Emergency total aortic arch replacement for a renal transplant recipient by mild hypothermia with selective cerebral perfusion

Masashi Toyama, MD · Naoki Kida, MD
Akinori Tamenishi, MD · Hiroshi Okamoto, MD

Abstract Hypothermia and immunosuppressive drugs may promote surgical wound infection. We successfully performed an emergency total arch replacement with mild hypothermia and selective cerebral perfusion for a renal transplant recipient. The postoperative course was almost uneventful without any surgical site infection.

Key words Renal transplant recipients · Total aortic arch replacement · Mild hypothermia · Surgical site infection

Introduction

Several methods of brain protection, including deep hypothermic circulatory arrest in combination with retrograde cerebral perfusion or selective cerebral perfusion (SCP), have been used for aortic repair. The optimal temperature for brain protection is still controversial. Hypothermia triggers thermoregulatory vasoconstriction, which decreases oxygen tension and therefore may predispose patients to perioperative wound infections.1 Recently, Khaladj and colleagues reported the usefulness of moderate hypothermic circulatory arrest with selective cerebral perfusion to prevent an adverse outcome.2 Transplant recipients are considered to be high-risk patients for perioperative infection because of daily immunosuppressive drugs. We performed an emergency total aortic arch replacement in a kidney transplant recipient using mild hypothermia with selective cerebral perfusion.

Case report

A 66-year-old man admitted to our hospital was suffering from chest pain. He was 172 cm tall and weighed 88.5 kg. He had a history of diabetes mellitus, hypertension, and nephropathy; and he had undergone renal transplantation 2 years before. He had been prescribed prednisolone, cyclosporin, and mycophenolate mofetil. His preoperative blood urea nitrogen and serum creatinine level were 18.8 mg/dl and 0.7 mg/dl, respectively.

Chest computed tomography revealed a giant distal aortic arch aneurysm that extended to the same level of the carina, massive pleural effusion, and severe coronary artery calcification. The aneurysm was 10 cm in maximum diameter. Bloody fluid was collected with thoracentesis. He was diagnosed as having impending rupture of a distal aortic arch aneurysm.

An emergency surgical repair was performed through a median sternotomy. His skin was prepared in a routine manner. For antibiotic prophylaxis, we followed the Society of Thoracic Surgeons Practice Guideline.3,4 No other special method was performed for the prevention of surgical site infection. A cardiopulmonary bypass (CPB) was established with venous drainage through the right atrium and arterial return through the right axillary and left femoral artery. The ascending aorta was opened at rectal and esophageal temperatures of 34.8°C and 25.7°C, respectively. Following circulatory arrest, SCP was begun through the right axillary artery and
left common carotid and subclavian artery with a 13F SCP balloon cannula. Selective cerebral perfusion with oxygenated blood of 30°C was maintained at a flow rate of around 1200 ml/min. For distal anastomosis, we used the stepwise technique. Total arch replacement was performed with a four-branched Dacron graft. Selective cerebral perfusion time, lower body circulatory arrest time, and CPB time were 122 min, 76 min, and 275 min, respectively. The lowest rectal temperature was 30.5°C. Seven packs of red blood cells were transfused intraoperatively. The patient was readily weaned from the CPB.

Intravenous sulbactam sodium/ampicillin sodium was administered for 48 hours after the operation. Intravenous prednisolone and cyclosporin were administered for 2 days. Thereafter, the oral supplemental mycophenolate mofetil was restarted.

There was no postoperative spinal cord dysfunction. This patient did not require postoperative hemodialysis despite being a renal transplant recipient. The maximum postoperative creatinine level was 2.0 mg/dl at postoperative day 1. Its level had recovered to the normal range at postoperative day 3. The patient was discharged home in good condition 3 weeks after surgery.

Discussion

We performed an emergency total arch replacement using mild hypothermic circulatory arrest and SCP for a kidney transplant recipient. This patient was carefully managed with cooperation of a cardiac team and a transplant team. The postoperative course was uneventful without any surgical site infection.

This patient had many risk factors for surgical site infection, which have been demonstrated, including male sex, obesity, diabetes mellitus, coronary disease, prolonged operating time, transfusion, and steroid use. He also had taken immunosuppressive drugs including cyclosporin and mycophenolate mofetil.

Hypothermia may promote surgical wound infection by triggering thermoregulatory vasoconstriction, which decreases subcutaneous oxygen tension. Reduced levels of oxygen in tissue impair oxidative killing by neutrophils. The cross-linking between strands of collagen with hydroxylation of amino acids give the healing wound tensile strength. Hypothermia also impairs immune function directly.

Transplant recipients have an increased incidence of preoperative risk factors, including comorbidity and immunosuppressive drug use. John and colleagues reported there was no significant difference between transplant and nontransplant recipients regarding the incidence of postoperative complications including pneumonia and sepsis after cardiac surgery. However, most of their patients (98.5%) underwent coronary artery bypass grafting, and the authors did not show the incidence of mediastinitis. Panneton and colleagues reported the results of aortic reconstruction in kidney transplant recipients, but they reported neither the lowest temperature during operation nor the incidence of surgical site infection.

Deep hypothermic circulatory arrest in combination with retrograde cerebral perfusion or SCP has been utilized worldwide for aortic surgery. Recently, the usefulness of mild hypothermic circulatory arrest with SCP was demonstrated by Khaladj and colleagues, who reported the prevention of temporary neurological dysfunction.

There is a special concern about spinal cord and renal dysfunction because of 76 min of lower body circulatory arrest time. In our institution, no spinal cord dysfunction was observed despite more than 30 cases of mild hypothermic circulatory arrest with SCP. The mean lower body circulatory arrest time was 65 ± 22 min. Kamiya and colleagues reported a paraplegia rate of 18.2% for patients whose lower body circulatory arrest time was more than 60 min. The number of their paraplegia cases was small. The reason why no spinal cord dysfunction was observed in our cases is still unclear. The perfusate temperature during SCP was 30°C with our method, although Kamiya and colleagues used 15°C. Deep hypothermia should cause spasm of collateral circulation to the spinal cord. The avoidance of deep hypothermia may prevent spasm of collateral circulation. The spinal cord may be perfused via the anterior spinal artery and collateral circulation during mild hypothermic circulatory arrest with SCP.

Warm renal ischemia of less than 40 min is reported to be tolerated. Prolonged CPB time affects renal function. Avoidance of deep hypothermia can decrease the CPB time.

Despite the high risk of surgical site infection and the invasiveness of this type of operation, the patient underwent total aortic arch replacement without any complications. We believe that the avoidance of deep hypothermia may indeed reduce the risk of surgical site infection.

Conclusion

We performed emergency total aortic arch replacement for a kidney transplant recipient using mild hypothermia with selective cerebral perfusion. His postoperative course was uneventful.