



Treatment of Common Bile Duct Injuries during Laparoscopic Cholecystectomy: Endoscopic and Surgical Management

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Abstract. The increase of laparoscopic cholecystectomy has resulted in an increase of bile duct injuries. The purpose of this article is to define the types of injury, their occurrence and frequency, and their management by endoscopic and surgical techniques. Three investigations were included in the present study. 1. A 3-year retrospective study among 29 hospitals with 25,007 laparoscopic cholecystectomies. 2. An 8-year prospective study at our institution of 6488 patients. 3. A prospective endoscopic study of 94 patients with injuries and strictures of the common bile duct (CBD) after laparoscopic cholecystectomy. A special classification for bile duct injuries was developed. Among 25,007 patients from 29 hospitals, a total of 74 lesions were detected with an incidence of 0.29%. At our institution, 20 cases were seen (0.29%) with type I, II, and III injuries. The 94 cases managed by endoscopic procedure were submitted to endoscopic retrograde cholangiopancreatography (ERCP) and papillotomy, with placement of several stents 5 to 10 F during 8 months. The results of this procedure have been excellent to good in 76% of the cases up to 3 years of follow-up. According to our previous and present experience, bile duct injuries after laparoscopic procedure are two times higher than after open procedure. The best treatment is the prevention of these injuries by careful surgical technique. If they occur, the best moment to repair them is during surgery. If they are noticed after the operation, endoscopic or surgical procedures can be employed.

Laparoscopic cholecystectomy has become the standard surgical treatment for patients with gallstones. There are many well-known benefits compared to open cholecystectomy and probably it is the most used laparoscopic procedure without discussion in the entire world. As the surgical teams gain experience, the classical contraindications for laparoscopic cholecystectomy have been progressively eliminated. Actually, gallbladder carcinoma remains the only absolute contraindication. With the increase of this laparoscopic procedure, some complications have also increased compared to open cholecystectomy. These complications are mainly bile leakage and injuries of the common bile duct [1–11]. The purpose of the present paper is to define the types of

injuries, their occurrence and frequency, and their management by endoscopic and surgical techniques.

Material and Methods

Patients Studied

Three different investigations were planned in order to answer the different questions mentioned above.

1. A 3-year retrospective cooperative study among 29 hospitals in Chile, in order to determine the types and frequency of the different injuries of the common bile duct.
2. A careful prospective study at our institution, which began on August 1990 until December of 1998, in order to determine the frequency and different treatments of injuries of the common bile duct, managed by a homogenous group of staff surgeons.
3. A prospective endoscopic study of referred patients with injuries of the CBD in order to manage them by endoscopic procedure.

Classification of Injuries of the CBD

We proposed a new classification [12] in order to classify and to propose alternative treatments of these injuries.

1. Type I corresponds to a small tear of the hepatic duct or right hepatic branch caused by dissection with the hook or scissors during the dissection of Calot's triangle (Figure 1).
2. Type II, which is a new type of injury which was seldom seen during open surgery, corresponds to lesions of the cysticocholedochal junction due to excessive traction (Figure 2), the use of a Dormia catheter (Figure 3), section of the cystic duct very close or at the junction with the CBD (Figure 4), or to a burning of the cysticocholedochal junction by electrocautery (Figure 5).
3. Type III corresponds to a partial or complete section of the CBD (Figure 6).

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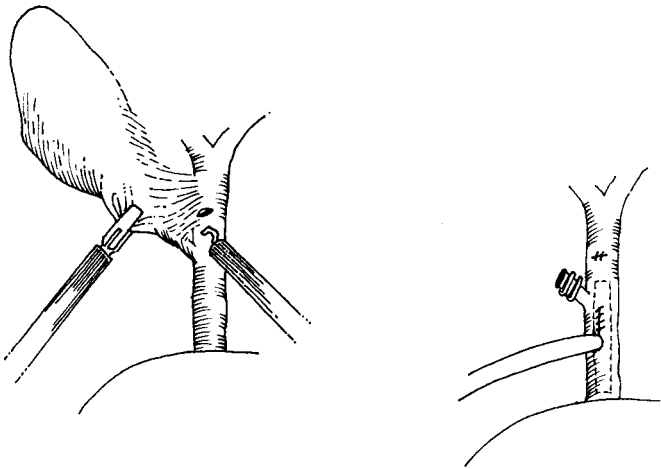


Fig. 1. Lesion of hepatic duct by hook and its repair by suture and placement of a T-tube.

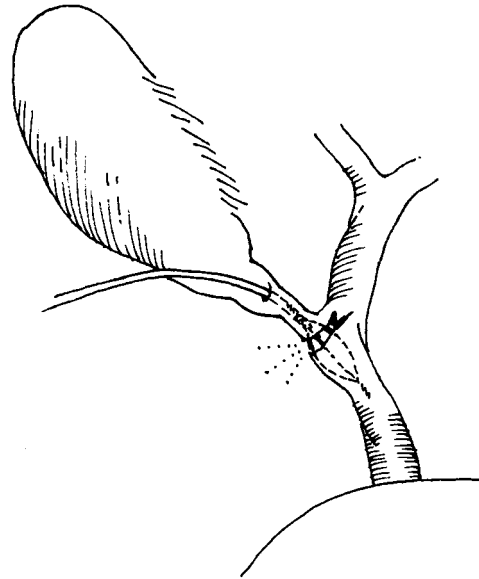


Fig. 3. Lesion of the cysticocholedochal junction by traction of a Dormia catheter.

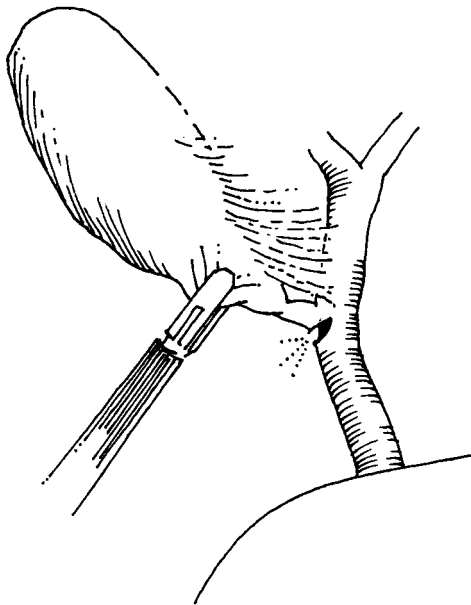


Fig. 2. Excessive traction of the cystic duct in an inflamed gallbladder.

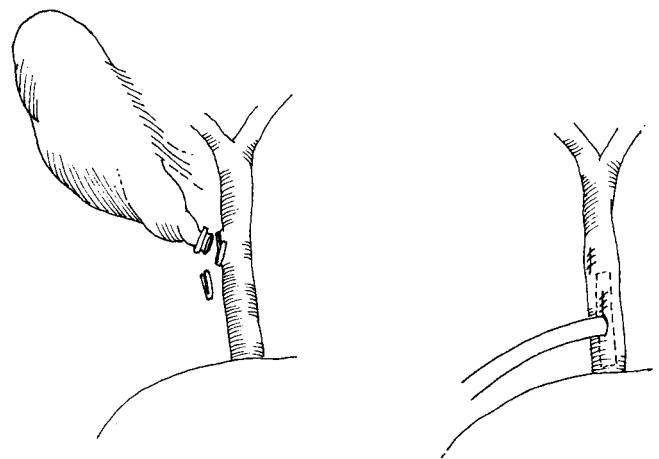


Fig. 4. Section of the cystic duct extremely close to the common bile duct and its repair by suture and distal placement of a T-tube.

4. Type IV corresponds to resection of more than 10 mm of the CBD (Figure 7).

Pathological Examination

All resected gallbladders were sent for a complete histological analysis to exclude an incidental carcinoma of the gallbladder, which is highly prevalent among our patients.

Results

Surgical Treatment

The incidence of injuries of the CBD during laparoscopic cholecystectomy in 25,007 patients operated on was shown in a cooperative

study among 29 hospitals during in a 3-year period (Table 1). A total of 74 cases were detected, with a mean incidence of 0.29%. There were similar frequencies among type I to III injuries, while resection of the CBD (type IV) occurred rarely. The prevalence of bile duct lesions at our institution among 6488 patients submitted to laparoscopic cholecystectomy is shown in Table 2. There were very similar incidences of each three types of CBD injuries. We have not had any type IV lesions. However, we also had the opportunity to treat four cases from other institutions, two patients with type III and two patients with type IV injuries.

The surgical treatments performed in these 24 patients are shown in Table 3. All patients with type I injury were repaired except for one during the initial operation. In six cases a suture of the tear was performed, adding a T-tube in four of them. Only one case presented a localized bile collection, which was reoperated on, the tear sutured,

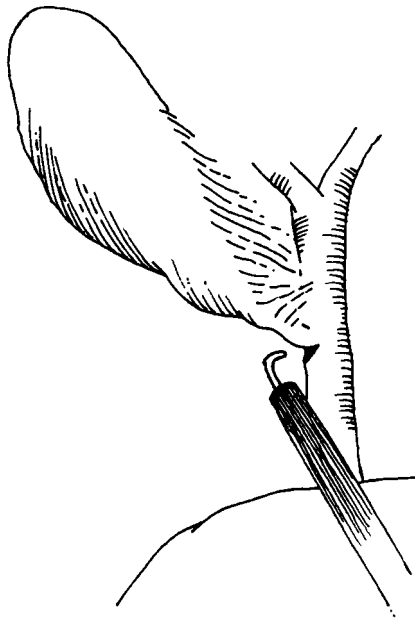


Fig. 5. Lesion of the cysticocholedochal junction by burning due to the hook.

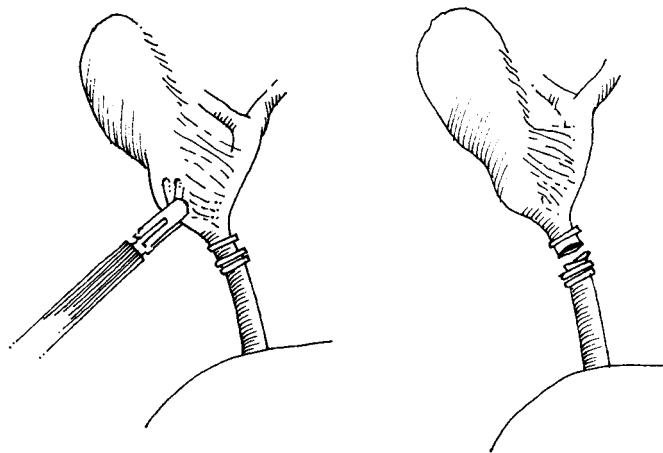


Fig. 6. Section of the common bile duct during laparoscopic cholecystectomy.

and a T-tube placed. All cases had an uneventful evolution and were asymptomatic at the late control. Patients with type II injuries had different behaviors. In two cases the lesion was noted immediately. They were converted to open surgery and a repair was performed, together with a T-tube. Four patients presented bile collection after surgery. All were reoperated on, and the lesion was sutured. In three cases a T-tube was added, while in one patient an ERCP stent was placed, which was removed 1 month later. One patient developed a stricture and had to be converted to a hepaticojejunal anastomosis 6 months later. The other five cases were asymptomatic at the late clinical control. Among the nine cases with partial or complete section of the CBD, in six the injury was noted during the primary operation. All of them were converted to open surgery and end-to-end anastomosis was performed in three cases plus a T-tube inserted,

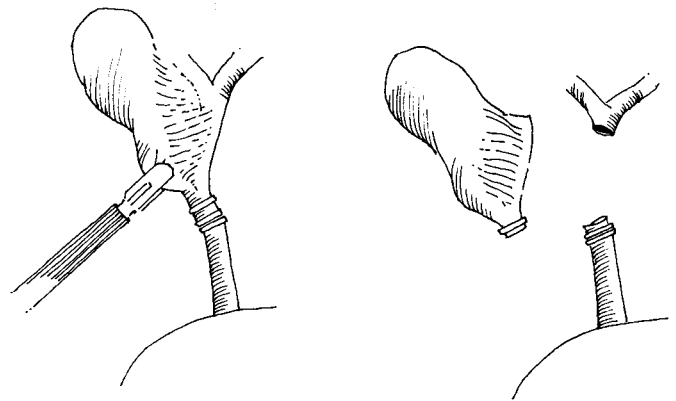


Fig. 7. Resection of the common bile duct during laparoscopic cholecystectomy.

Table 1. Injuries of the common bile duct during laparoscopic cholecystectomy. A 3-year cooperative study of 29 hospitals ($n = 25,007$).

	<i>n</i>	%
Type I	23	0.09
Type II	22	0.089
Type III	18	0.07
Type IV	11	0.04
Total	74	0.29
Mortality	0	

Table 2. Common bile duct lesions during laparoscopic cholecystectomy at University Hospital 1990–1998 ($n = 6488$).

	<i>n</i>	%
Type I	7	0.1
Type II	6	0.09
Type III	7	0.1
Total	20	0.29
Mortality	0	

while hepatico-jejunostomy was performed in three other cases. All had an uneventful course. In three patients the injury of CBD was not evident during surgery. All presented bile collections after the operation. One of them had a end-to-end anastomosis and in two a definitive hepatico-jejunostomy was performed. They have been asymptomatic up to now.

Two patients were referred after resection of the CBD. Both cases presented with biliperitoneum and were reoperated on and a hepaticostomy was performed. Four to 6 months later the definitive operation was made. Both are asymptomatic 3 and 4 years after surgery.

Endoscopic Results

Between September 1992 and August 1998, 94 patients with benign CBD strictures as sequelae of CBD injury during cholecystectomy were seen in our surgical endoscopy unit. They were 63 women and 31 men with a mean age of 56 years (range, 19–82 years).

The main symptoms at the time of referral were jaundice,

Table 3. Surgical treatment in 24 patients with injuries of the CBD.

Type of injury	<i>n</i>	Age	Sex	Intraoperative repair	Postoperative repair
I	7	62.1 (32–83)	6 f 1 m	6 = suture HD + Kehr tube in 4	1 = suture + Kehr tube
II	6	53.7 (31–67)	4 f 2 m	2 repair + Kehr tube	4 repair + Kehr tube in 3 and 1 ERCP (1 hepaticojejunostomy 6 months later)
III	9	47.9 (23–74)	7 f 2 m	3 termino-terminal anastomoses + Kehr tube 3 hepaticojejunal-anastomoses	2 hepaticojejunostomoses 1 termino-terminal anastomosis + Kehr tube
IV	2	32–33	1 f 1 m		2 hepaticojejunostomoses 4–6 months after primary surgery

CBD: common bile duct; f: female; m = male; HD: hepatic duct; ERCP: endoscopic retrograde cholangiopancreatography.

Table 4. Late results of endoscopic management of benign stricture of the common bile duct due to injury during laparoscopic cholecystectomy (*n* = 49).

Results	25 Months	> 36 Months
Satisfactory	41 (4%)	37 (76%)
Poor	8 (16%)	12 (24%)

abdominal pain, and fever. The details of the endoscopic procedure have been published previously (13). Previous to the endoscopic procedure, all patients received 500 mg IV ciprofloxacin. All cases were submitted to ERCP and papillotomy. A metal wire was advanced through the stricture and one or more stents 5–10 F were placed into the CBD. In six cases, balloon dilatation was needed prior to the placement of stents, and in two cases, balloon dilatation was used as the only procedure. In four patients, a nasobiliary catheter was used because of cholangitis. In 16 cases, retained CBD stones were diagnosed and treated during ERCP. In six cases, there was an external biliary fistula. After 15 to 30 days following initial ERCP, a second procedure was performed with the insertion of one or more stents. In some cases a maximum of five stents were placed in order to obtain an appropriate diameter of the stricture. Once this goal was reached, the stents were left in situ for an average of 8 months. After this time, the stents were taken out, and the patients were followed-up every 6 months to assess clinical status and liver function tests.

There were no complications from papillotomy nor was mortality observed. There were two complete failures (2%) due to a critical and severe stricture with angulation of the bile duct. During the 8 months with the stents in situ, it was necessary to change them in six patients due to obstruction and cholangitis. Forty-nine cases have been followed up very closely and the late results are shown in Table 4. It can be seen that 2 years after endoscopic procedure, 84% of the cases have satisfactory results, while at 3 years of follow-up, this value drops to 76% of success rate.

Discussion

Iatrogenic lesions of the CBD during laparoscopic cholecystectomy represent very serious injuries with frequent complications, high cost, and uncertain results at late follow-up [1–11]. Their incidence has increased compared to open cholecystectomy [13, 14] as can be seen in Table 5, comparing our results with open and laparoscopic procedure [12]. We postulate the following reasons for this increase.

1. There is a new generation of young surgeons with no experience or very little experience with open classic cholecystectomy.

Table 5. Comparison of bile duct injuries during cholecystectomy.

	Open	Laparoscopic
Global incidence	0.2%	0.3%
Small tear at hepatic duct (type I)	1 × 1000	1 × 900
Incomplete or complete section or resection of CBD (types III–IV)	1 × 1500	1 × 900

CBD: common bile duct.

2. There is pressure to accomplish the laparoscopic procedure at any cost because conversion can be interpreted as a failure, while it should be interpreted as a very good judgment of the surgeon.
3. The indications for laparoscopic cholecystectomy have increased, while at the beginning several “difficult” cases were avoided (Mirizzi’s syndrome, cholecysto-enteric fistula, previous upper abdominal surgery, etc.) In the present paper, we have analyzed only iatrogenic injuries of the CBD, while other severe complications such as bile leaks have not been mentioned and should be included in another publication. The introduction of laparoscopic cholecystectomy has changed the classic spectrum of bile duct injuries: an increase of these procedures has occurred in every surgical unit dedicated to laparoscopic procedure and new lesions have appeared, such as lesions of the cystic duct (type II lesions) which were seldom observed during open surgery. The incidence of bile duct injuries during laparoscopic cholecystectomy in several different surgical groups is shown in Table 6 [2, 15–31]. This complication is the only controversial and disadvantageous point in respect to laparoscopic cholecystectomy, which has so many advantages.

There are several aspects related to the occurrence of these injuries that should be commented on.

1. They have a biphasic behavior: they are more frequent at the beginning of the learning curve, then decrease with a more prudent behavior. A second increase occurs when experienced surgeons begin to operate on more difficult cases.
2. There is a general agreement that anomalies of the bile duct have no major role in the production of these injuries.
3. Patients are carefully selected for laparoscopic procedure because cases with acute cholecystitis with more than 8 days of occurrence and cases with scleroatrophic chronic cholecystitis may have a high rate of conversion.
4. An electrocautery and hook must be used with great care to avoid these lesions, because they were not used routinely with open surgery.
5. Although the routine use of intraoperative cholangiography [32] has not clearly diminished the incidence of bile duct

Table 6. Incidence of common bile duct injuries during laparoscopic cholecystectomy. A world-wide survey.

Author	Year	No. of Laparoscopic Cholecystectomies	No. of Injuries	% Injuries
SS Club [15]	1991	1518	7	0.5
Cushieri [16]	1991	1236	4	0.3
Airan [17]	1992	1771	4	0.2
Berci [18]	1992	1275	6	0.5
Suc [19]	1992	3606	25	0.7
Vereecken [20]	1992	3244	16	0.5
Litwin [21]	1992	2201	3	0.1
Deziel [22]	1993	77,604	459	0.6
Barkum [23]	1993	1300	5	0.4
Schlemp [24]	1994	3722	22	0.6
Windsor [25]	1994	4000	41	0.1
Schol [26]	1994	6076	49	0.8
Buanes [27]	1995	1699	9	0.5
Hjelmquist [28]	1995	11,164	57	0.5
Richardson [29]	1996	5913	37	0.6
Russel [30]	1996	15,221	38	0.2
Adamsen [31]	1997	7654	57	0.7
Vecchio [2]	1998	114,005	561	0.5
Csendes [34]	1999	25,007	74	0.3

injuries [12], its use when any doubt concerning the anatomy of the bile duct is present will allow diagnosis of an injury and immediate repair.

- There is a consensus that if any important bleeding occurs without clear visualization of the anatomy, the patient should be converted to open procedure, avoiding the placement of multiple clips blindly.

We present our classification of injuries of the bile duct, which has the advantage of classifying the severity of the lesions and proposing the surgical repair. The main point is the prevention of the occurrence of these lesions. If any damage occurs, it should be repaired during the same procedure whenever it is possible. We postulate that the best approach is to convert the patient to open surgery and to proceed according to the type of injury.

- In the presence of a small tear of the hepatic main duct or the right hepatic branch, the best surgical approach is to suture this tear and distally place a T-tube. In this way, the bile duct is decompressed and radiological controls can be obtained. The results of this approach are excellent.
- In the presence of any type of lesion of the cystic duct or cysticocholedochal junction, surgical treatment should be very similar; that is, a repair of the defect or lesion and distal placement of a T-tube.
- When a partial or complete section of the bile duct occurs, with less than 10 mm distance from the proximal and distal border of the section, an end-to-end anastomosis with a distal T-tube can be performed. An alternative treatment, according to the diameter of the bile duct, can be a hepaticojejunal anastomosis. The results with both procedures performed at the time of the occurrence of lesions are excellent [13]. If this lesion is recognized late after surgery, the best surgical repair seems to be an hepaticojejunostomy [13, 14].
- The resection of more than 10 mm of the CBD is rare in our experience and usually is not noticed during surgery. These

patients present a severe bile peritoneum with septic complications that make an immediate repair not advisable. These patients have been managed later by an hepaticojejunal anastomosis to both ducts, because usually a type III or IV stricture according to Bismuth's classification is present.

If a patient presents with a stricture of the CBD early or late after surgery, an excellent alternative treatment is the endoscopic procedure instead of immediate surgery [33]. With endoscopic procedures, it is very important to consider the etiology and location of the stricture, the experience of the endoscopic team, the cost of the procedure, and the possibility of an early and late follow-up. Endoscopic procedures have the advantage over surgery to be less invasive, less expensive, and with less complications. Besides, if an acute cholangitis is present, it offers an immediate decompression of the bile duct. Also an important difference with the percutaneous approach is the fact that ERCP does not cross the intercostal space and liver parenchyma. During an endoscopic procedure, the first important step is to perform a papillotomy, allowing the placement of stents, balloons, or expandable dilators. Because of their high cost, we have no experience with the use of expandable prostheses. The stents that we use by endoscopic procedure are extremely cheap, several stents (four or five) can be placed in the same bile duct and be exchanged easily. In this way, a great number of patients can be managed, and surgery is used in only those cases with recurrence of strictures.

Résumé

Introduction: L'augmentation des indications de la cholécystectomie laparoscopique est accompagnée d'une augmentation des lésions de la voie biliaire. Buts. Définir les types de lésions, leur survenue et leur fréquence ainsi que leur traitement par voie endoscopique ou chirurgicale. Matériel et méthodes Trois investigations différentes ont été incluses dans cette étude: a) Une étude rétrospective de 25007 cholécystectomies laparoscopiques réalisées dans 29 hôpitaux pendant 3 ans. b) Une étude prospective chez 6488 patients de 8 ans à notre institution. c) Une étude prospective endoscopique chez 94 patients ayant une lésion ou une sténose de la voie biliaire principale après cholécystectomie laparoscopique. Une classification spéciale a été développée pour les lésions biliaires. Résultats : Parmi les 25007 patients provenant de 29 hôpitaux, au total, 74 lésions ont été détectées pour une incidence de 0,29%. A notre institution, on a observé 20 cas (0,29%) des types I, II et III. Les 94 cas traités par procédés endoscopique ont eu une CPRE et une sphinctérotomie, associées à une insertion de plusieurs stents (5 à 10 F) pendant 8 mois. Les résultats de ce procédé ont été excellents à bon chez 76% des cas avec un suivi de 3 ans. Conclusions Selon notre expérience antérieure et présente, les lésions de l'arbre biliaire pendant la laparoscopie, sont deux fois plus fréquentes que pendant la cholécystectomie par voie ouverte. Le meilleur traitement est la prévention par une technique chirurgicale soigneuse. Lorsqu'elles arrivent, le meilleur moment pour les réparer est pendant l'acte chirurgical. Si on les découvre après opération, on peut soit les traiter par voie endoscopique, soit par chirurgie.

Resumen

Introducción. La popularización de la colecistectomía laparoscópica ha resultado en un incremento en el número de las lesiones biliares. **Propósito.** Definir los tipos de lesión, su ocurrencia y frecuencia y su manejo mediante técnicas endoscópicas y quirúrgicas. **Materiales y Métodos.** En el presente estudio se incluyeron 3 diferentes investigaciones: a) un estudio retrospectivo de 3 años en 29 hospitales y 25.007 colecistectomías laparoscópicas; b) un estudio prospectivo de 8 años en nuestra propia institución, que cubre 6.488 pacientes; c) un estudio prospectivo endoscópico de 94 pacientes con lesiones y estrecheces del colédoco luego de colecistectomía laparoscópica. **Se desarrolló una clasificación especial de las lesiones biliares.** **Resultados.** Entre 25.007 pacientes provenientes de 29 hospitales, se detectaron 74 lesiones, una incidencia de 0.29%. En nuestra institución se vieron 20 casos (0.29%), de los tipos I, II y III. Los 94 casos manejados mediante procedimientos endoscópicos fueron llevados a CPER y papilotomía, con colocación de “stents” 5 a 10 F durante 8 meses. Los resultados de este procedimiento han sido excelentes o buenos en 76% de los casos en un seguimiento hasta de 3 años. **Conclusiones.** Según nuestra experiencia previa y presente, las lesiones del tacto biliar luego de colecistectomía laparoscópica, son dos veces más numerosas que con la colecistectomía abierta. El mejor tratamiento es su prevención mediante cuidadosa técnica quirúrgica. Si se presentan, el momento óptimo para repararlas es durante la misma cirugía. Si son detectadas luego de la operación, se pueden usar métodos endoscópicos o quirúrgicos. **Injuries of the common bile duct during laparoscopic cholecystectomy. A 3-year cooperative study of 29 hospitals (n = 25,007). Common bile duct lesions during laparoscopic cholecystectomy at University Hospital 1990–1998 (n = 6488). Late results of endoscopic management of benign stricture of the common bile duct due to injury during laparoscopic cholecystectomy (n = 49).**

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