Early outcomes of hepatectomy for hepatocellular carcinoma: A retrospective cohort study

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Received February 10, 2026; Accepted May 6, 2026

DOI: 10.3892/wasj.2026.477

Abstract. Hepatectomy remains a potentially curative treatment for selected patients with hepatocellular carcinoma (HCC). The present retrospective observational study was conducted on a cohort of consecutive adults who underwent open hepatectomy with curative intent for primary HCC between January, 2021 to May, 2023. Preoperative characteristics, imaging findings, operative variables and early outcomes (in-hospital/30-day) were extracted from medical records. Post-hepatectomy liver failure (PHLF) and bile leak were defined using the International Study Group of Liver Surgery criteria, and univariable associations with any post-operative complications were assessed using the χ^2 or Fisher's exact tests. In total, 57 patients were included (mean age, 57.0±12.1 years; 78.9% male); all had preserved liver function (Child-Pugh A, 100%) and the majority were classified as Barcelona Clinic Liver Cancer stage B (89.5%). The mean operative time was 156.6±34.8 min and the mean estimated blood loss was 399.0±212.6 ml. A total of 9 patients (15.8%) developed ≥1 post-operative complication, with no 30-day mortality; the most frequent complications were PHLF (7.0%) and bile leak (5.3%). Complications were significantly associated with hypoalbuminemia (<35 g/l; P=0.0389), Barcelona Clinic Liver Cancer stage (P=0.0016) and major hepatectomy (P=0.0451). On the whole, the present study demonstrates that open hepatectomy for HCC is associated with acceptable early morbidity and no mortality in a carefully selected cohort. However, the identified risk factors should be interpreted cautiously, since the analyses were univariable and based on a limited number of events.

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Key words: hepatocellular carcinoma, hepatectomy, post-operative complications, bile leak

Introduction

Hepatocellular carcinoma (HCC) is the most common type of primary liver malignancy and a major cause of cancer-related mortality worldwide. According to GLOBOCAN 2022, liver cancer remains a major oncological burden globally, and Vietnam remains among the countries with a high disease burden (1). The burden is particularly high in Asia, where chronic hepatitis B virus infection and underlying cirrhosis remain dominant etiological factors. Since early-stage HCC is often asymptomatic and surveillance is inconsistently implemented, numerous patients present with intermediate or advanced disease, requiring treatment decisions that balance oncological control with preservation of hepatic functional reserve (1-4).

Surgical resection is potentially curative and remains a cornerstone treatment for patients with adequate liver function and resectable tumors. However, hepatectomy is technically demanding and may be complicated by substantial postoperative morbidity, particularly in patients with chronic liver disease. Post-hepatectomy liver failure (PHLF) and bile leakage are among the most clinically relevant adverse events, as they are associated with prolonged hospitalization, increased resource utilization and impaired short-term recovery. Standardized definitions from the International Study Group of Liver Surgery (ISGLS) (5,6) facilitate comparisons across studies, yet complication rates still vary widely according to patient selection, extent of resection, perioperative management and institutional experience (3,4,7,8).

Although outcomes have improved in high-volume centers, data from Vietnam and other low- and middle-income countries remain limited. Local evidence is required to benchmark early surgical safety and to describe pathological, as well as operative findings, and to identify potentially modifiable risk factors that can inform clinical decision-making. Therefore, the present study aimed to describe the clinical, laboratory, imaging, pathological and operative characteristics of patients undergoing hepatectomy for HCC at Da Nang Oncology Hospital (Da Nang, Vietnam), and to explore factors associated with early post-operative complications.

Patients and methods

Study design and setting. The present retrospective observational cohort study was conducted at Da Nang Oncology

Hospital, a tertiary referral hospital in the central zone of Vietnam. The medical records of consecutive patients who underwent hepatectomy for HCC between January, 2021 and May, 2023 were reviewed. The present cohort study has been reported in line with the STROCSS guidelines (9).

Study population. Consecutive adult patients (≥18 years of age) who underwent open hepatectomy with curative intent for primary HCC at Da Nang Oncology Hospital during the aforementioned study period were eligible. HCC was diagnosed according to institutional practice based on clinical assessment, serum α-fetoprotein levels when available, and contrast-enhanced computed tomography (CT) scan or magnetic resonance imaging (MRI). Patients were excluded if they underwent non-resectional procedures only (such as exploration or biopsy without hepatectomy), required re-operation for recurrent HCC during the same admission, or had incomplete records for key operative variables or postoperative outcomes.

A total of 60 patients were screened during the study period (from January, 2023 to June, 2023). Following the application of the eligibility criteria, 3 patients were excluded, including 1 patient who underwent exploratory laparotomy without hepatectomy as the tumor was found to be unresectable intraoperatively, 1 patient who underwent re-operation for recurrent HCC during the same admission, and 1 patient who had incomplete medical records for key operative and post-operative outcome variables. The final study cohort therefore included 57 patients who underwent open hepatectomy for HCC.

Diagnosis and preoperative evaluation. Pre-operative evaluation included demographics, presenting symptoms or reason for admission, medical history, viral hepatitis markers (HBsAg and anti-HCV) and routine laboratory tests (complete blood count, liver biochemistry and coagulation profile). Tumor characteristics were assessed on a contrast-enhanced CT scan or MRI, including typical arterial hyperenhancement and washout when present.

Liver functional reserve was assessed using the Child-Pugh classification. Tumors were staged using the Barcelona Clinic Liver Cancer (BCLC) system based on tumor burden, liver function and performance status at diagnosis (8).

All hepatectomies were performed using an open approach. Operative reports were reviewed to determine the type of resection (right hepatectomy, left hepatectomy, sectionectomy or segmentectomy) and the incision used. For analysis, hepatectomy was categorized as major (resection of ≥3 Couinaud segments) or minor (resection of ≤3 segments).

Perioperative management followed institutional protocols, including standardized anesthesia monitoring, intraoperative antibiotic prophylaxis and postoperative supportive care. Post-operative analgesic use and duration of hospitalization were recorded from the medical charts.

Outcomes and definitions. The primary outcome was the occurrence of any early post-operative complication during the index hospitalization or within 30 days post-surgery, as documented in the medical records. Patients could experience ≥1 complications.

PHLF and bile leak were defined and graded according to ISGLS criteria. PHLF was defined as post-operative deterioration in liver function requiring a change in clinical management, while bile leak was defined as bilious drainage with elevated bilirubin concentration in the drain fluid and/or the need for intervention (5,6).

Other post-operative events recorded included post-operative hemorrhage, ascites, surgical site infection, pleural effusion and other clinically significant adverse events. When sufficient documentation was available, complications were graded using the Clavien-Dindo classification (10).

Secondary outcomes included operative time, estimated blood loss, intraoperative adverse events, postoperative analgesic duration, post-operative length of stay and in-hospital/30-day mortality.

Ethics. The present study was conducted in accordance with ethical standards and the principles of the Declaration of Helsinki. The study protocol was approved by the Academic and Ethics Committee in Biomedical Research of Da Nang University of Medical Technology and Pharmacy (Approval No. 11/CT-HDDD, dated January 12, 2023). Permission to access patient medical records was granted by Da Nang Oncology Hospital. As this was a retrospective study using de-identified data, the requirement for informed patient consent was waived.

Statistical analysis. Data were analyzed using SPSS version 20.0 (IBM Corp.). Categorical variables were compared using χ^2 or Fisher's exact test, as appropriate. Continuous variables are presented as the mean ± standard deviation or median (interquartile range), depending on their distribution. A two-sided P-value <0.05 was considered to indicate a statistically significant difference.

Results

The baseline characteristics of the patients are summarized in Tables I and II. The cohort was predominantly male (78.9%), with a mean age of 57.0±12.1 years. The majority of the patients had a normal BMI (18.5-24.9 kg/^{m2}, 77.2%) and preserved liver function (Child-Pugh A, 100%). Chronic hepatitis B virus infection was the predominant viral background, and 42.1% of patients had an α-fetoprotein level ≥400 ng/ml.

The tumor characteristics are presented in Table III. Typical HCC imaging features on contrast-enhanced CT/MRI were present in 75.4% of the patients. A solitary tumor of >5 cm in size was the most common pattern (43.9%). The mean tumor size on imaging (6.5±3.0 cm) was similar to that on gross pathology (6.6±3.0 cm). As per the histopathological examination, the majority of tumors were moderately differentiated (70.2%), whereas 19.3% were poorly differentiated.

Operative details and early outcomes of the patients are presented in Table IV. Posterior sectionectomy was the most frequent procedure (28.1%), followed by left hepatectomy (21.1%). The mean operative time was 156.6±34.8 min, and the mean estimated blood loss was 399.0±212.6 ml. Intraoperative adverse events occurred in 5.3% of patients. Overall, 15.8% of patients developed ≥1 post-operative complications, most commonly PHLF (7.0%) and bile leak (5.3%). No post-operative mortality was observed.

The factors associated with any post-operative complications are summarized in Table V. Complications occurred more

Table I. Baseline demographic and clinical characteristics of the present study population (n=57).

Characteristic	Value
Sex, n (%)	
Male	45 (78.9)
Female	12 (21.1)
Age (years), mean ± SD	57.0±12.1
Age group (years), n (%)	<40:6 (10.5); 40-60:30 (52.6); >60:21 (36.8)
BMI (kg/m^2), n (%)	
<18.5	7 (12.3)
18.5-24.9	44 (77.2)
25-29.9	4 (7.0)
≥30	2 (3.5)
Reason for admission, n (%)	
Incidentally detected liver mass	24 (42.1)
Right upper quadrant abdominal pain	26 (45.6)
Other reasons	7 (12.3)
Viral hepatitis markers, n (%)	
HBsAg positive only	47 (82.5)
Anti-HCV positive only	1 (1.8)
HBsAg and anti-HCV positive (co-infection)	2 (3.5)
HBsAg and anti-HCV negative	7 (12.3)
Alpha-fetoprotein (ng/ml), n (%)	
<20	17 (29.8)
20-400	16 (28.1)
≥400	24 (42.1)
Child-Pugh class, n (%)	
Child-Pugh A	57 (100.0)
Child-Pugh B	0 (0.0)
BCLC stage, n (%)	
Stage 0	1 (1.8)
Stage A	5 (8.8)
Stage B	51 (89.5)

Data are presented as number and percentage unless otherwise indicated. BMI, body mass index; HBsAg, hepatitis B surface antigen; anti-HCV, antibody to hepatitis C virus; BCLC, Barcelona Clinic Liver Cancer.

Table II. Preoperative laboratory findings of the present study cohort (n=57).

Laboratory variable	Value
Hemoglobin (g/dl), mean ± SD	13.5±1.8
Anemia (Hb 9-12 g/dl), n (%)	13 (22.8)
Platelet count (x10^3/μl), mean ± SD	215.5±86.5
Thrombocytopenia (<150x10^3/μl), n (%)	10 (17.5)
Prothrombin time ≥70%, n (%)	57 (100.0)
INR <1.7, n (%)	57 (100.0)
Total bilirubin (μmol/l), mean ± SD	11.1±4.0
AST (U/l), mean ± SD	48.9±32.1
AST ≥37 U/l, n (%)	33 (57.9)
ALT (U/l), mean ± SD	42.8±25.9
ALT ≥40 U/l, n (%)	24 (42.1)
Albumin (g/l), mean ± SD	37.8±3.5
Albumin <35 g/l, n (%)	11 (19.3)

Continuous variables are presented as the mean ± standard deviation; categorical variables are presented as n (%). Hb, hemoglobin; INR, international normalized ratio; AST, aspartate aminotransferase; ALT, alanine aminotransferase.

Table III. Tumor characteristics on imaging and pathology.

Tumor characteristic	Value
CT/MRI appearance typical for HCC, n (%)	43 (75.4)
Ultrasound echogenicity	
Hyperechoic	21 (36.8)
Hypoechoic	20 (35.1)
Heterogeneous	16 (28.1)
Tumor burden on CT/MRI	
Solitary <5 cm	14 (24.6)
Solitary >5 cm	25 (43.9)
Multiple, max <5 cm	8 (14.0)
Multiple, max >5 cm	10 (17.5)
Tumor size on CT/MRI (cm), mean ± SD	6.5±3.0
Tumor size on pathology (cm), mean ± SD	6.6±3.0
Gross type	
Mass-forming	39 (68.4)
Nodular	11 (19.3)
Diffuse	7 (12.3)
Histological grade	
Well differentiated	6 (10.5)
Moderately differentiated	40 (70.2)
Poorly differentiated	11 (19.3)

HCC, hepatocellular carcinoma; CT, computed tomography; MRI, magnetic resonance imaging.

frequently in patients with pre-operative hypoalbuminemia (<35 g/l; 36.4 vs. 10.9%; P=0.0389), BCLC stage B (17.6 vs. 0% for BCLC A; P=0.0016) and those undergoing major hepatectomy (28.6 vs 8.3%; P=0.0451). Although thrombocytopenia exhibited a numerically higher complication rate, the association was not statistically significant (30.0 vs. 12.8%; P=0.1786).

Discussion

In the present retrospective cohort of 57 patients undergoing open hepatectomy for HCC at a tertiary oncology center in Vietnam, early outcomes were acceptable, with an overall complication rate of 15.8% and no post-operative mortality.

Table IV. Operative details and early postoperative outcomes.

Perioperative outcome	Value
Type of hepatectomy, n (%)	
Right hepatectomy	5 (8.8)
Left hepatectomy	12 (21.1)
Left lateral sectionectomy	0 (0.0)
Central hepatectomy	4 (7.0)
Anterior sectionectomy	8 (14.0)
Posterior sectionectomy	16 (28.1)
Segmentectomy	7 (12.3)
Bisegmentectomy	5 (8.8)
Incision, n (%)	
J-shaped subcostal (Makuuchi-type)	56 (98.2)
Midline laparotomy	1 (1.8)
Operative time (min), mean ± SD (range)	156.6±34.8 (60-240)
Estimated blood loss (ml), mean ± SD (range)	399.0±212.6 (105-1,000)
Intraoperative adverse events, n (%)	
Hemorrhage	2 (3.5)
Iatrogenic organ injury	1 (1.8)
Post-operative complications (patients may have >1), n (%)	
Post-operative bleeding	1 (1.8)
Bile leak	3 (5.3)
Ascites	2 (3.5)
Surgical site infection	3 (5.3)
Pleural effusion	2 (3.5)
Post-hepatectomy liver failure	4 (7.0)
Post-operative analgesic use (days), mean ± SD	5.3±1.7
Post-operative hospitalization period (days), mean ± SD	8.9±2.4

All patients had Child-Pugh A liver function, and the majority had chronic viral hepatitis, reflecting the epidemiological profile of HCC in Vietnam (2).

Notably, almost 90% of the patients were classified as BCLC stage B. Although transarterial chemoembolization is commonly recommended for intermediate-stage HCC, multidisciplinary selection and treatment stage migration may identify subsets with resectable disease and preserved liver reserve who could still be considered for surgery (3,4,8). The findings of the present study suggest that hepatectomy can be performed with acceptable short-term safety in carefully selected patients in this category; however, the present study did not include a non-surgical comparator group or long-term oncological follow-up. Therefore, these findings should not be interpreted as support for routine resection in all patients with stage B HCC.

PHLF (7.0%) and bile leak (5.3%) were the most frequent complications. These events are clinically important as they can prolong recovery and increase resource utilization. The observed rates are within the range reported in contemporary hepatectomy series, noting that incidence varies with baseline liver disease, the extent of resection and application of standardized definitions such as those from the ISGLS (5,6,11-13).

Operation time and blood loss in the present study cohort indicated technically feasible open resections in this setting. While minimally invasive liver surgery is increasingly adopted worldwide, open hepatectomy remains the primary approach in numerous centers due to tumor complexity, cirrhotic background and resource or training constraints. Ensuring consistent perioperative pathways and timely recognition and management of complications therefore remains essential (14,15).

Among the evaluated factors, pre-operative hypoalbuminemia was associated with a higher complication rate. Serum albumin reflects nutritional status, systemic inflammation and hepatic synthetic function; low values may identify patients with limited physiological reserve. Preoperative nutritional assessment and optimization, when feasible, may help reduce postoperative risk. Since the present analysis was limited to univariable comparisons, this association should be regarded as exploratory rather than an independent predictor.

Major hepatectomy was also associated with complications, consistent with the pivotal role of resection extent and future liver remnant in postoperative safety. In settings where quantitative volumetry or functional testing is not routinely available, cautious selection, meticulous operative technique and intensive post-operative monitoring are particularly important. The association between BCLC stage and complications may reflect greater tumor burden and operative complexity rather than stage alone. In addition, the predominance of moderately differentiated tumors on pathology provides useful context for interpreting the surgical case mix in the present cohort.

Although open hepatectomy remains the mainstay in numerous low- and middle-income settings, minimally invasive liver resection (laparoscopic or robotic) has expanded rapidly and is increasingly supported for appropriately selected patients (16,17). Recent systematic reviews and meta-analyses suggest that minimally invasive approaches can reduce blood loss and shorten recovery while maintaining comparable short-term safety and oncological adequacy vs. conventional resection when performed in experienced centers (15,18). Current practice guidelines continue to endorse surgical resection as a potentially curative treatment for selected patients with preserved liver function and resectable disease (3,4,8). In this context, the data of the present study provide a critical benchmark for open hepatectomy outcomes, and may inform stepwise adoption of advanced techniques (such as laparoscopy) through structured training and careful case selection.

In addition, perioperative optimization could further improve outcomes in similar real-world environments. The Enhanced Recovery After Surgery (ERAS) Society recommendations for liver surgery emphasize standardized pathways, including multimodal analgesia, goal-directed fluid therapy, early mobilization and early enteral nutrition, which have been associated with lower morbidity and a more rapid functional recovery (19). Using standardized ISGLS

Table V. Univariable analysis of factors associated with post-operative complications (any complication) following hepatectomy.

Factor	Complications (n)	Total (n)	Complication rate (%)	P-value
Platelet count (x$10^3/\mu$l)				
<150	3	10	30.0	0.1786
≥150	6	47	12.8	
Serum albumin (g/l)				
<35	4	11	36.4	0.0389
≥35	5	46	10.9	
BCLC stage				
BCLC A	0	6	0.0	0.0016
BCLC B	9	51	17.6	
Extent of hepatectomy				
Major hepatectomy	6	21	28.6	0.0451
Minor hepatectomy	3	36	8.3	

Data are presented as number with complication/total number in subgroup (%). P-values were calculated using the Chi-squared test or Fisher's exact test, as appropriate. BCLC, Barcelona Clinic Liver Cancer.

definitions for PHLF and bile leakage facilitates transparent benchmarking across studies (5,6). Given the association between hypoalbuminemia and post-operative complications in the present study cohort, targeted pre-habilitation, the optimization of hepatic reserve and parenchymal-sparing strategies for borderline patients may be particularly valuable (12).

These findings provide local benchmark data for the early outcomes of patients undergoing hepatectomy in Vietnam and highlight potentially actionable risk factors. Patients with hypoalbuminemia or those planned for major hepatectomy may benefit from enhanced perioperative optimization and closer post-operative surveillance.

The present study has several limitations which should be mentioned. Its retrospective single-center design is susceptible to incomplete documentation and may under-capture complications occurring following discharge. The sample size and event number were limited, and only 9 complication events were observed; consequently, only univariable analyses were performed and residual confounding cannot be excluded. The archived screening log did not permit reliable reconstruction of the exact number of exclusions in each category. In addition, the study did not assess several important long-term oncological outcomes, including resection margin status, recurrence, disease-free survival and overall survival. Therefore, future prospective studies with standardized complication grading, more comprehensive pathology datasets and longer follow-up are warranted.

In conclusion, open hepatectomy for HCC in carefully selected patients in the present study was associated with acceptable early post-operative outcomes and no 30-day mortality. Hypoalbuminemia, BCLC stage B disease and major hepatectomy were associated with post-operative complications in univariable analysis; however, these findings should be interpreted with caution due to the limited sample size and event number. Larger prospective studies with detailed pathological assessment and long-term follow-up are required to corroborate the present findings.

Acknowledgements

Not applicable.

Funding

No funding was received.

Availability of data and materials

The data generated in the present study may be requested from the corresponding author.

Authors contributions

Both authors (VTD and VKL) contributed equally to the conception and design of the study, as well as in data collection and analysis, and in the writing of the manuscript. VTD and VKL confirm the authenticity of the raw data. Both authors have read and approved the final version of the manuscript.

Ethics approval and consent to participate

The present study was approved by The Academic and Ethics Committee of Da Nang University of Medical Technology and Pharmacy (Approval no. 11/CT-HDDD, dated January 12, 2023), and permission to access patient medical records was granted by Da Nang Oncology Hospital. As this was a retrospective study using de-identified data, the requirement for informed consent was waived according to the ethics approval.

Patient consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

References

1. Bray F, Laversanne M, Sung H, Ferlay J, Siegel RL, Soerjomataram I and Jemal A: Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin 74: 229-263, 2024.
2. Llovet JM, Kelley RK, Villanueva A, Singal AG, Pikarsky E, Roayaie S, Lencioni R, Koike K, Zucman-Rossi J and Finn RS: Hepatocellular carcinoma. Nat Rev Dis Primers 7: 6, 2021.
3. Singal AG, Llovet JM, Yarchoan M, Mehta N, Heimbach JK, Dawson LA, Jou JH, Kulik LM, Agopian VG, Marrero JA, *et al*: AASLD practice guidance on prevention, diagnosis, and treatment of hepatocellular carcinoma. Hepatology 78: 1922-1965, 2023.
4. European Association for the Study of the Liver: EASL Clinical Practice Guidelines on the management of hepatocellular carcinoma. J Hepatol 82: 315-374, 2025.
5. Rahbari NN, Garden OJ, Padbury R, Brooke-Smith M, Crawford M, Adam R, Koch M, Makuuchi M, Dematteo RP, Christophi C, *et al*: Posthepatectomy liver failure: A definition and grading by the International study group of liver surgery (ISGLS). Surgery 149: 713-724, 2011.
6. Koch M, Garden OJ, Padbury R, Rahbari NN, Adam R, Capussotti L, Fan ST, Yokoyama Y, Crawford M, Makuuchi M, *et al*: Bile leakage after hepatobiliary and pancreatic surgery: A definition and grading of severity by the International study group of liver surgery. Surgery 149: 680-688, 2011.
7. Marrero JA, Kulik LM, Sirlin CB, Zhu AX, Finn RS, Abecassis MM, Roberts LR and Heimbach JK: Diagnosis, staging, and management of hepatocellular carcinoma: 2018 practice guidance by the American association for the study of liver diseases. Hepatology 68: 723-750, 2018.
8. Reig M, Forner A, Rimola J, Ferrer-Fàbrega J, Burrel M, Garcia-Criado Á, Kelley RK, Galle PR, Mazzaferro V, Salem R, *et al*: BCLC strategy for prognosis prediction and treatment recommendation: The 2022 update. J Hepatol 76: 681-693, 2022.
9. Riaz AA, Ginimol M, Rasha R, *et al*: Revised Strengthening the Reporting of Cohort, Cross-Sectional and Case-Control Studies in Surgery (STROCSS) Guideline: An Update for the Age of Artificial Intelligence. Premier Journal of Science 2: 2025. DOI: https://doi.org/10.70389/PJS.100081.
10. Clavien PA, Barkun J, de Oliveira ML, Vauthey JN, Dindo D, Schulick RD, de Santibañes E, Pekolj J, Slankamenac K, Bassi C, *et al*: The Clavien-Dindo classification of surgical complications: five-year experience. Ann Surg 250: 187-196, 2009.
11. Fan ST, Lo CM, Liu CL, Lam CM, Yuen WK, Yeung C and Wong J: Hepatectomy for hepatocellular carcinoma: Toward zero hospital deaths. Ann Surg 229: 322-330, 1999.
12. Kokudo T, Hasegawa K, Shirata C, Tanimoto M, Ishizawa T, Kaneko J, Akamatsu N, Arita J, Demartines N, Uldry E, *et al*: Assessment of preoperative liver function for surgical decision making in patients with hepatocellular carcinoma. Liver Cancer 8: 447-456, 2019.
13. Wang HQ, Yang J, Yang JY, Wang WT and Yan LN: Low immediate postoperative platelet count is associated with hepatic insufficiency after hepatectomy. World J Gastroenterol 20: 11871-11877, 2014.
14. Jiang S, Yu D, He H, Sun H, Sun Y, Zhou L, Wu Z and Gu Q: Short- and long-term outcomes in laparoscopic versus open hepatectomy for hepatocellular carcinoma in elderly patients: A systematic review and meta-analysis. J Laparoendosc Adv Surg Tech A 33: 321-334, 2023.
15. Hu L, Shi X, Wang A and Zhang F: A meta-analytic and systematic review to compare perioperative outcomes and prognosis between robotic and conventional (laparoscopic or open) liver resection in hepatocellular carcinoma cases. World J Surg Oncol 23: 348, 2025.
16. Dincer HA and Dogrul AB: Advances in minimally invasive liver surgery. North Clin Istanb 11: 586-592, 2024.
17. Abu Hilal M, Hoogteijling TJ, Edwin B, Dagher I, D'Hondt M, Marques HP, Swijnenburg RJ, Boggi U, Sucandy I, Ferrero A, *et al*: The Brescia internationally validated European guidelines on minimally invasive liver surgery. Br J Surg 112: znaf113, 2025.
18. Pilz da Cunha G, Hoogteijling TJ, Besselink MG, Alzoubi MN, Swijnenburg RJ and Abu Hilal M: Robotic versus laparoscopic liver resection: A systematic review and meta-analysis of comparative studies. Int J Surg 111: 5549-5571, 2025.
19. Joliat GR, Kobayashi K, Hasegawa K, Thomson JE, Padbury R, Scott M, Brustia R, Scatton O, Tran Cao HS, Vauthey JN, *et al*: Guidelines for perioperative care for liver surgery: Enhanced recovery after surgery (ERAS) Society Recommendations 2022. World J Surg 47: 11-34, 2023.