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Original Article

Bile duct injury outcomes following cholecystectomy: a cross sectional study

Sepehr Eslami[1], Lotfallah Abedini[2], Nazanin Vahedi Nouri[3], Mehdi Rabiee[2], Milad Kabiri Samani[4]

[1]Department of Orthopedics, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran; [2]Department of Surgery, School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran; [3]School of Medicine, Isfahan University of Medical Sciences, Isfahan, Iran; [4]Faculty of Medicine, Mazandaran University of Medical Sciences, Sari, Iran

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Abstract: Background: Considering the importance of the repairing time in patients with biliary duct injury, the aim of this study was to evaluate the outcomes of patents with bile duct injury following cholecystectomy. Methods: In this cross sectional study that was conducted on 64 patients with bile duct injury following cholecystectomy was referred to Shafa hospital in Tehran-Iran during 2010-2019 due to repair of biliary duct. Then patients were divided into two groups based on early and late referring time after bile duct injury, the postoperative outcomes were evaluated in two groups. Results: The alanine transaminase (ALT) and the aspartate aminotransferase (AST) in the late group were significantly higher than the early group. There were significant differences between the two groups based on the results of endoscopic retrograde cholangiopancreatography (ERCP) and magnetic resonance cholangiopancreatography (MRCP) ($P < 0.05$). The frequency of bile duct dilatation, cholangitis and itching in late group were significantly higher than early group, also the frequency of uncomplicated outcome in the early group were significantly more than late group ($P < 0.05$). Conclusion: The postoperative complication of biliary duct injury reduced, if patients diagnosed and referred at the same early stages (early referral).

Keywords: Bile duct injury, cholecystectomy, outcomes, early, late

Introduction

The first time in 1985, Erich Muhe introduced laparoscopic cholecystectomy (LC) to treat bile stones which the treatment of biliary stones changed dramatically, and led to widespread use of LC with surgeons in the worldwide [1]. Cholecystectomy is one of the most common surgical procedures performed by surgeons. Complications following bile duct injury such as gallbladder secretion or bile duct stenosis are Serious and life-threatening complication [2]. Biliary duct injury is a common complication and an incidence of about 0.8 per 1000 cases under cholecystectomy [3]. The affected factors such as age, gender, and diagnosed acute cholecystectomy are known for bile duct injury that increased risk of adhesion and inflammatory tissue responses [4]. Although the risk of biliary duct injury in laparoscopic cholecystectomy is higher than open cholecystectomy, so laparoscopic cholecystectomy is still a gold standard for symptomatic biliary stones and acute cholecystitis [5]. It seems that there is a relationship between more complications and surgical incision less than 2 cm [1]. It is also known that a misinterpretation of bile duct anatomy by surgeons (92.9%) is the most common cause of biliary duct injury, while in 70.9% of cases is due to the inexperienced surgeon [1]. Managing and treating patients with biliary duct injury is a real challenge between surgeons, especially for liver and bile duct surgeons. Due to the complexity of the injury, these patients should be referred to the third referral center to continue the treatment process. The most common biliary duct injuries are partial rupture and bile duct discharge, which can be treated with endoscopic retrograde cholangio-pancreatography (ERCP) or stenting through the skin and dilatation [6]. The surgical management is recommended for severe lesions, including the complete removal of the ducts or closing them [6, 7]. Most of these severe injuries also are followed by clangitis, jaundice, and peritonitis, and directly increase the risk of mortality. On the other hand, the long interval time between injury and treatment seriously impairs the qual-

Table 1. Demographic data of patients in both groups

Variables		Early referral	Late referral	*p*-value
n		39	25	-
Age (years) (mean ± SD)		45.07 ± 13.33	48.68 ± 13.00	0.72*
Gender	Male	8 (20.5%)	4 (16%)	0.65**
	Female	31 (79.5%)	21 (84%)	
Surgical procedure	laparoscopy	21 (53.8%)	14 (56%)	0.86**
	Laparotomy	18 (46.2%)	11 (44%)	

*Independent t test, **Chi Square.

ity of life [8]. Evidence suggests that these patients require multiple and long-term admissions for treatment [9]. Therefore, timely identification and repair can prevent late complications in these patients [10]. Considering the importance of the referral time of patients with complicated biliary duct to the 3rd-level treatment centers, the aim of this study was to evaluate the results of surgical repair based on referral time.

Materials and methods

This study was a cross-sectional study and 64 patients with bile duct injury were referred to Shafa Hospital in Tehran during 2010-2019 due to biliary duct repair after iatrogenic surgery. The inclusion criteria included all patients aged 18-70 years with biliary duct injury after open or laparoscopic cholecystectomy, and their injury was confirmed by the surgery history of the first surgeon and radiological studies, and their information included pre- and post-operation. Accordingly, the patients were divided into two groups, the first group was consisted of those who did not undergo primary surgery after the biliary tract injury and the patients were referred immediately (hereinafter referred to as "early referral") and the second group was included patients who have undergone reconstructive surgery to repair the injury (hereinafter referred to as "late referral"). Chronic or delayed onset was in patients of the second group because the first surgeon had repeated injury (repair) to the bile duct by failing to repair the bile duct, while in the acute group (early referral) the patients were referred to a liver and biliary duct surgeon immediately.

Afterward, all of these patients were under surgery by a liver and bile duct surgeon and the repairing method was the similar in all patients based on the type of injury. Repairing method in all cases was anastomosis of injured duct into the narrow bowel arch based on Roux-en-Y technique.

Patients were satisfied with the study and their information was entered into checklists, which included demographic information such as age, gender, and type of injury, post-operative information such as bile duct fistula, need for re-operation, postoperative complications (death, Inflammation, cholangitis, hernia, itching), the interval time from surgery to present of clinical symptoms and para-clinical information such as total and direct bilirubin, alanine transaminase (ALT), aspartate transaminase (AST), alkaline phosphatase (ALP), ERCP and magnetic resonance cholangiopancreatography (MRCP). Patients were followed up for at least one year by the surgeon and the required information was recorded in a separate checklist.

Statistical analysis

Data obtained from this study were entered into SPSS version 24. Independent t test was used to compare quantitative data between groups and chi square was used to compare qualitative data the two groups.

Also, qualitative data were presented as numbers or percentages, and quantitative data were presented as mean and standard deviation. It should be noted that *P*-value less than 0.05 was considered as a significant relationship.

Results

In this study, 64 patients (12 males and 52 females) with a mean age of 46.27 ± 13.22 years were participated and were divided in two groups: early (8 males and 31 females) and late referring times (4 males and 21 females). Also, there were no significant differences between the two groups regarding age, sex and type of surgical procedure (**Table 1**).

There was no significant difference between the two groups in terms of total bilirubin and direct bilirubin on the basis of para-clinical

Table 2. Preoperative clinical and para-clinical information between the two groups

Variables	Early referral group	Late referral group	*p*-value*
Total bilirubin (mean ± SD) (mg/dl)	17.35 ± 30.07	13.58 ± 24.87	0.53
Direct bilirubin (mean ± SD) (mg/dl)	7.14 ± 6.89	8.70 ± 6.96	0.89
ALT (Mean ± SD) (U/L)	96.55 ± 82.99	218.68 ± 245.80	0.002
AST (Mean ± SD) (U/L)	80.45 ± 115.28	212.93 ± 266.42	0.001
ALP (Mean ± SD) (U/L)	583.73 ± 428.14	1084.41 ± 567.26	0.35

*Independent t test.

information in the before of repairing surgery. However, ALT and AST in the late group were significantly higher than the early group (**Table 2**).

The imaging results for patients in the early and late group were reviewed. There was a significant difference between the two groups based on the results of ERCP and MRCP so that the incidence of complications or abnormalities in ERCP and MRCP in the late group was significantly higher than the early group (**Table 3**).

The mean time interval between the initial operation and the presenting the symptoms and referring the patients in the early and late groups were 2.39 ± 2.89 and 408.75 ± 586.66 days. Based on the complications after surgery, bile duct dilatation, cholangitis and itching were more frequent in the late group than in the early group ($P < 0.0001$ for biliary duct dilatation and itching, and $P = 0.02$ for cholangitis). In addition, there was no significant difference between the two groups based on the infection ($P = 0.77$), herniation ($P = 0.64$), biliary fistula ($P = 0.36$), and dehiscence ($P = 0.85$). Also, uncomplicated cases in the early group were significantly more than late group ($P < 0.0001$). The need for rehabilitations was in 2.8% of the early and 8% of the late groups. There was no significant difference between the two groups in terms of re-operation due to complications ($P = 0.35$). The mean following up duration of patients was 34.01 ± 20.40 months and there was no significant difference between the two groups in terms of duration of follow up ($P = 0.32$) (**Table 4**).

Discussion

Patients were followed up for an average of 38 months. The results indicated that the incidence of clinical symptoms such as post-operative liver dysfunction (such as itching and cholangitis), abnormal laboratory tests and imaging (dilation of bile duct) in late group was higher than the early group. Examination of the liver function tests before repair showed a higher level of liver function impairment in late group. Also, 64.1% of the early group and 16% of the late group were uncomplicated. In addition, mortality rates were one case in the early group with unknown cause and two cases in the late group (one case due to myocardial infarction and other due to pulmonary embolism). In a study by Felekouras et al. [7] who reviewed early and late interventional therapy in 92 patients with biliary duct injury following laparoscopic cholecystectomy from 1991 to 2011, the results of this study was indicated that 34 patient under early repair and 22 patients were under late repair and also the patients were followed for an average of 93 months. During this period (93 months), 2 patients died in the late bile duct repair group. So the result of this study indicated that patients with early bile duct injury should be immediately referred to an experienced specialist center in this field to prevent more complications of late repairing. In a study by Ismael et al. [11] that investigated the repair of biliary duct injury following cholecystectomy in three group including early-referral group (below 7 days), interstitial referral group (between 8 days to 6 weeks) and late referral group (over 6 weeks). It was concluded that out of 614 patients, 94% of them required hepaticojejunostomy, and the rate of postoperative complications was higher in the intestinal referral group than early and late groups. It was also concluded in this study that in cases of interstitial referral group (from 8 days to 6 weeks), more attention should be paid to controlling sepsis and delaying in duct injury repair.

In another similar study, which was performed on 35 patients with bile ducts injury following cholecystectomy and was under repairing bile duct, drainage was performed for 1 patient, 28

Table 3. Preoperative imaging results of patients in two groups

Imaging results		Early referral group	Late referral group	*p*-value*
ERCP	normal	1 (2.6%)	0 (0.0%)	0.02
	Common hepatic duct stenosis	4 (10.2%)	0 (0.0%)	
	Leakage of right sectoral bile duct	1 (2.6%)	0 (0.0%)	
	other	3 (7.8%)	9 (36%)	
MRCP	normal	3 (7.8%)	0 (0.0%)	0.004
	Common hepatic duct stenosis	11 (28.2%)	12 (48%)	
	Common bile duct stenosis	3 (7.8%)	2 (8%)	
	Cut off common hepatic duct	2 (5.1%)	0 (0.0%)	
	Cut off at the right duct	1 (2.6%)	0 (0.0%)	
	Cut off at the right sectoral bile duct	3 (7.8%)	0 (0.0%)	
	other	0 (0.0%)	10 (40%)	

*Chi Square.

Table 4. Postoperative information in two groups

Variables		Early referral group	Late referral group	*p*-value
Interval time between operation to referral (Day) (mean ± SD)		2.89 ± 2.39	408.75 ± 586.66	< 0.00 01*
Follow up duration (Month) (Mean ± SD)		34.28 ± 21.31	33.60 ± 19.48	0.32*
Postoperative complications	Bile duct dilatation	12 (30.8%)	19 (76%)	< 0.0001**
	Infection	9 (23.1%)	5 (20%)	0.77**
	Herniation	2 (5.1%)	2 (8%)	0.64**
	Cholangitis	1 (2.6%)	5 (20%)	0.02**
	Itching	1 (2.6%)	9 (36%)	< 0.0001**
	Bile Fistula	4 (10.3%)	1 (4%)	0.36**
	Fascia opening	2 (5.1%)	1 (4%)	0.85**
	Uncomplicated	25 (64.1%)	4 (16%)	< 0.0001**
Reoperation due to complications		1 (2.8%)	2 (8%)	0.35**

*Independent t test, **Chi Square.

patients had only hepaticojejunostomy, 5 patients were under hepaticojejunostomy and liver resection, and one case was under liver transplantation. Postoperative death was observed in one case (2.8%) due to liver failure following the resection of the liver, vascular injury was in 4 cases (11.4%) and severe complications were in 12 cases (34.3%), mean follow-up of patients in this study was 81 months and the patients who were referred with sepsis or who needed a previous laparotomy also had severe complications [12].

Another study found that the incidence of bile duct injuries is low, but its management and treatment is dependent on timely diagnosis, and complicated bile duct injury usually requires appropriate treatment at a 3-level center for multi-disciplinary surgery (surgery, radiology, and others) [13]. There was a controversy about the time of repair of the duct, based on the type of injury, so that some studies reported that early biliary dysregulation was not good and was associated with complications, mortality, and liver insufficiency [14]. Another study stated that bile ducts injury following laparoscopic cholecystectomy was a complicated problem that was significantly associated with postoperative mortality rates, most patients subsequently undergoing continuous surgery (chronic) require more surgical repair and patients with severe injuries are at risk of long-term mortality [15]. In other cases, it was stated that one-third of the injuries were not due to the inexperience of the surgeons, because it's for the laparoscopic cholecystectomy technique. Cholangiography is also very useful for finding the site of injury, and most injuries occur when reconstructive surgery is performed in a regular hospital rather than a level 3 center [16].

Conclusion

Based on the results of this study and similar articles, it is recommended that patients with biliary duct injury should be initially treated by a liver and biliary surgery. It is noteworthy that in cases of late referral due to high complications, prolonged patient involvement, and the need for reoperation, it can be costly for the patient (health and life).

Disclosure of conflict of interest

None.

Address correspondence to: Milad Kabiri Samani, Isfahan University of Medical Sciences, Isfahan, Iran. Tel: +989122915090; Fax: +983136688597; E-mail: Kabirimilad69@gmail.com

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