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Risk factors for blood loss in liver resection surgery: An Institutional Review.

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Abstract

Background: Surgical resection of the primary or metastatic liver lesions is the treatment of choice for patients with resectable tumors. Identifying and managing preoperative and intraoperative risk factors responsible for increased blood loss during liver resection is extremely important. Therefore, the present study aims to identify preoperative and intraoperative risk factors associated with blood loss during liver resection.

Methodology: A retrospective cross-sectional study was conducted on 72 patients who underwent liver resection for resectable primary and metastatic liver lesions at the Department of Surgical Oncology Hepatobiliary Unit, Shaukat Khanum Memorial Cancer Hospital, and Research Center Lahore. The study continued from October 2014 to July 2017, and data were collected from hospital records, including demographic, biochemical, and perioperative variables.

Results: Out of the total 38 patients, 52.8% were female, with a mean age of 40.59 ± 21.66 years at the time of surgery. The results after multivariate analysis conclude two independent risk factors responsible for significant blood loss of more than 1000 milliliters during liver resection. These factors include liver cirrhosis, where the odds ratio is 7.96 with 95% CI (1.00-63.31) and P-value of < 0.05 and operative time of ≥ 390 minutes where odds ratio is 8.94 with 95% CI (2.28-36.48) and P-value of 0.02.

Conclusion: The risk factors associated with increased intraoperative blood loss during liver resections in our population are mainly associated with preoperative parameters, including positive viral serology and radiologically proven liver cirrhosis. In contrast, intraoperative factors were intravenous fluid administration and operative time.

Keywords

Hepatocellular Carcinoma, Blood Loss, Cirrhosis, Pringle Technique.

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Introduction

Surgical resection of the primary or metastatic liver lesions is the treatment of choice for the patients who presented with resectable tumors. Liver resection is a major surgical procedure and requires proper preoperative planning before proceeding with any surgical intervention. Intraoperative blood loss during liver resection can lead to serious complications in the postoperative recovery phase like liver failure. Massive blood loss during surgery may need blood transfusion intraoperatively or in the postoperative course, ultimately contributing to negative outcomes. Liver failure in the postoperative recovery phase and complications associated with blood transfusion both can result in multiple morbidities and even mortality[1,2]. Martinez-Meir et al. reported in the literature that increased blood loss during liver resection surgeries is associated with postoperative morbidities and even mortalities[3].

Blood transfusions are potentially life-saving, but the risks of transfusion are well documented, and there is evidence that an allogenic blood transfusion in cancer resections has an adverse immunomodulatory effect associated with increased risk of tumour recurrence and poor prognosis[4].

Multiple randomized controlled trials in orthopedic and critical care surgery have compared liberal blood transfusion and restricted blood transfusion protocols, and their results concluded that restricted blood transfusion is at least equivalent and potentially beneficial in reducing morbidities and mortalities associated with major surgeries[5].

Despite improvement in surgical techniques, a better understanding of the physiological anatomy of the liver, better diagnostic conditions, availability of advanced surgical instruments, and advancement in anesthesiology, and critical care, liver resection remains a challenging surgical procedure. Managing excessive blood loss during liver resection has a central role in liver surgery and is still demanding and considered to be of major concern for hepatic surgeons[6,7].

Preoperative planning for this major surgical procedure can control intraoperative blood loss, which minimizes complications in the postoperative recovery phase. Identifying the preoperative and intraoperative risk factors responsible for increased blood loss during liver resection is extremely important. Optimizing these factors will minimize postoperative complications and enhance the postoperative recovery phase, directly influencing surgical outcomes.

The objective of this study was to identify preoperative and intraoperative risk factors associated with intraoperative blood loss during liver resection so that we can optimize these factors and improve surgical outcomes in our patients.

Methodology

A cross-sectional study was conducted on 72 patients who underwent liver resection for primary and metastatic liver lesions at the Surgical Oncology Hepatobiliary Unit, Shaukat Khanum Memorial Cancer Hospital and Research Center Lahore from October 2014 to July 2017.

The data were retrospectively collected through hospital records, including clinical, biochemical, and perioperative variables such as age, gender, diabetes, hypertension, ischemic heart disease, hepatitis, cirrhotic nature of the liver, ascites, varices, Child-Pugh score, preoperative chemotherapy, hemoglobin, white blood count, platelets count, prothrombin time, activated partial thromboplastin time, renal profile, liver function tests, central venous pressure, intraoperative intravenous fluid, intraoperative blood loss, operative time, tumor size, tumor location, benignity, malignancy, primary liver lesion, metastatic lesion, hepatic and portal vein involvement, major hepatectomy (if 3 or more segments involved), time of pringle technique, and tumor pathology. Patients were followed until the final histopathology of the specimen was received. The statistical analysis was carried out using SPSS version 23.0. Percentages and frequencies were used for categorical variables, while the mean and standard deviation was used for continuous variables. A Chi-square test and Fisher exact tests

were used to assess the association of categorical variables with blood loss. To identify the independent risk factors associated with blood loss, multivariable logistic regression (MLR) model was used, p-value < 0.05 was considered statistically significant.

Results

The mean age of patients at the time of surgery was 40.59 ± 21.66 years. Radiologically proven liver cirrhosis and positive viral serology were observed in 16.7% of patients. Chemotherapy was required and given to 47.2% of patients preoperatively. Results showed that patients in whom preoperative platelets count was < 80000 units per microliters of blood, radiologically proven liver cirrhosis, positive viral serology, intravenous fluid of > 7500 milliliters given during surgery, and operative time of ≥ 390 minutes have a blood loss of > 1000 milliliters during surgery with statistically significant (p<0.05) (Table 1).

Table 1: Baseline characteristics with respect to blood loss among the enrolled patients.

Variables		Total (n=72)	<1000 ml (n=45)	≥1000 ml (n=27)	p-value
Age in years; Mean±SD		40.59±21.66	36.07±22.95	48.14±17.18	0.02*
Gender	Male	34 (47.2)	22 (48.9)	12 (44.4)	0.72
	Female	38 (52.8)	23 (51.1)	15 (55.6)	
Presence of Comorbidities		26 (36.15)	17 (37.8)	9 (33.3)	0.70
Cirrhosis		12 (16.7)	2 (4.4)	10 (37.0)	0.001*
Platelets (<80,000/uL)		5 (6.9)	-	5 (18.5)	0.01*
Neo-adjustment chemotherapy		34 (47.2)	25 (55.6)	9 (33.3)	0.06
Positive Viral serology		12 (16.7)	2 (4.4)	10 (37.0)	0.001*
Hepatectomy (> 3 segments)		6 (8.3)	5 (11.1)	1 (3.7)	0.40
Pringle Technique		34 (47.2)	18 (40.0)	16 (59.3)	0.11
Operative time (> 390 minutes)		30 (41.7)	10 (22.2)	20 (74.1)	0.001*
Intraoperative IVF (Above 7500 ml)		25 934.7)	8 (17.8)	17 (63.0)	0.001*
Tumor Pathology	Metastatic Lesion	31 (43.1)	20 (44.4)	11 (40.7)	0.001*
	Gallbladder Carcinoma	14 (19.4)	11 (24.4)	3 (11.1)	
	Hepatocellular Carcinoma	13 (18.1)	2 (4.4)	11 (40.7)	
	Hepatoblastoma	10 (13.9)	10 (22.2)	-	
	Benign Lesion	4 (5.6)	2 (4.4)	2 (7.4)	

IVF= Intra-venous fluid
Values are given as mean±SD or n(%)
*p<0.05 is considered statistically significant.

Multivariate analysis of results performed using multivariate logistic regression model (MLR), the results points out two independent risk factors responsible for significant blood loss of more than 1000 milliliters during liver resection. These factors include liver cirrhosis, where the odds ratio is 7.96 with 95% CI (1.00-63.31) (p<0.05), showing that there is 7.6 times more chance of increased blood loss in patients with cirrhotic liver as compared to patients with normal liver parenchyma while the other factor was the operative time ≥ 390 minutes where odds ratio is 8.94 with 95% CI (2.28-36.48) and P-value of 0.02 showing that there is 8.9 times more chance of increased blood loss if the operative time is ≥ 390 minutes (Table 2).

Table 2: Predictors of blood loss.

Variables		OR (95% CI)	p-value
Age (years)		1.03(1.0-1.06)	0.10
Cirrhosis	Yes	7.96(1.00-63.31)	0.05*
Neoadjuvant Chemotherapy	Yes	1.96(0.47-8.09)	0.35
Operative Time	Above 390 Minutes	8.94(2.28-36.48)	0.02*
Intraoperative IVF	Above 7500 Ml	1.50(0.32-7.03)	0.60

*p<0.05 is considered statistically significant.

Discussion

This study points out several risk factors associated with major intraoperative blood loss during liver resection surgery. These risk factors are related to the clinical status of the patients before surgery and factors involved in the intraoperative period. Massive blood loss during liver resection is an indicator of liver failure development in the postoperative recovery phase. Liver failure, in turn, influences postoperative morbidities and even mortality. So, for the patient's best benefit, surgeons should do their best to minimize bleeding during liver resection. Therefore, if intraoperative blood loss is controlled, it will help us to prevent postoperative liver failure and its associated complications[8].

Risk factors evident in our study for massive intraoperative bleeding include positive hepatic viral serology, radiologically proven cirrhotic liver, pringle technique during surgery, intraoperative intravenous fluid administration, and the operative time. Some of the risk factors that are associated with massive intraoperative bleeding in other studies like biochemical parameters (prothrombin time, liver function tests, etc.), chronic degenerative diseases (diabetes, hypertension, ischemic heart disease, etc.) were not found to be significant in our study[9].

Most of the patients in our study have resectable primary or metastatic liver cancer, and some of them received Neo-adjuvant chemotherapy. In our study, the use of preoperative chemotherapy has not been associated with increased blood loss during liver resection compared to the patients who underwent upfront surgeries. These results, compared with international studies, showed a similar outcome[10].

Restricted use of perioperative intravenous fluid is associated with reduced intraoperative blood loss. It has a beneficial effect on the patient postoperative recovery phase, including improved renal functions, reduced postoperative complications, and early recovery[11]. Keeping in view this evidence, many world centers now use the policy of restricted intraoperative intravenous fluids during major surgical procedures like liver resection[12,13]. Such patients respond better to critical care and major surgical insults. Our study also favors that if intraoperative intravenous fluids are kept low, then blood loss is also reduced in these patients.

Several studies concluded that Intraoperative raised central venous catheter pressure is also associated with increased blood loss, especially during liver resection surgeries[14,15]. Still, it was not reflected in our study because we kept central venous pressure less than 5 cm of H_2O in all liver resections.

The duration of the surgical procedure itself is considered a significant parameter of intraoperative blood loss and associated morbidities in the postoperative period. Prolong duration of the surgery will increase intraoperative blood loss, which will, in turn, complicate the postoperative recovery phase. Duration of surgical procedure is affected by the intraoperative findings, variation in the liver anatomy, the extent of tumor resection, and underlying coagulopathies[16]. Our study also showed that patients whose surgery duration was ≥ 390

minutes have more blood loss (>1000 milliliters) than surgeries that took less than 390 minutes. Our study has certain limitations in that it is a retrospective study, and the sample size is small. We recommend testing the findings of this study in a prospective controlled study and with a large number of patients.

Conclusion

Blood loss during liver resection surgery is associated with both preoperative and intraoperative parameters. Preoperative parameters include platelet count, positive viral serology, and radiologically proven liver cirrhosis, while intraoperative factors include intravenous fluid administration and operative time. Hence controlling these parameters, we can reduce intraoperative blood loss, and in turn, it will help to minimize postoperative complications associated with this major surgical procedure.

Conflicts of Interest

The authors have declared that no competing interests exist.

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References

1. Mise Y, Sakamoto Y, Ishizawa T, Kaneko J, Aoki T, Hasegawa K, Sugawara Y,Kokudo N. A worldwide survey of the current daily practice in liver surgery. Liver Cancer. 2013; 2(1): 55-66.
2. Li Z, Sun YM, Wu FX, Yang LQ, Lu ZJ, Yu WF. Controlled low central venous pressure reduces blood loss and transfusion requirements in hepatectomy. World J Gastroenterol. 2014; 20(1): 303-309.
3. Martínez-Mier G, Esquivel-Torres S, Alvarado-Arenas RA, Ortiz-Bayliss AB, Lajud-Barquín FA, Zilli-Hernandez S. Liver resection morbidity, mortality, and risk factors at the departments of hepatobiliary surgery in Veracruz, Mexico. Rev Gastroenterol Mex. 2016;81(4):195-201.
4. Cockbain AJ, Masudi T, Lodge JP, Toogood GJ, Prasad KR. Predictors of blood transfusion requirement in elective liver resection. HBP. 2010; 12(1): 50-55.
5. Carson JL, Sieber F, Cook DR, Hoover DR, Noveck H, Chaitman BR, Fleisher L, Beaupre L, Macaulay W, Rhoads GG, Paris B. Liberal versus restrictive blood transfusion strategy: 3-year survival and cause of death results from the FOCUS randomised controlled trial. Lancet. 2015; 385(9974): 1183-1189.
6. Sand L, Lundin S, Rizell M, Wiklund J, Stenqvist O, Houltz E. Nitroglycerine and patient position effect on central, hepatic and portal venous pressures during liver surgery. Acta Anaesthesiol Scand. 2014; 58(8): 961-967.
7. Huntington JT, Royall NA, Schmidt CR. Minimizing blood loss during hepatectomy: a literature review. J Surg Oncol. 2014; 109(2): 81-88.
8. McNally SJ, Revie EJ, Massie LJ, McKeown DW, Parks RW, Garden OJ, Wigmore SJ. Factors in perioperative care that determine blood loss in liver surgery. Hpb. 2012; 14(4): 236-241.
9. Choi SS, Jun IG, Cho SS, Kim SK, Hwang GS, Kim YK. Effect of stroke volume variation-directed fluid management on blood loss during living-donor right hepatectomy: a randomised controlled study. Anaesthesia. 2015; 70(11): 1250-1258.
10. Yamazaki S, Takayama T. Current topics in liver Surgery. Ann Gastroenterol surg. 2019;15;3(2):146-159.
11. Zhang Y, Ge L, Weng J, Tuo WY, Liu B, Ma SX, Yang KH, Cai H. Neoadjuvant chemotherapy for patients with resectable colorectal cancer liver metastases: A systematic review and meta-analysis. World J Clin Cases. 2021; 9(22): 6357.
12. Choi SS, Kim SH, Kim YK. Fluid management in living donor hepatectomy: Recent issues and perspectives. World J Gastroenterol. 2015; 21(45): 12757.
13. Hughes MJ, Ventham NT, Harrison EM, Wigmore SJ. Central venous pressure and liver resection: a systematic review and meta-analysis. HPB. 2015; 17(10): 863-871.
14. Rahnemai-Azar AA, Cloyd JM, Weber SM, Dillhoff M, Schmidt C, Winslow ER, Pawlik TM. Update on liver failure following hepatic resection: strategies for prediction and avoidance of postoperative liver insufficiency. J Clin Transl Hepatol. 2018; 6(1): 97.
15. Yu L, Sun H, Jin H, Tan H. The effect of low central venous pressure on hepatic surgical field bleeding

and serum lactate in patients undergoing partial hepatectomy: a prospective randomized controlled trial. BMC Surg. 2020; 20(1): 1-9.

16. Lee SG. A complete treatment of adult living donor liver transplantation: a review of surgical technique and current challenges to expand indication of patients. Am J Transplant. 2015; 15(1): 17-38.