesis — 7 mm Hg, sinus rhythm, no signs of AV-, SA-blockades. The patient was discharged on the 20th day after resolution of the post-surgery complications: right-sided hemopneumothorax, 1st degree endobronchitis (Lemoine classification).

Clinical case discussion

In cardiac surgery, minimally invasive techniques do have obvious advantages over the classical surgical access patterns: they reduce blood loss, pain, the likelihood of infectious complications, and shorten the rehabilitation period [2]. Few surgeons have mastered minimally invasive techniques; there are no standards regulating the respective training, which means the end result largely depends on the surgeon and may vary in different clinics. In addition, far from all clinical cases are described in the published papers: not all surgeons are ready to report their failures and mistakes, while everyone wants to talk about successful complex operations. Nevertheless, there is evidence that the results of surgeries done through a short-scar access are quite comparable with the results of operations

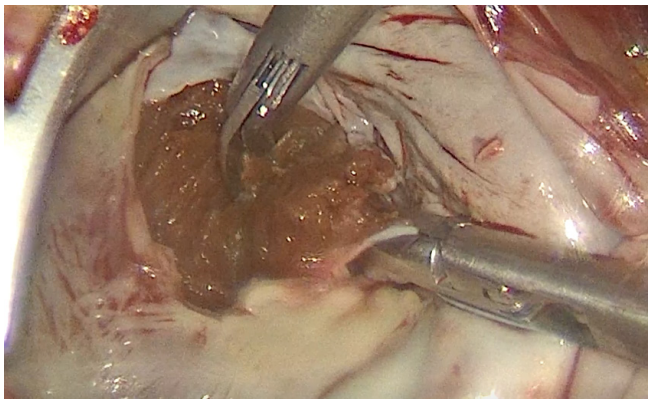

Fig. 5. The process of excision of the swelling muscle

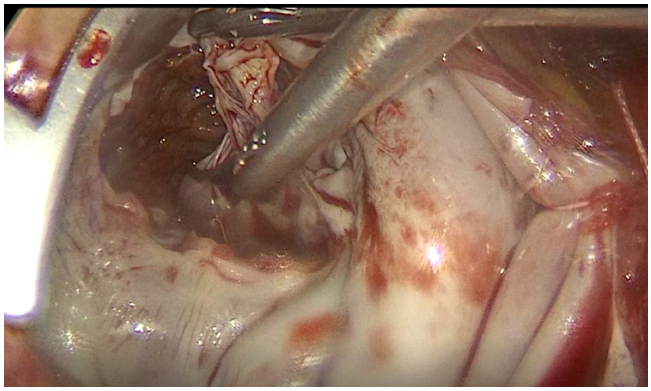

Fig. 6. Final stage of the process of excision of the MV and some of the subvalvular structures

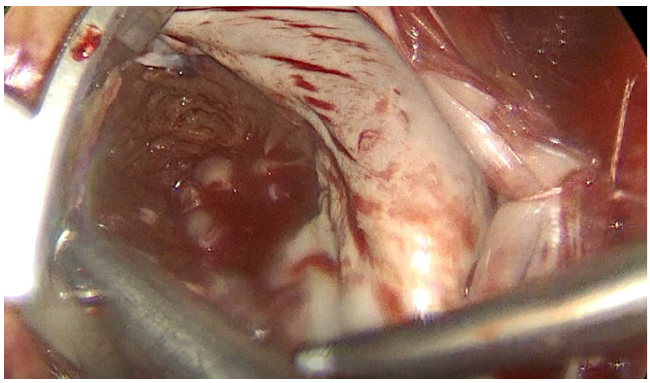

Fig. 7. LV after MV excision and myectomy (final view)

performed through a classic sternotomy [3]. Mini access probably can replace sternotomy, but only in the context of certain interventions. While the procedure is crucial for the patient, convenience of surgical access has to be a priority.

Myectomy can be transaortic, transapical, transventral, transmitral. Transaortic septal myectomy gives excellent long-term results [4] and is a classic solution for HOCM, but the decision to apply it should be based on rational reasons. The respective access is an optimal one when the target is an subaortic muscular stenosis, but if the obstruction is slightly lower, it can make the surgeon's work more difficult. There are improved myectomy techniques for such cases. The flaw with transaortic access is the ease with which surgeons can damage the conducting pathways passing at the central fibrous body's projection site (between right coronary and non-coronary cusps). Transmitral access is a good choice for myectomy at the midventricular level of the IVS [5]; the risk of damage to the pathways is lower with this approach. In the

described clinical case, we opted for the transmitral access, since it allows operating on the MV simultaneously.

If MV can be repaired, LV is exposed by cutting off the MV's anterior leaflet in case of a transmitral access. At the end of the myectomy, the valvotomy is sutured (if necessary, covered with patch), and the patient's valve can be saved. This technique has been used in and described in detail [6]. The method was repeated with video-assisted short-scar thoracotomy, with patients suffering from diffuse obstructive HOCM and SAM induced moderate mitral regurgitation.[7]

Preservation of the native MV and elimination of the obstruction are the main goals in the treatment of patients with HOCM. The frequency of MV replacement in the HOCM expert surgery centers is less than 5% [8], and in the Cardiology Republican Research and Practice Center (Minsk, Republic of Belarus) it is 0% (160 cases over the past 5 years). By itself, MV replacement for HOCM patients, compared with its repair or isolated myoseptectomy, is associated with worse immediate and long-term results; this is considered a disabling intervention, an opinion shared by Russian and foreign authors [9, 10]. Detachment of the chords in the MV's P2 segment (as in the case described) can be successfully corrected surgically in more than 95% of cases. For this patient, we decided to replace the MV taking into account her age and the unreasonable risk of repeated surgical intervention. In addition, there are no convincing data on the efficacy of reconstruction done through a mini access.

Thus, the surgical tactics, its expediency and conformity to the world experience in managing such patients are substantiated.

CONCLUSION

The described clinical case demonstrates the possibility of correcting HOCM with MV lesion through a right side short-scar thoracotomy.

There are specific indications for MV replacement in such patients: obvious inexpediency of native valve repair or significant mitral regurgitation not associated with the HOCM, which renders the repair impossible.

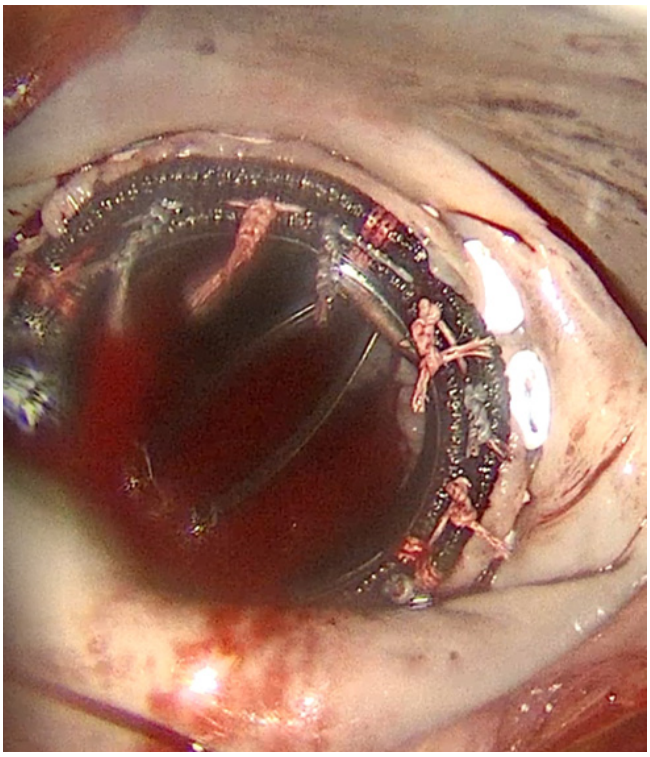

Fig. 8. MV prosthesis

On one hand, minimally invasive approaches in surgery still remain underutilized due to the technical complexity of the respective procedures and little experience accumulated in this area so far. On the other hand, minimally invasive techniques ensure results comparable to those achieved with open heart surgery. There is an obvious need for further development in this direction, especially considering the general trend in surgery towards minimal invasiveness.

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