

**ORIGINAL RESEARCH****HEART FAILURE AND CARDIOMYOPATHIES**

# Improvement in Sexual Dysfunction in Patients With Hypertrophic Cardiomyopathy Undergoing Septal Myectomy



## A Prospective Study

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**ABSTRACT**

**BACKGROUND** Septal myectomy improves symptoms in the majority of patients with obstructive hypertrophic cardiomyopathy (HCM), but there are limited prospective data on functional outcomes after operation.

**OBJECTIVES** The authors investigated quality of life measures and prevalence of sexual dysfunction before and after septal myectomy for obstructive HCM.

**METHODS** Between January 2018 and October 2019, 436 patients underwent transaortic septal myectomy at our clinic. All patients were screened for eligibility, and 197 (45.2%) were enrolled in this prospective survey study. Patients received a questionnaire pertaining to quality of life and sexual health before and within 4 to 6 months postoperatively, and 113 (57.4%) completed the follow-up survey.

**RESULTS** The mean age of the 54 (47.8%) women and 59 (52.2%) men was  $54.7 \pm 14.1$  years. Quality of life, including both mental and physical components, improved significantly in both men ( $P < 0.001$ ) and women ( $P < 0.001$ ). Women reported mild sexual dysfunction at baseline, and following septal myectomy, they experienced significant ( $P < 0.05$ ) improvement in most domains pertaining to sexual health. In men, the International Index of Erectile Function median score was 23 (IQR: 7.0-29.5), which is consistent with mild dysfunction at baseline, and there was significant improvement following surgery in young (age  $\leq 55$  years) men ( $P < 0.001$ ).

**CONCLUSIONS** Quality of life is significantly improved following septal myectomy in patients with obstructive HCM. Both women and men reported mild sexual dysfunction at baseline, and women and younger men (age  $\leq 55$  years) experienced significant improvements in sexual health. (JACC Adv 2024;3:100763) © 2024 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

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**ABBREVIATIONS  
AND ACRONYMS****FSFI** = Female Sexual Function Index**HCM** = hypertrophic cardiomyopathy**IIEF** = International Index of Erectile Function**IPSS** = International Prostate Symptoms Score**LVOT** = left ventricular outflow tract**PROMIS** = Patient-Reported Outcomes Measurement Information System

**H**ypertrophic cardiomyopathy (HCM) is the most common inherited cardiomyopathy and is associated with a wide range of symptoms including dyspnea on exertion, syncope, and palpitations.<sup>1</sup> These symptoms, as well as anxiety concerning sudden cardiac death can significantly affect a patient's lifestyle and reduce quality of life.<sup>2</sup> For patients with obstructive HCM, septal myectomy has been shown to improve overall survival and self-reported perceived health status.<sup>3</sup> However, there is a paucity of data on the extent and quantification of such improvements.

Sexual dysfunction is common in patients with cardiac disease, affecting as many as 43% of women<sup>4</sup> and 31% of men.<sup>5,6</sup> Studies suggest a higher prevalence of sexual dysfunction among cardiac patients with worse physical and emotional health.<sup>5,7</sup> The incidence and clinical impact of sexual dysfunction in patients with obstructive HCM is unknown.<sup>8</sup> Furthermore, whether relief of left ventricular outflow tract (LVOT) obstruction can improve sexual function has not been investigated. Therefore, the aim of our study was to evaluate quality of life including sexual function in symptomatic patients with obstructive HCM who underwent septal myectomy, and to quantify any postoperative changes.

**MATERIAL AND METHODS**

The study was approved by our Institutional Review Board. We conducted a prospective cohort study of patients who underwent septal myectomy for the treatment of obstructive HCM from January 2018 to October 2019. All patients with obstructive HCM who were referred to Mayo Clinic for septal myectomy were screened for inclusion, and those undergoing isolated transaortic myectomy who were older than 18 years and English speaking were considered eligible. A standardized script was used to approach these patients for inclusion in the study, and patient consent was obtained during their preoperative clinic visit. Patients who wished to participate signed a Health Insurance Portability and Accountability Act authorization form. Following enrollment, patients completed a baseline questionnaire and were sent a follow-up questionnaire at 4 to 6 months postoperatively. Those who failed to reply to the first mailing of the follow-up questionnaire were sent a second questionnaire, and if no response was received, a follow-up phone call was conducted. If interested in participating, a third questionnaire was mailed out to the patients. Patients who completed a

preoperative and postoperative survey were offered a 50 USD voucher as remuneration for their time.

Questionnaires were developed separately for women and men, although they contained overlapping questions pertaining to overall health and quality of life. Quality of life was assessed using the validated Patient-Reported Outcomes Measurement Information System (PROMIS v1.2) questionnaire, which scores global physical and mental function.<sup>9</sup> Sexual function in men was assessed using the International Index of Erectile Function questionnaire (IIEF-15), which is a well validated tool used to diagnose and assess treatment response of male sexual dysfunction.<sup>10</sup> The IIEF-15 contains 5 domains representing sexuality, with results typically reported in these individual domains. Women were evaluated with the Female Sexual Function Index (FSFI).<sup>11,12</sup> The FSFI is a multidimensional measure of female sexual functioning with 19 questions that have ordinal, Likert-type response formats and are scored from 0 (or 1) to 5. The FSFI total score is the sum of 6 domain/subscale scores and has a maximum score of 36 (range 2-36), with a score of 26 or less indicating sexual dysfunction. All surveys included questions regarding urinary function, which was measured using the International Prostate Symptoms Score (IPSS); this questionnaire has been validated for both women and men.<sup>13,14</sup> The IPSS consists of 7 questions related to voiding (total score range 0-35), with a score of 0 to 7 indicated mild symptoms, 8 to 19 indicated moderate symptoms, and 20 to 35 indicating severe symptoms.

Statistical analysis was stratified by sex, and the population was expected to be evenly distributed among females and males. The study was powered to detect significant improvements in FSFI full scale score (range 2-36) for female patients and IIEF-15 erectile function domain score for male patients (range 1-30). With a design to have at least 90% power to detect a clinically relevant 4-point (or greater) change in erectile function domain score among males, the sample size formula for a one-sample *t*-test was used to conduct the power analysis based on a two-sided test with a type I error rate of 0.05. The standard deviation of the change used in the power calculation was 8.5 points as estimated from review of prior studies.<sup>15-18</sup> Hence, a 4-point change in score is slightly less than one-half of a standard deviation, or an effect size of 0.47. With the same effect size assessed in females as well, the calculated sample size needed was 50 participants per sex. Due to an estimated loss to follow-up of 50%, we targeted a total accrual of 200 myectomy patients, 100 females and 100 males. Categorical variables were reported as

**TABLE 1** Baseline Characteristics of All Patients Who Participated in the Survey and Comparison With Those Who Did Not Participate

	Study Patients (n = 113)	Nonparticipants (n = 166)	P Value
Age, y	54.7 ± 14.1	58.2 ± 14.3	0.044 <sup>a</sup>
Male	59 (52.2%)	89 (53.6%)	0.818 <sup>b</sup>
Body mass index, kg/m <sup>2</sup>	30.7 ± 6.1	31.3 ± 7	0.535 <sup>b</sup>
Body surface area, m <sup>2</sup>	2 ± 0.3	2 ± 0.3	0.842 <sup>a</sup>
Smoking			0.484 <sup>b</sup>
No	64 (56.6%)	82 (49.4%)	
Former	41 (36.3%)	64 (38.6%)	
Yes	7 (6.2%)	18 (10.8%)	
Unknown	1 (0.9%)	2 (1.2%)	
Dyslipidemia	73 (64.6%)	116 (69.9%)	0.355 <sup>b</sup>
Cerebrovascular disease	4 (3.5%)	13 (7.8%)	0.202 <sup>c</sup>
NYHA functional class			0.323 <sup>b</sup>
1	1 (1.4%)	0 (0%)	
2	8 (11.4%)	8 (7.8%)	
3	61 (87.1%)	93 (90.3%)	
4	0 (0%)	2 (1.9%)	
Myocardial infarction	8 (7.1%)	12 (7.2%)	1.000 <sup>c</sup>
Hypertension	65 (57.5%)	106 (63.9%)	0.286 <sup>b</sup>
Peripheral vascular disease	1 (0.9%)	4 (2.4%)	0.651 <sup>c</sup>
Atrial fibrillation	7 (6.2%)	12 (7.2%)	0.813 <sup>b</sup>
Coronary artery disease	20 (17.7%)	34 (20.5%)	0.564 <sup>b</sup>
Postbypass LVOT gradient, mm Hg	2.0 ± 3.2	2.5 ± 4.2	0.137 <sup>a</sup>

Values are mean ± SD or n (%). <sup>a</sup>t-test. <sup>b</sup>Chi-square test. <sup>c</sup>Fisher exact test.  
 LVOT = left ventricular outflow tract.

counts (percentages) and continuous variables were reported as mean ± SD and range. Statistical significance was defined as  $P < 0.05$ . All statistical analyses were done using RStudio Version 4.1.2 (RStudio, PBC).

## RESULTS

**STUDY POPULATION.** Between January 2018 and October 2019, 436 patients underwent septal myectomy for obstructive HCM, and 197 (45.2%) were initially enrolled in the study. A total of 113 (57.4%) completed the follow-up questionnaire. The mean age of these 113 patients was 54.7 ± 14.1 years, and 59 (52.2%) were male (Table 1). Patients who did not participate in the survey appeared to be slightly older (58.2 ± 14.3 years vs 54.7 ± 14.1 years,  $P = 0.044$ ). All other baseline characteristics, including sex, body mass index, smoking history, diabetes, and dyslipidemia were similar among participants and nonparticipants.

**QUALITY OF LIFE.** Women reported significant improvement in physical PROMIS scores following surgery (38.3 ± 7.9 vs 49.1 ± 7.8,  $P < 0.001$ ) (Table 2).

**TABLE 2** Preoperative and Postoperative Survey Scores Among Female Patients (N = 54) Undergoing Septal Myectomy for Obstructive HCM

	Preoperative	Postoperative	P Value
Quality of life			
Physical T score	38.3 ± 7.9	49.1 ± 7.8	<0.001 <sup>a</sup>
Mental T score	45.5 (42.2-54.6)	53.1 (46.7-55.6)	<0.001 <sup>b</sup>
Sexual function			
Desire	3.0 (2.4-4.1)	3.6 (2.4-4.2)	0.039 <sup>b</sup>
Arousal	3.9 (1.6-4.8)	4.7 (3.6-5.4)	0.016 <sup>b</sup>
Lubrication	3.9 (1.5-5.1)	4.8 (3.4-5.7)	0.004 <sup>b</sup>
Orgasm	4.0 (1.2-5.2)	4.8 (2.9-5.6)	0.011 <sup>b</sup>
Satisfaction	4.2 (2.4-5.2)	4.8 (3.6-5.6)	0.021 <sup>b</sup>
Pain score	4.8 (2.2-6)	5.4 (3.7-6.0)	0.210 <sup>b</sup>
Urinary function			
IPSS	6 (2-11)	3 (2-8)	0.013 <sup>b</sup>
IPSS Q8	1 (1-2)	1 (1-1)	0.011 <sup>b</sup>

Values are mean ± SD or median (IQR). <sup>a</sup>Paired t-test. <sup>b</sup>Wilcoxon signed rank test.  
 HCM = hypertrophic cardiomyopathy; IPSS = International Prostate Symptoms Score.

There were also improvements in mental PROMIS scores (45.5 [IQR: 42.2-54.6] vs 53.1 [IQR: 46.7-55.6],  $P < 0.001$ ).

In male patients, there were significant improvements in postoperative physical health and quality of life, as measured by PROMIS scores (41.4 ± 7.9 vs 51.2 ± 9.7,  $P < 0.001$ ) (Table 3). There were also improvements in quality of life measures of mental health PROMIS scores (48.8 ± 8.2 vs 53.6 ± 8.4,  $P < 0.001$ ).

**SEXUAL FUNCTION.** At baseline, women did not report low scores in any domain of sexual function,

**TABLE 3** Preoperative and Postoperative Survey Scores Among Male Patients (N = 59) Undergoing Septal Myectomy for Obstructive HCM

	Preoperative	Postoperative	P Value
Quality of life			
Physical T score	41.4 ± 7.9	51.2 ± 9.7	<0.001 <sup>a</sup>
Mental T score	48.8 ± 8.2	53.6 ± 8.4	<0.001 <sup>a</sup>
Sexual function			
Erection function	23 (7-29.5)	23 (13-30)	0.483 <sup>b</sup>
Orgasm function	10 (4-10)	10 (6-10)	0.310 <sup>b</sup>
Sexual desire	6.8 (2.9)	6.9 (2.1)	0.841 <sup>b</sup>
Intercourse satisfaction	9 (1.5-12)	11 (6-13)	0.336 <sup>b</sup>
Overall satisfaction	6 (4-8)	6 (3-8)	0.569 <sup>b</sup>
Urinary function			
IPSS	6 (2-11)	5 (2-8)	0.172 <sup>b</sup>
IPSS Q8	1 (1-2)	1 (1-1)	0.107 <sup>b</sup>

Values are mean ± SD or median (IQR). <sup>a</sup>Paired t-test. <sup>b</sup>Wilcoxon signed rank test.  
 HCM = hypertrophic cardiomyopathy; IPSS = International Prostate Symptoms Score.

**TABLE 4** Changes in Preoperative and Postoperative Scores Among Male Patients Aged 20-55 Years (n = 32) and Aged >55 Years (n = 27)

	20-55 Years	>55 Years	P Value
Quality of life			
Physical T score	8.8 ± 10.5	11.1 ± 12.2	0.447 <sup>a</sup>
Mental T score	4.1 ± 11.2	5.6 ± 8	0.569 <sup>a</sup>
Sexual function			
Erection function	8.4 ± 12.8	-7.1 ± 11.4	<0.001 <sup>a</sup>
Orgasm function	10.7 ± 3.6	7.9 ± 4.1	0.008 <sup>a</sup>
Sexual desire	5.7 ± 2.6	4.2 ± 1.8	0.027 <sup>a</sup>
Intercourse satisfaction	15.6 ± 6.4	10.2 ± 5.6	0.001 <sup>a</sup>
Urinary function			
IPSS	-3.1 (8.0)	-0.9 (9.0)	0.337 <sup>a</sup>
IPSS Q8	3 (2-3)	3 (3-3)	0.760 <sup>b</sup>

Values are mean ± SD or median (IQR). <sup>a</sup>t-test. <sup>b</sup>Nonparametric Wilcoxon rank sum test.  
IPSS = International Prostate Symptoms Score.

but their cumulative score measured <26 indicating mild sexual dysfunction prior to surgery (Table 2). Women experienced significant improvements in most individual domains following surgery, including desire (IQR: 3 [2.4-4.1] vs 3.6 [IQR: 2.4-4.2],  $P = 0.039$ ) and arousal (3.9 [IQR: 1.6-4.8] vs 4.7 [IQR: 3.6-5.4],  $P = 0.016$ ), as well as their cumulative FSFI score.

In the analysis of erectile function in men, the median IIEF score was 23 [IQR: 7.0-29.5], preoperatively (mild erectile dysfunction 22-25), and this did not change significantly after operation in the overall cohort (23 [IQR: 13-30],  $P = 0.483$ ) (Table 3). However, in a subanalysis of younger (age 20-55) vs older (>55 years) men, there were significant differences between the two groups; IIEF score changes in younger patients indicated improvements of erectile

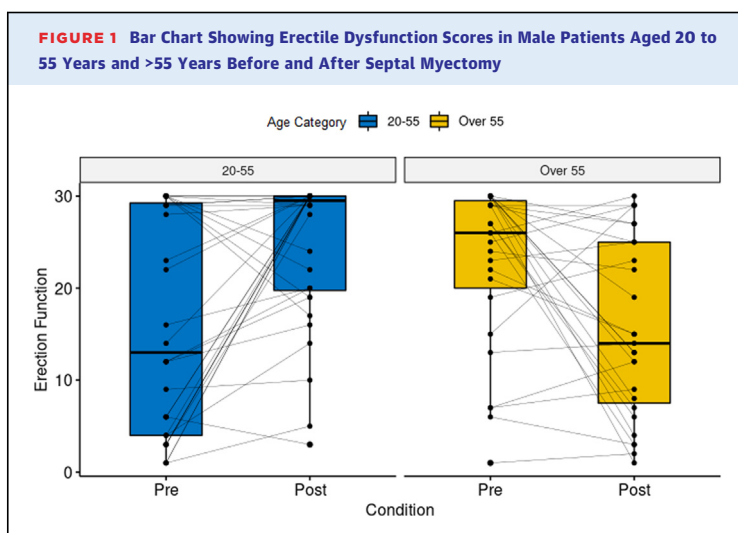
dysfunction that were not observed in older men (8.4 ± 12.8 vs -7.1 ± 11.4,  $P < 0.001$ ) (Table 4, Figure 1). Similarly, there were no changes in orgasm function for the overall cohort of patients ( $P = 0.310$ ), but when preoperative and postoperative comparisons were made by age, there were significant improvements in younger patients (10.7 ± 3.6 vs 7.9 ± 4.1,  $P = 0.008$ ). There were no significant changes after septal myectomy in measures of sexual desire, intercourse satisfaction, and overall satisfaction in the overall cohort, but these variables were improved in younger males.

**URINARY SYMPTOMS.** At baseline, the median IPSS score was (6 [IQR: 2-11]) for the female cohort indicating only mild to moderate urinary symptoms. The postoperative score was 3 (IQR: 2-8) ( $P = 0.013$ ). Quality of life related to urinary symptoms improved postoperatively (preoperative score 1 [IQR: 1-2] vs postoperative score 1 [IQR: 1-1],  $P < 0.001$ ). In men, the median IPSS scores improved significantly following surgery (6 [IQR: 2-11] vs 5 [IQR: 2-8],  $P = 0.172$ ). Men did not experience improvements in quality of life related to urinary symptoms (1 [IQR: 1-2] vs 1 [IQR: 1-1],  $P = 0.107$ ).

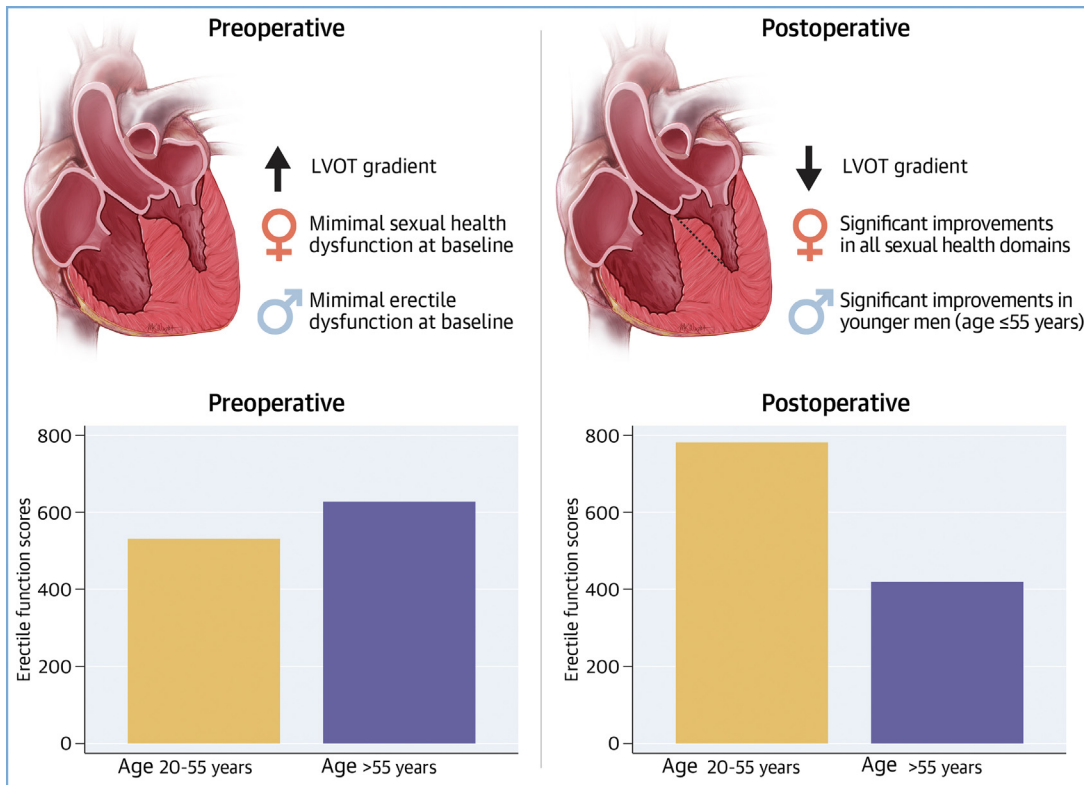
## DISCUSSION

This is the first prospective study of functional outcome of septal myectomy for obstructive HCM and the first investigation to demonstrate therapeutic improvement in sexual function after surgery. We found that multiple aspects of quality of life were improved encompassing both physical and mental health domains. Furthermore, following septal myectomy, we observed significant improvements in many domains of sexual function in female patients of all ages and younger (≤55 years) male patients (Central Illustration).

Retrospective reviews have demonstrated that septal myectomy for obstructive HCM has a positive impact on overall health, and improvements in functional status as well as self-reported health status following surgery.<sup>3,19,20</sup> The present prospective study adds important additional information on self-reported quality of life in patients undergoing myectomy. Previous studies on quality of life in patients with obstructive HCM have shown improvements following septal myectomy,<sup>20</sup> as well as with pharmacologic therapy using mavacamten.<sup>21</sup> These investigations utilized the Kansas City Cardiomyopathy Questionnaire, which focuses on symptomatic status. The current study used the PROMIS questionnaire, which examines quality of life pertaining to both physical and mental health. Our cohort reported



**CENTRAL ILLUSTRATION** Postoperative Improvement in Sexual Health Following Septal Myectomy Was Seen in Women and in Younger Men



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LVOT = left ventricular outflow tract.

significant improvement in both components of the PROMIS questionnaire. These improvements were observed in both women and men.

An important aspect of quality of life that is not measured using the PROMIS questionnaire or the Kansas City Cardiomyopathy Questionnaire pertains to sexual function. Prevalence of sexual dysfunction, which includes disorders of interest and desire, arousal, orgasm, dyspareunia and vaginismus, is relatively high in the general population and may affect as many as 43% of women and 31% of men.<sup>5,6</sup> Sexual dysfunction is especially common in patients with cardiovascular disease. For example, prevalence of erectile dysfunction has been reported in as many as 46% of men with coronary artery disease<sup>22</sup> and 84% in men with congestive heart failure.<sup>23</sup> Furthermore, studies indicated that a large proportion of patients do not return to normal sexual activity after surgical revascularization or valvular surgery.<sup>24</sup> For

many cardiovascular diseases, including obstructive HCM, beta receptor antagonists are the mainstay of medical therapy, and while they provide symptomatic relief in many patients, side effects including sexual dysfunction are common.<sup>25,26</sup>

While sexual function has been studied to varying degrees in patients with certain cardiac diseases, there are no data on the prevalence of sexual dysfunction in patients with HCM. Sexual function as a component of quality of life may be especially important in symptomatic patients with obstructive HCM who are, in general, younger than patients with other common cardiac diseases such as coronary artery disease and valvular aortic stenosis. Furthermore, sexual intercourse is accompanied by numerous changes in sympathetic and parasympathetic activity, with corresponding shifts in loading conditions that undoubtedly alter dynamic outflow tract obstruction in HCM.<sup>27</sup> Our study adds

new information on prevalence of sexual dysfunction in both sexes in a preinterventional and post-interventional setting.

In women, sexual function was assessed using the FSFI questionnaire, which measures multiple domains of sexual health. Overall, the cohort of women reported mild sexual dysfunction at baseline, as their cumulative preoperative scores on the FSFI questionnaire measured  $<26$ .<sup>28</sup> Following septal myectomy, women experienced significant improvements in most individual domains of sexual health as well as their cumulative FSFI score postoperatively. This improvement in sexual function may relate to symptom relief due to reduction in LVOT gradients, as well as decrease in use of beta receptor antagonists and other medications after surgery.<sup>29</sup>

In men, the International Index of Erectile Function (IIEF) questionnaire is a widely used tool to assess erectile and sexual dysfunction. Our study demonstrates that, at baseline, the IIEF scores of men were consistent with mild dysfunction. Although there were no significant changes in IIEF scores postoperatively among the overall cohort, there was a significant improvement in erectile function in younger patients ( $\leq 55$  years). We hypothesize that this improvement may be due to multiple factors including reduction in LVOT obstruction, decrease or even cessation of beta receptor antagonists, as well as lessening of anxiety related to cardiovascular health.<sup>30</sup> The reason for worsening erectile function among older patient is less clear but may include age-related erectile dysfunction.<sup>31</sup> Another possible explanation is prolonged disability and physical limitation related to the sternotomy.

Urinary symptoms can be measured using the IPSS score, and this tool has been validated and applied to both sexes. In our study, both women and men reported low IPSS scores at baseline, and improvements were seen in women. More importantly, quality of life pertaining to urinary symptoms appeared to improve following septal myectomy in women. Our results suggest that urinary symptoms are an important factor pertaining to overall quality of life in female patients with obstructive HCM.

**STUDY LIMITATIONS.** This is a single-center prospective analysis and includes a large HCM referral population. Follow-up information was collected by questionnaires, and response rates were relatively high (57.4%), likely due to prospective enrollment preceding surgery and detailed follow-up including

multiple mailings and a follow-up phone call. We were not able to determine sexual function and quality of life of patients who did not wish to participate in the study, as well as those who did not respond to the second survey, and this may have biased the results reported in this study.

## CONCLUSIONS

In this first study to assess sexual dysfunction in patients with obstructive HCM, we demonstrate the presence of mild sexual dysfunction in both women and men prior to surgery. Following septal myectomy, both women and younger men reported significant improvements in multiple domains of sexual health. Furthermore, both sexes described significant improvements in quality of life following surgery. These changes are likely due to improvement in functional capacity due to reduction of LVOT gradients, reduction and/or cessation of medications deleterious to sexual function such as beta receptor antagonists, and lessened anxiety related to cardiovascular health.

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## PERSPECTIVES

**COMPETENCY TO OUR KNOWLEDGE:** This is the first prospective study to evaluate sexual function in patients with hypertrophic cardiomyopathy. Following septal myectomy, multiple domains of sexual function improved in female and young male patients.

**TRANSLATIONAL OUTLOOK** Sexual health is an important factor in quality of life, and data from this study add to cardiologists' and surgeons' knowledge and ability to counsel patients regarding expected functional improvement following relief of left ventricular outflow tract obstruction.

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