



Does laparoscopic liver resection relieve symptoms in patients with benign liver tumors?

Ali laparoskopska resekcija jeter ublaži simptome pri bolnikih z benignimi tumorji jeter?

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ABSTRACT

Background: Modern imaging increasingly detects benign liver tumours. Most are managed conservatively, but surgery may be indicated for symptoms, tumour growth, diagnostic uncertainty, or tumour-related risk.

Aim: To evaluate symptom relief and perioperative outcomes after laparoscopic liver resection for benign liver tumours in a single-centre cohort.

Materials and Methods: We retrospectively analysed patients who underwent laparoscopic liver resection for benign lesions at University Medical Centre Maribor between April 2008 and August 2025. We included the patients with histologically confirmed hemangioma, hepatocellular adenoma, or focal

IZVLEČEK

Izhodišče: Benigne tumorje jeter zaradi sodobnih slikovnih preiskav odkrivamo vse pogosteje. Večino zdravimo konzervativno, pri izbranih bolnikih pa je resekcija indicirana zaradi simptomov, rasti tumorja, diagnostične negotovosti ali tveganj, povezanih s tumorjem.

Namen: Oceniti zmanjšanje simptomov ter perioperativne izide po laparoskopski resekciji jeter zaradi benignih tumorjev.

Materiali in metode: Retrospektivno smo analizirali bolnike, pri katerih je bila med aprilom 2008 in avgustom 2025 v Univerzitetnem kliničnem centru Maribor opravljena laparoskopska resekcija jeter zaradi benignih tumorjev. Vključeni so bili bolniki s

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nodular hyperplasia. We collected preoperative, perioperative, postoperative, and follow-up data. We assessed symptom relief 12 months after surgery.

Results: We included 19 patients: five with hepatocellular adenoma, eight with hemangioma, and six with focal nodular hyperplasia. The main indication was symptoms in 12 patients (63.2%), followed by diagnostic uncertainty in four (21.1%) and tumour growth in three (15.8%). Median tumour diameter was 5.5 cm, operative time was 120 minutes, blood loss was 20 mL, and hospital stay was 4 days. No intraoperative complications occurred. One postoperative complication with Clavien-Dindo grade I was recorded (5.3%). Symptoms improved in 8 of the 12 symptomatic patients (66.7%), indicating a statistically significant postoperative improvement ($p = 0.008$).

Conclusions: Laparoscopic liver resection was safe and provided symptom relief in most symptomatic patients with benign liver tumours.

histološko potrjenim hemangiomom, hepatocelularnim adenomom ali fokalno nodularno hiperplazijo. Zbrali smo perioperativne podatke in podatke kontrolnih pregledov. Zmanjšanje simptomov smo ocenili 12 mesecev po operaciji.

Rezultati: Vključenih je bilo 19 bolnikov: pet s hepatocelularnim adenomom, osem s hemangiomom in šest s fokalno nodularno hiperplazijo. Najpogostejša indikacija za resekcijo so bili simptomi pri 12 bolnikih (63,2 %), sledili sta diagnostična negotovost pri štirih (21,1 %) in rast tumorja pri treh (15,8 %). Mediana premera tumorja je bila 5,5 cm, trajanja operacije 120 minut, izgube krvi 20 mL in hospitalizacije 4 dni. Intraoperativnih zapletov, preklapov v odprto metodo, poškodb okolnih struktur, transfuzij ali smrtnosti ni bilo. Zabeležen je bil en pooperacijski zaplet stopnje I po klasifikaciji Clavien-Dindo (5,3 %). Zmanjšanje simptomov je bilo doseženo pri 8 od 12 simptomatskih bolnikov (66,7 %) in je bilo statistično značilno ($p = 0,008$).

Zaključki: Laparoskopska resekcija jeter je varna metoda in pri dveh tretjinah simptomatskih bolnikov z benignimi tumorji jeter prispeva k ublažitvi simptomov.

INTRODUCTION

Benign liver tumours are increasingly detected because of the widespread use and improved quality of modern imaging. Hemangioma, focal nodular hyperplasia (FNH), and hepatocellular adenoma (HCA) represent the most common benign solid liver lesions (1, 2). Many of these lesions are discovered incidentally during abdominal imaging performed for unrelated reasons, particularly in middle-aged women (3, 4). Hemangiomas are reported 2–6 times more frequently, FNH eight times more frequently, and HCA up to ten times more frequently in women than in men (5).

Advances in diagnostic imaging, particularly magnetic resonance imaging with hepatobiliary contrast

agents, have improved the characterisation of benign liver lesions. Nevertheless, reliable differentiation between HCA, FNH, and well-differentiated hepatocellular carcinoma can still be difficult in selected cases. When malignancy cannot be confidently excluded, diagnostic uncertainty may therefore become an indication for surgical resection (2, 3).

Although most benign liver tumours remain asymptomatic, some patients report abdominal pain, pressure, discomfort, or fullness, especially when lesions are large or located close to surrounding structures (6).

The management of benign liver tumours remains individualized. It depends on tumour type, size, growth pattern, symptoms, and the risk of complications (3, 4, 7) FNH and haemangiomas usually carry

no significant risk of malignant transformation. They are therefore managed conservatively in most cases. In contrast, HCA, particularly those larger than 5 cm, may be associated with haemorrhage or malignant transformation, and resection is commonly recommended when these risks are clinically relevant. For patients with smaller lesions or lesions without clear malignant potential, the indication for surgery is less well defined. Symptoms and their effect on quality of life often influence the decision (4, 6, 8).

A major challenge in clinical decision-making is determining whether non-specific abdominal symptoms are truly attributable to the liver lesion. This uncertainty must be balanced against the risks of surgery, even though liver resection is considered safe in experienced centres and is associated with low mortality and acceptable morbidity (2–4). The role of resection for benign disease still requires careful patient selection.

This study aimed to evaluate perioperative and postoperative outcomes after laparoscopic liver resection for benign liver tumours, with particular focus on symptom relief.

Materials and Methods

We retrospectively maintained database of patients who underwent liver resection at University Medical Centre Maribor between April 2008 and August 2025. Patients were eligible for inclusion if they underwent laparoscopic liver resection for a benign liver lesion, namely liver haemangioma, HCA, or FNH, confirmed by the final histopathological diagnosis.

At the time of surgery, all patients consented to the use of anonymised data for research purposes. Medical records were anonymised before analysis. Because of the retrospective design, the local Ethics Committee waived the requirement for formal approval.

For each eligible patient we extracted, demographic, perioperative, and follow-up data from the database. We analysed the data for the entire cohort and

separately by final histopathological diagnosis: HCA, haemangioma, or FNH.

Preoperative variables included sex, age, body mass index, American Society of Anaesthesiologists (ASA) score, liver steatosis, tumour diameter, Southampton difficulty score (9), and Iwate score (10). The indication for surgery was classified as diagnostic uncertainty, tumour growth, or symptoms. Perioperative variables included the type and extent of liver resection. We first classified resections as anatomical or non-anatomical based on whether they followed segmental liver anatomy (11).

The non-anatomical resections were recorded as atypical resections. We defined anatomically major resections as resections of three or more adjacent liver segments, whereas minor resections included segmentectomies and sectionectomies involving fewer than three adjacent segments (11). Technically major resections were analysed separately and referred to resections that are anatomically minor but technically demanding because they involve posterosuperior liver segments 1, 4a, 7, or 8, which are difficult to access laparoscopically (12, 13).

Intraoperative complications were defined according to Halls et al. and included blood loss exceeding 775 mL, unintentional injury to surrounding structures, or conversion to an open approach (9). Other variables were operative time, blood loss, use and duration of hepatic pedicle clamping, and blood transfusion requirement.

Postoperative and follow-up outcomes included postoperative morbidity, mortality, length of hospital stay, and self-reported symptom relief after surgery. Postoperative morbidity was defined as any postoperative complication and was classified according to the Clavien-Dindo classification (14).

Symptom relief was assessed in patients who were symptomatic before surgery and was defined as a decrease or absence of the presenting symptoms at 12-month follow-up after laparoscopic liver resection.

Statistical analysis

We performed statistical analysis using IBM SPSS Statistics for Windows, version 31.0.0.0 (IBM Corporation, Armonk, NY, USA). We reported percentages to one decimal place, and a considered p -values < 0.05 statistically significant. We presented categorical variables as counts and percentages, and tested differences between them using the Fisher–Freeman–Halton test. We express continuous variables as medians with interquartile ran-

ges and analysed them using the Kruskal–Wallis test because the distributions were non-normal. We analysed symptom relief using McNemar’s test for paired categorical data.

Results

During the study period, 19 patients underwent laparoscopic liver resection for benign liver tumours. Final histopathology confirmed HCA in 5 patients, haemangioma in 8, and FNH in 6. Table 1 summa-

Table 1. Preoperative characteristics of 19 patients undergoing laparoscopic liver resection for benign liver tumours.

	Total (n = 19)	HCA (n = 5)	Hemangioma (n = 8)	FNH (n = 6)	<i>p</i> -value
Male sex ^a	6 (31.6%)	0 (0.0%)	3 (37.5%)	3 (50.0%)	0.221
Age (years) ^b	48.0 (IQR 29.0)	48.0 (IQR 39.0)	57.0 (IQR 24.0)	39.5 (IQR 17.0)	0.074
Body mass index (kg/m ²) ^b	26.2 (IQR 6.1)	26.4 (IQR 9.4)	25.3 (IQR 5.8)	28.65 (IQR 6.1)	0.728
Tumour diameter (cm) ^b	5.5 (IQR 5.5)	5.2 (IQR 4.4)	6.15 (IQR 6.5)	5.0 (IQR 8.7)	0.810
ASA score 3 ^a	2 (10.5%)	1 (20.0%)	1 (12.5%)	0 (0.0%)	0.719
Liver steatosis ^a	4 (21.1%)	1 (20.0%)	1 (12.5%)	2 (33.3%)	0.780
Median Southampton difficulty score ^b	3 (IQR 1)	3 (IQR 3)	3 (IQR 2)	3 (IQR 2)	0.823
Median Iwate score ^b	5 (IQR 1)	4 (IQR 2)	4.5 (IQR 2)	5 (IQR 1)	0.128

^a Categorical variable, Fisher–Freeman–Halton test; ^b continuous variable, Kruskal–Wallis test. ASA, American Society of Anaesthesiologists; FNH, focal nodular hyperplasia; HCA, hepatocellular adenoma; IQR, interquartile range.

Table 2

	Total (n = 19)	HCA (n = 5)	Hemangioma (n = 8)	FNH (n = 6)	<i>p</i> -value
Diagnostic uncertainty	4 (21.1%)	2 (40.0%)	1 (12.5%)	1 (16.7%)	0.253 ^a
Tumour growth	3 (15.8%)	1 (20.0%)	0 (0.0%)	2 (33.3%)	
Symptoms	12 (63.2%)	2 (40.0%)	7 (87.5%)	3 (50%)	

^a Categorical variable, Fisher–Freeman–Halton test. FNH, focal nodular hyperplasia; HCA, hepatocellular adenoma.

izes baseline characteristics. The median age was 48.0 years; 6 patients (31.6%) were male; the median body mass index was 26.2 kg/m²; and the median tumour diameter was 5.5 cm. No statistically significant differences were observed between histopathological groups in sex, age, body mass index, tumour diameter, ASA score, liver steatosis, Southampton difficulty score, or I wate score.

Table 2 presents indications for surgery. Symptoms were the most common indication, present in 12 patients (63.2%). Diagnostic uncertainty was the indication in 4 patients (21.1%), whereas tumour growth was noted in 3 patients (15.8%). The distribution of surgical indications did not differ significantly between patients with HCA, haemangioma, and FNH.

Table 3 shows intraoperative and postoperative outcomes.

Five patients had atypical liver resections. There were 14 anatomical resections: two patients (10.5%) underwent technically major resections (right posterior sectionectomies), seven underwent left lateral sectionectomies, and five underwent segmentectomies. There were no anatomically major resections.

Median blood loss was 20 mL, and median operative time was 120 minutes. Hepatic pedicle clamping was used in 5 patients (26.3%), with a median total clamping duration of 25 minutes among those who underwent clamping.

No intraoperative complications and no transfusion requirements were recorded. Postoperative morbidity was low, with one Clavien-Dindo grade I complication (5.3%), and no postoperative mortality occurred. The median length of hospital stay was 4 days. Among the 12 patients who were symptomatic before surgery, symptom relief was achieved in

Table 3. Intraoperative and postoperative outcomes

	Total (n = 19)	HCA (n = 5)	Haemangioma (n = 8)	FNH (n = 6)	p-value
Technically major resection ^a	2 (10.5%)	0 (0%)	1 (12.5%)	1 (16.7%)	1.000
Anatomical resections ^a	14 (73.7%)	3 (60.0%)	5 (62.5%)	6 (100.0%)	0.101
Blood loss (mL) ^b	20 (IQR 200)	60 (IQR 310)	20 (IQR 70)	115 (IQR 255)	0.775
Operative time (min) ^b	120 (IQR 50)	130 (IQR 143)	115 (IQR 31)	127.5 (IQR 46)	0.624
Hepatic pedicle clamping ^a	5 (26.3%)	2 (40.0%)	1 (12.5%)	2 (33.3%)	0.530
Total hepatic pedicle clamping duration (min) ^b	25 (IQR 19)	25 (IQR 0)	47 (IQR /)	33 (IQR /)	0.223
Intraoperative complications	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	/
Length of hospital stay (days) ^b	4 (IQR 2)	5 (IQR 1)	4.5 (IQR 3)	3.5 (IQR 1)	0.092
Postoperative complication ^a	1 (5.3%)	1 (20.0%)	0 (0.0%)	0 (0.0%)	0.263
Symptom relief ^c	8 (66.7%)	1 (50.0%)	5 (71.4%)	2 (66.7%)	0.008

^a Categorical variable, Fisher–Freeman–Halton test; ^b continuous variable, Kruskal–Wallis test; ^c paired categorical data, McNemar’s test. FNH, focal nodular hyperplasia; HCA, hepatocellular adenoma; IQR, interquartile range.

eight patients (66.7%) at 12-month follow-up, representing a statistically significant postoperative improvement ($p = 0.008$).

Discussion

This single-centre experience suggests that laparoscopic liver resection can provide symptom relief for selected patients with benign liver tumours while maintaining a favourable perioperative safety profile. In our cohort, symptoms were the most common indication for surgery, accounting for 12 of 19 resections (63.2%) (Table 2). At 12-month follow-up, 8 of these 12 symptomatic patients achieved symptom relief (66.7%), representing a statistically significant postoperative improvement ($p = 0.008$) (Table 3). These findings support the role of surgery in carefully selected symptomatic patients, provided that other potential causes of abdominal complaints are reasonably excluded before resection, as symptom attribution in benign liver lesions is often challenging (6, 15).

Our results are broadly consistent with previous reports on liver resection for symptomatic benign liver lesions. Hoffmann et al. reported complete or partial symptom relief in 87% of symptomatic patients after resection, with no postoperative mortality and acceptable morbidity (3). Similarly, van Rosmalen et al. observed sustained symptom relief in 30 of 40 patients after a median follow-up of 54 months. However, they emphasized that establishing a causal relationship between benign liver tumours and abdominal symptoms can be difficult (6). In a systematic review including 42 studies and 4061 patients undergoing surgery for solid benign liver tumours, van Rosmalen et al. reported symptom relief in 82% of symptomatic patients after a weighted mean follow-up of 28.5 months, while noting the limited use of validated quality-of-life tools (16).

Diagnosis and management of benign liver tumours remain challenging due to varying tumor subtypes and associated risks (1). While guidelines of the

European Society for the Study of the Liver offer a helpful framework, they may not capture the full complexity of clinical practice (1). Haring et al. conducted a European study. They found variation in practice regarding lifestyle modification and imaging follow-up for patients with FNH, as well as in managing HCA larger than 5 cm before and during pregnancy (1). Additionally, management of HCA larger than 5 cm after lifestyle modification often differed from the European Society for the Study of the Liver guidelines (1).

Therefore, patient selection remains the main clinical challenge. Symptoms such as abdominal pain, pressure, discomfort, or fullness are non-specific and may persist after surgery if they are unrelated to the liver lesion. The decision to operate should be based on careful multidisciplinary assessment, including tumour type, size, location, growth pattern, diagnostic certainty, risk of complications, and the severity and persistence of symptoms (6, 7). In symptomatic patients, surgery should be considered only after alternative causes of symptoms have been excluded and after patients have been informed that symptom relief is likely but not guaranteed (7).

However, indications for surgery in benign liver tumours should remain restrictive. In our study, symptoms were the most frequent indication, followed by diagnostic uncertainty and tumour growth (Table 2). This distribution reflects current clinical practice: HCA is often resected due to the risk of haemorrhage or malignant transformation, particularly in larger lesions, whereas FNH and haemangiomas are usually managed conservatively unless symptoms, growth, or diagnostic uncertainty warrant intervention (4, 7, 17). The diagnostic evaluation of HCA and FNH relies primarily on magnetic resonance imaging and computed tomography (4). Diagnostic uncertainty was an indication for 21.1% of resections in our cohort (Table 2). It underlines that, despite advances in modern imaging, histological confirmation may still be required when malignancy cannot be confidently excluded (18).

The perioperative outcomes in this cohort support the safety of laparoscopic liver resection for benign disease in appropriately selected patients (Table 3). No intraoperative complications were recorded. Postoperative morbidity was low, with one Clavien-Dindo grade I complication (5.3%), and no postoperative mortality occurred. Median blood loss was 20 mL, median operative time was 120 minutes, and median length of hospital stay was 4 days (Table 3). These findings compare favourably with published series in which liver resection for benign disease has been associated with low mortality, acceptable morbidity, shorter recovery, and improved quality of life in selected patients (2, 3).

We performed anatomical resections in 14 patients (73.7%), with no statistically significant difference between histopathological groups (Table 3). Other perioperative outcomes, including operative time, blood loss, hepatic pedicle clamping, postoperative morbidity, and length of hospital stay, also did not differ significantly between histopathological groups.

This study has several limitations. First, the retrospective observational design limits the ability to establish a direct causal relationship between benign liver tumours and preoperative symptoms, because causal inference from observational data is vulnerable to bias and confounding (19, 20).

Second, the cohort was small and included three tumour entities, limiting subgroup analysis, reducing statistical power, and increasing the risk of imprecise estimates. Third, symptom relief was assessed clinically rather than with a validated quality-of-life or pain questionnaire; this is important because patient-reported outcome measures are increasingly recommended to capture pain, fatigue, anxiety, daily-life limitations, and quality of life in patients with benign liver tumours and cysts (15). Finally, this was a single-centre experience, and the results may not be generalisable to centres with different patient populations and surgical volumes.

Future prospective studies should employ standardised instruments to assess symptoms and quality of life, enabling a more consistent identification of patients who benefit from surgery for benign liver disease, as patient-reported outcome measures for benign liver tumours are still insufficiently standardized (15).

In conclusion, laparoscopic liver resection for benign liver tumours was safe in this cohort and was associated with significant symptom relief in most symptomatic patients. These findings support laparoscopic resection as a valuable treatment option for carefully selected patients, particularly when symptoms are persistent, diagnostic uncertainty remains, or tumour-related risks justify surgery.

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