

# Incidence of Bleeding from Anomalous Vessels in Liver Bed and Mode of Hemostasis in Patients Undergoing Laparoscopic Cholecystectomy

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## ABSTRACT

**Objective:** The objective of this study is to determine the frequency of encountering anomalous vessels in liver bed and mode of hemostasis to stop bleeding from these vessels.

**Material and Methods:** This observational cross sectional study was conducted from 01-08-2012 to 31-07-2016 in the Department of surgery of Mayo Hospital, Lahore.

**Results:** A total of 451 cases were included having mean age of  $37.10 \pm 10.26$  years. There were 347 (77%) females and 104 (33%) males. Gallstones were found in 424 (94%) patients and 27 (6%) patients had no gallstones. There were 98 (22%) acute on chronic cases and 353 (78%) chronic cases. The incidence of anomalous vessels in liver bed was 21%. Out of 95 cases with anomalous vessels, 65 (69%) had acute on chronic attack in past one week. Bleeding from liver bed was seen in 59 cases (13.1%). The hemostatic efficacy was 100% with endoclip technique and 83% with direct pressure application. In 9 patients direct pressure was not sufficient so endo-suturing was done.

**Conclusion:** Per-operative incidence of anomalous vessels in liver bed is higher in acute on chronic presentation. Careful dissection of liver bed can prevent bleeding from these vessels.

**Key words:** Cholecystectomy, laparoscopic, gallbladder, hemorrhage, complications, intraoperative (MeSH headings) 3

## INTRODUCTION

Symptomatic gallstone is one of the most common digestive track diseases presenting in surgical floor requiring either conservative or surgical management. Around 20% of total gallstones patients eventually become symptomatic with pain, fever and vomiting.<sup>1</sup> Incidence of gallstones is more in individuals with higher Body Mass Index (BMI). Women are known to be more prone to developing gallstone disease.<sup>2</sup>

Cholecystectomy is the procedure of choice in gallstones either done by open or close method. Previously open cholecystectomy was the procedure of choice but after 1989, with the introduction of laparoscopic cholecystectomy, the later became the procedure of choice.<sup>3</sup> Knowledge of relevant anatomy is important for the safe execution of any operative procedure. Specifically, in the context of cholecystectomy, it has long been recognized that misinterpretation of normal

anatomy as well as the presence of anatomical variations contribute to the occurrence of major per-operative complications. The commonest among these complications are port site bleed, port site hematoma, common bile duct (CBD) injury, biliary leakage, slippage of endoclip and hemorrhage from liver bed.<sup>4</sup> Such injuries in turn can cause significant complication and occasionally conversion of laparoscopic cholecystectomy to open cholecystectomy. There is now a fair amount of data to suggest the acceptance of laparoscopic cholecystectomy as the standard procedure for symptomatic gallstone disease.<sup>5,6</sup>

The most life threatening complication during laparoscopic cholecystectomy is hemorrhage.<sup>7</sup> Hemorrhage can occur from any site during the procedure e.g. port site, cystic artery, right hepatic artery, inferior vena cava, abdominal aorta and liver bed. Most of the times these bleeding

complications tend to occur in acute cases where surgeons encounter difficulty in clearing Calot's triangle.<sup>8</sup> This review discusses anatomical facts that are of relevance to the performance of a safe cholecystectomy. Misinterpretation of normal anatomy and anatomical variations contribute to the occurrence of major per-operative complications like bleeding from gall bladder bed during laparoscopic cholecystectomy. A look at the basic anatomy is therefore important for minimally invasive surgeons. This includes normal anatomy and variations of vascular supply between liver bed and gall bladder.<sup>4</sup>

Life threatening intra-operative bleeding during laparoscopic cholecystectomy is not very common and accounts for only 2% .<sup>9</sup> Mostly bleeding occur in cases of hepatic insufficiency, steroids use or in case of acute presentation in which bleeding occurs because of adhesions, increased vascular supply and friable tissue due to inflammation.<sup>10</sup> There are many vessels which communicate between the gallbladder and the liver bed.<sup>11</sup> These vessels tend to bleed during excision of gallbladder from liver bed in laparoscopic cholecystectomy. A bleed from the liver bed may be controlled by cauterization, direct pressure application or endoclips.<sup>12</sup> The study will encompass the factors that predispose the patient to development of per-operative hemorrhage and the commonly used techniques to prevent this hemorrhage.

**Objective:** The objective of this study is to determine the frequency of anomalous vessels in liver bed and mode of hemostasis to stop bleeding from these vessels.

## MATERIAL AND METHODS

The study is a prospective observational cross-sectional study that was conducted during two years period from August 2014 to July 2016, in the Department of General Surgery, King Edward Medical University, Lahore. Patients of either gender with age between 20 to 55 years diagnosed as gallstone disease and undergoing laparoscopic cholecystectomy were included in the study. Presence of gallstones was confirmed through ultrasonography. Those patients which had other co-morbid conditions such as diabetes mellitus, hypertension, liver cirrhosis and bleeding disorders were excluded from the study. Patients in whom laparoscopic surgery was later converted to open cholecystectomy due to any reason were also excluded from the study.

All the patients that presented during the study period and fulfilled the inclusion and exclusion criteria were enrolled in the study through non-probability consecutive sampling technique. Complete history and clinical examination was carried out to differentiate acute on chronic cases from chronic cases. The patients were then subjected to laparoscopic cholecystectomy carried out by a consultant surgeon with at least 200 laparoscopic surgeries experience. Per-operatively the presence of anomalous vessels in liver bed was confirmed by two surgeons and recorded. Presence of bleed from the liver bed during dissection, due to injury of anomalous vessels, was also recorded. Additionally, the mode of hemostasis used to stop this bleed and its efficacy was 5 noted. The methods to control hemorrhage included application of endoclips or direct pressure application for 5 minutes. Presence of no visible bleed from the injury site was labeled as effective hemostasis. All the surgeries were video recorded and pictures were taken to be later used as reference where needed.

All the data were entered in SPSS version 20 and were analyzed through its statistical package. Qualitative variables such as gender, presence of anomalous vessels in liver bed, mode of presentation and technique used for hemostasis and its efficacy were presented as frequency and percentages. Quantitative data such as age were presented as mean +S.D. Graphical images of per-operative findings were provided where necessary.

## RESULTS

A total of 451 patients fulfilled the inclusion and exclusion criteria and were included in the study. The mean age was  $37.10 \pm 10.26$  years with the age range between 20 to 55 years. There were 347 (77%) females and 104 (33%) males. The mean BMI of all patients was  $28.64 \pm 4.71$  kg/m<sup>2</sup> with the range between a minimum of 19.06 kg/m<sup>2</sup> to maximum of 36.14 kg/m<sup>2</sup>. Based on history and clinical examination, the mode of presentation in 98 (22%) patients was acute on chronic with acute attack occurring during the last one week, while 353 (78%) presented as chronic cases of cholecystitis. Per-operatively gallstones were found in 424 (94%) patients and there were 27 (6%) patients in which no gall stone were observed per-operatively.

Presence of anomalous vessels in liver bed was confirmed in 95 (21%) cases. Among these cases it was observed that 65 (68.4%) patients

had suffered an acute on chronic attack in the past one week and 30 (31.6%) patients had presented with chronic cholecystitis.



**Figure 1:** Figure showing active bleed from anomalous vessels from liver bed.



**Figure 2:** Figure showing direct pressure application for control of hemorrhage from bleeding vessels of liver bed.



**Figure 3:** Figure showing control of hemorrhage by Titanium clip application on a bleeding vessel of liver bed. The vessel in this patient was pulsatile showing arterial circulation

The incidence of bleeding from liver bed due to anomalous vessels was seen in 59 cases (13.1%). Out of these 59 cases, hemostatic clip was applied in 5 patients and direct pressure was applied on 54 patients. In 9 patients, pressure application alone was not sufficient so liver bed suturing was

performed which halted the bleeding. The hemostatic efficacy was 100% with endoclip technique and 83% with direct pressure application. The bleeding from liver bed was eventually controlled in all the patients before the surgery was concluded. In none of the patients post-operative bleed was noted.<sup>6</sup>

## DISCUSSION

Laparoscopic surgery is currently the treatment of choice for symptomatic cases of gallstone disease. Anomalous vessels may pose difficulties to the operating surgeon more so to the surgeons passing through the learning curve. The commonest of the vascular anomalies is the cystic artery arising from an extra hepatic branch of right hepatic artery, the left hepatic artery or from gastroduodenal, celiac or common hepatic artery.<sup>13</sup> A surgeon must anticipate these variations to prevent hemorrhage. In this study we have focused on another aspect of bleeding in laparoscopic cholecystectomy i.e., bleeding from the liver bed. In our study we found anomalous vessels in the liver bed in almost 21% of the patients. A study by Sahu et al., (2013) has reported an incidence of 7.7% of various vascular anomalies that are encountered during gall bladder dissection from liver bed.<sup>14</sup> The presence of these vessels between the gallbladder and liver bed have previously been reported in studies particularly in cirrhotic patients where increase in portal pressure predisposes to development of such collaterals.<sup>15,16</sup> Such collaterals always give rise to the possibility of uncontrolled hemorrhage from liver bed that can obscure the operative field and require surgical intervention to halt the bleed. Such cases require extra care while separating gallbladder from liver bed that may involve meticulous use of diathermy or harmonic scalpel.<sup>17</sup>

The demographic details from this study clearly indicate the predominance of gallstone disease in females with the mean BMI of all the patients falling in the overweight category (25-30 kg/m<sup>2</sup>). The literature is evident that obesity can lead to increased secretion of cholesterol from liver that can predispose to gallstones. In women, lesser lean body mass as compared to males and higher levels of adiposity are potential risk factors that predispose females to gallstone disease.<sup>18</sup> The modes of presentation such as acute on chronic and chronic cholecystitis were also recorded in this study. The incidence of bleeding from liver bed was higher in patients that have experienced an

acute attack in the last one week. In a retrospective analysis by Bansalet *al.*, (2015) on more than two thousand cases, intraoperative bleeding was seen in almost 4.5% of the cases. They observed that more than half of bleeding incidences were from the liver bed. Most of these cases were acute cholecystitis or with shrunken fibrotic gallbladder.<sup>7</sup> Karneet *al.*, (2014) observed that bleeding from liver bed occurred in 12.5% of the patients undergoing laparoscopic cholecystectomy. The incidence of bleed from liver bed in acute cases was twice as compared to chronic cases.<sup>8</sup> Sahu *et al.*, (2013) reported an incidence of densely adherent gall bladder to liver bed of more than 40% in cases with an acute attack of cholecystitis. They suggested that in such cases skeletonization and division and ligation of vessels becomes essential.<sup>14</sup> The reason for this difficulty is attributed to the fact that alteration of local anatomy occurs as a result of pericholecystitis and subsequently the cleavage plane between the gallbladder and liver bed is lost. These conditions predispose the traversing vessels to injury when attempt at dissection of gallbladder from liver bed is made.

Per-operative bleeding is a common complication of gallbladder surgery which include bleeding in the Calot's triangle and from the liver bed. A local study conducted at Khyber Teaching Hospital, Peshawar by Gulet *al.*, (2013), showed an incidence of liver bed bleeding of more than 10% which is comparable to our study.<sup>19</sup> In view of the complex anatomy and relatively frequent occurrence of anomalies, The Society of American Gastrointestinal Endoscopic Surgeons (SAGES) recommends the application of "Critical View of Safety (CVS)" under its Safe Cholecystectomy Program.<sup>20</sup> The CVS implies that at least one-third of the gallbladder should be separated from liver bed, Calot's triangle must be adequately cleared and only cystic artery and duct should be the two structures remaining between the hepatic ligament and gallbladder.<sup>21</sup> A study conducted in Melbourne by Lam *et al.*, (2014) based on the review of 100 images, identified the various causes of bleed from liver bed and postulated that CVS is implemented in less than half of the surgeries and found out that separation of gallbladder from liver bed was the most deficient part.<sup>22</sup> Following these safety guidelines can reduce the incidence of bleed from liver bed.

In the present study the control of hemorrhage was successfully achieved by both endoclips and

direct pressure application for 5 minutes. Endo-suturing was performed in those cases in which direct pressure application was not sufficient to halt the bleed. In literature multiple strategies have been mentioned to control hemorrhage from bleeding vessels during cholecystectomy. These techniques include cauterization, direct pressure application, endoclips and ligation of vessels.<sup>23, 24</sup> The choice of technique is largely dependent on surgeon's choice. However, if the hemorrhage from liver bed is severe then in such cases cauterization and pressure application may fail. Oversewing of the bleeding vessels may be the only solution in those cases.<sup>25</sup> Nevertheless, the solution to prevention of these bleeding complications lies in the careful dissection of gallbladder from the liver bed and following the principle of safe cholecystectomy such as Critical View of Safety.

The present study has some limitations as well. This study has focused mainly on the occurrence of bleed from liver bed and anomalies related to cystic artery and the biliary tree were not recorded. The control of hemorrhage was largely dependent on the subjective choice of the surgeon thus not allowing randomization which is crucial for such studies. This may be another limitation of the study. Additionally in setups where more advanced techniques such as harmonic scalpels are routinely used, the incidence of hemorrhage from liver bed may differ from that depicted in our study.

## CONCLUSION

Bleeding complications are common in gallbladder surgery. Liver bed may contain anomalous vessels that can bleed during dissection of gallbladder from liver bed. The incidence of bleeding is higher in acute on chronic cases. Anticipating such vascular anomalies can prevent their occurrence. However, if bleeding from liver bed does occur then direct pressure application or endoclips may be used. In persistent hemorrhage endo-suturing may be needed. A careful and meticulous dissection of the liver bed can prevent these complications.

## CONFLICT OF INTEREST

The authors declare no conflict of interest. There was no financial assistance taken for this study.

## DECLARATION

The authors declare that the manuscript has not been submitted earlier to any other journal and the

study has not been published or results presented at any conference. 9

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