

Determination of the Bile Ducts Injuries Risk in the Surgery of Cholelithiasis

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Abstract When performing operations on the abdominal organs, the frequency of intraoperative injury of the bile ducts is 0.09 - 3%. As a rule, iatrogenic trauma of the extrahepatic bile ducts occurs during surgery on the biliary tract, most often - cholecystectomy. The article is devoted to the stratification analysis of the risk of damage of the bile ducts in surgery for gallstone disease. The study revealed that the probability of damage of the bile ducts in gallstone disease surgery is 0.38% (in 54 from 14389 operated patients), and depending on the type of surgery, the frequency of this complication was 0.36% (in 32 from 8944) with laparoscopic cholecystectomy, 0.45% (11 from 2424) - with traditional cholecystectomy and 0.36% (11 from 3021) with cholecystectomy from a mini-access. A significant difference in the risk of damage was determined for acute calculous cholecystitis - 0.56% and chronic calculous cholecystitis - 0.30% (criterion $X^2 = 4.401$; $Df = 1$; $p = 0.036$). In turn, the risk of damage to the bile ducts also differed significantly during emergency surgery - 0.86% from planned interventions - 0.34% (criterion $X^2 = 5.654$; $Df = 1$; $p = 0.017$).

Keywords Cholelithiasis, Bile ducts, Cholecystectomy, Injury, Surgery

1. Introduction

According to the World Health Organization, damage to the bile ducts, despite the constantly improving technique of surgical interventions, is one of the most terrible complications of biliary surgery and has no tendency to decrease [1]. When performing operations on the abdominal organs, the frequency of intraoperative damage to the bile ducts is 0.09 - 3%. As a rule, iatrogenic trauma of the extrahepatic bile ducts occurs during surgery on the biliary tract, most often cholecystectomy, less frequently in operations on the stomach, duodenum, pancreas [2].

The “gold” standard in the treatment of cholelithiasis is laparoscopic cholecystectomy. A characteristic feature of the method is a new type of damage to the duct - thermal burn of the hepaticocholedochus.

At the same time, the risk of mechanical injury of the main bile duct pathways during clipping of the cystic duct is not excluded. Another feature of laparoscopic cholecystectomy was an increase in the proportion of high injuries [3-4]. Injuries at the level of the common hepatic duct, bifurcation of the lobar ducts and the isolated right and left lobar ducts make up 69%, whereas with “traditional” cholecystectomy such injuries occur in 44.8% [5]. The consequences of

iatrogenic damage to the bile ducts can cause catastrophic damage to the health of the patient and only in a timely and competently performed operation can prevent the development of such complications as biliary cirrhosis, portal hypertension, purulent cholangitis, hepatic failure [6]. In this regard, the prevention and surgical treatment of iatrogenic trauma of the bile ducts, the development of optimal treatment tactics and rational surgical techniques and the rehabilitation of patients are a pressing issue in hepatobiliary surgery.

2. Material and Methods

The paper analyzes clinical material based on the results of a comprehensive examination and surgical treatment of 14389 patients with cholelithiasis operated at the Republican Specialized Scientific-Practical Medical Centre of Surgery (RSSPMC) named after academician V.Vakhidov and Samarkand Medical Institute (SMI) between 2000 and 2017. Patients were divided into 2 groups. The comparison group consisted of 7179 interventions, 4293 (59.8%) of which were performed laparoscopically, 1259 (17.5%) cholecystectomy from a mini-access and 1627 (22.7%) operations performed in the traditional way in the period of 2000-2010.

The main group of the study consisted of 7210 cholecystectomies which in 4651 (64.5%) patients underwent by laparoscopic way, in 1762 (24.4%) patients cholecystectomy was made from a mini-access and in 797

(11.1%) cases the intervention was performed in the traditional way from (2011 to 2017).

3. Results

In the group of comparison during that period at the RSSPMC there were performed 3145 (74.8%) laparoscopic cholecystectomies (LC) and 1058 (25.2%) traditional cholecystectomies (TC). In that group at Samarkand Medical Institute (SMI) there were performed 1148 (38.6%) LC, 1259 (42.3%) cholecystectomies from mini- access and in 1627 (22.7%) cases – TC.

In the main group of investigation at RSSPMC there were performed 4037 (92%) LC and 353 (8.0%) TC; at the SMI –

614 (21.8%) LC, 1762 (62.5%) cholecystectomies from mini- access and 444 (15.7%) TC. The frequency of bile ducts injuries at both hospitals is given in the Tab. 1.

From the table below, in a comparative aspect, it can be seen that the frequency of bile ducts injuries in the comparison group was 38 (0.5%) cases, whereas in the main group this indicator was 16 (0.2%).

The probability of bile ducts injuries depending on the type of operation is shown in table 2. At the same time, in RSSPMC for 7182 laparoscopic cholecystectomies the frequency of damage of the gastrointestinal tract was 0.22% (16 cases), while at SMI clinic for 1762 laparoscopic cholecystectomies it was 0.91% (16 cases) ($\chi^2 = 16.571$; Df = 1; $p < 0.001$).

Table 1. The frequency of bile ducts injuries in the surgery of cholelithiasis

Surgery	Group of comparison (2000-2011)						Main group (2012-2017)					
	The RSSPMC		The SMI		Total		The RSSPMC		The SMI		Total	
	abs.	%	abs.	%	abs.	%	abs.	%	abs.	%	abs.	%
Total quantity of surgeries												
LC	3145	74.8%	1148	38.6%	4293	59.8%	4037	92.0%	614	21.8%	4651	64.5%
Cholecystectomy from mini- access	0	0.0%	1259	42.3%	1259	17.5%	0	0.0%	1762	62.5%	1762	24.4%
TC	1058	25.2%	569	19.1%	1627	22.7%	353	8.0%	444	15.7%	797	11.1%
Total	4203	100%	2976	100%	7179	100%	4390	100%	2820	100%	7210	100%
Frequency of bile ducts injuries												
LC	10	0.3%	10	0.9%	20	0.5%	6	0.1%	6	1.0%	12	0.3%
Cholecystectomy from mini- access	0	0.0%	10	0.8%	10	0.8%	0	0.0%	1	0.1%	1	0.1%
TC	2	0.2%	6	1.1%	8	0.5%	0	0.0%	3	0.7%	3	0.4%
Total	12	0.3%	26	0.9%	38	0.5%	6	0.1%	10	0.4%	16	0.2%

Table 2. The probability of bile ducts injuries subject to the type of surgery

Surgery	Hospital					
	The RSSPMC		The SMI		Total	
	abs.	%	abs.	%	abs.	%
Total amount of surgeries						
LC	7182	83.6%	1762	30.4%	8944	62.2%
Cholecystectomy from mini-access	0	0.0%	3021	52.1%	3021	21.0%
TC	1411	16.4%	1013	17.5%	2424	16.8%
Total	8593	100.0%	5796	100.0%	14389	100.0%
Frequency of bile ducts injuries						
LC	16	0.22%	16	0.91%	32	0.36%
	criterion $\chi^2=16.571$; Df=1; $p<0.001$					
Cholecystectomy from mini-access	0	0.00%	11	0.36%	11	0.36%
	-					
TC	2	0.14%	9	0.89%	11	0.45%
	criterion $\chi^2=5.654$; Df=1; $p=0.017$					
Total	18	0.21%	36	0.62%	54	0.38%
	criterion $\chi^2=14.481$; Df=1; $p<0.001$					

The frequency of bile ducts injuries at cholecystectomies from mini-access at the SMI (3021 surgeries) was 0.36% (11 injuries). At traditional cholecystectomies at the RSSPMC for 1411 interventions the iatrogenic injuries were pointed in 0.14% (2) of cases, whereas at the SMI for 1013 surgeries this index made up 0.89% (9) (criterion $\chi^2=5.654$; Df=1; $p=0.017$). Of the total number of injuries (n = 54; 0.38%), the

frequency of injuries in the RSSPMC was 0.21% (18 iatrogens), and in the SMI - 0.62% (36 injuries) ($\chi^2 = 14.481$; Df = 1; $p < 0.001$).

Table 3 shows the analysis of bile ducts injuries frequency subject to the type of surgery at the acute calculous cholecystitis (ACC).

Table 3. The probability of bile ducts injuries subject to the type of surgery at calculous cholecystitis

Surgery	Hospital					
	The RSSPMC		The SMI		Total	
	abs.	%	abs.	%	abs.	%
Total amount of surgeries						
LC	1924	64.2%	183	16.2%	2107	51.0%
Cholecystectomy from mini-access	0	0.0%	304	26.8%	304	7.4%
TC	1075	35.8%	646	57.0%	1721	41.7%
Total	2999	100.0%	1133	100.0%	4132	100.0%
Frequency of bile ducts injuries						
LC	10	0.52%	2	1.09%	12	0.57%
	criterion $\chi^2=1.007$; Df=1; $p>0.05$					
Cholecystectomy from mini-access	0	0.00%	3	0.99%	3	0.99%
	-					
TC	2	0.19%	6	0.93%	8	0.46%
	criterion $\chi^2=3.297$; Df=1; $p>0.05$					
Total	12	0.40%	11	0.97%	23	0.56%
	criterion $\chi^2=5.769$; Df=1; $p<0.05$					

Table 4. The probability of bile ducts injuries subject to the type of surgery at chronic calculous cholecystitis

Surgery	Hospital					
	The RSSPMC		The SMI		Total	
	abs.	%	abs.	%	abs.	%
Total amount of surgeries						
LC	5258	94.0%	1579	33.9%	6837	66.7%
Cholecystectomy from mini-access	0	0.0%	2717	58.3%	2717	26.5%
TC	336	6.0%	367	7.9%	703	6.9%
Total	5594	100.0%	4663	100.0%	10257	100.0%
Frequency of bile ducts injuries						
LC	6	0.11%	14	0.89%	20	0.29%
	criterion $X^2=14.740$; Df=1; $p<0.001$					
criterion χ^2 to ACC	8.623; Df=1; $p=0.003$		0.018; Df=1; $p>0.05$		2.707; Df=1; $p>0.05$	
Cholecystectomy from mini-access	0	0.00%	8	0.29%	8	0.29%
	-					
criterion χ^2 to ACC	-		-		0.153; Df=1; $p>0.05$	
TC	0	0.00%	3	0.82%	3	0.43%
	1.633; Df=1; $p>0.05$					
criterion χ^2 to ACC	0.467; Df=1; $p>0.05$		$X^2=0.018$; Df=1; $p>0.05$		1.535; Df=1; $p>0.05$	
Total	6	0.11%	25	0.54%	31	0.30%
	9.607; Df=1; $p=0.002$					
criterion χ^2 to ACC	0.024; Df=1; $p>0.05$		0.028; Df=1; $p>0.05$		4.401; Df=1; $p=0.036$	

Table 5. The probability of bile ducts injuries during emergency and elective surgeries

Surgery	Hospital					
	The RSSPMC		The SMI		Total	
	abs.	%	abs.	%	abs.	%
Total amount of injuries						
Emergency	528	6.1%	521	9.0%	1049	7.3%
Elective	8065	93.9%	5275	91.0%	13340	92.7%
Total	8593	1000%	5796	100.0%	14389	100.0%
Frequency of bile ducts injuries						
Emergency	4	0.76%	5	0.96%	9	0.86%
	criterion $\chi^2=0.136$; Df=1; $p>0.05$					
Elective	14	0.17%	31	0.59%	45	0.34%
	criterion $\chi^2=14.939$; Df=1; $p<0.001$					
X2 criterion to emergency surgeries	$\chi^2=5.477$; Df=1; $p=0.019$		$\chi^2=0.535$; Df=1; $p>0.05$		$\chi^2=5.654$; Df=1; $p=0.017$	
Total	18	0.21%	36	0.62%	54	0.38%
	criterion $\chi^2=14.481$; Df=1; $p<0.001$					

As can be seen from the table from 4132 cholecystectomies due to the acute calculous cholecystitis (ACC) in 23 (0.56%) cases there was damage of the bile duct (BD) (criterion $\chi^2 = 5.779$; Df = 1; $p < 0.05$). At the same time, the frequency BD injuries during laparoscopic cholecystectomy (LC) was 12 (0.57%), cholecystectomies from mini-access - 3 (0.99%), traditional cholecystectomies - 8 (0.46%) cases.

The frequency of BD injuries depending on the type of surgery for chronic calculous cholecystitis (CCC) is presented in Tab. 4.

From the presented table it is clear that at 10257 cholecystectomies the frequency BD injuries was 0.30% (31 cases). The frequency of damage during the performance of LC amounted to 0.29% (20 damage), with LC from the mini-access - 0.29% (8 cases) and TC – 0.43% (3 iatrogens).

At the same time, there was a significant difference in the risk of damage during cholecystectomy due to ACC (0.56%) and CCC(0.30%) ($\chi^2 = 4.401$; Df = 1; $p = 0.036$).

The probability of BD injuries depending on the profile of interventions (emergency and elective CHEC) is presented in Table 5.

In a comparative aspect, the table 5 shows that when 1049 cholecystectomies were performed on an emergency basis in 9 (0.86%) cases BD injuries occurred, whereas during planned operations (13340 cholecystectomies) iatrogeny occurred in 45 (0.34%) patients. At the same time, the risk of bile ducts injuries was significantly higher in patients operated on in an emergency order ($\chi^2 = 5.654$; Df = 1; $p = 0.017$).

This once again proves the high likelihood and risk of bile ducts injuries during cholecystectomies performed in an emergency order when there are some factors promoting the occurrence of iatrogenic injuries: destructive inflammatory changes and periprocess in the gallbladder neck with extension to hepatoduodenal ligament, intimate firm adherence of the Gartner's pocket to the common bile ducts

and etc.

The probability of the bile ducts injuries subject to the different factors revealed the followings data: the probability of bile ducts injuries in the surgery of cholelithiasis makes up 0.38% (in 54 from 14389 operated patients), the frequency of this complication subject to the type of surgery made up 0.36% (in 32 from 8944) during LC; 0.45% (11 from 2424) – during TC and 0.36% (11 from 3021) during mini-access cholecystectomy. A significant difference in the risk of injury in ACC – 0.56% and – 0.30% during CCC (criterion $X^2=4.401$; Df=1; $p=0.036$) was determined. In turn, the risk of BD injuries also differed significantly during emergency surgery - 0.86% from planned interventions - 0.34% (criterion $X^2 = 5.654$; Df = 1; $p = 0.017$).

4. Discussion

The introduction of new technologies in surgical practice brings new types of iatrogenic injury. Of great interest is the question of the causes of the extrahepatic biliary tract injuries. Many authors consider the cause of accidental injuries of the hepaticocoledochus anomalies of the biliary tract and vessels in the portal fissure, inflammatory infiltration and cicatricial adhesions in the neck of the gallbladder, bleeding that occurred during the operation, forced surgical intervention at night, Mirizzi's syndrome (type II) [7]. Despite certain successes achieved in this complex field of surgery, unsatisfactory results are observed in even the most experienced surgeons on average in 10% of cases [8]. According to Spence L.H. with co-authors such patients need repeated, sometimes repeated reconstructive operations and are rightly called "biliary cripples" [9]. From the point of view of treatment outcomes, the timing of detection of bile ducts lesions is crucial. Accordingly, the long-term results of surgical treatment depend on the time of detection and the nature of the injury [10]. The main reasons for failures in the treatment of injuries of the main bile ducts

are the untimely diagnosis and the performance of reconstructive surgeries that are inadequate in volume by surgeons who do not have adequate experience in biliary surgery [11]. There is no unity in the choice of the method of operation for “fresh” injuries of the bile ducts diagnosed intraoperatively or in the immediate postoperative period. There is still a desire for recovery operations, which give unsatisfactory results, due to the rapid development of cicatricial stricture or the failure of the anastomosis. A number of surgeons resort to duodenal anastomosis which leads to the development of duodenal fistula or reflux cholangitis, the development of anastomotic stricture [12]. The tactics of treatment of the bile duct injury are decisive factors that influence the choice of operation: the nature and location of injury, the condition of the crossed duct, the time of diagnosis of damage and the presence of a surgeon who has experience in reconstructive bile duct surgery. The analysis of the literature suggests that in the present period, the treatment and diagnostic tactics for iatrogenic injuries of the bile ducts is one of the most urgent and unresolved problems of modern hepatobiliary surgery.

5. Conclusions

The probability of the bile ducts injuries in the surgery of cholelithiasis is 0.38% while depending on the type of operation, the frequency of this complication was 0.36% (in 32 of 8944) during laparoscopic cholecystectomy, 0.45% (11 of 2424) - during traditional cholecystectomy and 0.36% (11 of 3021) - during cholecystectomies from the mini-access.

A significant difference in the risk of BD injuries in acute calculous cholecystitis (ACC) - 0.56% and in chronic calculous cholecystitis (CCC) - 0.30% was determined (criterion $X^2 = 4.401$; Df = 1; $p = 0.036$). In turn, the risk of the bile ducts injuries also differed significantly during emergency surgery - 0.86% from planned interventions - 0.34% (criterion $X^2 = 5.654$; Df = 1; $p = 0.017$).

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