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Modern views on treatment of critical mitral stenosis

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Abstract

Mitral stenosis - narrowing of the left atrioventricular orifice due to fusion of the leaflets of the bicuspid valve, changes in subvalvular structures and fibrous degeneration of the valve ring. This creates obstacles to the flow of blood from the left atrium and is accompanied by a decrease in stroke volume and cardiac output. Mitral stenosis leads to pulmonary hypertension syndrome. This review provides an update on rheumatic mitral stenosis, its possible causes, clinical picture diagnosis and modern treatment options in the evolving world. The latest therapeutic approaches, including lifestyle changes, medical, surgical, and transcatheter valvular interventions including percutaneous transcatheter mitral valvuloplasty will be discussed.

Keywords: Mitral stenosis; Treatment; Diagnosis; Surgery; Percutaneous coronary interventions

1. Introduction

Acquired heart disease, in particular rheumatic valvular heart disease, continues to be an epidemic in Asia. Since 1910, there has been a decrease in the incidence of rheumatic disease in developed countries, and at present the incidence is less than 1.0 per 100,000 population [1].

On the other hand, the incidence of rheumatic heart disease in developing countries remains significant. Since the decline in the prevalence of rheumatic fever in industrialized countries began before the era of penicillin and was thus associated with rising living standards, the continued prevalence of rheumatic heart disease in undeveloped or developing countries is not only due to the limited availability of penicillin. but to their socio-economic status (i.e. overcrowding, overcrowding, poverty and poor access to health care) [2].

According to the World Heart Federation's annual report, about 12 million people currently suffer from rheumatic fever and rheumatic heart disease worldwide, with high rates reported in the South Pacific islands. There have been several studies on the prevalence of rheumatic heart disease reporting 0.14/1000 in Japan, 1.86/1000 in China, 0.5/1000 in Korea, 4, 54/1000 in India and 1.3/1000 in Bangladesh [3,4,5,6]. In rapidly developing Asian countries, awareness of rheumatic heart disease prevails along with the widespread use of transthoracic echocardiography. In addition, the demand for adequate medical therapy is growing in tandem with explosive socioeconomic growth, which may lead to increased use of balloon mitral valvuloplasty (BMV [7].

The classification of mitral stenosis proposed by A.N. Bakulev and E.A. Damir [8]. It includes 5 stages of development of the defect:

- I - stage of complete compensation of blood circulation. The patient does not show any complaints, however, an objective examination reveals signs characteristic of mitral stenosis. The area of the mitral orifice is 3-4 cm2, the size of the left atrium is no more than 4 cm.

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- II - stage of relative circulatory insufficiency. The patient complains of shortness of breath that occurs during physical exertion, there are signs of hypertension in the pulmonary circulation, venous pressure is slightly increased, but there are no pronounced signs of circulatory failure. The area of the mitral orifice is about 2 cm2. The size of the left atrium is from 4 to 5 cm.
- III - the initial stage of severe circulatory failure. At this stage, there are phenomena of stagnation in the small and large circles of blood circulation. The heart is enlarged. Venous pressure is significantly increased. There is an enlargement of the liver. The area of the mitral orifice is 1-1.5 cm2. The size of the left atrium is 5 cm or more.
- IV - stage of pronounced circulatory failure with significant stagnation in the large circle. The heart is greatly enlarged, the liver is large and dense. High venous pressure. Sometimes small ascites and peripheral hypostases. Patients with atrial fibrillation also belong to this stage. Therapeutic treatment gives improvement. The mitral orifice is less than 1 cm2, the size of the left atrium is more than 5 cm.
- V - corresponds to the terminal dystrophic stage of circulatory failure according to V.Kh. Vasilenko and N.D. Strazhesko. There is a significant increase in the size of the heart, a large liver, a sharply increased venous pressure, ascites, significant peripheral edema, constant shortness of breath, even at rest. Therapeutic treatment does not work. The area of the mitral orifice is less than 1 cm2, the size of the left atrium is more than 5 cm.

Clinical picture. The main complaint of patients with mitral stenosis is shortness of breath because of a decrease in the minute volume of blood circulation and a violation of the mechanism of external respiration [9]. Its intensity is directly dependent on the degree of narrowing of the mitral orifice. Palpitations are the second sign of mitral stenosis after shortness of breath and are a manifestation of a compensatory mechanism in conditions of insufficient minute volume of blood circulation. Hemoptysis and pulmonary edema are less common and occur mainly when rheumatic vasculitis is combined with severe congestion in the pulmonary veins and bronchial vessels. Rarely, hemoptysis is associated with pulmonary infarction [10]. Pulmonary edema is caused by severe hypertension of the small circle in combination with left ventricular failure. The resulting hypoxia leads to an increase in the permeability of the vascular wall and the penetration of the liquid fraction of blood into the alveoli. Cough is a common symptom of mitral stenosis and is usually associated with congestive bronchitis. Pain in the region of the heart is a less constant sign of this defect, they appear only with a significant increase in the left atrium, accompanied by compression of the left coronary artery [11]. General physical weakness is very characteristic of mitral stenosis and is a consequence of chronic hypoxia of the body, in particular skeletal muscles.

The clinical manifestations of mitral stenosis are very diverse. It can be masked by violations of intracardiac hemodynamics from other causes, may not cause subjective sensations at all and at the same time cause a sudden attack of acute heart failure with a fatal outcome.

Diagnostics. In typical cases, there is pallor of the skin with cyanosis of the lips, cheeks, and tip of the nose. Auscultator data are very characteristic: "flapping", "cannon" first tone, accent and bifurcation of the second tone over the pulmonary artery [12]. The second component of this tone is recorded as a "click". Diastolic murmur with presystolic enhancement over the apex of the heart is a characteristic auscultator sign of mitral stenosis if sinus rhythm persists. With tachycardia, the listed auscultator signs may be absent. Therefore, when examining a patient, it is necessary to achieve a decrease in heart rate (calm down, give the patient a horizontal position, possibly resort to medication), and then repeat auscultation and phonocardiography.

X-ray signs are quite characteristic: a heart of a mitral configuration with a sharp expansion of the pulmonary artery and left atrial appendage, pronounced stagnation in the vessels of the lungs of a mixed nature, in severe cases - signs of hemosiderosis. On the radiograph in the right lateral projection, an increase in the right ventricle with filling of the retrosternal space is seen. The contrasted esophagus in this projection deviates along an arc of small radius (up to 6 cm), which indicates an increase in the left atrium.

A characteristic electrocardiographic sign is the deviation of the electrical axis of the heart to the right, signs of hypertrophy of the right ventricle and left atrium, as well as atrial fibrillation in the later stages of the disease. Phonocardiography signs, as a rule, correspond to other auscultations. Echocardiographic data are very characteristic, allowing to measure the mitral orifice with great accuracy, to get an idea of the nature of the anatomical changes in the valve, to recognize the presence of left atrial thrombosis and evaluate the function of the heart.

The main method of treatment of patients with mitral stenosis is surgical. Surgical treatment is indicated for patients with stage II-IV disease. Patients with stage I do not need surgery. In patients with stage V mitral stenosis, surgical

treatment is absolutely contraindicated, since it is associated with a very high risk. Nowadays, percutaneous balloon mitral valvuloplasty is widely used for the treatment of the disease.

Percutaneous balloon mitral valvuloplasty. Prior to the advent of BMV, most patients with symptomatic mitral stenosis underwent surgical mitral commissurotomy, either open or closed. The closed mitral commissurotomy was first described by Harken and Bailey in the late 1940s [13]. Subsequently, after the development of cardiopulmonary bypass, the open surgical commissurotomy replaced the closed technique in most countries in the late 1960s and early 1970s [14]. In 1982, Japanese cardiac surgeon Kanji Inoue first put forward the idea that a degenerated mitral valve could be inflated using a balloon made of strong but pliable natural rubber [15].

This concept was similar to the closed surgical technique already abandoned at the time. At first, this unique technique was largely limited to Far East Asia, while in most other countries, traditional cylindrical balloons, which were originally developed for pulmonary valvuloplasty, were used for mitral valvuloplasty. Lock et al in India reported for the first time the use of such a cylindrical balloon for mitral valvuloplasty [16]. Subsequently, the double balloon technique was proposed from Saudi Arabia as a potential alternative technique for balloon commissurotomy. The double balloon technique requires 2 guidewires to be placed at the apex of the left ventricle, through which 2 floating balloon catheters are then advanced through the mitral valve orifice. Although the double balloon method is certainly effective, it is more technically complex and therefore often requires a longer procedure time, which can lead to unintended complications. The conductor located in the apex of the left ventricle sometimes causes perforation of the apex, resulting in cardiac tamponade. In fact, the Inoue single cylinder BMW provides equivalent performance compared to the double cylinder method and with fewer procedural risks. Thus, today the Inoue single cylinder technique has become the most popular method for performing BMWs in most cases. World.

The BMV mechanism is the same as for closed mitral commissurotomy, which has already been abandoned. Pathological studies have shown that the main mechanism for successful BMV is the fracture of adhesions. Compared with surgical mitral commissurotomy, BMV has shown equal or better success rates and comparable rates of restenosis [17]. Randomized trials comparing BMV with closed commissurotomy have shown that BMV is superior to closed commissurotomy, providing greater valve area and better long-term outcomes [18].

A limitation of both scoring systems is the lack of information about the location of valvular anomalies in relation to adhesions, which may affect BMV results [19]. Since BMV theoretically helps resolve multiple sclerosis by breaking up adhesions, a valve with bilateral adhesions may be more beneficial. Conversely, a valve without adhesions, in which a rigid leaflet or annulus results in ostial stenosis, may not be effective in commissurotomy because the leaflets or subvalvular apparatus may break. In addition, the presence of severe or bilateral calcification of adhesions may predict poor outcome due to worsening of mitral regurgitation after procedure or suboptimal increase in valve area [20]. Whichever scoring system is adopted, BMW success requires careful evaluation of leaflet compliance, degree of degeneration and calcification of adhesions, subvalvular apparatus, annulus, and leaflets.

To detect a thrombus in the left atrium or left atrial appendage, trans esophageal echocardiography should be performed prior to performing LMA. At our institute, we never perform BMV if we find a thrombus in the left atrium or left atrial appendage. Although some researchers insist that BMV can be safely performed even in the presence of a thrombus in the left atrial appendage [21], this therapeutic approach should be seriously discouraged. If an MVP thrombus is detected, treatment with warfarin should be delayed and the prothrombin time and international normalized ratio monitored at a relatively higher level for 3 to 6 months, followed by repeat trans esophageal echocardiography to confirm resolution of thromboembolism [20]. If the thrombus has disappeared, then PMA can be safely performed, and if the thrombus remains, surgery on the mitral valve should be recommended along with removal of the thrombus.

There is controversy regarding indications for BMV in cases of (1) asymptomatic moderate (mitral valve area 1.0 to 1.5 cm 2) to severe (mitral valve area <1.0 cm 2) multiple sclerosis, (2) symptomatic mild (mitral valve area> 1.5 cm 2).) and (3) symptomatic severe multiple sclerosis with unfavorable anatomical characteristics.

In asymptomatic moderate to severe multiple sclerosis, both guidelines recommend early use of BMV for patients at high risk of embolism (ESC: paroxysmal atrial fibrillation [grade IIa], history of embolism [grade IIa], evidence of spontaneous atrial contrast echo [grade IIa]; AHA/ACC : New episode of paroxysmal atrial fibrillation [Class IIb] or haemodynamic decompensation; ESC: High systolic pulmonary artery pressure [Class IIa], need for major surgery [Class IIa] and pregnancy [Class IIa]; and AHA/ACC: Resting pulmonary hypertension [class I] or during exercise [class I] and poor exercise tolerance [class I] when patients have favorable clinical/anatomical characteristics) [22]. If patients

complain of exertional dyspnea that is disproportionate to the degree of multiple sclerosis, ACC/AHA guidelines recommend the use of exercise Doppler echocardiography to detect hemodynamically significant occult MS [23].

However, the prognostic value of such hemodynamic impairment during exercise remains unclear, and therefore the use of BMV for asymptomatic mild multiple sclerosis should be carefully reviewed on a case-by-case basis. The ACC/AHA guidelines recommend the use of BMWs in these scenarios (Class IIb) [24]. On the other hand, according to the ESC recommendations, mitral valve area >1.5 cm 2 is considered one of the contraindications to BMW [18].

Although underlying mitral valve morphology is the most important factor in determining outcome after therapy, PMV may be suggested as initial treatment (ESC: class IIa, AHA/ACC: class IIa) for selected patients with unfavorable anatomical characteristics but no unfavorable clinical characteristics. (ESC: Class IIa; ESC defines adverse clinical characteristics as the absence of multiple factors: advanced age, New York Heart Association [NYHA] class IV, severe pulmonary hypertension, atrial fibrillation, and history of commissurotomy) or have a high surgical risk. AHA: Class IIa) [25].

2. Conclusion

Overall, the results of surgical treatment of uncomplicated mitral stenosis are good. Immediately after the operation, patients note a decrease in shortness of breath, the phenomena of circulatory insufficiency gradually disappear. Long-term results depend on the initial state of the patients and the stage of the defect in which the surgical intervention was undertaken. They are best if the operation is performed in stage II-III, when secondary changes in the internal organs due to circulatory failure are reversible. The vast majority of such patients after 4-12 months. return to their previous jobs. Surgical treatment at the stage of severe disorders of the general circulation with irreversible morphological changes in the internal organs (sclerotic phase of pulmonary hypertension, cardiac cirrhosis of the liver, severe dystrophic changes in the myocardium, etc.) does not allow for a sufficiently complete rehabilitation of patients and stability of the results achieved in the long term. All patients who have undergone surgery should be under the supervision of a rheumatologist and receive seasonal antirheumatic treatment, as there is still a risk of restenosis or valve insufficiency, which often requires repeated surgery.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors have nothing to declare in relation to this article.

Author Contribution.

All authors equally contributed to this research.

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