Rev Bras Anestesiol. 2019;69(5):477–483

REVISTA BRASILEIRA DE ANESTESIOLOGIA

Publicação Oficial da Sociedade Brasileira de Anestesiologia
www.sba.com.br

SCIENTIFIC ARTICLE

Anesthesia for renal transplantation in patients with dilated cardiomyopathy: a retrospective study of 31 cases

Vipin Kumar Goyal, Priyamvada Gupta *, Birbal Baj

Mahatma Gandhi Medical College and Hospital, Department of Anaesthesiology, Critical Care and Pain Management, Jaipur, India

Received 15 December 2018; accepted 9 June 2019
Available online 14 September 2019

KEYWORDS
Anesthetic management;
Dilated cardiomyopathy;
Non-cardiac surgery;
Renal transplant;
Systolic dysfunction

Abstract
Background and objectives: Dilated cardiomyopathy is a state of progressive enlargement of cardiac chambers mainly left ventricle which leads to decreased cardiac output and ultimately cardiac failure. Although it has multifactorial etiology, it is quite common in patients with end stage renal disease who require renal transplant surgery for their cure. Both conditions go side by side and anesthetic management of such cases poses real challenge to anesthesiologist. Strict monitoring and control of cardiac physiology is of utmost importance besides meticulous fluid management, thus preserving renal blood flow on one hand and preventing cardiac failure on other hand. This is the basis of achieving good outcome of the renal transplant surgery.
Methods: This is a retrospective observational study done by analysing electronic database of 31 patients with dilated cardiomyopathy who underwent renal transplant surgery. Data was studied in terms of demographics, duration of renal disease, comorbidities mainly hypertension, cardiac echo graphic findings including ejection fraction, medications and post-operative outcome.
Results: Most common perioperative complication in this patient population was hypotension (51.61%) followed by pulmonary complications postoperative mechanical ventilation (12.9%) and pulmonary edema (6.45%). High incidence of hypotension may be a causative factor to increased rate of delayed graft functioning (12.9%) and acute tubular necrosis (2.23%) in these patients.
Conclusion: Strict monitoring and control of hemodynamic parameters as well as meticulous fluid therapy is the cornerstone in improving outcome in patients with dilated cardiomyopathy undergoing renal transplant surgery.

* Corresponding author.
E-mail: drpriyamvada@hotmail.co.uk (P. Gupta).

https://doi.org/10.1016/j.bjane.2019.06.002

PALAVRAS-CHAVE
Manejo anestésico;
Cardiomiopatia dilatada;
Cirurgia não cardíaca;
Transplante renal;
Disfunção sistólica

Anestesia para transplante renal em pacientes com cardiomiopatia dilatada: estudo retrospectivo de 31 casos

Resumo
Justificativa e objetivos: A cardiomiopatia dilatada é um estado de aumento progressivo das câmaras cardíacas, principalmente do ventrículo esquerdo, que leva à diminuição do débito cardíaco e, por fim, à insuficiência cardíaca. Embora tenha etiologia multifatorial, é bastante comum em pacientes com doença renal terminal que precisam de transplante renal para sua cura. Ambas as condições andam lado a lado e o manejo anestésico de tais casos é um verdadeiro desafio para o anestesiologista. A monitoração e o controle rigoroso da fisiologia cardíaca são de extrema importância, além de um meticuloso manejo dos líquidos, o que por um lado preserva o fluxo sanguíneo renal, por outro previne a insuficiência cardíaca. Essa é a base para alcançar o bom resultado da cirurgia de transplante renal.
Métodos: Este estudo observacional retrospectivo foi realizado mediante a análise de prontuários eletrônicos de 31 pacientes com cardiomiopatia dilatada submetidos à cirurgia de transplante renal. Os dados foram avaliados em termos demográficos, duração da doença renal, comorbidades (principalmente hipertensão), achados ecocardiográficos (incluindo fração de ejeção), medicamentos e resultados no pós-operatório.
Resultados: A complicação perioperatória mais comum nessa população de pacientes foi hipotensão (51,61%), seguida de complicações pulmonares, como ventilação mecânica pós-operatória (12,9%) e edema pulmonar (6,45%). A alta incidência de hipotensão pode ser um fator causador do aumento da incidência de atraso no funcionamento do enxerto (12,9%) e necrose tubular aguda (2,23%) nesses pacientes.
Conclusão: A monitoração rigorosa e o controle dos parâmetros hemodinâmicos, bem como a fluidoterapia criteriosa, são a pedra angular na melhoria dos resultados em pacientes com cardiomiopatia dilatada submetidos à cirurgia de transplante renal.

Introduction

Dilated cardiomyopathy (DCM) is progressive a disease of heart muscles that is characterized by dilatation and impaired contraction of left or both ventricles. Diagnostic criteria are left ventricular ejection fraction less than 40% or fractional shortening less than 25%.[1] Most common etiologic factors are hereditary, myocarditis, ischemic heart disease, valvular heart disease, chronic hypertension, volume overload, endocrine disease like thyroid disorders, diabetes mellitus, pheochromocytoma, toxins like ethanol, anticancer drugs, etc.[2] End stage renal disease (ESRD) – defined as glomerular filtration rate less then 15 $mL.min^{-1}$ – and patients on long standing dialysis almost always associated with cardiac abnormalities like ischemic heart disease, dilated cardiomyopathy, uncontrolled hypertension, pulmonary hypertension, valvular heart disease, etc.[3,4] Chronic hypertension, volume overload, anemia and metabolic abnormalities are culprit for development of dilation of left ventricle and low ejection fraction in this patient population. Renal transplant is preferred over dialysis for ESRD patients for better life quality, prevention of further deterioration and sudden death.[5] Perioperative anesthetic management of such high risk patients are very challenging for anesthesiologists and intensive care team. Perioperative complications of concern are left ventricular failure, ventricular and supraventricular arrhythmias, conduction abnormalities, thromboembolism, pulmonary edema, postoperative ventilator support, need for inotropes and vasopressors, acute tubular necrosis, delayed graft functioning and even sudden death.[6,7]

In this retrospective study we discuss the perioperative anesthetic management and outcome of 31 patients of DCM with ESRD who had undergone renal transplant at our center. This study will help to improve perioperative management of such high risk patients to reduce the incidence of perioperative complications by modification of preoperative optimization, hemodynamic monitoring, ventilatory strategy, etc.

Methods

After approval from institutional ethical committee we reviewed electronic data of 500 patients who had undergone renal transplant at our center from November 2012 to April 2018. Patients with ejection fraction <40% on echocardiography performed on the day before surgery were selected and perioperative records of these patients were searched thoroughly.

All patients were evaluated in detail at the time of preoperative anesthesia assessment including history, physical examination with relevant laboratory tests, cardiac and pulmonary tests. Patients were well informed about their cardiac status and written high risk consent depicting

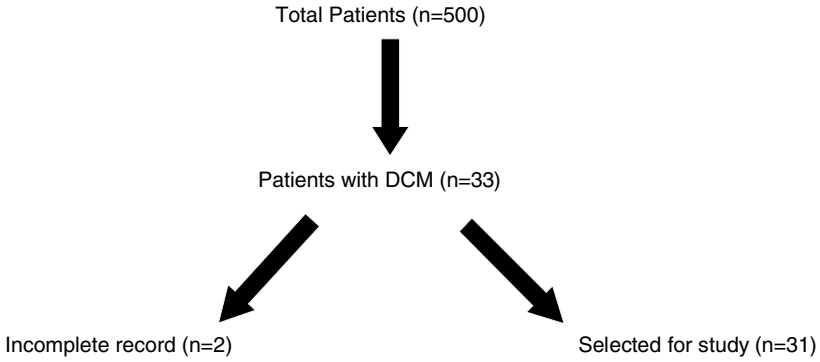

Figure 1 Showing study design.

risk of perioperative cardiac events and need for mechanical ventilation support were obtained. Oral Pantoprazole 40 mg and Alprazolam 0.25 mg were advised night before and 2 h before coming to operating room with sip of water. Immunosuppressants (Tacrolimus and Mycophenolate) were started two days before surgery. Antihypertensive, Antianginal, thyroid hormone drugs were continued till morning of surgery.

On arrival in operating room standard monitoring (non invasive blood pressure, pulse oximeter, electrocardiogram) were attached and IV line was secured. A 20G arterial cannula was placed in radial artery (non-fistulous arm) under local anesthesia and invasive blood pressure monitoring started. After infiltration of local anesthesia central venous catheter 7.5 F was inserted in either side of internal jugular vein under ultra sonic guidance and Central Venous Pressure (CVP) monitoring was started. Intravenous midazolam 1 mg and fentanyl 3 microgram.kg^{-1} were injected as premedication. Anesthesia was induced with etomidate 0.03 mg.kg^{-1} and trachea was intubated with appropriate size of endotracheal tube after administering intubating dose of atracurium 0.6 mg.kg^{-1}. Anesthesia was maintained on isoflurane in oxygen and air (50:50), atracurium infusion and intermittent boluses of fentanyl. Intravenous antibody (either basiliximab or Antithymocyte globulin) was given to all patients as per nephrologist choice. Target Mean Arterial Pressure (MAP) was maintained between 70–80 mmHg before reperfusion and between 90–110 mmHg after completion of anastomosis. CVP was kept around 10–12 mmHg. Normal saline and Kabilyter (Plasmalyte, Fresenius Kabi, India) were used during intraoperative period with packed red cells or 20% albumin if needed. No colloid was used in any patients. Inotropes, vasopressor or vasodilators were used according to patient vital parameters to maintain target mean arterial pressure. Arterial Blood Gas (ABG) was sent preoperatively on placement of arterial catheter after anesthesia induction and postoperatively at the end of surgery. ABG parameters like sodium, potassium, calcium, hemoglobin, blood pH, serum lactate etc. were recorded. Analgesia was maintained with IV infusion of paracetamol 15 mg.kg^{-1} every 8 h and IV fentanyl bolus for rescue analgesia.

Perioperative complications related to cardiac (need for inotropes or vasopressors, left ventricular failure, arrythmias), pulmonary (pulmonary edema, postoperative ventilator support) and renal (acute tubular necrosis, delayed graft functioning) were recorded.

Results

Perioperative records of five hundred patients with end stage renal disease undergone successful live donor renal transplant over period of November 2012 to April 2018 at our hospital were searched in detail. Preoperative echocardiography of thirty three patients were found of DCM (EF < 40%). Two patients were excluded from study in view of incomplete perioperative record while thirty one patients undergone retrospective analysis (Fig. 1). Incidence of DCM in our patients was 6.6%.

Patient demographic and clinical characteristics including age, gender, duration of CKD, other comorbidities (Hypertension, Diabetes mellitus, Pleural effusion), current medications and preoperative detailed echocardiography findings were noted. (Table 1) Most patients were male with an Average age of less than thirty five years. Incidence of Hypertension, Diabetes mellitus, Pleural effusion was 74.19%, 6.45% and 12.9% respectively. Mean ejection fraction was <34%. Mean duration of anesthesia was 193.54 ± 21.87 min. Mean intraoperative blood loss was 324.28 ± 63.39 mL. Only eight patients were required intraoperative blood transfusion and mean amount of leukoreduced packed red cells transfusion was 287.5 mL. Total amounts of crystalloids used during surgery was 1112.903 ± 233.44 mL of normal saline and 1077.41 ± 197.83 mL of balanced salt solution (Kabilyte, Fresenius Kabi). Colloid was not administered to any patient. Albumin was infused in two patients (Preoperative serum albumin <2.5 mg.dL^{-1}). Fluid and vasopressor management was guided by monitoring CVP and MAP. No advanced cardiac output monitor or dynamic variables of fluid responsiveness like Pulse Pressure Variation (PPV) or Stroke Volume Variation (SVV) were used. No renal preservative solution was used and kidney was perfused with cold solution of 500 mL of ringer lactate with heparin 5000 units, 2 mL papaverine and 5 mL 2% lidocaine. Average warm ischemia time was 3–4 min and cold ischemia time was 20–30 min in all patients. Urine production was immediate in all patients at reperfusion. No diuretics were used in any case (Table 2).

Table 1 Demographic and preoperative details of patients.

S.n°	Age/Sex	Comorbidities	Echocardiography		Medications
			Others	EF %	
1	32/F	CKD 18 months, HTN 5 yrs	Moderate to severe MR, Global hypokinesia	23	Nifedipine
2	40/M	CKD 18 months	DD grade III, Mild MR/PAH	40	NO
3	35/M	CKD 6 months, HTN 6 months, B/L pleural effusion	Dilated LV	40	Clonidine, Prazocin XL
4	38/M	CKD 6 yrs, HTN 5 yrs	Mod MR, Mild PAH, Conc. LVH	40	Amlodipine, Atenolol
5	38/M	CKD 1 yr, HTN 1 yr, Left sided pleural effusion	Global hypokinesia, Mild MR/PAH	40	Amlodipine, Carvedilol
6	45/M	CKD 1 yr, HTN 18 months	Mild MR/PAH, DD grade II, Global hypokinesia	30	Nifedipine, Clonidine, Carvedilol
7	45/M	CKD 4 yrs, HTN 4 yrs	Mild MR/TR/PAH, dilated LV	35	Amlodipine, Carvedilol
8	48/F	CKD 2 yrs, HTN 2 yrs	RWMA+ (apex and septum hypokinetic)	35	Nifedipine, Metoprolol XL
9	30/F	CKD 2 yrs, HTN 2 months	Mod MR/PAH/TR, DD grade II	30	Nifedipine, Clonidine
10	40/M	CKD 2 months, HTN 5 yrs	Global hypokinesia, Conc. LVH, LA/LV dilated	20	Carvedilol, Losartan
11	40/M	CKD 4 yrs, Right sided pleural effusion	Conc. LVH, DD grade II, dilated LA/LV, Global hypokinesia	25	NIL
12	45/M	CKD 9 yrs, HTN 1month, Re-transplant	Mod MR/PAH, DD grade II, Conc. LVH, dilated LA/LV	40	Nifedipine, clonidine, Metoprolol XL
13	46/M	CKD 4 months, DM 10 yrs	Mod MR, Mild PAH, Conc. LVH	40	Insulin
14	32/M	CKD 3 months, HTN 3 months, Right sided pleural effusion	Conc. LVH, pericardial effusion, dilated LA	40	Clonidine
15	41/F	CKD 8 months, HTN 2 months	Mod MR, Conc. LVH, dilated LV, RWMA+	25	Carvedilol Clonidine
16	20/M	CKD 2 months, HTN 2 months	Mod MR, Mild PAH, dilated LA/LV, DD grade III	25	Clonidine
17	48/M	CKD 1month, HTN 2 months	Global hypokinesia, DD grade III	25	Nifedipine
18	24/M	CKD 8 months, HTN 8 months	Mod PAH, dilated LA/RA, DD grade III, Global hypokinesia	25	Nifedipine, Clonidine, Carvedilol
19	56/M	CKD 2 months, HTN 2 yrs, DM 15 yrs	Mod TR/PAH, DD grade II, Conc. LVH, dilated LA	40	Clonidine, Amlodipine, Carvedilol
20	24/M	CKD 5 yrs, HTN 5 months	Mod MR/TR, mild PAH, DD grade II, Conc. LVH	35	Nifedipine, Carvedilol, Metoprolol XL
21	52/M	CKD 3 yrs	Mod MR/TR, Mild PAH, Conc. LVH, DD grade II	35	NO
22	22/M	CKD 7 months, HTN 7 months	Mild MR/TR/PAH	35	Nifedipine, Carvedilol
23	27/M	CKD 7 months, HTN 7 months	Mod MR, Mild PAH, DD grade I	35	Nifedipine
24	33/F	CKD 8 yrs, HTN 13 yrs	Conc. LVH, DD grade II, Mild MR	40	Nifedipine, Metoprolol XL
25	19/M	CKD 1 yr	Global hypokinesia, Mod MR/TR	30	NO

Table 1 (*Continued*)

S.n°	Age/Sex	Comorbidities	Echocardiography		Medications
			Others	EF %	
26	19/M	CKD 6 months, HTN 6 months	Mod MR/TR, Mild PAH, dilated LA	40	Nifedipine, Clonidine
27	30/M	CKD 2 yrs, HTN 2 yrs	Conc. LVH, dilated LV	40	Amlodipine, Metoprolol XL
28	21/F	CKD 5 months	Global hypokinesia	25	NO
29	33/M	CKD 7 yrs HTN 7 yrs	Global hypokinesia, Conc. LVH, Mild MR/PAH	40	Amlodipine, Prazocin XL, Carvedilol
30	23/M	CKD 18 months	Global hypokinesia, Severe TR, Moderate PAH, Conc. LVH, Dilated LA/RA	35	NO
31	24/M	CKD 5 months	Global hypokinesia, Dilated LA/LV	35	NO

CKD, chronic kidney disease; HTN, hypertension; EF, ejection fraction; Conc., concentric; LVH, left ventricular hypertrophy; MR, mitral regurgitation; TR, tricuspid regurgitation; DD, diastolic dysfunction; PAH, portal hypertension; B/L, bilateral; XL, extended release; LV, left ventricle; LA, left atrium; RV, right ventricle; RWMA, regional wall motion abnormality.

Table 2 Demographic and Clinical variable of patients.

Variable	
Age (Years) Mean ± SD	34.52 ± 10.58
Sex (Male/Female)	25/6
Hypertension	23 (74.19%)
Diabetes mellitus	2 (6.45%)
Pleural effusion	4 (12.9%)
Ejection fraction (%) Mean ± SD	33.65 ± 6.55
Duration of surgery (min)	193.54 ± 21.87
Fluid required	
Normal saline (mL)	1112.90 ± 233.44
Kabilyte (mL)	1077.41 ± 197.83
Blood loss (mL)	324.28 ± 63.39

Table 3 Showing preoperative and postoperative metabolic variables.

Variable	Preoperative	Postoperative
Hb ($g.dL^{-1}$)	9.28 ± 2.428	8.39 ± 2.158
Na+ ($mmoL.L^{-1}$)	132.09 ± 3.069	132.64 ± 3.199
K+ ($mmoL.L^{-1}$)	4.13 ± 0.661	3.88 ± 0.724
Ca++ ($mmoL.L^{-1}$)	1.13 ± 0.104	1.01 ± 0.114
pH	7.32 ± 0.065	7.31 ± 0.053
Lactate ($mg.dL^{-1}$)	1.32 ± 0.646	1.706 ± 0.932

Blood pH, hemoglobin concentration, serum potassium and calcium were lower at end of surgery while serum lactate was increased (Table 3). First 24 h urine output was 13.264 ± 5.49 L, while serum creatinine level on first postoperative day was 2.196 ± 0.806 $mg.dL^{-1}$. Hypotension was reported in 16 (51.61%) of patients that was managed with either norepinephrine alone or combination of norepinephrine and low dose epinephrine. Respiratory complication like pulmonary edema, need of postoperative mechanical ventilation were reported in 2 (6.45%) and 4 (12.9%) of patients respectively. One patient had acute tubular necrosis and 4 (12.9%) patients required dialysis within a week of transplant. (Table 4) None of patient had significant arrhythmia requiring medical management. No perioperative cardiac intervention (Left ventricular assist device, Intra aortic balloon pump or pacing) is required in any patients. No perioperative mortality is reported till discharge of patient.

Table 4 Postoperative outcome of patients.

Parameter	Value
24 h urine output (L)	13.26 ± 5.49
Serum creatinine ($mg.dL^{-1}$)	2.19 ± 0.80
Mechanical ventilation	4 (12.9%)
Pulmonary edema	2 (6.45%)
Hypotension	16 (51.61%)
Delayed graft functioning	5 (16.13%)
Acute tubular necrosis	1 (3.23%)

Discussion

Renal transplant is treatment of choice in patients with end stage renal disease. Chronic hypertension, volume overload, hemodialysis and many more physiologic ail-

ments leads to weakening of left ventricle in this patient population. Adequate preoperative optimization of cardiac status, balanced anesthesia with invasive monitoring and intensive postoperative care is the key to successful management.[8] Preoperative optimization includes but is not limited to:

Adequate control of blood pressure with modification of doses of anti-hypertensive agents;

Preoperative dialysis to correct hypervolemia, electrolyte imbalance and metabolic derangements;

Correction of anemia to improve oxygen carrying capacity;

Optimization of other commonly associated comorbidities: adequate control of diabetes, pulmonary diseases etc.

Intraoperative period is very critical to manage cardiac parameters in optimal range on one side while maintaining adequate renal perfusion on the other side for achieving adequate urine output. Grossly intraoperative goals needed in such patient's areas follows[9,10]:

Fluid optimization to maintain adequate preload (CVP 8–12 mmHg) and maintenance of perfusion pressure (MAP 90–100 mmHg) with judicious use of inotropes and vasopressors for good urine output:

Maintenance of normal cardiac rate and rhythm;

Maintaining electrolyte and metabolic parameters within normal range;

Invasive monitoring (IBP, CVP and CO) to achieve better hemodynamic control;

Balanced anesthesia with avoidance of cardiac depressants, slow injection of drugs, avoidance of nephrotoxic drugs, avoidance of sympathetic response and adequate pain control;

Readiness for emergency cardiac support system (intra aortic balloon pump, pacing and emergency drugs).

The patients with DCM and ESRD undergoing renal transplant present dual challenge for maintaining fluid electrolyte balance, desired hemodynamic parameters perioperatively. The imbalances which could be otherwise tolerated in renal transplant recipients could prove fatal in presence of DCM. Not much literature is available. There have been few studies of conducting such cases under central neuraxial block[11,12] but this requires perioperative withdrawal of antithrombotic agents. Since these patients are at increased risk of developing thromboembolism of pulmonary circulation, abstinence from antithrombotic agents could be detrimental. Hence general anesthesia is the preferred technique of anesthetic management. While administering general anesthesia care has to be taken to minimize myocardial suppression since both intravenous as well as inhalational anesthetic agents produce some degree of myocardial suppression. Selection of proper agent as well as administering in appropriate doses is important. Moreover, since there is increased arm brain circulation time due to slower circulation, we have to wait for sometime till the desired effect is achieved.

Postoperative period especially first 24 h are more critical in view of rapid changes in fluid volume status, electrolyte and metabolic derangement etc. Such patients can develop congestive cardiac failure.[13] Patients continue to be monitored closely after shifting to renal transplant intensive care unit. Fall and increase in blood pressure, oxygen desaturation, electrolyte and metabolic imbalance, urine output must be taken seriously and attended immediately so as to prevent dangerous consequences like cardiac failure, pulmonary edema, fatal ventricular and atrial arrythmias and renal shutdown, etc.[14]

Conclusions

Patients with DCM posted for renal transplant surgery are challenging for the anesthesiologist. It is a double-edged sword, so we have to maintain systemic vascular resistance and cardiac output specifically in the post-operative period. This is mandatory for preserving renal blood flow and thus proper functioning of grafted kidney. But on the other side we have to prevent dilated heart from going into failure. These goals can be successfully achieved by strict monitoring of blood pressure and cardiac output as well as judicious use of intravenous fluids and vasopressors.

Conflicts of interest

The authors declare no conflicts of interest.

References

1. Thiagarajah PH, Thiagarajah S, Frost EA. Anaesthetic considerations in patients with cardiomyopathies – a review. Middle East J Anesthesiol. 2009;20:347–54.
2. Luk A, Ahn E, Soor GS, et al. Dilated cardiomyopathy: a review. J Clin Pathol. 2009;62:219.
3. Martinez BS, Gasanova I, Adesanya AO. Anaesthesia for kidney transplantation – a review. J Anesth Clin Res. 2013;4:1–6.
4. Goyal VK, Solanki SL, Baj B, et al. Pulmonary hypertension and post-operative outcome in renal transplant: a retrospective analysis of 170 patients. Indian J Anaesth. 2018;62:131–5.
5. Josephson CB, Delgado D, Schiff J, et al. The effectiveness of renal transplantation as a treatment for recurrent uremic cardiomyopathy. Can J Cardiol. 2008;24:315–7.
6. Koplan BA, Stevenson WG. Ventricular tachycardia and sudden cardiac death. Mayo Clin Proc. 2009;84:289–97.
7. Koutalas E, Kanoupakis E, Vardas P. Sudden cardiac death in non-ischemic dilated cardiomyopathy: a critical appraisal of existing and potential risk stratification tools. Int J Cardiol. 2013;167:335–41.
8. Poldermans D, Bax JJ, Boersma E, et al. Guidelines for pre-operative cardiac risk assessment and perioperative cardiac management in non-cardiac surgery. Eur Heart J. 2009;30:2769–812.
9. Shibuya M, Kamekura N, Kimura Y, et al. Clinical study of anaesthetic management during dental treatment of 25 patients with cardiomyopathy. Spec Care Dentist. 2003;23:216–22.
10. Juneja R, Nambiar PM. Cardiomyopathies and anaesthesia. Indian J Anaesth. 2017;61:728–35.

11. Srivastava D, Tiwari T, Sahu S, et al. Anaesthetic management of renal transplant surgery in patients of dilated cardiomyopathy with ejection fraction less than 40%. Anesthesiol Res Pract. 2014;2014:525–969.
12. Bhosale G, Shah V. Combined spinal-epidural anesthesia for renal transplantation. Transplantation Proc. 2008;40:1122–4.
13. Holte K, Sharrock NE, Kehlet H. Pathophysiology and clinical implications of perioperative fluid excess. Br J Anaesth. 2002;89:622–32.
14. Strunden MS, Heckel K, Goetz AE, et al. Perioperative fluid and volume management: physiological basis, tools and strategies. Ann Intensive Care. 2011;1:2.