Sys Rev Pharm 2020;11(10):123-127
A multifaceted review journal in the field of pharmacy

Isolation & Clipping of Cystic Artery outside Versus inside Calot's Triangle Minimizes the Intraoperative Complications in Laparoscopic Cholecystectomy

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ABSTRACT

Background: Laparoscopic cholecystectomy (LC) is the "Gold Standard"for the treatment of cholelithiasis and acute cholecystitis, and is the commonest operation performed laparoscopically worldwide. In spite of this fact , still the most serious complications like extrahepatic bile duct injury (BDI) & vascular injury, are more common in LC than OC(open cholecystectomy).Objectives: to compare between the isolation & clipping of cystic artery outside & inside Calot's triangle in regard of minimizing the intraoperative complications in LC. Patients and methods: This is a prospective(therapeutic controlled trial) study of 508 patients with symptomatic gallstones (456/508=90% females & 52/508=10% males) who were admitted to Al-Diwaniya teaching hospital to undergo LC from April 2015 to April 2018.G*roup–A-*: consists of 272 patients (246/272=90.4% F & 26/272=9.6% M) selected to undergo a LC with standard conventional technique of dissection of cystic pedicle. G*roup –B-:* consists of 236 patients (210/236=89% F & 26/236=11% M) selected to undergo LC with isolation & clipping of cystic artery outside the Calot's triangle. Results: Cystic artery injury: In group-A-(29/272=10.7%) vs (8/236=3.4%) in group–B-. The control of bleeding in group-A-(34%=10/29) vs (100%=8/8) in group-B. Clipping was used to control bleeding in group-A-(5/29=17%) vs (8/8=100%) in group-B-, while electrocoagulation used in group-A-(5/29=17%) vs (0/8=0%) in group-B-. The conversion done in group-A- in (19/272=7%) vs (0/8=0%) group-B- A sizable posterior branch was identified in group-A-(6/272=2.2%) vs (62/236=26.3%) in group–B-.In group–A- the clear identification of the anatomy achieved in (202/272=74%) vs (236/236=100%) in group-B-. The conversion rate due to poor identification of the anatomy or complex anomalies in group-A-(4.4%=12/272) vs (0%) in group-B-.Conversion from LC to OC: The total conversion rate in group–A-(36/272=13.24%) vs (0%) in group-B-.. No mortality reported in our study. Conclusion: This technique significantly minimizes the overall conversion rate in LC.

Keywords: Laparoscopic cholecystectomy, anatomical anomalies in LC, the Calot's triangle, Complications in LC, cystic an injury in LC

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INTRODUCTION

Minimal access surgery (MAS), or minimally invasive surgery (MIS), is a marriage of modern technology that aims to accomplish surgical therapeutic goals with minimal somatic & psychological trauma [1]. MIS describes an area that crosses all traditional disciplines from general surgery to neurosurgery, it is a philosophy of surgery & a way of thinking [2]. Laparoscopic Cholecystectomy (LC) is the "Gold Standard"or mainstay for the treatment of cholelithiasis and acute cholecystitis and is the commonest operation performed laparoscopically worldwide [1,2,3]. Carl Langenbuch performed the first open cholecystectomy (OC) in Berlin, Germany, in 1882 [3,4]. Erich Mühe performed the first LC in Germany in 1985(1,2,3,4) , followed by Harry Reich and Eddie Joe Reddick an American in 1989(1,2,3,5), and by 1992, 90% of cholecystectomies in USA were being performed laparoscopically [5,6]. * An important consideration is the frequent anomalies of the structures contained between two leaves (15-20%) [7,8,9,10]. .The normal configuration is for an anterior cystic duct with the cystic artery situated posteriosuperior and arising from the right hepatic artery usually behind CBD.when we reviewed the cystic A&duct anomalies described in literatures ,most occur at the level of the Calots triangle.[12,13,14,15] ,for this reason we try to adopt a dissection technique of cystic pedicle in which we isolate the cystic A outside the Calots triangle at the gall bladder side to avoid anatomical variations or complexity at the level or inside the Caslots triangle as possible. Surgical technique with inadequate exposure and failure to identify structures before clipping and dividing them,excessive cephalad retraction of the gall bladder that align cystic duct with CBD,limited knowledge about anatomical variation and aberrant cystic duct or artery coursing inside the triangle of Calots ,are the most common causes of significant bile duct injuries in L.C.[3,9,10]

AIM OF THE STUDY

To compare the efficacy of isolation and clipping of the cystic artery outside versus inside the Calot's triangle in minimizing the intraoperative complications in LC.

PATIENTS & METHODS

This is a prospective (therapeutic controlled trial) study of 508 randomly selected patients with symptomatic gallstones; 456/508=90% females(F) & 52/508=10% males(M); who were admitted to Al-Diwaniya teaching hospital to undergo LC(Carl Storez com.) from April 2015 to April 2018. All patients were admitted through outpatient clinic & appropriate preoperative preparations have been done for them.
They were randomly divided into two groups:

1. ***Group–A-:*** consists of 272/508(53.5%) patients (246/272=90.4% F & 26/272=9.5% M, so; the F:M ratio is about 9.5:1). They were selected to undergo LC with the standard conventional technique of dissection of cystic pedicle for approaching the Calot's triangle. We advocated strict adherence to the principles of surgical dissection described by French [6,7] and American experts [8,17].

2. ***Group–B-:*** consists of 236/508(46.5%) patients (210/236=89% F & 26/236=11% M; so, the F:M ratio is about 8:1). They were selected to undergo LC the same as group-A-; but with different technique of dissection of cystic pedicle (a peritoneal fold containing the cystic duct & A, cystic lymph nodes & variable amount of fat) to approach the Calot's triangle, in which we do the isolation & clipping of cystic artery outside Calot's triangle.

The standard technique of dissection of cystic pedicle in LC was done as that adopted by French [6,7] & American [8,17] experts.

Statistical analysis

The results were expressed as number, percentage & *P*-value 0.05 regarded as the upper limit of significance. The Chi Square test was applied on the tables of the results to obtain the *P*-values.

RESULTS

This is a prospective therapeutic controlled trial study of 508 randomly selected patients with symptomatic gallstones, 456/508=90% F& 52/508=10% M (F:M ratio is about 9:1). All patients were admitted to Al-Diwaniya teaching hospital to undergo LC from April 2015 to April 2018; figure (1) shows the No. of F & M in our study.

Table 1: Methods of isolation & clipping of cystic A in group-A-

Gender	Isolation & clipping of cystic A inside the Calot's triangle	Isolation & clipping of cystic A outside the Calot's triangle	Isolation & clipping of cystic A outside the Calot's triangle due to an aberrant cystic A
Female	233/272 (85.6%)	Nil	13/272 (4.78%)
Male	22/272 (8.1%)	Nil	4/272 (1.47%)
Total	255/272 (93.7%)	Nil	17/272 (6.25%)

Table 2: Methods of isolation & clipping of cystic A in group-B-

Gender	Isolation & clipping of cystic A outside the Calot's triangle	Isolation of cystic A outside but clipping inside the Calot's triangle	Isolation & clipping of cystic A outside the Calot's triangle due to an aberrant cystic A
Females	192/236 (81.35%)	11/236 (4.6%)	7/236 (3%)
Males	16/236 (6.8%)	8/236 (3.4%)	2/236 (0.85%)
Total	208/236 (88.15%)	19/236 (8%)	9/236 (3.85%)

Table 3: The No. of patients with cystic A injury in each group. The chi square test is applicable & the P-value is below 0.05 (significant).

Cystic A injury	**Group-A-**	**Group-B-**	**Total No.**
+ ve	29 (10.66%) (19F+10M)	8 (3.4%) (6F+2M)	37
- ve	243 (227F+16M)	228 (204F+8M)	471
Total No.	272	236	508

Table 4: The conversion from LC into OC due to uncontrolled bleeding from injured cystic A in each group. The chi square test was applicable & the P-value is below 0.05 (significant).

Conversion into OC due to uncontrolled bleeding from cystic A	**Group-A-**	**Group-B-**	**Total No.**
+ ve	19 (65.5%)	0 (0%)	19
- ve	10	8	18
Total No.	29	8	37

Table 5: The No. of F & M patients in whom there were multiple small gallstones with some stones in the lower cystic duct in each group

Group	**Females**	**Males**	**Total**
A	116/272(42.6%)	7/272 (2.4%)	123/272 (45%)
B	103/236(43.4%)	11/236 (4.6%)	114/236(48%)

Table 6: Conversion rate from LC to OC:

Overall conversion	Group-A-	Group-B-	Total No.
+ ve	36 (13.24%) (22F+14M)	Nil	36
- ve	236	236	472
Total No.	272	236	508

DISCUSSION

When we reviewed the cystic A & duct anomalies described in the literature, most occur at the level of the Calot's triangle [18,19]. This technique of dissection in group-B- spares this area. When we compare the results in group-A- with group-B-, in reference to the large series, about the intraoperative complications including: cystic an injury, BDI, poor identification of the anatomy & anomalies of cystic A & bile ducts, difficult milking of gallstones from the lower end of cystic duct, & the rate of conversion into OC. The incidence of cystic an injury is higher in group-A- (10.7%=29/272) vs (3.4%=8/236) than in group-B-, which was near that found by Duca *et al* in 2003=(1.5%) [20]. The successful control of bleeding from injured cystic A was achieved in group-A- in (34.4%=10/29) vs (100%=8/8), which was near that found by Duca *et al* = (98%). The control of bleeding by clipping was achieved in group-A-(50%=5/10) vs (100%=8/8) in group-B-, while bleeding control by electrocoagulation was achieved in group-A-(50%=5/10) vs 0% =0/8 in group-B-; the finding of group-B- was near that found by Duca et al =(98%) rate of control of bleeding cystic A by clipping & no use of electrocoagulation for bleeding control was reported. The conversion rate due to uncontrolled bleeding from injured cystic A in group-A- was (7%=19/272) vs (0%=0/236)in group-B-, which was less than that found by Duca *et al* =(1.1%), Brune *et al* in 1994 =(0.48%) [21] & Tariq *et al* in 2007 =(1%) [22]. A sizable posterior branch was identified in 6/272 patients of group-A- (2.2%), & 62/236 patients in group–B- (26.3%).

This is considered a disadvantage in group-B- which means:

- More distal dissection of cystic A which increase in possibility of facing a sizable posterior branch of early branching cystic A.
- Increase in No. of clips used (increase in the cost).

The clear identification of the anatomy of cystic A & duct was achieved in group-A-(74%=202/272) vs (100%=236/236) in group-B-.

The percent of patients with adhesions obscuring the area of GB & the Calot's triangle was approximately equal in both groups: group-A-, (17%=46/272) vs (18%=43/236) in group-B-. The percent of identifying an aberrant single cystic A outside the Calot's triangle(no cystic A found inside the Calot) is slightly more in group-A- than –B- (6% vs 4%) respectively, which were both less than that found by Suzuki *et al* in 2000 =(11.1%) [23], & Milivoj *et al* in 1999 =(5.5%) [19]. The percent of conversion into OC due to poor identification of anatomy (complex anatomy) was recorded in group-A- only (4.4%=12/272); & no conversion done in group-B- (0%), which was less than that found by Duca et al (1.9%). The incidence of multiple small gallstones (with some stones in the lower end of cystic duct) in group-A- was (45%=123/272), which was near that of group-B- (43%=102/236), however; the rate of difficult milking of stones from the lower end of cystic duct in group-A- was (18%=49/272) vs (0%=0/236) in group-B-. The conversion rate due to difficult milking of stones from the lower end of cystic duct) in group-A- was (1.84%=5/272) vs (0%) in group-B-. No recorded BDI in both groups of our study, i.e. =(0%), which was near that found by Duca *et al*=(0.1%), Club series in 2003 & Shamiyeh *et al* in 2004=(0.8%) [24,25], with average of(below 0.5%) found by Kullman *et al* in 2005 [26]. The overall conversion rate was in group–A-(13.24% =36/272) vs (0%=0/236) in group –B-, while the conversion rate found by Khaitan *et al* in 2003 was (5%) [27] & Huscher *et al* in 2002 was (0.78%) [28,35,36]. No mortality recorded in our study(i.e.=0%), which was less than that found by Jatsko *et al* in 1995 =(1%) [29], & near that found by by Shamiyeh *et al* =(up to 0.2%), Wherry *et al* in 1994 [30], Peters *et al* in 1991 [31,37,38], Zucker *et al* in 1991 [32], & Club series =(0.04-0.1%).

CONCLUSION

We conclude that this dissection technique minimizes the incidence of cystic A injury in LC and Increases the ability & efficacy of bleeding control after cystic an injury in LC, so reducing conversion rate due to uncontrolled bleeding from cystic A. This technique also enhances the milking of stones from the lower end of cystic duct so reducing the conversion rate due to this cause. Keeps the incidence of bile duct injuries in LC within the national level in reference to largest recent series and Significantly minimizes the overall conversion rate in LC.

RECOMMENDATIONS

We recommend the use of the dissection technique of isolation & clipping of cystic A outside the Calot's triangle in all LC procedures.

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