Red Blood Cell Transfusion in Pediatric Orthotopic Liver Transplantation: An evaluation in 278 cases

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INTRODUCTION

- Liver transplantation in children is often associated with coagulopathy and significant blood loss.
- In 1985, Borland et al. reported on the anesthetic management of 68 liver transplants from our institution[1]. Blood loss was reported as a mean of 5.4 blood volumes (BV), with a range of 0.5 to 25 blood volumes.
- In the past few decades, particularly in adult liver transplants, improvements in surgical technique and anesthetic management have decreased the utilization of blood products significantly[2].
- While children benefit from some advances in adult liver transplantation, significant blood loss and need for blood product transfusions continue to be a challenge.
- In this retrospective study, we assess the transfusion practice of red blood cells at our institution over the course of nine years.

METHODS

- This is a retrospective review of patient data from the electronic medical records at the Children's Hospital of Pittsburgh of University of Pittsburgh Medical Center.
- All patients who underwent liver transplantation from January 2008 to June 2017 were included.
- Individual charts were reviewed for demographic data, primary diagnoses, surgical times, packed red blood cell volume transfused intraoperatively, and mortality.
- The primary outcome assessed was volume of packed red blood cell transfused. Secondary outcome was mortality.
- Estimated blood volume ranges used for different age groups were as follows: Premature infant 90ml/kg, term infant 80ml/kg, infants younger than 12 months of age 75ml/kg, children 12 months of age and older 70ml/kg.

RESULTS

- From January 2008 to June 2017, there were 278 liver transplants at our institution.
- The number of primary transplants were 259, second repeat transplants 15, and third repeat transplants 4. Seven patients underwent repeat liver transplantation during the study period; there were 271 patients studied total.
- The average age at transplantation was 6.9 years. 144 of 278 patients (51.8%) were female. Biliary atresia, maple syrup urine disease, urea cycle defect, and liver mass were the leading indications for transplantation, accounting for 66 (23.7%), 45 (16.2%), 24 (8.6%), and 23 (8.3%) transplants respectively (Table 1).
- 76 (27.7%) transplant cases did not require red blood cell transfusions (Figure 1). Among those transfused, 181 (89.6%) transplant cases required less than 1 blood volume (BV). The median BV transfused among all cases was 0.21 (Q1 = 0, Q3 = 0.45).
- There is a trend toward higher volume transfusions among infants (median 0.46 BV) compared to children greater than 12 months (0.12 BV).
- By diagnosis, the group requiring the highest median volume transfusions were patients with TPN-related liver failure, followed by patients undergoing repeat transplants (Figure 2).
- Comparison of primary versus repeat transplants show a trend towards higher volume transfusions in third transplant (median 2.71 BV), compared to second transplant (0.43 BV) and primary transplant (0.18 BV).
- Four of 271 patients (1.5%) died during the admission involving the liver transplantation. Nine of 271 patients (3.3%) died subsequently. Total mortality was 4.8%. Follow-up mortality data of every patient was done at the time of this study, which ended on June 14th 2017; time of follow-up from transplant date ranged from 9 days to 3,434 days.

CONCLUSION

- In contrast to historically reported trends, evaluation of current transfusion practices reveal that most pediatric patients undergoing liver transplantation receive less than one blood volume of packed red blood cells.
- Our study shows that more than one in four pediatric liver transplantations require no transfusion at all.
- Risk factors for greater transfusion need include younger age, TPN-related liver failure, and repeat transplantation.

REFERENCES

1. Borland LM, Roule M, Cook DR. Anesthesia for pediatric orthotopic liver transplantation. Anesth Analg. 1985; 64: 117-24.
2. de Boer MT, Molenaar IQ, Hendriks HG, Slooff MJ, Porte RJ. Minimizing blood loss in liver transplantation: progress through research and evolution of techniques. Dig Surg. 2005;22(4):265-75.

RESULTS: TABLES AND FIGURES

Diagnosis	Number of transplants	Average of age at transplant (year)	Female (%)	Death during admission	Death subsequent
1 - Repeat transplant	19	8.75	10 (52.6)	1	2
2 - Biliary atresia	66	1.51	38 (57.6)	0	2
3 - Maple syrup urine disease	45	13.10	25 (55.6)	0	0
4 - Crigler Najjar	14	11.29	10 (71.4)	0	0
5 - Hepatoblastoma/liver mass/embryonal	23	3.51	10 (43.5)	0	1
6 - Acute fulminant hepatic failure	17	7.00	5 (29.4)	1	1
7 - Urea cycle defect	24	3.50	14 (58.3)	1	1
8 - Alagille syndrome	5	5.52	3 (60)	0	0
9 - Wilson's disease	4	14.25	0 (0)	0	0
10 - TPN related liver failure	4	2.83	2 (50)	0	0
11 - Cystic fibrosis	3	16.33	0 (0)	0	0
12 - Familial cholestasis	9	5.61	7 (77.8)	0	0
13 - Alpha 1 anti-trypsin deficiency	6	4.65	2 (33.3)	0	0
14 - Primary sclerosing cholangitis	9	14.40	6 (66.7)	0	1
15 - Glycogen storage disease	2	7.58	1 (50)	0	1
16 - Organic acidemia	4	5.52	2 (50)	0	0
17 - Congenital hepatic fibosis	6	10.83	3 (50)	0	0
18 - Other	18	10.50	6 (33.3)	1	0
Total	278	6.94	144 (51.8)	4	9

Table 1. Patient characteristics

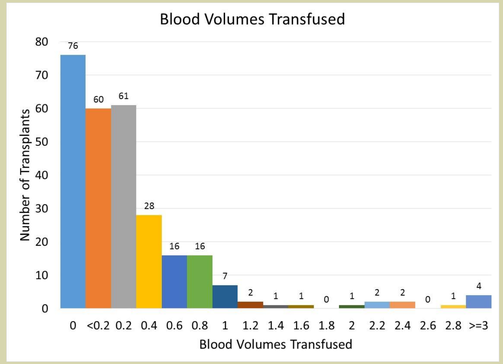

Figure 1. Distribution of blood volumes transfused

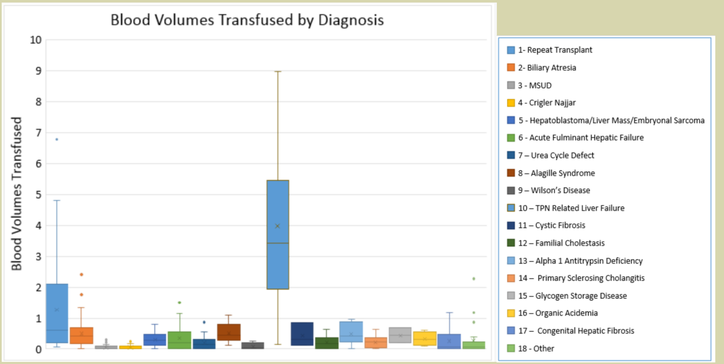

Figure 2. Blood volumes transfused by diagnosis