Liver resection for hepatic hemangiomas

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Original Article

ABSTRACT

Background: Hepatic hemangiomas are the most common benign liver tumors, often presenting management challenges. While many remain asymptomatic, some cause significant symptoms or complications, necessitating surgical intervention.

Aim: To investigate the indications and clinical outcomes of liver resection for hepatic hemangioma at the National Liver Institute, Menoufia University.

Patients and Methods: This retrospective study analyzed 45 patients who underwent liver resection for hepatic hemangioma from November 2019 to November 2023. Data collected included demographics, clinical presentation, imaging findings, surgical details, and postoperative outcomes.

Results: The study included 45 patients (84.4% female, 15.6% male) with a mean age of 41±9 years. The most common symptom was right hypochondrial pain (53.3%). Imaging revealed right lobe hemangiomas in 68.9% of cases. Nonanatomical resection was the most common surgical procedure (42.2%). Postoperative complications were minimal, with 93.3% of patients experiencing no complications. Pain improvement was reported by 95.6% of patients after 3 months. Significant changes in liver function tests were observed postoperatively, including decreases in albumin (3.969–3.493 g/dl, *P=0.029*), increases in alanine transaminase (44.64–166.09 U/l, *P<0.001*), and aspartate transaminase (39.44–142.53 U/l, *P<0.001*), and changes in coagulation parameters (international normalized ratio increased from 1.00 to 1.164, *P<0.001*).

Conclusion: Liver resection for hepatic hemangiomas is generally safe and effective, with high rates of symptom improvement and manageable postoperative changes in liver function. While most patients experienced no complications, the observed changes in liver function parameters underscore the need for careful postoperative monitoring. These findings support surgical intervention as a viable option for symptomatic hepatic hemangiomas.

Key Words: Hepatic hemangioma, liver function, liver resection, postoperative outcomes, surgical complications.

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INTRODUCTION

Cavernous hemangiomas are the most prevalent benign tumors of the liver, which is also the internal organ most commonly affected by these lesions[1]. While many individuals remain asymptomatic, others may experience a range of symptoms, from mild abdominal discomfort to severe, life-threatening complications[2]. These tumors show a higher prevalence in women[1], and some research indicates that exposure to exogenous estrogens, progesterone contraceptives, or hormone replacement therapy may significantly increase tumor size in affected women[3].

Ultrasonography, typically the initial imaging method used, offers 70–80% accuracy in diagnosing cavernous hemangiomas[4]. Its noninvasive nature and ease of repetition make it ideal for monitoring tumors once diagnosed[5]. MRI stands out as the most precise imaging technique, boasting 95% sensitivity and up to 100% specificity[6]. In cases of uncertainty, carefully conducted needle biopsies can be used for diagnosis.

Several publications have addressed the diagnostic and therapeutic challenges associated with hepatic hemangiomas. Recent years have seen numerous reports of favorable outcomes following surgical resection or enucleation[7]. However, for asymptomatic hepatic hemangiomas, conservative management is generally advised even in cases of giant lesions[4].

The factors influencing disease progression and outcomes remain poorly understood. It is worth noting that many follow-up studies originate from surgical centers, potentially skewing results toward larger, more complex tumors[2]. Our study aims to investigate the indications and

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clinical outcome of liver resection for hepatic hemangiomas in the National Liver Institute, Menoufia University.

PATIENTS AND METHODS:

Study design

This retrospective study was conducted at the Department of Surgery, Faculty of Medicine, Menoufia University from November 2019 to November 2023. The study was approved by the Institutional Ethics Committee (approval number 11/2015 SURG32). Informed consent was obtained from all patients included in the study.

Patient selection

Patients diagnosed with hepatic hemangioma with normal liver background and who underwent liver resection during the study period were included. The diagnosis of hepatic hemangioma was confirmed through imaging studies such as ultrasound, computed tomography (CT), or MRI. Patients with incomplete medical records or with abnormal liver background or those who did not undergo surgical intervention were excluded.

Data collection

Data were collected retrospectively from patient medical records. The following information was extracted:

• Demographic data: age, sex, weight, occupation.

• Clinical history: hypertension, diabetes, asthma, hypothyroidism, and prior surgical history (e.g. cholecystectomy, cesarean section, appendectomy, hernioplasty, hysterectomy).

• Clinical presentation: symptomatic or asymptomatic.

• Imaging findings: size and location of the hemangioma, diagnostic imaging modality.

• Prelaboratory findings: albumin levels, total bilirubin levels, direct bilirubin levels, alanine transaminase (ALT) levels, aspartate transaminase (AST) levels, hemoglobin (HB) levels, total leukocyte count (TLC), platelet count (PLT), international normalized ratio (INR), prothrombin concentration and tumor markers, including alpha-fetoprotein (AFP), carcinoembryonic antigen (CEA), and carbohydrate antigen 19-9 (CA19-9).

• Surgical details: type of resection, duration of surgery, intraoperative blood loss, and any complications

• Postoperative outcomes: length of hospital stay, postoperative complications, and improvement of symptoms.

Surgical technique

All surgeries were performed by experienced hepatobiliary surgeons. The surgical approach varied depending on the size and location of the hemangioma, as well as the patient's overall health. Types of liver resections included nonanatomical resection, segmentectomy, and lobectomy. Intraoperative ultrasonography was used to delineate the tumor margins and guide resection. Hemostasis was achieved using electrocautery and sutures.

Statistical analysis

Data were analyzed using SPSS, version 25.0 (IBM Corp., Armonk, New York, USA). Continuous variables were expressed as mean±SD, and categorical variables were presented as frequencies and percentages. The χ^2 test was used for categorical data, while the t test was used for continuous data. A *P value* of less than 0.05 was considered statistically significant.

Ethical considerations

This study was conducted following the principles of the Declaration of Helsinki. The confidentiality of all patients was maintained throughout the study.

RESULTS:

Demographic characteristics and clinical history

The study included 45 patients, with a female predominance (84.4%, n=38) compared with males (15.6%, n=7). The majority of patients were nonworkers (66.7%, n=30), while the remaining 33.3% (n=15) were workers. The mean age of the patients was 41 years with a SD of 9 years. The mean weight was 77 kg with a SD of 7 kg.

Regarding surgical history, 48.9% (n=22) of the patients had a prior surgical history, while 51.1% (n=23) did not. Among those with a surgical history, procedures included cholecystectomy (4.4%, n=2), appendectomy (13.3%, n=6), cesarean section (20.0%, n=9), hernioplasty (4.4%, n=2), hysterectomy (4.4%, n=2), and thyroidectomy (2.2%, n=1).

In terms of medical history, 26.7% (n=12) had a medical history, while 73.3% (n=33) did not. Conditions noted included hypertension in 8.9% (n=4), diabetes mellitus in 6.7% (n=3), asthma in 8.9% (n=4), and hypothyroidism in 2.2% (n=1).

Symptoms and preoperative imaging of liver hemangiomas

Among the patients, 53.3% (n=24) presented with right hypochondrial pain (dull aching pain), 26.6% (n=12) with epigastric pain (dull aching pain), 6.6% (n=3) with abdominal distention, 6.6% (n=3) with a sudden increase in size with abdominal pain, 4.4% (n=2) were accidentally discovered, and 2.2% (n=1) presented with syncope (stabbing pain) (Table 1).

Preoperative imaging using triple-phase-CT (TRI-CT) indicated that 68.9% (n=31) had hemangiomas in the right

lobe, and 31.1% (n=14) in the left lobe also showed that 55.5% (n=25) had hemangiomas of between 5 and 10 cm in size and 44.5% (n=20) more than 10 cm in size. Dynamic MRI of the abdomen confirmed right lobe hemangiomas in 68.9% (n=31) and left lobe hemangiomas in 31.1% (n=14) and also showed that 55.5% (n=25) had hemangiomas of between 5 and 10 cm in size and 44.5% (n=20) more than 10 cm in size. Preoperative ultrasound showed hepatic focal lesions in the right lobe in 71.1% (n=32) and in the left lobe in 28.8% (n=13) (Table 1).

Pictures group 1 (TRI-CT abdomen photos were taken for cases at the National Liver Institute).

Pictures group 2 (dynamic MRI abdomen photos were taken for cases at the National Liver Institute).

Preoperative tumor markers of liver hemangiomas

The mean levels of preoperative tumor markers were as follows: AFP had a mean of 2.38 ng/ml with an SD of 2.58, CEA had a mean of 0.59 ng/ml with an SD of 1.00, and CA19-9 had a mean of 2.87 U/ml with an SD of 5.32.

Operation

Regarding surgical procedures, laparoscopic operations included nonanatomical resection in 2.2% (n=1) and formal right hepatectomy in 4.4% (n=2). Open surgeries comprised posterior sectionectomy in 4.4% (n=2), nonanatomical resection in 42.2% (n=19), left lateral resection in 28.9% (n=13), formal left hepatectomy in 2.2% (n=1), and formal right hepatectomy in 15.6% (n=7) (Table 2).

Pictures group 3 (operations photos were taken for cases at the National Liver Institute).

Association between operation and operative time

Among laparoscopic surgeries, nonanatomical resections had the shortest mean operative time at 2.00±0.1 h, while formal right hepatectomy took the longest at 5.00±0.22 h. Open surgeries varied widely, with nonanatomical resections (1.73±0.32 h) being the shortest. The longest was a formal right hepatectomy, requiring 3.71±1.29 h. These results indicate that, on average, open surgeries had greater variation in duration, while laparoscopic procedures displayed more consistency.

Association between operation and blood loss

Laparoscopic nonanatomical resections exhibited the lowest mean blood loss at 200±12 ml, whereas formal right hepatectomies showed the highest at 1500±10 ml. In open surgeries, nonanatomical resections also had the lowest blood loss (171.05±14.64 ml), while formal right hepatectomies resulted in the highest (814.29±58.06 ml). Overall, laparoscopic procedures typically led to greater blood loss compared with open techniques, particularly in formal hepatectomies, where blood loss was significantly elevated.

Association between operation and requirement of blood transfusion

Among laparoscopic procedures, only formal right hepatectomy required transfusion, with 100% of cases needing three or five packs of blood. In open surgeries, the majority of nonanatomical resections (47.5%) and left lateral resections (32.5%) did not require transfusion. However, for posterior sectionectomy and formal right hepatectomy (open), transfusion needs were observed, with posterior sectionectomy cases requiring one (100%) pack and formal right hepatectomy requiring two (100%) packs and, in one case, seven (100%) packs. Overall, blood transfusion was less frequently required in open nonanatomical and left lateral resections compared with other surgeries.

Postoperative complications

Postoperative complications were minimal among the studied patients. The majority of patients (93.3%, n=42) experienced no complications. However, there were isolated instances of complications: common hepatic duct stricture occurred in 2.2% (n=1), intraoperative bleeding in 2.2% (n=1), and right-sided diaphragmatic hernia in 2.2% (n=1) (Table 3).

Postoperative follow-up for pain

Follow-up data indicated that 95.6% (n=43) of patients reported improvement in pain after 3 months of postoperative follow-up in the outpatient clinic. Only 4.4% (n=2) did not experience an improvement in pain (Table 4).

Association between outcome (hospital stay) with demographic and clinical characteristics

The length of hospital stay was analyzed in relation to various demographic and clinical characteristics. The mean hospital stay for female patients was 6 days (SD=2), compared with 5 days (SD=1) for male patients, with a *P value* of 0.231. Patients with no prior surgical history had a mean hospital stay of 6 days (SD=3), whereas those with a surgical history had a mean stay of 5 days (SD=1), with a *P value* of 0.751. Patients with no medical history had a mean hospital stay of 6 days (SD=2), while those with a medical history also had a mean stay of 6 days (SD=2), with a *P value* of 0.156. Regarding symptoms, patients with abdominal distention had a mean hospital stay of 5 days (SD=1), those with epigastric pain had a mean stay of 6 days (SD=1), and those with right hypochondrial pain had a mean stay of 6 days (SD=3), with a P value of 0.322.

Preoperative and postoperative laboratory investigations (liver function)

Comparing preoperative and postoperative laboratory investigations showed significant changes in liver function. The mean preoperative albumin level was 3.969 g/dl (SD=0.2334), which decreased to 3.493 g/dl (SD=0.4075) postoperatively (*P=0.029*). Total bilirubin levels decreased from a mean of 0.78 mg/dl (SD=0.14) preoperatively to

0.69 mg/dl (SD=0.32) postoperatively, though this change was not statistically significant (*P=0.064*). Direct bilirubin levels slightly increased from 0.16 mg/dl (SD=0.07) to 0.18 mg/dl (SD=0.10) postoperatively (*P=0.623*). Significant increases were noted in ALT, from 44.64 U/l (SD=18.355) preoperatively to 166.09 U/l (SD=96.030) postoperatively (*P<0.001*), and AST, from 39.44 U/l (SD=10.847) to 142.53 U/l (SD=74.897) postoperatively (*P<0.001*). HB levels decreased from 11.53 g/dl (SD=1.217) to 10.384 g/dl (SD=1.2055) postoperatively (*P<0.001*). TLC increased from 5.78×10^3/µl (SD=1.241) to 9.04×10^3/µl (SD=2.907) postoperatively (*P<0.001*). PLT decreased from 346.47×10^3/µl (SD=65.983) preoperatively to 220.07×10^3/µl (SD=58.141) postoperatively (*P<0.001*). INR increased from 1.00 (SD=0.000) preoperatively to 1.164 (SD=0.1334) postoperatively (*P<0.001*), and prothrombin concentration decreased from 100.00% (SD=0.000) to 76.18% (SD=12.824) postoperatively (*P=0.023*) (Figs. 1,2).

Table 1: Symptoms and preoperative imaging of liver hemangioma

	n (%)
Symptoms	
Right hypochondrial pain (dull aching pain)	24 (53.3)
Epigastric pain (dull aching pain)	12 (26.6)
Abdominal distention	3 (6.6)
Sudden increase in size with abdominal pain	3 (6.6)
Accidentally discovered	2 (4.4)
Syncope (stabbing pain)	1 (2.2)
TRI-CT findings	
Right lope lesion with criteria of hemangioma (query hemangioma)	31 (68.9)
Left lope lesion with criteria of hemangioma (query hemangioma)	14 (31.1)
Dynamic MRI abdomen	
Right lobe lesion with criteria of hemangioma	31 (68.9)
Left lobe lesion with criteria of hemangioma	14 (31.1)
Preoperative US	
HFL at the right lobe	32 (71.1)
HFL at the left lobe	13 (28.8)
TRI-CT findings (tumor size)	
Lesion size with criteria of hemangioma of 5–10 cm	25 (55.5)
Lesion size with criteria of hemangioma of more than 10 cm	20 (44.5)
Dynamic MRI abdomen (tumor size)	
Lesion size with criteria of hemangioma of 5–10 cm	25 (55.5)
Lesions size with criteria of hemangioma of more than 10 cm	20 (44.5)

HFL, hepatic focal lesions; TRI-CT, triple-phase computed tomography; US, ultrasound.

Table 2: Operation

	n (%)
Operation	
Lap	
Nonanatomical resection (lap)	1 (2.2)
Formal right hepatectomy (lap)	2 (4.4)
Open	
Posterior sectionectomy (open)	2 (4.4)
Nonanatomical resection	19 (42.2)
Left lateral resection (open)	13 (28.9)
Formal left hepatectomy (open)	1 (2.2)
Formal right hepatectomy (open)	7 (15.6)

Table 3: Postoperative complications

	n (%)
Postoperative complications	
None	42 (93.3)
Common hepatic duct stricture	1 (2.2)
Intraoperative bleeding	1 (2.2)
Right-sided diaphragmatic hernia	1 (2.2)

Table 4: Postoperative follow-up for pain

	n (%)
Postoperative follow-up in the outpatient clinic and improvement after 3 months of follow-up	
Pain improved now	43 (95.6)
No pain improvement	2 (4.4)

Fig. 1: Case 1: a case of formal left hepatectomy for a giant hemangioma in the left lobe, details obtained through personal communication with Dr Yahya Ahmed Fayed Lecturer of HPB Surgery Department, National Liver Institute, Menoufia University.

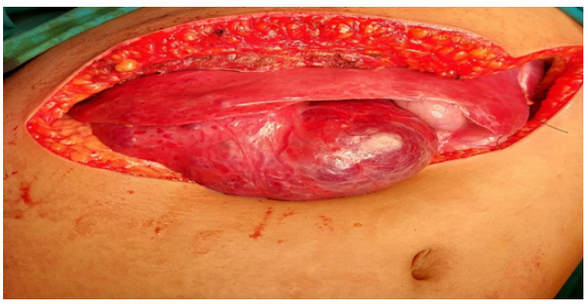

Fig. 2: Case 2: a case of nonanatomical resection of a giant hemangioma at seg VI and VII. Details obtained in personal communication with Dr Yahya Ahmed Fayed Lecturer of HPB Surgery Department, National Liver Institute, Menoufia University.

DISCUSSION

Hepatic hemangiomas are the most common benign liver tumors, often presenting clinical challenges in management decisions. While many remain asymptomatic, some cause significant symptoms or complications, necessitating intervention[4].

Our study aims to evaluate the outcomes of liver resection for hepatic hemangiomas, focusing on symptom relief, postoperative complications, and changes in liver function parameters.

Our study on liver resection for hepatic hemangiomas revealed a female predominance among patients, with the majority being nonworkers. The mean age was 41 years and the mean weight was 77 kg. Nearly half of the patients had a prior surgical history, with cholecystectomy, appendectomy, and cesarean section being the most common procedures. Most patients had no significant medical history, though some had hypertension, diabetes, or asthma. Right hypochondrial dull aching pain was the most common symptom, and imaging frequently identified hemangiomas in the right lobe of the liver. Postoperative complications were rare, with most patients experiencing no issues, and pain significantly improved in almost all patients after 3 months. Hospital stay did not significantly differ based on sex, surgical or medical history, or specific symptoms. Significant changes in liver function tests were observed postoperatively, indicating the impact of surgical intervention on hepatic function.

In our study, the most common symptom was right hypochondrial dull aching pain, followed by epigastric dull aching pain. These findings are consistent with those reported by Ibrahim *et al*.[8], who noted that pain is a common symptom due to the size and location of the hemangioma causing stretching of the liver capsule or pressure on adjacent structures. However, a minority of our patients were asymptomatic, with hemangiomas discovered incidentally, similar to the findings of Bajenaru *et al*.[9], who reported that many hemangiomas are often found incidentally during imaging for unrelated conditions.

Preoperative imaging using TRI-CT and dynamic MRI frequently identified hemangiomas in the right lobe. This prevalence in the right lobe is supported by studies like that of Bajenaru *et al*.[9], which reported a higher incidence of right lobe involvement. The use of ultrasound also showed a high detection rate of right lobe hemangiomas, aligning with the findings of Azizaddini and Mani[10], who emphasized the efficacy of ultrasound in initial screening for hepatic lesions.

The mean levels of preoperative tumor markers such as AFP (2.38 ng/ml), CEA (0.59 ng/ml), and CA19-9 (2.87 U/ml) were within normal ranges, indicating that these markers are generally not elevated in benign hepatic hemangiomas. This is in agreement with the study by Venkatesh *et al*.[11], which also reported normal levels of these tumor markers in patients with hepatic hemangiomas, distinguishing them from malignant hepatic tumors where elevated levels might be expected.

Our study highlights that nonanatomical resection was the most common surgical procedure, followed by left lateral resection and formal right hepatectomy. The choice of nonanatomical resection is often preferred due to its tissue-sparing nature, as supported by the work of Orcutt and Anaya[12], who advocated for minimal resection to preserve liver function while effectively managing symptoms and preventing complications.

Laparoscopic approaches were less common, which is consistent with the findings of Mithany *et al*.[13], who suggested that while laparoscopic liver resection is feasible and offers benefits such as reduced postoperative pain and shorter hospital stay, it requires significant expertise and is not universally applicable for all hepatic hemangiomas, particularly large or deeply located ones.

Our study demonstrates that laparoscopic nonanatomical resections for hepatic hemangioma have the shortest operative time, while laparoscopic formal right hepatectomy required the longest time. This is consistent with findings from the study by Wang *et al*.[14] highlighting that minimally invasive techniques can reduce operative duration for smaller or less complex resections due to streamlined access and reduced tissue manipulation. However, other literature, such as reports by Dong *et al*.[15], suggests that complex laparoscopic resections can extend the operative time due to increased technical demands.

Our study also found that laparoscopic approaches were associated with higher mean blood loss in cases like formal right hepatectomy compared with open resections. Liu *et al*.[16] advocate that the laparoscopic approach may limit blood loss due to enhanced visualization and controlled dissection; however, our findings align with studies like those of Xie *et al*.[7], indicating that blood loss may increase with more complex laparoscopic procedures due to factors such as extended operative time and vascular challenges.

Our study observed lower blood transfusion requirements in open nonanatomical and left lateral resections compared with complex laparoscopic procedures. Literature supports that simpler open resections generally involve lower transfusion rates, as shown in Kim *et al*.[17], due to limited blood loss

and shorter operative times. However, contrasting findings in studies by Serednicki *et al*.[18] indicate that laparoscopic approaches could reduce transfusion needs due to better blood management techniques.

Postoperative complications were rare, with the majority of patients experiencing no complications. This high rate of uncomplicated recoveries aligns with the findings of Liu *et al*.[16], who reported low complication rates in hepatic hemangioma surgeries, attributing it to improved surgical techniques and better perioperative care.

Notably, there were isolated cases of common hepatic duct stricture (2.2%), intraoperative bleeding (2.2%), and right-sided diaphragmatic hernia (2.2%). These complications, though uncommon, are documented in the literature. Wanjara and Kashyap[19] reported that bile duct strictures can occur, particularly in resections involving the hilar region, while intraoperative bleeding is a recognized risk in hepatic surgery due to the vascular nature of the liver.

The low rate of complications and favorable outcomes in our study are in line with other contemporary studies, such as those by Wang *et al*.[14], which emphasize the safety and efficacy of surgical management for symptomatic hepatic hemangiomas.

Our study found that 95.6% of patients reported improvement in pain 3 months after surgery. This high rate of pain resolution aligns with several studies. For instance, Shin *et al*.[20] reported significant pain relief in 92% of patients who underwent surgical resection for hepatic hemangiomas. Similarly, Yuan *et al*.[21] found that 88% of patients experienced complete resolution of symptoms postsurgery.

However, our results show a slightly higher success rate compared with some other studies. Tang *et al*.[22] reported symptom improvement in only 80% of their patients.

The 4.4% of patients in our study who did not experience pain improvement warrants further investigation. Zhang *et al*.[23] suggested that persistent pain postsurgery might be due to other underlying conditions or the development of adhesions.

Our analysis showed no statistically significant associations between the duration of hospital stay and various demographic or clinical characteristics, including sex, surgical history, medical history, and presenting symptoms. This finding contrasts with some existing literature.

Farhat *et al*.[24] reported that patients with a significant medical history had longer hospital stays following hepatic resection. Our study's lack of significant difference might be due to our smaller sample size or improvements in perioperative care that have equalized outcomes across patient groups.

Interestingly, we found that patients with abdominal distention had a slightly shorter mean hospital stay (5 days) compared with those with epigastric or right hypochondrial pain (6 days), although this difference was not statistically significant ($P=0.322$). This trend, while not reaching significance, suggests that the nature of preoperative symptoms might influence postoperative recovery.

Our study observed significant postoperative changes in several liver function parameters. Notably, we found significant decreases in albumin levels and increases in ALT and AST levels. These findings are consistent with those reported by Kalogirou *et al*.[25], who also noted transient elevations in liver enzymes following hepatic resection for hemangiomas.

The significant decrease in PLT and increase in INR observed are indicative of the impact of liver resection on coagulation parameters. Similar findings were reported by Maruyama *et al*.[26], who emphasized the importance of close monitoring of these parameters in the immediate postoperative period.

However, our finding of a nonsignificant change in total bilirubin levels contrasts with some studies. Sawangkajohn *et al*.[27] reported significant elevations in bilirubin levels following hepatic resection. This discrepancy might be due to differences in the extent of liver resection or variations in immediate postoperative management strategies.

The significant decrease in HB levels and increase in TLC observed are consistent with the expected physiological response to surgery, as reported by Maruyama and colleagues. These changes reflect the combined effects of surgical blood loss and the inflammatory response to tissue trauma.

This study provides valuable insights into the surgical management of hepatic hemangiomas, with a particular focus on postoperative outcomes and liver function changes. The strength of our study lies in its comprehensive analysis of preoperative and postoperative laboratory parameters, providing a detailed picture of the physiological impact of liver resection. In addition, our high rate of pain improvement postsurgery offers encouraging evidence for the efficacy of surgical intervention. However, our study has several limitations. The retrospective nature of the study introduces potential for bias in patient selection and data collection. Our sample size, while sufficient for many analyses, may have

limited our ability to detect significant associations in some comparisons, particularly regarding hospital stay duration. Furthermore, the single-center design may limit the generalizability of our findings to other populations or healthcare settings.

CONCLUSION

Our study demonstrates that liver resection for hepatic hemangiomas is generally safe and effective, with high rates of symptom improvement and manageable postoperative changes in liver function. While most patients experienced no complications, the observed changes in liver function parameters underscore the need for careful postoperative monitoring. Our findings support surgical intervention as a viable option for symptomatic hepatic hemangiomas.

CONFLICT OF INTEREST

There are no conflicts of interest.

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