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Ain-Shams Journal of Anesthesiology (2023) 15:74
https://doi.org/10.1186/s42077-023-00373-z

Ain-Shams Journal of Anesthesiology

CASE REPORT Open Access

Anesthetic management for renal transplant in patients with grade III diastolic dysfunction: case reports

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Abstract

Background Left ventricular diastolic dysfunction is frequently noticed in patients with multiple co-morbidities. Echocardiography is used to determine the presence of diastolic dysfunction and to grade its severity. In left ventricular diastolic dysfunction, the ventricular diastolic distensibility, filling, or relaxation is abnormal; however, the left ventricular ejection fraction may be normal or decreased.

Case presentation We present anesthetic management of two patients with diastolic dysfunction grade III for renal transplant. During declamping in renal transplant, high central venous pressures are required for adequate perfusion of the transplanted kidney. In the operation theater standard monitors including NIBP, SpO_2 and five lead ECG were attached. An arterial line (radial) and central line (right internal jugular) were established for IBP and CVP monitoring. Infusions of furosemide and dopamine were started. Nitrogycerine and milrinone infusions were prepared but were not required intraoperatively. Both the patients were extubated at the end of surgery.

Conclusions Increased incidence of major adverse cardiovascular events has been reported in surgical patients having grade III diastolic dysfunction. Hemodynamic instability and fluid overload in this set of patients are known to generate pulmonary edema.

Keywords Anesthesia, Renal transplant, Diastolic dysfunction

Background

Left ventricle diastolic dysfunction (DD) is the inability of the left ventricle chamber to fill up at low atrial pressures either due to improper relaxation or impairment in compliance. Various risk factors for developing DD are left ventricular hypertrophy, age, hypertension, and diabetes (Jeong and Dudley 2015). DD is often asymptomatic but can become symptomatic in stressful conditions like fluid overload, atrial fibrillation, etc. (Godfrey and Peck 2016). Echocardiography is used to determine the presence of DD and to grade its severity. Increased incidence of major adverse cardiovascular events has been reported in surgical patients having DD grade III (Fayed et al. 2016; Zhou et al. 2019). The perioperative setting is a challenge because of mechanical ventilation, anesthesia drugs, and also altered intravascular volume status because of perioperative fasting, fluid shifts, and intraoperative blood loss.

Case presentation

Case 1

We present a case of a 44-year-old man with chronic renal failure listed for renal transplant surgery. Other co-morbidities included hypertension, diabetes, and diabetic

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retinopathy. He gave a history of breathlessness relieved by pleural tapping. High-resolution computed tomography chest showed moderate pleural effusion and generalized ground glass opacities. 2D echocardiography reported a left ventricular ejection fraction of 50%, a DD grade III, a pulmonary artery (PA) pressure of 50 mmHg, a dilated left atrium (4.6×5.4 cm), and a thin rim of pericardial effusion. His hemoglobin was 7.3 g/dl, serum creatinine 5.40 mg/dl, and serum potassium 4.31 mmol/dl. Other laboratory investigations were within normal limits. Pleural tapping and dialysis were done a day prior to surgery. Intraoperatively, oxygen saturation (SpO_2), electrocardiogram (ECG), heart rate, invasive blood pressure (IBP), central venous pressure (CVP), pulse pressure variation (PPV), and bi-spectral index (BIS) were monitored. Anesthetic medications included midazolam, fentanyl, propofol, atracurium, and sevoflurane in air/oxygen mixture. Vital signs on induction included a blood pressure of 160/80 mmHg and a heart rate of 84 beats per minute. The patient stayed hemodynamically stable throughout the 5-h procedure. 0.9% sodium chloride was used as intravenous fluid; 350 ml of blood was also transfused. Fluid infusion was guided by CVP and PPV. At the time of declamping, CVP was maintained between 10 and 12 mmHg. The transplanted kidney functioned well immediately. Nitrogycerine and milrinone infusions were prepared but were not required intraoperatively. Extubation was attempted at the end of surgery, and the patient's vital parameters were within normal range; hence, the patient was extubated at the end of surgery. Intravenous infusions of frusemide and renal dose of dopamine were started and also fentanyl infusion for pain relief. The patient was comfortable after extubation and was shifted to the intensive care unit (ICU).

Case 2

A 58-year-old man with chronic renal failure was posted for renal transplant surgery. Other co-morbidities included hypertension, diabetes, chronic liver disease, and pulmonary Koch's for which anti-tubercular treatment was taken. He gave a history of cough relieved by pleural tapping. Ultrasound of the chest showed moderate right-sided pleural effusion with basal atelectasis. The patient expressed symptomatic relief after pleural tapping. The spirometry test suggested a mild restrictive defect with diminished flow in small airways and no post-bronchodilator reversibility. Mild ascites were noted on the ultrasound abdomen. The 2D echocardiography reported a DD grade III, a dilated left atrium (4.2×4.7 cm), a pulmonary artery (PA) pressure of 68 mmHg, and a left ventricular ejection fraction of 55%. Pleural tapping and dialysis were done a day prior to surgery. His hemoglobin was 9.8 g/dl, serum creatinine 4.64 mg/dl, serum potassium 4.03 mmol/ dl, aspartate aminotransferase 14.1, alanine aminotransferase 10.2, and gamma-glutamyl transferase 89.9. In the operation theater standard monitors including NIBP, SpO_2 and five lead ECG were attached. An arterial line (radial) and central line (right internal jugular) were established for IBP and CVP monitoring.

Anesthetic medications included midazolam, fentanyl, propofol, atracurium, and sevoflurane in air/oxygen mixture. Intraoperatively, electrocardiogram, heart rate, IBP, CVP, PPV, and BIS were monitored continuously. Vital signs on induction included a blood pressure of 140/80 mmHg and a heart rate of 68 beats per minute. The patient stayed hemodynamically stable throughout the 4-h procedure. 0.9% sodium chloride was used as intravenous fluid. Fresh frozen plasma was transfused in view of his hepatic status. Fluid infusion was guided by CVP and PPV. At the time of declamping, CVP was maintained between 10 and 12 mmHg. The transplanted kidney functioned well immediately. At the end of surgery, arterial blood gas analysis reported all parameters within the normal range. Extubation was attempted at the end of surgery, the patient's vital parameters were within the normal range; hence, the patient was extubated. Nitrogycerine and milrinone infusions were prepared but were not required intraoperatively. The patient was comfortable after extubation and was shifted to the ICU. Intravenous insulin and dopamine infusions and fentanyl infusion for pain relief were ongoing when the patient was shifted to the ICU.

Discussion

In DD grade III, the amount of blood flowing from the left atrium to the left ventricle is reduced during diastole. This little amount of blood flow during diastole increases the left ventricular endiastolic pressure, so markedly, that atrial contraction is unable to propel a sufficient amount of blood into the ventricle. During the perioperative period, DD is adversely affected by anesthetic agents; hence, a reduction in their dose by up to 30–50% has been recommended (Ryu and Song 2017). Anesthetic agents due to negative inotropic effect lead to atrial dilation and decrease the atrial input to the ventricular filling. Venous dilatation due to anesthetic agents decreases the preload. Positive pressure ventilation by increasing the intrathoracic pressure reduces venous return and consequently cardiac output. Inflation of the lungs leads to an increase in pulmonary vascular resistance, therefore increasing the right ventricle afterload. This leads to dilatation of the right ventricle which compounded with decreased preload leads to a reduction in left ventricular filling. This effect on patients with diastolic dysfunction is increasingly being recognized in perioperative medicine.

Tachycardia and arrhythmias shorten the diastolic period and impair ventricular filling, hence are avoided. Ischemia of the myocardium and increase in volume load are known to aggravate DD. Hence, medication for hypertension, arrhythmias, and ischemic heart disease should be continued in the perioperative period. Nitrates and diuretics are effective in pulmonary congestion by reducing blood volume thereby controlling end-diastolic pressures (Singh and Mehta 2018). The CHARM program has shown beneficial effects of angiotensin receptor blocker in these patients either alone or with angiotensin-converting enzyme inhibitor (Ripley et al. 2006). However, serum creatinine ≥ 3 mg/dl was an exclusion criterion. Angiotensin-converting enzyme inhibitors are not useful in the acute phase because of slower onset of action. Beta blockers are the mainstay in management especially in acute heart failure due to atrial fibrillation or severe myocardial ischemia. Patients with ejection fraction $< 35\%$ are provided maximal beta blockade, and if required, ivabradine is also recommended (Godfrey and Peck 2016). Pulmonary hypertension is well recognized in renal failure patients and has multifactorial etiology. Hyperinflation of the lungs during mechanical ventilation is known to increase pulmonary vascular resistance. Hypoxia and hypercarbia are detrimental and also increase PA pressure hence avoided. Factors aggravating pulmonary hypertension during anesthesia should be strictly avoided.

Tracheal extubation is a critical stage of anesthesia in patients with DD. At this stage, the vascular sympathetic tone is restored, and the central blood volume increases which can lead to pulmonary edema in an otherwise stable patient. The inability of patients with high left ventricular filling pressures, to accommodate the increase in left ventricular preload during the transition from positive pressure ventilation to negative pressure (spontaneous) breathing, leads to failure in weaning from ventilation. Low-dose nitoglycerine infusion (25 μg/min) during this period has been shown to diminish these adverse events (Ryu and Song 2017). Phosphodiesterase III inhibitors (milrinone) and calcium channel sensitizers (levosimendan) have positive lusitropic effects and are effective in treating circulatory failure in such patients. Though dobutamine in dose ≤ 5 μg/kg/min is known to have a lusitropic effect on normal hearts, this effect is blunted in these patients (Godfrey and Peck 2016). Low-dose dopamine is known to have a renoprotective effect by increasing renal perfusion and decreasing the resistive index. However, its action in a denervated transplanted kidney might not be adequate (Spicer et al. 1999). Adequate postoperative analgesia, intraoperative temperature control, and prevention of shivering are some of the sound anesthesia practices to prevent pulmonary edema. Diuresis is also helpful in these patients (Singh and Mehta 2018). Due to potential problems with extubation in these patients, a gradual approach is considered beneficial, and postoperative critical care admission is advised in severe cases. A spontaneous breathing trial is advised for extubation. Our transplant patients are transferred to the transplant ICU, and since urine output was good which would help in preventing fluid overload, a spontaneous breathing trial was given which was successful in both patients.

Conclusions

The extent of intraoperative cardiac monitoring in patients with DD depends on the severity of DD. Cardiac output monitoring for directing fluid management can be helpful but has not been studied well. Transthoracic echocardiography intraoperatively assesses ventricular systolic functions and dimensions. The focus should be on the reduction of left ventricular filling pressure while avoiding inadequate preload. The growing interest in this entity and its management will provide more specific guidelines on intraoperative monitoring and management of patients with left ventricular diastolic dysfunction.

Abbreviations

DD	Diastolic dysfunction
PA	Pulmonary artery
SpO_2	Oxygen saturation
ECG	Electrocardiogram
HR	Heart rate
IBP	Invasive blood pressure
CVP	Central venous pressure
PPV	Pulse pressure variation
BIS	Bi-spectral index
ICU	Intensive care unit

Acknowledgements

Not applicable.

Authors' contributions

HK, BCS, and MS have contributed equally to the preparation of the manuscript. All authors have read and approved the manuscript.

Funding

No funding has been accepted.

Availability of data and materials

Not applicable.

Declarations

Ethics approval and consent to participate

Ethics approval is exempted from Institutional Ethics Committee – Academics review, Kokilaben Dhirubhai Ambani Hospital. Written consent was taken from patients.

Consent for publication

Written informed consent for publication was taken from the patients.

Competing interests
The authors declare that they have no competing interests.

Received: 11 January 2023 Accepted: 16 August 2023
Published online: 15 September 2023

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