CASE REPORT

Anesthetic management of a pregnant living related liver donor

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SUMMARY. Pregnancy is often considered a contraindication to living related liver donation. There are serious medical and ethical considerations if a pregnant woman insists on undergoing partial hepatectomy to save her sick child. Herein we report a case of living related liver donation from a pregnant woman at 18 weeks of gestation to her 1-year-old child with decompensated cirrhosis due to biliary atresia. The left lateral segment of the liver was harvested for donation. Meticulous surgical technique and anesthetic management were mandatory in assuring a successful outcome. While this isolated case demonstrated that living related liver donation can be performed successfully with a pregnant donor, it should be undertaken only when there is absolutely no other donor and the recipient is in urgent need.

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INTRODUCTION

Shortage of donor livers for small pediatric liver transplant candidates prompted the development of surgical techniques for liver reduction as reduced-liver, split-liver and living donor liver transplantation.1–4 Living donor liver transplantation is now performed in many transplant centers worldwide. However, the major medical and ethical concern for this technique is donor risk. Such concern is legitimate, since hepatectomy is a major abdominal procedure carrying the potential risk of massive blood loss that may require blood transfusion; this correlates significantly with postoperative morbidity and mortality.5 The situation is even more complicated if the donor is pregnant. Safety and risks to both the donor-mother and the fetus should be given utmost considerations. Herein we report our experience in the anesthetic management of a pregnant living related liver donor.

CASE REPORT

The donor at the time of initial evaluation was a 33-year-old female, weighing 51 kg, mother to a 12-month-old girl with decompensated cirrhosis due to biliary atresia. This same daughter was the potential recipient, having been evaluated and recommended to undergo liver transplantation for continuing deterioration. Despite having had a Kasai operation, she had required several admissions to the intensive care unit for hepatic encephalopathy, massive ascites, hyperbilirubinemia (bilirubin 20.3 mg%) and coagulopathy (prothrombin time >50 s).

The deceased organ donation rate in Taiwan is very low. Aside from the girl's mother, there was no other suitable living donor within third-degree consanguinity, which is required by Taiwan law. In the course of pre-donation evaluation, the mother was found to be 12 weeks pregnant. Multidisciplinary consultations were conducted, involving the hospital ethics committee, transplant surgical team, anesthesiologists, psychologist,
obstetrician, transplant coordinator and social worker. A possible miscarriage rate of 5.8% was explained to the pregnant mother donor and family members. Despite the risk, the donor-mother still decided to go for living liver donation and keep the pregnancy.

The living donor partial hepatectomy was scheduled for 18 weeks of gestation, unless a deceased donor were to become available during the waiting period. The pre-operative imaging studies, which included computed tomography and magnetic resonance imaging scans, had been completed before she was known to be pregnant. Informed written consent for surgery and anesthesia was obtained from the potential donor-mother.

This gravida para 1 donor was an American Society of Anesthesiologists (ASA) Physical Status I patient. Her preoperative evaluation did not reveal any medical contraindications to living related organ donation. All laboratory test results were within acceptable limits. General endotracheal anesthesia was induced using fentanyl 2.0 μg/kg, thiopental 3.0 mg/kg, and atracurium 0.5 mg/kg. Anesthesia was maintained using isoflurane (end tidal isoflurane range, 1.4-1.8%) in oxygen-air mixture with atracurium as muscle relaxant. The ventilation rate was adjusted to maintain an end-tidal carbon dioxide tension (PETCO₂) of around 4 kPa (30 mmHg). Electrocardiogram, pulse oximetry, continuous arterial blood pressure, central venous pressure, end tidal CO₂, urine output and nasopharyngeal temperature (Hewlett Packard Viridia 24C, 71034 Boeblingen, Germany) were monitored.

The blood pressure and heart rate were kept at 110-140/60-80 mmHg and 80-100 beats/min, respectively, without vasopressors. The total amount of crystalloids given was 3200 mL. Furosemide 5 mg was given one hour after the operation began, to lower the central venous pressure and to maintain sufficient urine output (total 780 mL or 1.39 mL·kg⁻¹·h⁻¹) throughout the operation. The initial central venous pressure was 6 mmHg. It decreased gradually to around 3.7 mmHg during parenchymal transection. The left lateral segment was harvested as graft. Due to a variation in biliary tract anatomy detected preoperatively where the right anterior sector duct drained into the left hepatic duct, intraoperative cholangiography was performed. During cholangiography, the lower abdomen was covered by a lead shield to minimize radiation exposure to the fetus.

The total anesthesia time was 11 h. The estimated blood loss was 40 mL. Blood, blood products, and colloids were not given. The graft was successfully implanted into the recipient. Continuous fetal heart rate monitoring was not performed during the operation, but was determined pre- and postoperatively. Possible preterm labor was monitored by an obstetrician postoperatively in the intensive care unit. Prophylactic tocolytics were not given pre- or postoperatively. The donor was extubated 1 h after recovering from anesthesia. Her hemoglobin and creatinine concentrations are shown in Table 1. The postoperative course was uneventful; and she was discharged after one week. Five months later, she gave birth to a healthy term baby weighing 3430 g via normal spontaneous vaginal delivery without complications. The mother and her two children are all alive and well to date, 40 months after transplantation.

**DISCUSSION**

The anesthetic considerations during surgery in pregnancy include concern for the safety of two patients, the mother and the fetus. About 1-2% of pregnant women undergo general anesthesia for surgical procedures unrelated to delivery in the United States. The procedures are usually performed to maintain the health of the mother and/or ensure a successful pregnancy. Major surgery in a pregnant mother that will benefit neither herself, nor the fetus, but rather a third party has been reported, but only from a surgical standpoint. The anesthetic management has not yet been reported.

The ethical problem raised is an extraordinary challenge to everyone involved, primarily the family and the multidisciplinary transplant team. The mother has to risk herself and her unborn child to benefit one other person, her daughter. Usually the individual who gives consent to become a living related organ donor has to be competent, willing to donate, free from coercion, medically and psychosocially suitable, fully informed of the risks and benefits as a donor, and fully informed of the risks, benefits, and alternative treatment available to the recipient. In this particular case the risks extend to the unborn child. These risks include prematurity, abortion, and teratogenicity. Teratogenicity should be emphasized with its possibly latent effects, particularly in the central nervous system, as the central nervous system continues to develop during the entire pregnancy and early life. This type of teratogenicity is difficult, if not impossible, to predict and document. The worst situation would be to lose all three lives.

In non-obstetric surgery for a pregnant woman, the reported death rate is 0.006% and the abortion rate is 5.8%. Preoperative counseling before a decision is made is of paramount importance to the donor-mother.

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**Table 1. Donor hemoglobin and creatinine concentrations in the perioperative period**

<table>
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<th>Preoperative</th>
<th>Immediate postoperative</th>
<th>Postoperative day 1</th>
</tr>
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<tbody>
<tr>
<td>Hemoglobin (g/dL)</td>
<td>12</td>
<td>10.5</td>
<td>11.3</td>
</tr>
<tr>
<td>Creatinine (mg %)</td>
<td>0.3</td>
<td>0.4</td>
<td>0.4</td>
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</table>
and family. There is a very low chance of getting a deceased donor graft in Taiwan. This special peculiarity in our setting has to be taken into consideration. It was decided to perform the living donor partial hepatectomy during the second trimester while trying to keep the pregnancy.

Several precautions have to be taken. Based on our experience in non-pregnant donors, donor partial hepatectomy can be performed with minimal blood loss, thus assuring hemodynamic stability intraoperatively. Avoiding massive blood loss is a prerequisite to minimizing maternal hypotension, which may reduce uterine blood flow, and risk hypoxemia and asphyxia to the fetus.

Further, massive blood loss requires blood transfusion which correlates significantly with postoperative morbidity and mortality. A maneuver to prevent significant blood loss during liver resection is to keep the central venous pressure low. Maintaining the central venous pressure at around 3-4 mmHg has been regarded as a simple and effective way to reduce blood loss during parenchymal transection. Intravenous fluid restriction and forced diuresis using furosemide are used to lower the central venous pressure, as previously reported.

These precautions were effectively applied in our case and blood loss was only 40 mL. There were no significant changes in hemoglobin levels postoperatively. The anesthetic drugs used included fentanyl, thiopental, atracurium and isoflurane. These drugs have been reported to have no teratogenic effects. Although opioids and thiopental are known to diminish fetal heart rate and variability and cause neonatal sedation, depression of the neonatal central nervous and respiratory systems is not usually a concern unless immediate delivery of the fetus is planned. The effects of radiation on the fetus were minimized by using a protective lead gown to shield the lower abdomen of the mother during intraoperative cholangiography. The comprehensive management of this case led to a successful outcome for the transplant team and the family. The psychological benefits to the mother were particularly great because she preserved the lives of both her sick and her unborn child.

Pregnancy has been considered as an absolute contraindication to living organ donation. However, if intraoperative blood loss can be minimized and hemodynamic stability maintained, fetal hypoxia and preterm labor can be avoided during non-obstetric indicated surgery. General anesthesia using isoflurane during prolonged surgery did not seem to have adverse effects on the fetus. Although this single case was successful, it should not fundamentally alter the ethical concerns for donor-candidate selection in living donor liver transplantation. It suggests that in urgent situations when no other donor is available, a pregnant donor may be used successfully as a source of liver graft without harm to the donor or fetus. Free and voluntary informed consent should be obtained. The procedure is to be performed only in centers highly experienced in surgery and anesthesia in living donor liver transplantation.

REFERENCES