

ORIGINAL ARTICLE

A Comparison of Postoperative Sexual Function: Minimally Invasive Approach vs. Conventional Sternotomy in Mitral Valve Surgery

Mitral Kapak Cerrahisinde Minimal İnvaziv Yaklaşım ile Konvansiyonel Sternotominin Postoperatif Cinsel İşlev Açısından Karşılaştırılması

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ABSTRACT

Aim: In the context of mitral surgery, in recent years, classical sternotomy methods have gradually been replaced by minimally invasive surgical techniques. This study aimed to compare postoperative sexual function in patients who underwent open heart surgery by full sternotomy versus a minimally invasive method.

Methods: Ninety-four patients were included in this cross-sectional observational study. The patients' demographic and clinical information was obtained in the preoperative and postoperative periods, and the International Index of Erectile Function (IIEF-5) questionnaire form was applied. Clinical and erectile findings were compared between two groups: the minimally invasive and classical sternotomy groups.

Results: The mean age of the patients was 53.95 ± 13.85 years, and the demographic and clinical findings were similar between the surgical groups. The IIEF-5 sub-dimensions of sexual satisfaction, orgasmic function, sexual desire, and overall satisfaction scores were significantly higher in the minimally invasive group. The severe erectile dysfunction subscale was significantly higher in the classical sternotomy group.

Conclusions: In minimally invasive surgery with a smaller incision, the patient has a better quality of life in the postoperative period and returns to a normal life more quickly. In patients undergoing open heart surgery with the minimally invasive technique, sexual functions are less affected and patients return to their sexual life in a shorter time.

Keywords: Erectile dysfunction, minimally invasive surgery, sexual life, sternotomy.

ÖZ

Amaç: Mitral kapak cerrahisi alanında son yıllarda klasik sternotomi yöntemlerinin yerini giderek minimal invaziv cerrahi teknikler almaktadır. Bu çalışma, median sternotomi ile ve minimal invaziv yöntemle mitral kapak ameliyatı olan hastalarda postoperatif cinsel işlevi karşılaştırmayı amaçlamıştır.

Gereç ve Yöntemler: Bu kesitsel gözlemlsel çalışmaya 94 hasta dahil edilmiştir. Hastaların demografik ve klinik bilgileri preoperatif ve postoperatif dönemde elde edilmiş ve Uluslararası Erektıl Fonksiyon İndeksi (IIEF-5) anket formu uygulanmıştır. Minimal invaziv ve klasik sternotomi grupları arasında klinik ve erektıl fonksiyon bulguları karşılaştırılmıştır.

Bulgular: Hastaların ortalaması yaşı 53.95 ± 13.85 yıl olup, demografik ve klinik bulgular cerrahi gruplar arasında benzerdi. IIEF-5 alt boyutlarından cinsel tatmin, orgazmik fonksiyon, cinsel istek ve genel memnuniyet skorları minimal invaziv grupta anlamlı derecede yükseltti. Şiddetli erektıl disfonksiyon alt ölçüği ise klasik sternotomi grubunda anlamlı şekilde daha yükseltti.

Sonuçlar: Daha küçük insizyonla yapılan minimal invaziv cerrahide hastalar postoperatif dönemde daha iyi bir yaşam kalitesine sahip olmakta ve normal yaşamlarına daha hızlı dönenmektedir. Minimal invaziv teknikle açık kalp ameliyatı olan hastalarda cinsel fonksiyonlar daha az etkilenmektedir ve hastalar cinsel yaşamlarına daha kısa sürede dönenmektedir.

Anahtar Kelimeler: Cinsel yaşam, erektıl disfonksiyon, minimal invaziv cerrahi, sternotomi.

INTRODUCTION

Sternotomy is a type of surgery in which the sternum is cut open from top to bottom. Representing the most commonly used incision in cardiothoracic surgery, this technique provides superior and clear visualization of the heart, great vessels, and lung hilus (1). In this type of surgery, the patient is placed in the supine position; according to the surgeon's request, the patient can be positioned with one or both arms out to the side. The incision, which passes through the midline of the sternum, starts from the Incisura jugularis and ends on the linea alba at a point 1-2 cm below the processus xiphoideus. In median sternotomy, the most important feature is that the incision is made exactly at the midline of the sternum; this is the most commonly used approach. This technique is frequently used in many operations, such as upper mediastinal dissection, radical thymectomy, and resection of anterior mediastinal masses (2,3).

Minimally invasive surgery is a technique in which surgery is performed through small skin incisions. After this technique was first described by Cohn et al. (4), in the mid-1990s, Navia and Cosgrove (5) reported various minimally invasive approaches, such as mini-thoracotomy, hemisternotomy, and parasternal surgery (6-8). Although these reported techniques are different from each other, their common goal is to prevent complications associated with median sternotomy, such as infection, mediastinitis, and nerve damage (4,9-15). Minimally invasive procedures have many advantages, including less trauma and pain, shorter intubation time, better respiratory function, less bleeding, a lower risk of infection, better cosmetic results, shorter hospitalization, shorter intensive

care unit stays and recovery times, and reduced hospital costs as a result of all of the mentioned factors (4,16-18).

An erection can be defined as a vascular phenomenon facilitated by a favorable hormonal environment and psychological state and triggered primarily by neurological signals. A healthy erection requires the interaction of physiological, neurological, hormonal, vascular, and cavernosal factors, as well as the coordination of many regulatory systems. When considering sexual dysfunction in men, erectile dysfunction (ED) is often the most prominent condition, defined as the persistent and recurrent inability to achieve or maintain an erection sufficient for satisfactory sexual performance. It can occur as a result of changes in any one of the factors outlined above; however, such changes are often found in combination (19-21). Although ED is a treatable disease, it can cause negative physical, social, and psychological effects in patients (22).

Sexual function is an important part of quality of life. However, due to a variety of problems, sexual function may be impaired or irregular; for many individuals, such dysfunction negatively impacts their quality of life. This study aimed to compare sexual function as a component of quality of life in two groups of patients following open heart surgery, with one group undergoing a traditional median sternotomy and the other group undergoing surgery via a minimally invasive incision.

MATERIALS and METHODS

This study was designed in a cross-sectional manner to compare erectile function between patients undergoing

surgery via two different approaches. Since the center where the study was conducted included teams utilizing both conventional and minimally invasive techniques, patients were categorized into two groups for comparison. Information forms and the International Index of Erectile Function (IIEF) questionnaire were administered to the patients postoperatively. The inclusion and exclusion criteria were as follows:

1. Inclusion criteria:

- Male patients over 18 years of age
- Mitral and/or tricuspid valve intervention
- No neurological pathology
- Being sexually active 3 months before surgery

2. Exclusion criteria:

- Illiterate patients
- Poor preoperative left ventricular ejection fraction
- Reoperations and emergent procedures

Surgery Protocol

In the sternotomy group, a complete median sternotomy procedure was performed with the patient under general anesthesia. Aortobicaval cannulation was then carried out, followed by initiation of a cardiopulmonary bypass. Mild systemic hypothermia (32 °C) was preferred. The mitral valve was accessed by a transseptal incision via left or right atriotomy after cross-clamping. Unrepairable valves were resected, and valve implantation was performed with pledgeted sutures. Valve repair with tricuspid ring annuloplasty was performed in patients whose tricuspid valve was included in the intervention. The atriotomy was then closed, and the cross-clamp was removed after air extraction.

Drains were placed after bleeding control had been achieved. Four figure-of-eight steel wires were utilized to close the sternum. The subcutaneous tissue and skin were closed using the standard approach. The patient was transferred to the intensive care unit.

In the minimally invasive incision group, the femoral artery and vein were cannulated via an open incision in the femoral region, and the right jugular vein was cannulated using a percutaneous approach; these steps were all carried out under general anesthesia. The pericardium was opened through the fourth intercostal space on the right midaxillary line. Then, the cardiopulmonary bypass was initiated, and the blood was cooled to 32 °C. The mitral valve was accessed via a transseptal incision after left or right atriotomy. Unrepairable valves were resected, and valve implantation was performed with pledgeted sutures. Valve repair with tricuspid ring annuloplasty was performed in patients whose tricuspid valve was included in the intervention. The atriotomy was closed, and the cross-clamp was removed after air extraction. A thoracic drain was placed after bleeding control was achieved. To approximate the costae, a monofilament polydioxanone suture was used. The subcutaneous tissue and skin were then closed in a standard fashion, and the patient was transferred to the intensive care unit.

Data Collection

Data were collected from patients who underwent open heart surgery in the Cardiovascular Surgery Department of Ankara Bilkent City Hospital. Ethical approval for the study was obtained from the Ankara City Hospital Clinical Research Ethics

Committee (date: 06/29/2022; number: E1-22-2734) The informed consent form was read to the patients, and their verbal and written consents were taken as outlined in the Declaration of Helsinki. Two to six months after the operation, the patients were contacted by phone; the IIEF questionnaire items were administered, and the patients' responses were recorded.

The IIEF-5 questionnaire was administered to patients who met the inclusion criteria. Demographic and clinical information was obtained as the IIEF-5 form was completed. This information was compared between patients who underwent heart surgery with the minimally invasive technique versus normal sternotomy.

The 5-item IIEF questionnaire, which was created with 15 questions and then altered to a short, five-item version, has proven to be a quick and trustworthy self-administered measure for evaluating erectile function. This tool is simple to use in both clinical and research settings, and it has strong psychometric properties. The National Institutes of Health's definition of ED was used to guide the selection of the five elements, as well as to assess the candidates' ability to accurately identify the absence of ED when it was not present. These questions centered on satisfaction with sexual relations and erection. Test-retest repeatability was found to be satisfactory, and the IIEF had excellent internal consistency, which was determined from both the overall scale and specific domain scores. All the values obtained were more than 0.70, and more than half of the values were greater than 0.90, despite some variance in the degree of internal consistency between samples. The correlation values for test-retest

repeatability varied from 0.64 to 0.84, and they were all highly significant (23).

The Turkish validity study of the scale was conducted by Turunç et al. (24). In their study, the reliability level of the scale was found to be high, with a Cronbach's alpha of 0.959; the correlation values between the questions were between 0.892 and 0.924. From the results of the study, it was observed that the participants (n=100) understood the questions easily and gave the same or very similar answers in repeated measurements (24).

Power Analysis

The power analysis of the study was performed using GPower 3.1.9.6 (Universitaet Kiel, Germany) software. Since there is no information on IIEF-5 values after sternotomy in the literature, the values for the groups were determined from a pilot study. The scores for sexual satisfaction in the normal sternotomy and minimally invasive incision groups were used to determine the effect size. T-tests were selected as the test family, and the analysis type as means, where the difference between two independent means (two groups) was considered. The effect size was calculated as $d=1.057$, and by taking the power as 95% and type-I error rate as 0.05, the sample size for each group was determined as $n=42$. Therefore, 94 patients were enrolled in the study according to the eligibility criteria.

Statistical Analysis

The statistical analyses of this study were performed using SPSS 29.0 (IBM Inc., Armonk, USA). The descriptive statistics were presented as frequency (percentage) for categorical variables, $mean \pm standard\ deviation\ (SD)$ for numerical variables, and median (Q1–Q3) where necessary. The

normality of the IIEF scores was checked using the Shapiro-Wilk test. The comparison of erectile function scores between study groups was performed using an independent sample Student t-test or Mann-Whitney U test where necessary, and the relationships between the categorical variables were determined using the Monte Carlo exact chi-square test. The homogeneity of the scores was checked using the Levene test, and the results were presented with the effect size values of Cohen's d and Hedges' correction. In all analyses, a p -value <0.05 was considered a statistically significant result.

RESULTS

Ninety-four male patients who underwent open heart surgery were enrolled in the study. Of these, 44.7% were patients who underwent median sternotomy, while the remaining patients underwent open-heart surgery using minimally invasive methods. Patient age was in the range of 45–65 years. The mean age was 53.95 ± 13.85 years, and the median age was 57 years. The median number of days of hospitalization was calculated as 6 days. The majority of patients (68.1%) lived in the city, and more than half (53.2%) were employed. The smoking rate (36.2%) was higher than that of alcohol consumption (6.4%). More than half of the patients were primary school graduates, while the remaining patients reported that they had completed secondary and higher school education at similar rates.

The baseline demographic characteristics did not differ significantly between patients who underwent normal sternotomy versus those who had a minimally invasive

incision. The age values were similar in both groups ($p=0.804$). The number of hospitalization days was significantly lower in patients who underwent minimally invasive incision ($p=0.021$). The patients did not differ significantly in terms of marital status, cohabitation status, education level, place of residence, or employment status ($p>0.05$). There was no statistically significant difference in ejection fraction between the two groups. Moreover, no significant difference was found between the study groups in terms of smoking, alcohol use, or medications used. The use of angiotensin-converting enzyme inhibitor (ACEi) and angiotensin II receptor blocker (ARB) medications was low; furthermore, no patient was observed to use thiazides (Table 1).

The scores obtained from the sub-dimensions of the IIEF-5 questionnaire were compared between the study groups (Table 2). The IIEF-5 scale consists of five items. Four of the items receive score points and one dimension determines the severity of ED. It was found that the sexual satisfaction dimension score was significantly higher in patients who underwent minimally invasive surgery (9.65 ± 3.80) compared with the mean score of the full sternotomy group (6.42 ± 5.12 ; $p=0.022$). Orgasmic function was significantly higher in the minimally invasive surgery group (8.76 ± 1.92) than it was in the full sternotomy group (6.76 ± 3.99 ; $p=0.044$). The sexual desire subdimension score was 6.85 ± 1.74 in the full sternotomy surgery group and 8.07 ± 1.44 in the minimally invasive surgery group ($p=0.014$). Therefore, the overall erectile satisfaction score was significantly higher in the minimally invasive group (7.46 ± 2.56 ; $p=0.023$).

Table 1. General characteristics of patients between surgery groups

Characteristics	Categories	Full sternotomy (n=42)	Minimally invasive surgery (n=52)	p value
Marital status	Married	34 (81.0)	44 (84.6)	0.758
	Single	4 (9.5)	4 (7.7)	
	Divorced	4 (9.5)	4 (7.7)	
Living situation	Living alone	2 (4.8)	0	0.412
	Only with spouse	16 (38.1)	16 (30.8)	
	With spouse and children	18 (42.9)	28 (53.8)	
	With parents	4 (9.5)	4 (7.7)	
	Other	2 (4.8)	4 (7.7)	
Education level	Primary education	20 (47.6)	30 (57.7)	0.481
	Secondary school	10 (23.8)	12 (23.1)	
	Higher education	12 (28.6)	10 (19.2)	
Residence	Village	0	2 (3.8)	0.633
	City	16 (38.1)	12 (23.1)	
	Province	26 (61.9)	38 (73.1)	
Work status	Working	22 (52.4)	28 (53.8)	0.921
	Retired	20 (47.6)	24 (46.2)	
Smoking		18 (42.9)	16 (30.8)	0.396
Alcohol		2 (4.8)	4 (7.7)	0.686
DM		16 (38.1)	8 (15.4)	0.079
HT		16 (38.1)	22 (42.3)	0.772
PAD		2 (4.8)	4 (7.7)	0.686
HL		10 (23.8)	12 (23.1)	0.953
BB		42 (100.0)	44 (84.6)	0.063
Nitrate		0	2 (3.8)	0.369
ACEis		8 (19.1)	10 (19.2)	0.987
ARBs		10 (23.8)	6 (11.5)	0.271
Age	Year (mean±SD)	54.52±12.80	53.50±14.88	0.804
Hospital stay	(Median; Q1–Q3)	(7; 6–8.5)	(5.5; 5–7)	0.021*

*: significant at the 0.05 level according to Mann–Whitney U test

ACEi: angiotensin-converting enzyme inhibitor; ARB: angiotensin II receptor blocker; BB: beta blocker; DM: diabetes mellitus; HL: hyperlipidemia; HT: hypertension; PAD: peripheral arterial disease; Q1: quartile1; Q3: quartile3; SD: standard deviation

ED levels differed significantly between the study groups ($p=0.036$). The rate of severe ED was significantly higher in the full sternotomy group (33.3%) compared with the minimally invasive group (7.7%). In addition, the proportion of patients without ED was significantly higher in the

minimally invasive group (30.8%) than it was in the full sternotomy group (9.5%). The rates of moderate and mild ED did not differ significantly between the groups. Postoperative beta-blocker usage was similar in both groups, with no significant statistical difference observed.

Table 2. Comparison of erectile functions between the groups

IIEF-5 factors	Full sternotomy (n=42)	Minimally invasive surgery (n=52)	Cohen's d/ Hedges' correction	p
	Mean±SD	Standardizer/point estimate		
Intercourse satisfaction	6.42±5.12	9.65±3.80	4.43/-0.726 4.51/-0.714	0.022*+
Orgasmic function	6.76±3.99	8.76±1.92	3.02/-0.663 3.07/-0.652	0.044*+
Sexual desire	6.85±1.74	8.07±1.44	1.58/-0.772 1.60/-0.759	0.014*
Overall satisfaction	5.66±2.63	7.46±2.56	2.63/-0.692 2.56/-0.680	0.023*
Erectile dysfunction, n (%)				
Severe	14 (33.3)a	4 (7.7)a		
Moderate	6 (14.3)	8 (15.4)		
Mild to moderate	2 (4.8)	6 (11.5)		0.036**
Mild	16 (38.1)	18 (34.6)		
No erectile dysfunction	4 (9.5)b	16 (30.8)b		

*: significant at the 0.05 level according to the Student t-test, +: Unequal variances assumed according to Levene's test

**: significant at the 0.05 level according to the Monte Carlo exact chi-square test; a and b: same superscript letters denote the significantly different categories

DISCUSSION

For many years, patients and surgeons have been more interested in clinical outcomes than in postoperative quality of life. With the rise of minimally invasive techniques and advancements in surgical instruments and perfusion technology, surgeons have increasingly focused on improving their skills in this field. Recently, however, the importance of postoperative quality of life has been recognized, and studies on this subject have been initiated. Research on this topic has shown that minimally invasive cardiac surgery significantly improves postoperative quality of life compared with cardiac surgery conducted via median sternotomy (25,26).

Normal sexual function is characterized by a set of psychological and physiological processes that are often associated with such factors as hormones, an individual's psychological state, gender, age, disease, and medications being used (27). Postoperative immobility caused by surgery may lead to ED over time (28–30). Such a situation can harm the patient's quality of life during and after recovery. The resulting impairment in quality of life may make the patient depressed, prolong the healing process, and lead to more intense depressive moods in patients who do not consult their physician for ED after recovery. However, that an active and healthy sexual life is an important element of quality of life for patients who have undergone surgery

is often overlooked. Indeed, surgeons rarely advise their discharged patients about their sexual life after surgery and how it may be affected. Although the incidence of postoperative sexual dysfunction is high, it has been observed that patients do not prefer to consult with medical professionals on the topic of when they can start their sexual life after surgery. In some countries, this is due to the privacy of sexual life. This suggests that both surgeons and patients who undergo heart surgery are more concerned with the clinical consequences of the surgery than with returning to sexual life (31–33). There are not enough scientific studies on postoperative sexual dysfunction; furthermore, according to our knowledge, no study in the literature has focused on sexual dysfunction after cardiac surgery using a minimally invasive approach.

In this study, which is the first of its kind in the field, we compared the effects of sternotomy and minimally invasive surgical techniques on the postoperative sexual life of patients. In classical sternotomy, the operation is performed by passing all surgical equipment through the incision along the sternum. Sternal dehiscence remains a persistent concern for surgeons following median sternotomy. To mitigate this risk, various enhanced surgical techniques beyond standard closure methods have been developed and described; these methods aim to reduce the incidence of dehiscence and improve patient outcomes (34). Despite the development and implementation of various enhanced surgical techniques designed to minimize the risk of dehiscence, median sternotomy continues to carry such a risk. In the postoperative period, patients are prevented from returning to their

daily activities because of this concern; in contrast, patients operated on using the minimally invasive technique can start their daily activities earlier.

In the minimally invasive technique, incisions are usually made through the intercostal spaces, and surgical instruments are passed through these incisions to perform cardiac surgery. Because this approach is less invasive than traditional open heart surgery, recovery is usually faster, and patients experience less pain and discomfort. Furthermore, given that the incision is small and the sternum is not opened, the movement limitation is minimal.

Postoperative rehabilitation after cardiac surgery often presents an increased risk of sternal overload. To mitigate this risk, following classical sternotomy, patients who are susceptible to dehiscence and whose specific cases involve a borderline unstable sternum that do not require surgical stabilization are advised to wear a chest corset for about 2 months (35). As a result, they are not allowed to sleep on their side or stomach. In contrast, in minimally invasive surgery, there is no concern about reoperation because of movement of the sternum. This surgical approach eliminates mobility limitations, reduces anxiety about the possibility of reoperation, and allows sexual function to recover at an earlier stage. This suggests that by minimizing the limitation of movement and enabling patients to return to their sexual life earlier, minimally invasive surgery not only improves patients' quality of life during the recovery process but also avoids ED caused by prolonged immobility (20,22,25,29). The results of the IIEF-5 questionnaire administered to our patients support

these previous findings relating to patients undergoing minimally invasive procedures. IIEF-5 sub-dimensions—namely, sexual satisfaction, orgasmic function, sexual desire, and overall satisfaction—had higher scores in the minimally invasive patient group than they did in the full sternotomy group. Moreover, the ED dimension also showed a difference between the groups. In particular, the proportion of patients with severe dysfunction was significantly higher in patients undergoing full sternotomy; in contrast, the proportion of patients without dysfunction was higher in patients who underwent a minimally invasive procedure.

A significant issue associated with median sternotomy is postoperative pain. Various methods of combatting this problem have been proposed in previous studies. In one study, Pala et al. (36) demonstrated that continuous parasternal local anesthetic infusion reduces postoperative opioid use and accelerates hemodynamic recovery by mitigating potential opioid side effects. At the same time, numerous studies have shown that minimally invasive procedures are advantageous compared with median sternotomy in this context because patients experience less postoperative pain. For instance, Silva et al. (37) found that patients undergoing minimally invasive cardiac procedures reported lower pain intensity and fewer pain sites from the third postoperative day onward; these patients needed less pain medication and had shorter intensive care unit stays compared with those who underwent median sternotomy. Although pain management was not the primary focus of our study, it is well established that postoperative pain can adversely affect sexual function. Indeed, pain can lead to physical discomfort,

psychological distress, and reluctance to engage in sexual activity. In particular, chest wall pain following sternotomy may limit mobility, induce anxiety about wound integrity, and reduce overall well-being; all of these factors may contribute to sexual dysfunction. In our patient cohort, pain management was achieved without the use of opioids, eliminating the potential confounding effects of opioid-induced hormonal alterations in our study. Therefore, we hypothesize that the impairment in sexual function observed in the sternotomy group was primarily related to the direct effects of postoperative pain rather than pharmacological influences. Further research with larger cohorts and objective pain assessment tools could provide a deeper understanding of the relationship between postoperative pain and sexual function.

Despite its strengths, this study has some limitations. The first is the small sample size of the study, although the analysis showed that the power value was high. To address this, future studies could be conducted with a larger sample. The second limitation is that the study was not a randomized controlled trial. The number of surgeries performed was small, and it was difficult to follow up with patients to assess erectile function afterwards. Many patients did not respond or refused to take part in the study. The third limitation is that only the IIEF-5 questionnaire form was used for erectile function information in the study. In addition, preoperative sexual function was not assessed. However, as one of the inclusion criteria was being sexually active 3 months before surgery, it was assumed that significant preoperative sexual dysfunction was unlikely. Nevertheless,

to better understand the impact of preoperative conditions on postoperative outcomes, future studies should include preoperative sexual function assessments. Ultimately, this study may serve as a prelude to investigating erectile function after cardiovascular surgery. Further studies may include randomized controlled trials with large samples and advanced analyses, including clinical and biochemical data on erectile function.

CONCLUSION

Compared with classical surgical applications, minimally invasive methods in surgery improve the quality of life of patients. With classical sternotomy, the sexual life of patients in the postoperative period is also affected. Therefore, surgical treatment with minimally invasive procedures is a superior method in that it allows patients to continue their sexual life faster and more effectively and to avoid ED. To obtain additional insights on this topic, the number of studies in this field should be increased.

Conflict of interest: The authors declare that they have no conflict of interests.

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