



Our Clinical Experience in Iatrogenic and Traumatic Bile Duct Injury: A Retrospective Analysis

İyatrojenik ve Travmatik Safra Yolu Yaralanmalarındaki Klinik Deneyimlerimiz: Bir Retrospektif Analiz

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Abstract

Background: The purpose of this study is to present our experience of diagnosis, clinical course, treatment and outcome in iatrogenic and traumatic bile duct injury.

Methods: Sixteen patients, who were treated due to iatrogenic and traumatic bile duct injury between June 2009 and October 2014 at İnönü Universty, were analysed retrospectively.

Result: Of the sixteen patients with bile duct injury, 4 (%25) were males and 12 (%75) were females. 3 (%18.75) of the bile duct injuries occurred due to trauma and 13(%81.25) occurred due to laparoscopic cholecystectomy. 2 (%12.5) patients were taken to emergency surgery due to trauma in our center. 14 (%87.5) patients were operated previously in other clinics and referred to our center due to complications. In the treatment of bile duct injury, 1 (%6.25) patient underwent duct to duct anastomosis while the others 15 (%93.75) were treated with Roux-en-Y hepaticojejunostomy. The average length of stay of patients in the hospital was 18.9 days, and the average follow-up time was 25.6 months.

Conclusion: Bile duct injury may occur with iatrogenic or traumatic causes and can cause severe morbidity and mortality. Laparoscopic cholecystectomy is still the most common cause of bile duct injury. Regardless of their causes, bile duct injuries are serious conditions that require experienced treatment in terms of management. The time between onset of bile duct injury and surgical procedure is insignificant and treatment may give successful results in centers with experienced surgeons in hepatobiliary surgery.

Keywords: Bile Duct Injury; Iatrogenic; Cholecystectomy; Trauma; Hepaticojejunostomy.

Özet

Amaç: Bu çalışmanın amacı; iyatrojenik ve travmatik safra yolu yaralanmalarının tanı, klinik seyir, tedavi ve sonuçlarına ilişkin deneyimlerimizi sunmaktır.

Gereç-Yöntem: Haziran 2009- Ekim 2014 tarihleri arasında İnönü Üniversitesi Genel Cerrahi Kliniği'nde iyatrojenik veya travmatik, safra yolu yaralanması nedeniyle tedavi edilen 16 hasta retrospektif olarak incelendi.

Bulgular: Safra yolu yaralanması olan 16 hastanın 4 (%25)'ü erkek, 12 (%75)'si kadın idi. Safra yolu yaralanmalarının 3 (%18.75)'ü travmaya, 13 (%81.25)'ü laparoskopik kolesistektomi ameliyatına bağlı olarak meydana gelmişti. 2 (%12.5) hasta travma nedeniyle tarafımızdan acil ameliyata alınmıştı. 14 (%87.5) hasta ise başka merkezlerde daha önce ameliyat edilip, komplikasyon gelişmesi üzerine kliniğimize sevk edilmişti. Safra yolu yaralanmalarının tedavisinde 1 (%6.25) hastaya uç uca anastomoz, 15 (%93.75) hastaya Roux-n Y hepaticojejunostomi yapıldı. Hastalara ait hastanede kalış süresi ortalama : 18.9 gün ve ortalama takip süresi: 25.6 ay idi.

Sonuç: Safra yolu yaralanmaları iyatrojenik veya travmatik nedenlerle meydana gelebilir ve ciddi mortalite ve morbiditeye neden olabilir. Laparoskopik kolesistektomi ameliyatları halen safra yolu yaralanmalarının en sık sebebidir. Safra yolu yaralanmaları; nedeni ne olursa olsun, tedavi yönetimi açısından ciddi deneyim gerektiren bir durumdur. Safra yolu yaralanmasının oluş zamanı ile biliyer rekonstrüksiyonun yapılma zamanı arasındaki süreden bağımsız olarak, hepatobiliyer cerrahi konusunda tecrübeli klinikler tarafından yapılan biliyer rekonstrüksiyon işlemi ile başarılı sonuçlar alınabilir.

Anahtar Kelimeler: Safra Yolu Yaralanması; İyatrojenik; Kolesistektomi; Travma; Hepaticojejunostomi.

Received/Başvuru: 14.09.2015
Accepted/Kabul: 19.10.2015

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For citing/Atıf için

Barut B, Gonultas F, İnce V, Yönder H. Our clinical experience in iatrogenic and traumatic bile duct injury: a retrospective analysis. J Turgut Ozal Med Cent 2016;23(1):42-8

DOI: 10.5455/jtomc.2015.09.019

INTRODUCTION

Bile duct injury (BDI) occurs due to iatrogenic and traumatic reasons. The most frequent reason behind iatrogenic BDI is cholecystectomy surgery. Nowadays, BDI occurs at an incidence rate of 0.5% during laparoscopic cholecystectomy operations (1). The most important local risk factors for BDI connected to cholecystectomy surgery are male patients, acute cholecystitis, acute biliary pancreatitis, bleeding in Calot's triangle, large stones located in Hartmann pouch, Mirizzi's syndrome, surgery lasting longer than 2 hours and fibrotic gallbladder. These factors are responsible for 15-35% of BDI cases (2). As the cause of more than half of these cases, the most important risk factor in BDI is inexperienced surgeons (3). Traumatic BDI constitutes less than 1% of all intra-abdominal injuries (4). The most common reconstruction process in surgical treatment of BDI is the Roux-n Y hepaticojejunostomy (HJ) (5).

In this article, we aim to share our clinical experience regarding the timing of surgical procedures

MATERIALS and METHODS

The study includes 16 iatrogenic or traumatic BDI patients who were treated at General Surgery Department, Inonu University between June 2009 and October 2014. We retrospectively evaluated the demographic data, causes of injury, diagnosis and treating time, clinical and laboratory results, bile duct injury types according to Strasberg classification, diagnostic tools, treatment methods, hospital stay, mortality, and early and late morbidity rates of these patients.

Except for 2 (12.5%) patients, who underwent emergency surgery in our clinic due to gunshot wounds (GSW) and blunt trauma, all the patients were operated in other centres before they were referred to our clinic.

RESULTS

There were 4 males (25%) and 12 (75%) female in our patient group with an age range of 16-68 years (mean age: 39 years). BDI development causes were as follows: in 1 (6.25%) patient due to GSW, in 2 (12.5%) patients due to blunt abdominal trauma, and in the remaining 13 patients (81.25%) due to laparoscopic cholecystectomy surgery. 5 (38,4%) of the laparoscopic cholecystectomy surgeries were conducted under emergency conditions due to acute cholecystitis while the remaining 8 (61.6%) were conducted under elective conditions due to cholelithiasis. In only 1 (7.9%) of the laparoscopic cholecystectomy operations we had to switch to open surgery during the operation.

14 (8.75%) of the 16 BDI patients were previously operated in other centres and then referred to our clinic.

Of these 14 patients, 13 (92.8%) had bilious drained from the abdomen whereas 1 (1.2%) patient had hemorrhagic drainage. In the physical examination, all of the patients had abdominal distention, coordinate accuracy, and defence. Except for 2 (12.5%) patients, who underwent emergency surgery due to trauma, and 1 (6.25%) patient, who was operated under emergency conditions due to bleeding following laparoscopic cholecystectomy, all 13 (92.8%) patients had high fever.

We evaluated the preoperative complete blood count and blood biochemistry parameters of all the patients. The laboratory findings of the patients were as follows: 13 (81.25%) patients had high WBC values; 10 (62.2%) had high CRP values; 8 (50%) patients had high ALT and AST values; 9 (56.2%) patients had high total bilirubin values; and 10 (62.2%) patients had high GGT and ALP results. Of the 16 patients, 13 (92.8%) patients underwent abdominal ultrasonography (USG), computed tomography (CT), and endoscopic retrograde cholangiopancreatography (ERCP) for diagnostic purposes; two patients, who were operated under emergency conditions due to GSW and a motor vehicle accident, respectively, along with one more patient, who was admitted to the emergency service with intra-abdominal haemorrhage and hypovolemic shock after laparoscopic cholecystectomy, were examined only with abdominal ultrasound imaging. 4 (25%) of our patients underwent magnetic resonance cholangiopancreatography (MRCP). In 12 (92.3%) of the 13 patients, the BDI diagnosis was confirmed with preoperative ERCP. In 1 (7.7%) patient only, who had right sectoral duct injury, was considered to have a leak in the cystic stump.

The time between the onset of BDI and reconstruction process varied between 0 and 90 days (mean: 18.8 days). In case of our GSW patient, who had liver laceration, vena cava inferior and renal injury, and hemo-pneumonia in the right side of the chest, BDI was detected during the operation. Given the patient's poor general condition, the operation was terminated and the patient was intubated and sent to the intensive care unit after packing. On the 2nd postoperative day, the patient was reoperated for depacking and the biliary reconstruction was then completed.

All the patients underwent intraoperative cholangiography prior to biliary reconstruction and after the reconstruction process. In the postoperative period, the check-up cholangiography processes were administered through catheters on the 15 postoperative day. All postoperative cholangiography results were normal and there was no anastomotic leakage. In ten (62.5%) patients, the feeding catheters were removed after this imaging process while 6 (37.5%) had to keep the catheters for the follow-ups until the postoperative 2nd month, when their cholangiography results were assessed normal. To determine the type of BDI, we used the Strasberg classification (Table 1) (6).

Table 1. Strasberg classification

Type A	Bile leak in the cystic tract or accessory ducts in the gall bladder.
Type B	Binding proximal and distal sections of the aberrant right hepatic duct and their complete section with the gall bladder.
Type C	Binding distal section of the right aberrant hepatic duct and its complete section along with the gall bladder. Leaving the proximal of the aberrant right hepatic duct and bile leak from this point.
Type D	Lateral injury in the main bile duct.
TypeE1	Complete section of the bile duct with the remaining hepatic duct at a length of 2 cm or more.
TypeE2	Complete section of the bile duct with the remaining hepatic duct at a length of less than 2 cm.
TypeE3	Stenosis in the left and right hepatic duct bifurcation line.
TypeE4	Stenosis involvement in the left and right hepatic ducts.
TypeE5	Total stenosis in the main hepatic duct and complete section of the gal bladder along with binding the proximal and distal of the right aberrant hepatic duct

Table 2. Early and late complications and treatment approaches to these complications.

EARLY COMPLICATIONS	TREATMENT
Wound infection: 5(%31,25)	Medical dressing
Minimal bile leak (<30cc/day): 3(%18,75)	Monitoring, spontaneous recovery
Bilioma: 3(%18,75)	Percutaneous drainage
Pneumonia: 2(%12,5)	Medical treatment
Intraabdominal abscess: 1(%6,25)	Relaparotomy, surgery drainage
Pleural effusion: 1(%6,25)	Pleural drainage
Increase in total bilirubin level: 1(%6,25)	A single session of plasmapheresis
LATE COMPLICATIONS	TREATMENT
Anastomotic stenosis: 1(%6,25)	Balloon dilatation
Chronic liver disease: 1(%6,25)	Monitoring

Table 3. Types, etiology, surgical treatment, additional organ injuries, and treatment durations of BDI.

Injury type	Etiology	Surgical Treatment	Additional organ treatment	Duration between onset of BDI and reconstruction process
TypeE1	GSW	HJ on CHT plane	VCI, RV, PV, LV	2 days (Emergency surgery of VCI, RV, LV and choledochus repair; HJ on postoperative 2nd day)
TypeE1	LC	HJ on CHT plane	N/A	5 days
TypeE1	LC	HJ on CHT plane	PV	21 days
TypeE1	LC	HJ on CHT plane	RHA	4 days
TypeE2	LC	HJ on 0,5 cm below the right/left hepatic duct junction	RHA	4 days
TypeE2	LC	HJ on 0,5 cm below the right/left hepatic duct junction	RHA	10 days
TypeE2	LC	HJ on 0,5 cm below the right/left hepatic duct junction	RHA	4 days
TypeE2	LC	HJ on 0,5 cm below the right/left hepatic duct junction	N/A	7 days
TypeE2	LC	HJ on 0,5 cm below the right/left hepatic duct junction	N/A	5 days
TypeE3	LC	HJ the right/left hepatic duct junction	N/A	10 days
TypeE3	LC	HJ the right/left hepatic duct junction	N/A	12 days
TypeE3	LC	HJ the right/left hepatic duct junction	N/A	40 days
TypeE4	BAT	HJ in the left hepatic duct	LV	42 days
TypeE4	LC	HJ in the right hepatic duct	N/A	45 days
TypeE4	LC	HJ in the right hepatic duct	N/A	90 days
TypeE4	MVA	End-to-end anastomosis on the LV left hepatic duct		0 days

GSW: Gunshot wounds; VCI: Vena cava inferior; RV: Renal vein; PV: Portal vein; LV: Liver; LC: laparoscopic cholecystectomy; HJ: Hepaticojejunostomy; RHA: Right hepatic artery; CHT: Common hepatic duct; BAT: Blunt abdominal trauma; MVA: Motor vehicle accident.

According to the Strasberg classification, 4 patients (25%) had E1, 5 (31.2%) patients had E2, 3 (18.8%) patients had E3, and 4 (25%) patients had E4 injuries.

One of our patients, who had been in a motor vehicle accident, had full-thickness incision in the left biliary tract. As far as the reconstructive process is concerned, this patient underwent end to end anastomosis through the feeding catheter. The rest of the patients underwent Roux-n Y hepaticojejunostomy with 5/0 PDS and front-to-end sutures. All anastomoses were performed with 5F feeding catheters. One end of the catheter was placed in the proximal biliary tract while the other end was placed 4-5 cm from the jejunum out through the abdomen.

The data concerning the type of BDI, its etiology, surgical treatments, additional organ injuries, and the time between the onset of BDI and the biliary reconstruction are summarised in Table 3. The complications seen within 30 days after the biliary reconstruction process were regarded as early complications; complications after the first 30 days were regarded as late complications. The early and late complications as well as the treatment of these complications are given in Table 2.

Table 4. Data about the patients.

Age	16-68 years Mean: 39 year
Sex	Male: 4 (%25) Female: 12 (%75)
Etiology	Laparoscopic cholecystectomy: 13 (%81,25) Trauma: 3 (%18,75)
Strasberg classification	E1: 4 (%25) E2: 5 (%31,25) E3: 3 (%18,75) E4: 4 (%25)
Additional organ injury	Right hepatic artery: 4 (%25) Liver: 3 (%18,75) Portal vein: 2 (%12,5) Renal vein: 1 (%6,25) Vena cava inferior: 1 (%6,25)
Diagnosis time	0-20 days Mean: 3,9 days
Treatment time	0-90 days Mean: 18,6 days
Biliary reconstruction	Hepaticojejunostomy: 13(%93,75) End-to-end anastomosis: 1(%6,25)
Hospitalisation duration	0-35 days Mean: 18,9 days
Follow-up duration	2-66 months Mean: 25,6 months

DISCUSSIONS

BDI is caused by iatrogenic and traumatic reasons and leads to severe morbidity, in some cases, to mortality such as secondary bile peritonitis, sepsis, and even death. Laparoscopic cholecystectomy is the most frequently performed surgical procedure in symptomatic gallstone surgery. Although BDI incidence is lower in

open cholecystectomy surgery, laparoscopic cholecystectomy has become the preferred procedure due to less postoperative pain, shorter hospitalisation and return duration by surgeons and patients alike (7).

The frequent application of laparoscopic cholecystectomy surgery has brought about some reduction in the BDI incidence. However, cholecystectomy and, particularly, laparoscopic cholecystectomy, have been subjects of lawsuits against surgeons for malpractice while researchers have started discussing the safety of cholecystectomy. The latter technique has also become a subject of training practices as it has also turned out to be an important cause of serious morbidity and even mortality. Indeed, 81.25% of our patients had to be treated due to laparoscopic cholecystectomy procedures. Although the risk of complications in emergency cholecystectomy surgery is higher than those encountered in elective surgery, it should be remembered that BDI may develop during elective surgeries, as it was the case in our series, and surgeons should be extremely careful about this matter.

Practitioners should be tactful as far as BDI-related risk factors are concerned. If they suspect the safety of a thorough cholecystectomy after initiating a laparoscopic procedure, we believe that practitioners should not act conservatively as to whether to switch the procedure to open surgery. Also, if the surgeon is inexperienced in terms of laparoscopic cholecystectomy, we think that a second and more experienced surgeon should be present in the operating room.

Only one third of BDIs can be noticed during surgery. If BDI is detected during laparoscopic cholecystectomy, there is an indication of switching to open surgery. In this case, the most significant point is to avoid excessive dissection during open surgery especially if surgeon is not sufficiently experienced in biliary reconstruction; in this picture, surgeon may consider draining surgery area and refer the patient to a different centre. Excessive dissection and administering biliary reconstruction by inexperienced surgeons will reduce the success of reconstruction process (8, 9).

The most common signs and symptoms in patients suspected for BDI are abdominal pain, abdominal distention, fever, bilious drainage from the abdominal drain, abdominal tenderness on physical examination, rebound and deterioration in the defense and laboratory parameters (10). So, following cholecystectomy surgery, signs like fever, abdominal pain, abdominal distention, bilious drainage from the abdominal drain may cause increase in cholestatic enzymes like WBC and CRP and this increase should be kept in mind for a potential BDI picture.

For the diagnosis of BDI, the most commonly used imaging methods are ultrasound, CT, MRCP, ERCP and percutan transhepatic cholangiography (PTC). With USG, widening intrahepatic and extrahepatic bile ducts can be measured while it can also reveal abdominal fluid accumulation, abscesses, and biloma. CT is a more

specific imaging modality in patients with suspected bile leak. PTC is an imaging method that is more useful in patients with proximal BDI. MRCP is a non-invasive method with a sensitivity rate of 85-100% and used in imaging the biliary tract. While ERCP is the most useful in imaging of wounded biliary tracts, it also leads to the treatment of BDI (10). In our series, except for 3 (18.75%) patients who underwent emergency surgery, the remaining 13 patients (81.25%) were administered preoperative ERCP; in 12 (92.3%) of the patients, ERCP proved to be diagnostic. For this reason, although it is a more invasive procedure than other imaging methods, we believe that ERCP is a very valuable and objective procedure in the diagnosis and treatment of BDI.

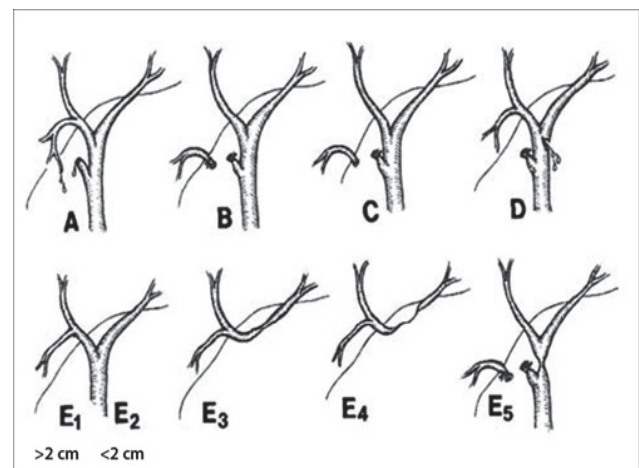
Iatrogenic BDI is often seen with other intra-abdominal organ injuries after blunt or penetrating abdominal traumas. In patients with intra-abdominal bleeding, BDI can be overlooked or, even if it is diagnosed, its treatment may be postponed until patients are more stable (11). As research in literature has taught us, we first administered primary liver repair, vena cava inferior and renal vein repairs for the patient who underwent emergency surgery due to GSW. During the operation, we also applied primary choledochal repair and packing to this patient. The patient was then intubated and taken to the intensive care unit for further depacking biliary reconstruction at a later time. In one of our patients, who underwent emergency surgery due to intra-abdominal haemorrhage after developing intra-operative portal vein injury during laparoscopic cholecystectomy at a different centre, we failed to detect BDI during the operation. This patient was diagnosed with BDI when we noticed postoperative leak from the abdominal.

As far as BDI classification is concerned, there are many classifications used in the literature (12, 13). We adopted the Strasberg classification for BDI classification in our study (Figure 1).

The first treatment option in iatrogenic and traumatic BDI is the endoscopic method. If this method proved ineffective, Roux-Y hepaticojejunostomy is the most preferred method among many biliary reconstruction processes (14). A total of 15 (93.75%) patients underwent HJ in our series; for the remaining 1 (6.25%) patient, we applied end-to-end anastomosis. In this surgical technique, proximal biliary tracts are prepared for anastomotic and distal biliary tract is closed with sutures. In HJ, absorbable polydioxanone (PDS 4/0, 5/0) sutures are used. Low postoperative stricture rate is the reason why HJ is the most preferred method (15). For Terblanche et al. have stated that HJ has given them a success rate of 90% (16); Rossi and Tsao's study have indicated that end-to-end anastomosis may lead to a 40-50% rate of strictures in the long term (17). However, bypassing the saffron by using HJ may result in gastric hypersecretion, changes in pH values, and increased gastrin levels and, eventually, can cause increased incidence of duodenal ulcers. Increase in plasma triglyceride, gastrin, and glucagon-like immunoreactive levels along with decrease in gastrin and gastric inhibitory polypeptides and insulin levels are among the

common laboratory findings in patients undergoing HJ. As the bile flow path changes due to HJ, fat metabolism impairment may take place, too, which is another frequently seen sign in these patients (18, 19). Another drawback of HJ is that it is not suitable for endoscopic examinations required for the diagnosis and treatment of biliary strictures that may develop in the postoperative period. An alternative solution to this issue can be preparing a long jejunal loop during the operation and locating this loop in the right subcostal area (permanent-access hepaticojejunostomy). This jejunal loop can be open or closed and enables endoscopic dilatation in case of biliary stricture development (20).

Figure 1. Strasberg classification



The timing of biliary reconstruction process after the onset of BDI, early or late, is an important factor affecting the success of the process. The success rate of reconstruction conducted within the first 4 days of injury is high whereas this rate is lower in processes applied between 4 days to a few weeks particularly because of inflammation in the tissues and narrow bile duct to be reconstructed; in the latter case, complication rates are also quite high (21).

However, in their study comparing the results of high intra-hepatic bilioenteric anastomosis in inflammation and scar free, well-vascularized bilioenteric anastomosis with cases undergoing anastomosis on the common hepatic duct level, Mercado et al. have reported a success rate of 97% in high intrahepatic repair group and of 85% in extra hepatic repair group regardless of the time of reconstructive surgery. For the bilioenteric anastomosis administration in this study, researchers have applied anastomosis on unscarred, well-vascularized segments with tension-free mucosa-to-mucosa technique along with one-to-one 4/0 absorbable sutures (22).

In our series, 10 (62.5%) of the 16 patients underwent biliary reconstruction process within the first 4-21 days of the onset of BDI, when tissues are most inflamed and swollen. Studying early and late complications in these 10 patients, we observed late onset of complications in

only 1 (10%) patient. This case was the patient who had been admitted due to portal vein injury following laparoscopic cholecystectomy and undergone portal vein repair in our clinic; we noticed BDI 15 days after the repair and administered HJ on the postoperative 21st day. This particular patient was followed for 44 months and developed cirrhotic changes in the liver. As far as early complications are concerned, we observed self-repairing biliary fistula that did not require any additional intervention in 1 (10%) patient, high bilirubin levels that had started on postoperative day 2 and ended on postoperative day 3 with plasmapheresis requirement in 1 (10%) patient, wound infection in 1 (10%) patient, pneumonia in 1 (10%) patient, and biloma in 1 (10%) patient.

The time between the onset of BDI and biliary reconstruction for the remaining 6 patients of our series varied between 0-2 days and 40-90 days. In other words, this group comprised patients who underwent operations within the first 48 hours or 6 weeks of injury with considerably low intra-abdominal inflammation levels. Analysing early and late complications in these patients, we observed anastomotic stricture in 1 (10%) patient as a late complication and applied anastomosis dilatation to the patient with PTC. As early complications, we observed pleural effusion in 1 (16.6%) patient, pneumonia in 1 (16.6%) patient, wound infection in 4 (66.6%) patients, self-repairing biliary fistula without the need for further in 2 (33.2%) patients, percutaneously drained biloma in 2 (33.2%) patients, and surgically drained intra-abdominal abscess in 1 (16.6%) patient.

The average hospitalisation time for patients who underwent biliary reconstruction during dense intra-abdominal inflammation was 14.7 days; this was 24.3 days in the other group.

Analysing complications and length of hospital stay in the two groups, we noticed no significant difference between the groups in terms of early or late complications; contrary to what is expected, patients undergoing biliary reconstruction during the inflammatory phase had shorter hospital stay.

Although research indicates a strong correlation between surgical success and biliary reconstruction process with emphasis on the relation concerning the duration between onset of BDI and HJ administration, clinical / surgical experience plays a very important role in successful biliary reconstruction process regardless of the time elapsed between BDI onset and reconstructive treatment, as it can be observed in our experience.

CONCLUSION

BDI may develop due to iatrogenic and traumatic reasons and may prove to be a serious cause of morbidity and mortality. Whatever the cause, BDI is a serious condition the treatment of which requires experience. Early diagnosis of BDI and experienced treatment decrease morbidity and mortality rates

dramatically. Regardless of the time between the onset of BDI and surgical application, biliary reconstruction may give successful results if surgery is conducted by surgeons experienced in hepatobiliary surgery.

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