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Original Research Article

Management of Biliary Injuries after Open and Laparoscopic Cholecystectomies

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Abstract

Bile duct injuries during laparoscopic and open cholecystectomy are still serious problems which may cause secondary biliary cirrhosis resulting in chronic liver failure. Injuries occur as a result of technical errors or misidentification of biliary ducts. BDIs are major cause of patient morbidity and litigation. This study aimed to evaluate the management of bile duct injuries (radiological, endoscopic or surgical management) following open and laparoscopic cholecystectomy in a tertiary referral hospital. A prospective clinical study was conducted 50 patients (9 males and 41 females) who sustained bile duct injuries during open and laparoscopic cholecystectomy. Patients were thoroughly investigated to decide the final management, and they were followed up to two years post operation to find out short- and long-term complications. The most common presentations of those patients were biliary fistula, 18 (36%) and jaundice, 14 (28%). After resuscitation, the definite managements were percutaneous drain under ultrasound guide for one patient (2%), Endoscopic retrograde cholangio pancreatographystenting or sphinectrotomy for 5 patients (10%) andhepaticojejunostomy for complete common hepatic duct transection for 43 patients (86%), most of which were done 8weeks after the primary operation. One patient succumbs before any intervention.

According to the results of this study, patients with bile duct injuries are preferably treated in hepato-biliary department, where all radiological, endoscopic and experience surgeon available. Roux-en-hepaticojejunostomy is the procedure of choice for the management of patients sustaining complete transaction injury of common hepatic duct, while percutaneous drain is an excellent option for the drainage of intraperitoneal bile collection, without need for open drainage.

Key Words: Cholecystectomy, iatrogenic bile duct injuries, Complications

علاج اصابات القناة الصفراوية ما بعد عمليات استئصال المرارة جراحيا او منظاريا

الخلاصة

لاتزال أصابات القناة الصفراوية اثناء استئصال المرارة بالمنظار او جراحيا م ن المشاكل الخطيرة التي قد تسبب تشمعا صفراويا ثانويا مؤديتا الى الفشل الكبد المزمن. تنتج هذه الاصابات عن اخطاء فنية او عدم التعرف على القنوات مما يسبب مضاعفات مرضية للمريض واشكالات قانونية للطبيب . هدفت هذه الدراسة الى تقييم طرق معالجة اصابات القنوات الصفراوية في مستشفى الاحالة الرئيسي (بالتداخلات الاشعاعية، المنظارية أوالجراحية) والتي تحصل بعد استئصال المرارة جراحيا أو منظاريا . شملت هذه الدراسة ٥٠ مريضا (٩ ذكور و ٤١ انثى) ممن اصيبوا بأذى القناة الصفراوية اثناء استئصال المرارة. خضع المرضى للفحص الشامل من اجل تحديد طريقة العلاج النهائية ، وتمت متابعتهم لمدة عامين بعد عملية الاصلاح للكشف عن مضاعفات قصيرة وطويلة الامد. ابرز الاعراض التى ظهرت على المرضى المصابين بأذى القنوات الصفراوية كانت ناسور الصفراء ١٨ (٣٦%)

واليرقان ١٤(٢٨%). وبعد اجراء الانعاش اللازم كان العلاج النهائي على شكل بزل من خلال الجلد بمساعدة الا مواج فوق الصوتية لمرض واحد (٢%)، تصوير البنكرياس بالتنظير الباطني بالطريق الراجع مع وضع عبارة أو قص معصرة الصفراء لخمس مرضى (١٠%) ، ومفاغرة القناة الكبدية بالصائم لـ ٤٣ مريضا (٨٦%)معظمهم بعد ٨ أسابيع من حصول الاذى . توفي أحد المرضى قبل اي تداخل . على ضوء نتائج هذه الدراسة يفضل ان يعالج مرضى اصابات القنوات الصفراوية في مراكز تخصصية حيث تتوفر الامكانات التشخيصية من اشعة وناظور وجراحين ذوي خبرة . مفاغرة القناة الكبدية بالصائم هي الطريقة المفضلة لعلاج المرضى المصابين بالقطع الكامل للقناة الصفراوية العامة ، في حين يعد البزل خلال الجلد خيار ممتاز لمعالجة تجمع المادة الصفراوية في البريتون بدون الحاجة الى اجراء فتح بزلي.

الكلمات المفتاحية : استئصال المرارة ، اصابات القنوات الصفراوية علاجية المنشأ، المضاعفات.

Introduction

Bile duct injury (BDI) is a serious and potentially life-threatening complication of cholecystectomy, with severe consequences in some patients [1,2]. Apart from early postoperative complications, there is also a risk of long-term sequelae such as strictures of the common bile duct and repeated attacks of cholangitis [3]. In addition, such injuries represent a vast economic burden to the society and they raise a high rate of medico-legal claims [2].

Before the advent of laparoscopic cholecystectomy (LC) in the late 1980s, open cholecystectomy (OC) was the prevalent mode of treatment for gall-stones with an incidence of BDIs between 0.1 and 0.3% [4].During the early era of LC, the incidence was 1–2 %. However, with growing experience of laparoscopic surgeons and availability of better operating instruments, the rate of iatrogenic BDIs has dropped to 0.3–0.6% [5] and the LC is now accepted as the treatment of choice for symptomatic gallstones [4,5].

Two major risk factors can predispose for BDIs; patients related risk factors are either anatomical or pathological. Misidentification of common bile duct (CBD), and anatomical variation are among the most important anatomical factors. On the other hand, acute severe and chronic cholecystitisare well-known pathological factors. Operator factors (surgeon and assistants) are associated with imperfect operative technique e.g. excessive upward retraction on the gallbladder or insufficient lateral retraction or excessive tenting of the bile duct may confound correct anatomical identification [6].

Magnetic resonance cholangiopancreato-graphy (MRCP) is the most sensitive and accurate test frequently used for the diagnosis of complications of cholecyst-ectomy including BDIs even though percutaneous transhepatic cholangiography (PTC) can better delineate certain complications, e.g.common bile duct (CBD) strictures [7]. Other investigations in use are endoscopic retrograde cholangiopancreatography (ERCP) ultra-sonography, and intra-operative cholangio-graphy [8,9].

The treatment of BDIs has changed since the introduction of laparoscopic surgery. Most bile leaks are now treated with endoscopic procedures like stents and endoscopic sphincterotomy, whereas the more severe cases will still need a repair of the common bile duct [10].

This study aimed to evaluate the management of bile duct injuries (radiological by peritoneal dialysis (PD) catheter, endoscopic by ERCP or surgical management in form of bilio-enteric anastomosis) following open and LC in a tertiary care center and to choose the best option in proper time according to the level of injury and general conditions of the patients

Materials and Methods

A prospective study from December 2013 to April 2016 was conducted in

Gastroenterology and Hepatology Teaching Hospital/Medical City/Baghdad. Patients with biliary complication after open or LC either in our center or those referred to our center from other tertiaries whether they need surgical intervention or not were eligible for this study. All patients were evaluated by a multidisciplinary team and the best available treatment option was decided. The information regarding primary operative procedure, presenting symptoms, the type and level of biliary tract injury, diagnostic procedures, and therapeutic interventions before and after referral was obtained from patient records.

The prospective diagnosis of biliary injury as well as the complications occurring to the other organs, particularly the liver, was made according to history, clinical presentation, blood investigations, liver function tests,sonography, magnetic resonance MRCP and CT scan in some patients. Exclusion criteria involve the presence of biliary leak or obstructive jaundice secondary to external traumatic injuries (blunt and penetrating injuries), biliary stricture secondary to liver transplantation, and hepatocellular jaundice. After applying these criteria, a total of 50 patients with BDIs satisfied the requirement of this study. They were 9 men (18%) and 41 women (82%) with mean age of 41.6±11.3 years at the time of repair surgery. The primary surgery of three patients was done in our center, while the other 47 patients were referred from other hospitals in Baghdad and other Iraqi governorates.. Other demographic data for those patients are presented in table 1.

The anatomic extend of BDIs was classified according to Strasberg-Bismuth classification system [11]. Three definitive treatments were adopted which were radiological interventions, endoscopic therapy and surgical interventions (hepaticojejunostomy-HJS). Patients having surgical repair were further classified in two groups based on time period from injury to repair into: intermediate (3 days to 6 weeks), and late (after 6 weeks). In patients with collection and/or sepsis, biliary drainage and treatment of sepsis preceded the definitive repair.

After discharge, patients were followed regularly in the outpatient clinics, and both short- and long-term complications were recorded. Postoperative complications were considered short-term when occur within 30 days of repair surgery; otherwise, they were considered long-term complications. The follow-up time was the period extending from the date of repair surgery to the last follow-up visit or death. This time ranged from 0 to 24 months with an average of 13.24±37 months.

Results

Demographic Data of Patients

Fifty patients (47 patients referral and three patients from our center) with BDIs had been treated in Gastroenterology and Hepatology Teaching Hospital (GE&HTH)/ Medical City/Baghdad. Table (1) shows the demographic date of patients.

Table 1: Baseline data of patients with bile duct injuries

Characteristics	Values
Age/ years (mean±SD)	41.6±11.3
Sex	
Males	9(18%)
Females	41(82%)
Smoking	
Ex/current	3(6%)
Never	47 (94%)
Comorbidities	
Hypertension	5(10%)
Type 2 DM	3(6%)
Asthma	1(2%)
Ischaemic heart disease	1(2%)
Preoperative investigations	
ERCP	14(28%)
Trans abdominal US	44(88%)
CT	28(56%)
MRI	41(82%)
Type of primary Operation	
OC	٧(١٤%)
LC	40(80%)
LC then converted to OC	3(6%)
Method of cystic duct identification	
Critical view of safety	3(6%)
Infundibular approach	22(44%)
Unknown	25(50%)
Site of operation	
General hospital	40(80%)
Private hospital	10(20%)
Indication for repair	
Cholangitis	4(8%)
Jaundice	14(28%)
Intra-abdominal sepsis	8(16%)
Biliary fistula	18(36%)
Pain	10(20%)

DM: diabetes mellitus, ERCP: Endoscopic retrograde cholangiopancreatography, CT: computerized tomography, MRI: Magnetic resonance imaging, PTC: percutaneous trans-hepatic-cholangiogram, OC: open cholecystectomy, LC: laparoscopic cholecystectomy.

Injury was recognized during Index operation in 9 (18%). One of them had hepaticojejunostomy, one had suture of duct(s) with t-tube, while the others referred to our center after insertion of abdominal drain near the injury. Forty primary operations were done in general hospitals versus 10 operations in private hospitals. Forty patients (80%) underwent LC; 7(14%) underwent OL, while 3(6%) started with LC then converted to OC. The cystic duct identification was done by the infundibular

technique 22(44%), and critical view of safety 3(6%). Injury was recognized during primary operation in 9 (18%). One of them had hepaticojejunostomy, while other one had suture of duct(s) with or without t-tube.

As indicated in table 1, five diagnostic imaging methods were used for investigation of BDIs which were MRCP (figure 1) in 14 (28%), trans abdominal US in 44 (88%), CT in 28 (56%), and MRI in 41 (82%).

Figure 1: Magnetic resonance cholangiopancreatographyShowingE2 injury.

Accordingly, BDIs were classified to 7 Strasberg-Bismuth grades, with most patients had E2 (40%) or E3 (30%) grades (Figure 2).

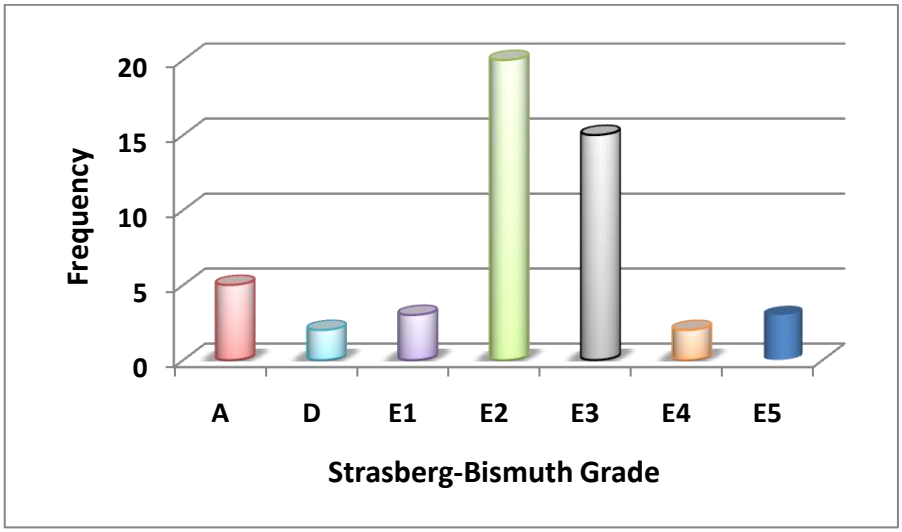

Figure 2: Strasberg-Bismuth injury classification of 50 patients

Timing and Types of Treatment

Initially, patients resuscitated by fluid and electrolyte correction, nutritional support, control sepsis, and skin protection in case of bile fistula. A total of 6 patients (12%) were received definitive non-surgical treatment. Per-cutaneous drain was deployed to drain billoma in 28patients, and it was considered

as definite treatment in one patient with Strasberg class A injury. Fourteen patients underwent ERCP; however, only in 5 patients with class Strasberg A and D, the condition resolved and no further surgery was required (Figure 3).

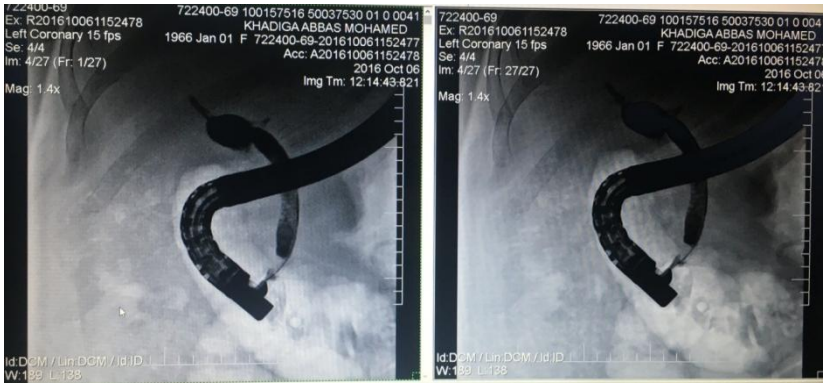

Figure 3: Endoscopic retrograde cholangiopancreatography Showingcomplete trisection ligation of common hepatic duct.

One patient (2%) died pre-operatively before biliary reconstruction operation due to sepsis. For the other 43 patients, only two (4.6%) had intermediated repair (within 3 days to 6 weeks) with hepaticojejunostomy, while the vast majority of patients were with Strasberg class E injury (the classical injury) and received late repair (after 6 weeks of BDIs). Forty patients of those (97.5%) required definite surgical repair in form of hepaticojejunostomy according Hipp-Couinaud technique, while double-barrelledhepatico-jejunostomy was used as a definitive repair in one patient (2.5%).

Surgical Procedure

Surgical approach was by exposure through a right subcostal incision extended slightly to the opposite side or midline. The dissection of the biliary tree was carried cranially along the anterior side of the hilar plate to obtain viable bile duct with well-vascularized epithelium. The exposed bile ducts were opened above the area of fibrosis and ischemia (figure 4). The base of segments 4B or 5 was cored (The Hepp-Couinaud technique) if necessary (Strasburg E4 injury). The actual anastomosis was carried out with interrupted 3-0 or 4-0 absorbable (vicryl or polydioxanon) sutures into Roux-en-Y jejunal loop at least 45 cm long. The posterior row of sutures was tied intra-luminally. In some cases, the dissection had to be carried above the bifurcation, resulting in two or three open bile ducts. In such cases, the anastomoses were performed separately. Intraluminal stents were not used.

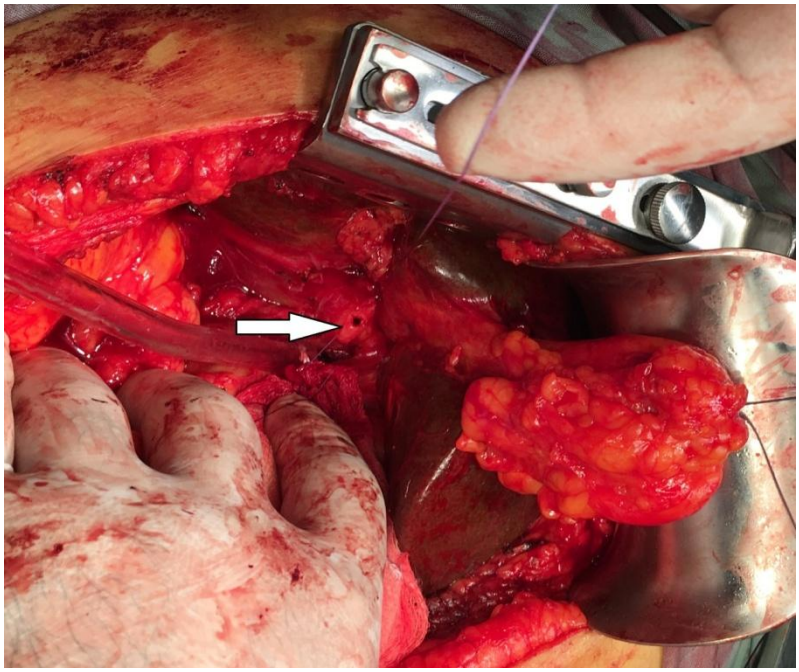

Figure 4: Bile duct opening above the site of fibrosis

Postoperative Complications

Short Term Complications

Short term complications were reported within 30 days post operation. These include superficial wound infection, 5 (10%); pneumonia, 2 (4%); postoperative transfusion, 1(2%) and urinary tract infection, 2 (4%). Procedure-specific complications include bile leaks, 4 (9%); cholangitis, 1(7%), and pancreatitis, 2(14%) after ERCP, and blocked 5(17%) and slipped catheter 3(10%) after PD catheter. Each case of these treated individually according to its requirement.

Table 2: short-term complications

Short Term Complications	No (%)
Postoperative	
Superficial wound infection	5(10%)
Deep incisional wound infection	1(2%)
Pneumonia	2(4%)
Urinary tract infection	2(4%)
Bleeding/transfusion	1(2%)
Procedure-specific	
ERCP (n=14)	
Cholangitis	1(7.14%)
Pancreatitis	2(14.28%)
PD (n=28)	
Block	5(17.85%)
Slipped	3(10.71%)
Surgery (n=43)	
Biliary fistula	4(9.3%)

Long Term Complications

For two years follow-up, a total of 9 (18%) long-term complications have been recognized; all of which were related the surgical operation. Table 3 shows these complications and their management. Bile duct stricture and incisional hernia represented the most common long term complication with 6.97% incidence for each.

Table 3: Long-term complications

Long Term Complications	No (%)	Managements
Incisional hernia	3(6.97%)	Mesh repair
Stricture	3(6.97%)	Redo hepaticojejunostomy
Liver atrophy	1(2.32%)	Referred for liver transplantation
Bile duct stones	2(4.65)	Redo hepaticojejunostomy with stone removal

Discussion

This prospective study aimed to evaluate the management of BDIs after LC or OC in a referral tertiary center. Generally, data regarding BDIs in Iraq are very rare, and there are no reliable records for the annual incidence of these injuries. However, dealing with 50 patients with BDIs within less than 30 months (the duration of the study) reflects a high rate of BDIs following cholecystectomy. In one study, Al-Hilfi and Ahmed [12] investigated the risk factors associated with the incidence of vesculobiliary injuries. They found that acute cholecystitis (72%), private hospitals (20%) and inexperienced surgeon (20%) are the main risk factors.

Among the many factors accused for this high rate is the dissection method. Patients' records showed that 44% of the primary surgery employed in fundibular technique to avoid surgical induced morbidity, while only 6% had the critical view of safety, may be due to the relative novelty of last method. Vettoretto *et al*. [13] showed that critical view of safety is more proper to be used than infundibular technique especially for young surgeons. Recently, Al-Helfy [14] successfully used methylene blue as an alternative method to eliminate BDIs during LC although more studies are required to reach solid conclusion.

The other factor is the type of surgery. The current study revealed that most (80%) of referred cases with BDIs underwent LC. Three facts could be extracted from this result. Firstly it is in accordance with the general concept that more BDIs are associated with LC compared to OC. Secondly, it reflects the presence of adequate facilities for conducting LC in most Iraqi governorates. In this regard, Aziz *et al*. [15] in Egypt, reported more BDIs in OC than LC (61% vs 39%) and attributed this result not to the procedure itself but to the predominant of OC because of lacking facilities for conducting LC in many Egyptian regions. Finally, this result confirms the conclusion of Al-Hilfi and Ahmed [12] in that many surgeons still do not satisfy the learning curve.

In this study BDI (E2) represented 40% of injuries, High injuries (E3 to E5) represented 40% of injuries. In comparison to other study, high injuries (E3 to E5) represented 37% of injuries [16].American study comprising 83,000 patients revealed that about 60% of the leaks were related to the cystic duct. We found that the Strasberg (type E) injuries are the most common type of injury which is called the classical injury. This agrees with other study [5].

Sometimes, pre-operative level of BDIs which defined by MRCP were different from actual intra operative finding, which

means that (E3) injury preoperative could be (E2) or (E4) injury. We thought this false higher MRCP staging occurred when there is filling defect (stone or sludge) above the stricture giving the impression of higher level injury, while false down MRCP staging occurred when separated right and left ducts (Strasberg E4) enface on each other on antero-posterior MRCP picture forming structure like CHD (Strasberg E3) giving false impression of lower injury.

Timing of repair is very crucial for successful proper management of BDIs. Unfortunately, the optimum period was not well-defined [17]. Sahajpal*et al*. [18] proposed two periods to minimize the risk of biliary stricture which are immediately (within 72 hrs) or late (after 6 weeks) of injury. Most patients in this study had late surgical repair. In this concern, it is well-known that immediate recognition and repair of such cases are associated with better outcome [19]. However, delayed referral to the tertiary center is very common, and in most cases the inflammatory response was in its peak when the patient referred to the center. Murr*et al.* [20] considered the inflammation and infection as unfavorable conditions for immediate surgery. A minimum period of 4–6 weeks between injury and repair is desirable for resolution of tissue edema and inflammation and for dilatation of the proximal ductal system [21]. For that reasons, the definitive repair in most patients was postponed until the inflammation subsides.

Three management options were considered in this study which were PD catheter, ERCP, and surgery. PD was done under US guide to aspirate intraperitoneal collection as a definitive way of treatment (in one patient with type A injury), or as a bridge for definitive treatment (in 27 patients). On the other hand, 5 patients (with A or D types)were successfully treated by ERCP stenting or sphinectrotomy. Other 9 underwent unnecessary and unsuccessful ERCP, with high complications rate, presumably that they have partial BDIs before full radiological assessment. ERCP should not be used as a diagnostic tool for BDIs especially (type E1-E5) injuries (figure 3) as it carries a considerable rate of morbidity, while MRCP can solve diagnostic dilemma (figure 1). Other studies report nonsurgical management of major bile duct injuries to be successful in 19% to 22% of the cases referred [22, 21]. The outcome of therapeutic endoscopy depends on the type of injury. In selected patients, the overall success may reach 93% [11,23]. The endoscopic or radiologically guided intervention may not be successful as a primary treatment in the more complex injuries but it is certainly advantageous in recurrent anastomotic strictures or in patients not suitable for surgery [22,24].The vast majority of the patients (43 patients) in this study were treated by surgery, 42 were treated by hepaticojejunostomy. The other one had Double-barreled hepatico-jejunostomy. Roux-en-Y hepaticojejuno-stomy is still the gold standard definitive procedure for iatrogenic bile duct injuries. In one study, 59.38%cases had undergone Roux-en-Y hepaticojejunostomy for CBD and CHD injuries [4].

There was only one patient (2%) who died pre-operatively before biliary reconstruction operation due to sepsis, and no intra-operative or postoperatively mortality occurs. This result is close to that obtained by Aziz *et al*. [15] who reported 4% mortality among Egyptian patients with LC-BDIs underwent surgical repair, and to that obtained by Sahajpal et al. [18] reported who reported 1% mortality among American patients having similar repair. Many factors are known to influence the mortality rate, the most important of which are patient's conditions at referring time, duration of follow up period and accessibility of the patient to specialized health center. Thus variation in mortality rate between different

studies does not precisely reflect the proper or improper management of BDIs.

Complications following BDIs management are not uncommon. The most prevalent shor-term complication in this study is superficial wound infections (10%). In almost similar study, it was found 13% of the patients experienced short-term complications with only 4% of them having wound infections [18]. Generally, such complications are expected and could be treated successfully without major impact. Long-term complications, on the other hand, could be disastrous. In the current study, 18% of patients had long- complications after two years follow-up, with incisional hernia and biliary stricture most prevalent. This rate of complications is considered reasonable when compare with the international studies. Almost very close results have been obtained by Sahajpal et al. [18] who had 16% of their patients with long-term complications, 2 of whom had bile duct stricture, and 2 patients with incisional hernia.

Collectively, these data indicate that early referral to a tertiary care center with experienced hepatobiliary surgeons and skilled interventional radiologists would appear to be necessary to assure optimal results. Roux-en-hepaticojejunostomy is the procedure of choice preferred by hepatobiliary surgeons for the management of complete transaction CHD injuries. PD catheter is an excellent option, for the drainage of intraperitoneal bile collection, without need for open drainage. Endoscopic intervention by ERCP is an invasive procedure and should be considered only when definitive treatment is decided that is mainly for minor BDIs (types A and D). Adoption of the critical view of safety method of cystic duct and artery identification by the surgeons can prevent major duct injury in most instances.

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