Anesthetic Management for Coronary Bypass Patients on Hemodialysis : Report of 4 Patients

SIRILAK SUKSOMPONG, M.D.*,
UNGKAB PRAKANRATTANA, M.D.*,
SOMCHAI SRIYOSCHATI, M.D.**

Abstract

We reported our own experience in four patients with chronic renal failure on maintenance hemodialysis undergoing coronary artery bypass graft surgery (CABGS). A balanced general anesthesia with endotracheal intubation was successfully achieved by using midazolam, atracurium, fentanyl, pentothal, nitrous oxide in oxygen and isoflurane. All patients were hemodialyzed within 24 hours before operation. One patient started peritoneal dialysis 10 hours after surgery. Three other patients were managed by hemodialysis the day after surgery. There was no hospital mortality. Many aspects of management of these patients which differ from those of routine cardiac surgical patients are outlined and discussed.

Key word : Chronic Renal Failure, Hemodialysis, Anesthetic Management, Coronary Artery Bypass Graft

**SUKSOMPONG S,
PRAKANRATTANA U, SRIYOSCHATI S
J Med Assoc Thai 2001; 84: 745-750**

The advancement of medical care has improved the life expectancy of patients with chronic renal failure. These patients were managed by chronic ambulatory peritoneal dialysis or hemodialysis. Cardiac problems either unrelated to or as a complication of dialysis such as atherosclerotic disease, pericardial effusion and cardiac tamponade may need surgery. The first case was an aortic valve replacement that was reported in 1968 by Lansing and collegues[1]. Since then an increasing number of patients with long-term hemodialysis have undergone cardiac surgery around the world. Also there is an increasing in frequency. Although morbidity and mortality of coronary artery bypass graft surgery (CABGS) are more than the normal population but it is acceptable. This report is a

* Department of Anesthesiology,
** Cardiovascular and Thoracic Surgery Division, Department of Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.

review of our own experience with four patients who underwent coronary artery bypass graft surgery.

CASE REPORT

Case 1

A 54-year-old man had a history of hypertension for 6 years. He was diagnosed with end stage renal disease for 1 $^1/_2$ years and received maintenance hemodialysis twice per week. One year ago, he devoloped signs and symptoms of angina pectoris. Chest X-rays showed mild cardiomegaly with atherosclerotic aorta and early cardiac decompensation. The ECG showed inverted T in lead I, aVL, V_{5-6}, and LVH by voltage. During medical treatment the angina became worse. Cardiac catheterization showed occlusion at mid LAD, distal right coronary artery (RCA), obtuse marginal branch (OM) and diagonal. His preoperative blood chemistry showed hematocrit 28 vol per cent, serum potassium 4.9 mEq/L, BUN 54 mg/dL and creatinine 7.9 mg/dL.

Case 2

A 74-year-old woman had a history of hypertension and myocardial ischemia for 7 years. She was on medical treatment. Two months before surgery, she had angina and the ECG showed first degree AV block with non Q myocardial infarction. Blood test showed hematocrit 25 vol per cent, serum potassium 6.7 mEq/L, BUN 39 mg/dL and creatinine 4.6 mg/dL. Kidney ultrasonogram revealed diffuse parenchymal disease with small cysts of the right kidney. Chronic renal disease was diagnosed without oliguria. Her cardiac symptoms were relieved with medical treatment. One month later she presented with angina, congestive heart failure and oliguria. Hemodialysis was performed. Cardiac catheterization showed 90 per cent occlusion of left circumflex artery, 80 per cent occlusion of proximal LAD and normal RCA. Left ventricular ejection fraction (LVEF) was 30 per cent. Chest X-rays showed pulmonary congestion with mild pulmonary edema.

Case 3

A 68-year-old woman, with a history of diabetes for 15 years, had developed renal failure one year previously and was on hemodialysis twice per week. She had chest pain, and dyspnea two weeks before surgery. Physical examination revealed tachycardia and crepitation in both lungs. Electrocardiogram showed ST depression in lateral lead, left ventricular hypertrophy with strain. She was treated as acute pulmonary edema. After the condition improved, cardiac catheterization was done and an 80 per cent occlusion was found at mid LAD, 60 per cent occlusion at circumflex and 80 per cent occlusion at RCA, LVEDP was 20 mmHg, LVEF was 32 per cent, and LV aneurysm of lateral wall and apex. Her blood test demonstrated hematocrit 27 vol per cent, serum potassium 4.9 mEq/L, BUN 36 mg/dL and creatinine 4.5 mg/dL.

Case 4

A 71-year-old man, a known case of diabetes for 10 years, was diagnosed with renal failure and had been on hemodialysis twice a week for one year. He had angina and heart failure 5 weeks before surgery. Congestive heart failure improved with medical treatment. Before surgery, chest X-rays showed mild pulmonary congestion and mild cardiomegaly. The electrocardiogram showed inferior wall ischemia and left ventricular hypertrophy. Echocardiogram showed mild tricuspid regurgitation, fair to poor left ventricular function, and LVEF was 45 per cent. Coronary angiography indicated calcified left main lesion, diffuse lesion of LAD, and more than 90 per cent stenosis of proximal RCA. Blood test showed hematocrit 28 vol per cent, BUN 36 mg/dL, creatinine 5 mg/dL and serum potassium 3.5 mEq/L.

All of them were scheduled to undergo elective coronary artery bypass graft surgery (CABGS) under general anesthesia.

Preoperative Preparation

Hemodialysis was performed within 24 hours prior to surgery. Chronic anemia with hematocrit was 25 to 28 volume per cent without blood transfusion. The concentration of serum potassium was 3.5-4.9 mEq/L, creatinine 4.5-7.9 mg/dL and plasma albumin 2.7-3.9 g/dL. Arterial blood gases were analysed as preoperative baseline. No abnormal coagulogram was found in any of the patients.

Preoperative medications consisted of oral ranitidine and midazolam. Therapy with preoperative cardioactive drugs was continued until the morning of surgery. Oxygen therapy was applied *via* a nasal cannula of 3 litre per minute.

Anesthetic Management

In the operating room automatic blood pressure cuff, pulse oximeter and electrocardiogram leads were applied. An 18-gauge catheter for intravenous fluid and medication, was inserted into a peripheral vein on the upper limb without arteriovenous (A-V) shunt/fistula. At the same limb, radial or brachial artery was cannulated for blood pressure monitoring and blood sampling. A small dose of fentanyl 25-50 μg was administered intravenously. End-tidal CO_2 was monitored *via* a face mask during preoxygenation and *via* the tracheal tube at the Y-piece of the anesthetic circuit after intubation. Flow-directed pulmonary artery catheter was inserted into the right internal jugular vein for central venous pressure, pulmonary artery pressure and pulmonary capillary wedge pressure monitoring.

After preoxygenation, anesthesia was slowly induced with midazolam 0.04 mg/kg, thiopental 1 mg/kg, fentanyl 5 μg/kg intravenously, followed immediately by 0.6 mg/kg of atracurium to facilitate tracheal intubation. Anesthesia was maintained with 50 per cent nitrous oxide in oxygen and isoflurane 0.2-1 per cent inspired concentration with a fresh gas flow of 3 L/min. Muscle paralysis with atracurium, and intravenous infusion of fentanyl were considered for balanced anesthesia. Mechanically controlled ventilation was contributed to maintain $PaCO_2$ 35-40 torr. Additional monitoring included nasopharyngeal temperature, urine output, activated clotting time (ACT), arterial blood gases (ABGs), hematocrit, serum sodium, potassium and glucose.

Slow intravenous administration of tranexamic acid 20 mg/kg and desmopressin 0.3 μg/kg were performed before skin incision. Cefalosporin was used as prophylactic antibiotics. Potassium free crystalloid solution was infused throughout the surgical period with consideration of avoiding fluid overload.

When it was ready for cardiopulmonary bypass (CPB), heparin 300 units/kg was given intravenously to achieve ACT of more than 480 seconds. CPB was instituted with a roller pump and membrane oxygenator (Maxima, Medtronic Cardiopulmonary, Anahein, CA) with hypothermia to 30-28°C, aortic cross-clamping and intermittent antegrade cold blood cardioplegia. An ultrafiltration device was added to the CPB circuit to remove excess water. The bypass circuit prime consisted of a mixture of blood, 0.9 per cent NaCl, 25 per cent albumin 100 ml, sodium bicarbonate as a buffer, mannitol and heparin 5,000 units. The patients were adequately anesthetized with midazolam and fentanyl where were adequately muscle relaxant with atracurium. At completion of CABG proximal anastomosis, termination of CPB was uneventful with nasopharyngeal temperature 37.5°C, normal cardiac sinus rhythm, electrolytes and acid-base balance as well as adequate ventricular filling pressure. Number of grafts were 5, 3, 4 and 4 in patients number 1 to 4 respectively. All of the patients needed pharmacologic support with moderate dosage of dobutamine, dopamine and milrinone. Nitroglycerin was intravenously infused to promote coronary flow *via* graft conduits. Intraaortic balloon pump (IABP) was not required for CPB weaning. Heparin neutralizing dose of protamine was 1 mg for every 100 units of total heparin administered. Transfusion of fresh frozen plasma 8-10 ml/kg and platelet concentrates 0.1 unit/kg were hemostatic benefit to these patients.

At the completion of surgery, the patients were mechanically ventilated in the cardiac surgical intensive care unit (SICU). Continuous observation, hemodynamic monitoring and standard post cardiac surgery care were mandatory. Successful tracheal extubation were performed 6-8 hours following CABGS.

Postoperative dialysis was performed within 24 hours following CABGS. The first patient had peritoneal dialysis 10 hours after surgery, and restarted hemodialysis the next day. The other three patients underwent hemodialysis on the first postoperative day. No use of systemic heparin on hemodialysis. No patient returned to OR for hemostasis of postoperative bleeding. Postoperative hematocrit was 30 ± 2 vol per cent. There was no hospital mortality in this report.

DISCUSSION

Because survival of patients with chronic renal disease has improved, the number of dialysis-dependent patients requiring myocardial revascularization has increased as well. Renal disease impairs the ability to maintain body fluid, electrolytes, acid-base balance in the face of operative stress, and to excrete waste products and drug metabolites[2]. For patients undergoing cardiopulmonary bypass, however, particular concern exists

because of the large fluid loading prime, and potassium from cardioplegic solution. They may have some degree of metabolic acidosis which could generate subsequent decrease in myocardial function. Patients with chronic renal failure are anemic, so crystalloid cardiopulmonary bypass prime could reduce hemoglobin to levels that would seriously reduce oxygen carrying capacity. The other perioperative risks include pulmonary congestion / edema, cardiac dysrhythmias, pulmonary aspiration and bleeding due to platelet dysfunction[3,4].

Dialysis-dependent patients need either peritoneal or hemodialysis to control fluid overload, hyperkalemia, metablic acidosis and waste products. In addition, the platelet dysfunction that accompanies uremia will be improved. Dialysis is preferred 24 hours preoperatively to keep fluid and electrolytes balance, BUN and creatinine as near normal as possible and to avoid dysequilibrium during anesthesia[5,6]. All four patients were hemodialysed on the day before CABG to improve uremic condition and to control fluid overload. Their blood tests showed normal coagulogram, acceptable abnormalities in serum potassium, magnesium, ionized calcium and hematocrit. There was no blood transfusion to any patients on the day before surgery. Some centres perform intraoperative hemodialysis and have reported a good outcome[7,8]. Hemofiltration was performed intraoperative CPB instead of hemodialysis in these four patients. Problems of fluid overload and hyperkalemia at the end of surgery did not occur. Postoperative peritoneal dialysis was preferable to hemodialysis for the first 7 postoperative days as hemodialysis might induce hemodynamic instability especially hypotension and bleeding diathesis. However, peritoneal dialysis was performed only on the first patient while the other 3 patients were considered hemodialysis with acceptable mild to moderate hemodynamic disturbance. There was no bleeding problem from using local heparinized hemodialysis. Maintenance of postoperative fluid therapy was kept at a mininum, 500-700 ml/day, and consisted of 5 per cent dextrose in water as crystalloid and 25 per cent albumin as colloid solution to maintain hemodynamic stability when their hematocrit was 28-30 vol per cent.

Imbalance of potassium in the perioperative period of cardiac surgery may cause life-threatening cardiac dysrhythmias. The etiology of increasing potassium level during surgery is tissue trauma, hemolysis during CPB, red blood cell transfusion and cardioplegic solution[3]. Some authors recommended intraoperative hemodialysis with a potassium-free dialysate[7,8]. Our four patients' early postoperative serum potassium was within normal limits which may be due to hemodilution effect.

The requirement of blood and blood products in uremic patients are greater than those in the normal group. Platelet dysfunction that accompanies uremia will cause perioperative bleeding which needs more transfusion. Pharmacological mean was proved to decrease perioperative bleeding in cardiac operations. Desmopressin acetate administration has been shown to improve uremic-induced platelet dysfunction[9-11]. Tranexamic acid is useful in reducing blood loss and transfusion requirement for cardiac surgery[12-14]. Aprotinin has been shown to reduce blood transfusion in patients undergoing cardiac surgery[3,14]. Considering its effects on renal function, aprotinin should be used at a reduced dosage in patients with preexisting renal dysfunction[3,15]. All of the patients did well and returned home on the 13th to 34th postoperative day. The second and third patients died 43 and 25 months after surgery respectively. Owen CH et al reported 1-and 2-year survival rates of 84 per cent ± 8 per cent and 45 per cent ± 13 per cent, respectively[16]. In our report 1-and 2-year survival rates were 100 per cent and 50 per cent respectively. Compared to the normal population, patients on maintenance hemodialysis had an increased risk of perioperative morbidity and mortality. We concluded that successful anesthetic management for coronary artery bypass graft surgery in dialysis-dependent patient can be performed with meticulous care and well-performed team work.

(Received for publication on January 20, 2000)

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การให้ยาระงับความรู้สึกผู้ป่วยไตวายที่มารับการผ่าตัดเส้นเลือดหัวใจ : รายงานผู้ป่วย 4 ราย

ศิริลักษณ์ สุขสมปอง, พ.บ.,*
อังกาบ ปราการรัตน์, พ.บ., สมชาย ศรียศชาติ, พ.บ.***

รายงานผู้ป่วยโรคไตวายที่ได้รับการฟอกไตมารับผ่าตัดเส้นเลือดหัวใจ จำนวน 4 ราย ผู้ป่วยได้รับการให้ยาระงับความรู้สึกแบบ general ด้วยยา midazolam, fentanyl, pentothal, atracurium, isoflurane, ไนตรัสออกไซด์ และออกซิเจน ผู้ป่วยจะได้รับการฟอกไตภายใน 24 ชั่วโมงก่อนการผ่าตัด ผู้ป่วยรายแรกได้รับการทำ peritoneal dialysis หลังผ่าตัด 10 ชั่วโมง อีก 3 รายต่อมาได้รับการฟอกไตวันรุ่งขึ้นจากการผ่าตัด หลังผ่าตัดผู้ป่วยกลับบ้านได้ทุกราย ความสำเร็จของการให้ยาระงับความรู้สึกและการผ่าตัดอยู่ที่การร่วมกันดูแลผู้ป่วยอย่างดีระหว่างอายุรแพทย์ ศัลยแพทย์ และวิสัญญีแพทย์

คำสำคัญ : ไตวาย, การฟอกไต, การให้ยาระงับความรู้สึก, การผ่าตัดเส้นเลือดหัวใจ

ศิริลักษณ์ สุขสมปอง, อังกาบ ปราการรัตน์, สมชาย ศรียศชาติ
จดหมายเหตุทางแพทย์ ฯ 2544; 84: 745–750

* ภาควิชาวิสัญญีวิทยา,
** หน่วยศัลยศาสตร์หัวใจและทรวงอก, ภาควิชาศัลยศาสตร์, คณะแพทยศาสตร์ศิริราชพยาบาล, มหาวิทยาลัยมหิดล กรุงเทพ ฯ 10700