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ORIGINAL RESEARCH ARTICLE

Sexual function in patients supported with left ventricular assist device and with heart transplant

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Abstract

Aims Sexual dysfunction is common among patients with heart failure (HF) and considered an important hamper to quality of life. While implantation of left ventricular assist device (LVAD) may prolong and improve life in advanced HF, limited data are available on its impact on sexual function. The aim of this study is to evaluate sexual function in LVAD patients and compare this with patients after heart transplantation (HTx).

Methods and results Sexual activity and satisfaction of stable patients with durable LVAD or after HTx were evaluated using a validated questionnaire and visual analogue scale from 0 to 10. Data were collected from 31 patients (mean age 59 ± 12 years, 87% male), 17 after HTx and 14 with LVAD. Pleasure or satisfaction with sex was significantly higher in HTx patients ($P = 0.0005$). In total, 29% LVAD patients and 71% HTx patients reported content with sexual activity. Recalled satisfaction with sex life pre-operation was comparable between the groups. During support, satisfaction with sex life using visual analogue scale was 7.6 ± 3.1 for HTx versus 3.9 ± 4.0 for LVAD patients ($P = 0.017$). In total, 11 LVAD patients (79%) reported specific problems in sexual function including erectile dysfunction or vaginal dryness (8, 57%); problems with the LVAD, cable, or batteries (5, 36%); problems with orgasm (4,29%); and other problems such as fear of injury, feeling depressed, partner issues, self-image, and pain (1, 7% each).

Conclusion Sexual dysfunction occurs in patients with LVAD support and may be more prominent than after HTx. Problems limiting sexual function related to physiological, psychological, and equipment merit consideration during follow-up.

Keywords Sexual function; Left ventricular assist device; Heart failure; Heart transplantation

Introduction

Heart failure (HF) is a prevalent clinical syndrome involving functional impairment due to insufficient cardiac function. Sexual function is an important aspect of general health and one's quality of life, both in healthy and diseased persons. Normal sexuality involves the desire, ability, and satisfaction in performing sex and requires complex social, psychological, and physiological capacities. The physiological demands in performing sex include the ability

to perform exercise (about 4 METS)[1] and the ability to sustain erection in men. In women, physiological ability is less well demonstrable and may manifest with vaginal lubrication.[2] During sexual activity, there is a need for an increase in heart rate and blood pressure achieving the peak during orgasm.[3–5] To sustain these physiological demands, multiple systems including cardiac, vascular, muscle, and nervous must interplay. The physiologic and social conditions required to maintain normal sexual function make it a useful sentinel that may be used by the attending health professional to assess general morbidity or sufficient health.

Because many of the capacities necessary to maintain sexuality function abnormally in HF patients, it is not surprising that these patients suffer impaired sexual function.[6,7] Negative effects on sexual function have also been reported with other cardiac conditions and were associated with anxiety, fear of fatal cardiac event, and lack of awareness of acceptable activities post-cardiac incidents.[8,9] In addition to the risk factors, co-morbidities, and psychosocial burden that affect the sexual function of HF patients, treatments have also been associated with an impact on the quality of life and in particular the sexual function of patients with HF. Although different therapeutic interventions may be very effective in improving HF symptoms and longevity, their impact on sexual aspects of life might differ. Heart transplantation (HTx) is regarded as the optimal treatment for advanced HF patients; however, in a number of studies, the majority of HTx patients continued to suffer from sexual dysfunction.[10–12] Implantation of left ventricular assist device (LVAD) to stage D HF patients is known to prolong and improve the quality of life.[13–15] Even though sexuality is an element of one's quality of life,[6] there is a lack of data on the effect of LVAD implantation on the sexual function of patients with advanced HF. We therefore set out to evaluate the sexual function of patients with advanced HF after treatment with LVAD with comparisons with patients after HTx.

Methods

This is a cross-sectional study including HF patients in stable medical condition after implantation of a durable LVAD or after HTx.

Sample

All eligible consecutive patients attending the designated LVAD and HTx clinics at the HF unit, Rabin Medical Center, from November 2012 to July 2013 were approached. Patients who were hospitalized in the previous month and/or those who declared not to have a sexual partner were excluded. Participants who consented were handed the study questionnaire and independently interviewed by one of the study medical staff. The protocol of the study was approved by the institutional ethics committee.

Measurement

Participating patients were asked to complete a questionnaire consisting of four main sections: (1) general information, (2) functional ability, (3) medications, and (4) sexual function. The general information section included the demographic characteristics of the patient and identified the patient as part of the LVAD or HTx groups. The functional ability section was aimed to assess the effort ability of patients on the basis of the New York Heart Association (NYHA) classification. The medications section was completed by the physician or the nurse and included data on the type and dose of the following medications: beta blocker, angiotensin-converting enzyme inhibitor or angiotensin receptor blocker, diuretic, alpha blocker, phosphodiasterase 5 inhibitor (PDE5i), nitrate, and aldosterone inhibitor. For information on sexual function, a validated sexual function questionnaire[6] was used with modifications to include appreciated change in sexual function perceived by the patient to occur since his/her operation. The questionnaire was translated to Hebrew and back-translated to English and checked to ensure consistency. This part included 13 questions regarding current status and comparing the sexual life of the patient before operation with the current status. Patients were asked to grade problems with the spouse, interest in sexual activity, pleasure or satisfaction with sex, problems with frequency of sexual activity, and disturbance to sexual performance on a scale of 1 to 4. To describe the change in sexual function as recollected compared with before surgery, answering possibilities were[1] significant improvement,[2] minor improvement,[3] no change, or[4] deterioration. Satisfaction with sexual life was rated on a visual analogue scale from 0 to 10 (0 for low, 10 for full satisfaction). Patients first filled the questionnaire privately and subsequently had the opportunity to discuss the questions with a clinic nurse or physician.

Statistical analysis

Continuous data with normal distributions were presented using mean and standard deviation. Non-normally distributed variables were presented using median and first and third quartiles. Categorical data were presented with frequencies and percentages. Two-sided Wilcoxon

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Table 1 Patient characteristics, medications and functional status

	All ($n = 31$)	LVAD ($n = 14$)	HTx ($n = 17$)	P
Age (years)	59 ± 12	64 ± 6	54 ± 14	0.121
Male	27 (87%)	12 (86%)	15 (88%)	1.000
Diabetes mellitus	15 (48%)	6 (43%)	9 (53%)	0.722
Hypertension	15 (48%)	10 (71%)	5 (29%)	0.032*
Ischemic aetiology	23 (77%)	12 (92%)	11 (65%)	0.104
Smoking	0 (0%)	0 (0%)	0 (0%)	1.000
Time from operation months, median (IQR)	14 (6;68)	6 (4;14)	63 (16;111)	0.0001*
Medications:				
Beta blockers	21 (68%)	12 (86%)	9 (53%)	0.068
ACE-I or ARB	21 (68%)	12 (86%)	9 (53%)	0.068
Loop diuretic	17 (55%)	12 (86%)	5 (29%)	0.003*
Alpha blocker	4 (13%)	2 (14%)	2 (12%)	1.000
Phosphodiasterase 5 inhibitor	8 (26%)	8 (57%)	0 (0%)	0.0004*
Aldactone antagonist	8 (26%)	8 (57%)	0 (0%)	0.0004*
Functional:				
NYHA class > II	9 (29%)	5 (36%)	4 (23%)	0.693
Dizziness	5 (16%)	2 (14%)	3 (18%)	1.000
Unemployed	26 (84%)	14 (100%)	12 (70%)	0.048*

Patient characteristics for all patients and separately for patients in the LVAD and HTx groups as well as comparisons between the groups are shown. LVAD, left ventricular assist device; HTx, heart transplantation; ACE-I, angiotensin converting enzyme; ARB, angiotensin receptor blocker; NYHA, New York Heart Association.
*Statistically significant ($P < 0.05$).

signed rank test was used for comparisons of continuous data and Fisher's exact test for discrete variables; $P < 0.05$ was considered statistically significant.

Results

Sample characteristics

We approached 36 patients. Two patients supported with a LVAD and three HTx patients reported not to have a sexual partner and thus were excluded from the study. All other 31 patients participated in the study including 14 with LVAD and 17 HTx patients. Two patients after HTx who were previously bridged with LVAD were considered in the HTx group. The sample consisted of 27 (87%) men and 4 women, with a mean age of 59 (SD 12) years. Among patients with LVAD, 11 were supported with Heartmate II (Thoratec, Pleasanton, CA) and 3 with HVAD (Heartware, Framingham, MA). Baseline characteristics, medications, and functional parameters are shown in *Table 1*. The study evaluation was performed later after the operation in the HTx compared with the LVAD group.

Table 2 Sexuality for patients with left ventricular assist device compared with heart transplantation patients at the time of questionnaire and the change in sexuality compared with pre-operative self-recall

Variable	All ($n = 31$)	LVAD ($n = 14$)	HTx ($n = 17$)	P
Problems with the spouse				
At time of questionnaire	1.2 ± 0.5	1.1 ± 0.3	1.3 ± 0.7	0.375
Change since operation	2.5 ± 0.9	2.5 ± 0.9	2.5 ± 0.9	0.891
Interest in sexual activity				
At time of questionnaire	2.0 ± 1.0	2.2 ± 1.0	1.8 ± 0.9	0.231
Change since operation	2.8 ± 1.0	2.8 ± 1.1	2.7 ± 1.0	0.672
Problems with frequency of sexual activity				
At time of questionnaire	2.1 ± 1.2	2.6 ± 1.3	1.7 ± 1.0	0.059
Change since operation	2.6 ± 1.1	2.6 ± 1.1	2.5 ± 1.1	0.770
Pleasure or satisfaction with sex				
At time of questionnaire	2.0 ± 1.2	2.7 ± 1.1	1.3 ± 0.9	0.0005*
Change since operation	2.5 ± 1.1	2.8 ± 1.0	2.2 ± 1.1	0.161
Disturbance to sexual performance				
At time of questionnaire	2.0 ± 1.3	2.8 ± 1.4	1.5 ± 0.9	0.011*
Change since operation	2.4 ± 1.0	2.6 ± 0.9	2.3 ± 1.0	0.349

Answers to sex life related questions for all, patients with LVAD, and HTx patients using a 1 to 4 scale where 1 is better and 4 is worse. Possible answers to describe the change in sexual function were[1] significant improvement,[2] minor improvement,[3] no change, and[4] deterioration. Comparisons were made between LVAD and HTx groups.
LVAD, left ventricular assist device; HTx, heart transplantation.
*Statistically significant ($P < 0.05$).

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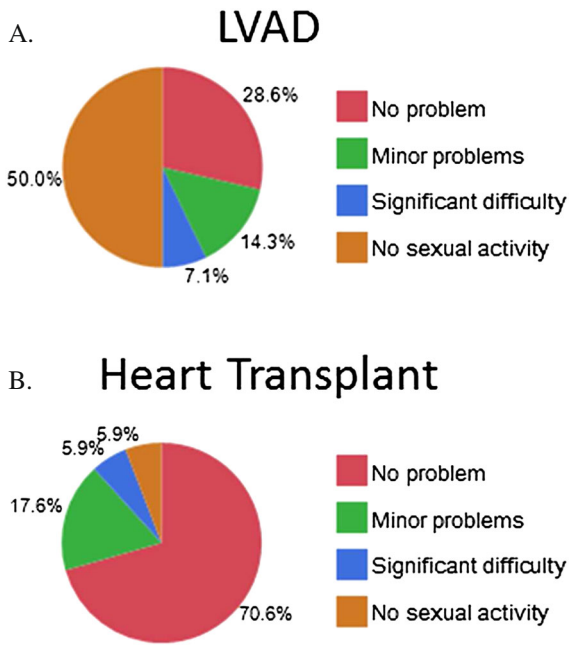

Figure 1 Problems with performing sexual activity among patients with left ventricular assist device and after heart transplantation.

There was a trend for older age among LVAD patients with mean age difference of 10 years, not statistically different ($P = 0.121$). Patients with LVAD had more history of hypertension and were more often treated with loop diuretics and with aldosterone antagonist. Eight patients from the LVAD group were treated with PDE5i for pulmonary hypertension, typically with sildenafil 20 mg TID. About a third of the patients in the LVAD and a quarter of those in the HTx groups reported significant effort limitations (NYHA class > II), and the majority reported no current employment.

Sexual activity

Sexual activity variables are shown in *Table 2*. HTx patients reported better pleasure with sexual activity compared with the LVAD patients. In total, two LVAD patients (14%) had full satisfaction, five (36%) had mild disturbance, two (14%) had significant disturbance, and five (36%) patients reported no pleasure or satisfaction with sex. In the HTx group, the majority (14, 82%) of the patients reported having full pleasure or satisfaction. Most patients ranked the change since operation as minor or non-significant.

Other differences between the groups shown in *Table 2* were found with identifying a problem in the frequency of performing sex and with disturbance to sexual performance. Distribution of problem with performing sexual activity among patients with LVAD and HTx is shown in *Figure 1*. Twenty-nine per cent in the LVAD group reported no problem with sexual activity compared with 71% in the post-HTx group.

The results of the visual analogue scale for general satisfaction with sex life are shown in *Table 3*. The recalled satisfaction with sex life before the operation for both groups was not significantly different. During follow-up, the satisfaction with sex life in the post-HTx group was better than for the LVAD group. The changes in satisfaction for both groups are shown in *Figure 2*. Whereas general satisfaction is shown to improve in patients with HTx, there is a more mixed picture among those with LVAD, with an overall trend for less content.

Among the patients with LVAD, 11 patients (79%) reported on specific reasons that may contribute to problems in sexual function and performance. Listed causes were the following: erectile dysfunction or dryness (8, 57%); problems with the LVAD device, cable, or batteries (5, 36%); problems with orgasm (4, 29%); fear of injury (1, 7%); feeling depressed (1, 7%); partner issues (1, 7%); problem of self-image (1, 7%); and pain (1, 7%). Among the patients after HTx, 11 (65%) reported specific problems including erectile dysfunction or dryness (4, 23%), feeling depressed (3, 18%), partner issues (3, 18%), weakness (2, 12%), and fear of injury (1, 6%).

Discussion

In this study, we investigated sexual function of patients on chronic continuous flow LVAD support and compared

Table 3 General satisfaction with sex life (current and compared with pre-operative)

Variable	All ($n = 31$)	LVAD ($n = 14$)	HTx ($n = 17$)	*P*
Satisfaction with sex life before surgery (0–10 scale)	5.5 ± 3.8	4.7 ± 4.3	6.1 ± 3.3	0.336
Satisfaction with sex life current (0–10 scale)	5.9 ± 3.9	3.9 ± 4.0	7.6 ± 3.1	0.017*
Change in satisfaction with sex life pre-operative to current	0.4 ± 3.7	−0.8 ± 1.8	1.4 ± 4.6	0.050*

Results of a 0–10 visual analogue scale regarding general satisfaction with sex life (0 for low, 10 for full satisfaction) among all patients, those with LVAD, and HTx patients with comparison between the LVAD and HTx groups. Patients were asked on the current satisfaction as well as the recalled satisfaction before the operation.
LVAD, left ventricular assist device; HTx, heart transplantation.
*Statistically significant ($P < 0.05$).

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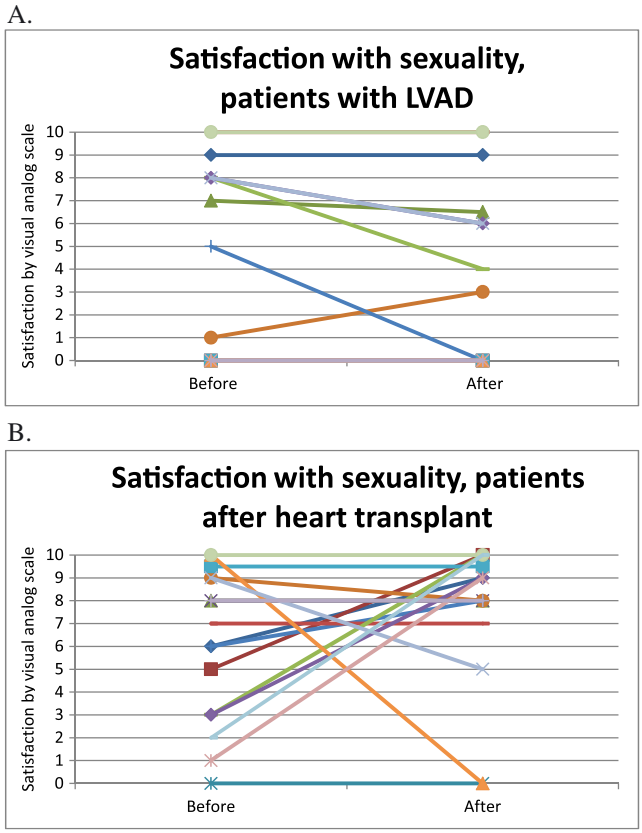

Figure 2 Satisfaction with sex life among patients with left ventricular assist device and after heart transplantation.

this with the sexual function of patients after HTx. Despite satisfactory effort ability, we found significant limitations to sexuality in both groups that seemed more prominent among patients supported with an LVAD. These limitations were attributed to specific causes in the majority of patients.

This is a novel study that provides insights regarding the sexual function of HF patients supported with an LVAD. While patients with advanced HF treated with LVAD enjoy multiple benefits including decrease in morbidity and mortality, sexual health among these patients has been scarcely investigated. Interviewing nine patients with LVADs, one report suggested improved sexual function attributed to the LVAD support.[16] A survey conducted among 301 patients with durable continuous flow LVAD using the Changes in Sexual Function Questionnaire-14 was recently published. Only 59 patients (20%) responded to this questionnaire, and among those, sexual dysfunction was identified in the majority (71% in men and 79% in women).[17] While responder bias may confound the interpretation, these results suggest post-LVAD sexual limitations similar to the findings in the current study.

In this study, patients reported a mean value of 5.9 (on a scale from 0 to 10) in scoring the satisfaction with their current sex life, and they looked back on their sex life before the operation scoring a 5.5. This is higher compared with a HF population without LVAD or HTx,[6] where patients scored 4.5 for their current sex life. In that study, patients rated their current satisfaction with sexuality lower than before their disease and lower than healthy community controls. All patients were less satisfied with their current sexuality than before their HF. Surprisingly in our study, while HTx patients experienced an overall increase in satisfaction with sex life, LVAD patients reported an overall decrease.

When directly inquired regarding sexual function during the interview, all patients were forthcoming to discuss the subject, and specific contributing factors have been identified in the majority. Performance dysfunction (erectile dysfunction or vaginal dryness) was the most prevalent. Multiple factors might contribute to erectile dysfunction among patients supported with LVAD including low systolic blood pressure, previous co-morbidity (such as diabetes mellitus or peripheral vascular), and insufficient cardiac output. Erectile dysfunction could also be attributed in part to endothelial dysfunction that has been suggested in patients on continuous flow devices.[18,19] Therefore, it is possible that factors contributing to sexual dysfunction with HF are not completely reversed during the LVAD support. As there

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is little knowledge about sexual function after heart transplant and LVAD, some extrapolations can be deduced from reports on other solid organ transplant. With renal replacement therapy, it is interesting that erectile function is impaired in both patients undergoing hemodialysis as well as after kidney transplant compared with healthy controls[20] (although somewhat better after transplant[21]). After liver transplant, sexual function improves, but not to the level of healthy controls,[22] also implying that complete recovery of sexuality after chronic organ dysfunction is rare.

Another contributor to sexual dysfunction was associated with LVAD machinery. Quality of life in patients living with older first-generation LVADs has been shown to be significantly lower than patients 3 months post-HTx.[23] The currently used newer devices are smaller, lighter, and compatible with near-normal lifestyle. However, the abdominal power cable exit and dependence on external batteries may still cause problems with intimacy and sexual activity. Modifications of driveline exit site such as the post-auricular or lower chest may have advantages over the traditional abdominal site for infection prevention as well as be more suited for intimacy. Certainly, the futuristic wireless LVAD may improve quality of life including sex life.

A third type of contributing factor is more psychosocial in nature and includes fear, depression, altered self-image, and problems with the partner. Similar problems were reported in patients with HF without LVAD or HTx.[6] These may further aggravate the 'physiological' disturbances and vice versa to form a mutually reinforcing triad of depressive symptoms, cardiovascular disease, and erectile dysfunction.[24] Specific counselling, both medical and psychological, may be helpful in alleviating these issues.

This study is the first to compare LVAD and HTx patients and strengthens previous observations that sexual dysfunction might persist under LVAD support. Patients in our experience were forthcoming and thankful for addressing sexual issues during the interview, and important potentially reversible issues were identified. By raising the awareness of the medical teams taking care of LVAD-supported patients, we hope patient's care may be improved in this important aspect of well-being. Future studies will examine the effectiveness of such interventional efforts.

Limitations and strengths

The study is limited in sample size and therefore should be considered accordingly as hypothesis generating. The cross-sectional design incurred limitations in the ability to compare changes in sex life, and the use of recalled satisfaction may be influenced by the current status. There is no control group of HF patients on medical therapy, although comparison was performed with published information on such a group using a similar questionnaire. We did not perform a psychological evaluation of the patients, and performing this may have added to the understanding of causes of sexual dysfunction. The population at our centre is diverse and includes Ashkenazi, non-Ashkenazi Jews, and Arabs; therefore, there may be social differences in this population. However the diversity of the population may be considered a strength as well. The comparison of patients on LVAD support with patients after HTx carries obvious limitations. Specifically, the different times after the operation may have selected healthier patients in the HTx group. On the other hand, such a comparison can also be considered a strength, as both groups have (had) severe HF and an intense medical intervention, changing the course of their disease and daily life. The study setting carries a possible strength as HTx and LVAD patients are treated in the same clinic by similar health professionals, and the clinical setting achieved the degree of intimacy allowing patients to expose problems in sexuality.

Author contributions

Authors T. H., T. J., D. M., Y. G., B. M., and T. B. participated in research design; T. H., S. S., T. J., and T. B. participated in the writing of the paper; T. H., D. M., V. Y., S. B., B. M., and T. B. participated in the performance of the research; T. H., S. S., Y. G., and T. B. participated in data analysis.

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Conflict of Interest

The authors declare no conflicts of interest.

Abbreviations

ACE-I: angiotensin-converting enzyme inhibitor
HF: heart failure
HTx: heart transplant
LVAD: left ventricular assist device
NYHA: New York Heart Association
PDE5i: phosphodiasterase 5 inhibitor

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