Original Article

Comparative analysis of perioperative renal function in patients undergoing heart transplantation and left ventricular assist device implantation: a multicenter retrospective study

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Background: Renal function is a crucial factor affecting the prognosis of patients with end-stage heart failure (HF). The differential impacts of heart transplantation and left ventricular assist device (LVAD) implantation on renal function are unclear. Therefore, we compared the perioperative renal function changes in patients who underwent heart transplantation with that of patients who underwent LVAD implantation.

Methods: This study included 77 patients who underwent heart transplantation and 59 patients who underwent LVAD implantation at five hospitals between January 2019 and December 2023. These patients were divided into two groups based on surgery type: heart transplantation or LVAD implantation. The estimated glomerular filtration rates (eGFRs) before surgery and on postoperative days (PODs) 1, 7, and 30 were compared. A subgroup analysis was conducted for patients with preoperative renal dysfunction, and paired-samples *t*-tests were used to compare renal function changes before and one month after surgery.

Results: Patients in the LVAD group were older (56.4 *vs.* 44.4 years, P<0.001) and had lower preoperative eGFRs (72.5 *vs.* 91.3 mL/min/1.73 m^2, P=0.001) than patients in the heart transplantation group did. On POD 1 and POD 7, the LVAD group continued to have a lower eGFR than the heart transplantation group. The baseline eGFRs were not significantly different (63.3 *vs.* 60.4 mL/min/1.73 m^2, P=0.44) in patients with preoperative renal dysfunction (eGFR <90 mL/min/1.73 m^2). However, on PODs 1, 7, and 30, the eGFR in the LVAD group was significantly greater than that in the heart transplantation group. By POD 30, renal function in the LVAD group had recovered to near-normal levels (60.4–87.6 mL/min/1.73 m^2), whereas in the heart transplantation group, the eGFR remained close to the preoperative level (63.3–63.4 mL/min/1.73 m^2). In the LVAD group, the eGFR significantly increased on POD 30, with 84.7% (50/59) of the LVAD patients showing varying degrees of improvement in renal function. In the heart transplantation group, patients' eGFRs on POD 30 were comparable to their preoperative values, with more than half of them showing a decreased eGFR. Among the patients with preoperative renal dysfunction, 10 without a history of preoperative continuous renal replacement therapy (CRRT) underwent postoperative CRRT in the heart transplantation group; nine of them died within three months of transplantation. In the LVAD group,

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three patients without preoperative CRRT support required CRRT postoperatively, with one case of early mortality.

Conclusions: For patients with end-stage HF and concurrent renal dysfunction, compared to heart transplantation, LVAD implantation with this new device resulted in significantly improved renal function. With no malfunctions, the device operated in a safe and effective manner and was successfully managed to improve renal function.

Keywords: Left ventricular assist device (LVAD); heart transplantation; renal function; end-stage heart failure (end-stage HF)

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Introduction

The prevalence of heart failure (HF) continues to rise, with over 60 million HF patients worldwide. As a complex and challenging clinical syndrome to manage, HF is often considered the "cancer" of cardiovascular diseases and imposes a significant burden on public health resources (1). Heart transplantation and left ventricular assist device (LVAD) implantation are the primary treatments for end-stage HF, and both can improve patient survival and quality of life significantly. Despite an increase in the number of donor hearts, the demand still far exceeds the supply, and the use of implantable LVADs has offered more options for patients (2). In October 2018, the United Network for Organ Sharing (UNOS) in the United States approved a new heart allocation policy that improved the identification of candidates in urgent need of transplantation and addressed the geographical imbalance in organ donation. Under the new policy, patients with an LVAD as a bridge to transplant (BTT) are given lower priority for heart transplantation, which has led to a decrease in LVAD use as a BTT and an increase in its use in long-term destination therapy (DT) (3).

Heart transplantation and LVAD therapy each has advantages and disadvantages. The major downside of heart transplantation is the need for immunosuppressive drugs and graft deterioration; severe infections and immune rejection greatly limit the survival time of recipients. In contrast, the disadvantage of LVAD therapy is the inconvenience of carrying external device components, which has a significant impact on daily life. With advances in technology and management, complications, such as device malfunction, infection, bleeding, and stroke, have significantly decreased, and survival rates have greatly increased. For end-stage HF patients who cannot wait or are ineligible for heart transplantation, LVAD implantation is undoubtedly the best choice (4-6).

The choice between heart transplantation and LVAD implantation is not clear when patients are eligible for both. In certain patient populations, the prognostic differences between these two treatments are not fully understood. For example, the impact of these two strategies on renal function in end-stage HF patients has not been fully elucidated, especially when testing a new LVAD with a unique principle of operation. Studies have

Highlight box

Key findings

- Compared to heart transplantation, left ventricular assist device (LVAD) implantation with this new device resulted in significantly improved renal function in patients with pre-existing renal dysfunction.

What is known and what is new?

- Previous studies have shown renal function in patients supported by LVAD remains stable or even improves. This study yielded evidence from direct comparisons of perioperative renal function changes between patients who underwent heart transplantation and patients who underwent LVAD implantation.
- This is the first study to demonstrate that the new LVAD device from China improves the renal function of end-stage heart failure (HF) patients.

What is the implication, and what should change now?

- Renal function is an important consideration if there are doubts on which surgery to choose for an end-stage HF patient. The results of this study suggested that LVAD implantation is a better choice for these patients with impaired renal function.

shown that long-term use of immunosuppressive drugs, such as calcineurin inhibitors (CNIs), can damage renal tubules and vessels (7,8). Current data show that renal function in patients supported by LVADs remains stable or is even improved (9,10). However, evidence from direct comparisons of perioperative renal function changes between patients who underwent heart transplantation and those who underwent LVAD implantation needs further investigation.

Guidelines indicate that irreversible renal dysfunction [creatinine clearance rate, estimated glomerular filtration rate (eGFR) <30 mL/min/1.73 m^2] is a contraindication for isolated heart transplantation (5). Although renal dysfunction is not listed as a contraindication for LVAD therapy in the guidelines, some centers still consider severe renal dysfunction (eGFR <40 mL/min/1.73 m^2) as a relative contraindication, mainly because of the increased mortality risk after LVAD implantation in these patients (11-14). Moreover, current guidelines lack recommendations for selecting between heart transplantation or LVAD implantation in patients with end-stage HF combined with renal dysfunction (eGFR <90 mL/min/1.73 m^2) (5,6). The decision among the options for these patients often hinges on the subjective choices of patients and physicians rather than scientifically valid evidence, which may affect patient prognosis. Therefore, our study aimed to compare the perioperative renal function changes in patients who underwent heart transplantation and patients who underwent LVAD implantation to evaluate the impact of these two strategies on renal function, thereby providing a basis for choosing a treatment strategy for end-stage HF patients with renal dysfunction. We present this article in accordance with the STROBE reporting checklist (available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1682/rc).

Methods

Study design

A multicenter retrospective investigation was conducted with 136 end-stage HF patients who underwent surgical treatment at one of five hospitals across China (Beijing Anzhen Hospital of Capital Medical University, Henan Provincial Chest Hospital, Zhejiang Provincial People's Hospital, The Second Affiliated Hospital of Zhejiang University School of Medicine, The First Affiliated Hospital of Xi'an Jiaotong University) from January 2019 to December 2023. The LVAD group was composed of patients who received the CH-VAD (CH-VAD® left ventricular assist system) (CH Biomedical, Suzhou, China). After thorough preoperative evaluation and multidisciplinary cardiac team discussion, 77 patients underwent heart transplantation, whereas 59 patients underwent LVAD implantation. The inclusion criteria were as follows: (I) aged ≥18 years; (II) clinical diagnosis of end-stage HF that is unresponsive to drug treatment; and (III) history of heart transplantation or CH-VAD implantation. Clinical data were collected retrospectively. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Ethics Committee of Beijing Anzhen Hospital, Capital Medical University (No. 2021-28) and informed consent was taken from all the patients.

The primary observation indicators included the eGFR measured on three different days before surgery and on the 1st, 7th, and 30th days after surgery. The eGFR was calculated using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) formula. The average eGFR of the three different days before surgery was used as the preoperative eGFR. We defined renal dysfunction as eGFR <90 mL/min/1.73 m^2 (15). Additionally, data on the postoperative use of continuous renal replacement therapy (CRRT) were collected.

Device description

Developed by CH Biomedical (now BrioHealth Solutions), the CH-VAD is a fully magnetically levitated centrifugal blood pump. It features an independent electric motor and magnetic bearing, which allows for a larger impeller within a smaller pump. The pump measures 47 mm in length and 25 mm in thickness, with a weight of 186 grams. The device was specifically designed to enhance hemocompatibility. The optimized blood compatibility of the CH-VAD has been evaluated via computational fluid dynamics, bench tests, and a series of animal studies (16-19). The device was approved for commercial use in China in 2021.

Statistical analysis

Data analysis was performed using SPSS 26.0 software. Continuous variables conforming to a normal distribution were presented as the means ± standard deviations and were analyzed using the independent samples *t*-test or paired-samples *t*-test for comparison; nonnormally distributed

Table 1 Baseline clinical characteristics of patients stratified by surgery type [mean ± SD or n (%)]

Variables	HT (n=77)	LVAD (n=59)	P
Male	60 (77.9)	47 (79.7)	0.81
Age (years)	44.4±18.6	56.4±11.2	<0.001
BMI (kg/m^2)	22.3±4.8	22.6±3.6	0.66
LVEF	28.4±10.6	26.4±5.8	0.20
Smoking	31 (40.3)	30 (50.8)	0.35
Drinking	25 (32.5)	26 (44.1)	0.28
Diabetes mellitus	17 (22.1)	18 (30.5)	0.38
Hypertension	14 (18.2)	14 (23.7)	0.51
Ischemic heart failure	22 (28.6)	29 (49.2)	0.01
Minimally invasive surgery	0 (0.0)	20 (33.9)	<0.001
Surgical duration (h)	6.5±1.2	6.4±1.4	0.86
Cardiopulmonary bypass time (min)	177.8±44.1	162.0±48.9	0.056
Cross-clamp time (min)	69.1±18.2	82.5±56.8	0.10
Mechanical ventilation time (h)	89.3±142.9	125.8±305.0	0.36
ICU duration (h)	129.8±132.2	104.0±116.3	0.26
Overall hospitalization period (days)	34.0±19.3	46.6±25.7	0.002
Preoperative eGFR (mL/min/1.73 m^2)	91.3±37.9	72.5±26.0	0.001
Preoperative eGFR <90 mL/min/1.73 m^2	43 (55.8)	43 (72.9)	0.041

SD, standard deviation; HT, heart transplantation; LVAD, left ventricular assist device; BMI, body mass index; LVEF, left ventricular ejection fraction; ICU, intensive care unit; eGFR, estimated glomerular filtration rate.

continuous variables were presented as the medians and interquartile ranges (IQRs) and were analyzed using the paired-samples Wilcoxon signed-rank test. Categorical variables were presented as counts and percentages, and group comparisons were conducted using Fisher's exact test or the Chi-squared test. P values less than 0.05 (two-tailed) were considered statistically significant.

Results

Between January 2019 and December 2023, at five hospitals, 77 patients with end-stage HF underwent heart transplantation, whereas 59 underwent CH-VAD implantation. Fifty-eight LVAD-implanted patients were receiving ongoing support at the time. Compared with heart transplant patients, LVAD patients were older (56.4 *vs.* 44.4 years, P<0.001), more likely to have ischemic HF (49.2% *vs.* 28.6%, P=0.01), and more likely to have undergone minimally invasive surgery (33.9% *vs.* 0.0%, P<0.001). The overall hospitalization period was significantly longer in patients who underwent LVAD implantation than in those who underwent heart transplantation (46.6 *vs.* 34.0 days, P=0.002). At baseline, LVAD patients presented worse renal function than heart transplant patients did (eGFR 72.5 *vs.* 91.3 mL/min/1.73 m^2, P=0.001). Moreover, a greater proportion of LVAD patients had renal dysfunction (eGFR <90 mL/min/1.73 m^2) (*Table 1*).

On the first day after surgery, the eGFR in both groups significantly decreased from the presurgery level, marking the lowest point of perioperative eGFR, and then began to recover to varying degrees. Postoperatively, the eGFR of the heart transplantation group was not significantly different from that of the LVAD group until the 30th day, when the proportion of patients with renal dysfunction in the LVAD group was significantly lower than that in the heart transplantation group (33.9% *vs.* 53.2%, P=0.03) (*Table 2*).

Patients in both groups were further divided into subgroups

Table 2 Postoperative renal function and early death [mean ± SD or n (%)]

Variables	HT (n=77)	LVAD (n=59)	P
POD1 eGFR (mL/min/1.73 m^2)	75.6±42.7	68.7±28.0	0.56
POD1 eGFR <90 mL/min/1.73 m^2	57 (74.0)	45 (76.3)	0.76
POD7 eGFR (mL/min/1.73 m^2)	88.9±48.7	84.3±33.7	0.92
POD7 eGFR <90 mL/min/1.73 m^2	43 (55.8)	27 (45.8)	0.24
POD30 eGFR (mL/min/1.73 m^2)	90.0±45.0	94.3±24.0	0.71
POD30 eGFR <90 mL/min/1.73 m^2	41 (53.2)	20 (33.9)	0.03
Postoperative CRRT	14 (18.2)	8 (13.6)	0.47
Early death	11 (14.3)	1 (1.7)	0.01

SD, standard deviation; HT, heart transplantation; LVAD, left ventricular assist device; POD, postoperative day; eGFR, estimated glomerular filtration rate; CRRT, continuous renal replacement therapy.

Table 3 Postoperative renal function and early death subgroup analysis [mean ± SD or n (%)]

Variable	Preoperative eGFR <90 mL/min/1.73 m^2			Preoperative eGFR ≥90 mL/min/1.73 m^2		
	HT (n=43)	LVAD (n=43)	P	HT (n=34)	LVAD (n=16)	P
Preoperative eGFR (mL/min/1.73 m^2)	63.3±16.3	60.4±18.5	0.44	126.7±25.7	105.0±11.0	<0.001
POD1 eGFR (mL/min/1.73 m^2)	49.9±13.8	58.2±21.5	0.04	108.1±44.9	96.9±23.9	0.26
POD1 eGFR <90 mL/min/1.73 m^2	43 (100.0)	40 (90.0)	0.08	14 (41.2)	5 (31.3)	0.50
POD7 eGFR (mL/min/1.73 m^2)	61.7±27.7	73.6±32.4	0.07	123.3±47.9	112.9±15.3	0.26
POD7 eGFR <90 mL/min/1.73 m^2	35 (81.4)	26 (60.5)	0.03	8 (23.5)	1 (6.3)	0.14
POD30 eGFR (mL/min/1.73 m^2)	63.4±24.2	87.6±22.1	<0.001	123.7±42.7	113.5±18.5	0.25
POD30 eGFR <90 mL/min/1.73 m^2	34 (79.1)	19 (44.2)	0.001	7 (20.6)	1 (6.3)	0.22
Postoperative CRRT	11 (25.6)	8 (18.6)	0.44	3 (8.8)	0 (0.0)	0.22
Postoperative CRRT without preoperative CRRT	10 (23.3)	3 (7.0)	0.04	0 (0.0)	0 (0.0)	–
Early death	9 (20.9)	1 (2.3)	0.008	2 (5.9)	0 (0.0)	0.32

SD, standard deviation; eGFR, estimated glomerular filtration rate; HT, heart transplantation; LVAD, left ventricular assist device; POD, postoperative day; CRRT, continuous renal replacement therapy.

based on their preoperative eGFR: <90 mL/min/1.73 m^2 and ≥90 mL/min/1.73 m^2. Subgroup analyses were conducted to compare postoperative eGFR levels. In patients with normal preoperative renal function (eGFR ≥90 mL/min/1.73 m^2), the preoperative eGFR in the heart transplant group was significantly greater than that in the LVAD group (126.7 *vs.* 105.0, P<0.001). There was no significant difference in postoperative eGFR between the two groups (*Table 3*).

In patients with preoperative renal dysfunction (eGFR <90 mL/min/1.73 m^2), the preoperative eGFRs were similar between the two groups (63.3 *vs.* 60.4 mL/min/1.73 m^2, P=0.44), but on postoperative days (PODs) 1, 7, and 30, the eGFR in the LVAD group was significantly greater than in the heart transplantation group (*Table 3* and *Figure 1*). The trend of perioperative eGFR changes in patients with preoperative renal dysfunction (*Figure 2*) revealed an increasing difference in eGFR between LVAD patients and heart transplant patients, with renal function in the LVAD patients recovering to near-normal by POD 30, whereas heart transplant patients' renal function remained close to the preoperative level. Paired-samples

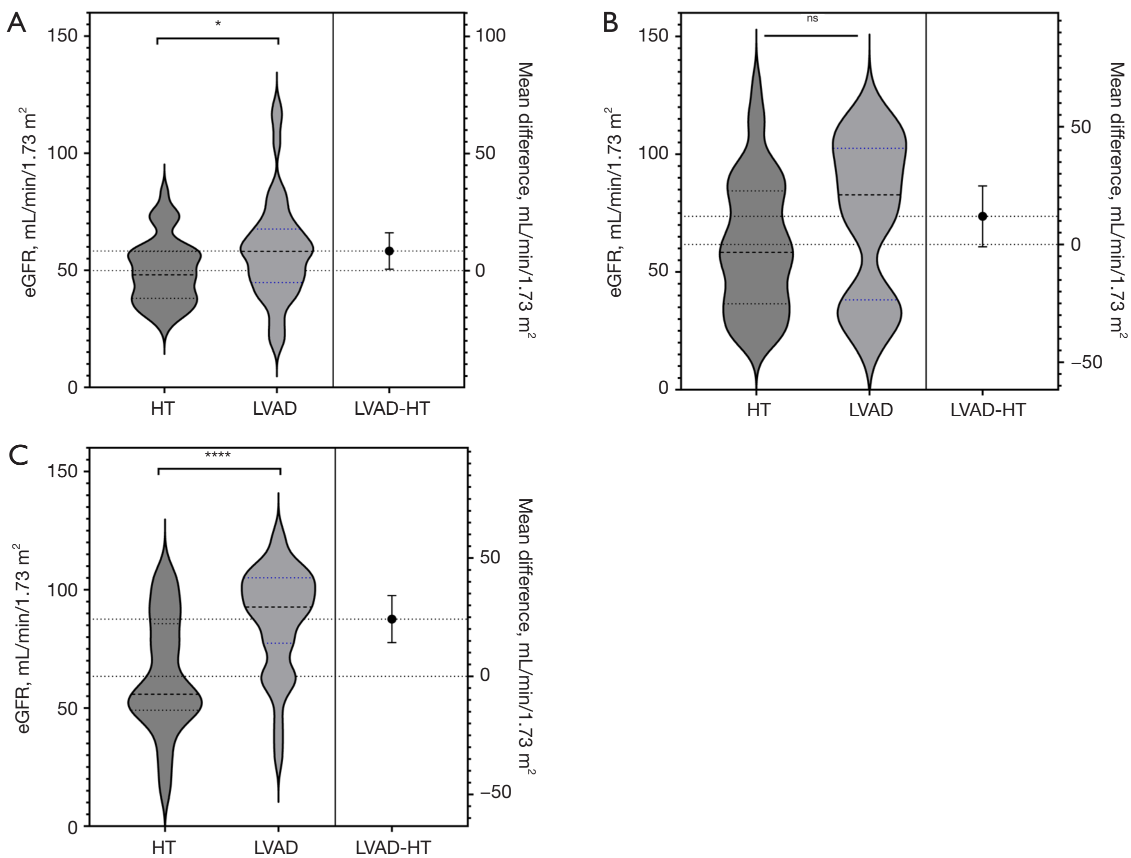

Figure 1 Comparison of postoperative renal function in patients with preoperative renal dysfunction (eGFR <90 mL/min/1.73 m^2) stratified by surgery type. (A) eGFR on POD1. (B) eGFR on POD7. (C) eGFR on POD30. ns, P>0.05; *, P≤0.05; ****, P≤0.0001. HT, heart transplantation; LVAD, left ventricular assist device; eGFR, estimated glomerular filtration rate; POD, postoperative day.

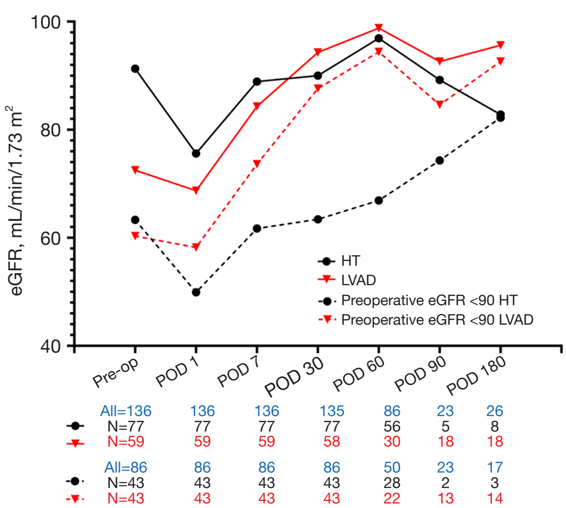

Figure 2 Comparison of perioperative renal function changes in patients stratified by surgery type. POD, postoperative day; eGFR, estimated glomerular filtration rate; HT, heart transplantation; LVAD, left ventricular assist device.

t-tests of the preoperative eGFR and POD 30 eGFR in all LVAD and heart transplant patients revealed that the eGFR improved significantly in the LVAD group by POD 30, with 84.7% (50/59) of the LVAD patients showing varying degrees of improvement in renal function. In contrast, the POD 30 eGFR of the heart transplant group was comparable to their preoperative eGFR, with more than half the patients having lower postoperative eGFRs than they did preoperatively (*Figure 3*). Among patients with preoperative renal dysfunction, 10 of those without preoperative CRRT underwent postoperative CRRT in the heart transplantation group; nine of them died within 3 months of transplantation. In the LVAD group, three patients without preoperative CRRT required CRRT postoperatively, with one case of early mortality. Among the patients with normal preoperative renal function, three heart transplant patients continued to require renal replacement therapy postoperatively;

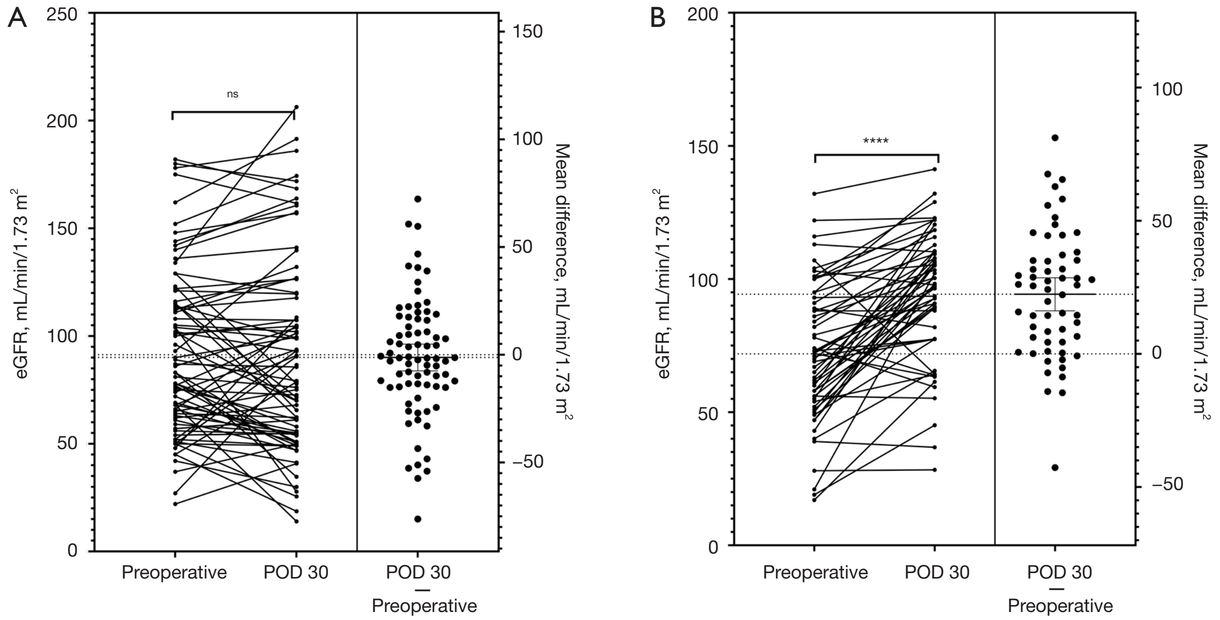

Figure 3 Changes in renal function before and 1 month after surgery. (A) Changes in renal function before and 1 month after surgery in patients with LVAD. (B) Changes in renal function before and 1 month after surgery in patients who underwent heart transplantation. ns, P>0.05; ****, P≤0.0001. POD, postoperative day; eGFR, estimated glomerular filtration rate.

Table 4 LVAD patients' postoperative renal function and early death subgroup analysis [mean ± SD or n (%)]

Variables	Implantation strategy			Etiology of heart failure		
	Median sternotomy (n=39)	Minimally invasive (n=20)	P	Ischemic heart failure (n=29)	Non-ischemic heart failure (n=30)	P
Preoperative eGFR (mL/min/1.73 m^2)	74.3±22.5	68.8±32.2	0.50	76.4±22.2	68.6±29.1	0.25
POD1 eGFR (mL/min/1.73 m^2)	69.0±27.9	68.1±28.8	0.91	70.2±27.5	67.3±28.8	0.70
POD1 eGFR <90 mL/min/1.73 m^2	31 (79.5)	14 (70.0)	0.42	23 (79.3)	22 (73.3)	0.59
POD7 eGFR (mL/min/1.73 m^2)	82.5±33.6	87.7±34.4	0.58	81.5±34.1	86.9±33.6	0.54
POD7 eGFR <90 mL/min/1.73 m^2	19 (48.7)	8 (40.0)	0.53	14 (48.3)	13 (43.3)	0.70
POD30 eGFR (mL/min/1.73 m^2)	96.9±20.4	88.9±30.0	0.23	91.7±24.2	96.7±23.9	0.43
POD30 eGFR <90 mL/min/1.73 m^2	12 (30.8)	8 (40.0)	0.39	11 (37.9)	9 (30.0)	0.46
Postoperative CRRT	1 (2.6)	7 (35.0)	0.001	3 (10.3)	5 (16.7)	0.48
Early death	0 (0.0)	1 (5.0)	0.15	1 (3.4)	0 (0.0)	0.30

LVAD, left ventricular assist device; SD, standard deviation; eGFR, estimated glomerular filtration rate; POD, postoperative day; CRRT, continuous renal replacement therapy.

two of them died early. No deaths occurred and there was no need for renal replacement therapy post-LVAD implantation in any case (*Table 3*).

Patients in the LVAD group were divided into subgroups based on the implantation strategy used and etiology of their HF. The subgroup analyses of postoperative eGFR revealed no significant difference between the subgroups. Moreover, the use of postoperative CRRT was significantly greater in the minimally invasive surgery group than in the median sternotomy surgery group (*Table 4*).

Discussion

The field of mechanical circulatory support continues to evolve, with a number of emerging devices with unique principles of operation preparing to enter clinical trials and the market. In addition, learning how to manage the operation of these devices is necessary for the optimal medical management of end-stage HF patients. Medical management includes monitoring not only the hemodynamic performance of these pumps but also their impact on end organ function. Renal function, for example, is a crucial factor affecting the prognosis of patients with end-stage HF. The purpose of this multicenter retrospective study was twofold: (I) to compare the differential impacts of heart transplantation *vs.* a LVAD on renal function and (II) to investigate the safety, performance, and optimal medical management of a new MagLev LVAD (CH-VAD, CH Biomedical).

This investigation directly compared perioperative renal function in heart transplant and LVAD patients who were treated with the novel CH-VAD. Arshad *et al.* (20) reported that, compared with heart transplantation, LVAD implantation is associated with a better renal function prognosis. Our study further established the renal benefits of LVAD implantation compared with heart transplantation in patients with pre-existing renal dysfunction. The patients experienced a sharp decrease in eGFR immediately after surgery, which was believed to have been caused by acute kidney injury due to surgical trauma and potential hemolysis. Over the following month, the eGFRs of the LVAD patients quickly rebounded. Based on previous research (21), regarding the long-term effects, LVAD patients showed improvement in their renal function, which tended to stabilize near their preoperative levels. However, we did not collect sufficient data to analyze the long-term effects on the eGFR; therefore, follow-up will continue.

In our study, the CH-VAD patients had significantly different baseline characteristics than the heart transplant patients, including a lower eGFR and an older age by 12 years. Notably, study has shown that renal function becomes impaired with age (22). In general, the surgical trauma associated with LVAD implantation is comparable to that associated with heart transplantation, with similar durations of aortic clamping and surgery. Despite these findings, the CH-VAD patients tended to have better renal recovery postoperatively, although the difference was not statistically significant. We believe that the renal benefits of LVAD implantation compared to those of heart transplantation are most prominent in patients with pre-existing renal dysfunction. Therefore, we conducted a subgroup analysis of patients with preoperative renal dysfunction, which demonstrated that, in these patients, the renal benefits of LVAD implantation were greater than those of heart transplantation. However, this benefit was not observed in patients with normal preoperative renal function. This finding is of great clinical importance, as current guidelines for heart transplantation and LVAD implantation only consider irreversible renal failure a contraindication for surgery, leaving the optimal surgical strategy for patients with reversible renal dysfunction unknown.

Most patients who undergo heart transplantation or LVAD implantation have reversible renal dysfunction related to poor renal perfusion caused by congestive HF. Like other studies have demonstrated, reversible renal impairment tends to improve with improvements in cardiac function postsurgery. Nevertheless, both treatment strategies involve factors that may impair renal function. Post-heart transplantation, the immediate use of antirejection drugs is necessary. These drugs pose unavoidable potential risks. Study has shown that CNIs can cause acute renal injury due to inadequate renal vascular constriction and dilation responses (23). Three potential factors associated with LVAD implantation can influence renal impairment: chronic hemolysis, continuous flow replacing pulsatile flow, and progressive right HF (17). As the adverse effects of chronic hemolysis and continuous flow on renal function have been observed in animal models and case reports only, their clinical impacts on renal function are not fully understood. Normalization of left ventricular output post-LVAD implantation can lead to a rapid increase in blood return to the damaged right ventricle, exacerbating right HF and renal vein hypertension and leading to a decline in renal function (24). Therefore, attention to the management of right HF post-LVAD implantation is essential to prevent renal function decline. In all the centers participating in this study, the LVAD patients underwent standardized screening and adjustments by a cardiac multidisciplinary team, with active postoperative right heart function support. The onset of early postoperative right HF in this study was low. In summary, the nephrotoxicity of antirejection drugs counteracts the improved renal perfusion associated with heart transplantation, resulting in minimal renal benefit compounded by the risk of renal deterioration in heart transplant patients. This is in contrast to LVAD implantation, which has been found to be associated with an increased likelihood of early improvement in renal function.

Because the eGFR data we collected after one month postoperatively were limited, the comparative analyses focused on the eGFR within one month postoperatively only. However, the limited data may yield interesting findings. A study on the previous generation of LVADs revealed that early improvement in renal function is common but seems to be largely transient, with a continued decline in eGFR subsequent to a peak in function at 1 month (25,26). There was a different pattern of renal function changes in fully magnetically levitated centrifugal LVAD patients in our study: renal function did not significantly deteriorate one month after surgery (*Figure 2*). This difference in renal function benefit may be the result of improved LVAD technology.

Based on the results of paired-samples *t*-tests for pre- and postoperative renal function, the majority of patients post-LVAD implantation had early postoperative renal function improvement compared with their preoperative levels. In contrast, in heart transplant patients, early postoperative renal function showed no improvement over preoperative levels, with over half the patients experiencing a decline in renal function. The renal benefits for LVAD patients compared with those for heart transplant patients in our study were significant, leading to the conclusion that LVAD implantation is the preferred treatment for patients with preoperative potentially reversible renal dysfunction. Despite significant differences in the proportions of patients with ischemic HF and minimally invasive surgery between the LVAD group and the heart transplantation group, the results of the subgroup analyses suggested that these differences, as shown in *Table 4*, were unlikely to impact or change the overall results.

Conclusions

This study demonstrated that, compared with heart transplantation, LVAD implantation significantly improved renal function in patients, a difference that existed only in patients with pre-existing renal dysfunction. The renal benefits of LVAD implantation appear to be superior to those of heart transplantation in terms of the use of postoperative CRRT and early postoperative mortality. Therefore, we believe that LVAD implantation is a better choice for end-stage HF patients with impaired kidney function. Finally, the CH-VAD performed in a safe and effective manner and was responsive to optimal medical management, resulting in improved renal function. Long-term follow-up is needed to determine whether the improvement of renal function in the LVAD group can be sustained over time.

Acknowledgments

None.

Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1682/rc

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Ethics Committee of Beijing Anzhen Hospital, Capital Medical University (No. 2021-28) and informed consent was taken from all the patients.

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