Original article

Risk factors for post-operative coagulopathy following hepatic resection and safety of epidural anesthesia: a retrospective cohort single center study

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Objectives Hepatic resection is a major abdominal surgery which potentially induced post-operative coagulopathy. Moreover, coagulopathy has become one of the major concerns about the safety of epidural anesthesia.The aim of this study is to identify the incidence and risk factors of coagulopathy after hepatic resection and evaluate the safety of epidural anesthesia.

Methods A retrospective review of elective hepatic resections over a 10-year period was performed. Post-operative coagulopathy was defined as either INR ≥ 1.5 or platelet level < 100,000/μL. A logistic regression analysis was used to identify the independent risk factors, which use to calculate the area under the ROC curve to measure the accuracy of the model.

Results Five hundred and thirty-six patients were included in this study. The incidence of post-operative coagulopathy was 33 percent. The independent factors associated with post-operative coagulopathy included pre-operative thrombocytopenia (OR=10.380 (4.010-26.872)); pre-operative INR > 1.3 (OR = 17.743 (4.751- 66.255)); delta (POD 1 - preoperative) INR > 0.3 (OR = 18.637 (8.949-38.812)); hepatectomy with hilar resection (OR = 3.354 (1.681- 6.692)); estimated blood loss >1,000 mL (OR = 2.086 (1.105-3.936)) and colloid administration > 600 mL (OR = 2.056 (1.052-4.019)). The area under the ROC curve was 0.876.

Conclusion The incidence of coagulopathy after hepatic resection was common. The results showed the possible safety of epidural anesthesia in patients with normal pre-operative coagulation and underwent minor or major hepatectomy without hilar resection. The benefits and risks of epidural anesthesia in hepatic resection should be carefully weighted.
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Keywords: hepatic resection, post-operative coagulopathy, risk factors, epidural anesthesia

Introduction

The liver is a major organ that regulates the coagulation system by synthesis of coagulation factors as well as the anticoagulant system. The impairment of hepatic synthetic function following hepatic resection included both the coagulation and anticoagulant system has been reported in several studies (1, 2). These studies showed the coagulation profile derangement after hepatic resection either minor (< 3 hepatic segments) or major (≥ 3 hepatic segments) hepatic resection (3). In addition, major hepatic resection resulted in more frequent occurrence of post-operative coagulopathy. Our region, the northern part of Thailand, has a high incidence of cholangiocarcinoma which usually requires a major hepatectomy with hilar resection and vascular reconstruction in some cases (4). A Few studies have focused on attempting to identify the risk factors of coagulopathy after hepatic resection which were duration of surgery, resected liver weight, volume of

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blood loss, and intravenous fluid administration (5,6). However, no studies mentioned the extension of surgery and the type of intravenous fluid administration.

The use of thoracic epidural anesthesia has been shown to be beneficial in cases of major abdominal surgery, resulting in decreased post-operative pain and opioid consumption (7,8). Furthermore, several studies showed epidural anesthesia to be safe, shortening hospital stays and decreasing post-operative pulmonary complications in hepatic resection (9-11). However, coagulopathy became a major concern about the safety of continuous epidural anesthesia after hepatic resection due to the risk of postoperative coagulopathy and epidural hematoma (12).

The aim of this study was to identify the incidence and risk factors of coagulopathy after hepatic resection in our center and evaluate the safety of epidural anesthesia in that group.

Methods

After approval of the study protocol by the Institutional Review Board, a retrospective review was performed of all patients who underwent an elective hepatic resection in Maharaj Nakorn Chiang Mai Hospital from January 1, 2007 to December 31, 2017. Written informed consent was obtained from patients or their guardians. The data was collected prospectively from the medical records. Baseline characteristics included age, gender, body mass index (BMI), co-morbidity, the American Society of Anesthesiologist (ASA) physical status classification, pre-operative diagnosis, chronic hepatic disease, and pre-operative laboratory investigations data were collected.

Intra-operative data including type of hepatic resection included hilar resection and vascular reconstruction, hepatic vascular occlusion, epidural anesthesia, volume and type of fluid administration, estimated blood loss, blood product transfusion, operative time, lowest temperature, duration of hypothermia, and presence of acidosis were collected.

Post-operative data including the incidence of epidural hematoma, day of epidural removal, length of hospital stay, 30-day mortality, International normalized ratio (INR), and platelet count from post-operative day 1 to day 5 were collected. Post-operative coagulopathy was defined as either INR ≥ 1.5 or platelet level < 100,000/μL. The definition of intraoperative hypothermia was a core body temperature less than 36 °C during the operation. Patients who received any form of anticoagulants and did not have post-operative prothrombin and platelet data were excluded from the study.

Statistical analysis

The distribution of normality was tested by the Kolmogorov-Smirnov test. Normal distributed continuous data was reported as mean ± standard deviation and compared by T-test. Non-normal distributed continuous data was reported as median ± interquartile range and compared by the Mann-Whitney U test. Categorical data was reported in number (percentage) and compared by Chi-square test. A logistic regression analysis was used to identify the independent risk factors of post-operative coagulopathy. All significant factors in univariate analysis were used in multivariate analysis. The significant factors from the multivariate analysis were used to calculate the area under the receiving operating curve (ROC) to measure the accuracy of the model. For all analyses, the *p*-value less than 0.05 was considered statistically significant.

Results

A total of 612 patients underwent hepatic resection in our center from January 1, 2007 to December 31, 2017. Eighty-one patients were excluded from the study due to a lack of available laboratory data for post-operative coagulopathy. Five hundred thirty-six patients were therefore included in the study. The patients were allocated into 2 groups, those with post-operative coagulopathy and those without. Demographic and pre-operative data were shown in Table 1. The median age, gender, co-morbidities, and ASA classification were not significantly different between the two groups. The majority of the patients

Table 1. Baseline characteristics in liver resection patients (n=536)

Baseline characteristics	Presence of postoperative coagulopathy (n=177)	Absence of postoperative coagulopathy (n=359)	*p*-value
Gender			0.382
Male	99 (55.9)	215 (59.9)	
Female	78 (44.1)	144 (40.1)	
Age (yr)	55.00 (48.00-64.00)	56.00 (49.00-64.00)	0.795
BMI (kg/m^2)	22.14 (19.52-24.88)	22.00 (19.90-24.21)	0.696
Co-morbidity			
Cardiovascular disease	41 (23.2)	86 (24.0)	0.839
Non-cardiovascular disease	80 (45.2)	147 (40.9)	0.349
ASA physical status			
1	20 (11.3)	58 (16.2)	0.055
2	129 (77.9)	269 (74.9)	
3	26 (14.7)	31 (8.6)	
Preoperative diagnosis Benign tumor	14 (7.9)	53 (14.8)	0.168
HCC	79 (44.6)	161 (45.0)	
CCA	59 (33.3)	107 (29.9)	
Liver metastasis	13 (7.3)	20 (5.6)	
Others	12 (6.8)	17 (4.7)	
Chronic hepatic disease			0.291
Hepatitis B	19 (10.8)	54 (13.2)	
Hepatitis C	6 (3.4)	5 (1.2)	
Hepatitis B & C	3 (1.7)	6 (1.5)	
Type of hepatic resection			
Minor hepatectomy	69 (39)	154 (42.9)	0.387
Major hepatectomy	108 (61)	205 (57.1)	
Hilar resection	58 (32.8)	78 (21.7)	0.006*
Vascular reconstruction	22 (12.4)	37 (10.3)	0.467
Portal vein embolization	2 (1.1)	11 (3.1)	0.171
Preoperative laboratory investigation			
International normalized ratio	1.12 (1.03-1.23)	1.05 (1.00-1.12)	< 0.001*
Prothrombin time (sec)	12.10 (11.10-13.28)	11.30 (10.70-12.00)	< 0.001*
Partial thromboplastin time (sec)	31.30 (29.23-34.48)	31.50 (29.20-33.80)	0.585
Platelet count (x10^3/uL)	232.00 (169.50-317.00)	264.00 (205.00-334.00)	0.005*
Hemoglobin (g/dl)	12.00 (10.45-13.15)	12.40 (11.40-13.70)	0.001*
Hematocrit (%)	36.00 (32.35-39.90)	38.00 (34.70-41.80)	< 0.001*
Aspartate aminotransferase (U/L)	47.50 (30.25-79.00)	36.00 (26.00-64.00)	0.001*
Alanine aminotransferase (U/L)	37.00 (22.25-62.50)	29.00 (19.00-55.00)	0.018*
Total bilirubin (mg/dL)	0.94 (0.60-2.27)	0.68 (0.45-1.16)	< 0.001*
Direct bilirubin (mg/dl)	0.34 (0.16-1.26)	0.19 (0.12-0.48)	< 0.001*
Alkaline phosphatase (U/L)	132.00 (94.25-217.00)	114.00 (77.00-186.75)	0.016*
Blood urea nitrogen (mg/dL)	11.00 (9.00-14.00)	12.00 (9.00 0-14.00)	0.498
Creatinine (mg/dL)	0.90 (0.70-1.10)	0.90 (0.70-1.00)	0.267

Value are median (interquartile range) or number (percentage)

*Statistically significant with $p < 0.05$

BMI; body mass index, ASA=American Society of Anesthesiologists, HCC; hepatocellular carcinoma, CCA; Cholangiocarcinoma who underwent hepatectomy were diagnosed with hepatocellular carcinoma (44.78%), followed by cholangiocarcinoma (30.97%), benign disease (12.50%), and liver metastasis (6.16%). Pre-operative laboratory data was shown in Table 1. Patients with post-operative coagulopathy had significantly higher pre-operative INR, Prothrombin time (PT), Aspartate transaminase (AST), Alanine transaminase (ALT), Total Bilirubin (TB), and Direct Bilirubin (DB). The pre-operative hemoglobin and platelet count were significanly lower in the post-operative coagulopathy group. Major hepatectomy was performed in 58.39%. Among all patients, 25.37% underwent hilar resection and 11.01% had vascular reconstruction. Operative data was shown in Table 2. Operative time and estimated blood loss were significantly longer and higher in the post-operative coagulopathy group. The incidence of intra-operative hypothermia was not significantly different, but the lowest core temperature during the operation was significantly lower and the duration of hypothermia was significantly longer in the post-operative coagulopathy group. Intra-operative intravenous fluid administration was significantly higher in the post-operative coagulopathy group. The incidence of metabolic acidosis was not significantly different between both groups.

The incidence of post-operative coagulopathy was 33%. The maximal median derangement of INR in the post-operative coagulopathy group was 1.61 (1.37-1.82) on post-operative day 4-5 and the lowest platelet level was 127.5x10^3/μL (89.5-188) on post-operative day 4-5 as well. In the post-operative coagulopathy group, thoracic epidural anesthesia had been performed in 68 patients (38.4%). The numbers of patients in this group receiving post-operative FFP and platelet

Table 2. Intraoperative data in hepatic resection patients (n=536)

Intraoperative data	Presence of postoperative coagulopathy (n=177)	Absence of postoperative coagulopathy (n=359)	*p*-value
Volume of fluids administered during surgery (mL)			
Total intravenous fluid	3150.0 (2240.0-4250.0)	2400.0 (1750.0-3192.5)	<0.001*
Crystalloids	2000.0 (1300.0-2900.0)	1745.0 (1250.0-2400.0)	0.006*
Colloids	1000.0 (550.0-1600.0)	500.0 (0.0-1000.0)	<0.001*
Starch	1000.0 (450.0-1500.0)	500.0 (0.0-1000.0)	<0.001*
Gelatin	0.0 (0.0-100.0)	0.0	0.006*
Estimated blood loss (ml)	1200.0 (600.0-1875.0)	650.0 (400.0-1025.0)	<0.001*
Intraoperative transfusion	107 (60.8)	148 (41.5)	<0.001*
Volume of PRBC received (ml)	210.0 (0.0-530.0)	0.0 (0.0-250.0)	<0.001*
Volume of FFP received (ml)	0.0 (0.0-630.0)	0.0	<0.001*
Units of platelets received (unit)	0.0	0.0	0.004*
Operating time (minutes)	405.0 (310.0-502.5)	350.0 (285.0-435.0)	<0.001*
Epidural block	68 (38.6)	157 (44.0)	0.240
Core body temperature at the end of surgery (°C)	34.7 (34.0-35.5)	35.0 (34.4 -35.6)	0.013*
Lowest core body temperature (°C)	34.50 (33.90-35.13)	34.80 (34.30-35.40)	0.003*
Intraoperative hypothermia	143 (89.9)	292 (91.0)	0.716
Duration of hypothermia (minutes)	340.00 (236.25-448.75)	290.00 (180.00-392.50)	<0.001*
Acidosis	24 (34.3)	44 (33.6)	0.921
Vascular occlusion (Pringle's maneuver)	18 (10.2)	35 (9.7)	0.878
Duration of Pringle's maneuver (minutes)	30.00 (8.75-42.50)	15.00 (9.00-24.00)	0.184

Value are median (interquartile range) or number (percentage)

*Statistically significant with $p < 0.05$

PRBC; packed red blood cells, FFP; fresh frozen plasma

Table 3. Postoperative outcomes in hepatic resection patients (n=536)

Intraoperative data	Presence of postoperative coagulopathy (n=177)	Absence of postoperative coagulopathy (n=359)	*p*-value
Postoperative transfusion	98 (56.3)	50 (14.2)	<0.001*
PRBC transfusion	73 (42.0)	26 (7.4)	<0.001*
FFP transfusion	67 (38.5)	31 (8.8)	<0.001*
Platelet transfusion	18 (10.3)	0 (0.0)	<0.001*
Epidural hematoma	0 (0.0)	0 (0.0)	N/A
Length of hospital stay (days)	9.0 (8.0-14.0)	8.0 (7.0-12.0)	0.002*
30-day mortality	10 (5.7)	5 (1.4)	0.005*

Value are median (interquartile range) or number (percentage), *Statistically significant with $p < 0.05$
PRBC; packed red blood cells, FFP; fresh frozen plasma

Table 4. Postoperative INR and platelet data

Parameters	All patients (n=536)	Presence of postoperative coagulopathy (n=177)	Absence of postoperative coagulopathy (n=359)	*p*-value
INR POD 1	1.23 (1.12-1.40)	1.50 (1.29-1.63)	1.19 (1.10-1.29)	<0.001*
INR POD 2-3	1.37 (1.24-1.60)	1.55 (1.34-1.72)	1.28 (1.16-1.38)	<0.001*
INR POD 4-5	1.38 (1.20-1.68)	1.61 (1.37-1.82)	1.20 (1.10-1.31)	<0.001*
Platelet POD 1	208.00 (155.0-281.0)	177.50 (113.75-250.50)	218.00 (164.00-293.00)	<0.001*
Platelet POD 2-3	186.00 (138.0-253.0)	142.00 (94.00-199.00)	208.00 (163.50-279.00)	<0.001*
Platelet POD 4-5	175.00 (117.8-238.5)	127.50 (89.50-188.00)	196.00 (160.00-292.00)	<0.001*

Value are median (interquartile range) or number (percentage), *Statistically significant with $p < 0.05$
PRBC; packed red blood cells, FFP; fresh frozen plasma, POD; post-operative day

transfusion were 28 (41.8%) and 5 (7.5%) respectively. These were to correct post-operative coagulopathy before the removal of the epidural catheter. The median of the epidural catheter removal was on a post-operative day 3 in both groups. However, there was no incidence of epidural hematoma recorded in either group. The patients who had post-operative coagulopathy had significantly higher 30-day mortality and longer hospital stay (Table 3).

Univariate analysis showed a significant association between, pre-operative anemia (Hb < 10 g/dL) (OR = 2.048 (1.172-3.581), pre-operative thrombocytopenia (platelet count < 150x10^3/μL) (OR = 3.599 (1.986-6.523)), pre-operative INR > 1.3 (OR= 4.688 (2.156-10.190)), delta INR (Post-operaive INR day 1 – preoperative INR) > 0.3 (OR = 15.165 (8.712-26.396)), hepatectomy with hilar resection (OR = 1.756 (1.175-2.624)), estimated blood loss >1,000 mL (OR = 3.749 (2.561-5.489)), Colloid administered > 600 mL (OR = 3.349 (2.278-4.925)), Operating time > 360 minutes (OR = 1.774 (1.229-2.560)), and duration of hypothermia > 300 minutes (OR = 1.981 (1.346-2.915)). Multivariate analysis showed the independent factors associated with post-operative coagulopathy included: pre-operative thrombocytopenia (OR=10.380 (4.010-26.872)); pre-operative INR > 1.3 (OR = 17.743 (4.751-66.255)); delta INR > 0.3 (OR = 18.637 (8.949-38.812)); hepatectomy with hilar resection (OR=3.354 (1.681–6.692)); estimated blood loss >1,000 mL (OR = 0.086 (1.105-3.936)), and colloid administration > 600 mL (OR = 2.056 (1.052-4.019)). The significant factors from the multivariate analysis were used to calculated the area under the ROC to evaluate the accuracy of the model. The area under the ROC curve was 0.876 (Figure 3).

Discussion

The incidence of post-operative coagulopathy in our study was 33% with the post-operative INR

Table 5. Risk factors of postoperative coagulopathy in hepatic resection patients

Variable	Univariate analysis		Multivariate analysis	
	Odds Ratio (95% CI)	*p*-value	Odds Ratio (95% CI)	*p*-value
Age > 65 years	0.879 (0.567–1.361)	0.563		
ASA classification > 2	1.513 (0.878–2.605)	0.136		
Hemoglobin < 10 g/dL	2.048 (1.172–3.581)	0.012*	1.880 (0.750–4.716)	0.178
Preoperative platelet count < 150 (x10^3/μL)	3.599 (1.986–6.523)	<0.001*	10.380. (4.010–26.872)	0.001*
Preoperative INR > 1.3	4.688 (2.156–10.190)	<0.001*	17.743 (4.751–66.255)	<0.001*
Delta INR > 0.3 (POD 1 INR – preoperative INR)	15.165 (8.712–26.396)	<0.001*	18.637 (8.949–38.812)	<0.001*
Major hepatectomy	0.719 (0.486–1.065)	<0.100*		
Hilar resection	1.756 (1.175–2.624)	0.006*	3.354 (1.681–6.692)	0.001*
Volume of blood loss > 1,000 mL	3.749 (2.561–5.489)	<0.001*	2.086 (1.105–3.936)	0.023*
Crystalloid administered > 1,750 mL	1.317 (0.918–1.888)	0.135		
Colloid administered > 600 mL	3.349 (2.278–4.925)	<0.001*	2.056 (1.052–4.019)	0.035*
Operating time > 360 minutes	1.774 (1.229–2.560)	0.002*	0.886 (0.432–1.820)	0.743
Duration of hypothermia > 300 minutes	1.981 (1.346–2.915)	0.001*	1.796 (0.930–3.469)	0.081

*Statistically significant with p-value < 0.05

ASA; American Society of Anesthesiologists, POD; post-operative day, INR; International normalized ratio

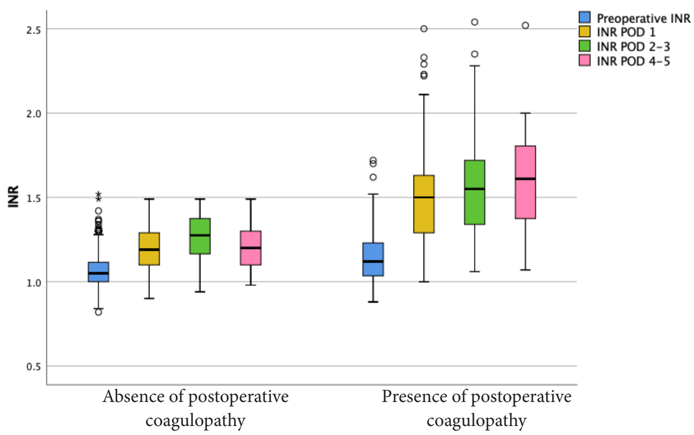

Figure 1. Preoperative and postoperative INR values

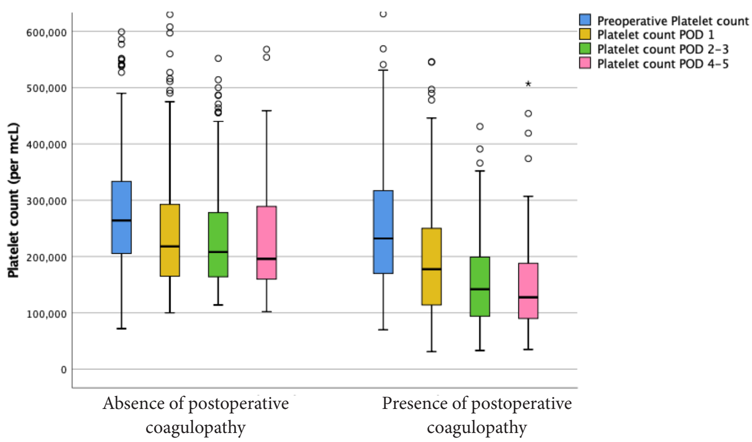

Figure 2. Preoperative and postoperative platelet count values

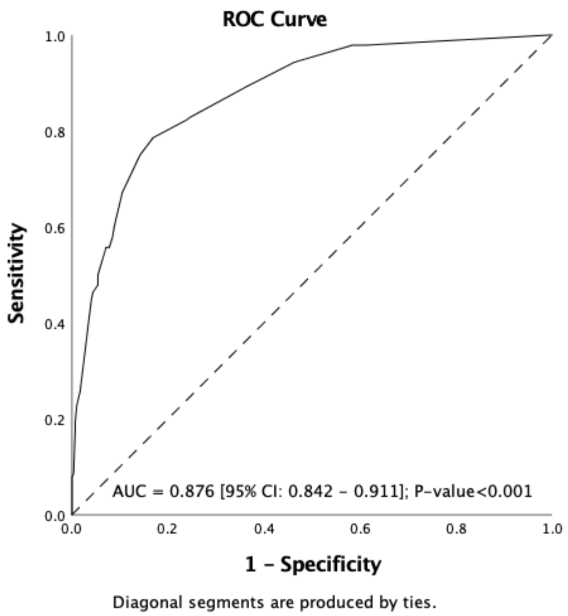

Figure 3. ROC curve of the logistic regression model

reaching the maximum level at post-operative day 4-5 as well as platelet count. The majority of our patients underwent a major hepatectomy and nearly half of them had combined a major hepatectomy with hilar resection. Univariate analysis showed a significant association between pre-operative anemia, pre-operative thrombocytopenia, pre-operative INR > 1.3, Delta INR > 0.3, hepatectomy with hilar resection, estimated blood loss > 1,000 mL, colloid administration> 600 mL, operating time > 360 minutes, duration of hypothermia > 300 minutes, and Post-operative coagulopathy. Multivariate analysis showed pre-operative thrombocytopenia, pre-operative INR > 1.3, delta INR > 0.3, hepatectomy with hilar resection, estimated blood loss >1,000 mL, colloid administration > 600 mL were the independent factors associated with post-operative coagulopathy patients. Delta INR > 0.3 was the strongest risk factor of post-operative coagulopathy followed by pre-operative INR > 1.3 and pre-operative thrombocytopenia. This is one of the largest studies identifying incidence and risk factors of coagulopathy after hepatic resection which included cholangiocarcinoma patients who required a major hepatectomy with hilar resection.

One of the major roles of the liver is protein, pro-coagulant, and anticoagulation factors synthesis. Hepatic resection leads to a significantly decreased number and function of hepatocytes resulting in post-operative coagulopathy (13-15). The incidence of coagulopathy following hepatic resection ranged from 28.2 to 53.5 percent (5,11, 16,17). Regarding the independent factors for post-operative coagulopathy, pre-operative INR > 1.3, and pre-operative thrombocytopenia were associated with a degree of cirrhosis and portal hypertension (18,19). Patients who had impaired hepatic function trended to have more incidence of post-operative coagulopathy which was noted in many studies (5,6). The extent of surgery also showed an impact on the incidence of coagulopathy after hepatic resection. Recent studies showed major hepatectomy and blood loss > 1,000 mL were significantly associated with post-operative coagulopathy (5,13). Our study showed that blood loss > 1,000 mL was an independent risk factor associated with post-operative coagulopathy as well, however, a major hepatectomy without hilar resection was not a significant risk factor. Hepatectomy with hilar resection was mainly operated in peri-hilar cholangiocarcinoma or intrahepatic cholangiocarcinoma with hilar invasion patients to obtain a negative resection margin. These operations had a longer operative time, lower future liver remnant, and higher blood loss than major hepatectomy alone which potentially caused post-operative coagulopathy (20,21).

The study by Jacquenod et al. showed volume of fluid administration > 4,000 mL was one of the dependent risk factors for post-operative coagulopathy. Our study separated the total intravenous fluid administration by type to colloid and crystalloid. Due to a lack of availability of human albumin-based colloid, more than 95% of colloid usage in our institute was starch-based. Our results showed that there was no association between crystalloid infusion and post-operative coagulopathy. On the other hand, colloid infusion > 600 mL was significantly associated with post-operative coagulopathy. Several recent studies showed starch-based colloid had an anticoagulant effect which was proven by a thromboelastogram and may increase the risk of post-operative bleeding (22-24). The mechanism was a dose-dependent dilutional effect of starch stated by Langenecker et al. (24). The strongest risk factors for post-operative coagulopathy in our study were delta INR > 0.3. In our study, 117 patients had a delta INR > 0.3 (20%). Seventy-six percent of these had post-operative coagulopathy even though most of them had a normal pre-operative INR and platelet count (median (IQR)) = 1.1 (1.0-1.2) and 257 (194-328), respectively. To our best knowledge, no reports regarding delta INR on post-operative day 1 could predict post-operative coagulopathy after hepatic resection.

Thoracic epidural analgesia is widely used in major abdominal surgery including hepatic resection and showed benefits in reduced post-operative pulmonary complications, facilitated early mobilization, and shortened hospital stays (8-10). One of the largest studies about epidural anesthesia-related complications in major abdominal surgery showed the incidence of epidural hematoma was 3.7:10,000. However, only one patient was associated with coagulopathy after the administration of anticoagulants (25). According to a national survey by Cook et al. that included 707,455 cases in which central neuraxial block was used and the results showed the incidence of epidural hematoma was extremely low (1:150,000) (26). Several studies, including our study, demonstrated coagulative derangement after hepatic resection, however, there were no reported of epidural hematoma after combined epidural anesthesia among these operations (1,3,5,6).

Due to the maximal intensity of post-operative pain occurring in the first 48 hours, the trend was to remove the epidural catheter on post-operative day 3 (27). Moreover, the enhanced recovery after liver surgery also suggested removal of the epidural catheter on post-operative day 3 if the pain was well controlled by oral pain medication to facilitate mobilization (12). However, several studies showed the median range of epidural catheter removal was on post-operative day 3-5 depending on each center's protocol (3,5,28). According to neuraxial anesthesia guidelines, the derangement of INR and platelet would be corrected by either fresh frozen plasma or platelet concentration before removal of the catheters (29).

This study showed a peak median INR value on a post-operative day 4-5 which differ from the previous studies (20,30). Furthermore, removal of the catheters was mostly on post-operative day 3 in our center. However, there was no incidence of epidural hematoma associated epidural anesthesia even though 33% of our patients had post-operative coagulopathy. Several studies supported the conventional coagulation tests detected a hypercoagulable state (2,31), despite the thromboelastography (TEG) tracing revealing normal coagulation or hypercoagulability after hepatic resection. (20,30-33). These reasons might explain why the incidence of epidural hematoma was extremely low compared to the incidence of coagu lopathy following hepatic resection. However, the impaired synthesis of coagulant and anticoagulant factors remains poorly understood and TEG was not indicated as a better tool to evaluate the coagulative status before insertion or removal of the epidural catheter.

One limitation of this study was the retrospective single study with a lower rate of epidural catheter insertion compared to other studies. Some important factors and laboratory investigations were not obtained by retrospective data such as degree of cirrhosis, thromboelastography, and fibrinogen level.Nevertheless, our study could provide useful information about post-operative coagulopathy in a more specific population which had a higher incidence of cholangiocarcinoma, and required complex procedures such as hepatectomy with hilar resection. Moreover, our study had specified data about the type of colloid which was rarely reported to be associated with coagulopathy in hepatic resection.

Conclusions

In summary, the incidence of coagulopathy after hepatic resection was common. The benefits and risks of epidural analgesia in hepatic resection should be carefully weighed upon an individual patient bias. The results of our study showed epidural analgesia may be a safe option in patients who had normal pre-operative coagulation and underwent minor or major hepatectomy without hilar resection. Furthermore, one should consider the potential anticoagulative properties of colloid solution, especially the starch-based one, in patients who had an estimated blood loss > 1,000 mL or underwent hepatectomy with hilar resection. Also, for the patients with post-operative delta INR > 0.3, INR and platelet level should be carefully monitored even if the post-operative day 1 coagulation tests were within normal limits.

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Conficts of interest

The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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การศึกษาปัจจัยเสี่ยงของการเกิดภาวะการแข็งตัวของเลือดผิดปกติหลังผ่าตัดตับ และความปลอดภัยในการใช้สายระงับปวดในช่องเหนือไขสันหลังในผู้ป่วยที่เข้ารับการผ่าตัดตับ

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วัตถุประสงค์ การผ่าตัดตับถือว่าเป็นการผ่าตัดเปิดช่องท้องที่มีความเสี่ยงต่อการเกิดภาวะการแข็งตัวของเลือดผิดปกติหลังผ่าตัด ซึ่งการเกิดภาวะการแข็งตัวของเลือดผิดปกติจะส่งผลต่อความปลอดภัยในการใส่สายระงับปวดเหนือช่องไขสันหลัง โดยวัตถุประสงค์ของงานวิจัยนี้ คือ การหาอุบัติการณ์และปัจจัยเสี่ยงในการเกิดภาวะการแข็งตัวของเลือดผิดปกติหลังผ่าตัดตับรวมถึงการประเมินความปลอดภัยในการใส่สายระงับปวดเหนือช่องไขสันหลัง

วิธีการ เป็นงานวิจัยแบบทำการศึกษาย้อนหลัง (retrospective study) ในผู้ป่วยที่เข้ารับการผ่าตัดตับแบบนัดหมายในระยะเวลา 10 ปีที่ผ่านมา สำหรับภาวะการแข็งตัวของเลือดผิดปกติ หมายถึง ค่า INR มากกว่าหรือเท่ากับ 1.5 หรือค่าเกร็ดเลือดน้อยกว่า 100,000 ต่อไมโครลิตร สำหรับการหาปัจจัยเสี่ยงในการเกิดภาวะการแข็งตัวของเลือดผิดปกติหลังผ่าตัดตับ ได้มีการวิเคราะห์โดยการใช้การถดถอยโลจิสติควิเคราะห์ข้อมูล (logistic regression analysis) ร่วมกับได้มีการคำนวณหาพื้นที่ใต้กราฟ ROC เพื่อดูความแม่นยำของ model

ผลการศึกษา ผู้ป่วยจำนวน 536 คน เข้าร่วมการศึกษาในงานวิจัยแบบ retrospective study พบว่าอุบัติการณ์ในการเกิดภาวะการแข็งตัวของเลือดผิดปกติ เท่ากับร้อยละ 33 ปัจจัยเสี่ยงในการเกิดภาวะการแข็งตัวของเลือดผิดปกติหลังผ่าตัดตับ ได้แก่ ค่าเกร็ดเลือดก่อนผ่าตัดต่ำ (OR=10.380 (4.010-26.872)), ค่า INR ก่อนผ่าตัดมากกว่า 1.3 (OR = 17.743 (4.751-66.255)), ค่าความแตกต่างของค่า INR ก่อนผ่าตัดและหลังผ่าตัดวันที่หนึ่งต่างกันมากกว่า 0.3 (OR = 18.637 (8.949-38.812)), การผ่าตัดตับที่บริเวณขั้วตับ (OR = 3.354 (1.681-6.692)), การเสียเลือดระหว่างการผ่าตัดมากกว่า 1,000 มิลลิลิตร (OR = 2.086 (1.105-3.936)) และการให้สารน้ำประเภท colloid มากกว่า 600 มิลลิลิตร (OR = 2.056 (1.052-4.019)) ซึ่งพื้นที่ใต้กราฟ ROC มีค่าเท่ากับ 0.876

สรุป อุบัติการณ์ของการเกิดภาวะการแข็งตัวของเลือดผิดปกติหลังผ่าตัดตับถือเป็นภาวะที่พบได้บ่อย ซึ่งจากผลการศึกษาวิจัยพบว่าการใส่สายระงับปวดเหนือช่องไขสันหลังมีความปลอดภัยในผู้ป่วยที่มีค่าระดับการแข็งตัวของเลือดก่อนผ่าตัดปกติและเข้ารับการผ่าตัดตับที่ยกเว้นบริเวณขั้วตับ ดังนั้นการคำนึงถึงประโยชน์และความเสี่ยงของการใส่สายระงับปวดเหนือช่องไขสันหลังจึงเป็นสิ่งสำคัญที่ต้องตระหนักถึงในผู้ป่วยที่เข้ารับการผ่าตัดตับ **เชียงใหม่เวชสาร 2563;59(4):215-25.**

คำสำคัญ: การผ่าตัดตับ ภาวะการแข็งตัวของเลือดผิดปกติหลังผ่าตัด ปัจจัยเสี่ยง การใส่สายระงับปวดเหนือช่องไขสันหลัง