Anesthetic Management for Liver Transplantation from Living Donor to Adult Recipient

— A Case Report —

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The orthotopic liver transplantation from a brain death patient is a relatively common surgical technique for the treatment of the end stage liver disease in foreign countries[1]. However, organ transplantations from brain death patients are not accepted in Japan because of many social factors. Recently, liver transplantation from a living donor to pediatric recipient was introduced[2] and this method has become the common liver transplantation technique in Japan. But, liver transplantation from living donor to adult recipient has not been reported.

We experienced the anesthetic management for transplantation of a liver graft from a mother to her 38-year-old daughter who was suffering from end stage liver disease secondary to Wilson's disease. This is the first report of anesthetic management for a liver transplantation from living donor to adult patient.

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Case Report

The patient was a 38-year-old woman, weighing 47 kg and height 156 cm, who was admitted to our hospital in January, 1991, with the diagnosis of Wilson's disease. In 1976, she was noted to have liver dysfunction and splenomegaly. She had been suffering from ascites and pleural effusion since 1984 and developed hyperammonemia in the same year. In 1990, her condition deteriorated to hepatic coma with renal dysfunction. Plasma exchange was performed several times in 1991. The living related liver transplantation from her mother was scheduled in June, 1991.

Preoperative problems included hepatic failure, coagulopathy, anemia, renal insufficiency, and hypoproteinemia.

Anesthetic management in the donor

The donor who was the mother of the recipient, was a 59-year-old woman, weight 50 kg and height 150 cm. She had no problems in her physical condition. After insertion of an epidural catheter in the Th9–10 inter vertebral space, anesthesia was induced with fentanyl,

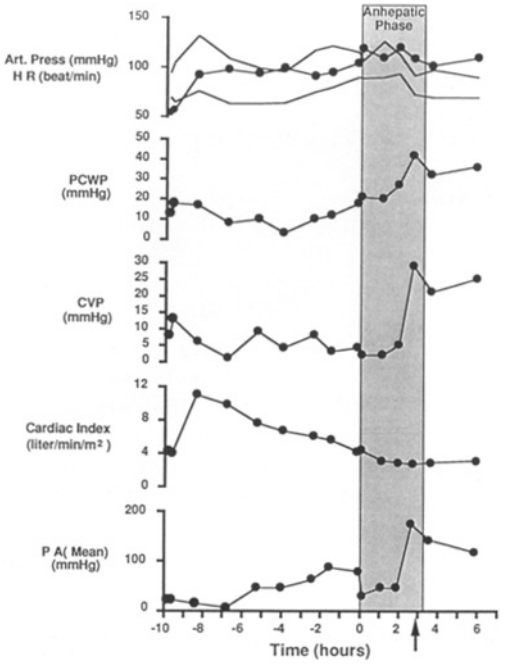

Fig. 1. Changes in various circulatory parameters. The shaded area shows the anhepatic phase. The arrow indicates the accidental airway obstruction.

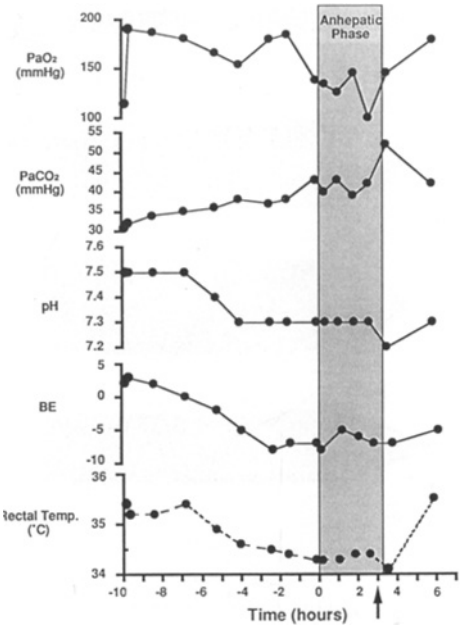

Fig. 2. Changes in rectal temperature and various parameters of arterial blood gases and acid-base balance. The shaded area shows the anhepatic phase.

thiamylal, midazolam, and vecuronium. General anesthesia was maintained with bolus administration of fentanyl and midazolam, with 70% nitrous-oxide in oxygen. Bolus administration of 1.5% mepivacaine into the epidural catheter was also used. In order to maintain the liver perfusion, dopamine and prostaglandin E_1 were continuously administered during the operation. The donor liver graft was perfused with the UW solution[3,4]. Five hundred milliliters of blood were lost and 300 ml of the autologous blood were infused. The post operative course was uneventful.

Anesthetic management in the recipient

After preoxygenation via face mask, a rapid induction was performed with a fentanyl dose of 6.4 $\mu g \cdot kg^{-1}$, vecuronium dose of 0.17 $mg \cdot kg^{-1}$, and thiamylal dose of 1.6 $mg \cdot kg^{-1}$, followed by tracheal intubation with a soft cuffed endotracheal tube. Anesthesia was maintained with continuous infusion of fentanyl at 3.0 $\mu g \cdot kg^{-1} \cdot min^{-1}$ and vecuronium at 0.1 $mg \cdot kg^{-1} \cdot min^{-1}$, with inhalation of isoflurane (1.0–3.0%) and controlled mechanical ventilation was done using a mixture of pure oxygen and air ($F_{I_{O_2}}$ 0.45). The monitors used during the operation included urine volume, rectal temperature, radial artery pressure, electrocardiogram, arterial oxygen saturation by a pulse oximeter, end-tidal carbondioxide concentration by a capnogram, and mixed venous oxygen saturation by a pulmonary artery oximetry catheter.

The hepatic circulation was isolated from the systemic circulation at 12.5 hours after the induction of anesthesia. The veno-venous bypass technique[5,6] was used during the anhepatic phase.

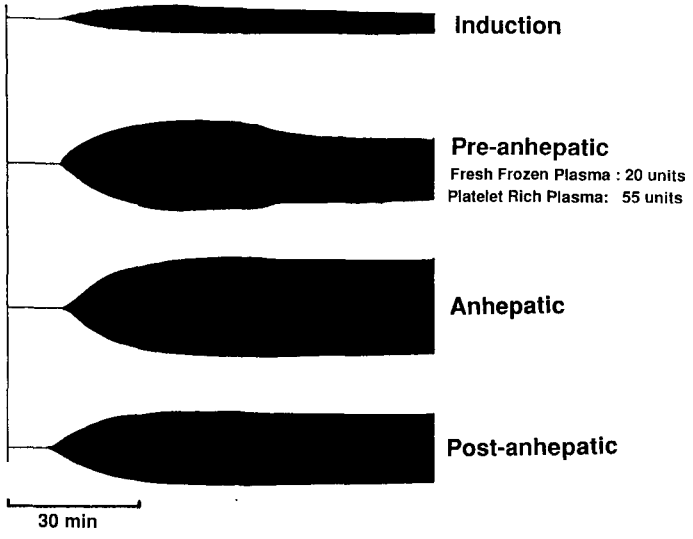

Fig. 3. Changes in thromboelastography. Coagulopathy identified in the induction phase was improved in association with the use of blood products. Deterioration of the coagulation profile during the anhepatic phase did not occur.

The femoral and portal vein cannulas were joined with a Y-connector leading to a centripetal force pump (Bio-Medicus model 510 console) and return flow was drained to the axillar vein. The flow was maintained at 1,500–1,600 $ml \cdot min^{-1}$.

Figure 1 shows the changes in hemodynamic parameters during the operation. There appeared to be no dramatic changes at the start of the anhepatic phase except a slight increase of heart rate and a slight decrease of pulmonary arterial pressure. The pulmonary arterial pressure, however, increased abruptly just before the end of the anhepatic phase (arrow in figure). Simultaneously, a decrease of arterial oxygen saturation, an increase of end-tidal carbon dioxide concentration, and an increase of airway pressure were noted. We suspected the possibility of endotracheal tube obstruction. Extubation and re-intubation of the trachea were performed immediately. The endotracheal tube was obstructed by a clot formed secondary to bleeding from the nasopharynx. The nasal mucosa was injured by the naso-gastric tube inserted before the start of the operation. The clot might have formed because the coagulation profile improved by the administration of blood products. Because of this event, the typical, clinical signs of post-reflow syndrome were masked.

Figure 2 shows the changes in body temperature and several parameters of blood-gas analysis. No dramatic changes were encountered at the start of the anhepatic phase. Hypoxia and hypercapnea occurred secondary to the episode of tracheal tube trouble mentioned above. Body temperature at the start of the operation was 35.2°C and decreased to 34.3°C before the anhepatic phase. The body temperature decreased further and reached down to 34.1°C at 30 min after the reperfusion.

Intraoperative changes in thromboelastographic pattern are shown in figure 3. Although the coagulation profile had been abnormal preoperatively, it was improved by the administration of blood products including platelet rich plasma and fresh frozen plasma prior to the anhepatic phase. Deterioration of hemostasis during the anhepatic phase did not occur in our patient.

The anhepatic phase lasted 3 hours and 35 minutes. The surgical and anesthetic times were 22 hours and 25

hours, respectively. The total blood loss was 19,000 ml.

At the end of the procedure, the patient was transferred to the intensive care unit. The post-operative managements included plasma exchange, hemofiltration, and hemodialysis were done for hepatic and renal failure. However, the patient died from multiple organ failure on the 16th post-operative day.

Discussion

Liver transplantation from a living donor is a relatively new operative technique[7,8]. Although the problems in anesthetic management are not yet described, the anesthetic management for this operation is essentially similar to that of liver operations using veno-venous bypass, such as orthotopic liver transplantation and extracorporeal liver resection[9-12].

Since massive bleeding at the time of reperfusion was not encountered in this patient, the special equipment for rapid transfusion[13] was not needed. Continuous bleeding, however, occurred during the dissection phase and first half of the anhepatic phase secondary to coagulopathy, collateral channels, and portal hypertension.

Previous reports demonstrate hypotension associated with clamping of the inferior vena-cava without veno-venous bypass[14-16]. In our patient, severe hypotension at the time of clamping was prevented by the use of a veno-venous bypass. Clinical signs of post-reflow syndrome[15,16] was masked due to the episode of airway obstruction.

Hypothermia is a common complication of liver transplantation[9-12,14-17]. We therefore employed a heated humidifier, heating blanket, wrapping of the extremities with a bandage for cast padding and an aluminum seat, and irrigation of the abdomen with warm saline. Despite these attempts the body temperature decreased to 34.1°C. It is considered that the method of maintaining body temperature should be improved by other means, such as the use of a heat exchanger incorporated into the extracorporeal circulation system.

The thromboelastgram provided an accurate evaluation of the intraoperative coagulation profile. Deterioration of this profile during the anhepatic phase[13,17] was not identified in our patient. Administration of blood products, namely platelet rich plasma and fresh frozen plasma, might have prevented the coagulopathy during the anhepatic phase.

In summary, we described the anesthetic management of liver transplantation from the living donor to the adult patient. This was the first case of liver transplantation from the living donor to the adult patient to be performed in Japan. Special caution should be paid to massive bleeding, severe circulatory derangement, hypothermia and coagulopathy in anesthetic management of this operation. The same problems reported in the management of conventional orthotopic liver transplantation and extracorporeal liver resection were also encountered in this new oerative procedure. It is necessary to slove these problems to manage the patient undergoing this new technique.

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