

Bile duct injury, experience from 3 years in a tertiary referral center

Lesión de vía biliar, experiencia de 3 años en un hospital de tercer nivel

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Abstract

Objective: The main goal of this research is to determinate the epidemiological characteristics and the experience in the management of patients with the diagnosis of bile duct injury, referred to the Unidad Médica de Alta Especialidad, Centro Médico Nacional Siglo XXI, in the gastrointestinal surgery service and its comparison with the statistics reported worldwide. **Method:** It is a retrospective, observational, descriptive study. The data analysis was performed with the IBM SPSS 26 software platform. Measures of central tendency and dispersion were applied. The Fisher's exact test was used for categorical variables. Statistical significance is accepted if $p < 0.05$. **Results:** 70 patients were included, between the period of January 1, 2017 to December 31, 2019. According to the Strasberg-Bismuth system, the distribution was: type A 15.7%, B 1.4%, C 0, D 7.1%, E1 1.4%, E2 21.4%, E3 32.9%, E4 18.6%, E5 1.4%. Management was predominantly surgical (78.3%). Two deaths were reported with a mortality of 2.9%, the registered morbidity was 37.1%. **Conclusions:** The referral to a specialized center for proper management is the key to a satisfactory recovery in this type of patients. Establishing protocols for prompt care will help reduce morbidity and mortality.

Keywords: Bile ducts. Mortality. Cholecystectomy.

Resumen

Objetivo: Conocer las características epidemiológicas y la experiencia en el manejo de pacientes con diagnóstico de lesión de vía biliar referidos a la Unidad Médica de Alta Especialidad, Centro Médico Nacional Siglo XXI, al servicio de gastrocirugía, y su comparación con la estadística mundial. **Método:** Estudio retrospectivo, observacional y descriptivo. El análisis de los datos se realizó con la plataforma de software IBM SPSS 26. Se aplicaron medidas de tendencia central y dispersión. La prueba exacta de Fisher se utilizó para variables categóricas. La significancia estadística se estableció como $p < 0.05$. **Resultados:** Se incluyeron 70 pacientes entre el 1 de enero de 2017 y el 31 de diciembre de 2019. Según el sistema de Strasberg-Bismuth, la distribución por tipos fue: A 15.7%, B 1.4%, C 0%, D 7.1%, E1 1.4%, E2 21.4%, E3 32.9%, E4 18.6% y E5 1.4%. El manejo fue predominantemente quirúrgico (78.3%). Se reportaron dos decesos, con una mortalidad del 2.9%, así como una morbilidad del 37.1%. **Conclusiones:** El envío a un centro especializado es esencial para el adecuado manejo en sus diferentes modalidades, así como para su recuperación satisfactoria. Establecer protocolos para la pronta atención reducirá la morbimortalidad en estos pacientes.

Palabras clave: Vía biliar. Mortalidad. Colectectomía.

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Introduction

Bile duct injury is defined as any iatrogenic interruption or obstruction in the bile ducts, secondary to surgery¹. The number of cholecystectomies for chronic lithiasic cholecystitis in our country is unknown, but in other countries, such as the United States of America, a number between 750,000² and 1.2 million per year³ is reported. In Mexico, in 2007, 218,490 consultations were granted for cholecystitis, ranking first as a cause of general surgery consultations; this is the second most frequently performed surgical intervention at the Mexican Social Security Institute (IMSS), with a total of 69,675, of which 47,147 were performed with the open technique and 22,528 by laparoscopy⁴. According to data reported by the National Institute of Geography and Statistics, the number of hospital discharges in general and specialty hospitals in 2019 with a diagnosis of cholelithiasis and cholecystitis was 72,832.

The use of open surgery to resolve chronic lithiasic cholecystitis has been decreasing over the years, with laparoscopic surgery being the procedure of choice for surgical resolution; however, we do not always have this resource.

Mexico is a developing country in which first and second level public hospitals are the basis of the health system, where it is about solving the main surgical pathologies that afflict the population, such as appendectomies, hernia repair or cholecystectomies. Third level hospitals are in charge of solving complex surgical problems that cannot be solved in the aforementioned hospitals, either due to a lack of trained personnel or the necessary equipment. The incidence of this pathology caused laparoscopically has not reported significant changes over time, being in the 1990s from 0.2% to 0.6%⁵, and currently being found in a very similar way between 0.4% and 0.6% according to various studies. In laparoscopic cholecystectomy, contrary to open surgery, in which ranges from 0.2% to 0.3%², are reported. There are few records in Mexico on its real incidence, since we do not have a reliable database on the number of cholecystectomies and the complications that arise from them; however, there are isolated reports from second and third level hospitals from which we can obtain an idea of the incidence in our country. Gutiérrez et al.⁷ conducted a study with 532 patients for 4 years in whom laparoscopic cholecystectomy was performed, three of them presenting bile duct injury, which represented 0.56% of the total population⁷.

Velasco et al.⁸ analyzed 855 cholecystectomies, of which 341 were laparoscopic and 514 conventional, and reported a total of 11 bile duct lesions, with an incidence of 0.87% in laparoscopic cholecystectomy and 0.58% in open cholecystectomy, which is above international standards. The fact of not presenting changes in the incidence over the years suggests in some way that we are not taking into account all the information published in the literature with the intention of reducing the frequency of bile duct injury.

The change in surgical technique from open to laparoscopic surgery has shown a benefit in patients in different areas, such as less in-hospital time, decreased postoperative morbidity and faster return to daily activities, despite presenting a higher incidence of bile duct injury. For this it is important to know what are the factors involved in the development of this type of injury in surgery.

Strasberg proposes that laparoscopic cholecystectomy can be summarized as a three-step procedure, determining the critical safety vision^{9,10}:

- 1) Dissection of adipose and fibrous tissue of the hepatocystic triangle.
- 2) The lower third of the gallbladder is separated from the liver to expose the cystic plaque.
- 3) Two and only two structures enter directly into the vesicle.

Intraoperative difficulty is directly related to the likelihood of injuring the bile duct, so the surgeon must determine whether or not gallbladder conditions, such as alterations in anatomy, an aberrant right liver duct, acute or chronic inflammation around the gallbladder and the hepatoduodenal ligament, will allow him or may not be able to carry out an adequate dissection in a difficult cholecystectomy. Strasberg determined this situation as a "tipping point", which is a point of no return, in which we made a decision to refrain from performing a total cholecystectomy and finish it in another safer way, so we must keep in mind what rescue procedures we can use to finish the procedure¹¹⁻¹⁵.

The cost of bile duct injury repair is highly variable depending on where it is performed, whether in a public or private hospital. There are studies that have analyzed the economic impact, but they are limited to case series of a single institution. Fong et al.¹⁶ analyzed the period of time between 2005 and 2014, during which they had 1493 patients with bile duct injury, of which 1227 were surgical management and 216 by endoscopy. Surgically treated patients had lower hospital readmission and fewer emergency department visits, but repair costs were higher compared to

endoscopy use (\$37,687 vs. \$25,705 USD; $p < 0.001$); however, patients managed endoscopically had an increase in cumulative costs at 90 days and beyond (\$56,972 vs. \$51,183 USD; $p < 0.001$).

In Mexico there are few tertiary level hospitals that have both human and material resources to offer adequate treatment to patients with bile duct injury. Studies conducted so far on the epidemiological characteristics in patients with this diagnosis are limited. The objective of this study is to know basic data in a hospital of tertiary level of care of the IMSS, such as the most frequent type of injury, the time and place of reference, the association of vascular injury, the type of reconstruction, postoperative complications and mortality, as well as experience in pre-surgical and surgical management, which are necessary to optimize the treatment offered to patients and that this leads to improving the quality of life in the short, medium and long term.

Method

A retrospective, observational and descriptive study was conducted, whose study universe is made up of patients admitted to the Bernardo Sepúlveda Specialty Hospital, of the Siglo XXI National Medical Center, with iatrogenic lesion of the bile duct, in the gastrosurgery service, from January 1, 2017 to December 31, 2019. An intentional (non-probabilistic) sampling was performed including all patients admitted with the diagnosis of bile duct injury from the censuses of the gastrosurgery service, from January 1, 2017 to December 31, 2019. Patient information was collected from the physical and electronic record, and includes demographic characteristics, details about initial cholecystectomy, identification of the lesion intraoperatively or not, time from bile duct injury at cholecystectomy to final management, Interventions performed both in the local hospital and in the reference hospital prior to its definitive treatment, diagnostic methods for bile duct injury and laboratories for admission to the reference hospital. The inclusion criteria were patients who were admitted with a diagnosis of bile duct injury in the gastrosurgery service of the Bernardo Sepúlveda Specialty Hospital, of the National Medical Center Siglo XXI. The exclusion criteria were patients with incomplete clinical records or who did not have a record. Statistical analysis was performed using the IBM SPSS 26 software platform. Measures of central tendency and dispersion were applied. Fisher's exact test was used for categorical variables. Statistical significance was set at $p < 0.05$.

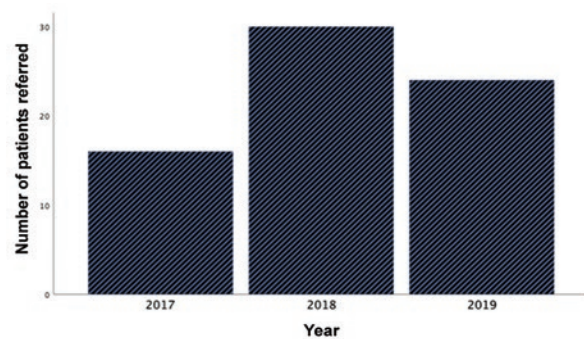


Figure 1. Patients referred per year.

Results

Between January 1, 2017 and December 31, 2019, 93 patients were classified in the censuses of the gastrosurgery service as bile duct injury, and of these, 23 were excluded from the analysis: in two patients bile duct injury was ruled out and in 21 patients it was not possible to have their clinical record physically or electronically.

Of the 70 patients diagnosed with bile duct injury included for the study, the number of patients referred per year to our hospital was 16 in 2017, 30 in 2018 and 24 in 2019 (Fig. 1).

The mean age was 45 years, with a minimum of 16 and a maximum of 80, and with a higher frequency of the female sex (53 patients; 75.7%) against the male (17 patients; 24.3%). The most common indication for cholecystectomy was urgent, in 36 patients (51.4%), while in 34 patients (48.6%) with bile duct injury it was performed electively. It was performed openly in 21.4%, laparoscopic in 58.6% and with conversion to open surgery in 20%.

The time of detection of the lesion in the bile duct was postoperative in 74.3% and during surgery in 25.7%. The most common clinical manifestations at the time of reference were external biliary fistula, bilioperitoneum and cholangitis, which affected 47.1%, 18.6% and 12.9%, respectively. The reference time to our hospital had a median of 11 days, with a range of 1 to 739 days.

As part of the diagnostic approach, to confirm and stage the lesion, and to establish a subsequent plan, imaging studies were used: ultrasound, computed tomography, endoscopic retrograde cholangiopancreatography (ERCP), T-tube cholangiography and magnetic resonance cholangiopancreatography, which were performed in 42 (60%), 54 (77.1%), 38 (54.3%), 6 (8.6%) and 53 (75.7%) patients, respectively.

The patients were divided according to whether they presented biliary stenosis or leak: 53 (75.7%) had biliary leakage and 17 (24.3%) stenoses, once the diagnostic protocol was completed.

The Strasberg-Bismuth system was used to classify the bile duct lesion, distributed in the following types: A 15.7%, B 1.4%, C 0%, D 7.1%, E1 1.4%, E2 21.4%, E3 32.9%, E4 18.6% and E5 1.4%. The association of bile duct injury with vascular injury occurred in 12.9% of cases, with the right hepatic artery being the most frequent site of injury; in addition, it is observed that the greater the degree of injury there is an increase in the concomitant frequency of vascular injury (Table 1).

Thirty-seven patients (52.9%) were referred from different points in Mexico City, while 33 (47.1%) were referred from other states (Fig. 2).

Prior to definitive treatment at our institution, patients underwent different procedures at their local hospitals. To avoid further complications after the injury or failing to repair the damage, endoscopic, radiological, surgical or radiological/endoscopic methods were used in 27.1%, 1.4%, 70% and 1.4%, respectively. Of the patients in whom the lesion was identified intraoperatively, the placement of drains and sending to our hospital was the most performed procedure, in 66.7%, followed by primary repair in 27.8%, and only in 1 patient (5.5%) a bile duct bypass tube and drains were placed. In contrast, in patients with postoperative lesion identification, the main procedures performed were ERCP, laparotomy plus drain placement and expectant management secondary to drainage placement during cholecystectomy, in 36.5%, 25% and 21.2%, respectively. Nutritional support with total parenteral nutrition was used in 9 patients (12.9%), with a mean time of use, prior to definitive treatment, of 7.11 ± 2.89 days. The management of the lesion in our hospital consisted predominantly of surgery, in 78.3%, while endoscopic treatment was performed in 21.7%. Bilioenteric reconstruction was the most used procedure in 75.4%, followed by ERCP in 21.7% (Table 2). The detail of the management according to the type of lesion according to the Strasberg classification is shown in Table 3.

The albumin level was determined upon admission to our hospital and classified into two groups depending on whether it was normal or abnormal, defined as greater or less than 3.5 mg/dl, respectively (Table 4). At the time of admission, the albumin of 47 patients (67.1%) was below normal values (< 3.4 g/dl), while 23 patients (32.9%) had albumin > 3.5 g/dl. Of those with low

Table 1. Clinical characteristics of the patients

Characteristics	n	%
	70	100
Age, years (mean $\pm$ SD)	45.17 $\pm$ 17.23	
Sex		
Female	53	75.7
Male	17	24.3
Indication for cholecystectomy		
Elective	34	48.6
Urgency	36	51.4
Type of cholecystectomy		
Open	15	21.4
Laparoscopic	41	58.6
Converted	14	20
Time of detection of the lesion		
Intraoperative	18	25.7
Postoperative	52	74.3
Strasberg-Bismuth classification		
A	11	15.7
B	1	1.4
C	0	0
D	5	7.1
E1	1	1.4
E2	15	21.4
E3	23	32.9
E4	13	18.6
E5	1	1.4
Imaging tests		
Ultrasound	42	60
Abdomen/contrast CT scan	54	77.1
ERCP	38	54.3
CPRM	53	75.7
T-probe cholangiography	6	8.6
Days to repair, median (range)	20 (3-749)	
Reference days, median (range)	11 (1-739)	
Days from admission to repair, median (range)	6 (1-551)	
Vascular injury	9	12.9
Location of vascular lesion		
Right hepatic artery	9	100
A	1	11.1
E2	1	11.1
E3	3	33.3
E4	4	44.4
Clinical presentation		
Jaundice	5	7.1
Abdominal pain	3	4.3
Cholangitis	9	12.9
Bilioperitoneum	13	18.6
Septic shock	2	2.9
External biliary fistula	33	47.1
Septic shock+bilioperitoneum	1	1.4
Bilioperitoneum+pancreatitis post-ERCP	1	1.4
Cholangitis + biliary fistula	1	1.4
Cholangitis + STDA	1	1.4
Bilioenteric fistula	1	1.4

ERCP: endoscopic retrograde cholangiopancreatography; MRCP: MRI retrograde cholangiopancreatography; SD: standard deviation; STDA: upper gastrointestinal tract bleeding.

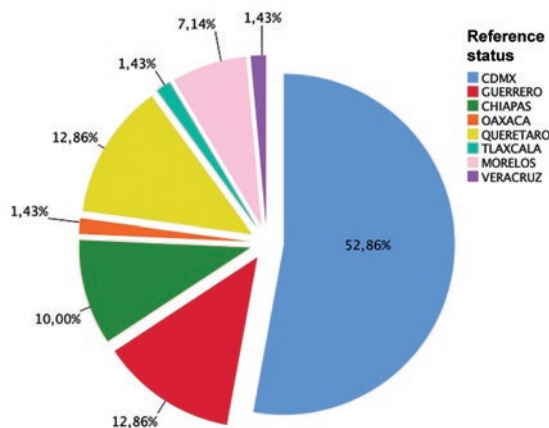


Figure 2. Place of reference of patients.

albumin, 19 (27.1%) had biliary fistula and 11 (15.7%) manifested as bilioperitoneum at admission (Table 4).

Patients were followed from the time of repair, either medical or surgical, and postsurgical complications occurred in 26 (37.1%), the most common being bilioenteric diversion stenosis (19.2%), followed by bilioenteric diversion dehiscence, infection (pulmonary/abdominal), incisional hernia and biliary fistula (15.4%, 15.4%, 15.4% and 11.5%, respectively). Mortality was 2.9%, with cardiogenic shock and septic shock plus cholangiocarcinoma being the causes of death for the two patients (Table 5).

The association of abnormal albumin level on admission, defined as < 3.5 mg/dl, with the presence of postoperative complications was analyzed; 69 patients were included in this group, as one patient died prior to repair. Fisher's exact test was used for the analysis and no statistically significant association was found with the occurrence of complications ($p = 0.672$).

The definition of early or late repair does not have a universally defined time, so for this study it was used as the definition of early repair before 14 days and late after 14 days, based on a meta-analysis conducted by Wang et al.¹⁷ in 2020. In our study, 25 patients (37.1%) underwent early repair and 44 (62.9%) underwent late repair, finding no association with postoperative complications ($p = 0.121$).

Discussion

The results of the experience in the management of bile duct injury in a national reference center over a period of 3 years are presented. Patients referred to our hospital from Mexico City were 52.9%, of which

Table 2. Injury management

Characteristics	n	%
	70	100
Intervention prior to final repair		
Surgical	49	70
Endoscopic	19	27.1
Radiological	1	1.4
Radiological + endoscopic	1	1.4
Type of previous intervention		
Laparotomy + drainage	13	18.6
Primary repair	6	8.5
Intraoperative drainage placement	23	32.9
Drain + T-probe	7	10
Percutaneous drainage	1	1.4
ERCP + percutaneous drainage	1	1.4
ERCP	19	27.1
Final procedure*		
Surgical	54	78.3
Endoscopic	15	21.7
Type of final procedure*		
Roux-en-Y hepatic jejunal anastomosis	52	75.4
Primary closure	1	1.4
ERCP (stent ± sphincteroplasty)	15	21.7
T + drain probe placement	1	1.4
Use of preoperative TPN	9	12.9
Preoperative TPN days (mean ± SD)	7.11 ± 2.89	

ERCP: endoscopic retrograde cholangiopancreatography; SD: standard deviation; TPN: total parenteral nutrition.

*One patient with E2 lesion died prior to repair.

two hospitals constituted approximately 50% of the patient volume. Knowing these data is of vital importance, since from them you can make a feedback and determine which are the points in which you are failing to perform a cholecystectomy.

We can observe that the preoperative diagnostic protocol is still without having a determined algorithm for all patients, since ultrasound, computed tomography, ERCP, T-probe cholangiography and magnetic resonance cholangiopancreatography were performed in 42 (60%), 54 (77.1%), 38 (54.3%), 6 (8.6%) and 53 (75.7%) patients, respectively. From this we could create an algorithm regarding the imaging studies necessary to have an adequate diagnosis of the bile duct lesion and its subsequent planning of the treatment, whether surgical or medical, as proposed in figure 3.

Immediate complications occurred in 53.84% (14) of patients, which resolved satisfactorily. The incidence of stenosis reported in the literature ranges from 4.1% to 69%, and in most studies it is 10% to 20%¹⁸. The patients who required surgical management with a bilioenteric reconstruction in our hospital were 52, with

Table 3. Definitive treatment according to the Strasberg classification

Strasberg-Bismuth classification	n	Drainage + T probe	ERCP	Primary repair	Bilioenteric reconstruction
	69				
A	11	0	11	0	0
B	1	0	0	0	1
C	0	0	0	0	0
D	5	0	4	1	0
E1	1	0	0	0	1
E2*	14	1	0	0	13
E3	23	0	0	0	23
E4	13	0	0	0	13
E5	1	0	0	0	1

ERCP: endoscopic retrograde cholangiopancreatography.

*One patient with E2 lesion died prior to repair.

Table 4. Biochemical characteristics on admission

Characteristics	n	%
	70	100
Albumin (mean $\pm$ SD)	3.13 $\pm$ 0.682	
< 2 g/dl	4	5.7
2.1-2.4 g/dl	8	11.4
2.5-2.9 g/dl	15	21.4
3-3.4 g/dl	20	28.6
3.5-3.9 g/dl	13	18.6
4-4.4 g/dl	8	11.4
4.5-5 g/dl	2	2.9
Albumin		
Abnormal (< 3.4 mg/dl)	47	67.1
Normal (> 3.5 mg/dl)	23	32.8

SD: standard deviation.

*One patient with E2 lesion died prior to repair.

a satisfactory resolution in 90.38% according to the criteria of McDonald et al.¹⁹, because five patients presented stenosis of the anastomosis, with a calculated incidence of stenosis of 9.61% and a mean stenosis time of 402 days. Post-stenosis management of the anastomosis was performed surgically in 100% of cases, with remodeling of the bilioenteric diversion; Of these, three patients presented satisfactory resolution of stenosis, and conversely in two it was ineffective

with progression to secondary biliary cirrhosis. In the case of biliary leakage, only medical management (fasting/total parenteral nutrition $\pm$ octreotide) was considered in patients with low biliary output, defined as < 200 ml per day; otherwise, management was performed with hepaticojejunal anastomosis.

To a lesser extent, endoscopic management with sphincterotomy and/or *stent* placement was performed, with type A and D lesions according to the Strasberg classification being those that can be resolved with non-surgical management. The time in which the repair is done, either early or late, has no relation to the postoperative result as long as adequate prior management is given to the patient, the most important being the control of sepsis^{20,21}.

In our study, the association with vascular injury presented a frequency of 12.9%, being lower than that reported globally in the world, which is around 25%^{22,23}. Likewise, we can observe that the greater the degree of injury, the greater the probability of vascular injury, since we found a higher frequency of vascular injury in types E3 (33.3%) and E4 (44.4%).

During the study, the relationship between the development of postoperative complications, mainly anastomosis dehiscence in the case of repair with bilioenteric reconstruction, and an abnormal albumin level, defined as < 3.5 mg/dl prior to repair, was analyzed. In the statistical analysis, Fisher's exact test was used and it was found that there is no statistically significant association with the occurrence

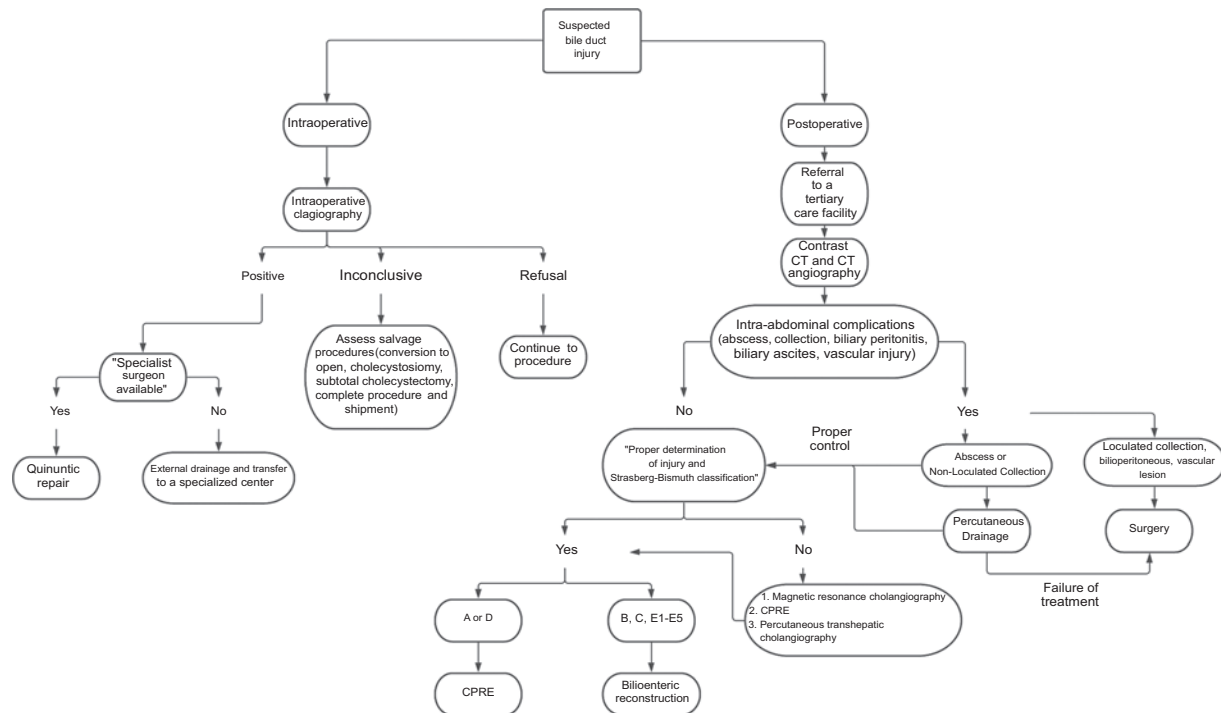


Figure 3. Proposed algorithm for the management of bile duct injury.

Table 5. Postoperative complications and management

Characteristics	n	%	Days, mean (range)	Postoperative management
	26	(100%)		
Stenosis - HYA	5	(19.2%)	402 (312-525)	HYA Remodeling
Dehiscence - HYA	4	(15.4%)	Immediate complication	HYA Remodeling
Low-output biliary fistula (< 200 ml)	3	(11.5%)	Immediate complication	Medical treatment and/or TPN
Cholangitis	1	(3.8%)	Immediate complication	Antibiotic management
Infection* (lung/abdominal)	4	(15.4%)	Immediate complication	Antibiotic management and/or percutaneous drainage
Incisional hernia	4	(15.4%)	208.5 (194-223)	Surgical repair
Intra-abdominal collection	2	(7.7%)	Immediate complication	Percutaneous drainage
Secondary biliary cirrhosis	2	(7.7%)	639.5 (588-691)	Medical management/liver transplantation
Post-ERCP stenosis	1	(3.8%)	315	Bilioenteric diversion
Mortality	2	(2.9%)		
Overall survival	68	(97.1%)		
Cause of death	Septic shock, cholangiocarcinoma, cardiogenic shock			

ERCP: endoscopic retrograde cholangiopancreatography; HYA: hepatic-jejunum anastomosis; TPN: total parenteral nutrition.

*One patient had hospital-acquired pneumonia, two patients had liver abscess and one patient had pseudomembranous colitis.

of complications ($p = 0.672$), and it can be concluded that a low albumin level is not a contraindication to perform surgical repair.

The statistics found in our hospital mostly agree with those of the rest of the world, being of interest the points of association between early repair time (defined as before 14 days according to the meta-analysis of Wang et al.¹⁷ on which we base our repair time) against late repair and the development of early complications, in which no differences were found, so hospital management prior to treatment, whether medical, endoscopic or surgical, is the cornerstone to obtain a satisfactory result for the patient^{24,25}.

Likewise, repair by an expert surgeon such as the hepatopancreatobiliary surgeon was not taken into account in this study, since studies show a lower probability of postoperative success when surgery is performed by a general surgeon not experienced in this type of intervention^{8,25,26}. However, as can be seen in our results, the incidence of stenosis is within the low values reported worldwide; one explanation would be that our surgeons, both hepatopancreatobiliary and general, have developed sufficient surgical experience in performing such a procedure, from both theoretical and practical cooperation within our surgical service.

On the other hand, both morbidity (37.1%) and mortality (2.9%) of our hospital are within those reported in other countries, which gives us a reference point on the adequate management we provide to patients in our institution^{2,18}.

An important aspect that should be highlighted is the difficulty, as well as the lack of transparency, that exists in our country to obtain basic information about our health system; In this case, for example, the information requested on the number of cholecystectomies in recent years through the different state and federal agencies was nil. The supposed access to information that we should have is an important barrier to be able to identify the weak points that prevent us from improving our health system and that limit us in the quality of patient care.

Conclusions

The main objective of this study is to determine the epidemiological characteristics of patients who are referred to our institution with a complex diagnosis such as bile duct injury, in order to be able to develop algorithms over time that allow us to develop a superior diagnostic protocol, as well as an optimization in surgical management always promoting the recommendations already existing in the literature, such as the

critical vision of safety and time out in the case of difficult cholecystectomy for its adequate resolution and prevention of complications.

With this we can conclude that the data obtained are similar to those reported worldwide, and that the management provided so far has been developed adequately, so we can consider that we are a reference hospital for the management of this type of complications.

Bile duct injury is a complication of a very common procedure in our environment, which involves specialized management in reference centers that can provide adequate management in order to improve the quality of life of patients.

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The authors declare that they have no conflict of interest.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Ethical disclosures

Protection of people and animals. The authors declare that no experiments were carried out on humans or animals for this research.

Data confidentiality. The authors declare that they have followed the protocols of their work center regarding the publication of patient data.

Right to privacy and informed consent. The authors declare that no patient data appears in this article.

References

1. Bile duct injury. Clinical Practice Guide. Mexico: Mexican Association of General Surgery; 2014.
2. Ismael HN, Cox S, Cooper A, Narula N, Aloia T. The morbidity and mortality of hepaticojejunostomies for complex bile duct injuries: a multi-institutional analysis of risk factors and outcomes using NSQIP. *HPB (Oxford)*. 2017;19:352-8.
3. Jones MW, Deppen JG. Open cholecystectomy. [Updated 2020 Oct 1]. Treasure Island (FL): StatPearls Publishing; 2020 Jan. Disponible en: <https://www.ncbi.nlm.nih.gov/books/NBK448176>
4. The IMSS in figures. Surgical interventions. *Rev Med Inst Mex Seg Soc*. 2005;43:511-20.
5. Peristat J. Laparoscopic cholecistectomy: the European experience. *Am J Surg*. 1993;165:444-9.
6. Cohen J, Charpentier K, Beard R. An update on iatrogenic biliar injuries: identification, classification and management. *Surg Clin N Am*. 2019;99:283-99.
7. Gutiérrez J, Medina G, Ortiz S, Lozano H. Lesión de vía biliar. Prevalence in patients with laparoscopic cholecystectomy in a specialty hospital. *Cir Gen*. 2011;33:38-42.
8. Velasco MF, Salinas JA, Rodarte A, Bernal AK, Ron C. Comparative analysis of bile duct lesions: prevalence in patients with laparoscopic cholecystectomy and open cholecystectomy at General Hospital 450 in Durango, Mexico. *Cir Gen*. 2018;40:159-63.

9. Strasberg SM. A three-step conceptual roadmap for avoiding bile duct injury in laparoscopic cholecystectomy: an invited perspective review. *J Hepatobiliary Pancreat Sci.* 2019;26:123-7.
10. Hunter JG. Avoidance of bile duct injury during laparoscopic cholecystectomy. *Am J Surg.* 1991;162:71-6.
11. Strasberg SM, Brunt LM. Rationale and use of the critical view of safety in laparoscopic cholecystectomy. *J Am Coll Surg.* 2010;211:132-8.
12. Jabłońska B, Lampe P. Iatrogenic bile duct injuries: etiology, diagnosis and management. *World J Gastroenterol.* 2009;15:4097-104.
13. Kanakala V, Borowski DW, Pellen MG, Dronamraju SS, Woodcock SA, Seymour K, et al. Risk factors in laparoscopic cholecystectomy: a multivariate analysis. *Int J Surg.* 2011;9:318-23.
14. Fullum TM, Downing SR, Ortega G, Chang DC, Oyetunji TA, Van Kirk K, et al. Is laparoscopy a risk factor for bile duct injury during cholecystectomy? *JSLs.* 2013;17:365-70.
15. Strasberg SM. Avoidance of biliary injury during laparoscopic cholecystectomy. *J Hepatobiliary Pancreat Surg.* 2002;9:543-7.
16. Fong ZV, Pitt HA, Sicklick JK, Strasberg SM, Loehrer AP, Talamini M, et al. Cost of bile duct injury: surgical vs endoscopic management. *J Am Coll Surg.* 2017;225(4):S113.
17. Wang X, Wen-Long Y, Xiao-Hui F, Bin Z, Teng Z, Yong-Jie Z. Early versus delayed surgical repair and referral for patients with bile duct injury. *Ann Surg.* 2020;271:449-59.
18. Schreuder AM, Busch OR, Besselink MG, Ignatavicius P, Gulbinas A, Barauskas G, et al. Long-term impact of iatrogenic bile duct injury. *Dig Surg.* 2019;17:1-12.
19. McDonald ML, Farnell MB, Nagorney DM, Ilstrup DM, Kutch JM. Benign biliary strictures: repair and outcome with a contemporary approach. *Surgery.* 1995;118:582-90; discussion 590-1.
20. Martinez S, Upasani U, Pandanaboya S, Attia M, Toogood G, Lodge P, et al. Delayed referral to a specialist centre increase morbidity in patients with bile duct injury after laparoscopic cholecystectomy. *Int J Surg.* 2017;44:82-6.
21. Kpoor V. Bilde duct injury repair earlier is not better. *Front Med.* 2015;9:508-11.
22. Buell JF, Cronin DC, Funaki B, Koffron A, Yoshida A, Lo A, et al. Devastating and fatal complications associated with combined vascular and bile duct injuries. *Arch Surg.* 2002;137:703-10.
23. Bilge O, Bozkiran S, Ozden I, Tekant Y, Acarli K, Alper A, et al. The effect of concomitant vascular disruption in patients with iatrogenic biliary injuries. *Langenbecks Arch Surg.* 2003;388:265-9.
24. Kirks RC, Barnes TE, Lorimer PD, Cochran A, Siddiqui I, Martinie JB, et al. Comparing early and delayed repair of common bile duct injury to identify clinical drivers of outcome and morbidity. *HPB (Oxford).* 2016;18:718-25.
25. Jabłońska B, Lampe P, Olakowski M, Gorka Z, Lekstan A, Gruska T, et al. Hepaticojejunostomy vs. end-to-end biliary reconstructions in the treatment of iatrogenic bile duct injuries. *J Gastrointest Surg.* 2009;13:1084.
26. Renz BW, Bösch F, Angele MK. Bile duct injury after cholecystectomy: surgical therapy. *Visc Med.* 2017;33:184-90.