Prediction score in the Blood component utilization in live donor liver transplant of chronic liver disease patients: a comprehensive study

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Liver Tx. is blood intensive

- Starzl et al. first LT in 1963.
- First 4 patients died of heavy bleed despite they had done > 100 LT practices on mammal models.
- Only in 1967 first successful LT done.

Liver Tx. is blood intensive

1. Richly vascular-
    1. Receives 28% of the cardiac output - at the rate 58 ml/min per 100 g of liver (10 times more bl supply A/C/W an average body part)
    2. Is unique among organs- it receives blood via two distinct circulatory routes: systemic circulation and hepatic portal circulation.
2. Seat of production of coagulation and anticoagulation factors- deranged in end stage liver diseases, which leads to coagulopathy

Liver Tx. is blood intensive

3. Thrombocytopenia-
    1. Decreased thrombopoietin.
    2. Increased platelet destruction due to associated splenomegaly.
4. Portal hypertension itself is a risk factor for increased surgical bleed

Blood requirement in LT

Requirement of blood has reduced with time from over 100 units in the 1970s to 5-6 units recently.

1. Modifications in surgical techniques (piggyback, venovenous bypass, argon beam coagulation).
2. Autologous transfusion through cell savers.
3. Better cold preservation techniques, point of care tests (TEG)
4. Better control over coagulation and fibrinolysis pathways (rVIIa, EACA, tranexemic acid).

However, LT is still one of the most blood intensive surgeries.

Need for a scoring system

- McCluskey et al formulated 7 parameter index to predict massive blood loss during LT.
- Authors have analysed the effect of MELD and CTP score on the usage pattern.
- Authors have analysed from perspective of effect of blood tx on outcome.
- Some as fresh v/s old effect.
- Main emphasis on PRBCs.
- None are valuable predicting the volume of blood requirement.

Aims

- Development of a comprehensive* scoring system to calculate the blood demand during and within 48 hours of the LT.
- *All blood components included.

Materials and methods

- Retrospective data on 228 adult patients who underwent live donor liver transplant (LDLT), from March 2010 to July 2015.
- 149 patients selected post exclusion.
- 39 different parameters (demographic, comorbid, surgical and laboratory) pertaining to the patient were analysed including 3 scoring systems (CTP, MELD, Mc Cluskey)
- Binomial logistic regression and ROC analysis were used to arrive at the scoring system. Impact of application of score was analysed.

36 parameters

1. Age
2. Gender
3. Cold ischemia time (CIT)
4. Warm ischemia time (WIT)
5. Duration of surgery
6. Surgical blood loss
7. Weight
8. Height
9. BMI
10. Diagnosis
11. Presence / absence of ascites
12. Spontaneous bacterial peritonitis (SBP)
13. Hepatic encephalopathy (HE)
14. Acute kidney failure (AKI)
15. Upper gastroenterological (UGI) bleed
16. Comorbidity (hypertension, diabetes mellitus, hypothyroidism, tuberculosis, COPD etc.)
17. Previous surgeries
18. Re -exploration
19. Serum bilirubin total (SBT in mg%)
20. Serum bilirubin direct (SBD in mg%)
21. Serum bilirubin indirect (SBI in mg%)
22. SGOT in IU;
23. SGPT in IU
24. ALP in IU;
25. GGT in IU
26. Total protein (TP in g%)
27. Serum albumin (SA in g%)
28. Serum globulin (SG in g%)
29. Serum albumin to globulin ratio (A/G)
30. Blood urea (BU in mg%)
31. Serum creatinine(Cr in mg%)
32. Serum sodium (Na in mmol/ L)
33. Serum calcium (Ca in mmol/ L)
34. Haemoglobin (Hb in g%); Platelet (/µL)
35. Prothrombin time (PT in sec)
36. International normalised ratio (INR).

Why only ADULT CLD-LDLT ?

- A/AC-LF lacks the compensatory effect usually associated with CLD.
- DDLT intraoperative factors such as CIT and WIT vary, organ hibernation is more.
- Children blood requirements are different.
- We wanted a homogeneous population

Results

- 149 patients = 125 males + 24 females
- Average patient aged 45 years and weighed 68 kg.
- Average duration of the surgery was 16 hours.
- Average blood lost was 3.8 l.
- Average score of CTP, MELD and McKluskey system were 10, 18 and 3 respectively

Transfusion

- The blood usage data showed that the PRC, FFP, CRYO, SDP and RDP were 6,4,2, 1 and 0 on an average (median) respectively.
- There were 9 (6%) patients who needed more than 10 u of PRCs (a massive transfusion).
- The TI, MSBOS, TP and CT values were 6.63 units, 9.94 units, 99.99% and 3.01 respectively.

TTx as a surrogate

- 1TTx = 1PRBC + 1 FFP + 1 CP+ 1 SDP + 6 RDP.
- For a comprehensive score development (negate individual affinities).
- The packed red cell, fresh frozen plasma, cryoprecipitates and random donor / single donor platelets units showed a high significant correlations ($r=70- 85\%$, $p < 0.05$).
- Approving the TTx as a surrogate marker for transfusion of other components.

Univariate analysis

- Male gender,
- Warm ischemia time(min),
- Presence of ascites,
- Presence of SBP,
- High CTP score,
- High MELD score,
- High SBT and SBI levels,
- Fall in albumin levels,
- Increased s. globulin levels,
- Increased s. creatinine levels,
- Low Hb
- Increased INR

Binary logistic regression and ROC Curve

Binary Logistic Regression, ROC, Score derivation					
	Exp β	Score	Cut off	AUC	P
Hb g%	- 0.892	-1	10.85 g%	80 %	0
Globulin	1.436	1.5	3.75 g%	68 %	0.02
SBP	1.6	1.5	presence	64 %	0.028
CTP	1.1	1	10 pts	63 %	0.038

Score tested on our data..

Application of score on own data				
Score	PRC	FFP	Cryoprectpitate	RDP/SDP
0- 2	6	6	2	4 RDP
2- 4	7	6	4	5-6 RDP/ 1 SDP
4- 5	9	9	4	6 SDP / 1 SDP
P value*	0	0	0.048	0.036

*** Correlation coefficient (r) = 0.8**

Impact of the score on inventory*

	PRC	FFP	CRYO	SDP	RDP
Demandas per present MSBOS	1300	1300	1300	270	390
Demand as per new MSBOS**	650	585	260	65	65
Demand* as per scoring system**	437	411	134	33****	32*****
Reduction in demand	**66% & 33%**	**68% & 30%**	**90% & 50%**	**88% & 51%**	**92% & 51%**

***This is the yearly demand considering 65 CLD-LDLTs / year**

**** Calculated as mean of component usage * 1.5**

****Score tier 1 has 49% of patients, tier 2 has 40% of patient, tier 3 has 11% of the patients. Demand is calculated based on this distribution.**

***** demand of only tier 2 and 3 patients;****** demand of only tier 1 patients.**

Importance of this study

- First of its kind where the estimate of amount of bleeding from a patient can be anticipated during the workup stage itself.
- All components are taken into account.
- Formulated using readily available parameters.
- Reduction in demand (kept ready before surgery)can be translated as reduction in usage of resources, manpower and ultimately the cost incurred.
- Can be a model for application in other surgeries as well if the same methodology is followed.

Thank you
Questions please..