

## Control of cystic artery in Laparoscopic Cholecystectomy: To clip or to use monopolar electrocautery

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### ABSTRACT

**Objective:** The purpose of this study was to compare monopolar electrocautery with clip application for securing hemostasis of cystic artery in patients undergoing laparoscopic cholecystectomy.

**Methodology:** A comparative study was performed on data collected during a 6-years period (2005-2011) from 600 patients who underwent laparoscopic cholecystectomy. In 306 cases assigned to group 1, the cystic artery was clipped while in 294 cases assigned to group 2, the cystic artery was coagulated with monopolar electrocautery.

**Results:** In group 1, the cystic artery was single in 91%, branched in 6% and absent in 3% cases while in group 2, the cystic artery was single in all cases. The cystic artery was of normal size in 82%, short in 7%, long in 8% and absent in 3% cases in group 1 while in group 2, it was normal in size in 88%, short in 3% and long in 9% cases. The cystic artery was originating from the right hepatic artery in 97% cases and from the superior mesenteric artery in 3% cases in group 1. In group 2, the cystic artery was originating from the right hepatic artery in 97% cases and not visualized in 3% cases. In group 1, only 3 patients had an intra-operative hemorrhage while in group 2, 3 of the patients had bleeding. The post operative recovery was also similar in both groups with 83% and 81% patients going home on the next day.

**Conclusions:** There was no difference in the outcome of patients whether clips or monopolar electrocautery was used for hemostasis of cystic artery in laparoscopic cholecystectomy.

**KEY WORDS:** Cholelithiasis, Laparoscopic Cholecystectomy, Monopolar electrocautery.

Pak J Med Sci October - December 2011 Vol. 27 No. 5 981-984

### How to cite this article:

Imran M, Hasan A, Masood R, Sami Ullah, Taimur M. Control of cystic artery in Laparoscopic Cholecystectomy: To clip or to use monopolar electrocautery. Pak J Med Sci 2011;27(5):981-984

### INTRODUCTION

The first well documented excision of the gall bladder or cholecystectomy was performed by

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- \* Receiver for Publication: June 8, 2011
- \* Revision Received: September 5, 2011
- \* Revision Accepted: September 19, 2011

Carl Langenbuch in 1882.<sup>1</sup> The first laparoscopic cholecystectomy was performed by Muhe in 1986.<sup>2</sup> Laparoscopic cholecystectomy is now considered the gold standard in the treatment of symptomatic gallstones.<sup>3</sup> Initially this new technique was associated with a significant increase in morbidity, in particular iatrogenic biliary injuries and arterial hemorrhage. Anatomical relations on laparoscopic visualization are seen differently as compared to open surgery. So the surgeon has to rely on his sound knowledge of the variations in Calot's triangle and do meticulous dissection in order to avoid injury to the extra-hepatic biliary tree.<sup>4,5</sup> The course and length of the cystic artery in the Calot's triangle is variable.<sup>6,7</sup>

The world wide use of surgical clips in laparoscopic surgery has led to a variety of complications.<sup>8</sup>

Clips can slip, dislodge, ulcerate, migrate, internalize and give rise to necrosis of cystic duct with the risk of bile leakage and other complications.<sup>9</sup> New techniques in place of clips are now used which include different types of hemostatic devices.<sup>10</sup> Hemostatic devices used in laparoscopic cholecystectomy are monopolar electrocautery, bipolar electrocautery, ultrasonic coagulator and Ligasure vessel sealing system. Although ultrasonic coagulator and Ligasure are superior to monopolar electrocautery in terms of safety, they are not universally available in hospitals. Hence in this study, we compared monopolar electrocautery with clip application for securing hemostasis and to identify the safest and least complicated way for hemostasis of the cystic artery in laparoscopic cholecystectomy.

### METHODOLOGY

The study was conducted at Surgical Unit-I, Fauji Foundation Hospital, Rawalpindi from April 3, 2005 to April 2, 2011. Six hundred consecutive patients, both male and female with cholelithiasis, who underwent laparoscopic cholecystectomy in surgical unit-I were included in this study. Each patient was evaluated by detailed history and thorough physical examination. Investigations like blood complete picture, urine routine examination, serum urea and creatinine, random blood sugar, liver functions tests, hepatitis screening and ultrasound abdomen were performed. We used intra-operative cholangiography in selected patients with suspicion of gall stones passing into the common bile duct (CBD), especially those with multiple small gall stones with a wide cystic duct and those whose CBD seemed dilated intra-operatively. Those patients who had pre-operative jaundice, abnormal LFTs and a dilated CBD on ultrasound examination were sent for a pre-operative ERCP to rule out choledocholithiasis.

**Data collection:** All patients admitted through outpatient department or emergency in surgical unit-I with the diagnosis of biliary colic, cholelithiasis, acute cholecystitis, empyema gall bladder and mucocele gall bladder (in whom gall bladder surgery was indicated) were included in the study. Two groups were made based on the intra-operative Width of the Cystic artery using the tip of a Maryland's forceps for measurement. Group 1 consisted of 306 patients with a wide cystic artery width ( $> 1$  mm) in which we used clips (medium-large liga clips) to ligate the cystic artery. Group 2 consisted of 294 patients with a narrow cystic artery width ( $< 1$  mm) and branched / absent cystic artery in whom we used monopolar electrocautery with spatula,

hook or scissors for hemostasis of cystic artery. Cautery machine ERBE, ICC 300 was used. Voltage was 30 watt using spray mode.

Informed consent was taken from all patients regarding the use of clips or monopolar electrocautery prior to inclusion in the Study which was approved by the Ethics committee of the Fauji Foundation Medical College, Rawalpindi. None of the patients refused inclusion in the study. Data was collected on a well structured proforma which included personal profile of patients, clinical diagnosis, date of operation, co-morbidities / previous surgery, ultrasound and laboratory investigation reports.

Intra-operative complications like cystic / right hepatic artery injuries and common hepatic duct, common bile duct or cystic duct injuries and post-operative complications like hemorrhage, bile leakage and biliary obstruction were also followed up.

**Data Analysis:** The data of 600 patients, male and female undergoing laparoscopic cholecystectomy was collected on the patient proforma and then transferred to the data sheet IV of SPSS 10. The frequency calculation for cystic artery number, cystic artery position, difficult dissection and miscellaneous variations were performed with the help of descriptive statistics from this data sheet. The frequencies and percentages for various operative complications like hemorrhage and iatrogenic injury to hepatobiliary tree were also studied. Chi-square test was used to compare the post-operative recovery of the two groups.

### RESULTS

All surgeries were done by consultant surgeons. The median age was 48.80 years in group 1 and 46.68 years in group 2. The median weight was 67.67 Kg in group 1 and 64.25 Kg in group 2. Our study was based on non-probability / convenient sampling. The majority of the study population was female i.e. 588 (98%) patients in group 1 and 582 (97%) in group 2. Only 12 (2%) patients in group 1 and 18 (3%) in group 2 were male.

Majority of cases, 88% in group 1 and 96% in group 2 presented with a clinical diagnosis of biliary colic. Acute cholecystitis was seen in 7% cases in group 1 and in 4% cases in group 2. 2% cases in group 1 had an empyema gall bladder while 3% cases also in group 1, had a mucocele of the gall bladder. A nasogastric tube was routinely used in 251 (82%) consecutive patients in group 1 and 241 (82%) consecutive patients in group 2. (492 (82%) patients in total) However in the last one year, it is no longer used routinely.

In group 2, the cystic artery was single in 91%, branched in 6% and absent in 3% cases while in group 1, the cystic artery was single in all cases. The cystic artery was originating from the right hepatic artery in 97% cases and from the superior mesenteric artery in 3% cases in group 1. In group 2, the cystic artery was originating from the right hepatic artery in 97% cases and not visualized in 3% cases. Other variations included Calot's arteries and Moynihan's hump in 3% cases in group 1 while the gall bladder arterial supply was arising from the liver bed in 3% cases in group 2.

In our study, we divided the cystic artery width into narrow (< 1 mm) and wide (> 1 mm) based on intra-operative measurement with the tip of a Maryland's forceps. The patients with a narrow artery were put in group 2 while those with a wide artery were put in group 1. The patients with branched and absent cystic artery were also included in group 2. We also divided the cystic artery length into three groups i.e. short (< 1 cm), normal (1-3 cm) and long (> 3 cm). The cystic artery was of normal size in 82%, short in 7%, long in 8% and absent in 3% cases in group 1 while in group 2, it was normal in size in 88%, short in 3% and long in 9% cases.

The post operative recovery of the two groups was similar with a P value of 0.89 which was not significant. Two hundred fifty four out of 306 (83%) patients in group 1 went home on the next day while 49 (16.5%) were discharged on the second day. In group 2, 238 out of 294 (81%) patients went home on the next day while 53 (18.5%) were discharged on the second day. 0.5% cases (3 patients each) in both groups, which required conversion to open surgery, remained in the hospital for 3 days post-operatively.

**Complications:** Six patients (1%) out of 600 suffered from intra-operative hemorrhage which required conversion to open operation. One patient in group 1 had hemorrhage from a supra-duodenal vein injury, which was revealed by about 500 ml. of blood in the drain within 20 minutes of completion of laparoscopic cholecystectomy. The patient was operated by open technique and bleeding from a supra duodenal vein was controlled by pressure and ligation of the vein. Two patients, also in group 1, had a difficult dissection of the gall bladder from its fossa in the liver due to hepatomegaly and an overhanging left lobe, so the procedure was converted to open cholecystectomy. The other 3 patients, earlier cases in group 2, had bleeding from the cystic artery which required conversion to open surgery. So the complication rate of the two groups was the

same (statistically insignificant). A redivac drain size 16 attached to a drainage bag was placed for a day in cases in which there was bile spillage from the Gall Bladder.

## DISCUSSION

The median age of patients was 48.80 years in group 1 and 46.68 years in group 2. The age distribution in this study population is the same as that of western population.<sup>11</sup> Our study shows that cholelithiasis occurs mainly in obese patients as described in classical textbooks.<sup>12</sup> International data suggests that gallstone disease is 3 to 4 times more common in females than males.<sup>13</sup> A different scenario was reflected in our study with a female population of 98% as our hospital mainly treats the families of retired army personnel.

The majority of cases, 88% in group 1 and 96% in group 2 presented with a clinical diagnosis of biliary colic. Acute cholecystitis was seen in 7% cases in group 1 and in 4% cases in group 2. Two percent cases in group 1 had an empyema gall bladder while 3% cases also in group 1, had a mucocele of the gall bladder. Salman Yousuf Guarya noticed similar results i.e. 476 (86.7%) cases presented with chronic cholecystitis, 63 (11.4%) acute cholecystitis, 6 (1%) mucocele of the gallbladder and 2 (0.4%) had empyema gallbladder.<sup>14</sup>

In our study, the cystic artery was absent in 3% cases in group 2 while there was a single cystic artery in 91% cases. Suzuki M and colleagues and Hugh TB and colleagues reported a single cystic artery in 76.6% and 72% of their patients respectively.<sup>15,16</sup> This difference may be attributed to a different geographical zone population sample. In 6% cases in group 2, we found a branched cystic artery. Ayaz and colleagues noticed a branched cystic artery in 20% of their cases.<sup>7</sup> In group 1, the cystic artery was single in all cases. Aberrant gall bladder blood supply from the liver bed was found in 3% cases in group 2. Ding has reported the incidence of cystic artery originating from liver parenchyma to be 2.5%.<sup>17</sup>

The purpose of our study was to compare monopolar electrocautery with clip application for securing hemostasis and to identify the safest and least complicated way for hemostasis of the cystic artery in laparoscopic cholecystectomy. We found no difference in the two groups of patients as far as post operative recovery and post operative complications were concerned (P value 0.89). Huscher and colleagues compared the ultrasonic coagulation division of the cystic artery and duct with ligation

and found no difference in both methods regarding post operative mortality and complications.<sup>18</sup>

The use of monopolar electrocautery in the Calot's triangle is still considered taboo by most surgeons, so this study is the first of its kind and the closest comparison that can be made is with an ultrasonic coagulator. There are no recent studies similar to this one.

However with monopolar electrocautery, the depth of burn is less predictable and current can be conducted through non-insulated instruments and trocas. So the laparoscopic surgeon must pay great attention to the anatomical dissection of the Calot's triangle. Excessive and unnecessary dissection or use of electrocautery near the common bile duct should be avoided.<sup>19</sup>

In our study of 600 patients, we found both methods to be safe and equally practical. The post operative recovery was also equivocal in both groups with a low incidence of complications. 6 patients (1%) out of 600 suffered from intra-operative hemorrhage which required conversion to open operation. Khan in his study noticed a conversion rate of 6.4%.<sup>20</sup> The morbidity encountered in our study is comparable to local and international data and is in the acceptable range.

## CONCLUSIONS

We conclude that as far as the hemostasis of the cystic artery is concerned, monopolar electrocautery has comparable results to the conventional clip method. Hence we consider it to be an alpha error. But the all important step is the careful dissection of the Calot's triangle and the identification of the cystic artery, so as to do a safe hemostasis be it by clip method or monopolar electrocautery.

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