

# Vascular Surprises in Calot's Triangle during Laparoscopic Cholecystectomy

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## Abstract

**Background:** To identify the vascular anomalies, variations of Calot's triangle during laparoscopic cholecystectomy

**Methods:** In this prospective observational study one thousand patients with a diagnosis of cholelithiasis were included. Exclusion criteria were patients younger than 12 years and older than 80 year. Calot's triangle dissection was done meticulously. Cystic artery and hepatic artery anomalies and variations were observed and analyzed on SPSS 21.

**Results:** The age varied from 12 to 80 years. On the basis of distributional variation the cystic artery was single in 90% cases, branched in 7% cases and absent in 3% cases. On positional variations the cystic artery was superomedial to the cystic duct in 85% cases, anterior in 7% cases, and posterior in 3% cases and low lying in 5% of the cases. On the basis of length variation results showed that 80% cases had a normal cystic artery. A short cystic artery was found in 5% cases and a long cystic artery was present in 5%. Other arterial variations are of hepatic artery i.e. Moynihan's Hump (3%) and right hepatic artery present in Calot's triangle in 5%

**Conclusions:** For the safety of laparoscopic cholecystectomy one should be well aware of the anatomical variations of the cystic and hepatic artery.

**Key Words:** Cholelithiasis, Cholecystitis, Laparoscopic Cholecystectomy.

## Introduction

Cholelithiasis is very common in western countries and their frequency varies from 20-30%. It is increasing every year and the reason is because of increased intake of junk food.<sup>1</sup> Cholelithiasis is common in Pakistan as well and the standard procedure for it is cholecystectomy.<sup>2</sup> Laparoscopic cholecystectomy is very popular among minimal invasive surgery and replacing the conventional surgery.<sup>3</sup> Its advantages are truly based not only on the skill but also the good knowledge of anatomy and variations of Calot's triangle. With the advent of laparoscopic

cholecystectomy, though there are a lot of benefits but initially surgeons had faced a lot of complications.<sup>4</sup> Surgeon were not really well aware about the anatomical variations of the Calot's triangle. There was injudicious use of vessel sealing devices and third excessive skeletonization of the triangle. Vigilant steps should be carried out during dissection of cystic duct and artery in open as well in laparoscopic cholecystectomy to prevent complications.<sup>5</sup>

In 1891 Calot described the Calot's triangle and it is very important landmark during laparoscopic cholecystectomy. This triangle is formed below by cystic duct, above by inferior border of liver and medially by common hepatic duct and cystic artery and lymph node lie within it.

## Patients and Methods

It was an observational study in which the vascular anomalies were assessed. It was conducted at the Surgical Unit II of Holy Family Hospital, Rawalpindi from January, 2012 to December, 2016. A total of 1000 patients were included who underwent laparoscopic cholecystectomy. The length of the cystic artery was measured by cautery tip which is 1cm in length. Surgeon evaluated the dissection of Calot's triangle easy and difficult. Dissection of gall bladder done by hook, ligasure or harmonic. Informed consent was taken from all patients. On a pre-designated patient proforma data were collected. The cystic artery distributional (single, double, branched), positional and length variations were noted. Cystic artery variations in the form of number and position and length in term of frequency, difficult dissection and hepatic artery anomalies and variations were carried out with the help of descriptive statistics.

## Results

Out of 1000 patients majority were between 12-80 years (mean 48±13). Only 200(20%) patients were male and females were 800 (98%). Per operatively in 80% were of cholelithiasis, acute cholecystitis were seen in 6% patients while 6% patients had an empyema gall

bladder and 8% had a mucocele of the gall bladder. Calot's triangle dissection was assessed easy in 80%. Anatomical variations are elaborated as positional, distributional and length variations of cystic and hepatic artery. In 90% cases, there was a single cystic artery (Table 1; Figure 1). In 3% cases, cystic artery was absent and gallbladder was receiving blood supply from liver bed. (Table 1). According to cystic artery length, it was divided into three groups i.e. short, normal (1-3 cm) and long. The results showed that 800 (80%) patients had a normal cystic artery. (Figure 4). A short cystic artery was found in 15% (Figure 3) and a long cystic artery (Figure 2) was present in 5% (Table 2). Positional variations of the cystic artery was seen in the Calot's triangle. In 85% cases the cystic artery was superiomedial to the cystic duct. (Figure 8). The most common variation was a cystic artery anterior to the cystic duct in 7% cases. (Figure 5) A cystic artery posterior to the cystic duct was found in 3% (Figure 6) and low-lying 5% (Figure 7) (Table 3). Caterpillar hepatic artery seen in 3% (Figure 10) and in 6% right hepatic artery was taking a sharp turn in front of the cystic duct and lies within Calot's triangle. (Figure 9; Table 4). Ten patients (1%) out of 1000 suffered from intra-operative bleeding which required conversion to open operation. 5 patients have hemorrhage because of branched cystic artery which was controlled by applying the clip. 5 patients had uncontrollable bleeding because of damage to right hepatic artery which was assumed by surgeon cystic artery

Colour page



Figure 4. Normal cystic artery seen above the cystic duct



Figure 5. Anterior cystic artery which is clipped



Figure 6. Posterior cystic artery which is twisted around cystic duct



Figure 7. Low lying cystic artery in front of clipper prong



Figure 8. Superiomedial cystic artery lying above the cystic duct

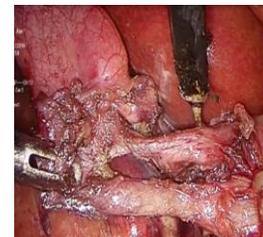


Figure 9. Right hepatic artery in Calot's triangle

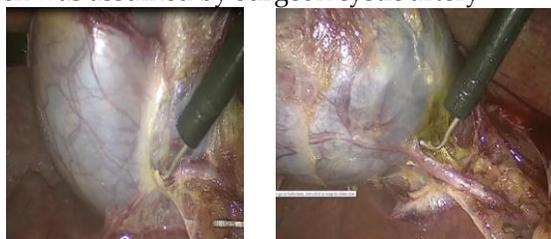


Figure 1. Branched cystic artery and cystic duct already clipped at common bile duct site



Figure 2. Long cystic artery seen above the cystic duct



Figure 3. Short cystic artery seen above the cystic duct

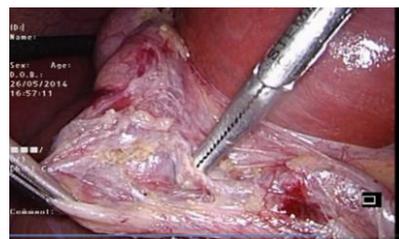


Figure 10. Moynihan's hump on medial side and cystic artery is originating from it. Maryland is pointing towards cystic artery

**Table1. Distributional variations of cystic artery**

Single cystic artery	90%
Branched cystic artery	7%
Absent cystic artery	3%

**Table:2 Length Variations of cystic artery**

Normal length cystic artery	80%
Short length cystic artery	15%
Long length cystic artery	5%

**Table:3 Positional variations of cystic artery.**

Superiomedial cystic artery	85%
Anterior cystic artery	7%
Posterior cystic artery	3%
Low lying cystic artery	5%

**Table:4 Hepatic artery variations and anomalies.**

Caterpillar Hepatic artery	3%
Right hepatic artery within calot's triangle	6%

## Discussion

Minimal invasive surgery is replacing the conventional surgery.<sup>7</sup> In order to prevent complications, it is very important to know the details of anatomy and the variations of cystic artery and duct.<sup>9</sup> In present study the age range was 12-80 years which is the same as that of Western population.<sup>1</sup> Cholithiasis occurs mainly in obese patients as described in classical textbooks, even in Pakistan the cholithiasis is more common in obese people.<sup>10</sup> In our study 98% of patients were female and only 4 (2%) male. International data suggests that gallstone disease is 3 to 4 times more common in females than males.<sup>11</sup>

Per operatively 80% were of cholelithiasis, acute cholecystitis were seen in 60(6%) patients while 60 (6%) patients had an empyema gall bladder and 80 (8%) patients had a mucocele of the gall bladder. In his study, M.Taimur noticed similar results i.e. biliary colic in 88% cases. Acute cholecystitis was seen in 7%, mucocele in 3% and empyema in 2% cases<sup>12</sup>. Minimal invasive surgery is beneficial in acute cholecystitis.<sup>13</sup>

We found that in 85% of the cases cystic artery lies within the calot's triangle. This normal path of cystic artery was also seen by Badshah and colleagues which is 66.6% . In the study by Hugh and colleagues, the normal path was in 76%.<sup>17</sup> We also assessed the

positional variation of cystic artery i.e it lies anterior to the cystic duct in 70 (7%) cases and it was consistent with Haythem A and colleagues which reported that cystic artery lies anterior to cystic duct in 16% of cases.<sup>18</sup> This anomaly is dangerous because during skeletonization of the cystic duct, the anterior lying artery may be damaged or excessive bleeding can start. Another positional variation we noted that cystic artery lies posterior to the cystic duct and it was seen in 6% of cases.<sup>4</sup> positional variation of cystic duct seen was that cystic artery is low lying and it was seen in 5% of the cases and it was consistent with the study of Badshah and colleagues in which 4% cases had low lying cystic artery.

In our study, the cystic artery was absent in 3% cases while there was a single cystic artery in 90% cases. Badshah and colleagues reported a single cystic artery in 66.6% of their patients.<sup>18</sup>

In 7% cases a branched cystic artery was found. Singh et al and Adnan Al et al noticed a branched cystic artery in 6% of their cases.<sup>4,19</sup> We have also noticed that in 800 (80%) cases, the cystic artery was of normal length. A short cystic artery was seen in 5% cases while a long cystic artery in 50 (5%) cases. De Silva reported a mean length of cystic artery to be 2.3cm seen in his study and M.Taimur and colleagues had the same the result.<sup>9</sup> When the cystic artery is not found in the usual common position, then a variant anatomy should be kept in mind to avoid troublesome bleeding during the procedure. In 6 (3%) cases, the right hepatic artery was taking a sharp turn in front of the cystic duct and the cystic artery was arising as a short twig from the right hepatic artery. Most of the time young surgeon assume it cystic artery and try to clip it .Uncontrolled bleeding can start which sometime end in disaster because of panic to control, sometimes damage the other surrounding structures. Another anomaly i.e Moynihan's Hump is reported in 1% of cases by Ayyaz et al and 4% by Adnan Al et al.<sup>19,26</sup>

Ten out of 1000 suffered from intra-operative hemorrhage which required conversion to open technique and bleeding control by pressure and ligature. Khan in his study noticed a conversion rate of 6.4%.<sup>24</sup> The morbidity encountered in our study is comparable to local and international data and is in the acceptable range. There was no mortality in this series. More emphasis is however needed to properly train young surgeons in the field of laparoscopic surgery.<sup>25</sup>

## Conclusions

1. In order to avoid the iatrogenic injuries, it is very important that surgeon must be well versed about the anatomy and their variations and how to deal with this situation.

2. It is required to emphasize on basic principle of Calot's triangle that critical angle and dissection above the sulcus of Rouviere's. When nature has created any anatomical variations, it should always be respected.

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