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Hypertrophic Obstructive Cardiomyopathy: Short Term and Early Outcome After Septal Myectomy?

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Abstract:

Background: A heterogeneous disease, hypertrophic obstructive cardiomyopathy (HOCM) is defined by asymmetrically distributed left ventricular hypertrophy and obstruction of the left ventricular outflow tract (LVOT). The objective of this investigation was to compare the outcomes of a proper septal myectomy in patients with HOCM.

Methods: We conducted this prospective randomized investigation on 40 diseased persons aged >18 years old, both sexes, with septal myectomy alone (extended septal myectomy), HOCM with mean pressure gradient across LVOT > 50 mmHg at rest or upon provocation, New York Heart Association (NYHA) functional class II to IV, despite the use of optimal medical treatment, which includes calcium channel blockers, beta-blocking agents, or both. All patients undergoing extended septal myectomy.

Results: Left atrial volume, left ventricular end systolic volume, left ventricular end diastolic volume and systolic pulmonary artery pressure were significantly lower before discharge, three and six months than baseline ($P<0.05$), while the left ventricle ejection fraction was insignificantly different. NYHA class, interventricular septum, mitral regurgitation grade, SAM and LVOT pressure were significantly lower before discharge, three and six months than baseline. Medication number was insignificantly different between baseline and before discharge, while significantly lower in 3 and 6 months.

Conclusions: After septal reduction surgery, patients with HOCM may have remarkable changes in their clinical condition and echocardiogram results.

Keywords: Septal myectomy, Hypertrophic Obstructive Cardiomyopathy, New York Hear Association

1. Introduction

Hypertrophic Obstructive Cardiomyopathy (HOCM) Is A genetic condition that causes the interventricular septum hypertrophy, which in turn hinders the left ventricle's ability to empty during systole. [1, 2] .

As a genetic disorder, HOCM is transmitted through the autosomal dominant gene. It is the most prevalent genetically transmitted cardiomyopathy.

Missense mutation for a gene of the 11 genes that code for cardiac proteins (B-myosin heavy chain, troponin, and actin) causes HCM.

HCM as a clinical entity was first defined by Brock in 1957 [3]. For young people, especially those who participate in athletic competitions, It's the main reason behind unexpected cardiac death. [4, 5]

In HOCM, there was some degree of asymmetric left ventricular hypertrophy in association with left ventricular outflow (LVOF) obstruction [6].

Never forgetting Beta-blockers, verapamil, or disopyramide are among the medicinal treatments that the majority of people with HOCM receive.[7, 8].

About 10% of individuals with obstructive HCM continued to suffer from symptoms after receiving these medications. These symptoms could involve dyspnea with exertion, syncope, chest pain, or difficulty exercising. Septal myectomy should be considered for diseased people with obstructive HOCM who keep having symptoms despite medicinal treatment and who have a resting or provoked gradient more than 50 mmHg. [9].

Reduction of symptoms is often achieved successfully with surgical myectomy. A total of 96% and 90% of patients in a group that had surgical myectomy reported an improvement in heart failure symptoms to a class I or II according to the New York Heart Association (NYHA), respectively. [10].

To the best of our knowledge, there is a lack of international and Egyptian trials that have assessed the safety and efficacy of septal myectomy in HOCM patients. In this study, we aimed to compare the results of adequate septal myectomy in patients with HOCM.

Patients and Methods:

This prospective randomized research was performed on 40 diseased people aged >18 years old, both sexes, with septal myectomy alone (extended septal myectomy), HOCM with a mean pressure gradient exceeding 50 mmHg at repose or upon provocation, functional class II–IV according to the NYHA, even when treated optimally with -blockers, calcium channel blockers, or a combination of the two. Following approval from the Ethical Committee of Assiut University Hospitals in Assiut, Egypt, the investigation was conducted from December 2019 to December 2023. The patients were allowed to provide signed consent.

Patients with intrinsic pathology of the mitral valve, non-obstructive physiological characteristics, and those who had undergone previous mitral valve surgery were excluded.

Preoperative Evaluation

All diseased people were subjected to complete history taking about complaints (exertional dyspnea, anginal pain or syncope), clinical examination (general and local cardiac), laboratory investigations [complete blood count (CBC), liver and renal function test) and radiological investigations for confirm diagnosis are electrocardiography (ECG) and electrocardiography (transthoracic and trans esophygeal).

All patients underwent routine preoperative preparation in the ward fasting for 6 to 8 hours. Premedication was given including prophylactic intravenous (IV) antibiotics.

Assessment of functional status was performed by using the New York Heart Association (NYHA) Functional Classification.

Stress echocardiography was done for any individual with a recognized or suspected HOCM, without resting LVOT obstruction. Cardiac computed tomography (CT) was done for all cases to detect left anterior descending coronary artery (LAD) myocardial bridge. If it was detected, coronary angiography to assess the significance of that bridge by FFR.

If there is no other known reason, like hypertension or valve disease, and there is ≥ 15 mm of increased left ventricular wall thickening anywhere in the LV wall, then it is likely that the patient has HOCM.

Surgical procedure

The surgical procedures were performed under general anaesthesia. Transoesophageal echocardiography was carried out following the induction of general anesthesia to evaluate the cardiac anatomy and quantify the preoperative LVOT gradient and SAM. The median sternotomy was performed to optimize the exposure to the aorta and left ventricle. A single, two-staged venous cannula was inserted through the right atrium to bypass cardiopulmonary bypass. A 1000 Ml initial dose of cold blood cardioplegia was administered through a tack vent after the aorta was cross-clamped. Surgery called a transverse-oblique aortotomy was carried out. An aortic incision was started at the commissure of the right and noncoronary sinuses and proceeded towards the base of the noncoronary sinus; it was important to allow around 1 cm of space between the annulus of the aorta and the end of the incision. Visibility of the septum was also improved by gentle pushing of the lateral surface of the heart with a swab on a stick. The LV cavity was explored to check the presence of any subaortic membrane or septal endocardial fibrosis at the site of contact with anterior mitral leaflet. The white endocardial fibrous scar was a significant surgical landmark that marked the area of contact between the anterior mitral leaflet and the septum. In order to ensure complete the alleviation of obstruction, the septectomy was performed beyond the visible scarring. The first incision into the septum was made with a No. 10 blade attached to a long handle, which was situated just to the right of the nadir of the right aortic sinus. Using a 15-blade scalpel, two parallel longitudinal incisions were made; the first incision started about three mm below the aortic annulus at the level of the right coronary ostium to be safe away from the bundle of His. The other line was made below the commissure between right and left coronary cusps of both incisions were extended downwards into the LV cavity. A transverse incision was made into the septum between the two longitudinal incisions, about 3 to 5 mm underneath and parallel to the aortic valve. The breadth of the No. 10 knife blade, which was approximately eight mm, was used to determine the appropriate depth of the incision. After that, the incision was further advanced to the left ventricle's apex, and the anterior papillary muscle's base and trabeculations were also removed. The left ventricle's anterior wall was shifted posteriorly using a sponge stick to improve visibility. Based on prebypass TEE imaging, the surgical specimen from a septal myectomy usually contained three to twelve grams of tissue that had been excised, with the resected muscle being two-thirds the thickness of the septum. If the papillary muscles were hypertrophied or adherent to the septum, they were freed to allow free mobility. Subsequent to the patient's withdrawal from cardiopulmonary bypass, we measured the pressure gradient between the aorta and left ventricle by direct needle puncture repeatedly after myectomy for proof of complete alleviation of the LVOT blockage.

Transoesophageal echocardiography was the procedure is repeated to ensure that the LVOT obstruction has been relieved, to determine any obstruction at any other level, and to confirm the absence of an aortic valve lesion or ventricular septal defect. Aortotomy was then closed by two running 4-0 or 5-0 prolene sutures. An additional step was performed in patients with significant LAD myocardial bridge, which was unroofing of the bridge. The operating surgeon divided the muscular band that covered the LAD artery. A piece of the excised muscle was routinely sent for histopathological examination to confirm the diagnosis of HOCM. **Figure 1**

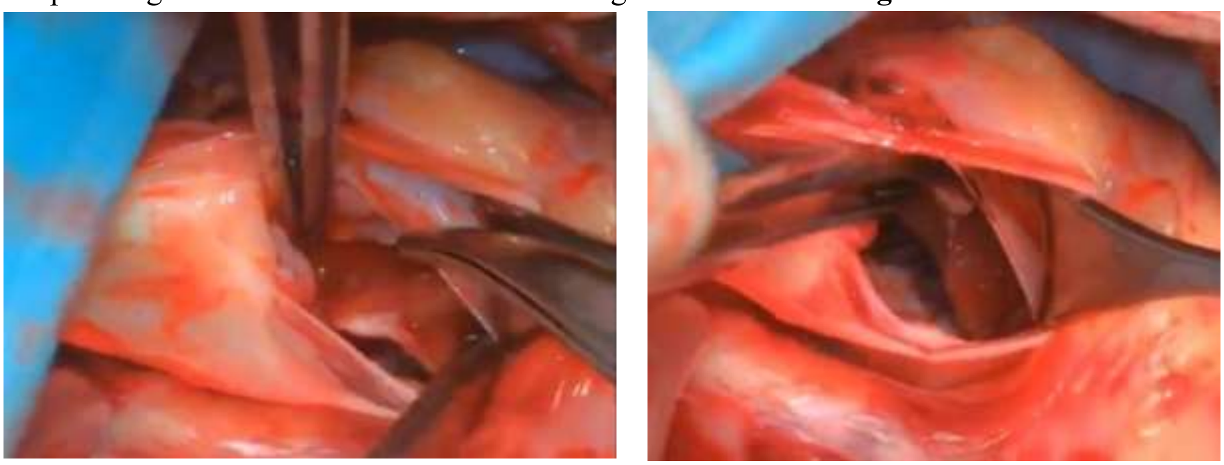

Figure 1: Extended Septal Myectomy in Hypertrophic Obstructive Cardiomyopathy

Post operative care:

All cases were transferred to the ICU after the procedure. ECG was done on admission to the ICU to record the baseline rhythm of the patient and to detect any conduction disturbances. Any post-operative complications, and the need for temporary or permanent cardiac pacing were recorded. Duration of mechanical ventilation, ICU stay, and total hospital stay were recorded.

Follow up: The same clinical and functional (NYHA class changes), and echocardiographic parameters were collected before operation, was repeated before discharge, three and six months after the operation. The changes in medication number were also recorded.

Statistical analysis

SPSS v26 (IBM Inc., Chicago, IL, USA) was employed to conduct the statistical analysis. The normality of the data distribution was assessed using the Shapiro-Wilks test and histograms. The mean and standard deviation (SD) of quantitative parametric variables were presented and contrasted between the two groups using an unpaired Student's t-test. The Mann Whitney test was employed to analyze quantitative non-parametric data, which were presented as median and interquartile range (IQR). Chi-square test or Fisher's exact test when appropriate was employed to analyze qualitative variables, which were presented as frequency and percentage. Significance was considered when a two-tailed P value is < 0.05.

Results:

Basic demographic data, patients' presentation, duration of complaint, number of commenced medications and NYHA class were presented in this table. **Table 1**

Table 1: Basic demographic data, patients' presentation, duration of complaint, number of commenced medications and NYHA class in the study group

		N=40
Age (years)		43.76±8.18
Sex	**Male**	30 (75%)
	Female	10 (25%)
BMI (kg/m^2)		27.62±2.34
Medical comorbidities	**HTN**	16 (40%)
	DM	7 (17.5%)
	Chronic renal disease	2 (5%)
Smoking		21(50%)
Exertional dyspnoea		40 (100%)
Exertional angina		22 (55.5%)
Syncope		8 (20%)
Disease duration (years)		3 (1 – 4)
NYHA class		4 (2 – 4)
Medications number		2 (1 – 3)

Data are presented as mean ± SD or frequency (%) or median (IQR). BMI: Body mass index, HTN: hypertension, DM: diabetes mellitus, NYHA: New York Hear Association.

Regarding to preoperative echocardiographic, the mean of IVS width was 27.20±5.71mm, LVOT gradient was 98.18 ± 13.92 mmHg, LVEF was 61.78±7.36, LAV was 47.68±6 mm, LVESV was 35.60±4.04 ml/m^2, LVEDV was 51.45±3.56 ml/m^2 and systolic PAP was 17.70±0.97 mmHg. The median MR grade was 3 (1 – 3) and SAM grade was 3 (1 – 3). LAD myocardial bridge was in 11(27%) patients. Regarding Cardiac catheterization, it was significant in 8(80%) patients, while insignificant in 3(20%) patients. **Table 2**

Table 2: Preoperative echocardiographic, cardiac computed tomography, cardiac catheterization findings in the study group

	N=40
IVS width (mm)	27.20 ± 5.71
MR grade	3 (1 – 3)
SAM grade	3 (1 – 3)

LVOT gradient (mmHg)		98.18±13.92
LVEF (%)		61.78±7.36
LAV (mm)		47.68±6
LVESV (ml/m^2)		35.60±4.04
LVEDV (ml/m^2)		51.45±3.56
Systolic PAP (mmHg)		17.70±0.97
LAD myocardial bridge		11(27%)
Cardiac catheterization	**Significant lesion**	8(80%)
	Insignificant lesion	3(20%)

Data are presented as mean ± SD or frequency (%) or median (IQR). IVS: interventricular septum, MR: Mitral regurgitation, SAM: Systolic anterior motion, LVOT: Left ventricular outflow tract, LVEF: Left ventricular ejection fraction, LAV: Left atrial volume, LVESV: Left ventricular end systolic volume, LVEDV: Left ventricular end diastolic volume, PAP: Pulmonary artery pressure, LAD: Left anterior descending.

The median bypass time was 69 (50 – 84) min, cross clamp time was 54 (34–74) min, operative time was 5(4 – 6) hours, ventilation duration was 4 (2 – 5) hours, ICU stay was 4 (2 – 5) days, hospital stay was 7 (5 – 8) days. Heart block occurred in 1(2.5%) patient. Regarding Early postoperative complications, postoperative bleeding occurred in one patient (2.5%). No patients developed neurological sequalae, pulmonary infection, wound infection, AF, or VSD. **Table 3**

Table 3: Operative data, duration of mechanical ventilation, ICU stay, hospitalization and early postoperative complications in the study group

		N=40
Bypass time (min)		69 (50 – 84)
Cross clamp time (min)		54 (34 – 74)
Operative time (hours)		5 (4 – 6)
Complications	**Heart block**	1 (2.5%)
Ventilation duration (hours)		4 (2 – 5)
ICU stay (days)		4 (2 – 5)

Hospital stays (days)	7 (5 – 8)
Early postoperative complications	
Neurological sequalae	0 (0%)
Renal complications	0 (0%)
Bleeding	1 (2.5%)
Pulmonary infection	0 (0%)
Wound infection	0 (0%)
AF	0 (0%)
VSD	0 (0%)

Data are presented as mean ± SD or frequency (%) or median (IQR). ICU: intensive care unit, AF: Atrial fibrillation, VSD: ventricular septal defect.

NYHA class, IVS, MR grade, SAM and LVOT pressure were significantly lower after surgery (before discharge, three and six months than baseline). Medication number was insignificantly different between baseline and postoperative (before discharge, while significantly lower in 3 and 6 months). **Table 4**

Table 4: Changes in NYHA class, medication number, IVS, MR grade, SAM and LVOT pressure at follow-up in study group

	NYHA class	**Medication number**	**IVS**	**MR grade**	**SAM**	**LVOT pressure**
Baseline	4 (2 – 4)	2 (1 – 3)	27.20±5.71	3 (1 – 3)	3 (1 – 3)	98.18±13.92
Before discharge	2 (1 – 3)	2 (1 – 3)	18.25±4.67	1 (0 – 3)	1 (0 – 3)	25.08±7.67
	< 0.001*	0.125	**< 0.001***	**< 0.001***	**< 0.001***	**< 0.001***
Three months	2 (1 – 2)	1 (1 – 2)	17.23±4.64	0 (0 – 3)	1 (0 – 3)	23.98±7.54
	< 0.001*	**< 0.001***	**< 0.001***	**< 0.001***	**< 0.001***	**< 0.001***
Six months	2 (1 – 2)	1 (1 – 2)	16.13±4.54	0 (0 – 3)	1 (0 – 2)	21.08±7.40
	< 0.001*	**< 0.001***	**< 0.001***	**< 0.001***	**< 0.001***	**< 0.001***

Data are presented as mean ± SD or median (IQR). * Significant p value <0.05. NYHA: New York Hear Association, IVS: Interventricular septum, MR: Mitral regurgitation, SAM: Systolic anterior motion, LVOT: Left ventricular outflow tract.

LAV, LVESV, LVEDV and systolic PAP were significantly lower after surgery (before discharge, three and six months) than baseline (P<0.05), while LVEF was insignificantly different.

Table 5

Table 5: Changes in LVEF, LAV, LVESV, LVEDV and systolic PAP at follow-up in study groups

	LVEF	**LAV**	**LVESV**	**LVEDV**	**Systolic PAP**
Baseline	61.78±7.36	47.68±6	35.60±4.04	51.45±3.56	17.70±0.97
Before discharge	60.18±4.34	44.83±6.89	33.78±2.95	46.70±2.45	15.93±1.35
	0.162	**0.039***	**0.049***	**< 0.001***	**0.042***
Three months	60.68±6.24	43.93±6.84	32.83±2.89	45.70±2.45	15.95±1.34
	0.185	**0.015***	**0.009***	**< 0.001***	**0.045***

Six months	59.35±4.45	44.58±6.50	31.80±2.87	44.70±2.45	15.30±1.22
	0.092	**0.033***	**< 0.001***	**< 0.001***	**0.043***

Data are presented as mean ± SD or median (IQR). * Significant p value <0.05. LVEF: Left ventricular ejection fraction, LAV: Left atrial volume, LVESV: Left ventricular end systolic volume, LVEDV: Left ventricular end diastolic volume, PAP: Pulmonary artery pressure.

Discussion

LVOT obstruction and asymmetrically distributed left ventricular hypertrophy are the hallmarks of the heterogeneous disease known as HOCM [6, 11].

Regarding preoperative echocardiographic, cardiac computed tomography, cardiac catheterization findings

In the current study, the median of bypass time was 69 (50 – 84) min, cross clamp time was 54 (35–74) min, operative time was 5 (4 – 6), ventilation duration was 4 (2 – 5) hours, ICU stay was 4 (2 – 5) days, hospital stay was 7 (5 – 8) days. Heart block occurred in 1(2.5%) patient. Regarding Early postoperative complications, postoperative bleeding occurred in one patient (2.5%). No patients developed neurological sequalae, pulmonary infection, wound infection, AF, or VSD. In another similar study by Holst et al. [12] the median hospitalization period is 6 days, in extended myectomySun et al. [13] also highlighted the rare incidence of such an adverse event after septal myectomy in HOCM patients as it ranged between 0.5% and 1.4%. . This is identical to what was published by Desai et al. [14] denied the incidence of the same complication in their enrolled 173 HOCM patients who underwent septal reduction surgery.

NYHA class, IVS, MR grade, SAM and LVOT pressure were significantly lower postoperatively, before discharge, three and six months than baseline. Medication number was insignificantly different between baseline and before discharge, while significantly lower in 3 and 6 months.

Similarly, Kofflard et al. [15] reported that septal myectomy yielded more improvement in NYHA class compared to before surgery. According to our findings, Kofflard et al. [15] reported that there was a significant decline in the number of commenced HOCM medications after myectomy. In the myectomy, it decreased from 1.3 ± 0.7 to 1 ± 1.2 after the procedure. In agreement with our findings, Kofflard et al. [15] a previous study reported significant decrease regarding IVS after myectomy than preoperative assessment (27 ± 4 vs. 26 ± 5 mm, respectively – p = 0.56). Another study confirmed our findings by Kofflard et al. [15] regarding the significant beneficial impact of extended septal myectomy on the MR grade (p < 0.005), which ranged between 0 and 3 . There is significant decline in LVOT pressure after myectomy than baseline data [16-18]. In the study published by Kofflard et al. [15] preoperative LVOT gradient had mean values of 87 ± 36 in the extended myectomy and postoperative assessment revealed more decline in that parameter after the operation .

LAV, LVESV, LVEDV and systolic PAP were significantly lower after surgery, three and six months than baseline, while LVEF was insignificantly different. Yang et al. [19] reported that the same parameter decreased significantly after septal reduction procedures in HOCM patients (from 70.2 ± 4.3 to 63.7 ± 4.3% - p = 0.019). This improvement in ventricular emptying and reduction in LVOT obstruction can result in a decrease in LVESV [20]. This improvement in ventricular filling and reduction in LVOT obstruction can result in a decrease in LVEDV [20]. This coincides with Ha et al. [21] reported that following septal myectomy, left atrial volume index (58.1 ± 18.3 vs. 45.3 ± 14.6 mL/m2, P = 0.001) decreased significantly. Our findings are supported by the published research of Yang et al. [19] reported that the mean pulmonary artery pressure decreased from 29.3 ± 16.2 to 20 ± 6.7 mmHg after surgery (p = 0.05), and the systolic pulmonary artery pressure decreased from 46 ± 26.9 to 30.5 ± 8.3 mmHg (p = 0.048).

One of the study's limitations was the small sample size. The study was in a single center. Our study lacks intermediate and long-term follow-up assessment. That should encourage researchers to conduct more studies in the near future to cover the previously mentioned perspectives.

Conclusions:

Septal reduction surgery is associated with significant clinical and echocardiographic changes, compared in treatment of patients diagnosed with HOCM.

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Conflict of Interest: Nil

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