Early outcome after hepatectomy for hepatocellular carcinoma: a retrospective study

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Background data
One of the most common malignancies worldwide is hepatocellular carcinoma (HCC). The mainstay of HCC therapy is surgery. Liver transplantation and liver resection, with a 5-year survival of 60–80%, are considered the only curative treatment modalities and produce the highest performance for correctly chosen candidates.
In noncirrhotic patients with HCC as well as in cirrhotic patients with strong or adequate hepatic reservoir, liver resection is approved as the first-line therapy.
Patients and methods
The research involved 243 cases that underwent HCC hepatectomy. Full history taking, detailed physical inspection, and regular laboratory investigations were done for all cases. Furthermore, for specific information of tumor expansion, preoperative computed tomography or MRI was performed.
Results
Morbidity was encountered in 114 (46.9%) cases in the current study. Internal hemorrhage was encountered in six (2.5%) cases, and five of them were managed by exploration, whereas the remaining case was managed by interventional radiology. Bile leakage was encountered in 13 (5.3%) cases; five cases were managed by endoscopic retrograde cholangiopancreatography, two cases were managed by ultrasound-guided tube drainage, and the other six cases resolved spontaneously.
Postoperative liver cell failure was encountered in 96 (39.5%) cases. Besides, portal vein thrombosis was encountered in one (0.4%) case, and it was managed by conservative treatment. Early mortality was experienced in 10 (4.1%) cases in our study, and all these cases died owing to liver cell failure.
Conclusion
Respecting the principles of liver surgery, hepatic resection can be performed, even in cirrhotic patients, with acceptable morbidity and minimal mortality. The most common complication after hepatic resection, in our study group, was postoperative liver failure, which was mostly reversible.

Keywords:
computed tomography, hepatocellular carcinoma, liver cell failure

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Introduction

One of the most widespread malignancies globally is hepatocellular carcinoma (HCC). The mainstay of HCC therapy is surgery. Liver transplantation and liver resection, with a 5-year survival of 60–80%[1], are considered the only curative treatment modalities and produce the highest results in correctly chosen candidates.

As a first-line therapy, liver resection is tolerated in noncirrhotic patients with HCC as well as in cirrhotic patients with a strong or adequate liver reservoir [2].

Preoperative evaluation is required before the identification of patients with HCC for resection to ensure that surgery must be done with a curative purpose, that is full tumor resection, preferably with resection of the entire vascular tumor territory. There should be no indication of extrahepatic tumor extension, the liver functional reserve should also be sufficient, the chance of postoperative liver decompensation should be low, and there should be strong operational risk evaluation based on general condition, dietary status, and relatively low comorbidity [3].

In recent years, perioperative liver resection mortality for HCC has decreased dramatically from 15% in the 1980s to less than 5% in most large liver centers, with some reporting mortality of less than 1% [4].

Perioperative mortality predictors are predominantly associated with the degree of liver dysfunction, the presence of portal hypertension, and the duration of resection [5].

Ascites, respiratory complications such as pleural effusion and pneumonia, and bile leakage and wound infections are the most prevalent complications after liver resection. Complications that are less frequent but life-threatening include liver failure, bleeding, and portal vein thrombosis [6]. HCC recurrence following resection is widespread and occurs in up to 85% of patients following 5 years after resection [7].

Recorded survival rates vary from 80 to 90% at 1 year, 60 to 85% at 3 years, and 40–75% at 5 years after resection [8]. Approximately 15% of patients should predict 10-year survival after liver resection for HCC [7].

Patients and methods

This is a retrospective study that was conducted over the period between January 2013 and December 2018, aiming to identify the early outcomes after liver resection for HCC at Gastrointestinal Surgical Center, Mansoura University, Egypt. This research was performed at the Department of General Surgery, gastroenterology center Mansoura University Ethical Committee approval and written, informed consent were obtained from all participants.

Study patients

Patients who underwent hepatectomy for HCC in the period between 2013 and 2018 were included. A total of 243 cases were included in our study.

Inclusion criteria were anesthetically fit, Child A classification, and good liver functions with adequate reservoir.

Exclusion criteria were recurrent HCC after resection, diffuse type of HCC with ascites or thrombocytopenia, HCC with extrahepatic metastasis, and emergency conditions such as leaking hepatoma.

Data for this study were retrieved from the internal web-based registry system supplemented by medical records of the patients included in the medical archive of the Gastrointestinal Surgery Center, Mansoura University.

Patient consent

A written informed consent was obtained from all cases before the operation after describing and explaining the operative and postoperative details as well as complications of the surgical procedure.

(1) Preoperative laboratory assessment included the following:
   (a) Routine laboratory investigations were ordered for all cases, including complete blood count, renal functions, as well as bleeding profile.
   (b) Investigation for assessment of liver function, for example liver enzymes, serum albumin, serum bilirubin, and international normalized ratio.
   (c) Tumor marker, for example, alpha fetoprotein.
   (d) Hepatitis markers, for example, HBs Ag and hepatitis C virus antibody (HCV Ab).

Preoperative radiological assessment

(1) Radiological investigation for assessment of hepatic focal lesion, for example, abdominal ultrasound, triphasic abdominal computed tomography (CT), and dynamic abdominal MRI in doubtful cases.
(2) Radiological investigation for metastatic workup, for example, chest radiography and bone scan.
(3) CT volumetric study for assessment residual liver volume.
(4) CT arteriography, portography, and venography if the tumor was in close relation to the main liver vasculature, or if major hepatectomy was planned.
(5) Echocardiography, ECG, and pulmonary function tests to assess the cardiopulmonary status if needed.

Preoperative endoscopy

Almost all patients underwent routine esophagogastroduodenoscopy for detection of signs of portal hypertension (esophageal varices).

Multidisciplinary team approach

All patients were discussed at weekly multidisciplinary seminars including hepatopancreatobiliary surgeons and interventional radiologists.

Anesthetic assessment

All cases were assessed by our anesthetic team according to the ASA score.

Classic technique of liver resection was done

Postoperative course

Patients were referred to ICU routinely for at least 1 day after operation. Monitoring of blood pressure; pulse, oxygen saturation, respiratory rate, urine

output, central venous pressure, and drain output, color, and amount was carried out. Complete blood count was obtained on a daily basis. Serum creatinine was ordered for kidney function assessment. Serum albumin, serum bilirubin, and international normalized ratio were obtained daily. Portable chest radiograph was ordered when required, for example, for diagnosis of pleural effusion and exclusion of pneumonia. After assuring patient stabilization, the patient is transferred to the general ward. Deep venous thrombosis prophylaxis was done with elastic stocking.

(1) Enteral feeding was mostly instituted on the first postoperative day. Drains were removed according to color and the amount of output. Hospital discharge was decided afterward.

Clinical outcomes

Postoperative morbidity was defined as any other deviation from the standard postoperative course, and the classification of Clavien-Dindo was graded.

Biliary leakage was characterized as the concentration of bilirubin in the drain fluid at least three times the serum concentration of bilirubin on or after day 3 of surgery, or as the need for radiological or surgical intervention resulting from biliary collection or bile peritonitis [9].

Among the literature on hepatic surgery, the concept of posthepatectomy hemorrhage varies considerably. Posthepatectomy hemorrhage is described by the International Research Group on Liver Surgery as follows: (a) a postoperative decrease in hemoglobin level of more than 3 g/dl compared with the postoperative baseline level; (b) the requirement for postoperative transfusion of packed red blood cell (PRBCs) for a reduced amount of hemoglobin, and (c) any need for radiological intervention (such as embolization) and/or frequent bleeding reduction laparotomy. According to transfusion criteria, posthepatectomy hemorrhage was also classified. Grade A is known to be the transfusion of up to two units of PRBCs, grade B involves transfusion of more than two units of PRBCs, and grade C is characterized by the requirement for invasive procedures such as embolization and/or repeat laparotomy [10].

Posthepatectomy liver failure (PHLF) is defined as impaired ability of the liver to maintain its synthetic, excretory, and detoxifying functions, which are characterized by an increased international normalized ratio and concomitant hyperbilirubinemia (according to the normal limits of the local laboratory) on or after postoperative day 5 [10,11].

Regarding ascites, grade 1 ascites is mild and is only detectable by US examination. Grade 2 ascites or moderate ascites is manifested by moderate symmetrical distension of the abdomen. Grade 3 ascites is large or gross ascites with marked abdominal distension [12].

Postoperative mortality was defined as death within 90 days after liver resection [13].

Follow-up

Liver resection patients were instructed to visit the outpatient clinic every 2 weeks in the first month, every month during the first 3 months, then every 3 months for the first year. Biannual visits were arranged later on.

Statistical analysis

For statistical analysis of the collected data, IBM's SPSS Statistics (Statistical Kit for Social Sciences) for Windows (version 25, 2017) was used (Statistical analysis was done using IBM SPSS statistics for windows, Version 24.0. Armonk, NY: IBM Corp). To verify the normality of the data distribution, the Shapiro–Wilk test was used.

Both experiments were performed with a 95% confidence interval. The value of P value less than 0.05 was found statistically important. Charts have been developed for Windows 2019 using the SPSS chart builder and Microsoft Excel.

Descriptive quantitative variables were expressed as mean and SD, median, interquartile range, minimum, and maximum as appropriate, whereas categorical variables were expressed as frequency and percentage.

Results

The number of patients included in this study were 243. The mean age of the included cases was 58.58 years (range, 18–78 years). We included 191 (78.6%) males and 52 (21.4%) females. History of previous surgery was reported in 35.4% of cases. A total of 13 (5.3%) cases underwent preoperative transcatheter arterial chemoembolization, whereas two (0.8%) cases had history of previous tumor ablation (Table 1).

Preoperative laboratory investigations

The preoperative routine laboratory investigations are illustrated in Table 2.

Table 1 Patients' demographic, surgical, and treatment characteristics

	All patients (*N*=243)				
	Mean±SD	Median	Minimum	Maximum	IQR
Age	58.58±8.223	59	18	78	55, 64
Sex					
Male			191 (78.6)		
Female			52 (21.4)		
History of previous surgery			86 (35.4)		
History of previous TACE			13 (5.3)		
History of previous RFA			2 (0.8)		

Data are expressed as mean and SD, median, minimum, maximum, and interquartile range (IQR) or as percentage and frequency. RFA, radiofrequency ablation; TACE, transcatheter arterial chemoembolization.

Table 2 Preoperative laboratory investigations

	All patients (*N*=243)				
	Mean±SD	Median	Minimum	Maximum	IQR
Albumin	3.84±0.48	3.80	3.10	5.00	3.50, 4.20
Total bilirubin	0.88±0.77	0.70	0.40	1.20	0.50, 1.00
Direct bilirubin	0.35±0.51	0.25	0.14	0.60	0.18, 0.35
ALT	52.00±34.61	42.00	20.00	280.00	29.00, 62.00
AST	63.19±40.94	52.00	20.00	240.00	36.00, 77.00
INR	1.09±0.13	1.00	1.00	1.50	1.00, 1.20
Platelets	158.05±75.51	145.00	94.00	433.00	104.00, 205.00
Creatinine	0.83±0.45	0.80	0.50	1.20	0.70, 0.90
AFP	454.21±713.47	31.00	1.00	2000.00	7.00, 724.00
CEA	3.68±2.95	3.50	0.50	40.90	2.70, 4.20
CA19_9	14.36±11.81	12.60	1.10	92.00	5.80, 17.70

Data is expressed as mean and SD, median, minimum, maximum, and interquartile range (IQR). AFP, alpha fetoprotein; ALT, alanine transaminase; AST, aspartate transaminase; CA, carbohydrate antigen; CEA, carcinoembryonic antigen; INR, international normalized ratio.

Table 3 Liver condition and viral status

	All patients (*N*=243)	
HCV	221	90.9%
HBV	2	0.8%
Liver cirrhosis	225	92.6%

HBV, hepatitis B virus; HCV, hepatitis C virus.

Table 4 Lesion size in the studied patients

	All patients (*N*=243)				
	Mean±SD	Median	Minimum	Maximum	IQR
Size	6.5±3.26	6	2	23	4.5, 8

Data is expressed as mean and SD, median, minimum, maximum, and interquartile range (IQR).

Liver condition and viral status

The majority of the included cases had a cirrhotic liver on CT scan (225 cases – 92.6%). Regarding the hepatic viral status, 221 (90.9%) cases were HCV positive, whereas only two cases were HBV positive (Table 3).

Size of detected lesions on computed tomographic scan

The mean size of the HCC lesions was 6.5 cm (range, 2–23 cm) (Table 4).

The surgical procedure

Open approach was the most common used approach in this study (232 cases – 95.5%), whereas the remaining cases were performed via laparoscopy. Only two cases underwent conversion to the open procedure owing to uncontrolled bleeding. Emergency pringle maneuver was performed in 12 (4.9%) cases. Portal vein thrombectomy was carried out in three (1.2%) cases (Table 5).

Type of liver resection

Localized resection was the most common performed procedure (116 cases – 47.73%), followed by left lateral segmentectomy (50 cases – 20.57%) and right hepatectomy (43 cases – 17.69%). Other operations are described in Table 6.

Operative data

The mean operative time was 184.59 min (range, 65–420 min). Pringle maneuver, when applied, had a mean duration of 18 min. The mean amount of blood loss was 1153.37 ml, whereas the mean number of blood units transfused was 2.44 units (Table 7).

Table 5 Surgical procedure

All patients (*N*=243)			
Approach	Open	232	95.5%
	Laparoscopic	9	3.7%
	Failed laparoscopic due to bleeding	2	0.8%
Associated portal thrombectomy		3	1.2%
Pringle usage	Elective	23	9.5%
	Emergency	12	4.9%

Data is expressed as frequency and percentage.

Table 6 Type of liver resection

	All patients (*N*=243)	
Localized resection	116	47.73%
Segmentectomy	10	4.1%
Left lateral sectionectomy	50	20.57%
Right anterior sectionectomy	1	0.4%
Right posterior sectionectomy	1	0.4%
Left hepatectomy	10	4.1%
Extended left hepatectomy	1	0.4%
Right hepatectomy	43	17.69%
Extended right hepatectomy	5	2.05%
Central hepatectomy	1	0.4%
Caudate lobectomy	5	2.05%

Data are expressed as frequency and percentage.

Intraoperative events

Operative complications were detected in 40 (16.5%) cases in our study. Intraoperative bleeding was encountered in 29 (72.5%) cases, whereas diaphragmatic injury was encountered in four cases. Other complications are described in Table 8. The most common source of bleeding was the feeding vessels of the tumor (15 cases – 51.7%). Only one (0.4%) case experienced intraoperative mortality (Table 8).

Postoperative ICU admission

A total of 175 (72%) cases were admitted to the ICU after operation. Most of them (88.7%) were admitted for routine postoperative observation. Other 12 (6.8%) cases were admitted owing to hypotension. Other causes of admission included liver cell failure (LCF), uncontrolled hypertension, disturbed consciousness level, and hepatic coma (Table 9).

Third POD findings

The routine laboratory values on the third POD are illustrated in Table 10. In addition, the mean amount of drain fluids was 324.78 ml (Table 10).

Operative morbidity

Morbidity was encountered in 114 (46.9%) cases in the current study. Internal hemorrhage was encountered in six (2.5%) cases, and five of them were managed by exploration, whereas the remaining case was managed by interventional radiology. Bile leakage was encountered in 13 (5.3%) cases; five cases were managed by endoscopic retrograde cholangiopancreatography, two cases were managed by US-guided tube drainage, and the other six cases resolved spontaneously (Table 11).

Operative morbidity and mortality

Postoperative LCF was encountered in 96 (39.5%) cases. Besides, portal vein thrombosis was encountered in one (0.4%) case, and it was managed by conservative treatment. Early mortality was experienced in 10 (4.1%) cases in our study, and all these cases died owing to LCF (Table 12).

Operative hospital and ICU stay

The mean duration of hospital stay was 6.91 days (range, 2–66 days), whereas the mean duration of ICU stay was 1.5 days (Table 13).

Discussion

This research was performed at the Gastrointestinal Surgical Centre, Mansoura University, with the goal of evaluating early hepatic resection outcomes for HCC. We included a total of 243 cases, with an average age of 58.58 years. In terms of sex representation, males and females combined for 78.6 and 21.4% of the included cases respectively.

Age is no longer considered a contraindication to liver resection [14,15]. Another study included 77 (57.89%) males and 56 (42.11%) females to assess the early outcomes after liver resections [16].

A large number of studies have shown that Child–Pugh classification could predict the prognosis of patients with HCC [17,18]. However, the two clinical indicators such as ascites and hepatic encephalopathy are subjective, and there is human error in the assessment, which might affect the accuracy [19].

The majority of the included cases had a cirrhotic liver on CT scan (225 cases – 92.6%). Regarding the hepatic

Table 7 Operative data

	Mean±SD	All patients (*N*=243)			IQR
		Median	Minimum	Maximum	
Pringle (min)	18.86±7.28	15.00	10.00	45.00	15.00, 20.00
Operation (min)	184.59±71.27	180.00	65.00	420.00	120.00, 240.00
Blood loss (ml)	1153.37±1229.50	700.00	0.00	6000.00	300.00, 1500.00
Blood units	2.44±2.66	2.00	1.00	26.00	1.00, 3.00

Table 8 Intraoperative events

All patients (*N*=243)			
Blood transfusion		117	48.1%
Intraoperative complications		40	16.5%
Type of complications	Bleeding	29	72.5%
	Another organ injury	1	2.5%
	Diaphragmatic injury	4	10.0%
	Opening of the mass	2	5.0%
	Injury of MHV	3	7.5%
	Left duct transection	1	2.5%
Source of bleeding	IVC	2	6.9%
	PV	2	6.9%
	Collaterals	1	3.4%
	Feeding vessels	15	51.7%
	HVs	5	17.2%
	Cut surface and portal vein branches	2	6.9%
	Hepatic veins and cut surface	2	6.9%
Intraoperative mortality		1	0.4%

HV, hepatic vein; IVC, inferior vena cava; MHV, middle hepatic vein; PV, portal vein. Data are expressed as frequency and percentage.

Table 9 Postoperative ICU admission and its cause

	All patients (*N*=243)	
ICU admission	177	72%
Admission cause		
Routine	157	88.7%
Hepatic coma	2	1.1%
Postoperative hypotension	12	6.8%
PHLF and ascites	1	0.6%
HTN	3	1.7%
Disturbed conscious level	1	0.6%
Hepatorenal	1	0.6%

Data are expressed as frequency and percentage. HTN, hypertension; PHLF, posthepatectomy liver failure.

viral status, 221 cases were HCV positive (90.9%), whereas only two cases were HBV positive (0.8%).

Viral hepatitis has been associated with both an incidence of surgical site infections and a reactivation of the virus, which can lead to severe liver damage and patient death after a liver resection [20,21].

In the current study, the mean size of the lesions resected was 6.5 cm (range, 2–23 cm).

Another study reported that the mean size of HCC in the open surgery group was 6.1 cm (range, 2.5–22 cm). This comes in line with our study results [22].

In our study, open approach was used in 232 (95.5%) cases, whereas the laparoscopic approach was used in 11 cases, of which two (18.18%) were converted owing to uncontrolled bleeding. Our center is new regarding the experience in laparoscopic liver resections, and that is why, such approach has a small ratio in the current study.

As a consequence of continuous technical developments in liver surgery, laparoscopic liver resection is increasingly performed worldwide [23].

Overall reported conversion rates are ~4%, and bleeding is reported as the most common cause for this (range, 2–5%), accounting for as many as 34% of patients who required conversion [24,25].

In this study, pringle maneuver was used in 35 (14.4%) cases: 23 elective and 12 emergency situations. Pringle maneuver had a mean duration of 18.86 min (range, 10–45 min). For durations longer than 15 min, intermittent maneuver was performed in our study to avoid liver ischemia.

Another study has reported that pringle maneuver was done in 223 (53%) cases during hepatectomy [26].

Table 10 Day three postoperative findings

	All patients (*N*=243)				
	Mean±SD	Median	Minimum	Maximum	IQR
Albumin	2.83±0.42	2.80	1.80	4.20	2.50, 3.10
Total bilirubin	1.80±1.29	1.50	0.50	8.20	1.00, 2.10
Direct bilirubin	1.25±1.10	0.90	0.20	7.40	0.70, 1.40
ALT	176.63±199.00	118.00	20.00	1405.00	73.00, 212.75
AST	193.62±644.67	100.00	20.00	9120.00	66.25, 169.00
INR	1.65±4.27	1.30	1.00	60.00	1.10, 1.40
Drain amount	324.78±549.83	117.50	0.00	5200.00	40.00, 395.00

Data are expressed as mean and SD, median, minimum, maximum, and interquartile range (IQR). ALT, alanine transaminase; AST, aspartate transaminase; INR, international normalized ratio.

Table 11 Types and management of postoperative morbidity

	All patients (*N*=243)	
Postoperative morbidity	114	46.9%
Clavien grade		
I	42	36.8%
II	46	40.4%
IIIa	9	7.9%
IIIb	8	7.0%
V	9	7.9%
Respiratory morbidity (*n*=13)		
Pleural effusion	11	84.6%
Pneumonia	1	7.7%
Pneumothorax	1	7.7%
Renal morbidity (*n*=3)		
Hepatorenal	3	1.2%
GIT morbidity (*n*=1)		
Ileus	1	0.4%
PUO	2	0.8%
Wound infection (bedside treatment)	6	2.5%
Internal hemorrhage	6	2.5%
Internal hemorrhage treatment		
Interventional	1	17%
Surgical	5	83%
Collection	11	4.5%
Collection treatment		
Conservative	6	54.5%
US tube	5	45.5%
Bile leakage	13	5.3%
Bile leakage treatment		
Conservative	6	46.2%
US tubes	2	15.4%
ERCP	5	38.5%

Data are expressed as percentage and frequency. ERCP, endoscopic retrograde cholangiopancreatography; GIT, gastrointestinal tract; US, ultrasound.

Table 12 Postoperative morbidity and mortality

	All patients (*N*=243)	
Portal vein thrombosis	1	0.4%
PV thrombosis management		
Conservative	1	0.4%
Postoperative ascites	95	39.1%
Ascites treatment		
Liver support	92	96.8%
US tubes	3	3.2%
LCF grade (*n*=96)		
A	56	58.3%
B	29	30.2%
C	11	11.5%
Liver abscess (treated by US tube drain)	1	0.4%
Early mortality (due to LCF)	10	4.1%

Data is expressed as percentage and frequency. LCF, liver cell failure; PV, portal vein; US, ultrasound.

Table 13 Postoperative hospital and ICU stay

	Mean ±SD	Median	Minimum	Maximum	IQR
ICU stay (days)	1.58 ±2.31	1.00	1.00	22.00	1.00, 1.00
Hospital stay (days)	6.91 ±6.67	5.00	2.00	66.00	4.00, 7.00

Data is expressed as mean and SD, median, minimum, maximum, and interquartile range (IQR).

In our study, localized resection was the most common performed procedure (116 cases – 47.73%), followed by left lateral segmentectomy (50 cases – 20.57%) and right hepatectomy (43 cases – 17.69%). Other resections included left hepatectomy, segmentectomy, sectionectomy, and central and extended right and left hepatectomies.

Another study handling the same perspective stated that minor resections were performed in 54% of the included cases, whereas the remaining cases underwent major resections (46%) [26].

Additionally, operative time had a mean duration of 184 min. The mean amount of blood loss was 1153.37 ml, and blood transfusion was done for 117 (48.1%) cases.

Another study reported that the mean duration of operation was 200 min in the open group, whereas it was 120 min in the laparoscopic group [22].

In another study, operative time and intraoperative blood transfusion were strongly associated with morbidity, a result that is consistent with previous studies [27]. In an analysis of 155 patients undergoing extended hepatic resection for HCC, Wei *et al*. [28] noted that the need for a perioperative blood transfusion was the only risk factor for substantial morbidity.

In our study, the mean duration of hospital stay was 6.91 days. In addition, the mean duration of ICU stay was 1.58 days. The most common cause of admission in our study was routine monitoring.

In another study, the length of hospital stay had a mean of 8 days in the open surgery group, whereas it was 5 days in the laparoscopic group. ICU admission occurred in 28.57% of the open cases [22].

Regarding morbidity in our study, it was encountered in 114 (46.9%) cases, whereas early mortality was experienced in 10 cases. LCF was the commonest morbidity (96 cases – 39.5%). Furthermore, ascites was present in 95 (39.1%) cases, and it was managed by medical treatment in most cases. However, three cases required tube drainage.

This high incidence of postoperative LCF could be attributed to the large ratio of patients having cirrhotic livers, in addition to major hepatectomies occupied a large percentage in our study.

Complications of any kind after hepatic resection occur in up to 40% of patients without cirrhosis, and at a higher rate in patients with some degree of cirrhosis [29,30]. This agrees with our study findings.

Ascites is common in patients with liver disease and is often found postoperatively [31]. The most severe complication of hepatic resection is PHLF [32]. Mortality related to PHLF can be as high as 70% [33–35].

Perioperative mortality after hepatic resection is between 1 and 3% in high-volume centers [32]. Analysis of 13 558 patients who underwent hepatobiliary surgery from the National Surgical Quality Improvement Program database of the American College of Surgeons; perioperative (30 day) mortality was 2.1% for patients undergoing hepatic resection and was equivalent for benign and malignant lesions [36].

Regarding bile leakage in the current study, it occurred in 13 (5.34%) cases. Six cases were managed conservatively, whereas the remaining cases required either endoscopic retrograde cholangiopancreatography or US-guided tube drainage.

The occurrence of bile leakage after resection of the liver depends significantly on the surgical repertoire of the center, its risk perception, and not the least, its surgical experience. Thus, the recorded occurrence rates of bile leakage following liver resection vary greatly between centers (6.5–27.2%) [37].

In our study, postoperative hemorrhage occurred in six (2.5%) cases. Most cases were managed by surgical exploration, whereas only one case was successfully managed by radiological intervention.The significance of postoperative bleeding is related to its frequency (0–10%), severity (mortality 0–3%), and to the fact that it conditions a shorter graft survival and longer hospital stay [38,39].

When it comes to the respiratory complications in our study, it occurs in 13 (5.3%) cases. It included pleural effusion, pneumonia, and pneumothorax.

Owing to the altered respiratory physiology from the extent of the incision and retraction needed for surgical exposure, pulmonary complications following open upper abdominal surgery are common. In a retrospective study of 555 patients undergoing hepatic resection, pleural effusion and pneumonia occurred in 40 and 22%, respectively [40].

Hepatorenal syndrome occurred in three (1.2%) cases in our study. Another study reported that progressive renal insufficiency occurred in ~11 (1.4%) cases [27].

In our study, postoperative collection was encountered in 11 (4.5%) cases. Six cases were managed conservatively, whereas the other five cases required tube drainage.

Abdominal collections are the most frequent postoperative complication in all abdominal surgeries. The incidence rate varies between 5.8 and 28% according to different series [39,41].

Regarding surgical site infection in the current study, it was encountered in six (2.5%) cases, and it was managed by bedside drainage and antibiotics.

Other authors reported that wound infections were experienced in 46 (5.9%) cases after liver resections [27].

Portal vein thrombosis was encountered in only one (0.4%) case in this study. This patient was managed by anticoagulants.

This occurs in 1–3% of cases [42]. Posthepatectomy PVT is a potentially life-threatening complication that can reduce portal flow to the liver and lead to the development of mesenteric ischemia when it extends to the superior mesenteric vein. Its clinical importance has been described in some liver transplantation literature studies [43], but there have only been a few studies regarding hepatectomy [42,44].

Conclusion

Respecting the principles of liver surgery, hepatic resection can be performed, even in cirrhotic patients, with acceptable morbidity and minimal mortality. The most common complication after hepatic resection, in our study group, was postoperative liver failure, which was mostly reversible.

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Conflicts of interest

There are no conflicts of interest.

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