

The Predisposing Factors for Post Cholecystectomy Biliary and Vasculobiliary Injuries: a Prospective Study

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Abstract: Background: Biliary and vasculobiliary injuries are commonly reported post-cholecystectomy events with various incidence rates depending on different risk factors. Assessing these factors is important in designing prevention strategies.

Aim of study: To assess the predisposing factors related to post cholecystectomy biliary and vasculobiliary injuries.

Patients and methods: A clinical prospective study carried out in the Gastroenterology & Hepatology Teaching Hospital/ Medical City Complex in Baghdad-Iraq through period of two years from 1st of February, 2021 to 31st of March, 2023 on sample of 50 patients with Biliary and vasculobiliary injuries. All patients with Biliary and vasculobiliary injuries referred from other hospitals to Gastroenterology & Hepatology Teaching Hospital were dealt with them by multidisciplinary team and received best available management option decided. Results: Common local factors were chronic cholecystitis (30%), acute cholecystitis (24%), bleeding (24%), followed by; previous laparotomy (16%) and biliary & vascular anomaly (6%). The surgeon experience was specialist in 82% of patients with post-cholecystectomy biliary injuries, while implemented by resident surgeon in 18% of cholecystectomies. The common clinical presentation of post-cholecystectomy biliary injuries was jaundice (36%) and laparoscopy was the common type of cholecystectomy (80%), while recognition of bile injury was immediate in 18% of patients.

Conclusions: The common local factors of post-cholecystectomy biliary and vasculobiliary injury are chronic or acute cholecystitis and bleeding. Female gender, clinical co-morbidity, low expertise of surgeon, governmental hospital and laparoscopy cholecystectomy are risk factors for post-cholecystectomy biliary injury.

Keywords: Cholecystectomy, Biliary and vasculobiliary injuries, Laparoscopy.

Introduction:-

Biliary and Vasculobiliary injuries (VBIs) are the most common serious and challenging surgical complications of cholecystectomy. Iatrogenic bile duct injury had been well recognized by 1920¹ and the introduction of laparoscopic cholecystectomy led to a sharp rise in its incidence.² Biliary injuries are commonly associated with vascular injuries, especially arterial injuries.³ In 1948, Shapiro and Robillard theorized that arterial injury might induce biliary ischemia and thereby worsen a biliary injury.⁴ The first actual description of an arterial injury leading to the failure of a biliary repair was provided by Brittain et al.⁵ In 1994, Madariaga et al. described a patient in whom the biliary injury seemed to potentiate hepatic ischemia induced by an arterial injury.⁶ Thus, a second concept began to emerge: namely, that a biliary injury, which disrupted collateral arteries running along the biliary tree, could exacerbate hepatic ischemia caused by an arterial injury. Although biliary and vascular injuries frequently occur together, there had been no overview of this subject in the literature and important

issues remain unresolved. These include the effect of vascular injuries on the outcome of biliary repairs, and the advisability and timing of vascular and biliary repairs when there are VBIs. Proper management requires a skilled and experienced hepatobiliary surgical team.^{7,8,9,10,11}

Biliary and VBIs are serious complication of cholecystectomy, arising in 0.2– 0.3% of patients undergoing an open procedure and 0.5% of those undergoing laparoscopic surgery.^{7,8} Concomitant vascular and biliary injuries (VBIs) are present in 12–61% of these patients.⁷ Isolated vascular injuries (mostly to the right hepatic artery) are usually uncomplicated in otherwise healthy patients,⁸ and discovered only as incidental findings at autopsy.⁸ However, hepatic artery flow disruption presents a significant problem with bile duct injuries (BDIs) repair or reconstruction owing to relative duct ischemia.^{7,8,9,10}

A Definition of VBI is an injury to both a bile duct and a hepatic artery and/or portal vein; the bile duct injury may be caused by direct trauma, ischemia in origin or both, and may or may not be accompanied by various degrees of hepatic ischemia.⁸

VBIs may be classified into two types, of which one is common and the other very uncommon. In the common variety, the right hepatic artery and a bile duct are injured.^{3,8} This variant accounts for about 90% of VBIs. The pathogenesis and consequences of right hepatic artery VBIs are well described.⁸ The most common consequence is biliary ischemia, which may lead to anastomotic problems such as bile leakage and stenosis. Clinically significant hepatic ischemia is uncommon and, when it occurs, it tends to evolve slowly. Death is a very infrequent consequence.^{7,8,9,10}

The uncommon type of VBIs involves a bile duct(s) and the proper hepatic artery, the common hepatic artery, the main portal vein, the right portal vein, or one of these veins as well as a hepatic artery, possibly including the right hepatic artery.¹¹ The consequences of such injuries are much more extreme. Hepatic infarction is common, often with rapid onset and frequently necessitating emergency right hepatectomy or urgent liver transplantation.¹¹ Death occurred in about 50% of the patients reported.^{8,9,10,11}

Contributing factors to biliary and VBIs include inflammation in the triangle of Calot, a short cystic duct, excessive cephalic retraction on the

gallbladder fundus, and insufficient or excessive lateral retraction of the gallbladder infundibulum due to impacted stone. Additionally, use of an end-viewing scope, excessive use of cautery, physician inexperience and aberrant vasculobiliary anatomy can play a role in these injuries.^{8,12}

Aim of study: To assess the predisposing factors related to post cholecystectomy biliary and vasculobiliary injuries.

Patients & Methods

Patients

Study design & settings

Current study was a clinical prospective follow up study carried out in the Gastroenterology & Hepatology Teaching Hospital/ Medical City Complex in Baghdad-Iraq through a period of two years from 1st of February, 2021 to 31st of March, 2023.

Study population

All patients with Biliary and vasculobiliary injuries referred from other hospitals in Baghdad and Iraqi governorate to Gastroenterology & Hepatology Teaching Hospital were the study population.

Inclusion criteria

1. Any patient with biliary complications after open or laparoscopic cholecystectomy whether they need surgical intervention or not referred to Gastroenterology & Hepatology Teaching Hospital.

2. Any co-morbidity.

Exclusion criteria

1. Obstructive jaundice or biliary leak due to traumatic injury (blunt & penetrating injury).
2. Jaundice post-cholecystectomy due to malignant cause.
3. Biliary stricture due to liver transplant.
4. Post-cholecystectomy common bile duct stone.
5. Hepatocellular jaundice.

Sampling

A convenient sample of 50 patients with Biliary and vasculobiliary injuries referred from other hospitals to Gastroenterology & Hepatology

Teaching Hospital was selected after eligibility to inclusion and exclusion criteria. **Methods**

Data Collection

The data was collected directly by researcher from patients and filled in a prepared questionnaire. The questionnaire was designed by the supervisor. The following information was checked in every patient:

1. General characteristics of patients with post-cholecystectomy biliary and vasculobiliary injuries: Age and gender.
2. Clinical history of patients with post-cholecystectomy biliary and vasculobiliary injuries: Clinical co-morbidity, smoking status and alcohol consumption.
3. Local and surgical factors of patients with post-cholecystectomy biliary injuries: Local factors, surgeons factors and hospital type.
4. Surgical factors of patients with post-cholecystectomy biliary and vasculobiliary injuries: Clinical presentation, type of cholecystectomy and recognition of bile duct injury.
5. Preoperative findings of patients with post-cholecystectomy biliary and vasculobiliary injuries: Preoperative investigations, findings of injury according to Strasberg et al classification and vascular injury.
6. Treatment characteristics of patients with post-cholecystectomy biliary and vasculobiliary injuries: Emergency, conservative, planned for surgery and intraoperative findings.
7. Outcomes of patients with post-cholecystectomy biliary and vasculobiliary injuries: Hospital stay duration, outcome and timing of death.

All patients referred from other hospitals in Baghdad and Iraqi governorates to Gastroenterology & Hepatology Teaching Hospital were classified according to risk factors into patients with general risk factors, patients with local risk factors, surgeons' factors and hospital type.

Diagnosis of Biliary and vasculobiliary injuries was depended on history & clinical presentation, chest & abdominal x-ray, sonography, CT-scan, MRCP and fistulogram. The investigations were mostly done in Gastroenterology & Hepatology Teaching Hospital and some of them were acquired from patients' records.

All patients with Biliary and vasculobiliary injuries referred from other hospitals to Gastroenterology & Hepatology Teaching Hospital were dealt with them by multidisciplinary team and received best available management option decided. **Ethical considerations**

1. Approval was taken from Iraqi Board of Medical Specializations.
2. An agreement was taken from hospital authorities.
3. An oral informed consent was taken from patients enrolled in the study.

Statistical analysis

All patients' data entered using computerized statistical software; Statistical Package for Social Sciences (SPSS) version 22 was used. Descriptive statistics presented as (mean \pm standard deviation) and frequencies as percentages. Multiple contingency tables conducted and appropriate statistical tests performed. Fisher's exact test was used for categorical variables. In all statistical analysis, level of significance (p value) set at ≤ 0.05 . **Results**

Fifty patients had been referred to Gastroenterology & Hepatology Teaching Hospital with post-cholecystectomy biliary and vasculobiliary injuries. During same period, other patients undergone cholecystectomy in Gastroenterology & Hepatology Teaching Hospital and in this group, only two patients from 850 patients had postcholecystectomy biliary injuries. Those two patients developed this complication after laparoscopic cholecystectomy, one of them was female with type A classification and managed by ERCP, while another one was male with type E1 injury and recognition of injury intraoperatively which treated immediately by Roux-en-y hepaticojejunostomy.

Both patients were stable after follow up.

Regarding the referred fifty patients, they presented with mean age of 43.8 ± 17.9 years and range of (20-70 years); 16% of patients were in age group of 20-29 years, 26% of them were in age group of 30-39 years, 32% of them were in age group of 40-49 years, 10% of them were in age group 50-59 years and 14% of patients were in age group of 60-70 years. Female patients with post-cholecystectomy biliary and vasculobiliary injuries were more than males (72% vs. 28%). **Table (3-1) and Figures (3-1), (3-2).**

Table 3.1 : General characteristics of patients with post- cholecystectomy biliary and vasculobiliary injuries.

Variable	No.	%
Age mean\pmSD (43.8\pm17.9 years)		
20-29 years	8	16.0
30-39 years	13	26.0
40-49 years	17	32.0
50-59 years	5	10.0
60-70 years	7	14.0
Total	50	100.0
Gender		
Male	14	28.0
Female	36	72.0
Total	50	100.0

The clinical co-morbidity of patients with post-cholecystectomy biliary injuries was positive in 28% of them; commonly hypertension (12%), ischemic heart disease (10%) and diabetes mellitus (6%). Current smoking was observed in 16% of patients with biliary injuries, while alcohol consumption was observed in 8% of them. (**Table 3-2**)

Table 3.2: Clinical history of patients with post-cholecystectomy biliary and vasculobiliary injuries.

Variable	No.	%
Clinical co-morbidity		
Diabetes mellitus	3	6.0
Hypertension	6	12.0
Ischemic heart disease	5	10.0
No	36	72.0
Total	50	100.0
Smoking status		
Current	8	16.0
None	42	84.0
Total	50	100.0
Alcohol consumption		
Yes	4	8.0
No	46	92.0
Total	50	100.0

Common local factors were chronic cholecystitis (30%), acute cholecystitis (24%), bleeding (24%), followed by; previous laparotomy (16%) and biliary & vascular anomaly (6%). The surgeon experience was specialist in 82% of patients with post-cholecystectomy biliary and vasculobiliary injuries, while implemented by resident surgeon in 18% of cholecystectomies. The hospital was governmental in 76% of cholecystectomies, while it was private in 24% of them. (*Table 3-3 and Figure 3- 3*)

3.3:Local and surgical factors of patients with post- cholecystectomy biliary and vasculobiliary injuries.

Variable	No.	%
Local factors		
Chronic cholecystitis	15	30.0
Acute cholecystitis	12	24.0
Bleeding	12	24.0
Biliary & vascular anomaly	3	6.0
Previous laparotomy	8	16.0
Total	50	100.0
Surgeon factors		
Specialist	41	82.0
Resident	9	18.0
Total	50	100.0
Hospital type		
Governmental	38	76.0
Private	12	24.0
Total	50	100.0

The common clinical presentation of post-cholecystectomy biliary injuries was jaundice (36%), followed by; external biliary fistula (28%), localized collection (26%) and biliary peritonitis (10%). The laparoscopy was the common type of cholecystectomy (80%), while open cholecystectomy was the surgical type for 20% of patients. Recognition of bile injury was immediate in 18% of patients, while postoperatively in 82% of them. (*Table 3-4and Figure 3-4*)

3.4: Surgical factors of patients with post-cholecystectomy biliary and vasculobiliary injuries.

Variable	No.	%
Clinical presentation		
Jaundice	18	36.0
External biliary fistula	14	28.0
Localized collection	13	26.0
Biliary peritonitis	5	10.0
Total	50	100.0
Type of cholecystectomy		
Open	10	20.0
Laparoscopy	40	80.0
Total	50	100.0
Recognition of bile duct injury		
Immediate	9	18.0
Postoperative	41	82.0
Total	50	100.0

Discussion

Biliary and Vasculobiliary injuries could be complication of many surgical operations of liver or bile ducts but most commonly is seen during cholecystectomy. The management strategies of these injuries needed highly experienced surgeons and represented big burden on national health resources in addition health burden on patients ¹⁷

Bailout strategy to avoid bile duct injury should be applied in cases of critical view of safety can not be achieved including termination of surgery and referred patient to specialist center or subtotal cholecystectomy according of surgeon experience ¹⁸.

In present study, mean age of patients with post-cholecystectomy biliary injuries was (43.8 years). This finding is close to results of Bikhtiyar et al¹⁹ prospective study in Iraq which revealed that mean age of patients with biliary leak after laparoscopic cholecystectomy was (42.13 years). Our study showed predominance of female gender inpatients with post-cholecystectomy biliary injuries. This finding is consistent with results of Tidjane et al 20 single center retrospective study in Algeria which reported that female gender is regarded as common risk factor for post-cholecystectomy biliary injuries.

The current study found that clinical co-morbidity of patients with postcholecystectomy biliary and vasculobiliary injuries was positive in 28% of them. Similarly, Rystedt et al 21 study in different European and African countries stated that clinical comorbidity increased the severity and mortality risk of post-cholecystectomy biliary and vasculobiliary injuries. Common clinical co-morbidities in our study were hypertension (12%), ischemic heart disease (10%) and diabetes mellitus (6%). Lee et al 22 study in South Korea reported that hypertension and diabetes mellitus are significant risk factors for cholecystitis.

Additionally, Ghani et al ²³ study in Pakistan found that some patients with post-cholecystectomy biliary and vasculobiliary injury had hypertension and diabetes mellitus. In our study, current smoking was observed in 16% of patients with biliary and vasculobiliary injuries, while alcohol consumption was observed in 8% of them. Both smoking and alcohol consumption were reported to be related with high risk of hepatobiliary diseases, but not affecting the outcome of cholecystectomy ²⁴.

The present study showed that common local factors of post- cholecystectomy biliary and vasculobiliary injury were chronic cholecystitis (30%), acute cholecystitis (24%), bleeding (24%), followed by; previous laparotomy (16%) and biliary & vascular anomaly (6%). These findings are in agreement with reports of Pesce et al ²⁵ review study in Italy which documented that common factors of post- cholecystectomy biliary and vasculobiliary injury were acute or chronic cholecystitis,

hemorrhage and anomalies. In same way, our study findings are close to results of Salem et al ²⁶ retrospective study in Egypt which found that common local factors of post-cholecystectomy biliary injury were acute or chronic cholecystitis, previous abdominal surgery and morbid obesity. Our study showed that surgeon experience was specialist in 82% of patients with postcholecystectomy biliary and vasculobiliary injuries, while implemented by resident surgeon in 18% of cholecystectomies. This finding is close to results of Christou et al ²⁷ retrospective study in France who stated that post-cholecystectomy biliary and vasculobiliary injury is rare but affecting quality of life and the surgeons experience is regarded as common risk factor for this injury. Our study showed also that hospital was governmental in 76% of cholecystectomies, while private in 24% of them. Consistently, Martínez-

Mier et al ²⁸ retrospective review study in Mexico reported that in low and middle income countries, the post-cholecystectomy biliary injuries are frequent in governmental hospitals.

In current study, the common clinical presentation of post- cholecystectomy biliary injuries was jaundice (36%), followed by; external biliary fistula (28%), localized collection (26%) and biliary peritonitis (10%). These findings are close to results of Renz et al ²⁹ review study in Germany which found that clinical presentation of post- cholecystectomy biliary injuries were fever, pain, jaundice, fistula and peritonitis. Our study found that laparoscopy was the common type of cholecystectomy (80%), while open cholecystectomy was the surgical type for 20% of patients. This finding coincides with results of Kaman et al ³⁰ study in India who reported earlier and higher incidence of post-cholecystectomy biliary injuries following laparoscopy cholecystectomy as compared to open cholecystectomy. In our study, recognition of bile injury was immediate in 18%, while postoperatively in 82% of them. This finding is close to results of Tidjane et al ²⁰ single center retrospective study in Algeria which revealed that 24.53% of post-cholecystectomy biliary injuries were immediately recognized, while 75.47% of them were recognized postoperatively.

Conclusions:-

- The common local factors of post-cholecystectomy biliary and vasculobiliary injury are chronic or acute cholecystitis and bleeding.
- Female gender, clinical co-morbidity, low expertise of surgeon, governmental hospital and laparoscopy cholecystectomy are risk factors for post-cholecystectomy biliary and vasculobiliary injury.
- The common clinical presentations of post-cholecystectomy biliary injuries are jaundice, external biliary fistula, localized collection and biliary peritonitis.
- The management of post-cholecystectomy biliary and vasculobiliary injuries is mostly done by Roux-en-y hepaticojejunostomy.
- The intraoperative classification of post-cholecystectomy biliary and vasculobiliary injuries is relatively different from preoperative classification of these injuries.
- The outcome of post-cholecystectomy biliary and vasculobiliary injury repair is acceptable.
- Retinal use of critical view of safety in open and laparoscopic cholecystectomy and knowing the warning signs will prevent its disastrous complications.

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