PHLEBOTOMY WITH CONTROLLED HYPOVOLEMIA IS ASSOCIATED WITH DECREASED RED BLOOD CELL TRANSFUSION IN LIVER SURGERY

L. BAKER^{1,2}, S. BENNETT^{1,2}, B. CHEN¹, S. SAEED^{1,2}, C. WHERRETT³, K. BERTENS¹, F.K. BALAA¹, G. MARTEL^{1,2}
¹ Liver And Pancreas Unit, Department Of Surgery, University Of Ottawa. ² Clinical Epidemiology Program, Ottawa Hospital Research Institute. ³ Department Of Anesthesiology, University Of Ottawa.

INTRODUCTION

- Blood loss during liver surgery is common → associated with worse perioperative morbidity and mortality
- Transfusion associated with significant risk
- Low central venous pressure (CVP) during liver transection protective of blood loss and transfusion requirement
- Intraoperative hypovolemic phlebotomy to lower CVP is associated with decreased blood loss
- The relationship between **phlebotomy** and **transfusion** requirement has **yet to be determined**

OBJECTIVE

Determine if **hypovolemic phlebotomy** is protective of red blood cell transfusion in patients undergoing liver resection

METHODS

Study design: retrospective review of prospectively collected data, cohort study: **hypovolemic phlebotomy** compared to control

Patient selection: all patients undergoing liver resection (2010-2016) at one referral center

Phlebotomy technique:

- Introduced in 2013, performed by one anesthetist
- 7-10mL/kg of patient body weight of whole blood removed in the 30 minutes preceding initiation of liver parenchymal transection
Example: for a 70kg patient, 490-700mL whole blood removed
- Minimal replacement IV fluid administered, vasopressors preferentially used to maintain hemodynamics
- Blood retransfused following parenchymal transection
- If transfusion required, retransfused phlebotomized blood, followed by allogenic blood transfusion if necessary

Phlebotomized cohort (n=45):

- Intervention based on availability of anesthetist trained in the study protocol and offered to selected patients
- Patients agreeable, verbal consent obtained
- Major resections favored
- Patients with significant renal, cardiac or cerebrovascular disease were excluded
- Patients with anemia (Hb<100g/L), coagulopathy (INR>1.5 or platelets <100x10⁹/L) or hepatic insufficiency (bilirubin >35umol/L) excluded

Data collected: Patient demographics, surgical details, laboratory data, phlebotomy data, and transfusion data were retrieved.

Patient factors	Surgery & Anesthesia	Details of liver resection
<ul style="list-style-type: none">GenderBMICADPrevious liver resectionHb <125Hb valuePlatelet value	<ul style="list-style-type: none">OR timeSurgeonPhlebotomyExtrahepatic resection	<ul style="list-style-type: none">Primary liver malignancyMajorNumber of tumorsLargest tumorBilobar diseasePringle maneuver

Statistical analysis: Variables identified on univariate regression associated with transfusion (p ≤0.2) examined in a multivariate logistic regression model

RESULTS

Table 1. A significantly larger proportion of patients underwent major hepatic resections and resections for primary liver malignancy in the phlebotomized cohort (p<0.05).

	Phlebotomy (n=45)	Control (n=328)	p
Age, median	63.4 (30.7, 84.3)	63.8 (21.8, 86.0)	0.578
Gender, female	18 (40.0%)	167 (50.9%)	0.170
BMI, median	24.5 (17.6, 43.9)	27.5 (15.3, 68.3)	0.0588
CAD	4 (8.9%)	26 (7.9%)	0.772
Major resections	38 (84.4%)	140 (42.7%)	<0.0001
Indication			0.0558
MCRC	22 (48.9%)	167 (51.1%)	
Cholangio/GB	6 (13.3%)	34 (10.4%)	
HCC	8 (17.8%)	23 (7.0%)	
Other	9 (20.0%)	103 (31.5%)	
Primary liver CA	14 (31.1%)	57 (17.4%)	0.0278

Table 2. Phlebotomy was associated with decreased blood loss and transfusion requirement (p<0.05).

	Phlebotomy (n=45)	Control (n=328)	p
OR time, median	305 (180, 526)	284 (62, 666)	0.473
Phlebotomy, g, median	521 (260, 850)	-	-
Phlebotomy, g/kg, median	7.23 (4.7, 10.2)	-	-
Blood loss, median	400 (100, 2100)	500 (0, 12000)	0.0563
Blood loss, mL/kg, median	5.87 (1.42, 22.6)	6.73 (0, 122.4)	0.0417
Losses >1,000 mL	8 (17.8%)	74 (26.3%)	0.219
pRBC Transfusion			
Index admission	5 (11.1%)	77 (23.5%)	0.0604
Intraoperative	2 (4.4%)	49 (15.4%)	0.0476
Postoperative	4 (8.9%)	53 (16.7%)	0.180
Perioperative 1 week	4 (8.9%)	61 (18.6%)	0.107
Length of stay	7 (4, 36)	6 (1, 369)	0.669

Table 3. Predictors of blood transfusion by multivariate analysis. Phlebotomy group 4.3 times less likely to receive blood transfusion.

Variables	OR	95% CI	p
Phlebotomy	0.231	0.081-0.655	0.0059
Major resection	2.858	1.622-5.036	0.0003
Preop hemoglobin <12.5 g/dL	6.045	3.482-10.493	<0.0001

Variables included in multivariable model: phlebotomy, CAD, major liver resection, preoperative Hb<125, extrahepatic resection

CONCLUSION

Phlebotomy with controlled hypovolemia appears to be significantly **protective** of red blood cell transfusion, **independent from other known risk factors**