

ORIGINAL ARTICLE

Management of complicated gallstones: Results of an alternative approach to difficult cholecystectomies

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Abstract

Laparoscopic cholecystectomy (LC) is the gold standard treatment of gallstones. Nevertheless, the incidence of conversion and injuries to the biliary tract is still high in difficult cholecystectomies. In this study we sought to determine how using operative risk predictive scores (PSs) and the Nassar scale to grade the difficulty of LC would optimize the perioperative management of complicated gallstone patients. We also evaluated whether the “fundus-first” approach to LC combined with ultrasonic dissection minimizes the risk of conversion and biliary injury in difficult cholecystectomies, and avoids routine intraoperative cholangiography. A prospective non-randomized study was carried out from 2005 to 2007 including 237 patients referred for gallbladder diseases. All patients were evaluated using an operative risk PS. The LC grade of difficulty was assessed according to Nassar. Diagnostic accuracy, sensitivity, and specificity of PS were calculated. LC in difficult cases was accomplished with a fundus-first approach. Outcome measures included: Conversion rate, bile duct (BD) injury rate, and postoperative complications according to Clavien. In 178 out of 237 patients, a higher risk of conversion and complication was predicted. In 146 out of these 178 cases, intra-operative grading confirmed the difficulty of the procedure. The PS diagnostic accuracy was 0.865, sensitivity was 100%, and specificity 65%. Positive predictive value and negative predictive value were 0.82 and 1, respectively. Conversion rate was 2.7%. Mean operating time and postoperative length of hospital stay were 75 minutes and 3.5 days. Intra-operative cholangiography was necessary in five cases, and one intraoperative biliary complication occurred with an uneventful postoperative course. Overall, postoperative complications were 2.7% with a mortality rate of 0.68% (1 myocardial infarction). Fundus-first LC by ultrasonic dissection is safe and minimizes the risk of conversion and biliary injuries in difficult cases. Difficult cholecystectomies may be predicted preoperatively; in these cases the fundus-first approach and ultrasound dissection may be advised.

Key words: *Laparoscopic cholecystectomy, difficult cholecystectomies, fundus-first cholecystectomy, acute cholecystitis, chronic cholecystitis, ultrasound dissection*

Introduction

Laparoscopic cholecystectomy (LC) is the gold standard in the treatment of gallstones. During the twenty years since its introduction, the procedure has been demonstrated to be safe with a very low incidence of complications. LC yields the same result as open cholecystectomy, but has an improved postoperative recovery in terms of pain, scarring, and quality of life. The first step of the standard technique is the exposure and identification of the anatomical structures in the area of Calot’s triangle, followed by their dissection, and finally the dissection of the gallbladder from

the liver bed (1–3). Today, laparoscopic surgery in patients with acute cholecystitis, sclero-atrophic cholecystitis, and those with anatomical structures difficult to visualize carries a significantly increased risk of conversion to open laparotomy and complications, especially involving the biliary tract (2–8).

There is a need to optimize the perioperative management in gallbladder disease cases where LCs are particularly difficult to perform. There are several published techniques to predict the difficulty of LC and the risk of conversion and/or bile duct injury during its execution (9–16). Predictions for a difficult LC may be arbitrary since they partially depend on the

surgeon's experience. Therefore, it is necessary to establish an objective framework to rate LC difficulty. One candidate is the scale proposed in 1995 by Nassar (17).

The objectives of the current study are

- to evaluate the utility of a preoperative scoring system that is effective in predicting the difficulty of an LC, and to determine the clinical relevance of an intra-operative assessment based on the Nassar scale and
- to evaluate if an approach to dissecting the gallbladder different from the standard retrograde method can translate into a safer treatment in terms of reducing conversions and complications.

Material and methods

From 2005 to 2007, 237 patients with simple or complicated gallstones were referred to our institution. Of these, 178 were classified as at-risk according to the predictive score given during preoperative assessment. The management of these patients included a preoperative evaluation of the risk of the operation and the possibility of conversion. At the time of the operation, the degree of difficulty was graded according to the Nassar scale. With complicated gallstones, the operation was performed with the anterograde (fundus first) approach, with the use of an ultrasound dissector (Harmonic - Ethicon EndoSurgery, J&J, Cincinnati, OH, USA) to dissect the tissue, perform coagulation, and divide structures of the cystic pedicle. Table I summarizes factors used to establish and predict the possibility of a difficult LC, with elevated risk of conversion and complications. Patients considered to be at increased risk were those with the presence of one or more of the clinical factors listed. Additionally, male gender and/or age > 60 were also considered risk factors.

In the cases of suspected or detected common bile duct stones, patients underwent preoperative cholangio-MRI and endoscopic retrograde cholangiopancreatography (ERCP) with endoscopic sphincterotomy. ERCP with sphincterotomy was also performed in cases of biliary pancreatitis.

Table II summarizes the Nassar scale with four degrees of LC difficulty, based on the appearance of the gallbladder, the visibility of the cystic pedicle, and the presence of adhesions. Figure 1 demonstrates the laparoscopic outline of the four degrees of difficulty according to the Nassar scale (Figure 1A,B Grade I, C,D Grade II, E,F,G Grade III, H,I,L,M Grade IV).

Table I. Predictive score of LC surgery risk and possibility of conversion.

Hepatobiliary ultrasound	Wall thickness Characteristics of gallstones Compressed gallbladder Dilated cystic duct and biliary tract Biliary lithiasis Pericholecystic fluid Gallbladder volume
Blood factors	Bilirubinemia Hepatic enzymes and biliary stasis Pancreatic enzymes Leukocytosis
Clinical factors	Presence of jaundice Obesity Diabetes Cirrhosis Clinical history of cholecystitis or acute pancreatitis Repeated colic pain episodes Previous surgery in the supra-mesocolic area Urgent hospitalization
Age	>60
Gender	Male

The validity of the preoperative predictive score was evaluated by analyzing diagnostic sensitivity and specificity, positive predictive value, negative predictive value, and diagnostic accuracy. In patients considered to be in the 3rd (Figure 1E,F,G) and 4th (Figure 1H,I, L,M) of the Nassar scale (difficult LCs), the operation was performed with the fundus-first approach and ultrasound dissections. Intra- and post-operative complications were evaluated as minor or major complications according to the Clavien classification (18).

During the 24 months before the period under consideration, the author performed 122 LCs for complicated gallstones (acute cholecystitis, severe chronic cholecystitis), with no preoperative assessment of risk of difficult LC. In this group of patients, the approach used for the dissection of the gallbladder, both in simple and in complex cases, was standard, using the retrograde method, mostly with preliminary emptying of the gallbladder (Figure 2A, B,C) and early preparation of the structures of the cystic pedicle (Figure 2D,E,F). In all these cases the dissection instrument used was an ultrasound dissector (Figure 2D,E,G,H). In this group of patients, associated surgeries, conversion rate, operating time, length of hospital stay, intra-operative cholangiography rate, management of associated common bile duct (CBD) stones, intra-operative biliary complications, postoperative morbidity and mortality were assessed retrospectively. This group of patients was used as a reference for evaluating the results of the Nassar grade III and IV cases among the 178 patients considered by this study.

Table II. Nassar classification of LC degree of difficulty.

	Gallbladder	Cystic pedicle	Adherences
Grade I	Soft walls, without any significant adherences with its own bed	Free, thin	Simple, in the infundibulum or Hartmann's pouch area
Grade II	Gallbladder mucocele Impacted stones	Covered by fat	Simple, with the gallbladder body
Grade III	Intra-hepatic Acute cholecystitis Compressed Fibrous Hartmann's pouch, adhering to the biliary tract or with gallstone wedged in	Anatomical irregularities Short, dilated, or hidden cystic duct	Dense, involving the bed Involving the hepatic flexure or the duodenum
Grade IV	Completely hidden Empyema/gangrene Tumor	Impossible to recognize	Dense, fibrous, completely covering the gallbladder Difficult to separate both from the duodenum and from the hepatic flexure

From: Nassar AHM, Ashkar KA, Mohamed AY, Hafiz AA. Is laparoscopic cholecystectomy possible without video technology? Minimally Invasive Therapy 1995;4:63–65.

Ultrasound dissection

The Harmonic device (Ethicon EndoSurgery, J&J, Cincinnati, OH, USA) is an ultrasound activated dissector that allows the active blade to vibrate at a frequency of 55.500 Hz (within the harmonic range of frequency). Such a frequency is requested to provide optimal hemostasis when the instrument is activated. The US generator features a power output setting and control software and the predisposition for a dual (hand-switch and footswitch) activation system. The aluminum-alloy hand-piece is provided with a piezo-electric transducer cooled by natural convection. Its "smart chip" technology provides data for set-point calibration, and allows diagnostic data collection and real-time control of the power output curve. The harmonic hand-piece used during laparoscopic cholecystectomy is 5 mm in axial diameter and is provided with curved blades. It is an actual multi-functional device that provides grasping, dissection, and simultaneous cutting and coagulation.

Surgical technique

The surgeon is positioned between the patient's legs with the monitor on the right side and assistant to the left. Pneumoperitoneum induction is performed with a modified open technique by introducing a transparent 10–12 mm unreinforced cannula under visual control directly into the peritoneal cavity in the supra-umbilical area. Afterwards, another three cannulas are inserted (two 5 mm cannulas and one

10–12 mm cannula) between the left side and the hypochondrium in the pararectal area, the subxyphoid region, and on the right side below the transverse umbilical line. The Harmonic dissector is introduced through the left operating cannula. An aspirator-irrigator introduced through the subxyphoid cannula retracts the liver, elevating it and allowing the gallbladder to be exposed. The atraumatic grasping forceps are introduced through the right operating cannula. The operation begins with the dissection of normal adhesions with the Harmonic dissector. In this phase, it is helpful to apply traction and countertraction with the grasping forceps on the side right of the patient and the subxyphoid irrigator-aspirator. Once the gallbladder is freed, it may be difficult to grasp due to the presence of hydrops, empyema, impacted stones, and overly thick or fragile walls. In the first cases, a needle is used to stab and suction the gallbladder to remove the fluid present (which is not always easy due to the density of the liquid) (Figure 3A,B); in the other cases attempts will be made to retract the gallbladder either with the grasping forceps or with the irrigator-aspirator, without grasping it. The use of a gauze swab, placed on segment IV, is used to avoid injuries to the hepatic parenchyma during lifting with the irrigator-aspirator.

Having confirmed the degree of difficulty of the dissection of Calot's triangle (with grading according to the Nassar scale), but keeping it as exposed as possible during the entire course of the operation, the next step is the dissection of the gallbladder from the liver bed starting from the bottom. The use of the Harmonic dissector allows for an anterograde

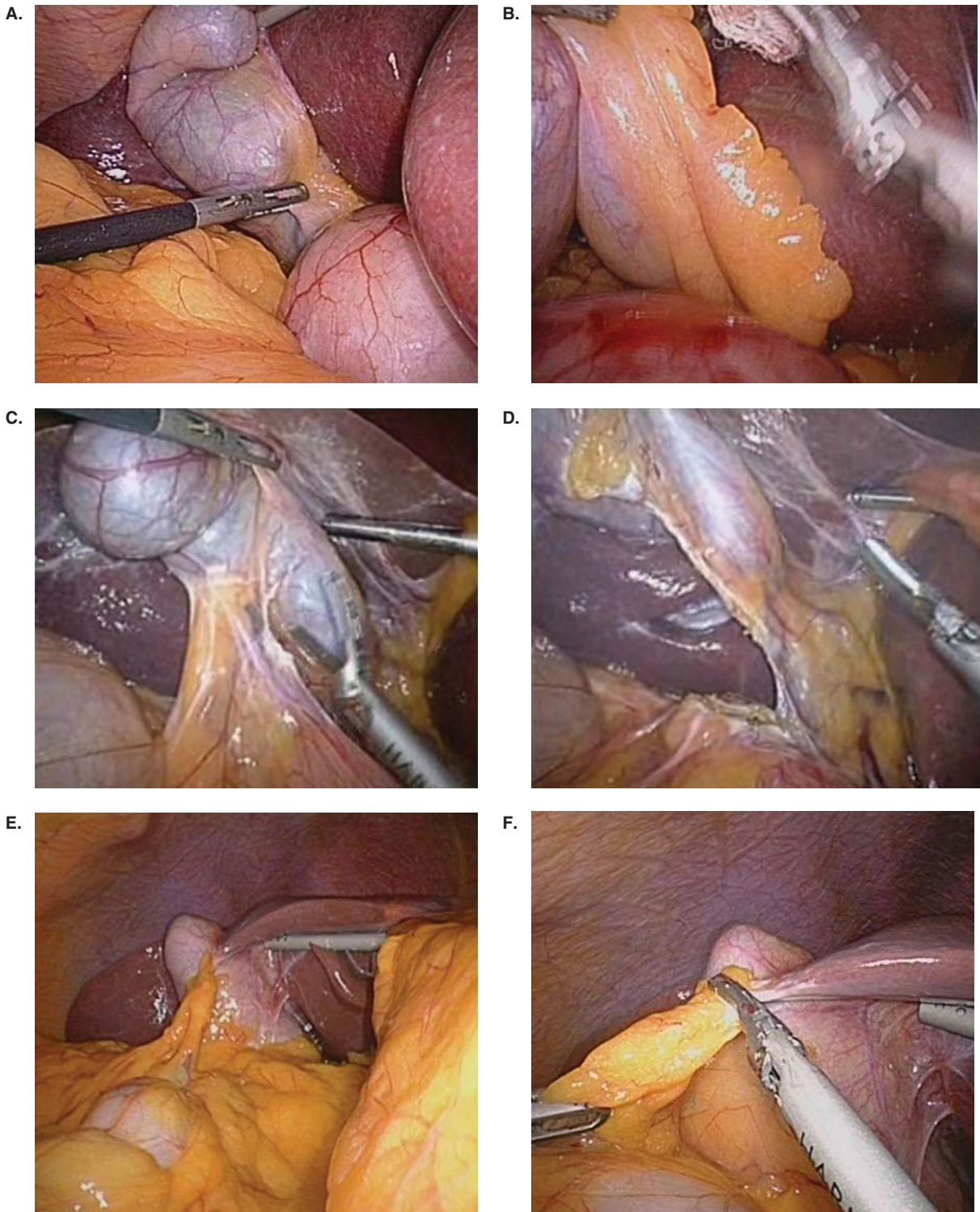


Figure 1. Degree of difficulty according to the Nassar scale: A,B: grade I; CD: grade II; EFG: grade III; HILM: grade IV.

dissection to take place without excessive bleeding even in the absence of a preventative dissection of the cystic artery (Figure 3C). At times the phlogistic response and edema are such that dissection of the

gallbladder from the liver bed is almost entirely carried out by blunt dissection. Other times, such as in sclerotic gallbladders that are compressed into the hepatic parenchyma, it is necessary to cut with the

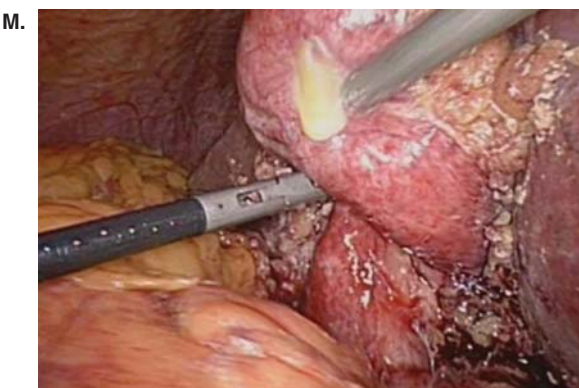
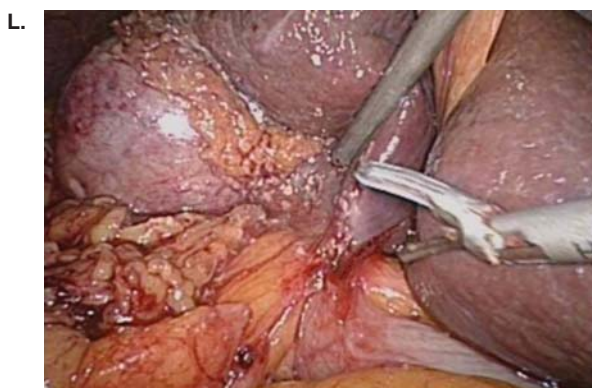


Figure 1. (Continued).

blade along a dissection line that is perceived thanks only to the experience of the surgeon. The most crucial moment of the fundus-first approach is when the Hartmann's pouch is reached from the top and on the right side. At this point, in order to minimize the risk of damaging the underlying structures, the dissection proceeds on two different sides, from the top towards the bottom both on the right and the left side, but also from the bottom towards the top,

being careful to gradually free the infundibulum. In this phase the infundibulum-cystic duct junction and the cystic artery can be seen (Figure 3D). The cystic artery is coagulated and dissected with the Harmonic dissector without positioning any clips. At times, it is found that the artery is blocked due to the phlogistic process, which often occurs in gangrenous gallbladders. Once the gallbladder is completely detached from the liver bed, the cystic duct is still attached

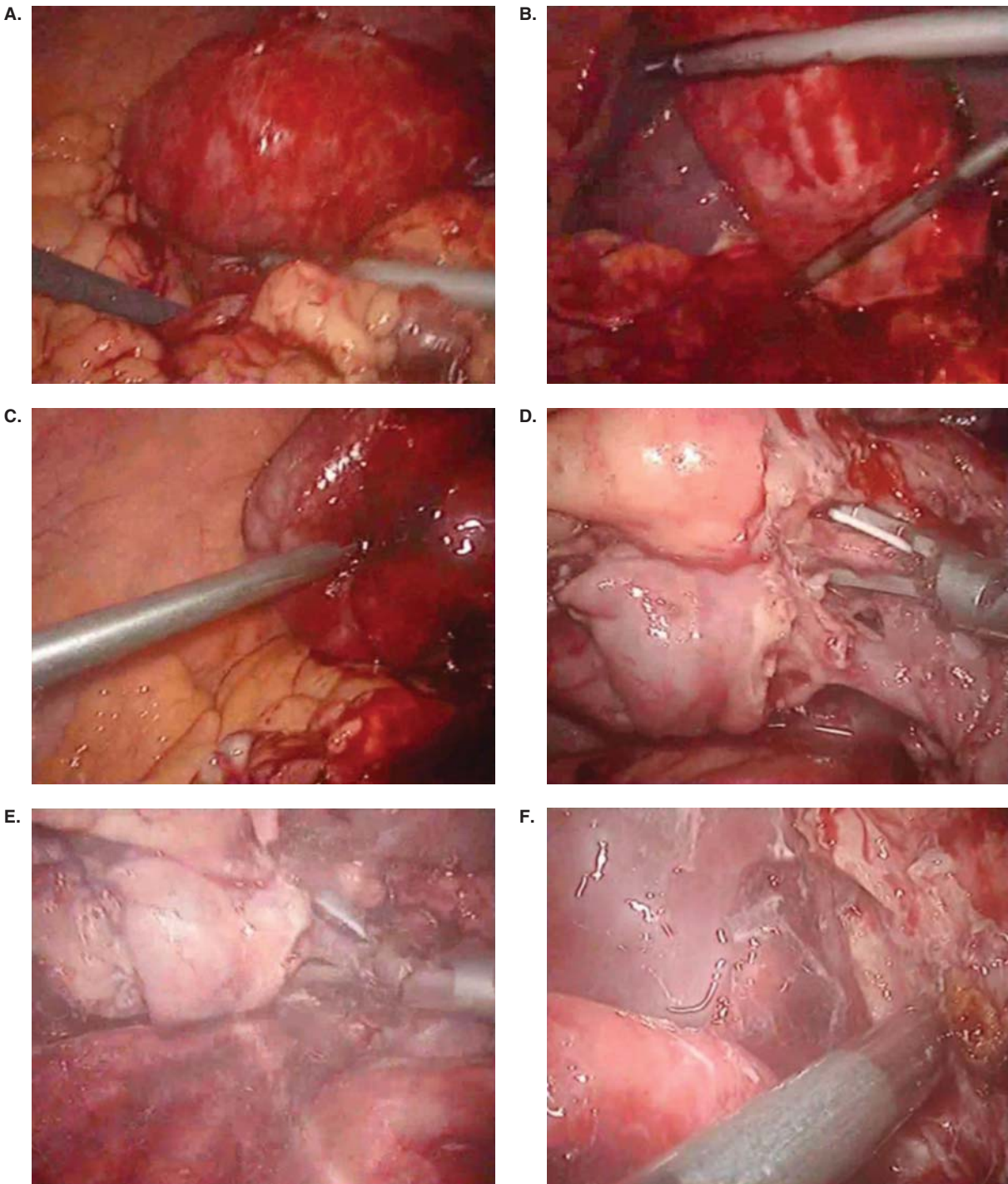


Figure 2. Difficult LC (Nassar Grade IV with retrograde method). A,B,C: Acute cholecystitis and empyema. Gallbladder bed and body freed from omental adhesions and liquid drawn out of gallbladder with needle. D, E, F: Structures of cystic pedicle are dissected with the Harmonic dissector and coagulated and cut with the same instrument without the need to apply clips; G,H: The gallbladder is dissected with the Harmonic dissector from the hepatic bed.

and is freed from the residual pericyclic tissue before it is dissected. In gangrenous gallbladders, the duct is often found to be fragile, and its dissection with the Harmonic dissector must be performed between

reabsorbing clips or ligation with reabsorbing material. If the cystic duct is very short or dilated (>3 mm) it is always recommended to dissect it with the Harmonic dissector after applying a reabsorbing clip at

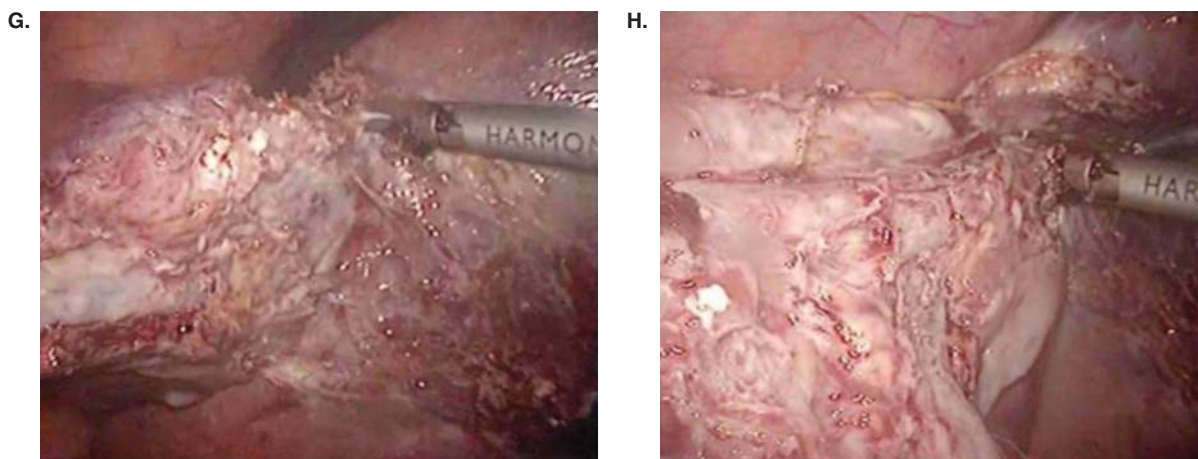


Figure 2. (Continued).

least on the bile duct side. At times, a dilated cystic duct can be cut with the Harmonic and then it can be secured with a reabsorbing endoloop. A cystic duct that is not dilated can be cut and closed safely with the Harmonic dissector (Figure 3E,F). In cases where the execution of an intraoperative cholangiography (IOC) is necessary, the cystic duct must not be opened with the Harmonic dissector since this would risk sealing the lumen, mainly if the opening is inadvertently made in the area of a Heister's valve. This would obstruct the passage of the cholangiography catheter. In these cases, a small incision of the cystic duct is made with standard laparoscopic scissors; the opening of the lumen is confirmed by bile leak: At this point the cholangiography catheter may be safely introduced. The catheter is advanced several centimeters; usually, this is a smooth maneuver. After flushing some saline solution into the CBD lumen, IOC is performed in a standard manner.

The gallbladder is extracted with an endobag. We routinely use this procedure, not only to avoid bacterial contamination, but also to avoid squeezing the organ in rare cases of tumor-related lesions. If contamination of the operating field is suspected due to the opening of the gallbladder in patients with acute cholecystitis or empyema, after washing takes place, a passive drain is left for 24–48 hours. In all other cases, after a careful hemostasis and washing of the operating field, no surgical drain is left.

Results

Of the 178 cases considered by this study, 146 patients had Nassar grade III or IV (109 and 37 patients, respectively) intra-operative difficulty rating. Table III shows the clinical history of these

patients. In 32 cases, patients considered potentially difficult preoperatively were found to be grade II on the Nassar scale during surgery. In these cases, adhesions were found, but there was no real difficulty recognizing the anatomical structures.

The diagnostic accuracy of the predictive score reported in detail in Table IV was 0.865, sensitivity was 100%, and specificity was 65%, with positive and negative predictive values of 0.82 and 1, respectively.

In the group of patients considered preoperatively to be difficult LCs, the male to female ratio was 68:78. The average age of the patients was 64.8-years-old (range 11–91) and the average weight was 73.3kg (range 45–103). In 25 cases, cholelithiasis was verified with MR cholangiography preoperatively: In 23 cases a sequential treatment was followed and in two cases (one gastro-resected patient and one unsuccessful sphincterotomy) exploratory surgery of the biliary tract was performed. In two cases the cholangiography showed common bile duct lithiasis and an intra-operative sphincterotomy with the rendezvous technique was performed. LCs were associated with a second surgical procedure in 18 cases. In every case, the associated surgery was planned and was never performed due to unforeseen circumstances.

In four cases, it was necessary to convert to an open procedure (2.7%): In one case to repair a lesion due to the disconnection of the short cystic duct during surgery for gangrenous cholecystitis, in one case it was required to complete exploration of the bile duct in a gastro-resected patient, and in two cases due to the presence of massive adhesions which made it impossible to access the gallbladder. No conversion was necessary due to a lack of recognition of the anatomical structures in Calot's triangle.

An IOC was performed in five cases: In two out of these five cases an intra-operative sphincterotomy

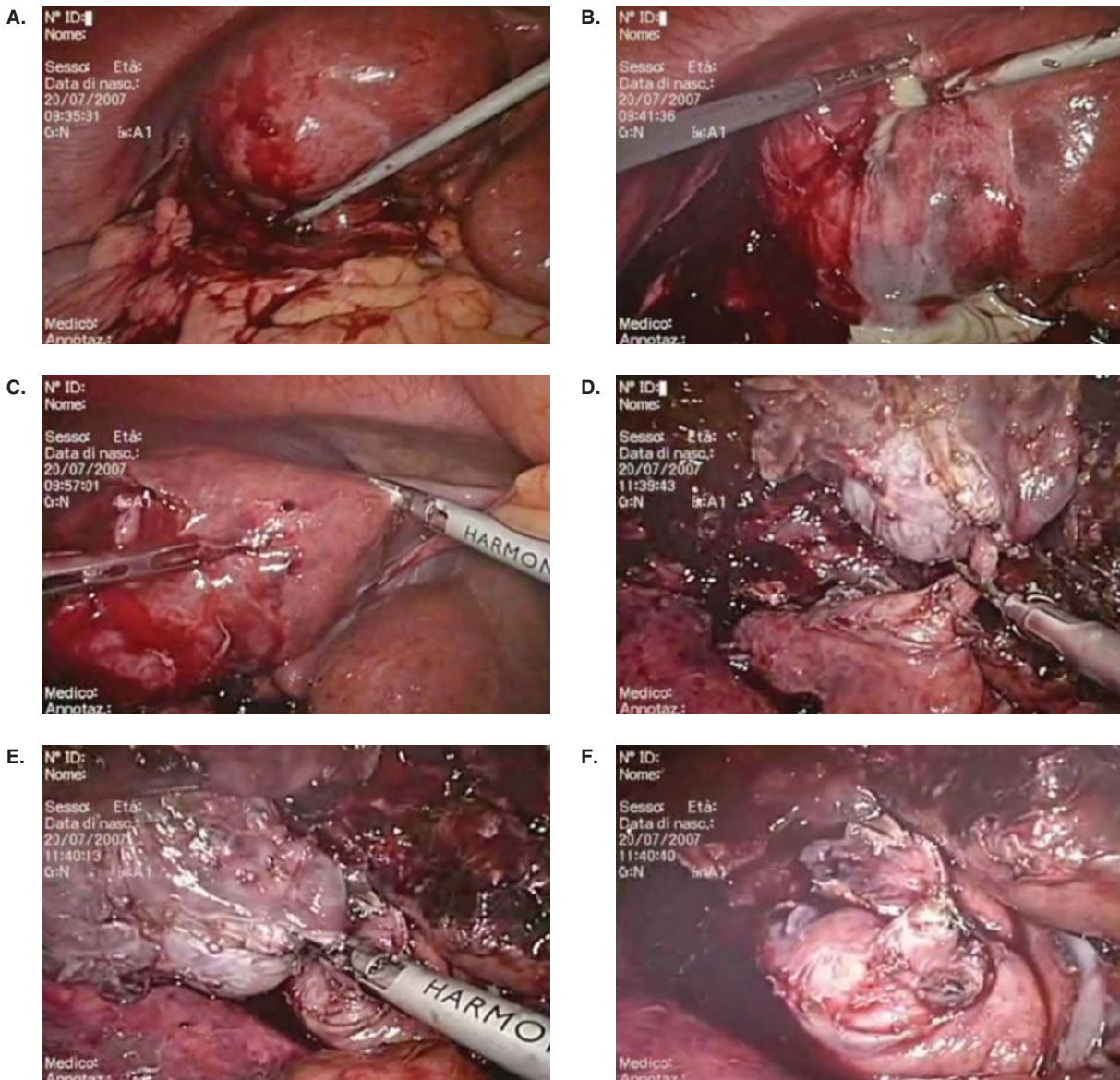


Figure 3. Difficult LC (Nassar grade IV with anterograde approach). A,B,C: Acute cholecystitis and empyema, partially intra-hepatic and partially gangrenous. Liquid removed with needle; D,E,F: Impossible to dissect the structures of the cystic pedicle safely in the Calot's Triangle and to see the infundibulum-cystic duct junction. The fundus-first method is used to dissect the gallbladder from the hepatic bed with the Harmonic dissector, minimizing blood loss and safely reaching the infundibulumcystic duct junction. The cystic artery and duct are coagulated and divided with the Harmonic dissector. At the end, the cystic stump is secured further with a reabsorbing clip.

using the rendez-vous technique was performed with subsequent removal of CBD stones. In both cases a stent was positioned by the endoscopist at the end of the procedure. In the remaining cases IOC did not show the presence of CBD stones.

Considering the successful laparoscopic cholecystectomies, the cystic duct was dissected and simultaneously closed with the Harmonic dissector in 61 cases (43%), while in 81 cases (57%) it was further secured with a reabsorbing clip or an endloop.

The only intra-operative complication was a cystic duct avulsion from the bile duct in a patient with gangrene of the gallbladder (Csendes type II lesion, minor according to McMahon) (19), immediately recognized and treated after conversion to a mini-laparotomy and applying a suture. There were no post-operative problems with this patient, who was discharged six days postoperatively. No post-operative complications were correlated with a biliary lesion or leakage. Only one death was reported due to a myocardial infarction on the 4th day after the

Table III. Indications for LC surgery in patients whose risk prediction has been confirmed by interoperative evaluation using the Nassar scale (clinical and anatomical-pathological history).

Acute cholecystitis	32/146	21.9 %
Chronic cholecystitis with/without pancreatitis	66/146	45.2 %
Wedged gallstone in the cystic duct/hydrops	15/146	10.2 %
Gangrenous cholecystitis	4/146	2.7 %
Cholecystitis + lithiasis of the biliary duct with/without pancreatitis	27/146	18.5 %
Mirizzi's syndrome	1/146	0.7 %
Tumor	1/146	0.7 %

operation in a 91-year-old patient operated on for acute cholecystitis.

In the reference group of 122 LCs performed with a standard retrograde procedure, where the operation reports were analyzed retrospectively, 76 LCs were found to be a Nassar grade III and 46 a Nassar grade IV. In three cases (6.5%) conversion to an open procedure was necessary. Eight cases (17.4%) were associated with a second procedure (a sphincterotomy with the rendezvous technique due to bile duct lithiasis in six cases).

Tables V and VI report the outcomes and intra- and post-operative complications of the patients from the two groups.

Discussion

Complicated gallstones still represent a surgical problem today both due to the incidence of complications and to the number of conversions. A better planning of the operation, obtainable during the preoperative assessment phase by adopting a predictive scoring

Table IV. Diagnostic accuracy of the predictive score of a difficult LC and risk of conversion during surgery. The result of the score is compared with the intra-operative grading regarding the difficulty of the cholecystectomy according to Nassar.

SCORE	Difficult LC + (YES)	Difficult LC - (NO)	
Pre-operative 237 patients			
SCORE + 178 patients	a 146	b 32	a + b 178
SCORE - 59 patients	c 0	d 59	c + d 59
	a + c 146	b + d 91	237

a = difficult cholecystectomies with + score, b = simple cholecystectomies with + score, c = difficult cholecystectomy with - score, d = simple cholecystectomies with - score, Sensitivity: 100%, Specificity: 65%, Accuracy: 0.865, PPV: 0.82, NPV: 1

system, can allow operative management to be optimized by planning IOCs or considering performance of the operation with the anterograde method.

On the other hand, it is important to establish a systematic and objective degree of difficulty for LCs. The Nassar scale allows for a difficult LC to be described easily by considering the nature of the disease, the visibility of the organ, the structures of the cystic pedicle, and the possibility of clearly establishing the anatomical layout (17). Strasberg's critical approach to dissecting the cystic structures is considered essential today to reduce the incidence of iatrogenic bile duct injury during LCs (20–22). Standard retrograde LCs have proven to be a safe technique, particularly if the principles established by Strasberg before reaching the division of the cystic artery and the cystic duct are followed. However, it is not always possible to obtain an optimal definition of the anatomy.

Therefore, it may be necessary to perform IOCs (23), which in some centers are executed routinely, while the majority of surgeons perform them when urgently needed (24). In any case, during so-called difficult LCs, i.e. acute cholecystitis or chronic sclero-atrophic cholecystitis, visualization of the infundibulum-cystic duct junction is often complicated, and the possibility of forced conversion to safely complete the operation increases significantly.

With the objective of minimizing the incidence of conversions and iatrogenic bile duct injuries, fundus-first LCs represent an evolution of Strasberg's critical approach, taking it a step further with the complete preliminary dissection of the gallbladder from the hepatic bed before dissecting the cystic structures. This allows a precise view of the anatomical structures, in particular a clear visualization of the infundibulum-cystic duct junction in relationship to still-intact structures. In this type of situation, an IOC is unnecessary. However, failure to perform preventive dissection of the cystic artery, as in the fundus-first approach, will result in moderate bleeding in the operating field if a standard dissection is performed with an electrocautery hook or high frequency scissors. This is frequently found when there is an elevated inflammatory reaction in the tissues as occurs in cases of acute cholecystitis. The use of ultrasound dissection technology allows this inconvenient situation to be avoided thanks to a simultaneous division of the tissues and hemostasis. In these cases, there is no blood in the operating field, contributing to the ability to view the anatomical structures and making the Harmonic dissector an indispensable complementary technology when performing anterograde LCs.

Table V. Results and intra-operative complications.

RESULTS*	2005–2007	Reference group
Associated surgeries	12.3% (18) 6 hepatic wedge resections, 2 explorations of the biliary tract, 2 rendezvous, 3 hernioplasties, 1 ovarian cyst removal, 1 right colectomy, 1 left colectomy, 1 gastric banding, 1 lymphadenectomy	17.4% (8) 6 rendezvous, 1 appendectomy, 1 hepatic wedge resection
Conversions	2.7% (4)	6.5% (3)
Surgery time	75 minutes (range: 20–300)	104 minutes (range: 15–265)
Post-operative hospital stay	3.5 days (range: 2–20)	4.7 days (range: 1–21)
Intra-operative cholangiography	3.4% (5)	23.9% (11)
Biliary tract lithiasis	17.1% (25)	17.4% (8)
Rendezvous	1.3% (2)	15.2% (7)
Preoperative ERCP + sphincterotomy	15.8% (23)	2% (1)
Intra-operative biliary complications	0.68% (1) Disconnection of the short cystic duct in gangrenous cholecystitis (minor according to McMahan, type II for Csendes)	2% (1) Small injury above the short cystic stump treated with one absorbable stitch

*Data expressed in percentages or average, total numbers or range in parenthesis.

Our experience reported here on the management of complicated gallbladder diseases allows us to confirm that the adoption of predictive risk scoring methods concerning the possibility of a difficult LC is simple due to its use of routine clinical data. This scoring system has a satisfactory degree of diagnostic accuracy and good sensitivity. The criteria largely overlap with those indicated by Wayand and others (9–16) for the prediction of difficulties and conversion

risks during surgery. These are relatively homogenous and have been adopted during the execution of pre-operative investigations.

Experiences with ultrasound dissection in LC have been reported by others and ourselves in the literature (25–32), as has the fundus-first approach to dissection of the gallbladder (33–36). However, the combination of the two methods has rarely been described (37,38) and defining the indications to manage difficult gallbladder surgeries based on precise perioperative management criteria is not reported in the literature. The fundus-first approach allows one to avoid to the use of IOCs to obtain a clear anatomical view of the biliary tree in most cases. When an IOC is used, it is done exclusively to confirm or exclude the presence of bile duct lithiasis. A reduction in the incidence of conversions is just as important. The results here are also improved in terms of intra- and postoperative complications compared to what has been reported in the literature concerning laparoscopic treatment of acute cholecystitis and sclero-atrophic cholecystitis, where the rates of conversion and complications are 22–44% (for conversion in cases of cholecystitis and empyema) (6,7) and 3% (for biliary complications in cases of sclero-atrophic cholecystitis) (2,3,8).

We are aware of the biases involved in a comparison between a prospective study and a past reference group of patients with complicated gallstones, consecutively treated with LCs with ultrasound dissections. However, with the standard retrograde approach, whose results were analyzed in retrospect,

Table VI. Post-operative complications according to Clavien's classification.

	2005–2007	Reference group
TOTAL COMPLICATIONS*	2.74%	8.7%
MAJOR COMPLICATIONS	1.37%	6.5%
Myocardial infarction	1 (0.68%)	
Blood collection (repeat laparoscopic surgery)	1 (0.68%)	
Myocardial ischemia		1 (2.1%)
Cerebral ischemia		1 (2.1%)
Acute pancreatitis		1 (2.1%)
MINOR COMPLICATIONS	1.37%	4.3%
Serum collection	2 (1.37%)	1 (2.1%)
MORTALITY**	0.68%	0
After emergent LC	1 (0.68%)	

*According to Clavien's classification.

**Not correlated with lesions to the biliary tract (heart attack).

we believe that it is important to highlight the most significant differences.

The incidence of conversion is lower for surgeries performed with the fundus-first approach compared to the retrograde method (2.7% vs. 6.5%). The need to resort to an IOC (still performed when necessary) was seen in 3.4% and 23.9% of the cases, respectively. Post-operative complication rates, none of which were closely related to the surgery, range from 2.7% in the fundus-first LC to 8.7% in the standard approach. In both groups, a minor bile duct injury was quickly repaired either with a mini-laparotomy or laparoscopically, which did not affect the postoperative course. The incidence of bile duct injuries in the group of patients treated with the fundus-first approach and ultrasound dissections appeared to be minimized (0.68%) compared to data found in the literature (2–8).

In conclusion, complicated gallbladder disease necessitates a careful management of the entire treatment process. The use of surgical risk prediction scores and an objective establishment of the degree of difficulty for LCs are the foundations of correct surgical planning. From this perspective the fundus-first approach to LCs, along with ultrasound dissection, has been demonstrated to be a safe method, allowing for the completion of surgery with no problems recognizing biliary anatomy, reducing the need for IOC, and minimizing the risk of conversion and bile duct complications.

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