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Renal Transplantation in Patients with Dilated Cardiomyopathy Done Under Spinal Epidural Anesthesia - A Retrospective Study

Spinal Epidural Anestezi Altında Yapılan Dilate Kardiyomiyopatili Hastalarda Böbrek Nakli - Retrospektif Bir Çalışma

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ABSTRACT

Objective: Renal transplantation (RT) is associated with a substantial improvement of left ventricular ejection fraction in end stage renal disease (ESDR) patients with dilated cardiomyopathy (DCM). The abnormal physiology due to ESRD and DCM, poses increased cardiovascular risk during surgery. This retrospective study discusses the anesthetic management and outcome of RT done under combined spinal epidural (CSE) in patients with DCM.

Methods: This retrospective observational study was done after analysing the electronic database of 17 patients with DCM who underwent RT under CSE. Datas like demographics, duration of renal disease, associated illnesses, echocardiographic findings, medications and post-operative outcome were studied.

Results: Most common perioperative complication was hypotension (intraoperative - 88.23%, postoperative - 76.74%). All patients had immediate urine production on reperfusion. Postoperatively, two patients (12%) developed ischemic changes on electrocardiogram and one patient (6%) had pleural tapping. None of the patients had acute tubular necrosis or dialysis requirements till discharge. No major cardiac or respiratory complications were observed in any patient.

Conclusion: Our successful renal transplant using the CSE approach in individuals with low ejection fraction can help in perioperative decision making for all the stakeholders involved as cardiovascular risk stratification can be a challenging task in these patients.

Keywords: Cardiomyopathy, chronic kidney disease, renal transplantation, ventricular dysfunction

ÖZ

Amaç: Renal transplantasyonu (RT), dilate kardiyomiyopatisi (DKM) olan son dönem böbrek hastalığı hastalarında sol ventrikül ejeksiyon fraksiyonunda belirgin bir iyileşme ile ilişkilidir. Son dönem böbrek hastalığı ve DKM'ye bağlı anormal fizyoloji, cerrahi sırasında artmış kardiyovasküler risk oluşturur. Bu retrospektif çalışmada, DCM'li hastalarda kombine spinal epidural (KSE) altında yapılan RT'nin anestezi yönetimini ve sonucunu tartışıyoruz.

Yöntem: Bu retrospektif gözlemsel çalışma, KSE altında RT uygulanan 17 DCM hastasının elektronik veritabanını analiz ederek yapıldı. Demografi, böbrek hastalığının süresi, ilişkili komorbiditeler, ekokardiyografik bulgular, ilaçlar ve postoperatif sonuç gibi veriler incelendi.

Bulgular: En sık görülen perioperatif komplikasyon hipotansiyondu (intraoperatif - %88,23, postoperatif - %76,74). İdrar çıkışı tüm hastalarda reperfüzyon sırasında hemen gerçekleşti. Ameliyat sonrası iki hastada (%12) iskemik elektrokardiyogram değişiklikleri gelişti ve bir hastada (%6) plevra tapping oldu. Hastaların hiçbiri taburcu olana kadar akut tübüler nekroz veya diyaliz gereksinimi yaşamadı. Hiçbir hastada majör kardiyak veya solunum komplikasyonu gözlenmedi.

Sonuç: Kombine spinal epidural yaklaşımını kullanarak düşük ejeksiyon fraksiyonu olan bireylerde gerçekleştirdiğimiz başarılı renal transplantımız, bu hastalarda kardiyovasküler risk stratifikasyonu zorlu bir görev olabildiği için perioperatif karar verme sürecinde yardımcı olabilir.

Anahtar sözcükler: Kardiyomiyopati, kronik böbrek hastalığı, böbrek nakli, ventriküler disfonksiyon

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INTRODUCTION

End-stage renal disease (ESRD) is commonly associated with cardiac abnormalities like ischemic heart disease, dilated cardiomyopathy (DCM), uncontrolled hypertension, pulmonary hypertension, and valvular heart disorders (1,2). The hallmark of DCM is dilatation and impaired contraction of the left ventricle or both ventricles. A left ventricular ejection fraction (EF) of less than 40% or fractional shortening of less than 25% are the diagnostic features of DCM (3). Chronic hypertension, volume overload, anemia, and metabolic abnormalities all have a role in the development of DCM (4). Renal transplantation (RT) significantly improves the left ventricular EF in ESRD patients with systolic dysfunction (5-8). The abnormal physiology due to ESRD and DCM, gives rise to increased cardiovascular risk (9). Cardiologist denial has been shown to be the most significant factor, which includes low EF, on multivariate analysis for negatively influencing transplant candidacy (10). Studies comparing RT in patients with normal EF and reduced EF have demonstrated similar results in graft survival, patient mortality, and adverse cardiac events (8,11).

Anesthetic technique for RT is either general anesthesia (GA) with endotracheal intubation or combined spinal epidural (CSE) (12-14). Studies comparing GA and CSE for RT in individuals with normal cardiac function indicates no significant differences in graft function, perioperative morbidity, and mortality (15-18). Very few descriptive studies discuss the anesthetic management of RT in patients with DCM (9,19). This retrospective study discusses the perioperative anesthetic management of patients with ESRD and DCM who had renal transplantation under CSE at our center. Outcomes like function of the transplanted kidney, and perioperative cardiac and respiratory complications were also analysed.

MATERIAL and METHODS

After receiving institutional ethical committee approval (vide approval number KIEC/TN2017/RR-21/32 2-17/RR21 dated 09/01/2023) and registration in the Clinical Trial Registry-India (vide trial registration CTRI/2023/06/054570, dated 30/06/2023, at www.ctri.nic.in), we reviewed electronic data of 270 patients who underwent RT at our center between January 2020 to December 2022. Criteria for inclusion: Patients who had RT under CSE anesthesia and an EF of less than 40% on echocardiography the day before surgery were chosen. Perioperative data of these patients were examined thoroughly. During the preoperative anesthetic assessment, all patient had a thorough evaluation that included a medical history, physical examination with pertinent laboratory testing, cardiac and pulmonary tests. High-risk written consent was obtained, outlining the cardiac risk during surgery. A day before surgery, all patients underwent hemodialysis through the arterio-venous fistula. The coagulation parameters were found to be normal. Oral ranitidine 150 mg and alprazolam 0.25 mg were advised the night prior and one hour before arrival to the operating room. Immunosuppressants (tacrolimus and mycophenolate) were initiated as per nephrologist's instructions. Cardiac and thyroid hormone medications were continued until the morning of the surgery. Standard monitoring devices, including electrocardiograms, pulse oximeters, and non-invasive blood pressure monitors, were set up in the operating room. Under ultrasonic guidance and local anesthesia infiltration, a 20G arterial cannula was secured into the radial artery (non-fistulous arm) for invasive blood pressure (IBP) monitoring and a central venous catheter (7 Fr) was inserted in either of the internal jugular veins for central venous pressure (CVP) monitoring. Under local anesthesia, an 18 G epidural catheter was inserted into the T12-L1 interspace while the patient was kept in sitting position.

A test dose of 3 mL of 2% lignocaine with adrenaline was administered to verify the position of the catheter. A 27 G Whitacre needle was used for injecting 12.5 mg of 0.5% hyperbaric bupivacaine and 25 µg fentanyl into the L2-L3/L3-L4 intrathecal space. An infusion of 0.5% bupivacaine combined with 2 µg mL^{-1} fentanyl was initiated through the epidural catheter at a rate of 5 mL hr^{-1}. Midazolam and fentanyl boluses were used intravenously for sedation. All patients received intravenous antithymocyte globulin (antibody) as instructed by the nephrologist. Mean arterial pressure (MAP) was targeted between 90-100 mmHg. The central venous pressure (CVP) was maintained at around 10-12 mmHg. Normal saline was administered intraoperatively to maintain the target CVP. Fluid and vasopressor administration was guided by CVP and MAP monitoring. Dynamic fluid responsiveness factors, such as pulse pressure variation (PPV) or stroke volume variation (SVV), or advanced cardiac output monitors were not employed. Inotropes, vasopressors, or vasodilators were given according to the patient's hemodynamic parameters to maintain the target MAP. Cold solution of ringer lactate containing 5000 units of heparin was used for kidney perfusion. An IV infusion of paracetamol 15 mg kg^{-1} every 8 hrs, alongside an epidural infusion of 5 mL hr^{-1} of 0.125% bupivacaine combined with 2 µg mL^{-1} fentanyl was used as postoperative analgesics. If MAP < 90 mmHg, fentanyl infusion at a rate of 0.5 µg kg^{-1} hr^{-1} was administered intravenously instead of epidural analgesia. The following perioperative complications were recorded: pulmonary edema, postoperative ventilator support, acute tubular necrosis, delayed graft functioning, hypotension (MAP), need for inotropes or vasopressors, left ventricular failure, arrhythmias. A complete blood count, renal function test, and electrolytes were done on postoperative day 1.

Statistical analysis

All data were recorded on a predefined proforma, and Bayesian statistical analysis was carried out using JASP software (Version 0.17.2), University of Amsterdam, Netherlands. The descriptive data is presented as mean and standard deviation (SD) for continuous variables. Normality of the data was checked using Shapiro-Wilk test and Bayesian Wilcoxon-signed rank test (non-parametric test) was used to compare it with the norm. A 2-sided Bayesian one-sample t-test was done to compare the sample age, duration of surgery, intravenous fluids used, duration of noradrenaline used and the ejection fraction in the echocardiography. The discrete quantitative variables were expressed as percentages.

RESULTS

A comprehensive review of perioperative data for 270 patients with ESRD who had successful RT at our hospital from January 2020 to December 2022 was conducted. Twenty patients were found to have DCM (EF < 40%). Three patients were excluded from the study (two patients had insufficient perioperative records and one patient preferred GA) while seventeen patients were subjected to retrospective analysis. The incidence of DCM in our study was 7.4%. Patient demographic and clinical characteristics including age, gender, duration of chronic kidney disease, other comorbidities (hypertension, diabetes mellitus, pleural effusion), current medications, and preoperative detailed echocardiography findings were documented (Table I). Bayesian Wilcoxon signed rank test was done with a sample of 1000 as the number of patients were less. Age (38.12 years) and duration of surgery (226.77 minutes) were compared to the norm (40 years and 240 minutes respectively) and returned a BF10 of 0.319 and 0.883 indicating evidence in favour of the null hypothesis (from same sample population). Most of the patients were men, and their average age was under forty. Incidence of hypertension, diabetes mellitus, pleural effusion, and ascites was 94.11%, 29.41%, 17.64%, and 29.41% respectively (Table II). Two patients had hypothyroidism, two patients underwent ABO incompatible RT, one patient tested positive for HbsAg, and one patient was reactive for Hepatitis C virus. The mean EF was less than 35%. The mean duration of anesthesia was 226.76 ± 33.16 minutes. The mean intraoperative blood loss was 304.28 ± 22.19 mL. The total volume of crystalloids administered during surgery was 1194.11 ± 281.67 mL of normal saline (Table III). No patients received colloid or blood transfusions. Renal preservative solution was not used in any of the cases. The average warm ischemia time and cold ischemia time were 3-5 minutes and 20-30 minutes respectively.

All patients had immediate urine production on reperfusion. Diuretic was not used in any case. The initial 24-hour urine output was 14.4 ± 5.15 L. The serum creatinine level on the first postoperative day was 2.29 ± 1.28 mg dL^{-1}. Fifteen patients (88.23%) had intraoperative hypotension. They were administered just norepinephrine. One patient experienced intraoperative hypertention and was initiated on nitroglycerin infusion. Postoperatively, 13 patients (76.74%) required noradrenaline administration. Of the 13 patients, 3 patients received noradrenaline for ≤ 10 hrs and 10 patients received noradrenaline for ≥ 10 hrs (median 24 hrs). One patient with severe left ventricle dysfunction (EF 22%) needed 96 hrs of inotropic support (noradrenaline for 48 hrs and dobutamine for 48 hrs). Two patients received albumin postoperatively, one of them underwent pleural tapping postoperatively (Table IV). At the end of the surgery, hemoglobin concentration and serum sodium levels were decreased (Table V).

The ejection fraction, intravenous fluid and duration of noradrenaline were compared to the norm (EF 60%, average use of 3000 mL of fluids and no use of noradrenaline) and returned a BF10 of 1360, 1550 and 332 (Figure I, Figure II, and Figure III) respectively, indicating evidence in favour of the alternative hypothesis (differing from sample population). Following the surgery, the study group had a decrease in creatinine (pre-surgery: 6.20 ± 2.01, post-surgery: 2.29 ± 1.28 mg dL^{-1}) and haemoglobin (pre-surgery: 9 ± 1.76, post-surgery: 8.15 ± 1.95 g/dl). A two-sided paired sample analysis revealed a Bayes factor (BF10) suggesting that the data were 190 and 2150 times more likely under the alternative than the null hypothesis. There was no change in the sodium values pre-surgery and post-surgery (BF10 = 0.258).

None of the patients had respiratory complications such pulmonary edema or the requirement for mechanical ventilation after surgery. There was no acute tubular necrosis or dialysis requirement for any of the patients. None of the patients had significant arrhythmia. Two patients developed postoperative ST segment depression. Their troponin levels were within normal limits. No patient needed any perioperative cardiac interventions, such as pacing, an intra-aortic balloon pump, or a left ventricular assist device. There was no perioperative death reported till the discharge of the patient. All patients were discharged between days 6 and 8 post-surgery. Six-month follow-up data showed that two patients got re-admitted. One patient was admitted for loose stools which got corrected. One patient was admitted with sepsis and lung infection. This patient developed multiorgan dysfunction syndrome and later succumbed. The remaining sixteen patients had normal urine output for six months post-surgery.

Table I. Demographics and Preoperative Details of Patients

S.No	Age/Sex	Comorbidities	EF	Other ECHO findings	Medications
1	29/F	HTN – 1 year, CKD – 1 year, MHD – 1 year, hypothyroid – 1 month, ascitic tapping is done multiple times.	38%	Global hypokinesia of LV, moderate RV dysfunction, moderate PAH, severe TR	NIL
2	46/M	HTN – 4 years, CKD – 2 years, MHD – 2 years	38%	Global hypokinesia of LV, moderate concentrate LVH, LA, RA dilated, severe PAH.	Nifedipine
3	52/M	HTN -15 years, DM – 15 years, CKD – 2 years, MHD – 3 months, ascitic tapping is done multiple times.	22%	Global hypokinesia of LV, All chambers dilated, RV dysfunction, mild PAH	Insulin
4	48/M	HTN – 15 years, DM – 15 years, CKD – 5 years, MHD – 1 year, CAD – 1 year,	30%	All chambers dilated, RV dysfunction, Grade 3 DD, mild PAH.	Insulin, Metoprolol
5	35/M	HTN – 4 years, CKD – 4 years, MHD – 4 years.	38%	All chambers dilated, Grade 3 DD, Moderate RV dysfunction, Severe PAH.	Clonidine, Prazosin, Amlodipine, Carvedilol.
6	37/M	HTN – 2 years, CKD – 2 years, MHD – 1 year, Ascitic tapping.	30%	All chambers dilated, Moderate PAH, Grade 3 DD	Prazosin, Nicardipine
7	28/F	HTN – 5 years, CKD – 5 years, MHD – 1 year.	40%	All chambers dilated, Grade 3 DD, Moderate PAH,	Amlodipine, Torsemide
8	53/M	HTN – 8 years, DM – 3 years, CKD – 3 years, MHD – 3years, CAD, pleural tapping.	30%	Global hypokinesia of LV, All chambers dilated, Grade 2 DD.	Nicardipine, Metoprolol, Prazosin, Insulin
9	34/M	HTN – 1 year, CKD – 1 year, MHD – 1 year, Seizure.	40%	Global hypokinesia of LV, Mild concentric LVH, Mild pericardial effusion	Nicardipine, Prazosin, Clonidine.
10	37/M	HTN – 3 months, CKD – 4 years, MHD – 1 month, Hypothyroid.	25%	Global hypokinesia of LV, LA dilated, Moderate MR, Grade 2 Aortic regurgitation.	Clinidipine, Ivabradine, Torsemide
11	20/F	HTN – 1 year, CKD – 2 years, MHD – 1 year, left pleural effusion	35%	Global hypokinesia of LV, Grade 2 DD, Moderate TR, LA, RA dilated.	Prazosin, Clonidine, Nicardipine, Metaprolol
12	46/M	DM – 12 years, CKD – 6 years, MHD – 6 months, CAD – 6 months, multiple ascitic tapping done.	30%	Global hypokinesia of LV, RV dysfunction, Grade 3 DD, Moderate TR, PAH	Carvedilol, Torsemide, Insulin.
13	37/M	HTN – 2 years, CKD – 2 years, MHD – 9 months	35%	Global hypokinesia of LV, Grade 2 DD, RA, LA dilated, Mild PAH.	Nicardipine, Metaprolol
14	42/M	DM – 10 years, HTN – 2 years, CKD – 2 years, MHD – 18 months, Multiple pleural and ascitic tapping done, ABO incompatible.	30%	Global hypokinesia of LV, RA/RV dilated, Severe PAH, TR. Grade 3 DD	Insulin
15	31/M	HTN – 1 year, CKD – 1 year, MHD – 7 months. HbsAg Positive	40%	Global hypokinesia of LV, LA dilated, Severe PAH.	Clonidine, Metaprolol, Nicardipine, Torsemide.
16	43/M	HTN – 3 years, CKD – 3 years, MHD – 10 months, ABO incompatible transplant.	30%	Global hypokinesia, Moderate PAH, Grade 3 DD,	Nicardipine Torsemide
17	30/M	HTN – 1 ½ years, CKD – 2 months, MHD – 2 months.	35%	Global hypokinesia, dilated LA, LV. Grade 2 DD, Moderate MR.	Isolazine, Bisoprolol, Torsemide, Clinidipine

M: Male, **F:** Female, **HTN:** Hypertension, **DM:** Diabetes mellitus, **CKD:** Chronic kidney disease, **MHD:** Maintenance hemodialysis, **CAD:** Coronary artery disease, **LV:** Left ventricle, **LA:** Left atrium, **RA:** Right atrium, **RV:** Right ventricle, **MR:** Mitral regurgitation, **TR:** Tricuspid regurgitation, **PAH:** Pulmonary artery hypertension, **OHA:** Oral hypoglycaemic agents, **LVH:** Left ventricular hypertrophy, **DD:** Diastolic Dysfunction, **EF:** Ejection fraction, **ECHO:** Echocardiogram.

Table II: Patient Demographics

Variable	Value
Age (years)	38.11±9.13
Sex (Male/Female)	14/3 (82%/18%)
Hypertension	16 patients (94%)
Diabetes mellitus	5 patients (29%)
Coronary artery disease	2 patients (12%)
Pleural effusion	3 patients (18%)
Ascites	5 patients (29%)
Ejection fraction (%)	33.29±5.42

Age and ejection fraction are expressed as Mean (±SD) and all others as numbers (%).

Table III: Intraoperative Parameters

Parameter	Value
Duration of surgery (mins)	226.76±33.16
Fluids given intraoperatively (mL)	1194.118 ± 281.67
Blood loss (mL)	304.28 ± 22.19
Hypotension (Number of patients)	15 (88%)

Duration of surgery, fluids given intraoperatively and blood loss are expressed as Mean ± SD and hypotension as numbers (%)

Table IV. Postoperative Parameters

Parameter	Value
24-hr urine output (L)	14.40 ± 5.15
2nd day urine output (L)	9.07±3.37
Hypotension n (%)	13 (76%)
Duration of inotropes (hrs) (min-max)	24 (8-96)
ECG changes n (%)	2 (12%)
Pulmonary edema	Nil
Mechanical ventilation	Nil
Delayed graft functioning	Nil
Acute tubular necrosis	Nil

Duration of ionotropes is expressed as Median value (min-max), 24-hr urine output and 2nd day urine output as Mean ± SD and rest as numbers (%). **ECG:** Electrocardiogram.

Table V. Preoperative and Postoperative Metabolic Variables

Variable	Preoperative	Postoperative
Haemoglobin (g dL^{-1})	9±1.70	8.15±1.95
Sodium (mmoL L^{-1})	137±2.78	136.88±4.07
Potassium (mmoL L^{-1})	4.57±0.77	4.65±0.80
Creatinine (mg dL^{-1})	6.2±2.01	2.29±1.28

All the values are expressed as Mean ± SD.

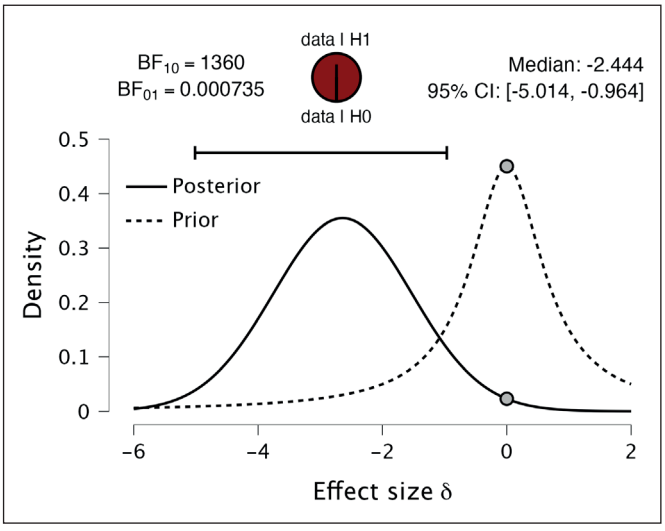

Figure 1. Bayesian graph depicting ejection fraction compared to a norm.

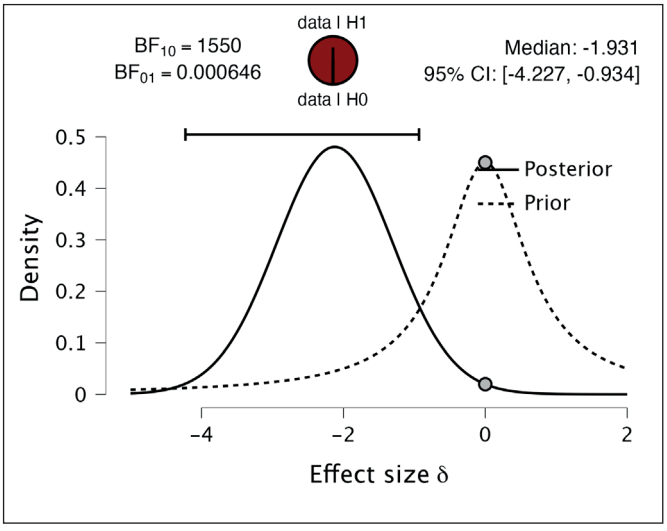

Figure 2. Bayesian curve depicting intravenous fluids used compared to a norm.

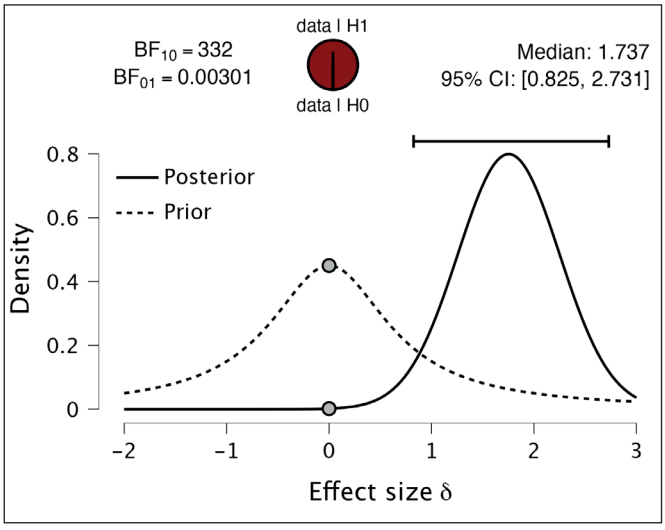

Figure 3. Bayesian curve depicting noradrenaline use compared to a norm.

Table VI. Comparison of Perioperative Details Between Diabetic and Non-Diabetic Patients

Parameter	Diabetic patients (n= 5)	Non-diabetic patients (n= 12)
Coronary artery disease	2 (40%)	0
Intraoperative inotrope	5 (100%)	10 (83.33%)
Postoperative inotrope	4 (80%)	9 (75%)
Postoperative ECG changes	2 (40%)	0
Postoperative Tapping	1 (20%)	0
Postoperative Albumin	2 (40%)	0

All the values are expressed as numbers (%). **ECG:** Electrocardiogram.

DISCUSSION

The present study outlines the effective anesthetic management of RT surgery in patients with DCM under CSE. At present, only two studies delineate the anesthetic management of RT in patients with DCM (9,19,20). Srivastava et al. in their study have successfully administered CSE for RT in patients with DCM (9). In a retrospective study of 31 patients, Goyal et al. discusses the anesthetic management and outcome of RT in patients with DCM under GA (19). Our study highlights the role of CSE in successful RT with decreased intraoperative intravenous fluids and even after administration of vasopressors in patients with low ejection fraction.

In our center, RT is routinely done under CSE. Despite the fact that GA offers the necessary depth and muscle relaxation for the procedure, myocardial depressant effects of anesthetic agents and stress of laryngoscopy and intubation can be harmful in patients with DCM. A low-dose subarachnoid block-induced moderate fall in systemic vascular resistance (SVR), helps to preserve the left ventricular outflow in systolic dysfunction (9). Sanatkar et al. found that individuals with low EF experienced a smaller drop in blood pressure after a low-dose subarachnoid block than those with EF > 40%. The researchers ascribed the discovery to an elevation in cardiac output resulting from the decrease in SVR and afterload in patients with low EF compared to the control group (21). In CSE, the reliable dense block provided by spinal anesthesia at the start, and an epidural catheter to prolong the duration of anesthesia can be a safe anesthetic approach. Effective postoperative pain treatment utilising epidural analgesia prevents an elevation in systemic vascular resistance and heart rate, hence preserving postoperative cardiovascular stability.

Additionally, regional anesthesia reduces polypharmacy, lowers the need for transfusions, lowers the risk of respiratory depression, pulmonary embolism, and deep vein thrombosis, and is associated with early recovery (9). Considering the aforementioned factors, the CSE technique with low-dose spinal anesthesia and epidural catheter was adopted at our hospital. The use of heparin during dialysis and the presence of coagulopathy are the two issues with the use of regional anesthesia in ESRD patients. All our patients had normal coagulation profile. Twenty-four hrs prior to surgery, heparin-free hemodialysis was done. It is important to prevent hypotension to maintain both myocardial and renal allograft perfusion (9). To maintain appropriate blood pressure, norepinephrine infusion was used to offset the vasodilating effects of anesthesia (3).

Preoperative optimizations include effective blood pressure management, preoperative hemodialysis, correction of anemia, and optimization of associated comorbidities. The objective of anesthesia during the intraoperative phase is to maintain intravascular volume and MAP in order to prevent decreased graft perfusion. Invasive monitoring is essential to maintain better hemodynamic control (22). Our fluid administration was guided by maintaining CVP of 10 -12 mmHg and MAP of 90-100 mmHg. The volume of fluids used differed from the norm but did not affect the patient outcome. Noradrenaline was used to maintain adequate blood pressure. Moreover, dynamic indicators of fluid responsiveness like SVV and PPV are also not useful in spontaneously breathing patients. Patients' blood pressure was monitored invasively. All our patients had immediate urine output on reperfusion. Successful management of RT patients require intensive postoperative care. There were no serious postoperative complications in our patients. Two of our patients developed isch-

emic changes in ECG and one patient required pleural tapping. All patients were discharged on postoperative day 6-8 with normal graft function.

Intraoperative hypotension was observed in 15 patients (88.23%) and postoperative hypotension was observed in 13 patients (76.74%). This contrasted with a study by Srivastava et al. and Goyal et al., which reported an incidence of hypotension of almost 50%. Goyal et al. employed GA for all of their cases. Even though the spinal dose used in our patients was similar to that of Srivastava et al, we used 0.5% of bupivacaine for epidural intraoperatively while Srivastava et al. used 0.25% of bupivacaine. The duration of noradrenaline requirement was also high in our group of patients compared to that of Srivastava et al. (9,19). Our investigation revealed that the diabetic patients had more preoperative issues and postoperative complications compared to non-diabetic patients (Table VI). Of the five patients with diabetes mellitus, two had CAD. They underwent coronary angiography and were on medical management. Non-diabetic patients did not have CAD. Intraoperative and postoperative hypotension was also more common among diabetics. One patient who required 96 hrs of inotropes postoperatively was also a patient with diabetes mellitus, with an EF of 22%. Two patients who developed postoperative ischemic changes were also diabetic. Despite the elevated prevalence of hypotension in our research, none of the patients experienced delayed graft function or acute tubular necrosis.

Our study has certain limitations: 1. This is a retrospective study. Some data such as postoperative blood gas values could not be retrieved. 2. Intraoperatively, we did not measure cardiac output or SVR. Hence intraoperatively we measured CVP and IBP and used noradrenaline alone. Cardiac output was evaluated by transthoracic echocardiography exclusively in the postoperative period, and dobutamine was administered to one patient. 3. This is a descriptive trial studying about CSE. Hence trials comparing CSE with GA in DCM patients are required.

CONCLUSION

Our successful RT using the CSE approach in individuals with low EF can help in perioperative decision making for all the stakeholders involved as cardiovascular risk stratification is a challenging task in these patients.

AUTHOR CONTRIBUTIONS

Conception or design of the work: KMS, SKK, NS, SP
Data collection: SP, IJ, KMS
Data analysis and interpretation: KMS, SKEJ, IJ
Drafting the article: KMS, NS
Critical revision of the article: SJ, MN
Other (study supervision, fundings, materials, etc): SJ, MN
The author (KMS, SKK, NS, SP, IJ, SKEJ, SJ, MN) reviewed the results and approved the final version of the manuscript.

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