

Comparison of Clinical Effects between Percutaneous Transluminal Septal Myocardial Ablation and Modified Morrow Septal Myectomy on Patients with Hypertrophic Cardiomyopathy

Hong-Chang Guo¹, Jin-Hua Li¹, Teng-Yong Jiang², Chang-Wei Ren¹, Jiang Dai¹, Yu-Jie Zhou², Yong-Qiang Lai¹

¹Department of Cardiac Surgery, Beijing Anzhen Hospital, Capital Medical University, Beijing 100029, China

²Department of Cardiology, Beijing Anzhen Hospital, Capital Medical University, Beijing 100029, China

Abstract

Background: Percutaneous transluminal septal myocardial ablation (PTSMA) and modified Morrow septal myectomy (MMSM) are two invasive strategies used to relieve obstruction in patients with hypertrophic cardiomyopathy (HCM). This study aimed to determine the clinical outcome of these two strategies.

Methods: From January 2011 to January 2015, 226 patients with HCM were treated, 68 by PTSMA and 158 by MMSM. Both ultrasonic cardiograms and heart functional class were recorded before, after operations and in the follow-up. Categorical variables were compared using Chi-square or Fisher's exact tests. Quantitative variables were compared using the paired samples *t*-test.

Results: Interventricular septal thickness was significantly reduced in both groups (21.27 ± 4.43 mm vs. 18.72 ± 4.13 mm for PTSMA, $t = 3.469$, $P < 0.001$, and 21.83 ± 5.03 mm vs. 16.57 ± 3.95 mm for MMSM, $t = 10.349$, $P < 0.001$, respectively). The left ventricular outflow tract (LVOT) pressure gradient (PG) significantly decreased after the operations in two groups (70.30 ± 44.79 mmHg vs. 39.78 ± 22.07 mmHg for PTSMA, $t = 5.041$, $P < 0.001$, and 74.58 ± 45.52 mmHg vs. 13.95 ± 9.94 mmHg for MMSM, $t = 16.357$, $P < 0.001$, respectively). Seven patients (10.29%) in the PTSMA group required a repeat operation in the follow-up. Eight (11.76%) patients were evaluated for New York Heart Association (NYHA) III/IV in the PTSMA group, which was significantly more than the five (3.16%) in the same NYHA classes for the MMSM group at follow-up. Less than 15% of patients in the PTSMA group and none of the patients in the MMSM group complained of chest pain during follow-up.

Conclusions: Both strategies can not only relieve LVOT PG but also improve heart function in patients with HCM. However, MMSM might provide a more reliable reduction in gradients compared to PTSMA.

Key words: Hypertrophic Cardiomyopathy; Myectomy; Percutaneous Transluminal Septal Myocardial Ablation

INTRODUCTION

Hypertrophic obstructive cardiomyopathy (HCM) is a disease characterized by hypertrophy of the interventricular septum, obstruction of left ventricular outflow tract (LVOT), and frequently, systolic anterior motion (SAM) of the mitral valve.^[1-3] Although medical intervention can provide relief of symptoms, a considerable number of patients with hypertrophic obstructive cardiomyopathy remain symptomatic, and in these participants, invasive interventions such as percutaneous transluminal septal myocardial ablation (PTSMA) and modified Morrow

septal myectomy (MMSM) are established treatment options.^[4,5] Extended septal myectomy can significantly relieve obstruction of LVOT and improve main complaints.^[6-8]

Address for correspondence: Dr. Yong-Qiang Lai,
Department of Cardiac Surgery, Beijing Anzhen Hospital, Capital
Medical University, No. 2, Anzhen Street, Beijing 100029, China
E-Mail: yongqianglai@yahoo.com

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

© 2018 Chinese Medical Journal | Produced by Wolters Kluwer - Medknow

Received: 04-12-2017 **Edited by:** Peng Lyu

How to cite this article: Guo HC, Li JH, Jiang TY, Ren CW, Dai J, Zhou YJ, Lai YQ. Comparison of Clinical Effects between Percutaneous Transluminal Septal Myocardial Ablation and Modified Morrow Septal Myectomy on Patients with Hypertrophic Cardiomyopathy. Chin Med J 2018;131:527-31.

Access this article online

Quick Response Code:



Website:
www.cmj.org

DOI:
10.4103/0366-6999.226075

However, experience with myectomy is limited at many centers.

PTSMA, regarded as a less invasive treatment than surgical procedure, is considered as an alternative to myectomy and is usually performed on patients who are not optimal surgical candidates or have a strong desire to avoid surgery.^[9,10] However, previous studies have also reported a greater need for pacemaker implantation and a higher rate of re-interventions after PTSMA compared to myectomy.^[11]

Handbook released by the American College of Cardiology/American Heart Association supplies a Class I recommendation to myectomy for patients with severe drug-refractory symptoms and LVOT obstruction in experienced centers with comprehensive hypertrophic cardiomyopathy (HCM) clinical program (Level of Evidence: C). PTSMA has been given a Class IIa recommendation for adult patients with an unacceptable surgical risk (Level of Evidence: B) in an experienced center.^[9] However, data on the effectiveness of these two septal reduction therapies in China are lacking. We report our experience in a comprehensive study of both procedures including periprocedural complications, re-interventions, long-term symptomatic status, and clinical outcome.

METHODS

Ethical approval

The study was conducted in accordance with the *Declaration of Helsinki* and was approved by the Ethics Committee of Anzhen Hospital (No. AZ00305). Informed written consent was obtained from all patients or their guardians (in the case of children) before their enrollment in this study.

Patients

Two-hundred and twenty-six patients with HCM (aged >18 years) with significant LVOT obstruction were selected who first visited the Department of Cardiac Surgery of Beijing Anzhen Hospital, Beijing, China, between January 2011 and January 2015. The following exclusion criteria included (1) concomitant moderate or greater aortic/mitral stenosis; (2) maximal (including provokable) LVOT pressure gradient (PG) <50 mmHg (1 mmHg = 0.133 kPa); (3) apical HCM variant; and (4) hypertensive heart disease in elderly patients. HCM was diagnosed by experienced cardiologists based on typical features, with ventricular myocardial hypertrophy (LV wall thickness >15 mm) in the absence of any other disease responsible for the hypertrophy.^[9,10] Resting/provokable LVOT obstruction (LVOT gradient >50 mmHg) was also included in the study.

Clinical data collection

The clinical data and demographic information were taken from the medical records of each patient including demographics, clinical outcomes, and echocardiographic parameters. Complications including the need for permanent pacing between two groups were recorded. The

echocardiographic parameters were analyzed before and after the operation.

Percutaneous transluminal septal myocardial ablation

PTSMA was performed using previously described techniques.^[12] Different catheters were inserted in the LV and aorta to measure pressures and PG of LV tract. Then, another catheter was placed in the selected branch of the left anterior descending artery. After balloon inflation, angiographic contrast was injected through the balloon catheter together with simultaneous transthoracic two-dimensional myocardial contrast echocardiography to determine the extent of the myocardium supplied by the selected septal artery. After delineation of the size of targeted myocardium, 1–4 ml of alcohol was slowly (1 ml/min) injected. The balloon was left inflated for 10 min after alcohol injection to prevent a retrograde spill of alcohol. During the procedure, patients without permanent pacemakers received a temporary pacemaker.

Modified Morrow myectomy

Standard cardiopulmonary bypass and myocardial preservation techniques were used. After aortotomy, the resection was started by making two parallel longitudinal incisions in the septum, the first beneath the nadir of the right coronary cusp and the second beneath the commissure between the right and the left coronary cusps. The classic incision was extended with a midventricular resection, beginning with continued resection leftward toward the mitral valve annulus and apically to the bases of the papillary muscles. All areas of papillary muscle fusion to the septum or ventricular free wall were divided, and anomalous chordal structures, muscle bundles, and fibrous attachments of the mitral leaflets to the ventricular septum or free wall were divided or excised.^[13]

PTSMA was usually selected in elderly patients who have a high risk of surgical therapy. When patients need receive valvular surgery or coronary artery bypass operation, they were excluded from the study. All patients gave informed consent before these respective procedures.

Follow-up study

Physical examination including assessment of New York Heart Association (NYHA) functional class and echocardiography was recommended during follow-up. The follow-up was carried out by subsequent clinic visits to the outpatient departments and telephone interviews with the patients and their relatives.

Statistical analysis

Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables were expressed as frequencies or percentages. SPSS V.22 (SPSS, Inc., IBM, Chicago, IL, USA) was used for the statistical analysis. Categorical variables were compared using Chi-square or Fisher's exact tests. Quantitative variables were compared using the paired samples *t*-test. A value of $P < 0.05$ was considered statistically significant for comparison of clinical outcomes.

RESULTS

Baseline clinical profiles

Of the 226 HCM patients, 68 (31.1%) patients were treated with PTSMA and 158 (69.9%) with MMSM. The patients in the PTSMA group were older than those in the MMSM group. A significantly higher proportion of patients in the MMSM group had hypertension as a presenting feature. No significant differences of other baseline clinical or echocardiographic profiles were observed between the two groups [Table 1].

Echocardiographic outcomes

The ejection fraction pre- and postprocedure was within normal ranges for both groups [Table 2]. The mean of the LV outflow gradient decreased from 70.30 ± 44.79 mmHg to 39.78 ± 22.07 mmHg in the PTSMA group ($t = 5.041$, $P < 0.001$) and from 74.58 ± 45.52 mmHg to 13.95 ± 9.94 mmHg in the MMSM group ($t = 16.357$, $P < 0.001$), indicating a significant hemodynamic improvement with both procedures. The residual PGs at rest were significantly reduced in the MMSM group than that in the PTSMA group after the operation. The septal thickness reduced from 21.27 ± 4.43 mm to 18.72 ± 4.13 mm in the PTSMA group ($t = 3.469$, $P < 0.001$) and from 21.83 ± 5.03 mm to 16.57 ± 3.95 mm ($t = 10.349$, $P < 0.001$) in the MMSM group. There was a significant difference in the absence of SAM between the two groups. SAM

decreased from 91.18% to 45.59% in the PTSMA group ($\chi^2 = 32.682$, $P < 0.001$) and from 93.67% to 5.06% in MMSM group ($\chi^2 = 248.141$, $P < 0.001$; Table 2).

Procedural, clinical outcomes, and follow-up

Four patients in the PTSMA group failed to complete the procedure, two for multiple side branches, one for a severe blood pressure drop after balloon inflation, and one for acute left heart failure in operation. The mean duration of hospitalization was shorter in the PTSMA group ($t = -4.462$, $P < 0.001$). Two patients in the MMSM group needed extracorporeal membrane oxygenation (ECMO) for postoperative low cardiac output. Forty (58.82%) patients in the PTSMA group had a right bundle branch block, compared with 22 (13.92%) of the patients in the MMSM group ($\chi^2 = 48.142$, $P < 0.001$). Interestingly, left bundle branch blocks were more common in the MMSM group ($\chi^2 = 13.182$, $P < 0.001$). Permanent pacemakers because of complete heart block were required in five patients (7.35%) of the PTSMA group and in four patients (2.53%) of the MMSM group ($\chi^2 = 2.809$, $P = 0.089$; Table 3).

The mean follow-up was 44.19 ± 15.19 months for the PTSMA group and 38.48 ± 15.93 months for the MMSM group. Six (8.8%) patients in the PTSMA group and 12 (7.6%) patients in the MMSM group died before long-term follow-up. Two patients in the PTSMA group

Table 1: Baseline characteristics of the patients in PTSMA and MMSM groups

Parameters	PTSMA (n = 68)	MMSM (n = 158)	Statistics	P
Age (years)	52.59 ± 10.54	49.20 ± 12.30	1.978 [†]	0.049
Male	43 (63.24)	94 (59.49)	0.279*	0.597
Syncope	22 (63.24)	53 (33.54)	0.030*	0.862
Angina	29 (32.35)	76 (48.10)	0.569*	0.451
NYHA (III/IV)	55 (80.88)	112 (70.89)	2.463*	0.117
Medical history				
Hypertension	37 (54.41)	43 (27.22)	15.377*	<0.001
Diabetes	5 (7.35)	7 (4.43)	0.808*	0.369
Coronary artery disease	10 (14.71)	17 (10.76)	0.704*	0.402
Family history of HCM	4 (5.88)	8 (5.06)	0.063*	0.801
History of radiofrequency	2 (2.94)	3 (1.90)	0.239*	0.625
Arrhythmias				
Atrial fibrillation	11 (16.18)	18 (11.39)	0.973*	0.324
Right bundle branch block	4 (5.88)	7 (4.43)	0.216*	0.642
Left bundle branch block	1 (1.47)	7 (4.43)	1.220*	0.269
Preoperative echocardiogram				
Septal thickness (mm)	21.27 ± 4.43	21.83 ± 5.03	-0.793 [†]	0.429
PW thickness (mm)	12.29 ± 2.47	12.75 ± 2.95	-1.115 [†]	0.266
LA (mm)	41.23 ± 5.56	42.94 ± 6.78	-1.831 [†]	0.068
LVOT PG (mmHg)	70.30 ± 44.79 [‡]	74.58 ± 45.52 [§]	-0.650 [†]	0.516
SAM	62 (91.18)	148 (93.67)	0.450*	0.503
MR Grade 1	31	44	6.748*	0.009
MR Grade 2	30	73	0.803*	0.773
MR Grade 3	7	41	6.965*	0.008

Data are presented as mean ± SD or n (%). * χ^2 values; [†]t values; [‡]The LVOT PG of 12 patients over 100 mmHg; [§]The LVOT PG of 32 patients over 100 mmHg. PTSMA: Percutaneous transluminal septal myocardial ablation; MMSM: Modified Morrow septal myectomy; NYHA: New York Heart Association; HCM: Hypertrophic cardiomyopathy; PW: Posterior wall; LA: Left atrium; LVOT: Left ventricular outflow tract; PG: Pressure gradient; SAM: Systolic anterior motion of mitral leaflet; MR: Mitral valve regurgitation; SD: Standard deviation. 1 mmHg = 0.133 kPa.

Table 2: Clinical outcomes and hemodynamic results of the study

Parameters	PTSMA (n = 68)				MMSM (n = 158)				Outcomes	
	Pre	Post	Statistics	P	Pre	Post	Statistics	P	Statistics	P**
Septal thickness (mm)	21.27 ± 4.43	18.72 ± 4.13	3.469*	0.001	21.83 ± 5.03	16.57 ± 3.95	10.349*	<0.001	3.710*	<0.001
LVOT PG (mmHg)	70.30 ± 44.79 [‡]	39.78 ± 22.07 [§]	5.041*	<0.001	74.58 ± 45.52	13.95 ± 9.94 [†]	16.357*	<0.001	12.146*	<0.001
LA (mm)	41.23 ± 5.56	39.94 ± 4.71	1.461*	0.146	42.94 ± 6.78	37.31 ± 6.59	7.491*	<0.001	2.982*	0.003
LVEF	69.28 ± 7.66	64.16 ± 5.33	4.523*	<0.001	67.65 ± 7.09	61.10 ± 7.46	8.011*	<0.001	3.069*	0.002
SAM	62 (91.18)	31 (45.59)	32.682 [†]	<0.001	148 (93.67)	8 (5.06)	248.141 [†]	<0.001	54.678 [†]	<0.001

Data are presented as mean ± SD or n (%). **t* values; [†] χ^2 values; [‡]The LVOT PG of 12 patients over 100 mmHg; [§]The LVOT PG of 15 patients over 50 mmHg; ^{||}The LVOT PG of 32 patients over 100 mmHg; ^{††}The LVOT PG of two patients over 30 mmHg. **: Compared post-operations parameters between two methods. PTSMA: Percutaneous transluminal septal myocardial ablation; MMSM: Modified Morrow septal myectomy; LA: Left atrium; LVOT: Left ventricular outflow tract; PG: Pressure gradient; SAM: Systolic anterior motion of mitral leaflet; LVEF: Left ventricular ejection fraction; SD: Standard deviation. 1 mmHg = 0.133 kPa.

Table 3: Complications and follow-up data of the study

Parameters	PTSMA (n = 68)	MMSM (n = 158)	Statistics	P
Mitral valve replacement	0 (0)	15 (9.49)	–	–
Right bundle branch block	40 (58.82)	22 (13.92)	48.142*	<0.001
Left bundle branch block	10 (14.71)	62 (39.24)	13.182*	<0.001
Permanent pacemaker insertion due to heart block from procedure	5 (7.35)	4 (2.53)	2.809*	0.089
Repeat procedure	7 (10.29)	0 (0)	16.785*	<0.001
Mortality postprocedure (<30 days)	2 (2.94)	2 (1.27)	0.767*	0.381
Late mortality (>1 year)	1 (1.47)	2 (1.27)	0.015*	0.902
Follow-up data				
NYHA (III, IV)	8 (11.76)	5 (3.16)	6.486*	0.011
Angina	10 (14.71)	0 (0)	24.311*	<0.001
Ventricular septal thickness (mm)	18.13 ± 4.14	16.47 ± 5.28	2.304 [†]	0.022
LVOT PG (mmHg)	33.51 ± 24.08 [‡]	15.82 ± 27.20 [§]	4.639 [†]	<0.001
SAM	34 (50.00)	8 (5.06)	63.447*	<0.001
LVEF	62.49 ± 5.88	64.96 ± 7.29	-2.451 [†]	0.015

Data are presented as mean ± SD or n (%). * χ^2 values; [†]*t* values; [‡]The LVOT PG of 19 patients over 50 mmHg; [§]The LVOT PG of 9 patients over 30 mmHg. PTSMA: Percutaneous transluminal septal myocardial ablation; MMSM: Modified Morrow septal myectomy; NYHA: New York Heart Association; LVOT: Left ventricular outflow tract; PG: Pressure gradient; SAM: Systolic anterior motion of mitral leaflet; LVEF: Left ventricular ejection fraction; SD: Standard deviation. –: No applicable. 1 mmHg = 0.133 kPa.

died of acute heart failure in the early postoperative period (<1 month). Two patients died of low cardiac output in the MMSM group. There was one later death (>12 months) in the PTSMA group with the patient dying of chronic heart failure. Two patients died 1 year after the procedure in the MMSM group; one of noncardiac cause and one of stroke. There was no significant difference between groups in the level of survival. Kaplan-Meier Curves demonstrated no difference in long-term survival between the PTSMA and MMSM groups ($\chi^2 = 0.190$, $P = 0.663$ by log-rank test). Seven patients received PTSMA required a repeat operation after the procedure; two of whom received second septal myocardial ablation and five patients received MMSM. Echocardiography examination demonstrated that the MMSM group had a lower LVOT PG 1 year after the operation [Table 3]. Eight (11.76%) patients were evaluated for NYHA III/IV in the PTSMA group, which was significantly more than 5 (3.16%) in the MMSM group at the latest follow-up. Less than 15% of patients in the PTSMA group and none of the patients in the MMSM group complained of any chest pain during follow-up.

DISCUSSION

Hypertrophic cardiomyopathy (HCM) is characterized by hypertrophy of the myocardium and is associated with various clinical presentations ranging from complete absence of symptoms to sudden, unexpected death. LVOT obstruction is present in 20–30% of HCM patients and a number of patients remain symptomatic despite optimal medical therapy, and surgical myectomy is usually recommended for HCM patients. Myectomy procedures were first reported by Morrow in 1975, and many variations of this procedure have been reported with varied efficacies since.^[14,15] Myectomy reduces or eliminates LVOT obstruction in most individuals, and its effects are usually sustained.^[15,16] Sigwart reported that inflating an angioplasty balloon catheter in the septal perforator resulted in a significant decrease in LVOT obstruction.^[17] Subsequently, intracoronary alcohol injection gained popularity in treating patients with HCM who are refractory to medical therapy. In this study, we report our experience of two strategies for treating refractory HCM.

The two groups of patients involved in this investigation had identical baseline gradients and achieved a similar

hemodynamic improvement after both procedures. This might be related to the similar mechanisms for eliminating obstructions that are common to both procedures. As noted in the previously, a similar reduction in basal septal thickness was noted after both MMSM and PTSMA. These observations are similar to the mechanisms by which successful septal myectomy relieves LVOT obstruction.

The two patient groups had similar baseline NYHA and Canadian Cardiovascular Society classes, and a similar number in each group suffered from syncope at baseline examination. After surgery, nearly 97% of the patients were in NYHA Class I or II, and after PTSMA, 88% of the patients were in these two classes. Angina disappeared in the MMSM group after surgery; however, 10 (14.71%) patients in the PTSMA group still suffered relevant symptoms. Complete heart block necessitating permanent pacing occurred in 7.35% of patients in the PTSMA group, which was higher than the MMSM group (2.53%), but the data are not statistically significant.

Two deaths occurred in the PTSMA group, both of them suffering acute left heart failure after balloon inflation. This may have been because of heart failure after extensive myocardial infarction. As expected, percutaneous interventions in older patients carry more risk due to the presence of atherosclerotic lesions. Two deaths were observed in the MMSM group because of low cardiac output syndrome postoperatively.

Seven patients suffered second interventions because of recurrent symptoms after the procedure in the PTSMA group, but none required it in the MMSM group. Two patients chose repeated PTSMA because they refused the thoracotomy operation, and five patients received the MMSM procedure. The results showed that MMSM was a more reliable strategy for treating LVOT obstruction.

Like most studies on HCM, this was a retrospective, nonrandomized study, with the common limitations inherent in this type of study. Although the PTSMA and MMSM groups were well matched in terms of baseline clinical profiles, there may have been bias that led patients to select MMSM instead of PTSMA. We just recorded the NYHA class and angina of patients in the follow-up.

In conclusion, both the PTSMA procedure and the MMSM procedure can reduce LVOT obstruction and alleviate symptoms in patients with HCM. However, the MMSM is superior to the PTSMA in reducing the LVOT gradient and alleviating the symptoms associated with HCM.

Financial support and sponsorship

This work was supported by grants from the National Natural Science Foundation of China (No. 81370328, and No. 81770371).

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Wigle ED, Sasson Z, Henderson MA, Ruddy TD, Fulop J, Rakowski H, *et al.* Hypertrophic cardiomyopathy. The importance of

- the site and the extent of hypertrophy. *Prog Cardiovasc Dis* 1985;28:1-83. doi: 10.1016/0033-0620(85)90024-6.
2. Wigle ED, Rakowski H, Kimball BP, Williams WG. Hypertrophic cardiomyopathy. Clinical spectrum and treatment. *Circulation* 1995;92:1680-92. doi: 10.1161/01.cir.92.7.1680.
3. Xiao Y, Yang KQ, Yang YK, Liu YX, Tian T, Song L, *et al.* Clinical characteristics and prognosis of end-stage hypertrophic cardiomyopathy. *Chin Med J* 2015;128:1483-9. doi: 10.4103/0366-6999.157656.
4. Nagueh SF, Lakkis NM, He ZX, Middleton KJ, Killip D, Zoghbi WA, *et al.* Role of myocardial contrast echocardiography during nonsurgical septal reduction therapy for hypertrophic obstructive cardiomyopathy. *J Am Coll Cardiol* 1998;32:225-9. doi: 10.1016/s0735-1097(98)00220-4.
5. Ball W, Ivanov J, Rakowski H, Wigle ED, Linghorne M, Ralph-Edwards A, *et al.* Long-term survival in patients with resting obstructive hypertrophic cardiomyopathy comparison of conservative versus invasive treatment. *J Am Coll Cardiol* 2011;58:2313-21. doi: 10.1016/j.jacc.2011.08.040.
6. McCully RB, Nishimura RA, Bailey KR, Schaff HV, Danielson GK, Tajik AJ, *et al.* Hypertrophic obstructive cardiomyopathy: Preoperative echocardiographic predictors of outcome after septal myectomy. *J Am Coll Cardiol* 1996;27:1491-6. doi: 10.1016/0735-1097(96)00038-1.
7. Schulte HD, Borisov K, Gams E, Gramsch-Zabel H, Lösse B, Schwartzkopff B, *et al.* Management of symptomatic hypertrophic obstructive cardiomyopathy – Long-term results after surgical therapy. *Thorac Cardiovasc Surg* 1999;47:213-8. doi: 10.1055/s-2007-1013146.
8. Merrill WH, Friesinger GC, Graham TP Jr., Byrd BF 3rd, Drinkwater DC Jr, Christian KG, *et al.* Long-lasting improvement after septal myectomy for hypertrophic obstructive cardiomyopathy. *Ann Thorac Surg* 2000;69:1732-5. doi: 10.1016/s0003-4975(00)01314-x.
9. Gersh BJ, Maron BJ, Bonow RO, Dearani JA, Fifer MA, Link MS, *et al.* 2011 ACCF/AHA guideline for the diagnosis and treatment of hypertrophic cardiomyopathy: Executive summary: A report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *Circulation* 2011;124:2761-96. doi: 10.1161/CIR.0b013e318223e230.
10. Elliott PM, Anastakis A, Borg MA, Borggrefe M, Cecchi F, Charron P, *et al.* 2014 ESC Guidelines on diagnosis and management of hypertrophic cardiomyopathy: The Task Force for the Diagnosis and Management of Hypertrophic Cardiomyopathy of the European Society of Cardiology (ESC). *Eur Heart J* 2014;35:2733-79. doi: 10.1093/eurheartj/ehu284.
11. Alam M, Dokainish H, Lakkis NM. Hypertrophic obstructive cardiomyopathy-alcohol septal ablation vs. Myectomy: A meta-analysis. *Eur Heart J* 2009;30:1080-7. doi: 10.1093/eurheartj/ehp016.
12. Nagueh SF, Groves BM, Schwartz L, Smith KM, Wang A, Bach RG, *et al.* Alcohol septal ablation for the treatment of hypertrophic obstructive cardiomyopathy. A multicenter North American registry. *J Am Coll Cardiol* 2011;58:2322-8. doi: 10.1016/j.jacc.2011.06.073.
13. Wang S, Luo M, Sun H, Song Y, Yin C, Wang L, *et al.* A retrospective clinical study of transaortic extended septal myectomy for obstructive hypertrophic cardiomyopathy in China. *Eur J Cardiothorac Surg* 2013;43:534-40. doi: 10.1093/ejcts/ezs332.
14. Dörge H, Schmitto JD, Liakopoulos OJ, Walther S, Schöndube FA. Extended myectomy for hypertrophic obstructive cardiomyopathy after failure or contraindication of septal ablation or with combined surgical procedures. *Thorac Cardiovasc Surg* 2004;52:344-8. doi: 10.1055/s-2004-830323.
15. Minakata K, Dearani JA, Nishimura RA, Maron BJ, Danielson GK. Extended septal myectomy for hypertrophic obstructive cardiomyopathy with anomalous mitral papillary muscles or chordae. *J Thorac Cardiovasc Surg* 2004;127:481-9. doi: 10.1016/j.jtcvs.2003.09.040.
16. Cohn LH, Trehan H, Collins JJ Jr. Long-term follow-up of patients undergoing myotomy/myectomy for obstructive hypertrophic cardiomyopathy. *Am J Cardiol* 1992;70:657-60. doi: 10.1016/0002-9149(92)90208-g.
17. Sigwart U. Non-surgical myocardial reduction for hypertrophic obstructive cardiomyopathy. *Lancet* 1995;346:211-4. doi: 10.1016/s0140-6736(95)91267-3.

经皮酒精消融术与改良Morrow手术治疗肥厚性梗阻性心肌病临床疗效的单中心比较研究

摘要

背景: 经皮酒精消融术和改良Morrow手术是针对肥厚性梗阻性心肌病左心室流出道梗阻的两种不同的治疗方法。本研究旨在比较这两种治疗方法的疗效。

方法: 选取2011年到2015年226例在我院住院的肥厚型梗阻性心肌病患者，其中68患者接受经皮酒精消融术，168例患者接受改良Morrow手术。患者在术前，术后和随访过程中接受超声心动图检查采集相关数据并记录心功能分级。

结果: 两组患者术后室间隔厚度显著减少，经皮酒精消融：术前 21.27 ± 4.43 mm，术后 18.72 ± 4.13 mm ($t=3.469, p<0.001$)，改良Morrow组：术前 21.83 ± 5.03 mm，术后 16.57 ± 3.95 mm ($t=10.349, p<0.001$)。两组患者术后左心室流出道压差均显著降低，经皮酒精消融：术前 70.30 ± 44.79 mmHg，术后 39.78 ± 22.07 mmHg ($t=5.041, p<0.001$)，改良Morrow组：术前 21.83 ± 5.03 mm，术后 16.57 ± 3.95 mm ($t=16.357, p<0.001$)。有7例接受经皮酒精消融患者接受再次外科手术治疗。随访期间，8例接受经皮酒精消融手术的患者心功能分级为III级以上，接受改良Morrow手术有5人。其中14.71%接受经皮酒精消融的患者术后仍有胸痛的症状发作。

结论: 经皮酒精消融术和改良Morrow术都可以显著改善患者心功能及缓解左室流出道梗阻，然而改良Morrow术缓解更加彻底。