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DOI: 10.17235/reed.2019.6245/2019
Link: PubMed (Epub ahead of print)

Please cite this article as:
Garcés Albir Marina, Martí Fernández Rosa, Martínez Fernández Guillermo, Muñoz Forner Elena, Dorcaratto Dimitri, Martín Arévalo José, Sabater Luis, Ortega Joaquín. The role of endoscopic retrograde cholangiopancreatography in the management of iatrogenic bile duct injury after cholecystectomy. Rev Esp Enferm Dig 2019. doi: 10.17235/reed.2019.6245/2019.

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OR 6245 inglés

The role of endoscopic retrograde cholangiopancreatography in the management of iatrogenic bile duct injury after cholecystectomy

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Received: 28/02/2019

Accepted: 15/03/2019

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ABSTRACT

Introduction: Iatrogenic bile duct injury (IBDI) is a complication with a high morbidity after cholecystectomy. In recent years, endoscopy has acquired a fundamental role in the management of this pathology.

Methods: a retrospective study of IBDI after open cholecystectomy (OC) or laparoscopic cholecystectomy (LC) of patients treated in our center between 1993 and 2017 was performed. Clinical characteristics, type of injury according to the Strasberg-Bismuth classification, diagnosis, repair techniques and follow-up were analyzed.

Results: forty-six patients were studied and IBDI incidence was 0.48%, 0.61% for LC and 0.24% for OC. A diagnosis was made intraoperatively in 12 cases (26%) and by endoscopic retrograde cholangiopancreatography (ERCP) in ten (21.7%) cases. The most common IBDI patient characteristics were acute cholecystitis (20/46, 43.5%), previous admission due to biliary pathology (16/46, 43.2%) and ERCP prior to

REVISTA ESPAÑOLA DE
ENFERMEDADES DIGESTIVAS
The Spanish Journal of Gastroenterology

cholecystectomy (7/46, 18.9%). The most frequent types of IBDI were D (17/46, 36.9%) and A (15/46, 32.6%). The most commonly used treatment was primary suture (13/46, 28.3%) followed by ERCP (11/46, 23.9%) with sphincterotomy and/or stents. In addition, ERCP was performed during the immediate postoperative period in six (13%) patients with a surgical IBDI repair in order to resolve immediate complications.

Conclusion: ERCP is useful in the management of IBDI that is not diagnosed intraoperatively. This procedure facilitates the localization of the injured area of the bile duct, therapeutic maneuvers and successful outcomes in postoperative complications.

Key words: Bile duct. Cholecystectomy. Iatrogenic bile duct injury. ERCP.

INTRODUCTION

Iatrogenic bile duct injuries (IBDI) have traditionally posed a challenge for surgeons due to their complexity and associated morbidities in patients with a benign disease. Laparoscopic cholecystectomy is one of the most common procedures in general surgery, with a morbidity of 3-12%. Bleeding of the liver bed and IBDI are among the most frequent postoperative complications, the latter is more severe and sometimes difficult to manage (1).

Bile duct injuries are defined as obstruction and/or partial or total division of the common bile duct (CBD) or some of the biliary tree ducts. The injuries may be caused by surgical procedures or non-surgical techniques such as endoscopies or interventional radiology procedures. The main cause of IBDI is cholecystectomy, either open or laparoscopic. The incidence of IBDI during open cholecystectomy (OC) is around 0.1-0.2% (1-8) and after laparoscopic cholecystectomy (LC) it rises to 0.3-0.5% (2-9). Recent studies have reported similar rates of IBDI after laparoscopic surgery and an open technique (10). Endoscopic retrograde cholangiopancreatography (ERCP) currently plays a fundamental role in the management of this type of pathology, as well as in the treatment of injuries traditionally considered to be surgical.

The aim of this study was to analyze IBDI treated in our center after LC or OC, describe the different IBDI types, evaluate management strategies and determine the role of

ERCP.

MATERIAL AND METHODS

A retrospective observational study was performed of patients who presented with IBDI after OC or LC, treated at our center from January 1993 to December 2017. The exclusion criteria included those under 18 years old and patients that underwent IBDI after procedures other than cholecystectomy.

Patients with IBDI were identified by reviewing the hospital stays and readmissions of all patients who had undergone a cholecystectomy. The data was obtained retrospectively from clinical documents between 1993 and 2011 and information from the last six years (2012-2017) was obtained prospectively. Data regarding demographic characteristics and previous hospitalization due to biliary pathology were collected. Furthermore, aspects related to the procedure (acute cholecystitis, chronic cholecystitis, ERCP or cholecystostomy), intraoperative bleeding, biliary abnormalities, urgent surgery, approach (open or laparoscopic), type of injury according to Strasberg-Bismuth classification (11,12) (Table 1), diagnosis, IBDI repair technique and follow-up were analyzed.

A descriptive analysis of the study variables was performed using the SPSS® for Windows® program and the absolute and relative frequencies for qualitative variables and central tendency for quantitative variables were calculated.

RESULTS

A total of 9,167 cholecystectomies were analyzed during the study period and 44 IBDIs (0.48%) were identified. The laparoscopic approach was used in 5,881 cases (64.1%) with 36 IBDIs (0.6%), while 3,286 patients underwent open surgery with a total of eight IBDIs (0.24%). Two IBDIs referred from other centers were also treated. Figure 1 shows number of OC and LC performed per year and IBDI distribution.

Of the 46 patients with IBDI treated at our center, 24 (52.2%) were female and the average age was 57.5 years (range, 23-85). Table 2 shows the clinical characteristics studied for patients with IBDI. The most common characteristic was acute cholecystitis, which was present in 20 of the patients (43.5%) who needed emergency

surgery. Sixteen patients (43.2%) had previously been admitted due to biliary pathology (acute pancreatitis, choledocholithiasis, cholecystitis or cholangitis) and seven patients (18.9%) had undergone ERCP prior to cholecystectomy.

The IBDI diagnosis was made intraoperatively and repaired during the same surgical procedure in 12 cases (26%). In the remaining 34 cases (74%), the diagnosis and treatment was postoperative. Depending on the technique applied, intraoperative diagnosis could be performed in ten of the 37 patients (27%) operated on by a laparoscopic approach and two of the nine patients (22.2%) who underwent OC. ERCP was the chosen treatment in eleven patients (23.9%) who were diagnosed postoperatively,

The distribution by IBDI type following the Strasberg-Bismuth classification and surgical approach is shown in figure 2. None of the IBDIs had an associated vascular injury. The most commonly used treatment was primary suture of the injury in 13 cases (28.3%), followed by endoscopic treatment using ERCP with sphincterotomy and/or stent insertion in eleven cases (23.9%). The different treatments used are summarized in table 3.

During follow-up, four patients required an ERCP after the initial treatment, with other techniques such as biliary sphincterotomy and/or stent placement in the CBD. Another patient required ERCP due to residual choledocholithiasis that prevented IBDI resolution and required stone extraction by biliary sphincterotomy (Fig. 3). All patients that required ERCP, either as the first therapeutic option or in the immediate postoperative period, presented a favorable evolution with resolution of the IBDI. Three patients who were initially treated with ERCP developed a benign stenosis of the bile duct, which required new stent insertion, bile duct cleaning or dilatation during follow-up. The median follow-up was 51.63 months, with a range from six to 273 months. All patients had a favorable evolution after IBDI repair, with no postoperative mortality at 30 and 90 days nor mortality from IBDI.

DISCUSSION

IBDI is a serious complication that should be kept in mind when performing a cholecystectomy. This type of injury can reduce the quality of life of patients typically

undergoing surgery for a benign procedure (13). As a new procedure, LC has a high incidence of bile duct injuries, probably due to the learning curve. However, over time it has established itself as the preferred approach, with amply demonstrated benefits of less postoperative pain, a shorter hospital stay and a lower morbidity (14). At present, the two approaches have similar IBDI rates (10,11).

The incidence of IBDI in our series was 0.48%, 0.24% for OC and 0.6% for LC. This is similar to that published in the literature, with rates of around 0.1-0.2% for open surgery and 0.3-0.5% for the laparoscopic approach (2-9). The overall incidence of IBDI in our series was higher in patients who underwent laparoscopic surgery, which can be explained by two factors. Firstly, bile leakage in the bed of the cholecystectomy (Luschka's duct) or through the cystic stump is not classed as IBDI in other series. However, it was classed as a bile duct injury in our series. Second, the proportion of patients who undergo laparoscopic surgery has changed over the years. The reversal of the open surgery trend towards the laparoscopic approach was observed around the year 2000. A similar increase was also seen in the use of ERCP to diagnose and treat these injuries, which has acquired a fundamental role in recent years.

Classically, acute cholecystitis has been considered as a risk factor for IBDI (15-22), mainly due to inflammation in the gallbladder and perivesicular area. This often makes it difficult to identify structures, with the consequent risk of injury. The Calot triangle is a particularly important structure to identify in order to minimize the possibility of a bile duct injury (23). In our series, 20 (43.5%) of the 46 IBDI required emergency surgery for acute cholecystitis.

Several studies have analyzed IBDI after cholecystectomy. A recent Swiss study analyzed IBDI produced by LC over eleven years (2000-2011) and 13 IBDI were identified with an incidence of 0.46%. The authors reported a rate of 31% IBDI type A and D and 38% type E injuries, in line with the results of our study (24). Likewise, a study published by Hogan et al. describes a series of 78 IBDI after LC collected over a period of 28 years. The authors established two study periods (1992-2004 and 2005-2014) in order to analyze the differences in IBDI treatment and type between the two study periods. They reported a decrease in type A injuries during the second period with an increase in type E injuries and more associated vascular lesions. The large

number of type E lesions found was striking and inconsistent with our series, where no associated vascular lesions were found (25).

Intraoperative IBDI diagnosis is always advantageous, since it allows a repair during the same surgical intervention. Suspected injuries during the postoperative period can benefit from ERCP as it is not necessary to perform the technique urgently if the patient is clinically stable or if the bile leak is drained. In a retrospective study of 518 post-traumatic or post-surgical biliary fistulas, the success rates and adverse events after ERCP did not depend on the timespan between clinical suspicion and the date of the procedure. This suggests that ERCP in these patients can be performed in an elective manner as a deferred emergency (26).

IBDI treatment remains a complex situation in which surgeons, endoscopists and interventional radiologists must work together in a multidisciplinary approach. For a correct diagnosis, it is essential to maintain a high index of suspicion (27). From our point of view, magnetic resonance cholangiopancreatography and CT scans provide highly valuable information for the diagnosis of this pathology. This allows us to explore the anatomy of the biliary tract and the hepatic hilum in order to plan treatment and to rule out associated vascular injuries that could alter the therapeutic approach. Subsequently, the endoscopic approach using ERCP could be considered as the first option (28).

Treatment via ERCP has flourished in recent years (29). The procedure consists of stent insertion, which is sometimes accompanied by sphincterotomy, in order to facilitate biliary drainage to the duodenum. Less invasive than surgery, this treatment has a high success rate. The complexity of the procedure depends on the technique, patient and pathology characteristics (30). More complex procedures such as surgical repair should be reserved for the centers with a high volume of endoscopic examinations (31,32), as it has been demonstrated that IBDI repair outcomes are more successful in the hands of expert surgeons (27).

ERCP treatment was used in 21.7% of cases in our series. This procedure has gained special relevance in the last eight years and is the second most common therapeutic option in our department for these injuries. Furthermore, it also serves to resolve cases where the bile leak persisted following the initial surgical repair. In our series,

ERCP successfully resolved the type E injuries of the Strasberg-Bismuth classification, which are considered as surgical injuries in most guidelines (27). Given the broad definition of IBDI type E and current advances in endoscopic techniques, we think that each case should be individualized to choose the most appropriate treatment.

This study has the limitations inherent to a retrospective series, with an incidence of cases that does not allow for comparative studies. However, few authors publish their experience with IBDI or the possibility of resolving them via ERCP. IBDI continues to be a feared and difficult to manage complication for surgeons and diagnosis and treatment of these injuries has improved in recent years. However, thanks to the contribution of endoscopy, we can obtain information on both the intrahepatic and extrahepatic anatomy of the bile duct, resolve the majority of cases in a less aggressive manner and fix post-surgical complications or injuries diagnosed during follow-up.

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The Spanish Journal of Gastroenterology

Table 1. Strasberg-Bismuth classification for iatrogenic bile duct injuries

Type A	Biliary leak in small canaliculus in continuity with the common hepatic duct. Leak of the cystic duct or Luschka duct
Type B	Partial occlusion of the biliary tree, almost always due to an aberrant right hepatic duct
Type C	Leak of a duct in communication with the common hepatic duct due to an aberrant right hepatic duct
Type D	Lateral injury of extrahepatic ducts less than 50% of the circumference
Type E	Circumferential injury (> 50% of the circumference) of larger bile ducts
E1	Injury more than 2 cm from the junction of the right and left hepatic ducts
E2	Injury less than 2 cm from the junction of the right and left hepatic ducts
E3	Stenosis or section at the junction of the right and left hepatic ducts, remaining united without separation
E4	Stenosis or section that affects the junction of the hepatic ducts, which are separated or joined by scar tissue
E5	Type C injury plus injury of the main bile duct below the junction of the hepatic ducts

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ENFERMEDADES DIGESTIVAS
The Spanish Journal of Gastroenterology

Table 2. Characteristics of patients with an iatrogenic bile duct injury

IBDI patient characteristics (n = 46)	*n*	*%*
Gender		
Women	24	52.2
Men	22	47.8
Surgery		
Open	9	19.6
Laparoscopic	37	80.4
DM II	7	15.2
Obesity	2	4.3
Acute cholecystitis	20	43.5
Previous admission due to biliary pathology	16	43.2
Percutaneous cholecystostomy	3	6.5
Chronic pancreatitis	2	4.3
Acute biliary pancreatitis	3	6.5
ERCP	7	15.2
Others	1	2.2
Biliary anomalies	4	8.7
Intraoperative bleeding	4	8.7

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The Spanish Journal of Gastroenterology

Table 3. IBDI treatment according to type of injury following the Strasberg-Bismuth classification

n, %	*Injury type (n)*	
Bile duct primary suture	13 (28.3)	A (7) D (5) E2 (1)
Kehr drainage into CBD	8 (17.39)	D (8)
Hepatic-jejunostomy	9 (19.6)	E1 (2) E2 (2) E3 (3) E4 (2)
ERCP stent	11 (23.91)	A (5) D (4) E2 (1) E5 (1)
Bile duct end-to-end anastomosis	1 (2.2)	E1 (1)
Drainage out CBD	2 (4.3)	A (2)
Conservative treatment	2 (4.3)	A (1) C (1)

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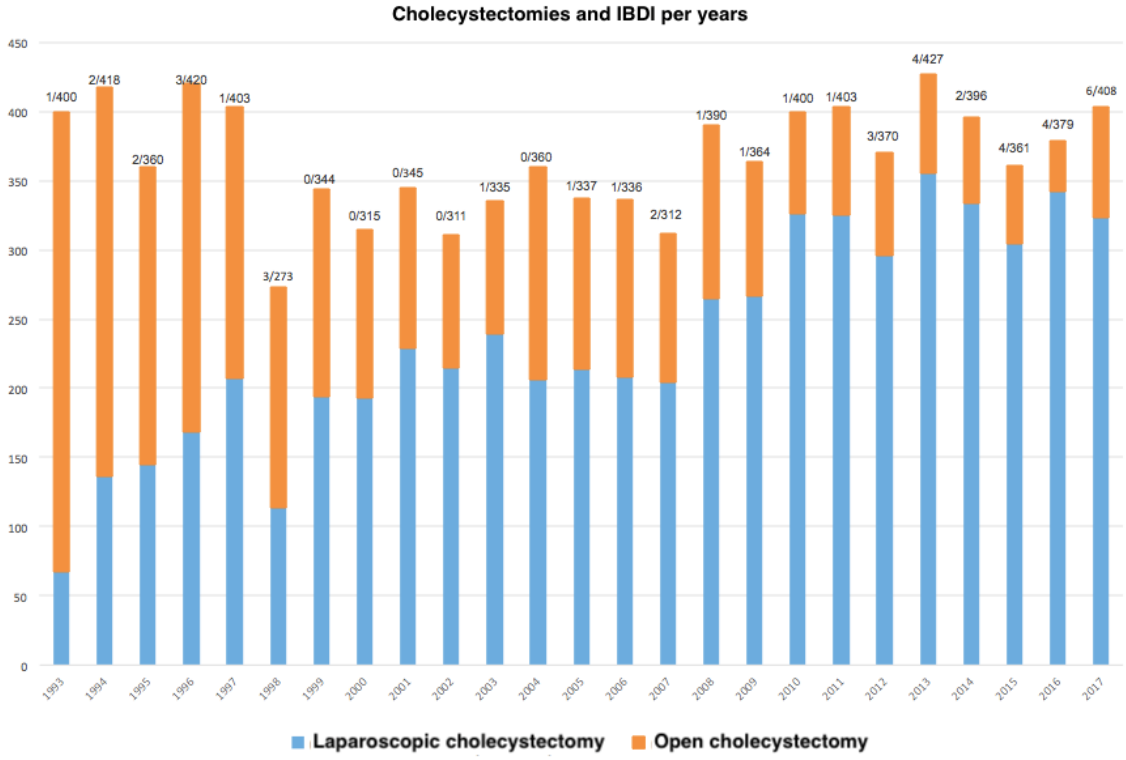
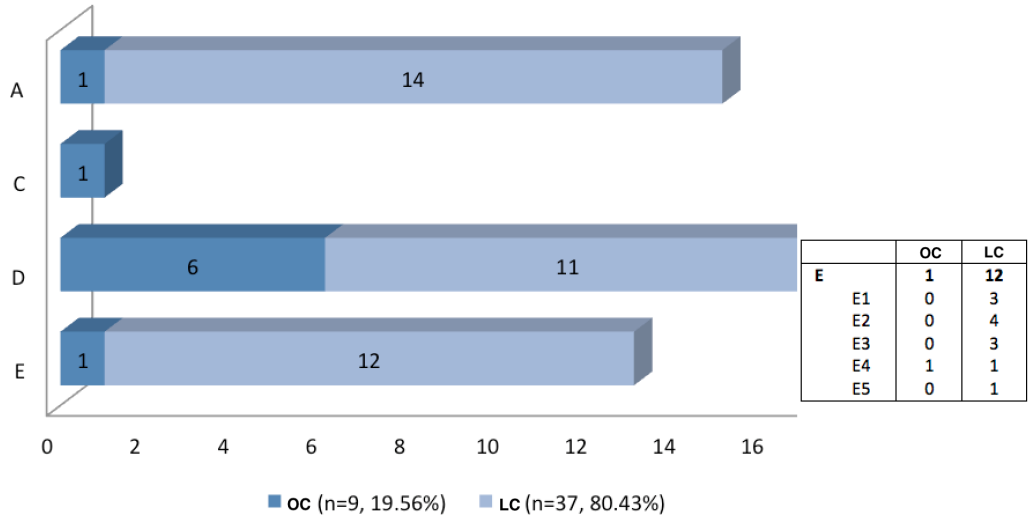


Fig. 1. Number of LC and OC performed per year and IBDI distribution (number of IBDI/total number of cholecystectomies).



	OC	LC
E	**1**	**12**
E1	0	3
E2	0	4
E3	0	3
E4	1	1
E5	0	1

Fig. 2. IBDI classification according to the Strasberg-Bismuth classification and cholecystectomy approach used (LC: laparoscopic cholecystectomy, OC: open cholecystectomy).

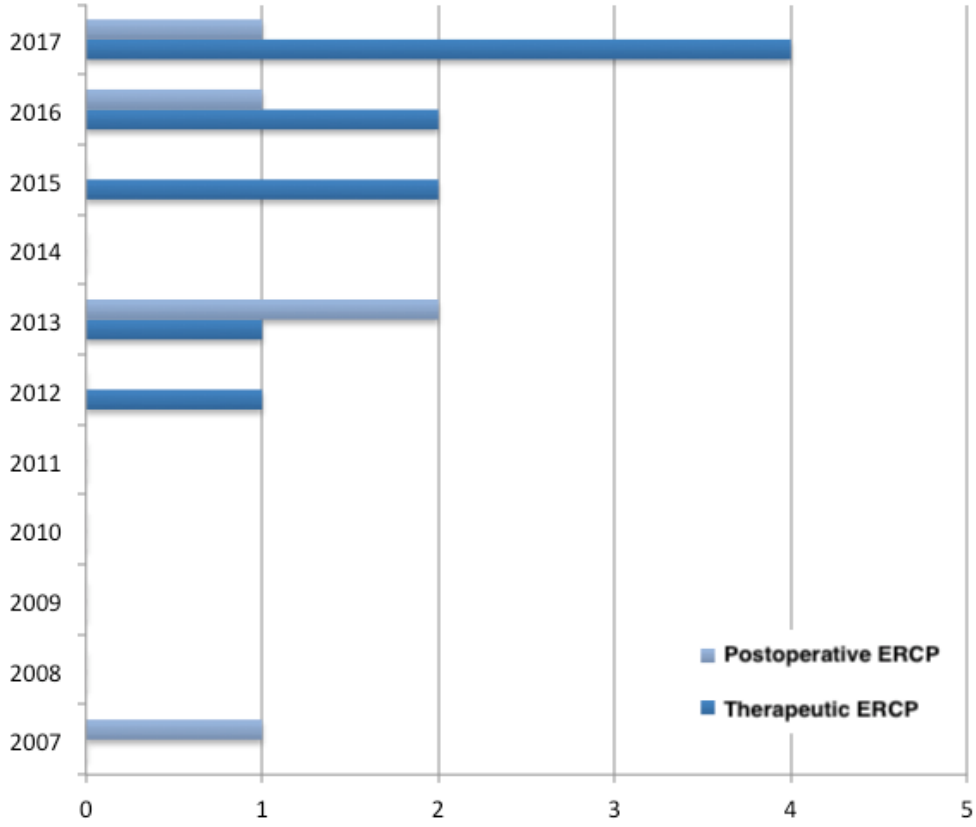


Fig. 3. The role of ERCP in IBDI diagnosis and treatment after cholecystectomy and the treatment of postoperative complications after surgical repair.