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ORIGINAL ARTICLE

# Single umbilical incision laparoscopic cholecystectomy: Initial experience of the Coelio Club

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## KEYWORDS

Gallbladder;  
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## Summary

**Aim:** To assess the initial results of single umbilical incision laparoscopic cholecystectomies (SUILC) performed by the members of the Club Coelio.

**Patients and methods:** This multicenter study involved 65 consecutive patients undergoing SUILC between September 2008 and December 2009. The operation was performed with a 0° scope in 35 and with a 30° scope in 30 patients. There were 56 women and nine men with a mean age of  $49 \pm 14$  years and a mean body mass index of  $25 \pm 4$ . The main perioperative parameters analyzed were duration of operation, conversion, morbidity and duration of hospitalization. One month after surgery, the esthetic result was assessed by each patient on a visual analogue scale (VAS). A VAS score between 9 and 10 was considered as an excellent result.

**Results:** During laparoscopy, some degree of cholecystitis was seen in 10 patients. Intraoperative cholangiography was performed in 57 patients and the mean duration of operation was  $68 \pm 22$  min. Conversion to conventional laparoscopic cholecystectomy (CLC) was required in eight patients (12%). We noted three complications (4%): two wound abscesses and one hemoperitoneum. The mean hospital stay was  $2 \pm 1$  days. The esthetic result was considered as excellent by 45 patients (69%). Multivariable analysis revealed that duration of operation was shorter after five procedures ( $61 \pm 25$  vs.  $72 \pm 18$  min, regression coefficient:  $-7$ ,  $P < 0.032$ ).

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and when a 30° scope was used ( $56 \pm 18$  vs.  $76 \pm 20$  min, regression coefficient:  $-14$ ,  $P < 0.011$ ), the conversion rate was higher in cholecystitis (60% [6/10] vs. 4% [2/55], OR: 33,  $P < 0.002$ ) and the percentage of excellent esthetic results was greater in patients who did not require a conversion to CLC (77% [44/57] vs. 12% [1/8], OR: 18,  $P < 0.012$ ).

**Conclusions:** Our study showed that SUILC is feasible with low morbidity but duration of operation is long and conversion to CLC is frequent in cholecystitis. However, duration of operation decreases with rising experience of the surgeon and when a 30° scope is used. The major value of this technique is cosmetic.

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## Introduction

In the search for less and less aggressive surgical techniques, single umbilical incision laparoscopic cholecystectomy (SUILC) is an alternative to natural orifice trans-endolumenal surgery (NOTES), judged by many as too complicated. The concept of minimally invasive surgery with one, practically invisible, scar is attractive but has to be objectively evaluated [1]. The goal of this study was to evaluate the feasibility and the efficacy of SUILC performed by surgeons belonging to the "Club Coelio", a group of French and Belgian surgeons involved in laparoscopic surgery.

## Patients and methods

### Patients

Eleven surgeons participated in this study: SUILC was performed between September 2008 and December 2009. Patient parameters were recorded prospectively. In all, 65 records were sent to the study coordinator in January 2010. The median number of operations per surgeon was 4 (1 to 26). There were 56 women and nine men, mean age  $49 \pm 14$  years old with a mean body mass index (BMI) of  $25 \pm 4$ . None of the patients had a BMI greater than 32. The indications for cholecystectomy were biliary colic ( $n=60$ ), biliary pancreatitis ( $n=2$ ), chronic cholecystitis ( $n=2$ ) and acute cholecystitis ( $n=1$ ). Nineteen patients had antecedent surgery: Mac Burney incision ( $n=7$ ), Pfannenstiel incision ( $n=6$ ), previous laparoscopy ( $n=5$ ) and supra- and infra-umbilical midline laparotomy ( $n=1$ ).

### Operative technique

The patient was positioned in the "French" position, the operator standing between the patient's legs. A 2 cm vertical transumbilical or curved infraumbilical incision associated with umbilical disinsertion was performed with umbilical disinsertion. Two different procedures were possible: either creation of the pneumoperitoneum with a Palmer needle and insertion of three standard 5 mm trocars through the same umbilical incision ( $n=13$ ) or insertion of a specific three channel trocar ( $n=52$ ), either SILS® ( $n=49$ ) or TRIPORT® ( $n=3$ ) through a 2 cm minilaparotomy at the umbilicus. The optical device used was a 10 mm 0° in 22 patients, a 5 mm 0° in 13 patients, a 10 mm 30° in eight patients and a 5 mm 30° in 22 patients. To enhance exposure of Calot's triangle, a straight needle suture passed through the abdominal wall, on both sides of the suspensory ligament and tied on the anterior abdominal wall suspended the round ligament. Whenever necessary, the gallbladder could be retracted to

the right lateral wall of the abdomen by the same means. For several patients in this series, the Endograb® retracting system was used. Reticulator instruments were used to optimize triangulation for dissection of Calot's triangle, but the surgeons had to cross their forearms during the operation. Two reticulator instruments were used routinely with the 0° optical device ( $n=35$ ). Conversely, when the 30° optical device was used ( $n=30$  patients), the operation could be achieved with one reticulator grasper and a straight hook ( $n=25$  patients). The cystic artery and canal were divided between two clips. At the end of the procedure, the gallbladder was placed in a sac and withdrawn through the umbilicus, which was then closed layer by layer.

### Methods

The following parameters were analyzed: use of intraoperative cholangiogram, duration of operation, conversion, analgesia consumption, morbidity, return to normal and professional activities, and cosmesis. Conversion to conventional laparoscopic cholecystectomy (CLC) was defined as the necessity to add at least two 5 mm trocars or one 10 mm trocar to perform the procedure. Adding a 2 mm trocar was not considered as a conversion. Patients evaluated their postoperative pain on day one using a visual analogue scale (VAS) and use of analgesics was evaluated according to the WHO classification [2]. One month after the operation, the cosmetic results were also evaluated using a VAS: a score between 9 and 10 was considered as excellent.

### Statistical analysis

All calculations were made with the Sigma Stat 3.5 program. Results were expressed as means  $\pm$  standard deviation for continuous values with normal distribution and as median and ranges for skewed continuous values. Comparisons were made with the Student *t*-test and the Mann-Whitney U test, respectively. Fisher's exact test was used for categorical values. Univariate and multivariable analysis were performed. All variables with *p* values less than 0.20 on univariate analysis were entered into multivariable analysis. Multiple linear regression or logistic regression was used as appropriate. A *p* value less than 0.05 was considered as statistically significant.

### Results

Seven patients had chronic cholecystitis, undetected before operation. In all, 10 patients had cholecystitis. Intraoperative cholangiograms were attempted in 59 patients

**Table 1** Variables influencing duration of operation.

Variables	<i>n</i>	Univariate analysis			Multivariable analysis		
		Mean ± Standard deviation (min)	<i>P</i>		Regression coefficient	Standard error of the mean	<i>P</i>
Number of operations	0 to 5	54	72 ± 18	0.036	−7.0	3.2	0.032
	> 5	11	61 ± 25				
Scope	0°	35	76 ± 20	0.001	−14.1	5.3	0.011
	30°	30	56 ± 18				
Cholecystitis	No	55	66 ± 19	0.162	5.9	6.7	0.381
	Yes	10	76 ± 34				

**Table 2** Variables influencing the conversion rate in conventional laparoscopic cholecystectomy.

Variables	<i>n</i>	Univariate analysis			Multivariable analysis			
		Conversion	%	<i>P</i>	Odds ratio	95% confidence interval	<i>P</i>	
Body mass index	< 29	54	4	7	0.023	8	0.6–91	0.101
	≥ 29	11	4	36				
Scope	0°	35	7	20	0.060	11	1–199	0.086
	30°	30	1	3				
Cholecystitis	No	55	2	4	0.001	33	4–291	0.002
	Yes	10	6	60				

(59/65 = 91%) and were successful in 57 (57/59 = 96%). Mean duration of operation was 68 ± 22 min. Duration of operation decreased significantly after five operations (61 ± 25 vs. 72 ± 18 min), was shorter when a 30° optical devices was used (56 ± 18 vs. 76 ± 20 min), and was longer in cholecystitis (76 ± 34 vs. 66 ± 19 min) (Table 1). In patients undergoing operation with a 30° optical device, when the surgeon had performed more than five operations (*n* = 16), the mean operation time was 46 ± 9 min. In multivariable analysis, surgeon experience (regression coefficient: −7, *P* < 0.032) and use of a 30° scope (regression coefficient: −14, *P* < 0.011) were the only independent predictive factors influencing duration of operation (Table 1). A 2 mm micro-instrument was inserted subcostally in 11 patients. Conversion to laparotomy was never needed, but conversion to CLC was performed in eight patients (12%). The decision to convert was usually taken early during the procedure, explaining why no statistically significant difference was found between the duration of operation of converted

and non converted patients (74 ± 32 vs. 66 ± 20 min [ns]). The conversion rate was higher when patient BMI was ≥ 29 (36% vs. 7%), when a 0° scope was used (20% vs. 3%) and when cholecystitis was present (60% vs. 4%) (Table 2). In multivariable analysis, cholecystitis was the only independent predictive factor for conversion to CLC (OR: 33, *P* < 0.002). The median VAS score for pain was 3 (0 to 9). Three patients required no painkillers. According to the WHO classification, 51 patients took class I medication, nine required class II and two patients used class III medication. We observed three postoperative complications (4%): two surgical site abscesses treated conservatively, and one patient sustained a hemoperitoneum requiring repeat laparoscopy for hemostasis. Two of these complications occurred in patients converted to CLC. The patient undergoing repeat operation for hemoperitoneum had an antecedent midline incision: bleeding originated from adhesions between the omentum and the abdominal wall, and not from the operative site. Mean duration of hospital stay was 2 ± 1 days

**Table 3** Variable influencing cosmesis.

Variables	<i>n</i>	Univariate analysis			Multivariable analysis			
		VAS 9–10	%	<i>P</i>	Odds ratio	95% confidence interval	<i>P</i>	
Body mass index	< 29	54	40	74	0.079	1.5	0.3–8	0.588
	≥ 29	11	5	45				
Antecedent surgery	No	46	35	78	0.080	2,3	0.6–8	0.203
	Yes	19	10	52				
Conversion	No	57	44	77	0.001	18	2–174	0.012
	Yes	8	1	12				

VAS: visual analogue scale.

and return to normal and professional activities was possible, respectively,  $9 \pm 5$  and  $23 \pm 7$  days after operation. No predictive factors for postoperative pain, hospital stay, postoperative morbidity or return to normal or professional activities were found. The median VAS score for cosmetic outcome was 9 (6 to 10). 45 patients (69%) rated their cosmetic result as excellent. A higher rate of excellent esthetic result was noted in patients with BMI < 29 (74% vs. 45%), without antecedent abdominal surgery (78% vs. 52%) and in non-converted patients (77% vs. 12%) (Table 3). In multivariable analysis, only the absence of conversion to CLC was an independent prognostic factor for excellent cosmetic results (OR: 18,  $P < 0.012$ ) (Table 3).

## Discussion

Four trocar conventional cholecystectomy (CLC) is the present gold standard for symptomatic cholelithiasis. Notwithstanding the well-established advantages of CLC over laparotomy [3], surgeons have continued to investigate less invasive procedures. Mini-laparoscopic cholecystectomy (MLC) was conceived in the 1990s under the name of «needlescopic cholecystectomy» [4]. Mini-laparoscopic cholecystectomy was defined as an operation for which the sum of the different trocar incisions was < 25 mm [5]. Classically, dissection is accomplished with micro-instruments with the optical device placed in the umbilicus [4]. The goal was to decrease abdominal wall aggression and thus decrease postoperative pain and allow quicker return to normal and professional activities. Two recent meta-analyses [5,6] have shown that the only real advantage of MLC was the cosmetic outcome, although duration of operation was longer and the technique more difficult to perform because of the fragility of the micro-instruments. In reality, this technique has not been widely adopted.

More recently, natural orifice trans-luminal surgery (NOTES) emerged as an alternative [7]. The NOTES technique requires multidisciplinary cooperation, is often long and difficult [1], has created ethical problems [8–10] as the transvaginal route, the most often employed, has been criticized [11]. Conversely, even though few surgical teams adhere to this concept, the development of NOTES has made surgeons realize the importance of the esthetic outcome of an operation [12,13]. The umbilicus is considered by some as an embryologic natural orifice [10]. It was therefore quite natural to see the development of laparoscopic surgery through an unique umbilical incision. This technique can be performed with conventional surgical instruments and the attending benefits are similar to those of NOTES.

The SUILC technique remains to be validated. The overall complication rate of CLC is 3% and common bile duct injury occurs in less than 1% [14]: it is our responsibility to make sure that SUILC does not result in worse outcomes [9]. Our series of 65 patients is one of the largest published to date. The first publications on SUILC involved around twenty patients [10,12,15–22], and only more recently have we seen three series of 100 patients [13,23,24] and a multicenter series of 297 patients [25]. Several technical variations have been described but the common denominator has been to use stay sutures to retract the gallbladder in order to obtain adequate vision and exposure to adhere to the triangulation principle for dissection of Calot's triangle. Passing sutures through the gallbladder leads to bile leakage in the operative field, which has been criticized because of the risk of infectious complications or of compromised carcinologic

results in the case of gallbladder carcinoma. In reality, bile leakage does not seem to have any harmful clinical consequences. Indeed, involuntary perforation of the gallbladder occurs in 20 to 32% of CLC [26,27] without increased postoperative morbidity, even when the bile is infected [28]. The incidence of unsuspected gallbladder carcinoma discovered only on the specimen is low (0.3 to 0.9%) [29,30] and patients are usually older (median: 73 years old) or present associated risk factors such as macrolithiasis, cholecystitis or polyps [29], characteristics which do not correspond to those of patients selected for SUILC. Last, the use of atraumatic retractors (for example Endograb®) should limit biliary contamination.

Our series was multicentric, involving surgeons who for the most part had limited experience with SUILC. The results published herein reflect everyday surgery rather than exceptional surgical feats, practiced by surgeons with long standing experience in the technique. Our study confirms the feasibility of the technique although operative times were relatively long. Mean operation durations of more than 75 min have been reported in several publications [17–22] but, as observed in our study, there is a learning curve, and operative times decrease as experience is gained [13,16]. On the other hand, while the 30° scope is not essential, it is recommended by several authors [13,16,23,25] because vision, exposure and dissection are facilitated. In our study, use of the 30° scope was also associated with decreased duration of operation, and allowed the use of only one roticulator grasper, making it easier to work, compared with two roticulator instruments.

The conversion rate to CLC varies between 0 and 15% in the literature. Our conversion rate was 12%, higher in the case of cholecystitis and, to a lesser degree, in obesity. While conversion should not be considered as a failure, it does pose an economic problem when an expensive, specific trocar (for instance SILS®, TRIPORT®) has been taken out of its package. For this reason, we, as others [15,18,19,21], do not recommend SUILC for the obese or in patients with cholecystitis.

Intraoperative cholangiograms have not always been performed routinely [13,15–18,21,22,24]. In the study by Curcillo et al. [25], IOC prolonged the operation by 19 minutes. As Bucher [11,12], however, we believe that cholangiograms should be performed routinely. Not only is the SUILC technique more challenging than CLC but we strongly feel that everything should be done to eliminate a common bile duct injury [9] if we want to validate this technique.

Our study confirms that postoperative morbidity after SUILC is low and similar to that observed after CLC [10–13,15–25]. There were no biliary complications in our series. In the literature, we found only three reports of biliary complications [19,23,25]. The outcome of other parameters such as pain, use of analgesics, duration of hospital stay and return to normal and professional activities were similar to those reported in CLC [23].

The scar of SUILC is often considered as “invisible”, but the patient is usually not asked about the cosmetic results. Our study is the first to objectively show a cosmetic advantage for SUILC. It is possible that the minimal invasive aspect of SUILC has positive repercussions for the patient such as improved postoperative quality of life but more studies are necessary to prove this.

Last, a minilaparotomy makes it much more easy to extract macrolithiasis, but increases the risk of incisional hernia at the trocar site. We found only one report of

immediately postoperative umbilical incisional hernia in the literature, related to a technical error during closure [17]. The long-term risk of developing incisional hernia cannot be evaluated for the time being because the follow-up of patients in all the published studies, including ours, is too short.

## Conclusion

Our study confirms that SUILC is reproducible and effective. Duration of operation is relatively long but should decrease with experience and the use of a 30° scope. Cholecystitis and obesity are relative contraindications for this technique. At present, the only obvious benefit for SUILC is cosmetic, but perhaps something essential for certain patients. In the near future, progress in instrumentation should make this operation easier. Further, ideally randomized, studies including quality of life analysis are necessary to objectively compare this technique to CLC.

## Conflict of interest statement

None.

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