Brief Report

Anesthetic management of living liver donors

Dinesh K. Choudhry MD FRCA,
Roy E. Schwartz MD,
Stephen A. Stayer MD,
Yuri Shevchenko MD,
Mohamed Rehman MD

Purpose: Living organ donation is being performed with increasing frequency to overcome the shortage of organs for transplantation. Our experience in the anesthetic management of donors with relevant issues is discussed and complications encountered are recorded.

Methods: Data were collected retrospectively and analyzed on all 22 left lateral hepatectomies performed at our institution between 1993 to 1997 for transplantation.

Results Major ethical concern was the risk to the donors and anesthetic issues were those of a major abdominal procedure. All except four donors were parents (mother/father). Average blood loss was 805 ± 479 ml and only two donors required blood transfusion. Mean operative time was 8.2 ± 1.5 hr. Thoracic epidural analgesia was the most commonly adopted mode of pain relief. Average time to return of bowel sound postoperatively was 3.1 ± 1.0 days and was not influenced by the postoperative analgesic technique used. Total duration of hospital stay was 8.4 ± 1.1 days. Three donors developed minor postoperative complications atrial fibrillation and retained JP drain; left lower lobe pneumonia; and incisional hernia. All patients recovered uneventfully.

Conclusion: Living organ donors contribute towards decreasing the shortage of organs for transplantation. Minimizing the discomfort associated with the surgical intervention and providing a complication-free perioperative course will positively influence the continued availability of such donations. On review of the first 22 left lateral hapatectomies performed, we observed only minor complications. Postoperative pain was a serious problem and thoracic epidural provided satisfactory analgesia.

Objectif : Le don d'organe vivant se fait de plus en plus souvent en raison du manque d'organes pour la transplantation. Notre expérience de l'anesthésie des donneurs ainsi que les questions qui y sont pertinentes sont examinées et les complications qui surviennent sont présentées.

Méthode : Une collecte rétrospective suivie d'une analyse des données des 22 hépatectomies latérales gauches réalisées pour la transplantation entre 1993 et 1997 à notre institution.

Résultats : Notre principale souci éthique a été celui du risque encouru par les donneurs, et nos choix anesthésiques, ceux d'une intervention abdominale majeure. Les donneurs, sauf quatre, étaient des parents (mère/père). La perte sanguine moyenne a été de 805 ± 479 ml, et deux donneurs ont eu besoin de transfusion. Le temps moyen de l'opération a été de 8,2 ± 1,5 h. L'analgésie épidurale thoracique a été privilégiée comme traitement de la douleur. Le temps moyen nécessaire au retour des bruits intestinaux postopératoires a été de 3,1 ± 1,0 jours peu importe la technique analgésique postopératoire utilisée. La durée totale du séjour hospitalier a été de 8,4 ± 1,1 jours. Trois donneurs ont développé des complications postopératoires mineures de fibrillation auriculaire et de rétention du drain de Jackson-Pratt, de pneumonie du lobe inférieur gauche et de hernie au site de l'incision. Tous les patients se sont rétablis sans incidents.

Conclusion : Les dons d'organe vivant permettent de palier le manque d'organes pour la transplantation. En réduisant l'inconfort associé à l'intervention chirurgicale et en procurant un environnement périopératoire sans complications, nous pourrons assurer le maintien de dons semblables. Lors de la révision des 22 premières hépatectomies latérales gauches, nous n'avons relevé que des complications mineures. La douleur postopératoire a été un problème sérieux que l'analgésie épidurale thoracique nous a permis de régler de façon satisfaisante.

From the Department of Anesthesia and Critical Care, St. Christopher's Hospital for Children, Erie Avenue at Front Street, Philadelphia, PA 19134-1095 USA.

Address correspondence to: Dinesh K. Choudhry MD FRCA, Department of Anesthesia and Critical Care, DuPont Hospital for Children, 1600 Rockland Road, P. O. Box 269, Wilmington, DE 19899, USA. Phone: 302-651-5350; Fax: 302-651-5365; E-mail: dchoudhr@nemours.org

Accepted for publication May 2, 1999

PEDIATRIC liver translation has grown in parallel with transplantation in adults. Currently, 15% of all hepatic transplants are performed on children under five years of age.[1] However, 25% of patients on urgent waiting lists die from lack of organ availability.[2] According to the United network for Organ Sharing census (1996), the number of recipients waiting for various organs has doubled from 1990 to 1995.

Twenty-two partial liver transplants have been performed at our institution. The purpose of this report is to describe our experience in managing the donors and review the anesthetic implications.

Materials and Methods:

Data were collected retrospectively and analyzed for all 22 partial liver donors since the inception of the liver transplant program in 1993 through 1997 at St. Christopher's hospital for Children.

All donors were healthy adults and their preoperative assessment consisted of routine evaluation of various organ systems. Investigations included: complete blood count, clotting profile, serum electrolytes, blood sugar, blood urea and creatinine, liver function tests, hepatitis screen, HIV screen and chest x-ray. Hepatic angiography and abdominal CT were performed to study the anatomy of the hepatic vasculature and assess liver size.

Following diazepam premedication, routine noninvasive monitors were placed, intravenous access established and regional technique, if planned, was performed before anesthesia.

Anesthesia, after pre-oxygenation, was induced with fentanyl, thiopental and pancuronium and, following tracheal intubation, was maintained with oxygen, air and isoflurane. A bolus of 8-to10 ml bupivacaine 0.5% with 100 µg fentanyl was administered epidurally and an infusion of bupivacaine 0.25% with 4 $\mu g \cdot ml^{-1}$ fentanyl was commenced at 0.1 - 0.15 $ml \cdot kg^{-1} \cdot hr^{-1}$.

Pressure points were padded, compression stockings were applied to lower extremities, and donors kept warm with warming blanket, warm intravenous fluids and warm humidified gases. At the end of surgical procedure, the tracheas were extubated and the donors were transferred to ICU for further management.

Data were collected retrospectively (Table). Comparisons were made between those who received thoracic epidural analgesia (TEA) *vs* other forms of analgesia with regards to reappearance of bowel sounds and duration of hospital stay. The data were analyzed using an independent t test expressed as the mean ± the standard deviation. Significance was defined as $P < 0.05$.

Results

Of 22 partial liver donors, 18 were parents of the recipients. Radial arterial catheters were placed in all except one and a central line was placed only in the first eight donors. Average blood loss was 805 ± 479 ml and only two donors required blood transfusion. Mean operative time was 8.2 ± 1.5 hr. The most commonly adopted modality to provide analgesia was TEA although lumbar epidural analgesia (LEA) and intrathecal morphine (ITM) were also used. Average time for return of bowel sounds was 3.1 ± 1.0 days and was not influenced by regional technique ($P = 0.1$). Donors were in the ICU for 4.1 ± 0.3 days and the total duration of hospital stay was 8.4 ± 1.1 days. The presence or absence of regional analgesia did not influence these durations. Three donors developed postoperative complications: one had pulmonary atelectasis, one developed atrial fibrillation and a retained segment of Jackson-Pratt drain, and one developed incisional hernia.

Discussion

Living related liver transplantation, although an important advance in organ availability required considerable ethical consideration before its introduction.[3,4,5] It involves transplantation of the left lateral hepatic segment – left lateral hepatic segmentectomy.[6] Potential benefits include an increased donor pool, haploidentical donor-recipient matches, elective timing, and nonischemic conditions before donation.[6] The term "living related" has been replaced with "living" because not all donors were related to the recipients.

Since all donors subject themselves to the risk of a major surgery, vigilance and optimal perioperative care is essential to minimize any associated morbidity or mortality. Issues of concern to the anesthesiologist are essentially those of a major abdominal procedure involving prolonged surgery, considerable fluid loss, potential for blood loss, heat loss, thromboembolic complications and postoperative pain.

Invasive arterial monitoring is beneficial for providing continuous blood pressure and easy access for blood sampling. Central venous pressure monitoring was performed in the first few cases but was subsequently considered unnecessary.

In order to provide adequate analgesia, four different modalities were used: ITM, LEA, TEA and intravenous opioids alone. We observed that TEA with local anesthetic-opioid combination provided excellent pain relief and preserved mobility. Since this was a retrospective study and pain score was not recorded, we are unable to claim objectively the superiority of TEA over other modalities of pain relief. However, we observed that analgesia was much superior with TEA

TABLE List of living partial liver donors with relevant information

No.	*Year of Opn.*	*Relation*	*Cent.line (IJ)*	*Art. Line*	*Estim. blood loss*	*Blood Transfusio need*	*Regional Technique*	*Postop. analgesia*	*Opn. time (Hr)*	*Bowel sound postop (Days)*	*Postop. complication*	*Hosp stay (Days)*
1	1993	Father	Yes	Yes	600	150 CS	ITM	PCA	10	4	None	10
2	1994	Father	Yes	Yes	1000	650 CS	None	PCA	10	3	None	10
3	1994	Father	Yes	Yes	800	No	LEA	LEA, PCA	9	4	None	10
4	1994	Father	Yes	Yes	850	No	LEA	LEA, PCA	8	5	None	8
5	1994	Mother	Yes	Yes	400	No	ITM	PCA	8	2	None	11
6	1995	Father	Yes	Yes	2500	4 units	LEA	LEA, PCA	10	3	None	9
7	1995	Father	No	No	600	No	LEA	LEA, PCA	10	3	A.Fib. Ret.JP drain	7
8	1996	Aunt	Yes	Yes	1200	2 units 450 CS	ITM	PCA	7	3	None	7
9	1997	Aunt	Yes	Yes	850	No	None	PCA	7	3	None	8
10	1997	Mother	No	Yes	400	No	ITM	PCA	7	3	None	7
11	1997	Mother	No	Yes	1000	No	ITM	PCA	8	5	None	9
12	1997	Mother	No	No	400	No	ITM	PCA	8	3	None	8
13	1997	Mother	No	Yes	NA	No	LEA	LEA, PCA	7	2	None	9
14	1997	Mother	No	Yes	300	No	TEA	TEA, PCA	7	2	None	8
15	1997	Mother	No	Yes	300	No	TEA	TEA	7	2	None	8
16	1997	G. Mom	No	Yes	1000	No	TEA	TEA, PCA	6	3	None	8
17	1997	Father	No	Yes	500	No	TEA	TEA	6	2	None	8
18	1997	Father	No	Yes	800	No	TEA	TEA	11	2	LLL Atelecta.	9
19	1997	Friend	No	Yes	800	No	TEA	TEA, PCA	10	3	Incis. Hernia	7
20	1997	Father	No	Yes	NA	No	TEA	TEA	6	2	None	8
21	1997	Father	No	Yes	1000	No	TEA	TEA, PCA	9	4	None	8
22	1997	Father	No	Yes	800	No	TEA	TEA, PCA	9	4	None	8

ITM: Intrathecal Morphine; PCA: Patient controlled Analgesia; LEA: Lumbar Epidural Analgesia; TEA: Thoracic Epidural Analgesia; CS: Cell Saver; LLL: left lower lobe; JP: Jackson-Pratt; NA: not available, CS: Cell saver

with increased patient satisfaction. None of our patients had any clinically evident thromboembolic complication. The literature indicates that TEA is not associated with a high incidence of serious neurological complications. The incidence of accidental dural perforation is similar to or smaller than that reported in the lumbar region. Despite 30 documented dural perforations in thoracic region, no serious neurological complication was observed.[7]

Recently, a Health advisory was issued by the Food and Drug Administration raising concerns over reports of epidural hematomas with concurrent use of heparin. However, we feel that the benefit provided by TEA in the form of superior analgesia, better mobility and decreased risk of DVT supersede the benefit provided by heparin.

The major ethical concern was the risk to the donor. Although the anesthesia-related risk is low, a 7% incidence of major perioperative complications has been reported.[8] These include splenectomy, lymphocele and bile leak. However, these complications occurred only in donors who underwent full left lobectomy which is technically more difficult and the plane to be transected is larger than in left lateral segmentectomy. Reduction in cut surface in left lateral segmentectomy involves less trauma and decreases blood loss.[9,10]

Conclusion

Minimizing discomfort and providing a complication-free perioperative course would positively influence the continued availability of such donations. We observed only minor complications on reviewing the first 22 living donors. Postoperative pain is a serious problem and we feel that TEA provides satisfactory pain relief.

References

1 *Lloyd-Still JD.* Impact of orthotopic liver transplantation on mortality from pediatric liver disease. J Pediatr Gastroentro Nutr 1991; 12: 305–9.

2 *Zitelli BJ, Malatack JJ, Gartner JC Jr, et al.* Evaluation of the pediatric patient for liver transplantation. Pediatrics 1986; 78: 559–65.

3 *Thistlethwaite JR Jr, Emond JC, Heffron TG, Whitington PF, Black DD, Broelsch CE.* Innovative use of organs for liver transplantation. Transplant Proc 1991; 23: 2147–51.

4 *Strong RW, Lynch SV, Ong TH, Matsunami H, Koido Y, Balderson GA.* Successful liver transplantation from a living donor to her son. N Engl J Med 1990; 322: 1505–7.
5 *Singer PA, Siegler M, Whitington PF, et al.* Ethics of liver transplantation with living donors. N Engl J Med 1989; 321: 620–1.
6 *Davis PJ, Belani GK.* Liver transplantation. *In*: Cook DR, Davis PJ (Eds.). Anesthetic Principles for Organ Transplantation. New York: Raven Press, 1994: 159–81.
7 *Giebler RM, Scherer RU, Peters J.* Incidence of neurologic complications related to thoracic epidural catheterization. Anesthesiology 1997; 86: 55–63.
8 *Prager MC.* Care of organ donors. Int Anesthesiol Clin 1991; 29: 1–16.
9 *Kawasaki S, Makuuchi M, Matsunami H, et al.* Living related liver transplantation: a wider application. Transplant Proc 1995; 27: 1170–2.
10 *Broelsch CE, Emond JC, Whitington PF, Thistlethwaite JR, Baker AL, Lichtor JL.* Application of reduced-size liver transplants as split grafts, auxillary orthotopic grafts, and living related segmental transplants. Ann Surg 1990; 212: 368–77.