RISK FACTORS FOR POST CHOLECYSTECTOMY VASCULOBILIARY INJURIES: A PROSPECTIVE STUDY IN IRAQI REFERRAL CENTER

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Abstract

Background: Vasculobiliary injuries (VBIs) during laparoscopic and open cholecystectomy are still serious problems which may cause liver ischemia. Injuries occur as a result of technical errors or misidentification of biliary ducts. VBIs are major cause of patient morbidity and litigation.

Aim: This study represents an analytical review of the patients of vasculobiliary injuries with the aim of providing risk factors, causes, relative frequencies, the clinical implications of such injuries and how to prevent such disastrous vasculobiliary injuries.

Patients and Methods: This prospective clinical study conducted in the Department of Surgery in Gastroenterology and Hepatology Teaching Hospital in Medical City/Baghdad from 18th of December 2011 to 25th of December 2013 and completed the research in Washington University in Saint Louis from 7th of January 2014 to 8th of March 2014 with The Pioneer Hepato-Pancreato-Biliary surgeon in the world (Professor Steven M. Strasberg) under the scholarship research program of Iraqi Ministry of Higher Education and Scientific Research. Fifty patients with VBIs were included in this prospective study ranging from 24 to 66 years old (mean age 40.76 year), 9 (18%) males and 41 (82%) females. All patients with VBIs referred from other hospitals in Baghdad and other Iraqi governorates. We classified the risk factors into three groups: General patient risk factors, local patient risk factors & surgeon factors. In all patients, the prospective diagnosis of VBIs were correctly made on history, clinical presentation, blood investigations, chest & abdominal x-rays, sonography, computed tomography scan (CT), magnetic resonance cholangiopancreatography (MRCP) and rarely doppler sonography.

Results: This study finds that VBIs done by inexperienced surgeons were observed in 20% (n=10), diploma Surgeon 20% (n=10), and injuries that occurred in cholecystectomy in acute phase 72% (n=36), private hospitals in 20% (n=10), comorbidities 14% (n=7), previous laparotomies 20% (n=10) are statistically significance if compared to control group done in Gastroenterology and Hepatology Teaching Hospital.

Conclusions: VBIs represent serious and challenging surgical complications and this study finds that acute cholecystitis, hospital type, experience and education level of surgeon are the most significant risk factors in selective set of logistic regression models.

Keywords: cholecystectomy, bile duct injury, vasculobiliary injury.
**Introduction**

Vasculobiliary injuries (VBIs) are the most common serious and challenging surgical complications of cholecystectomy. Iatrogenic bile duct injury had been well recognised by 1920 and the introduction of laparoscopic cholecystectomy led to a sharp rise in its incidence. Biliary injuries are commonly associated with vascular injuries, especially arterial injuries. In 1948, Shapiro and Robillard theorized that arterial injury might induce biliary ischemia and thereby worsen a biliary injury. The first actual description of an arterial injury leading to the failure of a biliary repair was provided by Brittain et al (1964). In 1994, Madariaga et al. described a patient in whom the biliary injury seemed to potentiate hepatic ischemia induced by an arterial injury. 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.

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. Concomitant vascular and biliary injuries (VBIs) are present in 12–61% of these patients. Isolated vascular injuries (mostly to the right hepatic artery) are usually uncomplicated in otherwise healthy patients, and discovered only as incidental findings at autopsy. However, hepatic artery flow disruption presents a significant problem with bile duct injuries (BDIs) repair or reconstruction owing to relative duct ischemia.

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.

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. This variant accounts for about 90% of VBIs. The pathogenesis and consequences of right hepatic artery VBIs are well described. The most common consequence is biliary ischemia, which may leads 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.
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. 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. Death occurred in about 50% of the patients reported.

Contributing factors to 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.

**Blood supply to bile ducts:**

1) **The supplying arteries:** The arteries shown in Figure 1 can all twig to the marginal arteries or, in some cases, directly supply the epicholedochal plexus. superior mesenteric artery (SMA); posterior superior pancreatoduodenal artery (PSPDA) the most important and constant artery; common hepatic artery(CHA); proper hepatic artery(PHA); right gastric artery(RGA); gastroduodenal artery(GDA); right hepatic artery(RHA); left hepatic artery(LHA); cystic artery(CA); left lateral hepatic artery(LLHA); A2, A3, A4, arteries to segments 2, 3 and 4. Replaced arteries can also supply the bile ducts.

![Fig.1: The supplying arteries of bile ducts with permission from Strasberg et al.](image-url)
2) **The marginal arteries:** Marginal arteries are disposed at 3, 9 and, rarely, 12 o’clock (not shown) on the common bile duct/common hepatic duct. The hilar marginal artery runs across the top of the confluence of the right and left hepatic ducts. (Figure 2)

![Figure 2](image_url)

*Fig.2:* The marginal arteries of bile ducts with permission from Strasberg et al.®

3) **The epicholedochal plexus:** The epicholedochal plexus is supplied by the marginal arteries and sometimes directly by the supplying arteries. The part of the network around the confluence of the right and left hepatic ducts has been termed the ‘hilar plexus’. However, it is continuous with the plexus that surrounds the common duct and is probably best considered as the hilar component of the epicholedochal plexus. (Figure 3)
Mature surgeons should not only be familiar with how to do things right, but should also realize how wrong things happen\textsuperscript{13}. Therefore Strasberg et al create a CVS (critical view of safety)\textsuperscript{14,15} in performing cholecystectomy and published in 1995. (Figure 4)
Critical View of Safety (CVS)\textsuperscript{14,15}

The critical view of safety has three requirements:

1) The triangle of Calot must be cleared of fat and fibrous tissue. It does not require that the common bile duct be exposed.

2) The lowest part of the gallbladder be separated from the cystic plate, the flat fibrous surface to which the nonperitonealized side of the gallbladder is attached. The cystic plate, which is sometimes referred to as the liver bed.

3) The two structures, and only the two, should be seen entering the gallbladder.

Once these three criteria have been fulfilled, critical view of safety has been attained (Figure 5). Failure to achieve critical view of safety as result of adhesion, inflammation, fibrosis or for any cause is an absolute indication to do conversion to open cholecystectomy.

However, although CVS will usually protect against making incorrect identification, it will not protect against direct injury to structures by persistent dissection in the face of highly adverse local conditions.\textsuperscript{15}

Miss identification is more common in:\textsuperscript{15}

1. Short cystic duct.
2. Stone impacted in Hartman pouch.

3. Gallbladder is tethered to CBD by fibrosis or inflammation.

4. Small caliber CBD.
Fig.5: Different appearances of the cystic plate. (A) Critical view of safety (CVS) is seen from in front of the gallbladder as usually shown. The cystic plate is very thin. (B) CVS is seen with the gallbladder reflected to the left so that a posterior view of the triangle of Calot is shown. The cystic plate is thicker and whitish. Both views fulfill criteria for CVS With permission from Strasberg et al.\textsuperscript{15}

Also there are several warning signs associated with VBIs published by Lien et al(2007)\textsuperscript{13}, these signs are:

1) Most common warning sign was status of acute inflammation, adding difficulty to procedures.

2) Unsuspected bleeding or appearance of unpredicted vessels or ducts: in these situations, possibility of a deviated operating target is more customary.

3) Acute inflamed tissue always appears different from normal tissue; it may be hard, dense, severely adhesive, and/or edematous. Dissection area should always be within area of acute inflammation, which may complicate dissection, but is nevertheless safe. By contrast, if the dissection areas become soft or loose during surgery, it indicates that the dissecting target has shifted toward the noninflamed area and therefore away from the safe zone. This shifting may result in inappropriate and dangerous dissection close to the CBD.

4) Paradoxical bile colour: white bile or turbid bile is common when the gallbladder is acutely inflamed. If clear bile observed during dissection, or clear bile appears after dirty bile, the surgeon must immediately consider bile origin—gallbladder or CBD.
5) Different mucosal pattern of CBD and Cystic Duct. The Former smooth and thin, and the latter villous and thick.

6) Surgeons’ feeling of hesitation during surgery should be taken as a sigh that something unusual has happened and that the situation must be reevaluated. Encountering these situations typically means that the surgeon's experience has been exceeded.

Experience alone is not sufficient to protect surgeons and their patients from VBIs. VBIs may lead to biliary, arterial or hepatic problems and the type and extent of these problems depend on the level of the biliary injury and the vessel(s) injured.\textsuperscript{16}

Recently there is a new classification (Hanover classification)\textsuperscript{17} in which patients were categorized according to levels and types of BDIs as well as associated vascular injuries Figure 6 (A-E), but Strasberg classification is still more practical in most centers of the world.
Pathogenesis of the ‘classical’ injury\(^8\) (Figure 7):

1. The common bile duct is mistaken as the cystic duct and is clipped and divided.
2. The dissection is carried up along the left side of the common hepatic duct in the belief that this is the underside of the gallbladder.
3. The common hepatic duct is transected as the surgeon tries to dissect what he believes is the gallbladder from the liver bed. If the structure is recognized as a bile duct at this point, it is often thought to be a second cystic duct or an accessory duct. As the common hepatic duct is divided, the right hepatic artery is often injured. (Figure 8)
Fig. 8: The final stage of the ‘classical’ injury. The hepatic duct has been divided. The right hepatic artery, which lies immediately behind the common hepatic duct, is injured. with permission from Strasberg et al.8

The aim of this study represents an analytical review of the patients of vasculobiliary injuries with the aim of providing risk factors, causes, relative frequencies, the clinical implications of such injuries and how to prevent such disastrous vasculobiliary injuries.

Patients and methods

With prior approval of the local Institutional Committee for Human Investigation, prospective study from 18th of December 2011 to 25th of December 2013 was conducted in Gastroenterology and Hepatology Teaching Hospital/Medical City/Baghdad and completed the research in Washington University at Saint Louis from 7th of January 2014 to 8th of March 2014 with the Pioneer Hepato-Pancreato-Biliary surgeon (Professor Steven M. Strasberg) under the scholarship research Program of Ministry of Higher Education and Scientific Research.

All patients referred to Gastroenterology and Hepatology Teaching Hospital/Medical City Baghdad with VBIs were evaluated by a multidisciplinary team and the best available treatment option decided.

Fifty patients with VBIs were included in this prospective study ranging from 24 to 66 years old (mean age 40.76 year). 9 (18%) males and 41 (82%) females. All patients with VBIs referred
from other hospitals in Baghdad and other Iraqi governorates. We classified the risk factors into three groups: General patient risk factors, local patient risk factors & surgeon factors. In all patients, the prospective diagnosis of VBIs were correctly made on history, clinical presentation, blood investigations, chest & abdominal x-rays, sonography, computed tomography scan (CT), magnetic resonance cholangiopancreatography (MRCP) and rarely doppler sonography.

For the purpose of statistical analysis, the control group was consisting of 860 patients with cholecystectomies, which were done in Gastroenterology and Hepatology Teaching Hospital/ Medical City Baghdad in the same period, ranging from 16 to 81 years old (mean age 39.29 year), 197(22.9%) males and 663(77.1%) females.

**Inclusion Criteria :**

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

2) Any comorbidity.

**Exclusion criteria :**

1) Biliary leak or obstructive jaundice secondary to traumatic injuries (blunt and penetrating injuries).

2) Biliary stricture secondary to liver transplantation.

3) Post cholecystectomy jaundice due to malignant cause.

4) Hepatocellular jaundice.

5) Post cholecystectomy CBD stones.

**Statistical analysis**

All statistical analysis was performed using the Statistical Package for Social Sciences (SPSS V.11, SPSS Inc., Chicago, Illinois, USA). Patient and surgeon related variables were considered in univariate analysis for association with each of the outcomes.12
Significance was taken at the p≤0.05 level. Chi-square (χ²) test was used for categorical variables and Student’s t-test for parametric data. Variables of clinical importance and those with significant associations confirmed in univariate analysis were introduced into a forward selective set of logistic regression models predicting each outcome separately, again assuming significance at the p≤0.05 level.\textsuperscript{12}

\textbf{Fig. 9.} Classification of open & laparoscopic injuries to the biliary tract. by permission from Strasberg et al.\textsuperscript{14}
Results

Fifty patients had been referred to Gastroenterology and Hepatology Teaching Hospital/Medical City/Baghdad.

During the same period 860 patients had undergone cholecystectomy in Gastroenterology and Hepatology Teaching Hospital/Medical City/Baghdad. In this group five out 860 (0.58%) patient had a biliary injury type (A) according to Strasberg et al classification\textsuperscript{14} which showed in Figure 9. All of them after laparoscopic cholecystectomy, two of them were males and three were females, two of them were managed conservatively, and the other two with Endoscopic Retrograde Cholangiopancreatography (ERCP). The last one was managed with percutaneous drainage under sonography guidance and all stabilized on follow up.

Tables (1) (2) & (3) show the variable risk factors in both groups.

Table (4) shows multiple logistic regression model, that combined the two set of variables include patients (general and local ) and surgeon factors, which is used to analyze the clinical significance of those variables in predicting development of VBIs. It had been found that surgeon experience, education level, surgery done on acute cholecystitis and hospital where operation performed are the most significant factors with p value of less than 0.05. Those highlighted factors show the significant level for VBIs.

We found no vascular injuries in 88% of patients in referred 50 patients while they were observed in 10% of patients associated with biliary injuries (right hepatic artery injury or pseudoaneurysm of cystic artery that develop sometimes when a technical failure in dealing with the cystic artery in the form of a slipped ligature, slipped clip, abuse of diathermy current and avulsion or laceration of the cystic artery. It is important to emphasize the need to apply a proper standard method in dealing with the cystic artery.\textsuperscript{18,19,20,21} A remaining 2% not known; means some investigations had not solved whether vascular injury present or not. (Figure 10 and Figure 11 which show the percentage of vascular injuries and type of vascular injuries respectively.)
Table 1 shows general patient risk factors in both groups (VBIs group and control group).

<table>
<thead>
<tr>
<th>General Patient Factors</th>
<th>Case (50)</th>
<th>Control (860)</th>
<th>P value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>40.76(±11.9)</td>
<td>39.29(±13.02)</td>
<td>0.43</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td>0.49</td>
</tr>
<tr>
<td>Male</td>
<td>9 (18%)</td>
<td>197 (22.9%)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>41 (82 %)</td>
<td>663 (77.1%)</td>
<td></td>
</tr>
<tr>
<td>Comorbidity</td>
<td></td>
<td></td>
<td>0.001</td>
</tr>
<tr>
<td>None</td>
<td>43 (80%)</td>
<td>812 (94.4 %)</td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>5 (10%)</td>
<td>22 (2.6%)</td>
<td></td>
</tr>
<tr>
<td>DM</td>
<td>0 (0%)</td>
<td>14 (1.8%)</td>
<td></td>
</tr>
<tr>
<td>IHD</td>
<td>0 (0%)</td>
<td>8 (9%)</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>2 (4.0%)</td>
<td>4 (5%)</td>
<td></td>
</tr>
<tr>
<td>Smoking</td>
<td></td>
<td></td>
<td>0.153</td>
</tr>
<tr>
<td>Non</td>
<td>47(94%)</td>
<td>838(97.4%)</td>
<td></td>
</tr>
<tr>
<td>Smoker</td>
<td>3 (6 %)</td>
<td>22 (2.6 %)</td>
<td></td>
</tr>
<tr>
<td>Alcohol</td>
<td></td>
<td></td>
<td>0.6</td>
</tr>
<tr>
<td>Non</td>
<td>50 (100%)</td>
<td>851 (99.0%)</td>
<td></td>
</tr>
<tr>
<td>Present</td>
<td>0</td>
<td>1. (1.0%)</td>
<td></td>
</tr>
</tbody>
</table>

*P value calculated using Chi square for categorical variable and independent t test for age.
Table 2 shows local patient risk factors in both groups (VBIs group and control group).

<table>
<thead>
<tr>
<th>Local Patient Factors</th>
<th>Case (50)</th>
<th>Control (860)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biliary &amp; vascular Anomaly</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non</td>
<td>49 (98%)</td>
<td>838 (97.4%)</td>
<td>0.63</td>
</tr>
<tr>
<td>Present</td>
<td>1 (2 %)</td>
<td>22 (2.6%)</td>
<td></td>
</tr>
<tr>
<td>Previous Laparotomy *</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>40 (80%)</td>
<td>779 (90.6%)</td>
<td>0.021</td>
</tr>
<tr>
<td>Yes</td>
<td>10 (20%)</td>
<td>81 (9.4%)</td>
<td></td>
</tr>
<tr>
<td>Surgery done on **</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acute cholecystitis</td>
<td>36 (72%)</td>
<td>21 (2.4%)</td>
<td>0.001</td>
</tr>
<tr>
<td>Chronic cholecystitis</td>
<td>14 (28%)</td>
<td>839 (97.6%)</td>
<td></td>
</tr>
</tbody>
</table>

*The relative risk for presence of previous Laparotomy is 2.12 (1.17–3.83 as 95% confidence interval). **The relative risk for acute cholecystitis is 29.8 (18.6 – 46.5 as 95% confidence interval).
Table 3 shows surgeon risk factors in both groups (VBIs group and control group).

<table>
<thead>
<tr>
<th>Surgeon Factors</th>
<th>Case (50)</th>
<th>Control (860)</th>
<th>P value</th>
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</thead>
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<tr>
<td>Experience</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>40 (80%)</td>
<td>860 (100%)</td>
<td>0.001</td>
</tr>
<tr>
<td>No</td>
<td>10 (20%)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Education Level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Board</td>
<td>40 (80%)</td>
<td>860 (100%)</td>
<td>0.001</td>
</tr>
<tr>
<td>Diploma</td>
<td>10 (20%)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Operative person</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resident</td>
<td>4 (8.0%)</td>
<td>757 (88%)</td>
<td>0.001</td>
</tr>
<tr>
<td>Specialist</td>
<td>46 (92%)</td>
<td>103 (12%)</td>
<td></td>
</tr>
<tr>
<td>Hospital type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>10 (20%)</td>
<td>0</td>
<td>0.001</td>
</tr>
<tr>
<td>Public</td>
<td>40 (80%)</td>
<td>860 (100%)</td>
<td></td>
</tr>
</tbody>
</table>

* Experience means surgeon who operated > 100 laparoscopic cholecystectomy.
Table 4: multiple logistic regression model with Unstandardized & Standardized Coefficients and statistical significance of risk factors

<table>
<thead>
<tr>
<th></th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>T</th>
<th>P value</th>
</tr>
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<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>.834</td>
<td>.042</td>
<td>19.657</td>
<td>.000</td>
</tr>
<tr>
<td>Age</td>
<td>.000</td>
<td>.000</td>
<td>-.012</td>
<td>-.921</td>
</tr>
<tr>
<td>Gender</td>
<td>-.011</td>
<td>.007</td>
<td>-.020</td>
<td>-1.506</td>
</tr>
<tr>
<td>Co Morbid</td>
<td>-.002</td>
<td>.006</td>
<td>-.004</td>
<td>-.333</td>
</tr>
<tr>
<td>Smoking</td>
<td>.006</td>
<td>.018</td>
<td>.004</td>
<td>.354</td>
</tr>
<tr>
<td>Alcoholism</td>
<td>.021</td>
<td>.029</td>
<td>.009</td>
<td>.708</td>
</tr>
<tr>
<td>Anomely</td>
<td>.007</td>
<td>.018</td>
<td>.005</td>
<td>.380</td>
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<tr>
<td>Prev.Laparotomy</td>
<td>.008</td>
<td>.010</td>
<td>.011</td>
<td>.866</td>
</tr>
<tr>
<td>Experience</td>
<td>.208</td>
<td>.027</td>
<td>.146</td>
<td>7.698</td>
</tr>
<tr>
<td>education Level</td>
<td>.067</td>
<td>.034</td>
<td>.031</td>
<td>1.956</td>
</tr>
<tr>
<td>License</td>
<td>-.029</td>
<td>.018</td>
<td>-.023</td>
<td>-1.624</td>
</tr>
</tbody>
</table>
Surgery done on acute cholecystitis | .209 | .014 | .222 | 14.430 | .000
hospital type | .739 | .019 | .665 | 38.892 | .000
Operative person | -.005 | .015 | -.004 | -.308 | .758

**Fig.10:** Percentage of vascular injuries.

**Fig.11:** Type of vascular injuries.

Sometimes some sort of interventions (procedures) was done to the patients with VBIs before referral to our hospital. (Figure 12)

**Fig.12:** Interventions (procedures) performed to the patient with VBIs before referral and type of intervention. * The sum of patients in this Figure (n=51), means one of patients need two types of intervention radiological drainage and then ERCP.
Figure 13 shows the level of injury pre and post-operative repair and we found that the Strasberg (type E) injuries are the most common type of injury which is called the classical injury.\(^8\)

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.

![Figure 13: Level of Biliary injury pre and actual operative finding.](image)

Regarding surgeon license in laparoscopic cholecystectomy we found that 7 out of 27 had no license (2.92%) and in spite of that they did laparoscopic cholecystectomy and did VBI. (Figure 14)

![Figure 14: License in laparoscopic cholecystectomy.](image)
Regarding mortality rate of the patients with VBIs, Figure 15 shows that there were only two patients (4%) died pre-operatively before biliary reconstruction operation, and no intra-operative mortality and there is only one patient (2%) died postoperatively. This patient gave history of severe bleeding at time of previous laparoscopic cholecystectomy which then converted into open cholecystectomy and consulted vascular surgeon to stop bleeding, he was referred to our hospital and a decision was made for reconstruction of biliary duct. This patient had an (E4) injury and right hepatic artery injury. During the reconstruction, we found a missed piece of gauze in foramen of Winslow. (Figure 16)

Reconstruction was done with Roux En-Y-Hepaticojejunostomy, but patient died in the 8th post-operative day because of septicemia.

![Pre, intra & Post Operative Mortality](image)

**Fig.15:** Pre, intra & Post-operative mortality.

*37 patient’s intraoperative means 8 patients excluded because of Strasberg A (manage non operatively) and 5 patients operated outside our Gastroenterology and Hepatology Teaching Hospital.

![Missed Gauze in foramen of Winslow](image)

**Fig.16:** Missed Gauze in foramen of Winslow.
Discussion

Investigation of causes of medical errors has led to better understanding that the everyday surgical environment is not safe as may be expected, and that surgeons as human beings will inevitably make mistakes. Considering accidents as information about a failed system is an effective strategy for improving the safety and quality of our medical care systems\textsuperscript{13,22}. The accident analysis process provides understanding of the background, causative factors, and causative mechanisms of accident, and also indicates that most injuries are preventable\textsuperscript{13}. Our thesis analysis process was especially concerned about patient general and local factors and surgeon factors and we expected to gain critical information to improve safety.

It had been found that surgeon experience, education level, cholecystectomy being done in acute phase and hospital type where cholecystectomy performed are the most significant factors with p value of less than 0.05 in our thesis and in comparison to other thesis like Strasberg et al\textsuperscript{23,24}(2002,2000), we found that the high rate of VBI injury was due to inexperience in the procedure. Also the incidence of injury when laparoscopic cholecystectomy is performed for acute cholecystitis was reported to be three times higher than that for elective laparoscopic cholecystectomy and twice as high as for open cholecystectomy for acute cholecystitis, and in our thesis the relative risk for acute cholecystitis in laparoscopic and open cholecystectomy is 29.8 (18.6 – 46.5 as 95% confidence interval).

Also in Christos et al\textsuperscript{25} (2008), he found that the risk of VBIs is 3.5 times higher in those with acute inflammation, but it was considered as independent risk factor. Early reports of laparoscopic VBIs cited that bleeding and subsequent attempts to achieve homeostasis are major contributing factors to bile duct injury.\textsuperscript{3}

Most patients with major VBIs were women (70%). The average age of patients with VBIs is 46.2 year and 29.4% had history of previous abdominal surgery.\textsuperscript{26} In comparison to our study most VBIs occur in women (82%), 20% had history of previous abdominal surgery and the average age of patients with VBIs is 40.76 year and also found that the classical injuries (Strasberg E) is the most common type of injury in our study and in published articles.\textsuperscript{14,26,27,28}

The role of obesity is difficult to evaluate, because it is so often present in patients with cholelithiasis.\textsuperscript{23}
Conclusions

• VBIs represent serious and challenging surgical complications and this study found that acute cholecystitis, hospital type, experience and education level of surgeon are the most significant risk factors in selective set of logistic regression models (univariate analysis).

• Comorbidities, laparoscopic license of surgeon and previous laparotomies are also statistically significant in multivariate analysis.

• Rational use of the critical view of safety in open & Laparoscopic Cholecystectomy and knowing the warning signs will prevent its disastrous complications.

• Prevention is our goal to reach.

Recommendations

• Critical view of safety is important for every surgeon who will do open and laparoscopic cholecystectomy.

• Injury to common bile duct occurs when it is mistaken for the cystic duct. If facilities are present, intra-operative cholangiography outlines the biliary anatomy and thus may decrease the risk of common bile duct injuries. It should be performed if anatomic abnormalities are suspected.

• Documentation of critical view of safety in open and laparoscopic cholecystectomy by photos or videos or both, if facilities are present, is very important.

• Proper management requires a skilled and experienced hepatobiliary surgical team
References


