

Biliary tract injuries during laparoscopic cholecystectomy: three case reports and literature review

D. PARMEGGIANI, G. CIMMINO², D. CERBONE¹, N. AVENIA³, R. RUGGERO, A. GUBITOSI, G. DOCIMO, S. MORDENTE, C. MISSO³, U. PARMEGGIANI

SUMMARY: Biliary tract injuries during laparoscopic cholecystectomy: three case reports and literature review.

D. PARMEGGIANI, G. CIMMINO, D. CERBONE, N. AVENIA, R. RUGGERO, A. GUBITOSI, G. DOCIMO, S. MORDENTE, C. MISSO, U. PARMEGGIANI

Introduction. Biliary tract injuries (BTI) represent the most serious and potentially life-threatening complication of cholecystectomy. During open cholecystectomies (OC), the prevalence of bile duct injuries has been estimated at only 0.1-0.2%. We report 3 cases of BTI during laparoscopic cholecystectomy (LC).

Case 1. Ascalesi Hospital, Naples 2003-2007, 875 LC (BTI 0,11%). During the dissection of triangle of Calot a partial resection of biliary common duct was made. Immediately the lesion was evident and sheltered in laparoscopy, suturing with a spin reabsorbable, without biliar drainage. The post-operative outcome was good, without alteration of the some parameters, and the patient was discharged after three days. At the last follow-up (January 2006) the cholangiography didn't show stricture or leakage.

Case 2. General and Laparoscopic Surgical Unit San Giovanni di Dio Hospital Frattamaggiore 2004-2007, 720 LC (BTI 0,13%). Patient affected by cholecystitis with gallstones. The patient did not present jaundice, but abdominal pain, leucocytosis, fever and US evidence of parietal gallbladder inflammation. LC was performed after 36 h; during operation, common biliar duct was misidentified for subverted anatomy caused by inflammation. The common bile duct was clipped, and the patient presented jaundice after three days after operation. The colangiography was performed showing the stop. Therefore a reoperation was needed and laparotomic Roux-en-Y hepaticojejunostomy was performed.

Case 3. Dpt of Emergency Surgery, Second University of Naples 2000-2007, LC 520 (BTI 0,19%). Patient affected by more than 20 years symptomatic cholelithiasis, with only obesity risk factor; she underwent laparoscopic cholecystectomy and sudden bleeding of the cystic artery, poor vision and probably the long history of symptoms, producing a flogistic alteration of the anatomy, caused a misidentification of the cystic duct and the common bile duct with complete or lateral clipping of the common hepatic duct. The error was unrecognized intraoperatively but after progressive jaundice the postoperative colangiography showed a nearly complete stop by two clips. Roux-en-Y hepaticojejunostomy with intraoperative cholangiographic control was performed.

RIASSUNTO: Lesioni della via biliare principale in corso di colecistectomia laparoscopica: descrizione di 3 casi e revisione della letteratura.

D. PARMEGGIANI, G. CIMMINO, D. CERBONE, N. AVENIA, R. RUGGERO, A. GUBITOSI, G. DOCIMO, S. MORDENTE, C. MISSO, U. PARMEGGIANI

Introduzione. Le lesioni della Via Biliare Principale (VBP) rappresentano la più seria e grave complicanza della colecistectomia. In corso di colecistectomia aperta l'incidenza di tale complicanza è stimata solo allo 0,1-0,2%. Riportiamo 3 casi di lesione della VBP in corso di Colecistectomia Laparoscopica (CL).

Caso 1. Ospedale Ascalesi, Napoli 2003-2007, 875 CL (lesioni VBP 0,11%). Durante la dissezione del triangolo di Calot, si reseca parzialmente il dotto biliare comune. Tale lesione veniva immediatamente riconosciuta e riparata senza convertire con una sutura riassorbibile e senza drenaggio biliare. Il decorso postoperatorio era buono, senza alterazioni bioumorali, e il paziente veniva dimesso dopo 3 giorni. Al follow up la colangiografia non mostrava stenosi o perdite.

Caso 2. Ospedale San Giovanni di Dio, Frattamaggiore 2004-2007, 720 CL (lesioni VBP 0,13%). Paziente affetta da colecistite litiasica, senza ittero, ma con dolore addominale, leucocitosi, febbre ed evidenza ecografica di flogosi parietale. CL veniva eseguita dopo 36 ore e durante l'intervento la VBP non veniva riconosciuta per una anatomia sovvertita dalla flogosi. Il coledoco veniva clippato e la paziente presentava un ittero marcato in III giornata. La colangiografia dimostrava quindi lo stop e la paziente veniva rioperata con epatico-digiunostomia su ansa a Y secondo Roux.

Caso 3. Dipartimento di Scienze Anestesiologiche, Chirurgiche e dell'Emergenza della Seconda Università di Napoli 2000-2007, 520 CL (lesioni VBP 0,19%). Paziente affetta da oltre 20 anni da colecistopatia litiasica sintomatica con solo obesità moderata come fattore di rischio; in corso di CL un improvviso sanguinamento dell'arteria cistica, la cattiva visione e probabilmente la lunga storia anamnestica, con le relative alterazioni flogistiche dell'anatomia, portavano a un mancato riconoscimento della VBP che veniva clippata. L'errore non veniva riconosciuto intraoperatoriamente, ma nel postoperatorio per l'ingravescente ittero; la colangiografia evidenziava lo stop e rendeva necessaria l'epatico-digiunostomia su ansa a Y secondo Roux.

Discussione. La più comune causa di lesione della VBP è il mancato riconoscimento anatomico del triangolo di Calot. Questo viene attribuito a fattori inerenti l'approccio laparoscopico, a un "training" inadeguato del chirurgo ed a fattori di rischio, legati ad alterazioni anatomiche. La "learning curve" laparoscopica del chirurgo è il fattore più importante nelle lesioni della VBP. Altri fattori di rischio sono la concomitante presenza di colecistite, aderenze infiammatorie, sanguinamenti e una eccessiva adiposità dell'ilo epatico. Questi fattori di rischio locali sembrano essere presenti nel 15-35% delle lesioni della VBP. Una

Second University of Naples, Dpt. of Emergency Surgery

¹ Ascalesi Hospital, Naples

² General and Laparoscopic Surgical Unit, San Giovanni di Dio Hospital Frattamaggiore, Naples

³ Unit of Endocrinological Surgery, University Hospital of Terni

© Copyright 2010, CIC Edizioni Internazionali, Roma

Discussion. *The most common cause of BTI is the failure to recognize the anatomy of the triangle of Calot. This is attributed to factors inherent to the laparoscopic approach, to inadequate training of the surgeon and to local anatomical risk factors. The laparoscopic "learning curve" of the surgeon is the most important factor of bile ducts injury. But also local anatomical risk factors are important such as acute cholecystitis, severe chronic scarring of the gallbladder and bleeding or excessive fat in the hepatic hilum. These local risk factors seem to be present in 15% to 35% of BTI. Abnormal biliary anatomy, such as a short cystic duct or a cystic duct entering into the right hepatic duct also may increase the incidence of BTI. Schematic representation of the common mechanisms of BTI during LC are: misidentification of the cystic duct and the common biliary duct, lateral clipping of the common biliary duct, traumatic avulsion the cystic duct junction, diathermic injury of common biliary duct during dissection of the Calot triangle or during the cholecystectomy, injury of anomalous right hepatic duct.*

Conclusion. *Conversion to laparotomy, in difficult cases involving inflammatory changes, aberrant anatomy or excessive bleeding, is not to be considered as a failure but rather as good surgical decision in order to ensure the patient's safety.*

KEY WORDS: Biliary tract injuries - Laparoscopic cholecystectomy.
Lesioni della via biliare principale - Colecistectomia laparoscopica.

Introduction

Biliary tract injuries (BTI) represents the most serious and potentially life-threatening complication of cholecystectomy. Since the introduction of laparoscopic cholecystectomy (LC) in 1987 by Philippe Mouret in France, an increase in these iatrogenic injuries has been observed worldwide. During open cholecystectomies (OC), the prevalence of bile duct injuries has been estimated at only 0.1-0.2% (Tab. 1).

The risk factors during OC include:

- surgeon's learning curve;
- acute or scleroatrophic cholecystitis;
- misidentified anatomy;
- misinterpreted or incomplete cholangiography;
- anatomical abnormalities and excessive bleeding.

Biliary anatomical variations are encountered in 18-39% of cases, with potentially hazardous anomalies predisposing to BTI in only 3-6%. Anomalous right hepatic ducts are considered the most dangerous type of ano-

alterata anatomia biliare, come un dotto cistico corto o un dotto cistico confluyente nel dotto epatico destro, sembra essere relativamente frequente e influenza l'incidenza di lesioni della VBP. I principali meccanismi responsabili di lesioni della VBP in corso di CL sono: mancato riconoscimento del dotto cistico e del dotto epatico comune, "clipping" laterale della VBP, avulsione traumatica del cistico dalla VBP, lesione termica della VBP durante dissezione del triangolo di Calot o lesione di un dotto epatico destro anomalo.

Conclusion. *La conversione laparotomica, nei casi resi difficili da importanti fenomeni flogistici, alterazioni anatomiche, eccessivo sanguinamento, non deve essere considerata un fallimento, ma piuttosto una buona scelta chirurgica per il paziente.*

maly (3). The injuries occurring during OC include partial or complete transection or wide resection. The bile duct reconstruction expose to the risk of stricture, that need delicate surgical approach.

The introduction of LC is associated with a significantly increased risk of BTI. In an American state-wide survey of Connecticut, which included 30211 patients, the incidence of BTI increased from 0.04% in 1989 to 0.24% in 1991, corresponding to the introduction of LC, but then decreased to 0.11% in 1993 (4).

We described three cases of BTI post-LC, repaired one in laparoscopy in one time, and two repaired later in laparotomy.

Case reports

Case 1 (Ascalesi Hospital, Naples) 2003-2007, LC 875 (BTI 0,11%).

In the April 2005 we observed M.C., 45 years old, man, body mass index (b.m.i.) 32, affected by symptomatic cholelithiasis. The patient had not jaundice or risk factor and therefore is admitted for a laparoscopic cholecystectomy. During the dissection of triangle of Calot a partial resection of biliary common duct was made. Immediately the lesion was evident and sheltered in laparoscopy, sutured with a reabsorbable thread, without biliar drainage. The post-operative outcome was good, without alteration of the parameters; the patient was discharged after three days. At the last follow-up (January 2006) the cholangiography didn't show stricture or leakage.

Case 2 (General and Laparoscopic Surgical Unit, San Giovanni di Dio Hospital, Frattamaggiore) 2004-2007, LC 720 (BTI 0,13%).

In the June 2005 C.V., 52 years, female, b.m.i. 38, was admitted in our Unit, affected by cholecystitis with gallstones. The patient did not present jaundice, but abdominal pain, leucocytosis, fever and US evidence of parietal gallbladder inflammation. LC was performed after 36 hours. During surgery, common biliary duct was

TABLE 1 - INCIDENCE OF BTI DURING OC (1,2).

Author	Year	Country	Number OCs	Patients with BTI (%)
Rosenquist	1960	Sweden	21530	43 (0.20%)
Bismuth	1981	France	53637	84 (0.16%)
Sandberg	1985	Sweden	92856	65 (0.07%)
Clavien	1992	USA/Switzerland	1088	0 (0%)
Roslyn	1993	USA	42474	91 (0.2%)
Gouma	1994	Netherlands	8780	45 (0.5%)

misidentified, for subverted anatomy caused by the flogosis, and was clipped; the patient presented jaundice at 3th day after operation. The colangiography showed the stop. At the reoperation a laparotomic Roux-en-Y hepaticojejunostomy was performed. The patient was discharged in eleventh days, with a Kehr drainage. After 40 days the drainage was removed and last follow-up (December 2005) evidenced the normality of hematic parameters, and a good clinical condition.

Case 3 Dpt Emergency Surgery, Second University of Naples 2000-2007, LC 520 (BTI 0,19%).

In May 2000 C.M., 56 years old, female, b.m.i. 37, admitted in our Unit, affected for more than 20 years by symptomatic cholelithiasis, with only obesity like risk factor, underwent laparoscopic cholecystectomy. The sudden bleeding of the cystic artery, poor vision and probably the long history of symptoms producing a flogistic alteration of the anatomy, caused a misidentification of the cystic duct and the common hepatic duct with complete or lateral clipping of the common hepatic duct. The error was unrecognized intra-operatively, but for postoperative progressive jaundice the colangiography showed an almost complete stop by two clips. A laparotomic Roux-en-Y hepaticojejunostomy under intraoperative cholangiographic control was performed. The patient was dismissed after seven days, with a Kehr drainage. After 30 days the drainage was removed and last follow-up (december 2003) didn't evidence any problem.

Discussion

The most common cause of BTI is the failure to recognize the anatomy of the triangle of Calot. This is attributed to factors inherent to the laparoscopic approach, to inadequate training of the surgeon and to local anatomical risk factors. Inherent risk factors of the laparoscopic approach are:

- limitation of two-dimensional vision;
- absence of manual palpation of the porta-hepatis;
- use of a tangential and inferior approach to the common bile duct;
- poor vision during significant bleeding.

The laparoscopic "learning curve" of the surgeon is the most important factor of bile duct injury. But also local anatomical risk factors are important such as acute cholecystitis, severe chronic scarring of the gallbladder and bleeding or excessive fat in the hepatic hilum. These local risk factors seem to be present in 15% to 35% of BTI (5). Abnormal biliary anatomy, such as a short cystic duct or a cystic duct entering into the right hepatic duct may increase the incidence of BTIs (6).

Some Authors have also stressed the importance of a right hepatic arterial anomaly running parallel to the cystic duct such as an anomalous or accessory right hepatic artery (7). Schematic representation of the common mechanisms of BTI during LC are:

- A - misidentification of the cystic duct and the common hepatic duct;
- B - lateral clipping of the common hepatic duct;
- C - traumatic avulsion of the cystic duct junction;
- D - diathermic injury of common hepatic duct during

dissection of the "Calot" triangle or during the cholecystectomy;

E - injury of anomalous right hepatic duct.

Some authors are trying to score the clinical management of LC with a Surgical Complexity Classification Index (SCCI) (8).

The role of intraoperative cholangiography (IOC) in the prevention of BTI remains controversial (9, 10). The greatest value of IOC is in the display of the biliary anatomy, and showing the severity of BTI.

Very interesting looks the role of magnetic resonance cholangiopancreatography, during the preoperative phase of risk patients (11, 12); the routine use of laparoscopic ultrasound seems to decrease BTI (13).

In every case we suggest a small drain after cholecystectomy, possibly removed the next day, it can represent an useful device in biloma management from bile accessory duct injuries (14).

In our first case the evidence of lesion and the partial damage permitted the reparation in laparoscopy with a simple suture, without complications. In the second and third cases, the evidence of lesion was late, with the appearance of post-operative jaundice. The vision of VHS registration allowed to evidence the injury, the intraoperative cholangiography confirmed the complete or partial clipping of common hepatic duct.

The most frequent procedure used for biliary repair is Roux-en-Y hepaticojejunostomy. Attention has been paid to a mucosa-to-mucosa hepato-enteric anastomosis to prevent recurrent bile duct stricture. End-to-end choledocho-choledochostomy, usually over a T-tube, is another surgical alternative provided that a microsurgical anastomosis on healthy biliary tissue is possible, wide bile duct excision isn't present and any tension on the anastomosis is evident.

The optimal conditions for bile duct reconstruction of BTI are absence of local inflammation and presence of proximal bile duct dilatation with the possibility of performe the anastomosis on a healthy biliary mucosa.

Conclusion

The debate continues, but the mentioned studies support the routine use of IOC for early detection and correction of LC-induced BTI. It may be especially important to turn to during the surgeon's learning curve when the risk is known to be major. A meticulous operative technique in observance of strict guidelines is very important in preventing BTI. The most important principle is adequate exposure of the operative field. This requires that the porta hepatis is put under tension by both upward, manual liver retraction and downward, passive retraction by the reverse Trendelenburg position. Optimal visualization of the portal structures is also essen-

tial. A frontal view of the porta hepatis should be achieved with the liberal use of a 30° angle laparoscope. Exposure of the triangle of Calot is critical for proper identification of the vital structures. Expert surgeon have stressed the importance of a lateral traction on the gallbladder infundibulum in order to open Calot's triangle. This places the cystic duct at a right angle to the common bile duct, thereby reducing the likelihood of misidentification.

Clear visualization of both the cystic duct and the choledochus should be obtained during clip placement and transection of the cystic duct. Overuse of electrocautery must be avoided during the dissection of Calot's triangle. IOC should be performed after complete dissection of all ductal structures in the triangle of Calot and before any division and finally, the dissection should be carried out close to the gallbladder during its removal from the liver bed. Another important principle is a low threshold for conversion to OC, especially when the anatomy remains unclear during the surgical dissection. Conversion to laparotomy, in difficult cases involving inflammatory changes, aberrant anatomy, or excessive bleeding, is not to be considered as a failure but rather as a good surgical judgement in order to ensure the patient's safety.

In case of intraoperative suspicion of BTI, a cholangiography must be performed immediately to identify the lesion. The recommended surgical strategy depends greatly on the experience of the surgeon. While all surgeons agree that injuries recognized during the operation are best treated immediately, there is no consensus on the management of injuries recognized after operation. Many still attempt endoscopic stenting or early surgical repair in the post-laparoscopic inflammatory stage, despite the well established fact that delayed primary repair gives the best results. In the case of delayed diagnosis, preoperative imaging is obtained by percutaneous transhepatic cholangiography and endoscopic retrograde cholangiopancreatography. A precise diagnosis is crucial and all intrahepatic ducts must be visualized. The optimal timing to do biliary repair has not been clearly established. However, in certain patients with a more distal BTI and a well-vascularized and non-inflamed bile duct, repair without dissection of the hilar plate may be feasible. In patients presenting with an established stenosis following a previous surgical repair several months earlier, percutaneous dilatation may be indicated. Finally, percutaneous dilatation of long-term strictures (ductal-to-ductal or hepato-enteric) may also be effective.

References

1. Bismuth H, Lazorthes F. 83rd Congress of the French Surgical Society (Paris, 21-24 September Oct;118(10):601-9.
2. Roslyn JJ, Binns GS, Hughes EF, Saunders-Kirkwood K, Zinner MJ, Cates JA. Open cholecystectomy. A contemporary analysis of 42,474 patients. *Ann Surg* 1993; 218(2):129-37.
3. De Filippo M, Calabrese M, Quinto S, Rastelli A, Bertellini A, Martora R, Sverzellati N, Corradi D, Vitale M, Crialesi G, Sali L, Roncoroni L, Garlaschi G, Zompatori M. Congenital anomalies and variations of the bile and pancreatic ducts: magnetic resonance cholangiopancreatography findings, epidemiology and clinical significance. *Radiol Med (Torino)*. 2008;30 [Epub ahead of print].
4. Russell JC, Walsh SJ, Mattie AS, Lynch JT. Bile duct injuries, 1989-1993. A statewide experience. Connecticut laparoscopic cholecystectomy registry. *Arch Surg* 1996;131(4):382-8.
5. Kholdebarin R, Boetto J, Harnish JL, Urbach DR. Risk factors for bile duct injury during laparoscopic cholecystectomy: a case-control study. *Surg Innov* 2008 Jun;15(2):114-9. Epub 2008; 29.
6. Wu YH, Liu ZS, Mrikhi R, Ai ZL, Sun Q, Bangoura G, Qian Q, Jiang CQ. Anatomical variations of the cystic duct: two case reports. *World J Gastroenterol* 2008; 7;14(1):155-7.
7. Idu M, Jakimowicz J, Iuppa A, Cuschieri A. Hepatobiliary anatomy in patients with transposition of the gallbladder: implications for safe laparoscopic cholecystectomy. *Br J Surg*. 1996 Oct;83(10):1442-3. Comment in *Br J Surg* 1997 ;84(3):427.
8. Planells Roig M, Cervera Delgado M, Bueno Lledó J, Sanahuja Santaf A, Garcia Espinosa R, Carbó Lopez J. Surgical Complexity Classification Index (SCCI): a new patient classification system for clinical management of laparoscopic cholecystectomy. *Cir Esp* 2008;84(1):37-43.
9. Nickkholgh A, Soltaniyekta S, Kalbasi H. Routine versus selective intraoperative cholangiography during laparoscopic cholecystectomy: a survey of 2,130 patients undergoing laparoscopic cholecystectomy. *Surg Endosc*. 2006 Jun;20(6):868-74. Epub 2006 May 12. Comment in *Nat Clin Pract Gastroenterol Hepatol* 2007;4(1):16-7.
10. Rosen MJ, Ponsky JL. Should intraoperative cholangiography be routinely attempted during laparoscopic cholecystectomy? *Nat Clin Pract Gastroenterol Hepatol*. 2007 Jan;4(1):16-7. Comment on *Surg Endosc* 2006;20(6):868-74.
11. Yamamoto S, Sakuma A, Rokkaku K, Nemoto T, Kubota K. Anomalous connection of the right hepatic duct into the cystic duct: utility of magnetic resonance cholangiopancreatography. *Hepato-gastroenterology* 2003;50(51):643-4.
12. Sperlano P, Pisaniello D, Del Viscovo L, De Falco M, Parmeggiani D, Piatto A, Parmeggiani U. Efficacy of magnetic resonance cholangiopancreatography in detecting common bile duct lithiasis: our experience. *Chir Ital* 2005;57(5):635-40.
13. Machi J, Johnson JO, Deziel DJ, Soper NJ, Berber E, Siperstein A, Hata M, Patel A, Singh K, Arregui ME. The routine use of laparoscopic ultrasound decreases bile duct injury: a multicenter study. *Surg Endosc* 2008;5 [Epub ahead of print].
14. Sperlano P, Pisaniello D, Parmeggiani D, Piatto A, Avenia N, d'Ajello M, Monacelli M, Calzolari F, Lucchini R, Parmeggiani U. Bile leakage after laparoscopic cholecystectomy: report of three cases in our experience. *G Chir* 2005;26(6-7):251-5.