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Editorial

Left Ventricular Assist Device under Chronic Kidney Disease: Cautious, But We Still Need More Details

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▸ See the article "Impact of Renal Dysfunction on Outcomes after Left Ventricular Assist Device: a Systematic Review" in volume 3 on page 69.

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Chronic heart failure (HF) increases not only the activation of the neurohormonal system and the renin–angiotensin–aldosterone system but also the consequent renal venous congestion, resulting in chronic kidney disease (CKD). CKD is characterized by kidney damage or a glomerular filtration rate (GFR) of <60 mL/min/1.73 m^2 for more than 3 months, regardless of its cause. CKD due to chronic HF is known as type 2 cardiorenal syndrome (CRS).[1] Regarding frequency, CKD occurs in 35–70% of HF patients as evident from cohort studies or sub-analyses of randomized controlled trials.[2] Approximately one-fourth of acute HF patients develop acute kidney injury (AKI) due to type 1 CRS.[3] HF patients have a complex pattern of cardiorenal interactions. Therefore, providing care to these patients is challenging because it requires multidisciplinary approaches. The occurrence of kidney dysfunction including AKI, CKD, or AKI combined with CKD before the use of left ventricular assist device (LVAD) is one of the challenges warranting research to draw a clear conclusion.

Following LVAD implantation, there are marked changes in arterial and venous system hemodynamics; increased cardiac output, improved organ perfusion, and reduction in renal venous congestion.[4] To obtain these best hemodynamic statuses, strategies and cautions are required to restore the renal function. Right ventricular (RV) function and shape, in particular, play important roles. Basically, as the LVAD decompresses the left ventricular (LV), a serial reduction of LV end-diastolic pressure, pulmonary artery pressure results in improvement of RV function. However, increased cardiac output after LVAD implantation, also increases venous return, potentially precipitates pre-existing RV failure.[5] Moreover, excessive leftward shift of the interventricular septum, often found during suction event in continuous-flow (CF) LVADs, may aggravate septal contraction, leading to RV failure.[6] RV failure early after LVAD implantation is not uncommon and occurs in up to 25% of LVAD patients within 2 weeks.[7] Therefore, an appropriate dose of inotropic agents, or use of the RV assist device, if necessary, together with a timely ramp test for optimization of LVAD parameters and blood pressure, are very important in the postoperative period for multi-organ preservation, including the kidneys.

Despite these efforts, it is difficult to predict the reversibility of renal function in case of CKD. Previous studies showed that after LVAD implantation, a significant increase in GFR was followed by a late return to near-baseline GFR levels, and in some patients, GFR declined even below the baseline.[4][8]

According to the European Society of Cardiology and International Society for Heart and Lung Transplantation guidelines, primary irreversible renal disease with severe renal dysfunction may contraindicate long-term mechanical circulatory system implantation because of poor prognosis.[9][10] However, how should we manage with moderate CKD patients (15< GFR <60 mL/min/1.73 m^2) or some CKD possibly combined with AKI? The guidelines do not state specific comments on those groups. Doctors in practice may expect recovery of impaired renal function, despite being chronic, after improvement of cardiac output and decongestion. Approximately 5.7% cases of LVAD implantation in patients with a GFR of less than 30 mL/min/1.73 m^2 or those under ongoing dialysis included in the Interagency Registry for Mechanically Assisted Circulatory Support (INTERMACS) registry might have reflected 'the expectations' of the clinicians.[10] However, evidence, for now, tell us that LVAD would be not the best choice for the patient group.

In a recently published meta-analysis performed by Ibrahim et al.,[11] patients with renal dysfunction (GFR <60 mL/min/1.73 m^2) (n=4,630) had a higher risk of all-cause mortality (relative risk, 2.21; 95% confidence interval, 1.39–3.51; p<0.01) than patients with normal renal function (GFR >60 mL/min/1.73 m^2) (n=22,019). The study suggests that GFR could be used to risk-stratify patients and guide decision-making before LVAD implantation. In this study, however, the type of LVAD used was not reported. Although Sandner et al.[12] reported no significant difference in the change in kidney function over time between patients receiving CF LVADs versus those receiving pulsatile-flow LVADs, there are theoretical concerns that long-term exposure to continuous flow versus pulsatile flow may affect end-organ perfusion differently. A novel generation of LVAD (i.e., HeartMate 3) offers the technical feature of "artificial pulse." Hence, it is considered more physiologically similar to a patient's heart. The long-term effects of this new generation of LVAD on kidney function currently remain unidentified.[13]

Another limitation of that study is that they did not analyze the data according to destination therapy (DT) or bridge to transplantation (BTT). In most of the articles analyzed in this study, DT and BTT were mixed in the patient populations. However, DT and BTT patients have far different baseline characteristics, especially age and comorbidities.

In one of the reference articles that analyzed the INTERMACS registry, DT was a constant risk factor for death (hazard ratio, 1.27). Consistently, a recent report published by Jawitz et al.[14] showed that BTT with an LVAD does not appear to be associated with worse renal outcomes even in patients with advanced CKD (estimated GFR <30 mL/min/1.73 m^2). These results suggest that we need to try to separately analyze BTT and DT in LVAD patients with CKD.

LVAD is a limited and expensive resource despite being a man-made machine. For patients with concomitant advanced HF and end-stage renal disease, patient selection should be performed in a more careful and responsible manner. Accordingly, supportive care or death may be the only option for certain patients without heart-kidney co-transplantation. However, we also have data of a small subset of patients with advanced CKD who survived for longer periods of time and who received a heart transplant.[15] This may suggest that some patients with CKD may benefit from LVAD implantation. More detailed investigations on specific conditions such as relative hemodynamic acuity at the time of LVAD implantation, including INTERMACS profiles or use of temporary circulatory support, the LVAD strategy (BTT vs. DT), or the incidence of RV failure according to the amount of shunt flow through arteriovenous fistulae, are warranted.

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