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Progress in Interventional and Surgical Treatment of Obstructive Hypertrophic Cardiomyopathy

Youjin Qiao*

Department of Cardiac Surgery, Heart Center, Qingdao Municipal Hospital, Qingdao 266000, Shandong, China

**Author to whom correspondence should be addressed.*

***A*bstract:** To improve the treatment effect of obstructive hypertrophic cardiomyopathy, this article focuses on the treatment of obstructive hypertrophic cardiomyopathy and conducts a comprehensive analysis of the disease. It highlights the limitations of traditional treatment methods and elaborates on interventional and surgical treatments. Additionally, this article compares the indications, risks, treatment effects, and costs of the two different treatment methods, providing a reference for doctors and patients in selecting clinical treatment plans.

Keywords: Obstructive hypertrophic cardiomyopathy; Interventional therapy; Surgical treatment

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1. Introduction

Obstructive hypertrophic cardiomyopathy is a disease that severely affects patients' physical health and may even threaten their lives. With the continuous development of medical technology, the limitations of traditional drug therapy and dual-chamber pacemaker treatment for this disease have gradually emerged. Simultaneously, interventional and surgical treatment methods have been continuously innovated and optimized, offering new hope for patients seeking effective treatment. Both interventional and surgical treatments have their advantages and disadvantages, and the most appropriate treatment method should be selected based on the patient's actual condition.

2. Overview of obstructive hypertrophic cardiomyopathy

Wen *et al.* proposed that hypertrophic cardiomyopathy is a genetic disease [1]. One of the main characteristics of this disease is myocardial hypertrophy, and common clinical symptoms include thromboembolism, heart failure,

and arrhythmia. The left ventricular outflow tract pressure gradient in obstructive hypertrophic cardiomyopathy is not less than 30 mmHg. According to the location of the obstruction, it can be divided into mid-ventricular septal obstruction, left ventricular outflow tract obstruction, and right ventricular obstruction.

In a healthy heart, the ventricular septum separates the left and right ventricles, with a thickness of approximately 0.9 cm. However, in patients with obstructive hypertrophic cardiomyopathy, the thickness of the ventricular septum increases significantly. When the heart is in a contractile state, the increased myocardial thickness narrows the passage between the left ventricle and the aorta, severely affecting the smoothness of blood flow to the aorta. This can lead to a series of symptomatic manifestations such as dyspnea, precordial pain, dizziness, and arrhythmia. In severe cases, patients may even experience sudden death.

3. Limitations of traditional treatments for obstructive hypertrophic cardiomyopathy

Although traditional treatments for obstructive hypertrophic cardiomyopathy play a significant role in managing the disease, their limitations have gradually become apparent with the continuous advancement of medical technology.

Pharmacotherapy serves as a fundamental approach in traditional treatments, commonly utilizing calcium channel blockers and beta-blockers. According to research, calcium channel blockers not only weaken myocardial contraction but also aid in myocardial relaxation. Beta-blockers, on the other hand, can reduce heart rate, attenuate myocardial contractility, improve left ventricular obstruction, and enhance ventricular dilation, thereby alleviating symptoms. However, pharmacotherapy can only provide symptomatic relief, but it cannot effectively inhibit the progression of myocardial hypertrophy or completely resolve left ventricular obstruction. For patients with severe disease, it is challenging to achieve improved quality of life and disease control solely through pharmacotherapy.

In the late 20th century, dual-chamber pacemaker therapy was widely used in the clinical treatment of obstructive hypertrophic cardiomyopathy. The basic principle of this therapy involves placing a right ventricular electrode at the apex of the patient's right ventricle to alter ventricular depolarization and advance the contraction and depolarization of the interventricular septum. Early studies showed that some patients with severe disease symptoms and those who did not respond significantly to pharmacotherapy experienced significant symptom relief, such as dyspnea and angina, and a reduction in left ventricular outflow tract pressure gradient after dual-chamber pacemaker therapy. However, subsequent controlled trials found that although dual-chamber pacemaker therapy can reduce the left ventricular outflow tract pressure gradient, many patients did not experience a significant decrease. The improvement in symptoms may have been solely due to the placebo effect of pacemaker implantation, leading to questions about the application of this treatment in obstructive hypertrophic cardiomyopathy.

4. Interventional therapy for obstructive hypertrophic cardiomyopathy

4.1. Percutaneous septal myocardial chemical ablation

Liu *et al.* proposed that percutaneous septal myocardial chemical ablation is a procedure guided by transthoracic echocardiography [2]. Through the skin, intercostal space, and apex of the heart, while the heart is beating, a radiofrequency needle is directly and precisely delivered to the location of myocardial hypertrophy

in the interventricular septum. With the help of the radiofrequency needle, the temperature of the hypertrophic myocardial tissue is locally increased, causing the myocardial cells to dehydrate and ultimately undergo coagulative necrosis.

The significant advantage of this interventional therapy is that it causes minimal trauma to the patient, does not require thoracotomy, and does not depend on the patient's good condition. Patients can recover quickly after the procedure and do not need absolute bed rest; they can immediately get out of bed and move around [3–5]. Clinical practice studies have shown that most patients with obstructive hypertrophic cardiomyopathy experience a significant decrease in left ventricular outflow tract pressure gradient and good symptom relief, such as dyspnea and chest pain, after undergoing percutaneous septal myocardial chemical ablation. Their activity level also improves significantly, leading to a better quality of life [6]. Long-term follow-up of patients has revealed that some patients continue to experience relief of left ventricular outflow tract obstruction years later. However, this interventional therapy also carries certain risks and may cause complications such as ventricular septal perforation, expansion of myocardial infarction range, coronary artery dissection, and complete heart block. Nevertheless, with the continuous advancement of medical technology, this interventional therapy has become more mature, and doctors have accumulated richer treatment experience, resulting in a lower incidence of complications [7].

4.2. Radiofrequency catheter ablation

Chen *et al.* proposed that radiofrequency catheter ablation is an interventional therapy that precisely ablates the location of septal obstruction through a catheter [8]. This interventional approach offers precise positioning without the need for vascular dissection, resulting in minimal trauma to the patient and faster postoperative recovery. The basic principle of this interventional therapy involves utilizing the thermal effect of radiofrequency current to induce necrosis of the diseased myocardial tissue in the heart, thereby blocking abnormal electrical conduction pathways and restoring normal heart rhythm.

During radiofrequency catheter ablation treatment, doctors can accurately determine the location of abnormal electrical activity in the heart with the support of three-dimensional mapping technology. They then precisely deliver the radiofrequency catheter to that location and perform ablation on the diseased tissue, minimizing damage to normal myocardial tissue. This interventional therapy has a high success rate and can achieve good treatment results for many patients who are intolerant to drug therapy or for whom drug therapy is ineffective or suboptimal. However, this interventional approach also carries certain risks and may cause complications such as phrenic nerve injury, peripheral arterial embolism, stroke, pulmonary vein stenosis, and pericardial tamponade, requiring doctors to have a high level of professional skill and rich experience.

5. Surgical treatment of obstructive hypertrophic cardiomyopathy

5.1. Classic surgical treatment

Surgical treatment for obstructive hypertrophic cardiomyopathy has a long history, and one of the classic surgical methods is the resection of interventricular septum myocardium. This surgical approach was proposed by Professor Morrow from the United States in the 1960s, so it is also known as the Morrow procedure. This surgical treatment requires the patient's heart to be stopped, and extracorporeal circulation needs to be implemented. Doctors need to perform thoracotomy to expose the heart and then directly resect the hypertrophic

interventricular septum myocardial tissue to completely relieve the left ventricular outflow tract obstruction. For many patients who do not respond to drug therapy or for whom the effect is suboptimal, the Morrow procedure brings new hope. Through the Morrow procedure, the left ventricular outflow tract pressure gradient can be significantly reduced, promoting the recovery of heart function. With the continuous development of medical technology, the Morrow procedure has also undergone continuous improvement.

The emergence of modified and extended Morrow procedure not only allows for the removal of hypertrophic septal myocardium, but also enables treatment of the patient's septal fusion area and mitral valve papillary muscles, severing the abnormal connection between the two. Through the application of the modified and extended Morrow procedure, left ventricular outflow tract stenosis and mitral regurgitation can be improved, resulting in more significant relief of patient symptoms. According to clinical practice research, patients treated with the modified and extended Morrow procedure showed a significant decrease in left ventricular outflow tract pressure gradient, better recovery of cardiac function, and significantly extended survival time. However, both the original Morrow procedure and the modified and extended Morrow procedure have limitations. Both require open-chest surgery, which can cause significant trauma, require a long recovery time, and have high requirements for the patient's own conditions.

5.2. Minimally invasive surgical treatment

To address the shortcomings of traditional surgical procedures, minimally invasive surgical treatments have emerged, particularly the "myocardial shaving system," which has brought new hope to patients with obstructive hypertrophic cardiomyopathy. This surgical approach involves making a small incision on the patient's left anterior chest wall and using the myocardial shaving system to resect hypertrophic myocardial tissue while the heart continues to beat, guided by B-mode ultrasound.

Compared to traditional open-chest surgical methods, the advantages of minimally invasive surgery are more significant. Firstly, minimally invasive surgery causes less trauma to patients. Traditional surgery requires thoracotomy with larger incisions and can damage the patient's chest bones and muscular tissue. Minimally invasive surgery, with smaller incisions, avoids significant bodily harm and reduces postoperative pain. Secondly, recovery is faster due to the reduced trauma. Patients can ambulate soon after surgery and quickly return to normal work and life. Thirdly, minimally invasive surgery offers higher safety as it neither requires cardiac arrest nor extracorporeal circulation, reducing the risks of infection, bleeding, and other complications. Finally, this surgical approach boasts a high success rate, with lower chances of postoperative complications and significant improvement in patients' quality of life. The advent of minimally invasive surgical techniques provides a more effective and safer treatment option for obstructive hypertrophic cardiomyopathy, deserving widespread clinical promotion.

6. Comparison of interventional therapy and surgical treatment for obstructive hypertrophic cardiomyopathy

In the treatment of obstructive hypertrophic cardiomyopathy, both interventional therapy and surgical treatment have their respective advantages. Doctors and patients need to comprehensively consider various factors before making treatment decisions to select the most appropriate treatment plan.

From the perspective of indications, surgical treatment has a broader range of applications. Surgical

treatment is suitable for patients who have not responded significantly to drug therapy, those with a heart function classification of III or IV, and those with a left ventricular outflow tract pressure gradient of no less than 50 mmHg. In particular, it is suitable for patients with severe ventricular septal hypertrophy or lesions affecting the apex of the heart, abnormal mitral valve structure, those who are not suitable for chemical ablation, and those with concurrent structural heart disease or other coronary heart diseases [9]. Surgical treatment can directly address the diseased tissue, remove hypertrophic myocardial tissue, and repair abnormal mitral valves. Radiofrequency catheter ablation in interventional therapy is suitable for patients with arrhythmia, while percutaneous septal myocardial chemical ablation is suitable for patients who are not tolerant of surgical treatment or have suitable anatomy for septal branch vessels.

From the perspective of risk, interventional therapy has a relatively small trauma and thus a lower risk, but it may also cause some complications. However, with the continuous development of medical technology, the probability of complications has been decreasing and doctors have accumulated rich treatment experience to effectively respond to complications in a timely manner. Surgical procedures require open-chest access, which can cause greater trauma to patients and carry a higher risk compared to interventional therapy. However, the current risk of surgical death has been significantly reduced, and some medical institutions have achieved almost zero mortality rates.

From the perspective of treatment effectiveness, surgical treatment can completely remove the hypertrophic myocardial tissue, significantly improve left ventricular outflow tract obstruction and mitral regurgitation, and achieve long-lasting treatment effects. It can also restore the patient's left ventricular pressure to near-normal levels and restore heart capacity. Some patients who have undergone surgical treatment for many years still maintain good heart function and have significantly improved quality of life. Although interventional therapy can also effectively improve patients' symptoms, the durability of the treatment effect may not be as good as surgical treatment for some patients.

When selecting a treatment plan, doctors and patients can also make appropriate choices based on the patient's economic conditions. Typically, the cost of surgical treatment is relatively high, which can be a challenge for patients' financial situation, while the cost of interventional therapy is relatively low [10].

In addition, when providing advice on treatment options, doctors need to comprehensively consider the patient's condition, physical status, and age. If the patient is young, physically fit, and the condition is suitable for surgical treatment, doctors may recommend prioritizing surgical treatment to achieve complete resolution of the disease. If the patient is older, has poor physical conditions, and is not tolerant of surgery, doctors may suggest interventional therapy. When advising patients on treatment options, doctors will provide detailed information about the advantages and risks of interventional therapy and surgical treatment, and select the most appropriate treatment plan through adequate communication and collaboration.

7. Conclusion

In summary, with the continuous development of medical technology, significant progress has been made in the treatment of obstructive hypertrophic cardiomyopathy. Traditional treatment methods have gradually been replaced by interventional therapy and surgical treatment. Both interventional therapy and surgical treatment have their respective advantages. Doctors need to recommend the most appropriate treatment method based on the patient's actual situation, as well as a comprehensive consideration of various treatment indications, risks,

effects, and costs. They should also explain the advantages of the selected treatment method to the patient and strive to gain their approval. With the continuous development and optimization of medical technology, the risk of interventional therapy and surgical treatment is expected to further decrease, and the treatment effect will be more durable. This can better improve patients' symptoms and enhance their quality of life.

Disclosure statement

The author declares no conflict of interest.

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