Int Surg 2011;**96:**35–44

Complications of Videolaparoscopic Cholecystectomy: A Retrospective Analysis of 1037 Consecutive Cases

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The authors describe some of the complications that appear more frequently with laparoscopic cholecystectomy than open cholecystectomy and the mechanisms underlying the occurrence of bile duct injuries, making reference to 0.58% of bile duct injuries in 1037 consecutive laparoscopic cases and the possibility of treatment.

Key words: Laparoscopic cholecystectomy – Gallstones – Intraoperative complications – Conversion – Bleeding – Bile duct injury

More than 20 years have passed since 1987, when the French surgeon Philippe Mouret first presented the technique of videolaparoscopic cholecystectomy (VLC),[1] which subsequently became more widely used as a result of the contributions of Jaques Perissat and Francois Dubois.[2] Videolaparoscopy immediately demonstrated its advantages: its less invasive use of small incisions led to less postoperative pain and a better aesthetic result; the enlarged operative field shown on a high-resolution screen was clearly visible to all of the members of the surgical team (unlike the open technique, which sometimes meant that only some members had an optimal view); it caused fewer postoperative intraperitoneal adherences; and it required a shorter period of hospitalization. However, it also had the disadvantages of the lack of tactile sensation and the third dimension of depth.

The initial learning phase was partially hindered by the fact that the instruments were still being developed, but this problem has since been overcome, and the procedure is now reliable and widely accepted, particularly by younger surgeons who have a more technologically refined mentality and whose hand-eye coordination is more practised in using this type of equipment. Nevertheless, the learning process naturally requires a gradual transition from exercises using special simulators to

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participation as third or second surgeon in order to acquire familiarity with the optics and instruments before undertaking responsibility for the operation under the support and guidance of an expert team (*i.e.*, the learning curve).

Having established that videolaparoscopy is a technique rather than a discipline, it is worth noting that laparoscopic cholecystectomy has become the gold standard treatment of symptomatic gallstones, with the number of complications being inversely proportional to the experience of the operator. Nevertheless, some hospital departments still tend to use the open technique more frequently because of its historical reliability,[3] which is above all associated with the classical figure of a traditional surgeon.

When learning how to perform a VLC, it can be helpful to use a laparascopic risk index[4,5] that incorporates (A) experience, with scores ranging from 1 (*i.e.*, no previous experience to 4 (*i.e.*, optimal experience); (B) instruments, with scores raging from 1 (*i.e.*, mediocre) to 3 (*i.e.*, good or available); and (C) the patient's clinical status, with scores ranging from 1 (*i.e.*, mildly symptomatic) to 5 (*i.e.*, acute cholecystic symptoms 72 hours after onset). If the laparascopic risk index (defined as $A \times B \div C$) is <1.5, a good outcome can be considered unlikely.

As mentioned in the introduction discussion about disadvantages, laparoscopy is characterized by the absence of direct tactile sensations, which makes careful anatomic preparation even more important,[1,6,7] because the area of the gallbladder and the extrahepatic biliary system often presents anatomic anomalies and variants of the biliary pathways and vessels.[8]

There has been a decrease in the occurrence of one of the most feared complications of cholecystectomy (*i.e.*, a lesioned main biliary pathway), but this has not been as great as it was logical to expect: although surgeons are now more experienced, the mean published incidences are still 0.60% to 0.75% in the case of laparoscopy, with variations ranging from 0.2% to 4%[9,10] compared with 0.35% to 0.50% in the case of laparotomy.[11–17] We have also found that biliary pathway lesions are more frequent when using the laparoscopic technique: 6 lesions (0.58% of 1037 patients) versus 1 lesion (0.51% of 198 patients).

In addition to the causes analyzed below in the Discussion section, the increased number of biliary pathway lesions is also due to the broadening of the indications for laparoscopic cholecystectomy[18,19] and its use in complex and complicated cases, which seems to suggest the presence of an intrinsic risk.

As well as the lack of tactile sensation and two-dimensional vision, complications may also be due to technical problems (*e.g.*, thermal insults with direct and indirect damage caused by monopolar energy, which are also dangerous because of the long-term effects of necrosis), equipment defects, and the scissors-like action of the clips.[14,20,21] It is useful remember that clips should be the right size and should not be handled once they have been positioned. Nevertheless, most complications seem to be due to misperception rather than the result of a lack of skill or knowledge or errors in judgement.[4,5,22]

In order to ensure anatomic control, it is essential to identify the elements of Calot's triangle,[23] which is formed by the common hepatic duct on the left, the cystic duct inferiorly, and the inferior surface of the liver superiorly (although the original description referred to the cystic artery as the upper side of the triangle). The cystic artery crosses Calot's triangle in 90% of cases and, typically, arrives there after having passed behind the common and right hepatic duct. There is now also a tendency to refer to a cystohepatic triangle,[6] which is bordered medially by the common and right hepatic ducts, laterally by the cystic duct, and superiorly by the inferior edge of the liver. Many surgeons agree that, especially in the case of inflammation, when the attempt to dissect and identify these elements exceeds 20 to 30 minutes, it is better to switch to the laparotomic approach.[20]

Materials and Methods

We reviewed the data relating to 1037 consecutive patients who underwent VLC during the 17 years from 1993–2009 at 3 General Surgery Units with partially the same and similarly experienced teams in order to ensure that the results were as homogeneous as possible. For a period of 10 years (2000–2009), it was also possible to make a direct comparison between the open and laparoscopic techniques (n = 950 cholecystectomies, of which n = 752 were performed laparoscopically); more recently, the latter has entirely replaced the former. The patients included 66 patients (6.37%) whose gallstones were resolved by means of preoperative endoscopic retrograde cholangiopancreatography (ERCP), often with papillotomy and the endoscopic removal of stones; 379 (36.5%) who underwent laparoscopic cholecystectomy because of acute cholecystitis (36.5%); and 28 (2.7%) who underwent

urgent surgery (*i.e.*, within 24–48 hours of the acute episode).

In addition to the normal blood tests and instrumental examinations preceding general anesthesia, the patients underwent abdominal ultrasonography, with particular attention being given to the gallbladder, the biliary pathways, and the liver; selected cases (*i.e.*, those with suspect formations and/or complex diseases) also underwent nuclear magnetic resonance cholangiography for purposes of verification. Patients with a history of jaundice or pancreatitis underwent preoperative ERCP (with endoscopic papillotomy and lithomomy, if necessary) in collaboration with an endoscopist and on the basis of precise protocol indications (*i.e.*, common bile duct (BD) dilation; the presence of stones in the main biliary pathway; previous jaundice; and alterations in such parameters as bilirubin, liver enzymes, biliary stasis, and pancreatic enzymes). All of the patients received antibiotic prophylaxis with first-generation cephalosporin.

Technically, the operator stands between the patient's legs. After an initial period using a Veress needle, the first supraumbilical trocar is inserted after the creation of the pneumoperitoneum using the open technique (trocar with balloon and/or Hasson's method); the other 3 trocars are inserted under visual guidance.

Intraoperative choledoscopy and cholangiography were used in selected cases, mainly for organizational reasons, although the latter technique permits a complete study of the biliary pathway.[24,25] The number of these procedures tended to decline with the increased use of nuclear magnetic resonance cholangiography, which we believe should be used in the case of any clinical or technologic doubt or suspicion concerning the biliary pathway.

Great care was taken to recover any stones or free clips from the abdomen because of the more theoretical than real possibility that they may cause granulomas or abscesses; in the case of a perforated gallbladder, the bladder was emptied and repeatedly washed with saline solution. With some rare exceptions, the procedure finished with the placement of subhepatic drainage (to be removed after 24 hours if nothing was collected); this has been a routine clinical procedure for some years. In general, and also for reasons of prudence, we prefer to clean up the common BD (CBD) approximately 30 to 40 days before performing a laparoscopic cholecystectomy.

As it is difficult to organize, the endolaparoscopic rendezvous technique was used in only 2 cases of gallstones with the presence of CBD stones and a difficult papilla (0.2% of the patients), and the technique consisted of a simultaneous VLC and ERCP, which was facilitated by inserting a guide wire through the cystic canal until beyond Vater's papilla, and an endoscopic lithotomy and papillosphincterotomy.[39]

Results

Thirty-four (3.28%) of the 1037 laparocholecystectomies led to complications: 6 BD lesions (0.58%), 18 cases of bleeding (1.74%), 5 cases of biliary pooling (0.49%), 2 intestinal lesions (0.20%), 2 trocar site infections (0.20%), and 1 postoperative occlusion (0.10%). Postoperative histology revealed 1 case of adenocarcinoma (0.10%). The gasless technique was used 4 times, the only complication being 1 mild subcutaneous hematoma. There were 14 coversions as a result of problems connected with the videolaparoscopic method (1.35%), which were mainly due to the presence of adherences or bleeding. To avoid the adherences, it was found that access to the right upper quadrant was useful. Six (3.03%) of the 198 open cholecystectomies led to complications: 1 BD lesion (0.51%), 2 intestinal lesions (1.01%), 2 cases of bleeding of the gallbladder bed (1.01%), and 1 case of biliary pooling (0.51%). Five hundred eighteen of all of the laparoscopic and laparotomic cholecystectomies involved female patients, and 717 involved males. The mean age of the 5 female and 2 male patients in whom a lesion of the main biliary pathway occurred was 46.2 years. Figure 1 shows the percentages of laparoscopic and laparotomic cholecystectomies from 2000–2009.

Most of the complications were secondary to the presence of a difficult gallbladder, one possible classification of which is that of Nassar *et al*[58] on the basis of the appearance of the gallbladder, the obviousness of the peduncle, and the presence of inflammatory adherences. In relation to operating difficulty, a gallbladder can be grade I (*i.e.*, soft walls, a free peduncle, lax adherences at the infundibulum), grade II (*i.e.*, mucocele, impacted with stones, abundant fat, simple adherences on the body), grade III (*i.e.*, intrahepatic, acute cholecystitis, retraction, fibrotic Hartmann's pouch, impacted stones, anatomic anomalies, short cystic duct, tenacious adherences at the fundus and the duodenum), grade IV (*i.e.*, empyema, gangrene, suspected cancer, unrecognisable peduncle, fibrous and tenacious adherences involving all of the gallbladder and the duodenum).

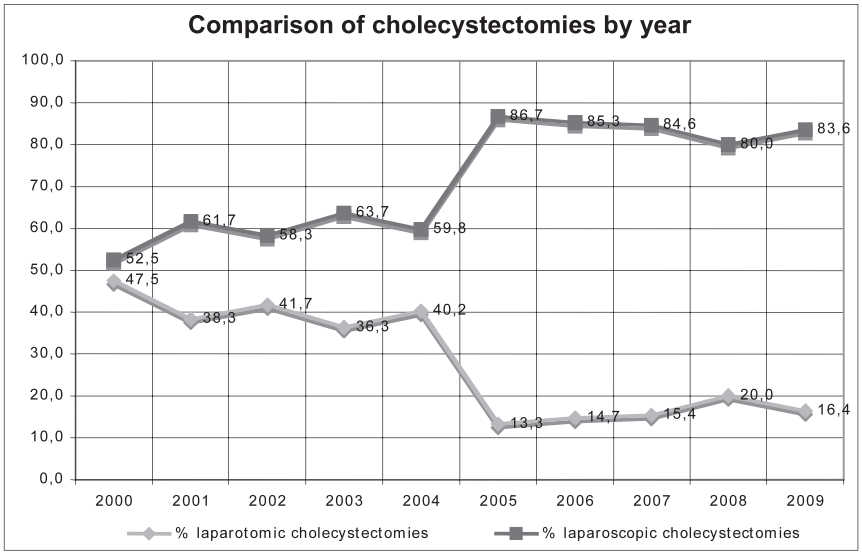

Fig. 1 Percentages of patients undergoing laparoscopic and laparotomic cholecystectomies by year.

Figure 2 shows the number and distribution of complications after laparoscopic cholecystectomy.

There were 14 conversions: 2 as a result of phlegmon and extensive adherences, 7 as a result of tenacious adherences or difficulties in isolating the hilus, 3 as a result of bleeding and an uncleanable operative field (n = 1 case of bleeding of the gallbladder bed and n = 2 of cystic artery bleeding), and 2 as a result of the presence of hepatic cirrhosis.

Two of the 3 intestinal lesions occurred during laparoscopy: in 2 cases (n = 1 during laparotomy and n = 1 during laparoscopy) a jejunal loop was lesioned, of which the first was repaired during the course of the operation and the second required laparotomic resection on the third postoperative day; in the third case, the transversal colon was lesioned during laparoscopy and underwent laparotomic repair on the third postoperative day.

Of the 18 cases of bleeding, 7 involved the gallbladder bed (n = 4 resolved laparoscopically and n = 3, laparotomically), 7 involved the abdominal wall caused by the trocar (n = 4 resolved laparoscopically and n = 3, laparotomically), 2 were *sine materia* (*i.e.*, no bleeding after the distancing of the clots, n = 1 laparoscopy and n = 1 laparotomy), 2 were due to a small lesion of the III hepatic segment caused by the trocar (*i.e.*, hemostasis in

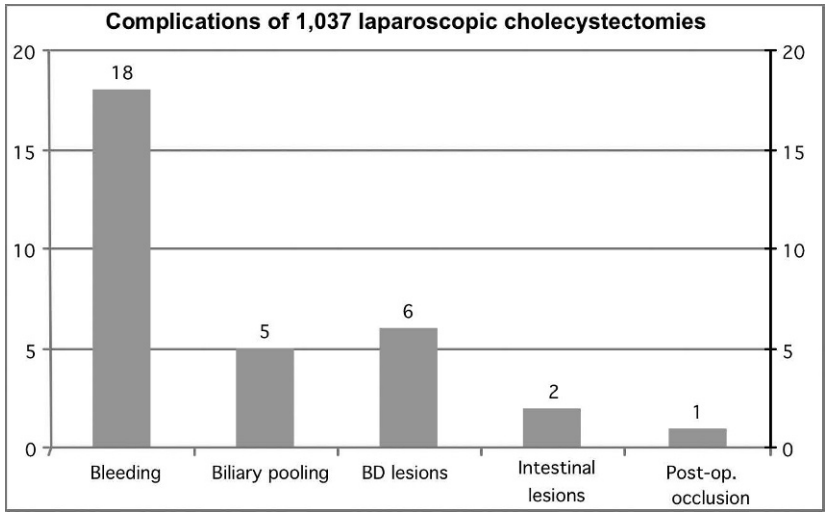

Fig. 2 Complications after laparoscopic cholecystectomy.

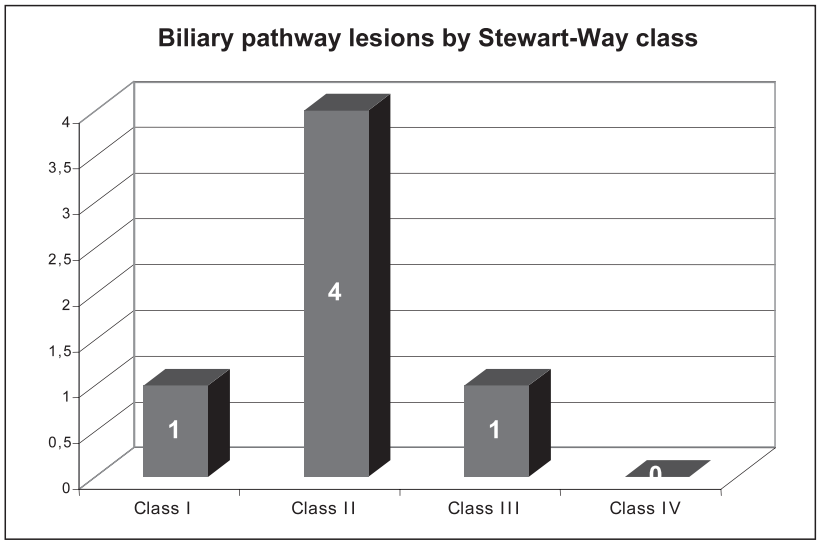

Fig. 3 Biliary pathway lesions in the first 3 of the 4 Stewart-Way classes.

laparotomy), and 1 was due to a hematoma of the right lobe (exploratory laparotomy on the third postoperative day, spontaneous resolution).

There were 5 cases of fistulas and biliary pooling after laparoscopic cholecystectomy; 3 resolved spontaneously, and 2 resolved after ERCP and stent placement. An early reintervention after a laparoscopic cholecystectomy was necessary in 1 case because of a curtain bridle between the omentum and a trocar site.

There were 7 lesions of the main biliary pathway [n = 6 during laparoscopy, (Fig. 3), and n = 1 during laparotomy]: 1, a deep lesion during laparotomic cholecystectomy, was resolved by means of a Roux-en-Y loop hepatico-jejunostomy during the course of the same operation; 1, a lesion of the common hepatic duct during laparoscopy, required laparotomic reconstruction on a Kehr T-tube; another, a lesion of the choledochus during laparoscopy, also required laparotomic reconstruction on a Kehr T-tube and the endoscopic positioning of a stent because of substenosis at the suture site; 1 tangential lesion of the right hepatic duct occurring during laparoscopy required the endoscopic positioning of a stent and the drainage of a subhepatic abscess under ultrasound guidance; a biliary fistula caused by stenosing odditis (after laparocholecystectomy) was treated by means of laparotomy, choledocholithotomy, duodenotomy, papillotomy and transduodenal plastic surgery on the sixth postoperative day; 1 case of Mirizzi syndrome, which started during laparoscopy, required conversion and a Roux-en-Y loop hepatico-jejunostomy because of a lesion of the main biliary pathway; and 1 direct laparotomic reconstruction on a Kehr T-tube was performed on the third postoperative day after a tangential lesion of the biliary pathway during laparoscopic cholecystectomy.

Discussion

As can be seen in the following data, the published frequencies of the different complications vary widely[9,10,12,26–32]: BD lesions, 0.2% to 4%; intraoperative bleeding, 0.47% to 1.9%; postoperative bleeding, 0.08% to 5%; intestinal lesions, 0.1% to 3.9%; trocar site infections, 0.45% to 8%; and conversions, 0.9% to 2.9%. Most of the complications become apparent during the procedure or in the subsequent 48 hours (*e.g.*, biliary losses, bleeding, intestinal lesions). Table 1 summarizes the percentages of complications in our case series.

The vascular complications associated with VLC that are most frequently reported in the literature include cystic artery bleeding, vascular lesions of the hepatic peduncle, bleeding of the hepatic bed of the gallbladder or the hepatic parenchyma, and bleeding of an omental vessel or the vessels of the

Table 1 Percentages of complications

Bleeding	1.74%
Biliary pooling	0.48%
BD lesions	0.58%
Intestinal lesions	0.19%
Postoperative occlusions	0.10%

BD, bile duct.

abdominal wall (caused by a trocar). Some bleedings are not due to any particular structural lesion but are caused by coagulation defects, particularly in patients with cirrhosis or portal hypertension; in the case of such defects, the videolaparoscopic indication must be carefully weighed against the risk.

In the case of bleeding from the cystic artery during the course of VLC, an attempt at hemostasis without conversion can be made, provided that the operative field can be cleaned (also by means of the addition of an additional trocar and the use of gauze, without positioning clips blindly or by using monopolar coagulation); however, in these cases, conversion may be the best solution. Conversion is necessary and must be rapid in the presence of major bleeding.[33]

Bleeding is favored by inadequate anatomic exposure, the presence of an acute inflammatory state, pre-existing liver disease, the extent of adherencies, and the association of coagulopathies. Trocar-induced bleeding (*i.e.*, parietal, visceral, or, rarely, major vascular bleeding) can be minimized by using the open technique to insert the first trocar and by inserting the others under the direct visual guidance of the telecamera.

Postoperative bleeding can be insidious and should, therefore, be frequently monitored by means of clinical checks and hemochrome testing (because silent drainage can be misleading). Bleeding at the trocar insertion site can be minimized by means of careful checking with the optic after the removal of the individual trocars by momentarily occluding the hole with a finger or damp gauze with low-pressure pneumoperitoneum.

Lesions of the main biliary pathway are among the major complications of laparoscopic cholecystectomy because of the difficulty of repair and the impact they have on the patient, who remains psychically and mentally tried regardless of their course.[14,34] Possible sequelae are a long hospital stay, a worse quality of life, greater morbidity, and, occasionally, mortality.[35–37]

Biliary pathway lesions (*i.e.*, BD injuries) can be divided into 4 classes by using the Stewart-Way classification[22,38]: class I: incision (incomplete transection) of the CBD; class II: lateral lesion of the common hepatic duct; class III: transection of the CBD or common hepatic duct; and class IV: lesions of the right hepatic duct or the right hepatic segmentary duct. Biliary lesions can be divided into 5 types according to Strasberg *et al*[21]: type A: biliary losses from a minor duct that maintains continuity with the CBD; types B and C: discontinuities in a part of the biliary tree (often involving an anomalous right hepatic duct; type B are ductal occlusions and type C sections without occlusion); type D: lateral lesions of the main biliary pathway (usually partial lesions); and type E: circumferential lesions of the main biliary pathway.

Another important classification of biliary lesions is that of Bergman *et al*[39]: type A—biliary loss as a result of the dehiscence of the cystic stump or the section of peripheral ducts with an intact BD; type B—biliary loss as a result of laceration of the BD, with or without associated stenoses; type C—BD stenosis without biliary loss; and type D—complete sectioning or excision of a segment of the biliary pathway.

However well the repair is performed, the future onset of cholangitis is possible, also in the form of recurrent episodes that may lead to biliary pathway stenoses or cholestatic liver cirrhosis.[14,40]

If not recognized intraoperatively, biliary pathway lesions are more frequently detected as biliary fistulas than as dilation as a result of complete obstruction (with pain and rapidly deteriorating liver function). Endoscopic retrograde cholangiography is the most important examination for detecting a lesion; percutaneous cholangiography is less frequently needed.

Many authors believe that the complete sectioning of the CBD, which is rare in laparotomy, is the most frequent biliary pathway lesion during laparoscopy and is often related to an erroneous conviction that it is the cystic duct. The main reason for a complete section of the main biliary pathway is a failure to recognize it, so it occurs ''without any doubt or hesitation''[14]; it is important to stress that this type of lesion is often caused by expert surgeons, who may tend to pay less attention as a result of a sort of technical habit.

According to the classification of Clavien,[41] the lesions can also be divided on the basis of their impact on the clinical course: grade I: lengthen the postoperative period but do not require treatment (*e.g.*, suppuration at a trocar insertion site); grade IIA: lengthen the postoperative period and require conservative treatment but do not leave sequelae (*e.g.*, moderate hematic or biliary loss; the use of endoscopy for a papillotomy or the placement of a temporary stent); grade IIB: require a second laparoscopy or a laparotomy but without sequelae (*e.g.*, dehiscence of the cystic duct, a bleeding hepatic bed, tangential BD lesion); grade III: complex lesions; and grade IV: death.

The most frequent cause of an iatrogenic biliary pathway lesion is a failure to recognize the anatomy of the hepatic peduncle (37% of cases),[8] followed by inflammatory alterations of the gallbladder (23%) and anatomic anomalies (13%).[3,42] A failure to identify the CBD can lead to its confusion with the cystic duct, with the subsequent positioning of clips and its sectioning; excessive traction on the gallbladder can lead to the high resection of the common hepatic duct and/or a lesion of the right hepatic artery; the presence of an aberrant right hepatic duct (2% of patients) can become an additional cause of mistaken anatomy.

The picture is complicated by possible pericholecystitis or a scleroatrophied gallbladder (a difficulty in finding a plane of cleavage in the gallbladder bed, modified local anatomy); liver cirrhosis associated with the biliary disease makes hemostasis and cleavage difficult. The presence of Mirizzi syndrome is to be greatly feared.[43]

The severity of the inflammation of the Calot's triangle also needs to be borne in mind, to the point that a scoring system has been created[14] on the basis of the complexity of the local situation: grade I: no inflammation (score 0); grade II: moderate inflammation, with the structures easily identifiable and separable (score 1); grade III: moderate inflammation, with the structures still reasonably clearly identifiable and separable (score 2); grade IV: severe inflammation, in which the structures are difficult to separate but are identifiable (score 3); and grade V: severe inflammation, in which the structures are very difficult to identify and separate, and conversion to open surgery is necessary (score 4).

Various techniques have been proposed as a means of avoiding problems in identifying the cystic duct and main biliary pathway[14,44]: lateral rather than cephalic traction of the infundibulum is preferable[45]; the incision of the ventral and dorsal serous matter of Calot's triangle must be followed by careful observation of the anatomy; a critical view of safety has been proposed,[20,21,46,47] which consists of completely dissecting the fat and fibrous tissue from Calot's triangle and isolating the cystic artery and duct by attacking the gallbladder in the lowest part of its adhesion to the cholecystic bed (a maneuver that is not easy in the presence of inflammatory tissue or a large infundibular stone). The junction between the cystic duct and gallbladder (infundibular technique) must always be precisely identified[21,45] before applying any clips or making any incision; it is better to use a laparoscope with a 30-degree view[45]; in particular cases, it has also been proposed to use a fundus-first technique that foresees the preliminary ultrasonographic dissection of the gallbladder bed before isolating the structures of the peduncle in order to avoid any bleeding caused by a failure to ligate the cystic artery beforehand.[48]

When the anatomy cannot be precisely identified, it is necessary to consider a conversion to laparotomy[26]; some authors suggest the use of laparoscopic echography[49] and intraoperative cholangiography.[50] In expert hands, intraoperative echography[50,51] has proved useful in detecting stones in the main biliary pathway, in recognizing the anatomy, and for dissection in the presence of Mirizzi syndrome; furthermore, unlike intraoperative cholangiography, it has the advantage of not requiring the previous isolation of the cystic duct.[51,52]

Lesion prevention therefore involves recognizing all of the elements of the gallbladder peduncle in Calot's triangle. In addition to the cystic artery and duct, these include the following: cystic arterioles of Calot; the cystic lymph node of Mascagni (near the infundibulum and the entry of the cystic artery into the cystic duct); the possible presence of a right hepatic artery (18%); the possible presence of an aberrant right hepatic artery arising from the superior mesenteric artery and from which the cystic artery originates in 83% of cases; the possible presence of right sectorial or segmentary hepatic ducts which converge in the BD beneath the hilar convergence or which outlet in the cystic duct (the so-called hepaticocystic canals); the possible presence of the right hepatic duct in the case of low extrahilar convergence[3]; or the confluence of the cystic duct in the right hepatic duct (which favors erroneous clipping). In practice, no structure should be clipped or sectioned until it has been surely identified. The use of an electrocauter near already positioned clips should be avoided in order to avoid causing necrotic areas as a result of heat transmission.

In the case of a lesion of the main biliary pathway, there is no doubt that it is important to recognize the lesion itself as soon as possible (and one should always be suspected), to check the anatomy and entity of the lesion, and, if the team is expert in hepatobiliary surgery, to make a primary repair with conversion to laparotomy. After performing intraoperative cholangiography[38] in order to make an anatomic evaluation of the damage, the repair can be direct on a prosthesis or T-tube (*e.g.*, in the case of a tangential lesion without any loss of substance). If this is not the case, a Roux-en-Y loop

hepaticojejunostomy may be necessary within 24 to 48 hours of the lesion occurring, if possible.[42]

Approximately two thirds of the lesions are suspected after VLC: the symptoms are related to the type of lesion and, in particular, include jaundice in the case of complete BD obstruction or a biliary fistula (onsite drainage) or choleperitoneum in the case of the complete or partial sectioning of the BD. The jaundice onsets early, appearing in the first 2 postoperative days, with an increase in the indices of stasis, gamma-glutamil-transjeptidasi (gamma-GT), and alkaline phosphatase.

Ultasonography is very useful in such cases, together with endoscopic retrograde cholangiography. The increase in bilirubin *per se* is not a reason for urgency unless there is the onset of fever,[42] and, if possible, the procedure should programmmed.

If the drainage is well positioned, a biliary fistula is formed in the case of biliary loss; if the drainage has already been removed or is badly positioned, biliary ascites develops, and the patient may be asymptomatic or may complain of vague abdominal pains even days afterward; ultrasonography is a great diagnostic help also in this case.

If the biliary pooling becomes infected, the patient rapidly develops a septic state, and repair is very difficult.[53–55] In this situation, it is better to wash and drain the abdominal cavity (even laparoscopically) in order to be able to study the lesion more clearly and acquire as much information as possible concerning the extent of the damage. If the loss is due to a peripheral duct or the dehiscence of the cystic duct, with an integral biliary pathway, an endoscopic sphinterotomy is often sufficient, with the removal of any stones from the biliary pathway, external drainage, and the positioning of a stent (most useful in the case of small tangential lesions).

The long-term result of the repair of this type of lesion greatly depends on the first decisions taken and the first provisions made[42]; the presence of an expert surgeon, an endoscopist, and a radiologist provides the best guarantee of a good result. In reality, only one third of the lesions are recognized during VLC.[56–58] If the lesion is complex and the operator is not capable of making a difficult repair, it is better to position drains in contact with the biliary loss and send the patient to a center specialized in hepatobiliary surgery.[42]

In conclusion, our experience tends to mirror that of other surgeons but leads us to believe that, even after 20 years, closed cholecystectomy has not yet reached the stage of providing the homogeneous results of traditional laparotomic surgery. Laparoscopy is a technique that could still undergo some technologic instrumental evolution and that requires dedicated progressive training; the aim is to reach an equilibrium between the complications of the 2 methods. The literature and our personal experience leads us to believe that, in the preoperative interview with the patient and in obtaining informed consent, it is correct to specify the real advantages, disadvantages, and risks of the 2 procedures.

Whenever possible, the BD lesions were treated by reconstructing the biliary pathway, with hepaticojejunostomy being reserved for just a few cases. The rationale underlying this choice arises from our conviction that, in the case of a future stenosis, there is still the possibility of intervening and performing a later hepaticojejunostomy, which becomes a relatively simple procedure when the biliary pathway is dilated. The patients who were treated by means of reconstruction, sometimes supported by subsequent endoscopic dilation and the positioning of 1 or 2 stents, have not needed any additional treatment.

References

1. Mouret PH. La cholécystectomie endoscopique a 4 ans. La coelio-chirurgie tient une solide tête de pont. *Lyon Chir* 1991;**8**(87):179–182
2. Dubois F, Icard P, Berthelot G, Levard H. Coeliscopic cholecystectomy. *Press Med* 1989;**18**(19):980–983
3. Corcione F, Miranda L, Ruotolo F. *Chirurgia Laparoscopica: Dall'Anatomia Alla Tecnica Chirurgica Standardizzata*. Naples, Italy: Idelson-Gnocchi, 2008
4. Caputo P, Faccini M, Zuccon W, Bonandrini L. Le complicanze biliari in corso di colecisti videolaparoscopica. *Min Chir* 2001;**56**:85–91
5. Caputo P, Zuccon W, Faccini M, Manelli A, Bonandrini L. Le sepsi addominali iatrogene nella chirurgia delle vie biliary. *Min Chir* 2001;**14**:197–204
6. Ruotolo F, Gallinaro LS, Smulevich E. Anatomia chirurgica della colecisti e delle vie biliari. *Osp Ital Chir* 2008;**14**:277–295
7. Mühe E. Die erste Cholecystektomie durch das Laparoskop Langenbecks. *Arch Klin Chir* 1986;**369**:804
8. Couinaud C. *Le Foie: Etudes Anatomiques et Chirurgicales*. Paris, France: Masson, 1957
9. Dholia KM, Memom AA, Sheikh MS. Laparoscopic cholecystectomy: experience of 100 cases at a teaching hospital of Sindh. *J Liaquat Univ Med Health Sci* 2005;**4**(3):105–108
10. Lim SH, Saleh I, Poh BK. Laparoscopic cholecystectomy: an audit of our training programme. *ANZ J Surg* 2005;**75**(4):231–233
11. Adamsen S, Hansen OH, Funch-Jensen P, Scultz S, Stage JG, Wara P. Bile duct injury during laparoscopic cholecystectomy: a prospective nationwide series. *J Am Coll Surg* 1997;**184**(6):571–578

12. Duca S, Bala O, AL-Hajjar N, Lancu C, Puia IC, Munteanu D *et al*. Laparoscopic cholecystectomy: incidents and complications—a retrospective analysis of 9542 consecutive laparoscopic operations. *HPB (Oxford)* 2003;**5**(3):152–158
13. Hugh TB. New strategies to prevent laparoscopic bile duct injury: surgeons can learn from pilots. *Surgery* 2002;**132**(5): 826–835
14. Misawa T, Saito R, Shiba H, Son K, Futagawa Y, Nojiri T *et al*. Analysis of bile duct injuries (Stewart-Way classification) during laparoscopic cholecystectomy. *J Hepatobiliary Pancreat Surg* 2006;**13**(5):427–434
15. Neugebauer S, Sauerland S, Troidl H. *Recommendations for Evidence-Based Endoscopic Surgery: The Updated EAES Consensus Development Conferences*. Paris, France; Springer, 2000:39–46
16. Richardson MC, Bell G, Fullarton GM. Incidence and nature of bile duct injuries following laparoscopic cholecystectomy: an audit of 5913 cases—West of Scotland Laparoscopic Cholecystectomy Audit Group. *Br J Surg* 1996;**83**(10): 1356–1360
17. Uragami A, Matsumoto H, Yamashita J, Hirai T, Tsunoda T. Results of questionnaire surveys at several affiliated institutions regarding intraoperative biliary tract injuries. *Tando, J Jpn Biliary Assoc* 2005;**19**:299
18. Legorreta AP, Silber JH, Costantono GN, Kobylinslki RW, Zatz SL. Increased cholecystectomy rate after the introduction of laparoscopic cholecystectomy. *JAMA* 1993;**270**(12):1492–1432
19. Orlando R, Russel JC, Lynch J, Mattie A. Laparoscopic cholecystectomy: a statewide experience—the Connecticut Laparoscopic Cholecystectomy Registry. *Arch Surg* 1993; **128**:494–499
20. Callery MP. Avoiding biliary injury during laparoscopic cholecystectomy: technical considerations. *Surg Endosc* 2006;**1654**:1658
21. Strasberg SM, Hertl M, Soper NJ. An analysis of 1518 laparoscopic cholecystectomies. *J Am Coll Surg* 1995;**180**(1): 101–125
22. Way LW, Stewart L. Causes and prevention of laparoscopic bile duct injuries: analysis of 252 cases from a human factors and cognitive psychology perspective. *Ann Surg* 2003;**237** (4):460–469
23. Calot JF. De la cholécystectomie. *Doctoral Thesis* 1890; **25**(ISSUE):50
24. Sartori CA, Balduino M. Indicazioni e tecnica della colangiografia intra-operatoria nella video-laparo-colecistectomia [in Italian]. *Osp Ital Chir* 2008;**14**:346–350
25. Traverso LW. Intraoperative cholangiography lowers the risk of bile duct injury during cholecystectomy. *Surg Endosc* 2006;**20**(11):1659–1661
26. Deziel DJ, Millikan KW, Economou SG, Doolas A, Ko ST, Airan MC. Complications of laparoscopic cholecystectomy: a national survey of 4292 hospitals and an analysis of 77,604 cases. *Am J Surg* 1993;**165**:9–14
27. Jatzko G, Lisborg PH, Petri AM. Multivariate comparison of complications after laparoscopic cholecystectomy and open cholecystectomy. *Am Surg* 1995;**221**(4):381–386
28. Memon W, Hanzada TW, Samad A, Laghari MH. Complications of laparoscopic cholecystectomy at Isra University Hospital, Hyderabad. *Pak J Med Sci* 2009;**25**(1):69–73
29. Shea JA, Healey MJ, Berlin JA, Clarke JR, Malet PF, Staroscik RN *et al*. Mortality and complications associated with laparoscopic cholecystectomy: a meta-analysis. *Ann Surg* 1996; **224**(5):609–620
30. Tan JT, Suyapto DR, Neo EL, Leong PS. Prospective audit of laparoscopic cholecystectomy at a secondary referral center in South Australia. *ANZ J Surg* 2006;**76**(5):335–338
31. Vecchio R, Macfadyen BV, Latteri S. Laparoscopic cholecystectomy: analysis of 114,005 cases of United States series. *Int Surg* 1998;**83**(3):215–219
32. Waseem M, Khanzada TW, Samad A, Laghart MH. Complications of laparoscopic cholecystectomy at Isra University Hospital, Hyderabad. *Pak J Med Sci* 2009;**25**(1):69–73
33. Piccoli M, Merolla E, Marchi D, Gentile IG, Mullineris B, Linginotti E *et al*. Complicanze vascolari della video-laparocolecistectomia. *Osp Ital Chir* 2008;**14**:439–445
34. Melton GB, Lillemore KD, Cameron JL, Sauter PA, Coleman J, Yeo CJ. Major bile duct injuries associated with laparoscopic cholecystectomy: effect of surgical repair on quality of life. *Ann Surg* 2002;**235**:888–895
35. Asbun HJ, Rossi RI, Lowell JA, Munson JI. Bile duct injury during laparoscopic cholecystectomy: mechanism of injury, prevention and management. *World J Surg* 1993;**17**(4): 546–552
36. Boerma D, Rauws EA, Kenlemans YC, Bergman JJ, Obertop H, Huibregtse K *et al*. Impaired quality of life 5 years after bile duct injury during laparoscopic cholecystectomy: a prospective analysis. *Ann Surg* 2001;**234**(6):750–757
37. Gates JA, Tompkins RK, Zinner MJ, Busuttil RW, Kallman C, Roslyn JJ. Biliary complications of laparoscopic cholecystectomy. *Am Surg* 1993;**59**:243–247
38. Stewart L, Way LW. Bile duct injuries during laparoscopic cholecystectomy: factors that influence the results of treatment. *Arch Surg* 1995;**130**(10):1123–1128
39. Bergman JJ, Van der Mey S, Rauws EA, Tijssen JG, Gouma DJ, Tytgat GN *et al*. Long-term follow-up after endoscopic sphincterotomy for bile duct stones in patients younger than 60 years of age. *Gastrointest Endosc* 1996;**44**(6):643–649
40. Laasch HU, Martin DF. Management of benign biliary strictures. *Cardiovasc Intervent Radiol* 2002;**25**(6):457–466
41. Clavien PA, Sanabria JR, Strasberg SM. Proposed classification of complications of surgery with examples of utility in cholecystectomy. *Surgery* 1992;**111**(5):518–526
42. Nuzzo G. Le lesioni iatrogene della via biliare principale. *Collana Monografica SIC* 2002; monograph
43. Mirizzi PL. Syndrome del conducto hepatico. *J Int de Chir* 1948;**8**:731–777

44. Woods MS. Bile duct injuries during laparoscopic cholecystectomy. *Surg Endosc* 1998;**12**(10):1280
45. Hunter JG. Avoidance of bile duct injury during laparoscopic cholecystectomy. *Am J Surg* 1991;**162**(1):71–76
46. Avgerinos C, Kelgiorgi D, Touloumis L, Baltatzi L, Dervenis C. One thousand laparoscopic cholecystectomies in a single surgical unit using the ''critical view of safety'' technique. *J Gastrointest Surg* 2009;**13**(3):498–503
47. Vracko J, Hunt MY, Wiechel KL. Safe laparoscopic cholecystectomy. *Surg Endosc* 2005;**19**(12):1666
48. Lirici MM, Califano A. Il management delle colecisti complicate [in Italian]. *Osp Ital Chir* 2008;**14**:400–409
49. Biffl WL, Moore EE, Offner PJ, Franciose RJ, Burch JM. Routine intraoperative laparoscopic ultrasonography with selective cholangiography reduces bile duct complications during laparoscopic cholecystectomy. *J Am Coll Surg* 2001;**193**(3):272–280
50. Kimura T, Suzuki K, Umehara Y, Kawabe A, Wada H. Features and management of bile duct leaks after laparoscopic cholecystectomy. *J Hepatobiliary Pancreat Surg* 2005;**12**(1):61–64
51. Kelly SB, Remedios D, Lau WY, Li AKC. Laparoscopic ultrasonography during laparoscopic cholecystectomy. *Surg Endosc* 1997;**11**(1):67–70
52. Siperstein A, Peral J, Macho J, Hansen P, Gitomirsky A, Rogers S. Comparison of laparoscopic ultrasonography and fluorocholangiography in 300 patients undergoing laparoscopic cholecystectmy. *Surg Endosc* 1999;**13**(8):113–117
53. Bismuth H, Majno PE. Biliary strictures: classification based on the principles of surgical treatment. *World J Surg* 2001; **25**(10):1241–1244
54. Lillemoe KD. Current management of bile duct injury. *Br J Surg* 2008;**95**(4):403–405
55. Schmidt SC, Settmacher U, Langrehr JM, Neuhaus P. Management and outcome of patients with combined bile duct and hepatic arterial injuries after laparoscopic cholecystectomy. *Surgery* 2004;**135**(6):613–618
56. Conzo G, Amato G, Angrisani L, Bardi U, Belli G, Brancaccio U *et al*. Hepaticojejunostomy in the treatment of iatrogenic biliary lesions following laparoscopic cholecystectomy: a retrospective study on 51 cases. *Hepatogastroenterology* 2007; **54**(80):2328–2332
57. Goykhman Y, Kory I, Small R, Kessler A, Klausner JM, Nakache R *et al*. Long-term outcome and risk factors of failure after bile duct injury repair. *J Gastrointest Surg* 2008;**12** (8):1412–1417
58. Nassar AHM, Ashkar KA, Mohamed AY, Hafiz AA. Is laparoscopic cholecystectomy possible without video technology? *Min Invas Ther* 1995;**4**(2):63–65