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Anesthetic Case for Pulmonary Resection in a Hemodialysis Patient with Poor Cardiac Function Following Coronary Artery Bypass Grafting

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Abstract

The patient was a 51-year-old woman who received CABG at 49 years old, and developed poor left ventricular cardiac function (EF, 26%; %FS, 14% and diffuse hypokinesis) after the surgery. The patient was scheduled to undergo thoracoscopy-guided left upper lobe resection. Prior to anesthetic induction, a Flotrac/Vigilleo System™ for an arterial pressure line was placed. After starting differential lung ventilation, hypotension and low cardiac index were confirmed by the system, and dobutamine administration was initiated. After that, systolic pressure fluctuated at around 90mmHg, and surgery was completed without any intraoperative complications.

Key words; anesthetic management, pulmonary resection, hemodialysis patient, poor cardiac function, Flotrac/Vigilleo System™

Introduction

The number of patients on hemodialysis (HD) due to chronic renal failure continues to increase, and the number of patients undergoing surgery is also on the rise. Among perioperative complications associated with chronic renal failure patients, the incidence of acute heart failure and increased susceptibility to infection is high, and particularly with pulmonary resection, acute right ventricular heart failure can be easily induced by a rapid decrease in the pulmonary vascular bed, an increase in pulmonary vascular resistance or an increase in pulmonary vascular permeability. We present herein a maintenance HD patient with poor left ventricular cardiac function following coronary artery bypass grafting (CABG) who was anesthetized to undergo thoracoscopy-guided pulmonary resection.

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Case Presentation

The patient was a 51-year-old woman who was 149 cm tall and weighed 55kg (dry weight). At 47 years old, she became anuric due to diabetic renal failure, and HD was initiated (3 times/week).

At 49 years old, two CABG procedures (Left internal mammary artery to left anterior descending artery and saphenous vein graft to posterolateral branch) performed for unstable angina.

In history of present illness, chest computed tomography performed on an outpatient basis following CABG identified lung cancer, and the patient was admitted to undergo surgery.

On admission, blood pressure, 130/68mmHg; heart rate, 70 beats/min; sinus rhythm; clear consciousness; able to walk without assistance; and no neurological abnormality were defined. No heart murmur was present, and respiratory sounds were clear. Mild anemia was confirmed (hemoglobin, 11.1g/dl; hematocrit, 35.1%). On the day before HD, serum creatinine, blood urea nitrogen and serum potassium were elevated at 8.80mg/dl, 65.2mg/dl and 5.9mEq/l,

respectively.

Vital capacity was 1.91 L, 76% of the predicted value, and forced vital capacity was 1.97 L, confirming restrictive impairment. Percentage forced expiratory volume in 1 second was 87.1%, representing 110% of the predicted value, so obstructive abnormality was not seen (Hugh-Johnes classification II). On echocardiographic findings, interventricular septum (IVS) 12mm, posterior wall (PW) 13mm, left ventricle diameter of diastolic/systolic (LVDd/Ds) 37/30mm, ejection fraction (EF) 26%, fractional shortening (FS) 14%, anteroseptal and akinetic LV wall motion and akinetic and asynergic apex was pointed out, but no significant valve regurgitation was revealed (NYHA classification II).

Anesthetic Course (See, **Fig. 1**):

No preanesthetic medication was used. At entry to the operating room, blood pressure was 180/90 mmHg, heart rate was 90 beats/min and SpO_2 98%. First, continuous nicorandil administration was initiated at 3mg/h. Anesthesia was induced using 0.2μg/kg/h of remifentanil, 50mg of propofol, 2mg of midazolam and 5mg of vecuronium, and a 35-Fr left double-lumen tube (Broncho-Cath™, Mallinckrodt Medical Co.Ltd, Athlone, Ireland)) was intubated. Anesthesia was maintained using oxygen, sevoflurane (1-2%) and remifentanil. After anesthesia induction, a Flotrac/Vigilleo System™ (Edward Lifesciences, CA, USA) for an arterial pressure line was placed, and intraoperative fluid therapy was performed using physiological saline (100ml/h). After the start of differential lung ventilation, systolic arterial pressure droped to about 70mmHg. Subsequently, methoxamine (3mg) and ephedrine (10mg) were administered, but blood pressure did not sufficiently increase. Also the flow-tracking sensor showed that cardiac index (CI) decreased to about 1.3 L/min/m^2, and 3μg/kg/h of dobutamine administration was started due to hemodynamic in stability. After that, systolic pressure and CI were maintained at about 90mmHg and 3.5 L/min/m^2, respectively. Surgery was performed using a thoracoscope in a conventional manner. Amount of blood loss was small, and total infusion of saline volume was 300ml. Duration of surgery and anesthesia were 59 and 147min, respectively. After the end of surgery, the endotracheal tube was removed after confirming spontaneous respiration, and dobutamine administration was discontinued. For postoperative pain management, intravenous patient controlled-analgesia was selected using 20μg/h fentanyl admini-

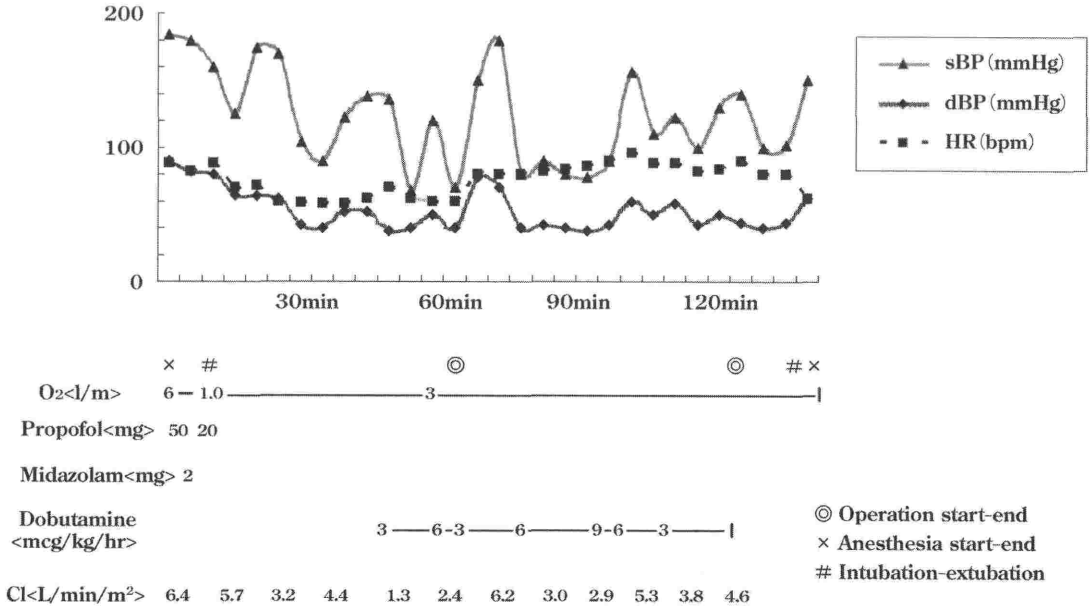

Figure 1 The Time Course of Anesthesia

stration was started during surgery. Postoperative course was favorable, and starting from the day after surgery, the patient began hemodialysis and was discharged on postoperative day 7 without any complications.

Discussions

In patients with chronic renal failure, malignant tumors are likely to develop because of various latent factors such as, decreased immunity, decreased antioxidation, chronic infection and inflammation[1~4]. Maisonneuve et al. reported that the incidence of cancer in hemodialysis patients was high in kidney cancer, bladder cancer and thyroid cancer, but not necessarily high in lung cancer, stomach cancer, colon cancer or breast cancer[1]. However, as the number of hemodialysis patient increases, opportunities for surgery will increase, and the absolute number of pulmonary resections on hemodialysis patients will continue to increase in the future.

The major problems for hemodialysis patients undergoing pulmonary resection are two-fold[5]. First, preoperative general conditions due to renal failure must be considered, such as poor nutrition, anemia, electrolyte abnormality, bleeding tendency and decreased immunity[6~10]. The present patient had low levels of hemoglobin and hematocrit and abnormal levels of blood urea nitrogen, creatinine and electrolytes. These conditions need to be corrected as much as possible prior to surgery, and the recommended levels of hematocrit, serum creatinine, blood urea nitrogen and serum potassium are 30%, 6mg/ml, 60mg/dl and 4.0mEq/L, respectively[10].

Postoperative electrolyte abnormality is also an issue. In the present patient, blood testing immediately after surgery showed that levels of serum potassium were within the normal range at 4.3mEq/L, and hemodialysis was conducted the day after surgery, but severe complications due to abnormal serum potassium such as ventricular arrhythmia were not confirmed. While hemodialysis needs to be resumed as soon as possible after surgery, postoperative bleeding caused by anticoagulant administration for hemodialysis poses a problem. In the present patient, nafamostat mesilate, an ultrashort-acting anticoagulant, was used as an anticoagulant for postoperative hemodialysis, and the patient did not experience postoperative bleeding[11].

The second issue is cardiorespiratory complications associated with pulmonary resection. After pulmonary resection, acute pulmonary hypertension is likely to occur due to a decrease in the pulmonary vascular bed. Particularly with renal failure patients, managing the water balance is very difficult, and the risk for pulmonary edema due to postoperative left ventricular heart failure is high. The present patient also underwent CABG, and preoperative echocardiography confirmed significantly poor left cardiac function. As a result, postoperative acute heart failure was likely, and strict water management and appropriate transient catecholamine support were required. Perioperative excessive transfusion must also be avoided for the purpose of preventing postoperative right ventricular heart failure. In addition, in patients with poor heart function such as the present case, active albumin administration and transfusion could be recommended to maintain an appropriate preload and thereby prevent low cardiac output.

In the present patient, central venous pressure was monitored, and cardiac output was monitored using a Flotrac/Vigilleo System™[12~15]. The FloTrac/Vigilleo System™ is able to determine arterial pressure-based cardiac output (APCO), cardiac index (CI), stroke volume (SV), and stroke volume variation (SVV) values on the basis of peripheral arterial pressure waveform analysis, and is used for hemodynamic monitoring during anesthetic management.

Tsuchida et al. reported a single case of perioperative death among 7 patients who also showed chronic renal failure and underwent pulmonary resection (about 14%)[5], but according to studies on various surgeries of chronic renal failure patients, the rate of perioperative mortality has ranged from 0% to 6%, and major causes of death have included heart failure, bleeding, sepsis, liver failure, pneumonia and hyperpotassemia[6]. Furthermore, in pulmonary resection,

perioperative mortality was thought to have further increased due to cardiopulmonary complications caused by decreased pulmonary volume and difficulty maintaining water balance. In particular, poor cardiac and respiratory functions are an important predictor for postoperative acute heart failure, and early hemodialysis or continuous hemodialysis must also be considered in patients with poor cardiac and respiratory functions for the purpose of preventing postoperative acute heart failure.

Conclusions

Perioperative complications for pulmonary resection in patients complicated by chronic renal failure include hyperpotassemia and acute heart failure, and stricter infusion therapy and cardiorespiratory management are required. We emphasize that because the present patient showed preoperative poor left ventricular heart function, stricter perioperative management was essential.

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