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Mitral Valve Procedures in Hypertrophied Obstructive Cardiomyopathy (HOCM) Surgery

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Abstract

Background: Hypertrophic obstructive cardiomyopathy (HOCM) is a genetic illness where the left ventricle of the heart becomes abnormally thickened, resulting in significant hypertrophy.

Aim of Study: To review hypertrophic obstructive cardiomyopathy (HOCM), how to diagnose it, indications of treatment, medical management, and surgical management, including the technique, advantages, challenges, outcomes, and prognosis.

Patients and Methods: This prospective research was performed on 100 cases with hypertrophied obstructive cardiomyopathy (HOCM). Who are Medication-refractory symptoms that interfere with everyday activity or quality of life, despite maximal medical treatment consisting of beta blockers, calcium channel blockers, or both, resting or provoked peak systolic LVOT gradient of 50mmHg or more, and the desired septal wall thickness necessary to effectively and safely carry out the treatment. (septal wall thickness ≥1.5cm).

Results: There was a highly significant variance among before and after surgery regarding NYHA grade, MR grade, SAM grade, septal thickness (mm), and LVOTG (mmHg) $p<0.001$, but a statistically insignificant variance was observed among preoperative and postoperatively regarding LVEF (%) $p=0.08$.

Conclusion: Our analysis indicates that MV surgery in cases with hypertrophic obstructive cardiomyopathy leads to significant clinical enhancements with minimal mortality and morbidity. In cases of hypertrophic obstructive cardiomyopathy, mitral valve operation can effectively ease symptoms, relieve the LV outflow tract gradient, and resolve mitral regurgitation.

Key Words: Mitral valve procedures – Hypertrophied obstructive cardiomyopathy – Outcomes.

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Introduction

HOCM is a genetic disorder where the left ventricle of the heart becomes abnormally thick, particularly in the basal interventricular septum. Hypertrophic obstructive cardiomyopathy is defined by the presence of blockage in the LV outflow tract, which can lead to sudden death and is typically caused by ventricular fibrillation **[1].**

The MV leaflets play a crucial role in the pathophysiology of LVOT obstruction in cases with hypertrophic obstructive cardiomyopathy **[2].**

Systolic anterior motion of the mitral apparatus and contact between the leaflets and the hypertrophied septum cause a narrowing of the LV outflow. This narrowing results in the development of dynamic pressure gradients and, in a significant number of cases, mitral regurgitation **[3].**

Moreover, research on structural changes in the mitral valve in hypertrophic obstructive cardiomyopathy has demonstrated an enhancement in both the length and area of the mitral leaflet. It remains unclear whether mitral valve abnormalities continue to contribute to mitral regurgitation and left ventricle outflow tract restriction following a suitable myectomy when mitral leaflet length and area aren't corrected with concomitant operations **[4].**

Individuals suffering from obstructive hypertrophic cardiomyopathy commonly report symptoms such as dyspnea during physical exercise, syncope, and chest pain resembling angina. Medical treatments, for example beta blockers, calcium channel blockers, and disopyramide, can help manage these symptoms. Nevertheless, pharmaceutical therapy often proves inadequate for several patients experiencing obstructive symptoms, necessitating the use of septal reduction treatment **[5].**

Drug therapy is typically highly effective in treating hypertrophic obstructive cardiomyopathy. Administering negative inotropic drugs was shown to improve symptoms, functional ability, and quality of life in most cases of hemodynamically severe blockage **[6].**

However, approximately five percent of cases continue to experience symptoms even with medication therapy and may be considered for invasive interventions such as Dual-chamber pacemaker insertion, percutaneous transluminal septal myocardial ablation, or operation **[7].**

The main objective of this research was to review hypertrophic obstructive cardiomyopathy (HOCM), how to diagnose it, indications of treatment, medical management, and surgical management, including the technique, advantages, challenges, outcomes, and prognosis.

Patients and Methods

This prospective research was performed on 100 cases of hypertrophied obstructive cardiomyopathy (HOCM).who had been previously reviewed at the cardiothoracic Department at Ain-Shams University and military hospitals from Aug. 2022 to Feb. 2024.

Inclusion criteria:

Any patient with HOCM who has all the following: Medication-refractory symptoms that interfere with everyday activity or quality of life, despite maximal medical treatment consisting of calcium channel blockers, beta blockers, or both, resting or provoked peak systolic LVOT gradient of 50mmHg or more, and the desired septal wall thickness necessary for the process to be conducted safely and efficiently. (septal wall thickness ≥1.5cm).

Exclusion criteria:

HOCM associated with ischemic or rheumatic heart disease and HOCM associated with myocardial bridge (due to lack of enough experience for managing this problem).

Methods:

All cases were exposed to the following:

History-taking: A thorough and detailed history is taken with special emphasis on the following: Demographic data, Symptoms, especially: Functional class of dyspnea (according to NYHA classification), syncope, palpitation, and angina; duration of symptoms before referral; medical management before operation (B-blockers, calcium channel blockers, or others); Pre-operative general risk factors for major surgery include previous cardiac surgery, liver problems, renal problems, diabetes mellitus (DM), and/or morbid obesity, as well as family history of similar conditions or sudden cardiac death. A clinical examination was done for all patients. Investigations: Routine laboratory investigations (Labs), radiological examination, Electrocardiogram (ECG): 12-lead ECG was done to:record the basic rhythm of the patient, whether sinus rhythm or A.F., and detect any preoperative conduction disturbances (presence of heart block and its degree). Echocardiography: Two-dimensional and Doppler trans-thoracic echocardiography was done for each patient to evaluate the following parameters: Left ventricular dimensions and function; LVOT peak systolic gradients in millimeters of mercury (mm Hg) at rest and with physiological provocation; interventricular septal wall thickness (SWT) in centimeters (cm); mitral valve structure and function; presence of MR and its degree; presence of systolic anterior motion (SAM); presence of AR and, if present, its degree; and left atrial (LA) diameter in centimeters (cm).

Preoperative preparation: All patients underwent routine preoperative preparation in the ward the night before the operation by shaving the chest, axilla, groin, and legs above the knees in men and the groin and axilla in women. The washing of the body is done with povidone-iodine (PVP-I) topical antiseptics. Premedications are given, including prophylactic intra-venous (IV) antibiotics, IV antacids, and intramuscular ten-milligrams morphine sulfate, prior to transfer to the operating room.

Surgical technique:

A real-time transesophageal echocardiogram was conducted using a Phillips iE33 machine from Philips Ultrasound Inc., located in Reedsville, PA, United States. The TOE has been conducted following the administration of anesthesia to assess the mitral valve lesion and determine the appropriate length and depth of resection into the left ventricular outflow tract. The aorta was clamped, and a cold crystalloid cardioplegic solution (Custodiol VR HTK Solution, Dr. Franz KöhlerChemie, Alsbach-Hahnlein, Germany) has been administered to protect the myocardium with antegrade root flow. In all patients, a transverse aortotomy technique for prolonged septal myectomy, as reported by Messmer **[8]**, has been employed. Following that, within the repair group, we conducted transaortic subvalvular apparatus procedures, which involved cutting the retracted secondary chordae and releasing and/or removing abnormal papillary muscles. In the replacement group, we conserved the posterior leaflet and inserted On-X prostheses (manufactured by On-X Life Technologies, Inc., Stafford, TX, United States) in the intra-annular position. This was achieved by employing U-stitches with pledgets in an anatomically aligned orientation with a forty-five-degree rotation around the long axis of the left ventricle. A control transesophageal echocardiogram was conducted after removing the bypass to evaluate the hemodynamics of the left ventricular outflow tract as part of a routine evaluation. The technique of direct transaortic catheterization was employed to measure pressure gradients. If there

was still a significant amount of moderate-to-severe mitral regurgitation or if a ventricular septal defect was present, cardiopulmonary bypass (CPB) was reintroduced.

Cases follow-up and management following surgery:

Monitoring and care of patients after surgery Prior to release, all cases had a transthoracic echocardiographic assessment. Cases who were released from the hospital and received regular follow-up care from cardiologists and surgeons. Following the patient's release, annual examinations have been arranged. When patients were unable to attend annual clinic visits, monitoring was conducted through communication with the referring cardiologist, the cases themselves, or their families. The ECG acquired from external doctors have been re-evaluated at our institution by the most skilled echocardiographers. Cases in the repair group who have been in sinus rhythm, as confirmed by twenty four-hour Holter monitoring, were provided low-dose aspirin after the operation. Cases that underwent mechanical mitral valve replacement were prescribed lifelong anticoagulant therapy, with a target international normalized ratio varying from 2.5-3.5.

Statistical analysis:

Data were supplied to the computer and assessed using the IBM SPSS software program version 20.0 (Armonk, NY: IBM Corp.). Numbers and percentages have been employed to characterize qualitative data. The normality of the distribution was confirmed utilizing the Kolmogorov-Smirnov test. Range (minimum & maximum), standard deviation, median, mean, and interquartile range (IQR) have been employed to describe quantitative data. The results were assessed at the five percent threshold of significance. The tests that were implemented were as follows: Chi-square test: Fisher's exact or Monte Carlo correction is utilized to compare categorical variables among distinct groups. Correction for chi-square when the expected count is below five in over twenty percent of the cells Student *t*-test: To compare two examined groups with quantitative variables that are normally distributed, Paired *t*-test: To compare two periods and normally distributed quantitative variables, use the Mann-Whitney test. Mann-Whitney test: A statistical test is used to compare two groups of quantitative variables that are abnormally distributed.

Results

According to this table, the mean age was 46.68±10.1, 57% of cases were males and 43% of cases were females (Table 1).

According to this table, 45% of patients had hypertension, 10% of cases had diabetes mellitus and 4% of patients had cerebral infarction (Table 2).

According to this table, 60% of patients were on beta blocker and 26% of cases were on calcium-channel blocker (Table 3).

According to this table, there were highly statistically significance variance among preoperative & postoperative regarding NYHA grade, MR grade and SAM grade <0.001 (Table 4).

According to this table, there were statistically insignificance variance among pre & post-surgery regarding LVEF (%) p=0.08, while there highly statistically significance variance was observed among pre & post-surgery regarding Septal thickness (mm) & LVOTG (mmHg) p<0.001 (Table 5).

Table (1): Distribution of general characteristics in the examined group.

	Examined group N=100
Age (year):	
Mean ± SD	46.68±10.1
Sex:	
Male	57 (57%)
Female	43 (43%)

Table (2): Distribution of comorbidities in the examined group.

	Studied group N=100
Comorbidities:	
Hypertension	45 (45%)
Diabetes mellitus	10 (10%)
Cerebral infarction	4 (4%)

Table (3): Distribution of drug therapy in the examined group.

	Studied group N=100
Drug therapy:	
Beta blocker	60 (60%)
Calcium-channel blocker	26 (26%)

Table (4): Distribution of NYHA, MR and SAM grade in the studied group.

	Preoperative N=100	Postoperative N=100	*p*-value
NYHA grade:			
I-II	34 (34%)	100 (100%)	<0.001
III-IV	66 (66%)	0 (0%)	
MR grade:			
0-1	0 (0%)	78 (78%)	<0.001
2	46 (46%)	22 (22%)	
3-4	54 (54%)	0 (0%)	
SAM grade:			
0-1	4 (4%)	100 (100%)	<0.001
3	96 (96%)	0 (0%)	

p-value >0.05: Not significant.
p-value <0.05 is statistically significant.
p<0.001 is highly significant.
NYHA: New York Heart Association.
MR : Mitral regurgitation.
SAM : Systolic anterior motion.

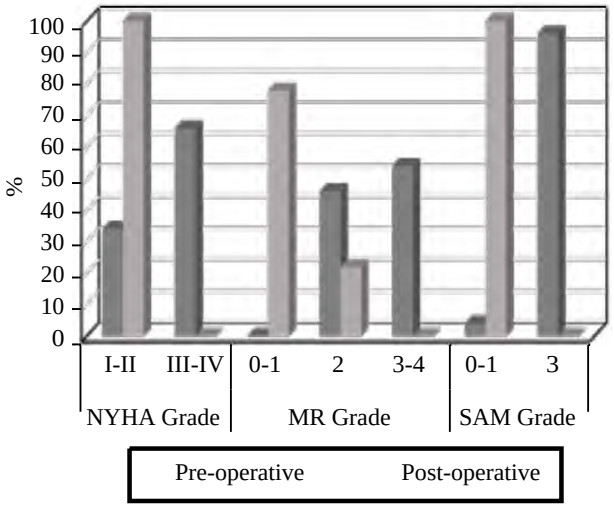

Fig. (1): Distribution of NYHA, MR and SAM grade in the studied group.

Table (5): Distribution of septal thickness, LVOTG and LVEF in the studied group.

	Preoperative N=100	Postoperative N=100	*p*-value
Septal thickness (mm): Mean ± SD	25.03±4.06	13.02±3.61	<0.001
LVOTG (mmHg): Mean ± SD	95.67±24.08	19.93±6.52	<0.001
LVEF (%): Mean ± SD	61.29±4.89	62.48±4.92	0.08

LVEF : Left ventricular ejection fraction.
LVOTG: Left ventricle outflow tract gradient.

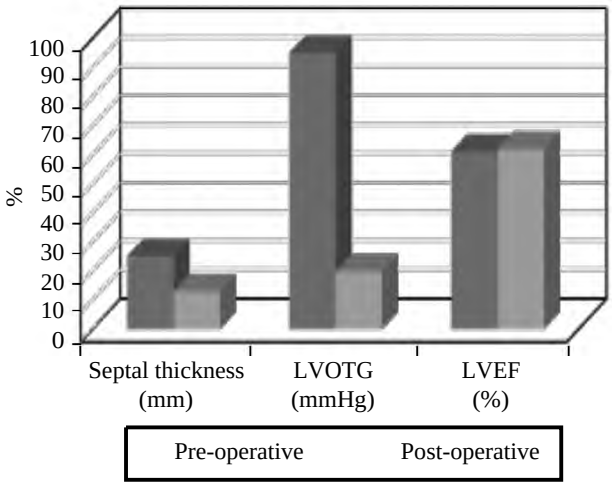

Fig. (2): Distribution of septal thickness, LVOTG and LVEF in the studied group.

Discussion

Transaortic septal myectomy is considered the most effective therapy for people with obstructive hypertrophic cardiomyopathy who don't have symptom relief from medication therapy. However, there is still a continuing debate regarding the necessity of doing additional surgeries on the mitral valve to alleviate mitral valve regurgitation that is correlated with systolic anterior motion **[2].**

The main results of this research were as follows:

The present study revealed that regarding demographic data in the studied group, the mean age was 46.68±10.1 years, 57% of cases were men, and 43% of cases were women.

This came in accordance with Jiang et al. **[9],** who aimed to provide a summary of the safety and efficacy of minimally invasive surgery for HOCM accompanied by severe mitral regurgitation. The study findings showed that the average age was 47.04±10.98 years, with 55.86 percent of cases being men & 43.14 percent being women.

Also, our findings are in line with Hong et al. **[10]**, which aimed to establish the indications and appropriate surgical approach for treating MR in cases with HOCM. The study findings indicated that the average age was 59.1±14.3 years, with men accounting for fifty-seven percent of the cases and women for forty-three percent.

Regarding comorbidities in the studied group, we revealed that 45% of patients had hypertension, 10% of patients had diabetes mellitus and 4% of patients had cerebral infarction.

As well, our results agree with Antal et al.'s **[11]** study to assess the surgical treatment of hypertrophic obstructive cardiomyopathy. Forty-one cases of symptomatic HOCM had an operation. They reported that 19 (46.3%) of patients had hypertension and 5 (12.1%) of patients had diabetes mellitus.

Regarding drug therapy in the studied group, we revealed that 60% of patients were on beta blockers and 26% of patients were on calcium channel blockers.

The findings we obtained align with those of Jiang et al. **[9]**, who found that 68.63% of patients were on beta blockers and 25.49% of patients were on calcium channel blockers.

The current investigation revealed a significant statistical distinction among the pre- & post-surgery conditions in terms of NYHA grade, MR grade, and SAM grade. The statistical significance of the result is highly significant (p<0.001).

Our findings align with the study conducted by Castedo et al. **[12]**, which aimed to examine the results of operations in cases with hypertrophic obstructive cardiomyopathy who did not respond to medication therapy and had operations at our hospital within the last year. According to their findings, while comparing the clinical and echocardiographic data before & after the operation, it was found that the procedure successfully corrected the mitral

regurgitation and removed the SAM. At the last monitoring, the cases showed a clear improvement in their ability to function seventy-seven percent (n = twenty) have been classified as NYHA (New York Heart Association) functional class I, nineteen percent (n = five) have been classified as functional class II, and ninety-six percent had no angina.

This result aligns with the study performed by Raffa et al. *[13]*, which aimed to evaluate the involvement of the mitral valve apparatus in LVOT obstruction and the outcomes of surgery for HOCM. A total of twenty-eight patients had an operation for HOCM. The study showed that NYHA decreased from 3±0.5 to 1±0.7 (p<0.0001) & MVR decreased from grade 3±1 to 1±0.7 (p<0.0001).

Our investigation revealed that there was statistically insignificant variation in left ventricular ejection fraction among the pre & post-surgery periods. However, there was a highly significant variation in septal thickness (millimeters) and LV outflow tract gradient (LVOTG, mmHg) among the pre & post-surgery periods.

In addition, our resultsagreed with those of Castedo et al. *[12]*, who observed that the surgical procedure resulted in a significant decline in interventricular septal thickness and LVOTG when comparing pre- & post-surgery clinical and echocardiographic data. There was a statistically insignificant difference in LVEF among the preoperative & postoperative periods.

Furthermore, Antal et al. *[11]* demonstrated a significant decrease in the LVOTG from an initial value of 116.65±37.4 millimeters of mercury to a final value of 22.47±16.34 millimeters of mercury compared to preoperative measurements. The mean septal wall thickness declined from 2.35±0.41 to 1.74±0.31.

Conclusion:

Our analysis indicates that MV surgery in cases with hypertrophic obstructive cardiomyopathy leads to significant clinical enhancements with minimal mortality and morbidity. Mitral valve surgery can effectively ease symptoms, relieve the left ventricular outflow tract gradient, and resolve mitral regurgitation in cases of hypertrophic obstructive cardiomyopathy.

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الحلول الجراحية الخاصه بالصمام الميترالى
فى جراحة اعتلال عضلة القلب الانسدادى المتضخم

اعتلال عضلة القلب المتضخم هو اضطراب القلب والأوعية الدموية الوراثى الأكثر شيوعاً، والذي يتميز بالتعبير غير المتجانس لهذا هو السبب الأكثر شيوعاً لتوقف القلبى المفاجئ لدى الشباب بما فى ذلك الرياضيين. ومع ذلك، غالباً ما يتم إهماله أو عدم تشخيصه.

تدفق الدم فى البطين الأيسر فى حالات اعتلال القلب المتضخم يكون غير متجانس ومتغير للغايه ويكون التضخم غير متماثل وبشكل اوضح فى الصمام مابين البطينين وتساهم بشكل كبير التشوهات الوظيفيه فى الصمام الميترالى على انسداد سريان الدم فى البطين الايسر.

وتمثل تشوهات الصمام الميترالى حوالى ثلثى المرضى بعيدا على التشوهات الخلقيه مايجعل الجراحيين مع اصلاحها جراحياً.

اصلاح انسداد تدفق البطين الأيسر فى المرضى الذين يعانون من اعتلال عضلة القلب الانسدادى التضخمى وأعراض الإعاقة المقاومة للعلاج الدوائى كانت مشكله كبيره للجراحين فى الآونة الأخيرة، حيث كان هناك تقدم كبير فى فهم الدورة السريرية الشاملة الأساسية، أصبحت البدائل العلاجية الأخرى مثل الاجتثاث الحاجز الكحولى للحاجز متاحة. ومع ذلك يبقى الحل الجراحى هو الافضل والاكثر فاعليه.

يحدث اعتلال عضلة القلب التضخمى فى ١ من كل ٥٠٠ بين البالغين فى أجزاء مختلفة من العالم. وبناء على ذلك، من خلال الاستقراء، تشير التقديرات إلى أنه في مصر هناك أكثر من ١٧٠،٠٠٠ مريض مع عدد كبير منهم معرضين لخطر المضاعفات. ومع ذلك، تم تقديم العلاج لعدد قليل جدا من المرضى. أدى الاهتمام الأخير لبعض أطباء القلب بإدخال استئصال الحاجز الكحولى إلى التركيز على المرض هذا وخضوع المزيد من المرضى للعلاج.

استئصال عضل الحاجز الجراحي يلغي الحركة الأمامية الانقباضية والارتجاع للصمام، مع تطبيع ضغوط البطين الأيسر وإجهاد الجدار يتم تحقيق كل هذه الأهداف دون إرهاق المرضى بأجهزة ما بعد الإجراء (على سبيل المثال ، أجهزة تنظيم ضربات القلب أو أجهزة تنظيم ضربات القلب) أو إنشاء ركائز يحتمل أن تكون غير منتظمة، كما قد يحدث مع استئصال الحاجز الكحولى. خطر الوفاة مع استئصال العضل مشابه، وفى بعض المؤسسات باستئصال الحاجز الكحولى. على مدى أربعة عقود، وثقت التقارير الواردة من العديد من المراكز فى جميع أنحاء العالم باستمرار وبشكل لا لبس فيه فوائد الجراحة على الدورة الدموية والحالة الوظيفية، واستعادة نوعية الحياة الطبيعية والمقبولة للمرضى من جميع الأعمار من خلال عكس مضاعفات قصور القلب إلى حد كبير. البقاء على قيد الحياة على المدى الطويل بعد استئصال العضل مشابه لعامة السكان ومتفوق على المرضى الذين لا يخضعون لعملية جراحية والذين يعانون من الانسداد.