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Published in:
The surgeon : journal of the Royal Colleges of Surgeons of Edinburgh and Ireland

DOI:
10.1016/j.surge.2019.09.008

Publication date:
2020

Surgical treatment for non-parasitic liver cysts improves quality of life

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ARTICLE INFO

Article history:
Received 18 July 2019
Received in revised form
19 September 2019
Accepted 30 September 2019
Available online 31 October 2019

Keywords:
Liver cyst
QoL
Treatment strategy
EORTC QLQ-C30

ABSTRACT

Background&purpose: Liver cysts occur frequently. Most are harmless, however some carry a significant patient burden. Optimizing treatment strategy is complicated as needs differ between patients. The current study assesses the effect of surgery on quality of life (QoL) of patients with non-parasitic liver cysts.

Methods: A retrospective cohort study of all patients who underwent surgery for non-parasitic liver cysts in three major Dutch medical centers from 1993 to 2017. Patient characteristics and surgery related variables were collected from the electronic patient file. QoL was measured before and after surgery using the EORTC QLQ-C30. Summary scores (SumSc) were calculated and compared to reference values of the general population. Multivariate analysis using logistic regression was performed for identifying outcome related factors. Increase of $\geq$ 10% in SumSc was defined as clinically relevant.

Main findings: Eighty-eight of 132 eligible patients (67%) completed two QoL assessments. Respondents demonstrated significant improvement in the global health status, on all 5 functional scales (all $p \leq 0.005$), on all 9 symptom scales after surgery (all $p < 0.05$), and on SumSc ($p < 0.001$) to levels similar or better than the general population. Patients with complications demonstrated a significant QoL gain ($p < 0.05$), and reported a similar postoperative status compared to patients without complications ($p = 0.74$). QoL gain for patients who underwent open and laparoscopic cyst fenestration were similar ($p = 0.08$). Multivariate analysis of SumSc found mechanical complaints as significant factor for $\geq$ 10% SumSc increase (OR 0.11, 95% CI (0.02–0.55).

Conclusions: Surgery is a safe and effective strategy to significantly improve QoL in patients with symptomatic liver cysts.

Abbreviations: PCLD, Polycystic Liver Disease; QoL, Quality of Life; EORTC QLQ-C30, European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core-30; SumSc, Summary Score; CCI, Comprehensive Complication Index; IQR, Interquartile Range.

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https://doi.org/10.1016/j.surge.2019.09.008

Introduction

Non-parasitic liver cysts (from now on referred to as liver cysts) are a diverse group of cystic- and congenital malformations of the biliary tree, leading to simple cysts or polycystic liver disease (PCLD).[1] Liver cysts are usually the result of an aberrant bile duct that has lost communication with the biliary tree leading to an isolated fluid-filled cavity.[1] Liver cysts are a relatively common phenomenon with a prevalence of 5% and a rising incidence during life, and are increasingly detected because of an increased use of imaging.[2] Although most patients are asymptomatic, a minority of patients may develop symptoms, including mechanical discomfort, pain, nausea, vomiting, fatigue for which surgical treatment might be indicated.[1]

Various treatment options are available for the treatment of simple liver cysts: from minimally invasive therapies such as cyst aspiration followed by sclerotherapy, to more invasive surgical options including (laparoscopic) fenestration or even (limited) liver resections.[7–9] Cyst aspiration followed by sclerotherapy, however, has a high risk of cyst recurrence and is therefore usually not recommended as first-line treatment for all patients.[1]

Liver cysts can adequately be treated by surgical fenestration when symptomatic, while (potentially) oncological biliary cystadenoma and cystadenocarcinoma require complete resection.[3,4] Pre-operative imaging in hepatic cysts has moderate accuracy with a sensitivity of 87.5–100% but a specificity of 43.1–53.4%.[3] There is no correlation of incidental findings on imaging with subjective symptoms of patients. Therefore it may be difficult to define the optimal treatment strategy.[5] Percutaneous cyst aspiration can help objectify cyst induced symptoms.[6]

The primary goal of surgical treatment in patients with liver cysts is symptom relief, and thereby gain of quality of life (QoL). The potential QoL benefit of surgical intervention for liver cysts, however, remains unclear. The aim of this study was to assess the QoL of patients with liver cysts before and after surgery.

Materials and methods

Study design and population

All patients who received surgical treatment except transplantation for liver cysts in three major Dutch medical centers from 1993 to 2017 were included. Patients were subjected to pre- and postoperative QoL assessment in a retrospective manner by the 'European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core-30' (EORTC QLQ-C30v3).[7] The QLQ-C30 consists of 30 questions covering 5 functional scales (physical, social, role, emotional, cognitive), 9 symptom scales (fatigue, nausea/vomiting, pain, dyspnea, insomnia, appetite loss, constipation, diarrhea, financial difficulties), plus as a global health scale. Functional scales are scored from 0 (no function) to 100 (uncompromised). Symptom scales are scores are scored 0 (no symptoms) to 100 (full symptom). Scales were calculated when more than half of available questions per scale were completed. The summary score (SumSc) was calculated according to EORTC scoring protocol – the mean of 13 of 15 scales, excluding the global health and financial impact scores and only when all remaining scales were available.[7,15] EORTC reference values were used for comparison to the general population. Exclusion criteria for participation in the QoL assessment were lost to follow-up, diagnosis of malignancy within 5 years before treatment of liver cysts or unwillingness to participate.

Endpoints

The SumSc was used as primary endpoint. Secondary outcomes were: rate of complications, frequency of recurrence, and duration of hospitalization.

Surgical procedure and follow-up

Indications for surgery were solely cyst related symptoms or suspicion of (pre)malignancy. Cysts were fenestrated by either open or laparoscopic approach, at surgeon's preference. Omental transposition was used at surgeon's preference. Cyst resection was performed in case of premalignant suspicion or when more appropriate than cyst fenestration. Patients were treated according to local protocol. Recurrence was defined as recurrent cyst-related symptoms confirmed by computed tomography (CT) or ultrasound confirmation.

Data collection and definitions

Data was obtained from the electronic patient file. Non-PCLD cysts were classified as "simple cysts". Location of treated cysts was categorized into left- (Couinaud segments I-IV), or right-hemi liver (Couinaud segments V-VIII), or bilobar. Comorbidities were assessed using the American Society of Anaesthesiologists (ASA) classification.[8] Complications were scored according to the Clavien-Dindo classification and Comprehensive Complication Index (CCI).[9,10]

Data analysis

Continuous variables were described using the median (IQR), whereas nominal and ordinal variables were described using totals, frequencies, percentages, and standard deviation. Normality was tested using the Shapiro-Wilk test. The Student t-test was used to investigate differences between groups for nominal variables and the chi-square or Fisher exact test for categorical variables. For related samples the paired Student t-test or Wilcoxon signed-rank test were used. A p-value ≤ 0.05 was considered statistically significant. The EORTC script was used to calculate the score. Preoperative and postoperative QLQ-C30 scores were compared using a paired t-test and presented in mean and SE (standard error), even when non-parametric, because median scores were often 100 for functional scales or 0 for symptom scales – losing nuance. Patients were categorized into young (< 70 years) or older ($\geq$ 70 years) for sub-analysis. Stratified analyses were performed for several characteristics; differences between the global health status before and after surgery were calculated. Clinically

Table 1 – Characteristics of the 132 patients surgically treated for liver cysts (1993–2017).

Category		Responders	Non-responders	p-value
Characteristic		$n = 88$	$n = 44$	
Age at surgery (%)	< 60 years	48 (54.5)	17 (38.6)	**0.03**
	60–69 years	28 (31.8)	13 (29.5)	
	70–79 years	11 (12.5)	9 (20.5)	
	> 80 years	1 (1.1)	5 (11.4)	
Gender (%)	Male	11 (12.5)	6 (13.6)	0.85
	Female	77 (87.5)	38 (86.4)	
Any comorbidity (%)	No	35 (39.8)	19 (43.2)	
	Yes	53 (60.2)	23 (52.3)	
	Missing	–	2 (4.5)	0.55
ASA-score (%)	1	24 (27.3)	11 (40.9)	**0.04**
	2	59 (67.0)	22 (57.6)	
	3	5 (5.7)	8 (1.5)	
	4	–	1 (2.3)	
	Missing	–	2 (4.5)	
Diagnosis (%)	Solitary simple cyst	21 (23.9)	11 (25.0)	0.87
	Multiple simple cysts	54 (67.0)	28 (63.6)	
	Polycystic liver disease	13 (5.7)	5 (11.4)	
*Indication (%)	Pain	43 (50.8)	24 (54.5)	0.08
	Obstructive symptoms	38 (43.2)	15 (34.1)	
	Potentially malignant	5 (3.8)	–	
	Infection	2 (1.5)	–	
	Hemorrhage	–	1 (2.3)	
	Asymptomatic growth	–	1 (2.3)	
	Missing	–	3 (6.8)	
Largest cyst size (%)	< 10 cm	17 (19.3)	2 (4.5)	**0.03**
	10–14 cm	35 (39.8)	17 (38.6)	
	≥ 15 cm	30 (34.1)	16 (36.4)	
	Missing	6 (6.8)	9 (20.5)	
Localization (%)	Left hemi liver	36 (40.9)	8 (18.2)	**0.04**
	Right hemi liver	38 (43.2)	24 (54.5)	
	Bi-lobular	11 (12.5)	9 (20.5)	
	Missing	3 (3.4)	3 (6.8)	
Previous hepatic procedure (%)	No intervention	76 (82.6)	33 (75)	0.23
	Percutaneous aspiration	8 (10.6)	6 (13.6)	
	Laparoscopic cholecystectomy	3 (2.3)	–	
	Open cholecystectomy	–	1 (0.8)	
	Missing	1 (1.1)	4 (9.1)	
Previous abdominal surgery (%)	No	40 (45.5)	19 (43.2)	0.87
	Yes	47 (53.4)	21 (47.7)	
	Missing	1 (1.1)	4 (9.1)	

A p-value ≤ 0.05 was considered statistically significant.

relevant QoL improvement was at a cutoff of 10%. A logistic regression model was used to assess the association between ≥ 10% improvement in QoL, and also used to analyze factors influencing duration of hospital stay. Full multivariable models were constructed with variables from the univariable analyses. The statistical analyses were performed using IBM SPSS statistics v23.0 (SPSS Inc., Chicago, IL, USA) and STATA/SE v12.0. Figures were generated with GraphPad Prism v5 (GraphPad Software, CA, USA).

Results

Study population and baseline characteristics

One hundred and thirty-eight patients were recorded. Six patients were excluded because of missing information, leaving 132 patients available for analysis. Eighty-eight patients (67%) returned the two QLQ-C30 questionnaires (Table 1). Responding and non-responding patients were similar in distribution of gender, rate of comorbidities, cyst type, symptoms, and rate of previous interventions. Median interval between intervention and questionnaire completion was 46 (18–136) months. Responding patients were younger ($p = 0.03$), had more moderate comorbidities ($p = 0.04$), and more equally distributed liver cysts ($p = 0.04$) (Table 1). More surgeries were performed in recent years. Thirty-four cases were operated from 1995 to 2008, compared to 54 from 2009 to 2017.

Quality of life assessment

In the group of responding patients, a significantly improved mean global health status after surgery was identified as it improved from 53.3 ± 2.8 to 78.3 ± 2.2 ($p < 0.001$). Patients demonstrated a significant postoperative improvement in

physical functioning, role functioning, emotional functioning, social functioning (all aforementioned $p < 0.001$) and cognitive functioning ($p < 0.01$) (Fig. 1A). Compared to the general population, patients showed a significant preoperative reduction of global health (53.5 vs. ref. 71.2; $p < 0.001$), physical (69.7 vs. ref. 89.8; $p < 0.001$), role (54.0 vs. ref. 84.7; $p < 0.001$), emotional (65.8 vs. ref. 76.3; $p < 0.001$), and social functioning (69.3 vs. ref. 87.5; $p < 0.001$). Cognitive, social and role functioning improved to levels similar to the general population. Postoperatively global health (78.2; $p < 0.01$), physical functioning (85.3; $p < 0.05$), emotional functioning (89.9; $p < 0.001$), and cognitive functioning (91.7; $p < 0.001$) improved to a better scores than the general population.

Surgical intervention provided benefit on all symptom scales, including fatigue, nausea and vomiting, pain, dyspnea, insomnia, appetite loss, constipation, diarrhea, and financial difficulties (Fig. 1B). Compared to the general population, patients had more fatigue (42.1 vs. ref. 24.1; $p < 0.001$), nausea and vomiting (21.2 vs. ref. 11.7; $p < 0.001$), pain (53.2 vs. ref. 20.9; $p < 0.001$), dyspnea (29.3 vs. ref. 11.8; $p < 0.001$), insomnia (47.2 vs. ref. 21.8; $p < 0.001$), appetite loss (31.0 vs. ref. 18.3; $p < 0.001$) and constipation (19.3 vs. ref. 6.7; $p < 0.001$). Occurrence of diarrhea (7.8 vs. ref. 7.0; $p = 0.7$) and financial problems (9.2 vs. ref. 9.5; $p = 0.91$) were the same. Postoperatively fatigue (20.2), nausea and vomiting (5.6), pain (17.6), dyspnea (12.6), insomnia (20.7), appetite loss (9.2) and diarrhea (4.2) improved to levels similar to the general population. Constipation and financial problems improved to levels better than the general population (12.4 and 2.7 with $p < 0.05$ and $p < 0.001$, respectively).

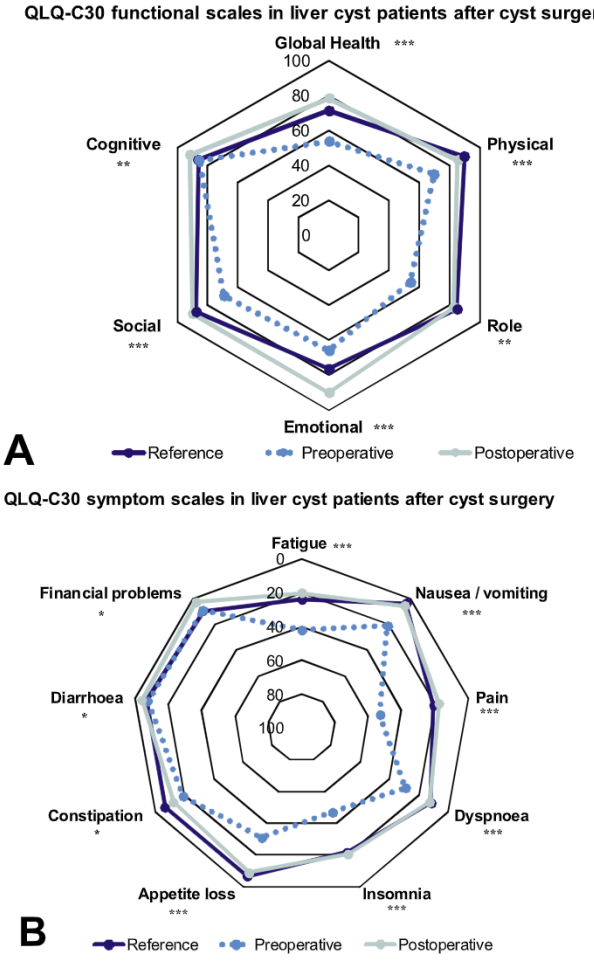

Figure 1 – QLQ-C30 scores for (A) functional and (B) symptom scales. A higher score on the functional scales indicates better function (A), whereas a higher score on the symptom scales indicate more symptoms (B). Values are provided for the preoperative patients (dotted blue lines), postoperative patients (solid light blue lines), as well as for a reference population (solid dark blue lines). Statistical significance was calculated for preoperative versus. postoperative scores (paired T-test); * = $p \leq 0.05$, ** = $p \leq 0.01$, *** = $p \leq 0.001$. Reference values were based on the EORTC Reference Manual.[7]

The SumSc could be calculated in 77 cases (87.5%) and also for subgroups based on complication occurrence, surgical fenestration strategy, and cyst type (Fig. 2). It showed postoperative improvement from mean 69.4 ± 2.2 to 88.5 ± 1.4 for the total cohort ($p < 0.001$; Fig. 2A). Subgroup analysis demonstrated patients with or without complications (Fig. 2B), patients treated via open or laparoscopic fenestration (Fig. 2C), as well as patients diagnosed with PCLD or simple cysts (Fig. 2D) all significantly improved their SumSc after surgery. A full (exploratory) logistic regression, including age, cyst type, largest cyst size, indication for surgery, type of surgery, and occurrence of a major comorbidities, was built to investigate the weight of factors associated with change in QoL (Table 3). The predefined ≥ 10% increase in SumSc occurred in 51 out of 77 patients (66.2%). Mechanical complaints was associated with a clinically relevant improvement of QoL (OR 0.10, 95% CI 0.02–0.55).

Surgical and postoperative outcomes

All relevant surgical and postoperative outcomes were analyzed and stratified in patients with and without complication occurrence (Table 2). Indications for surgery were mainly pain (48.9%) and spatial complaints (43.2%), followed by inability to exclude malignancy (5.7%), and infection (2.3%). There were no significant differences in surgical strategy between patients with simple cysts, or PCLD ($p = 0.35$). Two of 57 laparoscopic cases were converted to open surgery (2%). Additional cholecystectomy was performed in 20.5% of cases. Absolute rate of any complication was 13.6%. There were 7 grade IIIa complications: 1 infected intra-abdominal fluid collection, 1 case of infected ascites and 3 cases of pleural effusion requiring drainage, 2 cases of biliary leakage requiring endoscopic retrograde cholangiopancreatography. There were no grade ≥ IIIb complications. Grade IIIa complications occurred more frequently in open or converted procedures (5 out of 32 vs. 1 out of 55, $p = 0.02$). Median CCI score was 26.2 (11.8–31.7). Rate of complications was significantly higher in PCLD patients; $p = 0.05$. There was no change of complications through time (≤ 2008 vs. > 2008; $p = 0.53$).

Overall, cysts recurred in 18 of the total cohort of 88 patients (20.5%). An omental transposition was performed in 53 patients (60.2%), in 45 with simple cysts (60%) and in 8 patients (61.5%) with PCLD. Cysts recurred in 15.1% of patients who received an omental transposition, compared to 29.4% of patients without omental transposition ($p = 0.09$). Recurrence

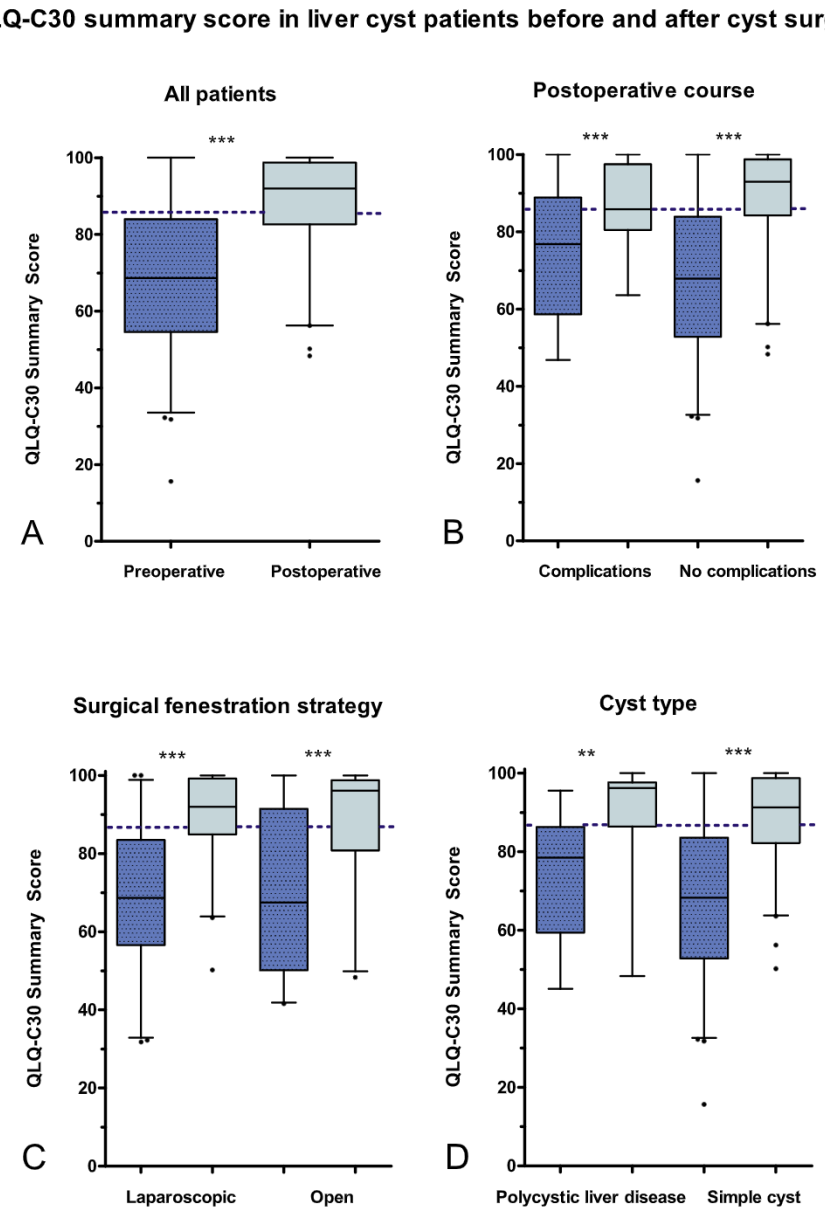

Figure 2 – QLQ-C30 summary score before and after surgical intervention for liver cysts (A) Total cohort, (B) Occurrence of complications, (C) Surgical fenestration strategy, (D) cyst type. Boxplots are provided for the preoperative patients (blue), postoperative patients (light blue), as well as for a reference population (blue dotted lines). Statistical significance was calculated for preoperative versus. postoperative scores (paired T-test); ** = $p \leq 0.01$, *** = $p \leq 0.001$. Reference summary score was calculated from the EORTC Reference Manual.[7]

rates were not significantly different when comparing laparoscopic fenestration to (converted into) open fenestration ($X^2 = 0.27$; $p = 0.78$). Ten patients underwent surgical re-intervention, while no further invasive treatment was performed in the remaining eight cases with cyst recurrence.

Discussion

This multi-center study assessed the QoL of patients surgically treated for liver cysts and analyzed post-operative outcomes. We demonstrated that the QoL of liver cyst patients significantly improved after surgery in two-thirds of the patients. Occurrence of complications did not influence QoL improvement negatively, nor did age, gender, or cyst type. Logistic regression showed that patients with mechanical complaints potentially benefit most from surgery. However, 20% of cysts recurred and 8% grade IIIa complications were seen.

Several other studies have investigated the influence of surgery on QoL of liver cyst patients.[5,11–14] Kamphues et al. found a significant improvement in QoL after laparoscopic fenestration in 31 patients using the QLQ-C30.[5] Kneuertz et al. assessed the QoL of patients treated for benign cystic and solid

Table 2 – Surgical and post-operative outcomes in patients treated for liver cysts.

Category		Any complication	No complication	p-value
Characteristic		$n = 12$	$n = 76$	
Median age at surgery (years, IQR)		55.5 (41.3–66.3)	59 (52–66)	0.33
Type of surgery (%)	Lap. Fenestration	5 (41.7)	49 (64.5)	0.29
	Open Fenestration	5 (41.7)	24 (31.6)	
	Segment resection	–	1 (1.3)	
	Hemihepatectomy	1	2 (2.6)	
	Missing	1 (8.3)	–	
Largest cyst size (%)	< 10 cm	1 (8.3)	16 (21.1)	0.20
	10–15 cm	3 (25.0)	32 (42.1)	
	≥ 15 cm	6 (50.0)	24 (31.6)	
	Missing	2 (15.4)	4 (5.3)	
Localization (%)	Left hemi liver	4 (33.3)	32 (42.1)	0.43
	Right hemi liver	5 (41.7)	33 (43.4)	
	Bi-lobular	3 (25.0)	8 (10.5)	
	Missing	–	3 (3.9)	
Cyst type (%)	Simple	4 (33.3)	17 (22.4)	**0.05**
	Multiple	4 (33.3)	50 (65.8)	
	Polycystic liver disease	4 (33.3)	9 (11.8)	
Omental transposition (%)	No	5 (41.7)	29 (38.2)	0.75
	Yes	6 (50.0)	47 (61.8)	
	Missing	1 (8.3)	–	
Median length of stay (days, IQR)	≤ 5	2 (16.7)	33 (43.4)	0.08
	6–9	3 (25.0)	26 (34.2)	
	≥ 10	6 (50.0)	16 (21.1)	
	Missing	1 (8.3)	1 (1.3)	
Clavien-Dindo (%)	I	3 (25.0)	–	
	II	2 (16.7)		
	IIIa	7 (58.3)		
Median CCI (IQR)		26.2 (11.8–31.7)	–	

Abbreviations: IQR, interquartile range; CCI, comprehensive complication index.
A p-value ≤ 0.05 was considered statistically significant.

hepatic lesions using a self-designed questionnaire including 64 patients diagnosed with simple cysts.[11] They found that surgery is most beneficial for patients with the greatest degree of preoperative symptoms (pain, decreased appetite, or fatigue). Gall et al. post-operatively measured QoL in 64 patients by using the SF-36 questionnaire and found no significant differences between different treatment strategies.[12] Their small sample size could have resulted in a type II error. De Reuver et al. published a series of 95 patients which compared conservative treatment to surgical intervention.[14] In the 55 responding patients, the authors found a significant improvement in QoL for both groups, as assessed by the 36-item Short-Form Health Survey for general QoL and Gastrointestinal Quality of Life Index for disease specific QoL.

Table 3 – Association of patient characteristics with change in summary health status (≥ 10% improvement, n = 51).

Category		≥ 10% increase SumSc			Logistic regression	
		n	%	p-value	Adjusted* OR (95% CI)	p-value
Characteristic						
Age	<70	46	69.7%	0.12	1.0 (reference)	
	70+	5	45.5%		0.70 (0.06–8.33)	0.78
Diagnosis	Simple cyst	64	68.8%	0.30	1.0 (reference)	0.39
	PCLD	13	53.8%		0.48 (0.09–2.52)	
Largest cyst size (cm)	< 10 cm	14	64.3%	**0.04**	1.0 (reference)	
	10–15 cm	30	50.0%		0.31 (0.05–2.03)	0.22
	> 15 cm	28	82.1%		5.11 (0.56–46.20)	0.15
Indication	Pain	38	78.9%	0.052	1.0 (reference)	
	Mechanical	34	55.9%		0.10 (0.02–0.55)	**0.01**
	Other	5	40.0%		0.03 (0.001–1.12)	0.058
Surgery	Laparoscopic	49	71.4%	0.16	1.0 (reference)	
	Open or conversion	27	55.6%		0.36 (0.09–1.52)	0.16
Major life event/major comorbidity	No	39	71.8%	0.58	1.0 (reference)	
	Yes	26	65.4%		0.24 (0.05–1.15)	0.07

A p-value ≤ 0.05 was considered statistically significant.

They found patients to have a QoL comparable to the general population after follow up. No multivariate analysis on factors influencing QoL gain was made.

Our current identification of mechanical complaints as beneficial indication for surgery in terms of QoL is a potential novelty. Alternate symptoms should not be disregarded however. Preoperative severity of experienced symptoms could weigh heavier in the potential gain of QoL than the actual type of symptom, as Gall et al. reported.[12] Symptom severity could also outweigh other factors such as age. We advocate to assess the need for surgery on an individual base and choose a treatment through a shared decision considering the benefits, harms, and effectiveness. For example higher age should not be regarded as contra-indication for surgery when a healthy and previously active, but elderly patient becomes impaired by cyst related symptoms.

The EORTC SumSc has not been used on patients with liver cysts before. The score has been validated robustly.[15] Although it does not replace individual QLQ-C30 scales, the SumSc compares the 15 scale outcomes by multiple testing. This reduces risk of a Type 1 error. It showed to have better differentiating abilities in a QoL study performed on a pulmonary oncology cohort.[16] The comparison of reported function and symptoms to the general population using the EORTC reference values after surgery for liver cysts is new. All scales showed improvement to levels comparable to or better than the general population.

Even though the QLQ-C30 is designed for oncology patients, the questionnaire addresses all relevant symptoms for liver cysts and provides an outcome suited for comparison with similar studies on this subject. The EORTC QLQ-C30 assigns equal weight to all scales. However, some scales are more relevant for patients than others. Our study has shown major improvement of all symptom scales, with differing statistical certainty. Financial problems, diarrhea, and constipation all showed significance with 95% confidence. Although significant, one could argue that other symptoms such as fatigue, nausea and pain are more relevant to the patients QoL – and these (among the rest) have shown a very strong improvement along with great statistical confidence. Another limitation was a slight difference in characteristics of non-responders and responders since the former were younger, had more comorbidities, and larger cysts which were located in the right hemi-liver more frequently. Age and existence of comorbidity could lead to underestimation of QoL gain whereas cyst size could not be correlated to the amount of QoL gain. Surgery could be more profitable for younger people because of better surgical outcomes and less occurrence of co-existing comorbidities.

A potential limitation of this study is the postoperative assessment of the preoperative state. Firstly, the difference in interval between intervention and questionnaire makes careful assessment of symptoms difficult. Studies have demonstrated the inaccuracy of this method, due to recall bias through memory distortion of their earlier health condition.[17] In addition, the "implicit theory of change" could be another possible mechanism leading to underestimation of the patients preoperative state.[18] This theory suggests that patients work backwards to their preoperative state from their presumed present, postoperative state and not on their perception of their actual health at a specific moment. This could lead to an over or underestimation in change of QoL, because patients believe their disease is progressing (or has been halted through surgery or medication) and that consequently their QoL must be deteriorating (or improving). This could be an explanation for the higher scores on some scales than the reference values (Fig. 2), and also why diarrhea or obstipation are mentioned as improving symptoms whilst these are not specifically associated with liver cysts. Both these mechanisms could lead to an underestimation of preoperative QoL. Although this limitation is potentially serious, the sample size of this current study makes it a valuable addition to previous literature published on this subject matter.

As this current study includes a relatively large time span, treatment strategies have inevitably evolved. As expected, analysis of the historical perspective showed an increased application of laparoscopic surgery. Laparoscopic cyst fenestration is associated with a reduction of postoperative pain, reduction of postoperative pain, more comfort, early mobilization, shorter hospital stay, and esthetic advantage, without compromising surgical efficacy.[19] This is in accordance with our findings.

Loehe et al. found that patients treated for PCLD experienced increased complications (simple cysts 5.8%, PCLD 20%).[20] Complications, however, were poorly defined. We stratified complications according to current standards and found a slight difference in rate of complications between patients. They occurred mostly in patients with multiple simple cysts.

There were significantly more cyst recurrences in patients with PCLD compared to patients with single and multiple simple cysts, as they recurred in 38.5%, 4.8% and 22.2% respectively ($p = 0.04$), less than previous results with which ranged from 11.1% to 41% for simple cysts and 42.9%–66.6% for PCLD.[5,20] An omental transposition hypothetically fills the remaining cyst cavity and thereby prevents cyst recurrence. In our series, it did not significantly reduce cyst recurrence rate as 8 out of 53 patients (15.1%) with omental transposition and 10 out of 34 patients without transposition (29.5%) had a cyst recurrence ($X^2 = 2.59$; $p = 0.11$).

In conclusion, surgical intervention is an effective strategy to significantly improve QoL. Both patients with symptomatic simple liver cysts as well as patients with PCLD benefit, with minor morbidity.

Declarations of interest

None.

Sources of financial support

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Acknowledgements

We thank dr. Perla Marang - Van de Mheen (Department of medical decision-making, Leiden University Medical Center, Leiden, the Netherlands) for her contribution to the QoL assessment.

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