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Obstructive Hypertrophic Cardiomyopathy: Cardiac Remodeling Before and After Morrow Septal Myectomy

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Abstract

This article presents the data of patients with obstructive form of hypertrophic cardiomyopathy after Morrow's myectomy and features of heart remodeling.

Keywords: Hypertrophic obstructive cardiomyopathy, cardiac remodeling, Morrow myectomy, features of cardiac remodeling after Morrow surgery.

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1. Introduction

Modern achievements in medicine largely reflect the powerful and progressive development of cardiological science and practice. The rate of information exchange in cardiology is extremely high. In recent years, non-coronary heart diseases have attracted special interest from scientists and clinicians, and the introduction of modern instrumental and laboratory diagnostic methods has significantly advanced this field of cardiology. One of the non-coronary myocardial diseases is hypertrophic cardiomyopathy.

Hypertrophic cardiomyopathy (HCM) is a genetically determined myocardial disease characterized by left ventricular (LV) myocardial hypertrophy (>1.5 cm) and/or right ventricular (RV) hypertrophy, most often of an asymmetric nature due to thickening of the interventricular septum (IVS). This hypertrophy cannot be explained solely

by pressure overload and occurs in the absence of other cardiac or systemic diseases, metabolic or multiorgan syndromes associated with left ventricular hypertrophy (LVH) [1].

The American Heart Association recommends the use of non-selective beta-blockers (bisoprolol) and non-dihydropyridine calcium channel blockers (verapamil) [2]. However, there is a group of patients resistant to medical therapy. Surgical treatment is indicated for this group. In 1958, British surgeons W.P. Cleland and E. Bentall performed the first transaortic subvalvular ventriculomyotomy. Five years later, in 1963, Andrew G. Morrow proposed transaortic subvalvular myectomy. Currently, there are two main surgical methods for correcting left ventricular outflow tract (LVOT) obstruction. The first is the generally accepted "gold standard" of treatment—Morrow myectomy and its modifications. The second, a relatively newer but promising method, is alcohol septal ablation [3,4]. Most studies and meta-analyses have shown that both methods are equally effective and significantly reduce the pressure gradient in the LVOT, leading to improvement in clinical and functional status of patients in the long-term period [5].

OBJECTIVE

To study the safety, clinical and hemodynamic efficacy, as well as to assess cardiac remodeling in patients with obstructive hypertrophic cardiomyopathy after Morrow myectomy based on the experience of the Republican Specialized Scientific and Practical Medical Center for Cardiology.

2. Methods

This study is a cross-sectional observational study conducted at the clinical base of the Republican Specialized Scientific and Practical Medical Center for Cardiology.

Over a two-year period, a total of 20 patients with obstructive hypertrophic cardiomyopathy underwent Morrow myectomy.The mean age was 43.55 ± 17.33 years (range: 16–73 years), including 10 female patients. All patients (100%) were diagnosed with systolic anterior motion (SAM) syndrome. Preoperative left atrial size was 51.8 ± 11.4 mm, left ventricular myocardial mass was 355.89 ± 115.17 g, and interventricular septal thickness was 22.72 ± 5.75 mm.

The volume of myocardial resection and evaluation of surgical outcomes were performed using echocardiography. In all patients, surgical intervention was carried out under cardiopulmonary bypass (CPB) under normothermic and hypothermic conditions (33–34 °C). In all cases, Morrow myectomy was successfully performed based on the applied method for calculating the resection volume. A follow-up echocardiographic examination was conducted before hospital discharge.

Statistical analysis of the obtained data was performed using the "Statistica 6.0" software. Results are presented as mean ± standard deviation (M ± SD), with statistical significance set at $p < 0.05$.

3. Results

Assessment of the effectiveness of the Morrow procedure in the studied patient group demonstrated positive dynamics in the main parameters of intracardiac hemodynamics (Table 1).

Parameters	with obstructive hypertrophic cardiomyopathy	after surgery	P
LV massa, g	355,89±15,17	311,27±21,21	<0.05
IVST, mm	22,72±5,75	15,895±3,23	<0.05
LA, mm	51,8±11,4	51,55±14,2	>0.05

During the analysis of intracardiac hemodynamic parameters, a significant reduction in interventricular septal thickness was noted by 30% (from 22.72 ± 5.75 mm to 15.895 ± 3.23 mm). Accordingly, left ventricular myocardial mass decreased by 13% (from 355.89 g to 311.27 g). The transverse diameter of the left atrium did not undergo significant changes.

There was no in-hospital mortality. After surgery, systolic anterior motion (SAM) syndrome resolved in all patients. Four patients (20%) required permanent pacemaker implantation due to the development of complete

atrioventricular block in the postoperative period. In two cases, atrial fibrillation was recorded, and in three patients, left bundle branch block developed in the early postoperative period while in the intensive care unit (Figure 1).

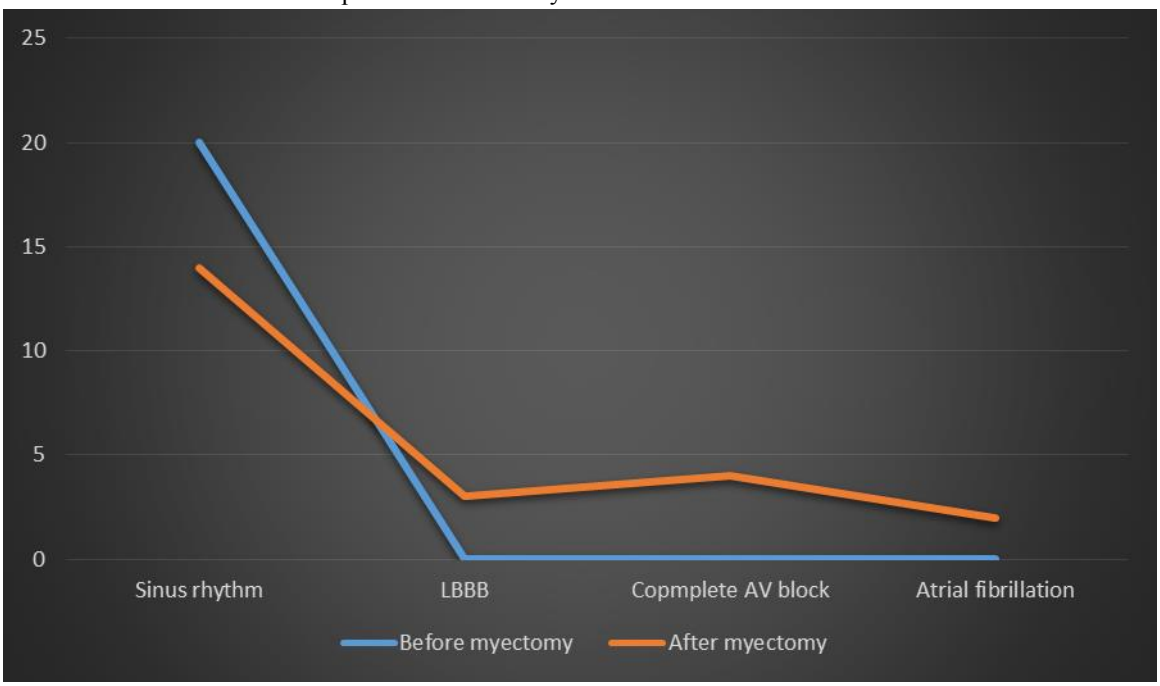

Figure 1. Dynamics of cardiac rhythm and conduction disorders in patients before and after surgical intervention.

Additional procedures were performed for concomitant cardiac pathology: aortic valve replacement in 1 patient (5%) and coronary artery bypass grafting in 3 cases (15%).

At 24-month follow-up, one case of late mortality was registered in a patient who had undergone coronary artery bypass grafting. No recurrence of left ventricular outflow tract (LVOT) obstruction was observed in the long-term period. A positive trend in clinical status was noted. According to the results of the 6-minute walk test, the mean walking distance increased from 125 m to 275 m, which was reflected in an improvement in heart failure functional class. At hospital admission, the mean NYHA functional class was III. After surgical intervention, one patient remained in NYHA class III, two patients were classified as NYHA class II, and all remaining patients achieved NYHA class I (Table 2).

Parameters	After myectomy	Before myectomy	p
6MWT	125±35,36 m	275±35,36 m	<0.0001
FC III (NYHA) (n) %	20 (100%)	1 (5%)	<0,0001
FC II (NYHA) (n) %	0	2 (10%)	>0,05
FC I (NYHA) (n) %	0	17 (85%)	<0,0001
HF (n) %	20 (100%)	2 (10%)	<0,0001

* differences are statistically significant at $p \leq 0.05$

4. Discussion

In 1995, the WHO/International Society and Federation of Cardiology (ISFC) Working Group on Cardiomyopathies proposed a classification of cardiomyopathies based on the leading pathophysiological mechanism or possible etiological factors, subdividing them into dilated (DCM), hypertrophic (HCM), restrictive (RCM), and specific cardiomyopathies [6].

The term “hypertrophy” was first introduced by Laennec (1755–1826), who also proposed the first classification of

hypertrophy in 1819 [7].

Hypertrophic cardiomyopathy is a common genetic disease caused by approximately 1,400 mutations in more than 11 genes [8–16]. According to the CARDIA study [17], the prevalence of HCM is approximately 1:500, and the natural course of the disease may lead to heart failure and sudden cardiac death. Patients with HCM are divided into obstructive and non-obstructive forms. Among patients with obstructive HCM, left ventricular outflow tract (LVOT) obstruction is most frequently observed (50–75% of cases). This obstruction develops due to systolic anterior motion (SAM syndrome) of the anterior mitral valve leaflet and its contact with the hypertrophied interventricular septum (IVS) [18].

Mortality ranges from 5–8% in the absence of specialized medical care and decreases to 1–2% with appropriate treatment and follow-up. The importance of timely diagnosis and treatment of obstructive HCM cannot be overestimated, as sudden cardiac death is one of the manifestations of hypertrophic cardiomyopathy [19]. Despite improved survival in recent years, patients' quality of life often remains relatively low.

Two principal forms of HCM are distinguished: with and without left ventricular outflow tract obstruction.

The first description of functional LV obstruction observed intraoperatively was made by Brock (1903–1980), who reported a case of attempted surgical treatment of myocardial hypertrophy with LVOT obstruction. In 1978, Maron published long-term results of surgical treatment in 124 patients, describing a 15-year follow-up of patients who underwent myectomy. Hospital mortality was 8%, and postoperative mortality related to HCM was 9% (11 patients, including 6 cases of sudden cardiac death). Recurrence of LVOT obstruction was observed in 12% of cases. The overall incidence of cardiac arrhythmias increased from 27% to 97%, including cases requiring permanent pacemaker implantation [20].

In 2014, a group of American authors published the results of a multicenter study evaluating long-term outcomes of surgical treatment of LVOT obstruction in 665 patients treated between 1998 and 2010. Overall in-hospital mortality was 5.9%, and permanent pacemaker implantation due to complete atrioventricular block was required in 8.7% of cases [21].

According to our data, there was no in-hospital mortality. During long-term follow-up, one case of death was recorded. After surgery, SAM syndrome resolved in all patients. Four patients (20%) required permanent pacemaker implantation due to complete atrioventricular block. Atrial fibrillation was documented in two cases, and three patients developed left bundle branch block in the early postoperative period while in the intensive care unit. No recurrence of LVOT obstruction was observed during the follow-up period. Transthoracic echocardiographic analysis demonstrated a statistically significant regression of left ventricular myocardial mass.

5. Conclusion

This study demonstrates that Morrow myectomy is a safe and effective procedure in patients with obstructive hypertrophic cardiomyopathy. Correction of concomitant cardiac pathology did not affect the postoperative course. Mid-term follow-up results indicate improvement in patients' functional status, absence of recurrence of left ventricular outflow tract obstruction, and positive changes in cardiac remodeling.

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