Volume Optimization Incorporating Negative Pressure Diuresis in Heart Failure (VOID-HF)

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Acute decompensated heart failure is a common problem and is frequently associated with diuretic resistance from cardiorenal syndrome. We present the first in human use of the JuxtaFlow Renal Assist Device (RAD) to treat congestion in patients admitted to the hospital with acute decompensated heart failure. In an open-label single-arm trial, patients admitted with acute decompensated heart failure who were diuretic resistant underwent placement of the RAD catheter system and received treatment for 24 hours with RAD. The primary endpoints were safety metrics (safe use of the device) and markers of hematuria. Secondary endpoints included markers of efficacy, including 24 hour urine output and biomarkers of renal function. Seven patients underwent an implant of the RAD catheter system, with six patients successfully completing the protocol. Among patients who completed the protocol, no structural abnormalities were identified on renal ultrasound. Significant improvements in 24 hour urine output and sodium excretion were noted despite a small sample size. The volume optimization incorporating negative pressure diuresis in heart failure (VOID-HF) trial demonstrated the early feasibility of the RAD catheter system, with six of seven patients completing the protocol. Further studies are indicated to determine if this novel therapy is a safe and effective addition to current standards of care. *ASAIO Journal* 2025; XX:XX–XX

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Background

Heart failure is a common, severe disease, affecting approximately a fifth of all people over the course of a lifetime.[1] Hospitalizations for acute decompensations are a common complication of the disease, are associated with substantial healthcare expenditure, and are associated with increased risk of mortality.[2–4] The crux of treatment of the decompensated patient is decongestion *via* volume removal, typically with intravenous (IV) loop diuretics.[5] Most patients admitted with acute decompensated heart failure present with signs and symptoms of congestion without evidence of low cardiac output and hypoperfusion, therefore, are considered "warm and wet." These patients do not require augmentation of cardiac output *via* inotropes or mechanical circulatory support, rather entirely depend on treatment *via* volume removal *via* bolus or continuous infusion IV loop diuretic.[6]

Cardiorenal syndrome (CRS) is common among patients admitted to the hospital with acute decompensated heart failure. It is thought to be present in 17.8% of all heart failure hospitalizations according to heart failure registry data of Medicare beneficiaries.[7,8] Cardiorenal syndrome is a complex pathophysiologic entity that is multifactorial; however, elevated renal vein pressure secondary to elevated plasma volume associated with decompensated heart failure is a crucial mechanism.[9,10] Although there are several types of CRS, our focus in this manuscript is primarily on CRS types 1 and 2, where the elevation in renal venous pressure and congestion is principally driven by heart failure. This leads to decreased urine output as the function of each kidney decreases and activation of the renin angiotensin aldosterone pathway, which leads to further sodium and water retention, worsening congestion.[11] As congestion worsens due to failure to remove adequate volume and intake exceeds urinary output, renal vein pressure further increases. Thus, a perpetual cycle of further injury and insult occurs, leading to further rises in renal venous pressure.

Cardiorenal syndrome manifests as a syndrome of diuretic resistance wherein diuretic doses that would otherwise lead to an appropriate volume of diuresis fail to produce the usual effect.[12] The combined diuretic resistance and elevated renal venous pressure lead to progressively worsening decompensation of heart failure as well as worsening renal injury. When escalating doses of diuretics overcome diuretic resistance, the renal venous pressure decreases as congestion resolves.

Cardiorenal syndrome can be challenging to treat, as the first line of treatment requires excess plasma volume removal. Given the impaired renal function implicit in this disease process, the renal injury may be so severe, and the renal venous pressure so great that despite high-dose diuretics,

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