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**Dr. Sneha Vaswani**
Consultant Anaesthesiologist, Jupiter Hospital, Thane, Maharashtra, India

**Dr. Naba Madoo**
Clinical Associate, Jupiter Hospital, Thane, Maharashtra, India

**Dr. Jill**
Consultant Nephrologist and Transplant Physician, Jupiter Hospital, Thane, Maharashtra, India

**Dr. Aniket Hase**
Consultant Nephrologist and Transplant Physician, Jupiter Hospital, Thane, Maharashtra, India

**Dr. Lokesh Sinha**
Consultant Urologist, Jupiter Hospital, Thane, Maharashtra, India

**Corresponding Author:**
**Dr. Sneha Vaswani**
Consultant Anaesthesiologist, Jupiter Hospital, Thane, Maharashtra, India

# Successful cadaveric kidney transplantation in a young female with end-stage renal disease and severe dilated cardiomyopathy (Ejection Fraction 10-15%): An anesthetic challenge

**Sneha Vaswani, Naba Madoo, Jill, Aniket Hase and Lokesh Sinha**

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**Abstract**
We report the case of a young female with end-stage renal disease (ESRD) secondary to vesicoureteral reflux in a solitary kidney, who successfully underwent cadaveric donor kidney transplantation despite severely depressed left ventricular systolic function (ejection fraction [EF] 10-15%). Her course was complicated by multiple vascular access failures, a prior right atrial thrombus, and dependence on peritoneal dialysis. The coexistence of ESRD and severe dilated cardiomyopathy posed an extraordinary anesthetic challenge. Meticulous multidisciplinary planning, judicious drug selection, restrictive fluid management, and proactive hemodynamic support enabled a stable intraoperative course and favourable recovery. Remarkably, at three-month follow-up, her EF had improved to 60%, signifying both myocardial and graft functional recovery. This case highlights that renal transplantation can be safely performed in carefully selected patients with severe cardiac dysfunction when managed through individualized anesthetic and perioperative strategies.

**Keywords:** End-stage renal disease, cadaveric renal transplant, dilated cardiomyopathy, ejection fraction, vesicoureteral reflux, high-risk anesthesia, hemodynamic optimization

## Introduction
Renal transplantation is the definitive treatment for end-stage renal disease (ESRD) and offers superior survival and quality of life compared to dialysis. However, performing transplantation in patients with severe left ventricular (LV) dysfunction presents major anesthetic and perioperative challenges due to limited myocardial reserve, volume sensitivity, and the risk of anesthesia-induced cardiovascular compromise. Patients with an ejection fraction (EF) below 20% are rarely considered operable, yet with recent advances in perioperative and critical care, transplantation may still be feasible in selected cases [1, 2]. Additionally, multiple studies suggest that renal transplantation may lead to reverse myocardial and structural cardiac remodeling via correction of the uremic milieu [3-6]. We describe the successful anesthetic management of a young female with ESRD and severe dilated cardiomyopathy (EF 10-15%) undergoing cadaveric renal transplantation, emphasising intraoperative maintenance, hemodynamic goals, transplant-specific protocols, and postoperative recovery.

## Case Presentation
A 26-year-old female (height 150 cm, weight 54 kg) with a history of chronic kidney disease, hypertension, and dilated cardiomyopathy was scheduled for cadaveric donor renal transplantation. She had a solitary kidney with vesicoureteral reflux since childhood, complicated by recurrent urinary tract infections and progressive renal dysfunction culminating in ESRD. She initially underwent hemodialysis via a right internal jugular venous catheter, followed by a left arteriovenous fistula (AVF) that thrombosed, a tunneled cuffed catheter (TCC) complicated by infection and a right atrial thrombus requiring surgical evacuation, and a subsequent right AVF which failed due to recurrent intradialytic hypotension—after which she was transitioned to peritoneal dialysis.
Preoperative laboratory evaluation revealed hemoglobin 9.1 g/dL, WBC 6,620/mm³, platelets

233×10⁹/L, serum sodium/potassium/chloride 136/6.8/108 mmol/L, and serum creatinine 7.1 mg/dL. Two-dimensional echocardiography demonstrated severe LV systolic dysfunction (EF 10-15%) with global hypokinesia, mild right ventricular dysfunction, moderate pulmonary hypertension, moderate mitral regurgitation, severe tricuspid regurgitation, and a dilated inferior vena cava with <50% collapsibility. ECG showed sinus rhythm with frequent premature atrial and ventricular complexes. She was classified as ASA Physical Status III and deemed "high-risk but operable" after multidisciplinary assessment.

Airway assessment revealed mouth opening >3 finger-breadths, Mallampati Class II, thyromental distance 7 cm, full neck extension. She was anticipated to have an easy airway; however, a difficult airway trolley (video-laryngoscope, bougie, supraglottic device) was kept ready given her high-risk cardiovascular status.

In the operating room, standard ASA monitoring was instituted: continuous ECG with ST-segment analysis, non-invasive blood pressure (NIBP), pulse oximetry ($SpO_2$), end-tidal $CO_2$ ($EtCO_2$) after intubation, core temperature monitoring, and neuromuscular transmission monitoring. A left femoral central venous catheter was secured under aseptic precautions for fluid and vasoactive drug administration. Multiple attempts to secure a radial arterial line under ultrasound guidance were unsuccessful due to poor vascular anatomy from prior access procedures. A defibrillator and external pacing pads were kept ready in view of her severely depressed ejection fraction.

Anesthesia was induced with fentanyl 100 µg, etomidate 20 mg, and cisatracurium 10 mg. Anticipating hypotension, noradrenaline (8 mg in 50 mL) was started at 2 mL/hr and dobutamine at 1 mL/hr before induction. Intubation was achieved smoothly using a size 7.0 mm cuffed endotracheal tube. Maintenance of anesthesia consisted of a 50:50 oxygen-air mixture with sevoflurane at 0.8-1 MAC (titrated to maintain hemodynamic stability), supplementary fentanyl boluses of 25-50 µg for analgesia, and cisatracurium for muscle relaxation. $EtCO_2$ was maintained between 35-40 mmHg, and normothermia was preserved via forced-air warming.

Intraoperative management followed a two-phase fluid strategy: restrictive (pre-reperfusion) to avoid right heart overload, then controlled expansion before graft reperfusion to optimise renal perfusion. Pre-existing hyperkalemia ($K^+$ 6.8 mmol/L) was corrected with insulin-dextrose and furosemide prior to induction. As per transplant protocol, methylprednisolone 500 mg IV was administered during induction, followed by mannitol 0.5 g/kg and furosemide 40 mg IV before reperfusion to promote diuresis and minimise ischemia-reperfusion injury. Mean arterial pressure (MAP) was maintained >70 mmHg, and central venous pressure (CVP) around 8-10 cm $H_2O$ during reperfusion. Potassium-containing fluids and colloids were avoided. Urine output commenced within 20 minutes of reperfusion and exceeded 150 mL intraoperatively, indicative of satisfactory graft perfusion.

The total surgical duration was approximately four hours. Hemodynamics were maintained throughout with incremental titration of noradrenaline (2-5 µg/min) and dobutamine (5 µg/kg/min). The patient was transferred to the intensive care unit (ICU) intubated for controlled hemodynamic weaning. She was successfully extubated later the same evening after achieving stable cardiac and respiratory parameters. Noradrenaline was discontinued the next day, and dobutamine was tapered off after 48 hours. Analgesia was managed with a low-dose fentanyl infusion (4 mL/hr) and later transitioned to paracetamol. Postoperative echocardiography revealed improvement in EF to 20-25%, with steadily increasing urine output and declining serum creatinine. She remained in the ICU for continued vascular and hemodynamic monitoring, then was shifted to the transplant ward. Her peritoneal dialysis catheter and DJ stent were removed subsequently. Follow-up Doppler confirmed normal graft perfusion. On subsequent follow-up at three months, the patient remained asymptomatic with stable graft function and a remarkable improvement in LV ejection fraction to 60%, consistent with myocardial recovery following correction of chronic uremic cardiomyopathy.

## Discussion

Patients with ESRD frequently develop a specific cardiac phenotype often termed "uremic cardiomyopathy", characterised by left ventricular hypertrophy, interstitial fibrosis, myocardial remodelling, chamber dilation, and systolic/diastolic dysfunction [3, 4]. These changes result from a combination of volume and pressure overload, anemia, secondary hyperparathyroidism, elevated fibroblast growth factor-23 (FGF-23), uremic toxins, chronic inflammation and neurohormonal activation [4, 5]. This complex pathophysiology places patients with ESRD and severely reduced ejection fraction at extremely high perioperative risk for non-cardiac surgery, and in the context of renal transplantation—even more so.

Our patient's EF of 10-15% placed her in the highest-risk category. Literature on renal transplantation in patients with severely impaired LV function is limited, but available data suggest that careful intraoperative planning and monitoring can lead to successful outcomes. For example, in a retrospective series of 31 patients with dilated cardiomyopathy undergoing renal transplantation, hypotension occurred in 51.6% and postoperative mechanical ventilation in 12.9%; the authors emphasised that strict hemodynamic control and meticulous fluid therapy are the cornerstones of good outcomes [7]. Additionally, a recent institutional review of 203 renal transplant recipients highlighted that 9.3% required intraoperative inotropic support and 3.9% required postoperative mechanical ventilation, underlining the co-morbid burden in this patient population [2].

In terms of myocardial recovery, the conventional teaching has been that uremic cardiomyopathy is only partially reversible. A systematic review and meta-analysis found no statistically significant change in left ventricular ejection fraction or left ventricular mass index after transplantation [3]. On the other hand, other studies report meaningful improvement: a retrospective analysis of 293 transplant recipients found that 12% improved LVEF by ≥10% after transplantation [6], and multiple case reports describe improvements to near-normal EF in recipients [5, 8]. In our case, improvement to 60% at three months is remarkable and aligns with the observation that younger age, non-ischemic cardiomyopathy, shorter dialysis duration and timely transplantation are favourable predictors of recovery [8].

Anesthetic management in this setting must balance two often conflicting goals: ensuring adequate perfusion of the

newly implanted graft while avoiding volume overload or precipitating right-heart failure. Pre-emptive initiation of vasopressor and inotrope support (such as noradrenaline and dobutamine) before induction is supported by the literature as a strategy to maintain systemic vascular resistance and augment contractility in patients with severely depressed myocardial function. The selection of induction agents is crucial: etomidate for cardiovascular stability, fentanyl to blunt sympathetic response, cisatracurium for neuromuscular blockade independent of renal clearance, and sevoflurane for maintenance with minimal myocardial depression were all chosen to support this balance. Fluid management requires a two-phase approach: initially restrictive during dissection to prevent right heart decompensation, followed by controlled expansion to support graft perfusion once vascular anastomoses are complete. Intraoperative correction of electrolyte derangements, avoidance of nephrotoxins, and targeted immunosuppression (e.g., methylprednisolone, mannitol, furosemide) further contribute to graft protection and systemic stability.

In our patient, rapid improvement in urine output intraoperatively was a favourable sign of graft perfusion, and the hemodynamic stability achieved intraoperatively correlated with the excellent postoperative outcome, including cardiac recovery. The dramatic improvement in EF from 10-15% to 60% within three months underscores the potential for cardiac reverse-remodelling after successful renal transplantation, especially in young patients with non-ischemic cardiomyopathy and limited dialysis duration.

The implications of this case are two-fold: (1) it challenges the notion that extremely low EF (<20%) is an absolute contraindication to renal transplantation, and [2] it emphasises the role of a multidisciplinary team (nephrology, cardiology, anesthesia, transplant surgery) in preoperative optimisation, intraoperative monitoring and postoperative follow-up. Of course, each case must be judged individually considering donor availability, intraoperative risk, graft quality, and patient comorbidities.

## Conclusion

This case demonstrates that cadaveric renal transplantation can be safely performed in patients with severe dilated cardiomyopathy (EF 10-15%) through meticulous anesthetic planning, judicious intraoperative management, and proactive hemodynamic optimisation. The patient's dramatic improvement in both renal graft function and cardiac ejection fraction highlights the potential for functional cardiac recovery following renal transplantation in ESRD patients with uremic cardiomyopathy. Severe LV dysfunction should not be considered an absolute contraindication to renal transplantation when guided by a high-level multidisciplinary perioperative care team.

## Conflict of Interest

Not available.

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