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ORIGINAL ARTICLE

Retrospective Cohort Study

Laparoscopic hepatectomy reduces postoperative complications and hospital stay in overweight and obese patients

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Abstract

BACKGROUND

Laparoscopic liver surgery is currently considered the standard of care for various liver malignancies. However, studies focusing on perioperative outcome after laparoscopic hepatectomy (LH) in overweight patients are still sparse and its benefit compared to open hepatectomy (OH) is a matter of debate.

AIM

To analyze postoperative outcomes in overweight [body mass index (BMI) over 25 kg/m²] and obese (BMI over 30 kg/m²) patients undergoing LH and compare postoperative outcome with patients undergoing OH.

METHODS

Perioperative data of 68 overweight (BMI over 25 kg/m²) including a subcohort of obese (BMI over 30 kg/m²) patients (n = 27) who underwent LH at our institution between 2015 and 2019 were retrospectively analyzed regarding surgical outcome and compared to an equal number of patients undergoing OH.

RESULTS

The mean BMI was 29.8 ± 4.9 kg/m² in the LH group and 29.7 ± 3.6 kg/m² in the OH group with major resections performed in 20.6% (LH) and 26.5% (OH) of cases, respectively. Operative time (194 ± 88 min *vs* 275 ± 131 min; P < 0.001) as well as intensive care (0.8 ± 0.7 d *vs* 1.1 ± 0.8 d; P = 0.031) and hospital stay (7.3 ± 3.6 d *vs* 15.7 ± 13.5 d; P < 0.001) were significant shorter in the LH group. Also, overall complications (20.6% *vs* 45.6%; P = 0.005) and major complications (1.5% *vs* 14.7%, P = 0.002) were observed less frequently after LH. An additional investigation analyzing the subgroup of obese patients who underwent LH (n = 27) and OH (n = 29) showed a shorter operative time (194 ± 81 min *vs* 260 ± 137 min; P = 0.009) and a reduced length of hospitalization (7.7 ± 4.3 d *vs* 17.2 ± 17 d; P < 0.001) but no difference in postoperative complications or overall cost.

CONCLUSION

LH is safe and cost-effective in overweight and obese patients. Furthermore, LH is significantly associated with fewer postoperative complications and reduced hospital stay compared to OH in these patients.

Key Words: Laparoscopic hepatectomy; Obesity; Overweight; Morbidity; Postoperative outcome; Cost

Core Tip: Laparoscopic liver resection has emerged as a considerable alternative to conventional liver surgery. However, studies focusing on perioperative outcome after laparoscopic hepatectomy in overweight patients are still sparse and its benefit compared to open hepatectomy is a matter of debate. Our comparative analysis demonstrated that the laparoscopic approach is significantly associated with fewer postoperative complications and reduced hospital stay compared to conventional open hepatectomy in these patients.

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INTRODUCTION

Overweight and obesity in Germany has been identified as a major health problem and its prevalence has been continuously growing over the last decades. According to the German DEGS1 study (2013), 67.1% of men and 53.0% of women are overweight. Also, the prevalence of obesity has risen substantially, as 23.3% of men and 23.9% women are currently considered to be obese[1]. Overweight is associated with multiple comorbidities which can influence postoperative outcome after minor and major liver resection[2]. Furthermore, several studies have reported an increased risk of technical difficulties during surgery and frequent occurrence of postoperative complications[3-5]. In addition, obesity may be associated with chronic liver disease, such as steatosis and nonalcoholic steatohepatitis, which can further increase surgical morbidity[6,7].

Laparoscopic surgery has several advantages compared to conventional surgery, such as less abdominal wall trauma, early postoperative regeneration and less postoperative morbidity[8,9]. About thirty years ago, obesity was generally considered a contraindication for laparoscopic surgery due to the associated technical difficulties. Around fifteen years ago, multiple studies had indicated obesity as a risk factor for conversion. However, recent studies have shown that laparoscopic surgery can be considered a standard procedure in obese patients, with good results after cholecystectomy, gastrectomy, and colectomy[10-12]. However, studies focusing on the perioperative outcomes after laparoscopic hepatectomy (LH) in overweight patients are still sparse and its benefit compared to open hepatectomy (OH) is a matter of debate[13-15]. Thus, the aim of this study was to analyze postoperative outcomes in overweight (BMI ≥ 25 kg/m²) and obese (BMI ≥ 30 kg/m²) patients undergoing LH and compare postoperative outcome with patients undergoing OH.

MATERIALS AND METHODS

We report a single-center retrospective analysis evaluating postoperative outcome after liver resection in overweight and obese patients with malignant liver tumors. Therefore, we compared short-term outcome and postoperative complications of patients with a BMI ≥ 25 kg/m² who underwent LH (n = 68) or OH (n = 68). The Institutional Review Board approval was obtained before analysis of the data (EK 423/19).

A total of 226 patients underwent LH between January 2015 and August 2019 at the Department of Surgery and Transplantation of the RWTH Aachen University Hospital of which 68 patients were overweight and presented with a malignant tumor. In the comparison group, 68 overweight patients (BMI ≥ 25 kg/m²) were selected from 497 individuals who underwent OH during the above-mentioned period at our institution. Selection was performed by matching for gender, age, BMI, diagnosis, ASA classification, previous abdominal surgery, and resection extent by two independent authors. Furthermore, a subset of 27 patients undergoing LH and 29 patients undergoing OH were considered to be obese (BMI ≥ 30 kg/m²) and were further analyzed separately. The indication for surgery was approved by a multidisciplinary tumor board including surgeons, hepatologists, oncologists and radiologists. The resection extent was defined according to segmental anatomic description by Couinaud and type of hepatectomy was classified according to Brisbane 2000 terminology[16]. Resections of more than three liver segments were categorized as a major liver resection.

Staging and surgical technique

All assigned patients were preoperatively examined in detail. For staging, a gadolinium-based magnetic resonance imaging and/or contrast-material enhanced computed tomography were performed to assess the number, size and location of liver tumors and to exclude distant metastases. The general laparoscopic approach as well as number and size of trocars were selected depending on tumor entity, size and localization of the hepatic lesions. All resections were performed fully laparoscopic without the use of any hybrid techniques. By default, the first 12 mm trocar was placed in the direction or next to the resection plane to ensure optimal triangulation after placement of two additional 5 or 12 mm trocars. Additional trocars were inserted if needed. Resection specimens were extracted through a suprapubic Pfannenstiel incision in a plastic recovery bag or *via* an extended 12 mm trocar incision. The attending surgeon stood between the patient's legs (French position) and the patient was positioned in a left tilted supine position. The pneumoperitoneum was maintained at 12 mmHg intra-peritoneal pressure. Intrahepatic lesions were routinely located by laparoscopic ultrasound. Parenchymal transection was commonly performed by Thunderbeat® (Olympus K.K., Tokyo, Japan) or Harmonic Ace® (Ethicon Inc., Somerville, NJ, United States). If necessary, a laparoscopic ultrasonic surgical aspirator (CUSA, Integra Life Sciences, New Jersey, United States) was chosen for deeper parenchymal transection in close proximity to major vascular structures or bile ducts. Vascular staplers (Echelon, Ethicon, Somerville, NJ, United States) or polymer clips (Teleflex Inc., Pennsylvania, United States) were used for the dissection of large vessels and bile ducts. Open hepatectomy was usually performed *via* a midline incision with rightward extension. Open parenchymal transection was carried out using the CUSA and titanium clips or sutures.

Data collection

All study data including demographics, tumor characteristics, clinical chemistry, and operative and postoperative data of every patient was prospectively collected within an institutional database. The postoperative course was reviewed for complications and rated according to the Clavien-Dindo classification and quantified using the Comprehensive Complication Index (CCI), which is based on the complication grading by Clavien-Dindo classification and implements every complication after an intervention. The overall morbidity is reflected on a scale from 0 (no complication) to 100 (death)[17,18]. Every patient’s individual postoperative course was also assessed for specific surgical complications, *e.g.*, biliary leakage, liver failure, wound infection, and pneumonia. Additionally, overall cost evaluation was performed based on patients age and CCI score according to Staiger *et al*[19], using a validated online cost-assessment tool, which estimates the total cost for 90 d after complex operations with a very high correlation[19]. A correction factor according to the cost analysis of the OSLO-COMET Trial was applied to compensate the increased intra-operative costs of LH compared to

OH[20]. In that particular study, the total intraoperative costs for laparoscopic surgery were $1926 compared to $1158 for the open operation, so a significant difference of $710 was included in our cost calculation.

Statistical analysis

The primary endpoint of this study was the occurrence of postoperative complications in overweight and obese patients undergoing laparoscopic or open hepatectomy. The secondary endpoints were in-house mortality, duration of hospitalization, ICU stay, and estimated costs. Categorical data are presented as counts and percentages and compared using the chi-squared test, Fisher's exact test, or linear-by-linear association according to the scale and number of cases. Data derived from continuous variables are presented as mean and standard deviation and are analyzed by the Mann-Whitney *U* test. The level of significance was set to $P < 0.05$, and *P* values are given for two-sided testing. Analyses were performed using SPSS Statistics 24 (IBM Corp., Armonk, NY, United States).

RESULTS

We here analyzed a cohort of 136 overweight patients (BMI ≥ 25 kg/m^2) with a malignant tumor diagnosis who underwent hepatectomy at our institution between 2015 and 2019 with 68 individuals undergoing LH and 68 individuals undergoing OH. The patients` characteristics of the overall cohort are summarized in Table 1.

Overweight patients

There were no significant differences between the LH and OH group in terms of patient sex ($P = 0.116$), age ($P = 0.812$), BMI ($P = 0.463$), tumor diagnosis ($P = 0.777$), ASA ($P = 0.328$) or previous abdominal surgery ($P = 0.592$). Mean BMI was 29.8 ± 4.9 kg/m^2 in the LH group and 29.7 ± 3.6 kg/m^2 in the OH group as shown in Table 1. Common diagnoses in both groups were liver metastasis (LH: 60.3% *vs* OH: 61.8%) followed by hepatocellular carcinoma (LH: 29.4% *vs* OH: 25.0%) and intrahepatic cholangiocellular carcinoma (LH: 10.3% *vs* OH: 13.2%). 59.1% of patients in the LH group and 64.7% of patients in the OH group were classified as ASA III or higher. With regard to clinical characteristics, we observed statistically significant differences in the presence of liver fibrosis (LH: 30.9% *vs* OH: 11.8%; $P = 0.006$), preoperative albumin (LH: 4.4 ± 0.4 g/dL *vs* OH: 3.6 ± 0.7 g/dL; $P < 0.001$), total bilirubin (LH: 0.4 ± 0.3 mg/dL *vs* OH: 0.9 ± 0.6 mg/dL; $P < 0.001$) and INR (LH: 0.98 ± 0.08 *vs* OH: 1.06 ± 0.07; $P < 0.001$). Perioperative characteristics are shown in Table 2. The mean operative time was significantly shorter in the LH group (LH: 194 ± 88 min *vs* OH: 275 ± 131 min; $P < 0.001$). We performed major resections in 20.6% of patients who underwent LH and in 26.5% of patients who underwent OH, respectively ($P = 0.419$). Intensive care stay was significantly shorter after LH (LH: 0.8 ± 0.7 d *vs* OH: 1.1 ± 0.8 d; $P = 0.031$) with an also significantly shorter hospitalization time (LH: 7.3 ± 3.6 d *vs* OH: 15.7 ± 13.5 d; $P < 0.001$). A total of 3 (4.4%) patients in the OH group died during the hospital stay, while no postoperative mortality was reported in the LH cohort. Overall complications (LH: 20.6% *vs* OH: 45.6%; $P = 0.005$) as well as major complications defined as Clavien-Dindo ≥ IIIb (LH: 1.5% *vs* OH: 14.7%, $P = 0.002$) occurred significantly less frequently in the LH group. A further detailed analysis of the complication types showed a significantly increased incidence of biliary leakage (LH: 1.5% *vs* OH: 14.7%; $P = 0.005$), postoperative liver failure (LH: 0.0% *vs* OH: 5.9%; $P = 0.042$) and pneumonia (LH: 0.0% *vs* OH: 8.8%; $P = 0.012$) after OH. CCI was also significantly higher in the OH group (LH: 3.9 ± 9.1 *vs* OH: 15.4 ± 23.6; $P < 0.001$), while estimated cost did not differ between the groups (LH: 10060 ± 1537 € *vs* OH: 11789 ± 5973 €; $P = 0.779$).

Obese patients

An additional investigation analyzed a subset of obese patients (BMI ≥ 30 kg/m^2) who underwent laparoscopic ($n = 27$) or open hepatectomy ($n = 29$). A review of patients` demographics showed a slightly older OH cohort (LH: 61.3 ± 10.4 years *vs* OH: 67.5 ± 11.0 years; $P = 0.036$), while we found no significant differences between the groups in terms of patient sex ($P = 0.116$), BMI ($P = 0.623$), diagnosis ($P = 0.628$), ASA score ($P = 0.835$) or previous abdominal surgery ($P = 0.512$). No significant differences in the presence of liver steatosis ($P = 0.186$), fibrosis ($P = 0.084$) or cirrhosis ($P = 0.329$) were observed. Preoperative albumin level was higher (LH: 4.3 ± 0.3 g/dL *vs* OH: 3.6 ± 0.5 g/dL; $P < 0.001$) while total bilirubin (LH: 0.4 ± 0.3 mg/dL *vs* OH: 0.9 ± 0.5 mg/dL; *P* <

Table 1 Patients' characteristics in the overweight and obese group (body mass index 25 kg/m^2)

	LH *vs* OH		
	LH cohort (*n* = 68)	OH cohort (*n* = 68)	*P* value
Demographics			
Sex, *n* (%)			0.116
Male	36 (52.9)	45 (66.2)	
Female	32 (47.1)	23 (33.8)	
Age (yr)	64.4 ± 10.2	64.5 ± 12.3	0.812
BMI (kg/m^2)	29.8 ± 4.9	29.7 ± 3.6	0.463
Diagnosis, *n* (%)			0.777
LM	41 (60.3)	42 (61.8)	
HCC	20 (29.4)	17 (25.0)	
iCC	7 (10.3)	9 (13.2)	
ASA, *n* (%)			0.328
I	0	0	
II	28 (41.2)	24 (35.3)	
III	35 (51.5)	42 (61.8)	
IV	5 (7.4)	2 (2.9)	
V	0	0	
Previous abdominal surgery, *n* (%)	23 (33.8)	26 (38.2)	0.592
Clinical characteristics			
Steatosis, *n* (%)	20 (29.4)	21 (30.9)	0.852
Fibrosis, *n* (%)	21 (30.9)	8 (11.8)	0.006
Cirrhosis, *n* (%)	9 (13.2)	12 (17.6)	0.477
Albumin (g/dL)	4.4 ± 0.4	3.6 ± 0.7	< 0.001
GGT (U/L)	85.1 ± 104.2	119.2 ± 219.0	0.326
Total bilirubin (mg/dL)	0.4 ± 0.3	0.9 ± 0.6	< 0.001
Platelet count (/nL)	254.0 ± 85.4	230.9 ± 90.5	0.135
Alkaline phosphatase (U/L)	85.1 ± 34.2	93.8 ± 84.2	0.584
INR	0.98 ± 0.08	1.06 ± 0.07	< 0.001
Hemoglobin (g/dL)	13.3 ± 1.7	13.6 ± 4.1	0.984

LH: Laparoscopic hepatectomy; OH: Open hepatectomy; BMI: Body mass index; LM: Liver metastasis; HCC: Hepatocellular carcinoma; iCC: intrahepatic cholangiocellular carcinoma; GGT: Gamma-glutamyl transpeptidase.

0.001) and INR levels (LH: 0.99 ± 0.07 *vs* OH: 1.06 ± 0.07; $P < 0.001$) were lower in the LH compared to the OH group. Table 3 shows the results of the analysis of perioperative data and a significantly shorter operative time (194 ± 81 min *vs* 260 ± 137 min; $P = 0.009$) and reduced length of hospitalization (7.7 ± 4.3 d *vs* 17.2 ± 17 d; $P <$ 0.001) were observed after LH. CCI, overall and major complications as well as the incidence of biliary leakage, postoperative liver failure, and pneumonia were not significantly different between the groups.

DISCUSSION

In this study, we compared the perioperative outcomes of LH and OH in overweight and obese patients in a large European monocentric cohort and provide evidence that

Table 2 Perioperative characteristics in the overweight and obese group (body mass index 25 kg/m^2)

	LH *vs* OH		
	LH cohort (*n* = 68)	OH cohort (*n* = 68)	*P* value
Operative data			
Operative time (min)	194 ± 88	275 ± 131	< 0.001
Major resection, *n* (%)	14 (20.6)	18 (26.5)	0.419
Operative procedure, *n* (%)			0.064
Atypical	15 (22.1)	23 (33.8)	
Segmentectomy	11 (16.2)	10 (14.7)	
Bisegmentectomy	28 (41.2)	17 (25.0)	
Left hepatectomy	0 (0.0)	5 (7.4)	
Right hepatectomy	13 (19.1)	13 (19.1)	
Extended left hepatectomy	0 (0.0)	1 (1.5)	
Conversion	4 (5.9)	-	
Postoperative data			
Intensive care/d	0.8 ± 0.7	1.1 ± 0.8	0.031
Hospitalization/d	7.3 ± 3.6	15.7 ± 13.5	< 0.001
Blood transfusion	12 (17.6)	16 (23.5)	0.396
Hospital mortality, *n* (%)	0 (0.0)	3 (4.4)	0.080
Postoperative complications, *n* (%)			0.065
No complications	54 (79.4)	37 (54.4)	
Clavien-Dindo I	4 (5.9)	5 (7.4)	
Clavien-Dindo II	5 (7.4)	8 (11.8)	
Clavien-Dindo IIIa	4 (5.9)	8 (11.8)	
Clavien-Dindo IIIb	1 (1.5)	3 (4.4)	
Clavien-Dindo IVa	0 (0.0)	4 (5.9)	
Clavien-Dindo IVb	0 (0.0)	0 (0.0)	
Clavien-Dindo V	0 (0.0)	3 (4.4)	
Clavien ≥ IIIb	1 (1.5)	10 (14.7)	
Clavien ≥ I	14 (20.6)	31 (45.6)	
Biliary leakage	1 (1.5)	10 (14.7)	0.005
Liver failure	0 (0.0)	4 (5.9)	0.042
Surgical site infections	2 (2.9)	6 (8.8)	0.145
Pneumonia	0 (0.0)	6 (8.8)	0.012
CCI	3.9 ± 9.1	15.4 ± 23.6	0.000
Estimated cost (€)	10060 ± 1537	11789 ± 5973	0.779

LH: Laparoscopic hepatectomy; OH: Open hepatectomy; CCI: Comprehensive Complication Index.

overweight patients undergoing LH have significantly fewer postoperative complications and reduced intensive care stay as well as overall hospitalization without increased overall costs.

Conventional open surgery in obese patients is associated with an increased morbidity risk and has adverse effects on the procedure itself[6,7]. Also, the influence of overweight and obesity on the results of laparoscopic surgery have already been reported for several indications. For example, BMI is a known predictor of

Table 3 Perioperative characteristics in the obese group (body mass index 30 kg/m²)

	LH *vs* OH		
	LH cohort (*n* = 27)	OH cohort (*n* = 29)	*P* value
Operative data			
Operative time (min)	194 ± 81	260 ± 137	0.009
Major resection, *n* (%)	5 (18.5)	5 (17.2)	0.901
Operative procedure, *n* (%)			0.257
Atypical	7 (25.9)	8 (27.6)	
Segmentectomy	4 (14.8)	7 (24.1)	
Bisegmentectomy	11 (40.7)	9 (31.0)	
Left hepatectomy	0 (0.0)	3 (10.3)	
Right hepatectomy	5 (18.5)	2 (6.9)	
Conversion	2 (7.4)	-	
Postoperative data			
Intensive care/d	0.7 ± 0.4	1.0 ± 0.8	0.240
Hospitalization/d	7.7 ± 4.3	17.2 ± 17	< 0.001
Blood transfusion	3 (11.1)	8 (27.6)	0.121
Hospital mortality, *n* (%)	0 (0.0)	0 (0.0)	0.080
Postoperative complications, *n* (%)			0.562
No complications	19 (70.4)	17 (58.6)	
Clavien-Dindo I	3 (11.1)	2 (6.9)	
Clavien-Dindo II	1 (3.7)	2 (6.9)	
Clavien-Dindo IIIa	3 (11.1)	3 (10.3)	
Clavien-Dindo IIIb	1 (3.7)	2 (6.9)	
Clavien-Dindo IVa	0 (0.0)	3 (10.3)	
Clavien-Dindo IVb	0 (0.0)	0 (0.0)	
Clavien-Dindo V	0 (0.0)	0 (0.0)	
Clavien ≥ IIIb	1 (3.7)	5 (17.2)	0.102
Clavien ≥ I	8 (29.6)	12 (41.4)	0.359
Biliary leakage	1 (3.7)	3 (10.3)	0.335
Liver failure	0 (0.0)	2 (6.9)	0.165
Surgical site infections	2 (7.4)	4 (13.8)	0.440
Pneumonia	0 (0.0)	0 (0.0)	-
CCI	5.4 ± 11.1	12.3 ± 16.8	0.132
Estimated cost (€)	10111 ± 1748	11021 ± 3133	0.710

LH: Laparoscopic hepatectomy; OH: Open hepatectomy; CCI: Comprehensive Complication Index.

perioperative results in laparoscopic colorectal surgery, as longer operation times, higher conversion rates, and increased morbidity, including anastomotic leakage and surgical site infection, were observed in obese patients[21,22]. In comparison to open surgery, the minimal-invasive approach is associated with less postoperative abdominal wall complications in obese patients, although the procedure is typically more technically challenging to perform. Adjustments in surgical equipment, such as the use of longer trocars and other operating equipment, may be necessary to successfully conduct laparoscopic surgery.

In contrast, inconsistent data are available regarding the safety of liver resection in obese patients. For example, a retrospective cohort study compared the impact of obesity on postoperative complications and 30-d mortality in 3960 patients undergoing liver resection using the NSQIP database of the American College of Surgeons. Here, it was reported that obesity is linked to increased perioperative complications without a substantial rise in 30-d mortality[2]. In contrast, Utsunomiya *et al*[23] reported no substantial difference between obese and non-obese patients with respect to postoperative complications following liver resection for hepatocellular carcinoma. They concluded that complications after OH in obese patients are mainly due to the access trauma, as most hepatectomies are performed *via* bilateral subcostal or J-shaped incisions and that obesity as a risk factor will be revised since the advent of laparoscopy in liver surgery. The latter was confirmed by Nomi *et al*[24], who analyzed 228 patients undergoing laparoscopic liver resection and found that higher BMI does not negatively impact the short-term outcomes after LH.

However, most of the available data focuses on the comparison of obese and non-obese patients while only few reports have analyzed small cohorts with LH in contrast to OH in overweight patients. Uchida *et al*[14] for example analyzed only 12 LH *vs* 10 OH cases. Nevertheless, they found a significantly shorter operation time and blood loss in patients with a BMI ≥ 25 kg/m^2 after LH, which is similar to our results. Another study by Toriguchi *et al*[25] observed a reduction in intraoperative blood loss and shorter hospital stay after LH than after OH in overweight patients. Of note, only 13 cases with LH were reported in the mentioned study which limits validity of this particular report.

The largest available series was published by Ome *et al*[26] and consists of 63 LH *vs* 79 OH in patients with a BMI ≥ 25 kg/m^2. The authors demonstrated a better short-term outcome with respect to the need for blood transfusion and length of postoperative hospital stay, but, as comparable to the other cited studies, only a small number of patients undergoing major liver resection (9%, 13/144) were included[26]. In contrast, our cohort contained at least 19% in both groups, who underwent major laparoscopic liver resection.

In our study a more detailed analysis of the complications revealed less frequent bile leakage, liver failure and pneumonia after LH compared to OH. Significant differences in short-term outcome and complications were only observed in the analysis of overweight patients and not in the obese subgroup. This lack of statistical significance in the obese subgroup might be explained by the smaller number of cases in this subanalysis.

From our point of view, LH in obese patients is feasible and safe, but nevertheless of increased difficulty. Regarding this issue, a study by Hasegawa *et al*[27] showed that the surgical difficulty of LH was influenced by obesity and prolonged the operation time. Additionally, Yu *et al*[13] reported that obesity increased the conversion rate of LH to up to 31% in their cohort of 29 patients with a BMI ≥ 28 kg/m^2. In comparison, we observed a conversion rate of 5.9% (BMI ≥ 25 kg/m^2) and 7.4% (BMI ≥ 30 kg/m^2) in our study. Our results are further based on a high-risk cohort, since more than 60% of our patients were classified as ASA III or higher. In many studies, patients are selected and the proportion of ASA I/II is up to 80%[28,29].

Analysis of the overall cost of our cohort was performed using a prediction tool with a correction factor according to the cost measurement of the OSLO Comet Trial for higher intraoperative material costs in LH and showed no significant difference in both overweight and obese patients between LH and OH. This confirms the results of a study by Wabitsch *et al*[30] which showed that higher intraoperative costs for LH are compensated by lower complication rates and a shorter length of hospitalization in comparison to OH.

Our analysis has certain limitations that need to be discussed. First, the results are based on a single-center cohort analyzed in a retrospective fashion with a limited number of patients, especially in the obese group; therefore, it is underpowered to reach a definitive conclusion and warrants confirmation from other groups. Second, our data were not obtained in a clinical trial and the patients were therefore not randomly assigned to OH or LH which limits validity.

CONCLUSION

Despite the aforementioned limitations, our comparative study of LH and OH in overweight patients does importantly add valuable aspects to the current literature as it comprises a significant proportion of individuals who underwent major liver resection. We therefore conclude that LH is safe and cost-effective in overweight and obese patients. Furthermore, LH is significantly associated with fewer postoperative complications and reduced hospital stay compared to OH in these patients.

ARTICLE HIGHLIGHTS

Research background

Laparoscopic liver surgery is considered the standard of care for various liver malignancies. However, several studies have reported an increased risk of technical difficulties during surgery and the frequent occurrence of postoperative complications in overweight and obese patients.

Research motivation

Studies focusing on perioperative outcome after laparoscopic hepatectomy in overweight patients are still sparse and its benefit compared to open hepatectomy is a matter of debate.

Research objectives

The aim of this study was to analyze postoperative outcomes in overweight (BMI ≥ 25 kg/m²) and obese (BMI ≥ 30 kg/m²) patients undergoing laparoscopic hepatectomy and compare postoperative outcomes with patients undergoing conventional open resection.

Research methods

Perioperative data of 68 overweight and obese patients who underwent laparoscopic hepatectomy at our institution between 2015 and 2019 were retrospectively analyzed regarding surgical outcome and compared to an equal number of patients undergoing open hepatectomy. The postoperative course was reviewed for complications and rated according to the Clavien-Dindo classification and quantified using the Comprehensive Complication Index.

Research results

We provide evidence that overweight patients undergoing laparoscopic hepatectomy have significantly fewer postoperative complications and reduced intensive care stay as well as overall hospitalization without increased overall costs.

Research conclusions

We conclude that laparoscopic hepatectomy is safe and cost-effective in overweight and obese patients. Additionally, this technique is significantly associated with fewer postoperative complications and reduced hospital stay compared to open hepatectomy in these patients.

Research perspectives

Additional research is needed to prospectively confirm our results and to evaluate outcomes in a larger and more balanced cohort to reach a definitive conclusion. Particularly in obese patients with a BMI above 30 kg/m², technical difficulties could be a factor in larger cohorts, which then become apparent.

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