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Original Research Article

Triple ligation technique of clipless laparoscopic cholecystectomy: a spanner especially for complicated cholecystitis

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ABSTRACT

Background: Although in the era of laparoscopic cholecystectomy cystic duct occlusion has been tried by clips, harmonic and plasma kinetic quite effectively but cost, availability and inadvertent injury to biliary duct are concerning factors. Intra-corporeal ligation has evolved to address these issues effectively as a boon especially for the peripheral centres where availability and cost of energy sources weighs heavier than their associated ease. Triple ligation technique is a time preserving modification without any compromise in safety and quality of surgery. The aim of our study is not only to elucidate the importance of intra-corporeal ligation in safety and cost of surgery but also to enlighten its role in safe management of even difficult cases of cholecystitis.
Methods: A retrospective observational study. All cases of symptomatic gallstones operated by laparoscopic triple ligation technique were included in the study.
Results: More than half (63.4%) of the cases in our study were having chronic cholecystitis was reported in 63.4% of the cases while 36.4 % cases have acute cholecystitis. Mean duration of surgery was 46.4 and 71.2 minutes in chronic and acute cases respectively. No case of bile duct or vascular injury has been reported in our study. Only 3.8% of the cases were converted to open. Gallbladder perforation was most common complication noted in 12.8% of the cases.
Conclusions: Triple ligation technique of laparoscopic cholecystectomy is not only a time sparing modification but is also a veritable, safe and frugal tool with excellent results even in complicated cholecystitis without compromising its outcome and prime.

Keywords: Cholecystectomy, Intra-corporeal, Ligation

NTRODUCTION

The conception of laparoscopy has revolutionized the art of surgery due to its vantages over classical open technique. The lately innovated laparoscopy cholecystectomy has been drastically refined over the years by better exploration of ergonomics, instauration of new energy sources and endo suturing. The conventional four ports access technique has been modified to three ports, two ports and single incision laparoscopic surgery with corresponding results.[1-3] Further cystic duct closure methods like clipping, harmonic scalpel, plasma kinetic and intra corporeal ligation have been tried with gratifying results.[4]

Metallic clip is the most commonly used method for cystic artery and duct closure which may be due to ease of learning and its execution, short operative time and time-tested safety of technique. Although it is not less than a boon for a budding surgeon but it is not free from complications. Bile leaks, migration of clip, inadvertently clipping of common bile duct and right hepatic artery have

been reported in literature.[5] Moreover, significant inflammatory reaction to metallic clips and artefacts on CT and MRI scans are other concerning issues.[6] Harmonic scalpel can be used for safe closer and division of cystic duct upto a diameter of 6 mm.[7,8] It not only shortens duration of surgery but also avoids need for repeated instruments change. Despite a novel tool a high cost and risk of thermal injury are limiting factors. Plasma kinetic is another recently innovated energy tool for closure of cystic duct but it has been tried mainly in experimental animals for closer of cystic duct but human studies are lacking.[4] Although clipping, harmonic scalpel and plasma kinetic are quite effective techniques for control of cystic artery and duct but high cost and poor availability in peripheral government hospital are limiting factors.

To replicate the reliability and satisfaction of ligation of cystic artery and duct as in classical cholecystectomy, intra corporeal ligation have been evolved as need of hour. It is a very effective, economic and versatile tool.[9,10] It is a boon especially for the peripheral centres where availability and cost of energy sources weighs heavier than their associated ease. Moreover, a large chunk of these cases has complicated cholecystitis. Counting on energy sources in such cases is not only risky but crops a high failure rate due to difficult callotsanatomy.[11] Intra corporeal ligation in such cases has endowed the surgeons with an additional safe tool before embarking on the classical open approach. It not only prevents from inadvertent rare but fatal complications of energy sources like thermal injury and slippage of clip, but also navigate through technical difficulties like clip size mismatch, inadequate space etc. it can be randomly practiced beyond the bars of cost, distant location and infrastructure. Although it demands a bit dedication in imbibing the art of intra corporeal knotting, but once learned, it empowers one to further venture in advance laparoscopy.

It is not a fact that developing countries including india are still struggling in installing newer modalities of surgeries in their remote and peripheral areas. Apart from cost of tools, poor connectivity for maintenance, untrained staff and zigzag hassles of budget allotment are other difficulties in adoption of these techniques in government sector. Intra corporeal ligation will not only address these tussles hand in hand but also reduces the operation cost.

Confronting these technical and economic issues in our rural government hospital, we have learned the art of intra corporeal ligation. Although it demands extra time and dedication as compare to its counterparts to adopt, but with an adequate practice operation time may be curtailed to what clips and other sources have.[9] However to address this issue we have modified the technique of quadrupal ligation to triple ligation. It not only clip time of classical quadrupal ligation but is equally productive without any compromise in safety and outcome. It isan asset especially in cases of short dilated cystic ducts and acute cholecystitis where clips may fail due to improper size and inadequate dissection of duct. Energy sources are also quite unsafe in such cases due to risk of thermal injuries.

We are presenting a retrospective study of 500 cases of clipless laparoscopic cholecystectomy performed in our rural government hospital using triple ligation technique of intra corporeal ligation where cystic artery is ligated medially and coagulated laterally before division. Cystic duct is ligated at two places and divided in between as in conventional method. Presence of lymph node laterally on cystic artery makes lateral knot time demanding, dodgy and quite deceptive. Hence, coagulation of cystic artery laterally is a technically easy and time saving modification without any compromise in quality and safety of surgery.

METHODS

It is a retrospective study of 500 cases of symptomatic gallstones who presented to our surgical unit at BPS Government Medical College for Women Khanpur Kalan, Haryana India from 1st July 2013 to 31st Decembe r2016.

Inclusion criteria

- All cases of symptomatic cholelithiasis

Exclusion criteria

All cases of open, mini lap and clip assisted laparoscopic cholecystectomies were excluded from the study.

All cases were admitted and operated after necessary investigations. All patients with preoperative CBD stones were subjected to ERCP for stone removal followed by lap cholecystectomy. An informed written consent for surgery as well as for open conversion if needed was taken before surgery. Data of all cases was recorded from case sheets of patients and analysed as it is a retrospective data analysis of routine surgical procedure.

Equipment's

The equipment's used for operating in our triple ligation technique were interestingly similar to any lap cholecystectomy like light source, high flow insufflator, HD camera with monitor, suction and irrigation device (carl Storz) and monopolar electrocautery. A 10 mm 30-degree telescope was used in all cases. Grasper (plain or traumatic) and Maryland dissector along with crocee forceps were used for dissection and ligation of cystic stump.

Operating Technique: A standard four ports access approach was used in all cases using two 10 mm metallic ports in peri umblical and epigastric sites while two 5 mm ports were used in right midclavicular and anterior axillary line. Cal lots triangle was exposed with dissection of cystic artery and duct. Cystic artery was ligated with silk 0 or 00 medially with a surgeon's knot and coagulated laterally with monopolar cautery attached to Maryland forceps

(Figure 1). Cystic artery was divided in between with scissors. Similarly, cystic duct was ligated about 5 mm away from CBD and ends of the suture were cut with endo scissors. Another knot was applied on cystic duct near neck of gallbladder which was also used for traction of cystic duct during its division by endo scissors in between the knots followed by the cutting of suture ends (Figure 2).

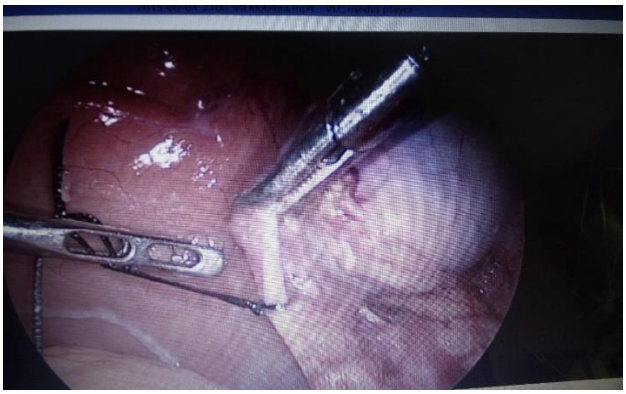

Figure 1: Cystic artery ligated medially and coagulated laterally.

Figure 2: Cystic duct ligated at two places and divided in between.

The clearance of departmental ethical committee was taken Although it is a retrospective data analysis of a routine surgical procedure so formal ethical clearance from ethical committee not taken. But in the medical record sheets of the patients consent regarding the use of patient information for research is there. Moreover, departmental permission from HOD has been taken and project has been sent to institutional ethical committee.

Statistics analysis

The data was analysed using descriptive methods using SPSS 20.0 version.

RESULTS

Gallstone disease commonly involves young females. Most (>69%) of our cases belongs to 20-50 years of age as depicted in Table 1. Fourth decade is the most common age group followed by 3rd and 5th decade as illustrated in Figure 1.

Table 1: Age and sex distribution of all cases.

Age (years)	Males	Females	Total	%
11-20	00	08	08	01.66
21-30	23	92	115	23.00
31-40	31	89	120	24.00
41-50	40	72	112	22,40
51-60	31	69	100	20.00
61-70	15	23	38	07.60
>70	01	06	07	01.40
Total	141	359	500	100

Oldest patient in our study was a male of 76 years of age while youngest patient was a 15 years female with pigment stones. Females were predominantly involved with male to female ratio of 1:2.54.

Chronic cholecystitis was noted in about two third (63.4%) of the cases while acute cholecystitis was detected in 36.6 % cases as illustrated in Table 2.

Intra corporeal knotting was done in all cases of clipless laparoscopic cholecystectomies using silk suture. Average duration in chronic cholecystitis cases was 46.4 minutes while in acute cases, it was 71.2 minutes as depicted in Table 2. A Postoperatively drain was used in majority (72.57 %) of the cases through lateral port site.

Table 2: Types of cholecystitis and duration of surgery.

Type of cholecystitis	Males	Females	Total	%	Average duration (minutes)
Chronic	78	239	317	63.4	46.4 (25-142)
Acute	63	120	183	36.6	71.2 (54-157)

Gallbladder perforation was most common complication noticed in about 12.80 % of the cases. A hemorrhagic drain output of upto 250 ml was noticed in 3.5 % of the cases, majority of whom (9 cases) were females. All these cases were managed conservatively.

Bile leak was reported in 07 cases varying from 50 - 500 ml/day. All of them were successfully managed conservatively with in situ drains. Liver injuries were also reported in 4 cases, all of them were of grade 1 due to injury either during epigastric port placement or during gallbladder dissection. All cases were managed conservatively with abgel and electrocautery. Wound infection was noticed in 5 cases. Port site sinuses were diagnosed in 8 cases, epigastric port being the commonest site (6 cases). Out of these 8 cases, 5 cases were diagnosed as tubercular on biopsy and responded to antitubercular treatment. Spillage of bile and stones during gallbladder removal was the most probable cause.

Table 3: Complications of cholecystitis.

Complication	Males	Females	Total	%
Gallbladder perforation	26	38	64	12.80
hemorrhage	05	09	14	03.50
Bile leak	02	05	07	01.40
Wound infection	02	03	05	01.00
Liver injury	01	03	04	0.80
Scar sinus	01	07	08	01.60

DISCUSSION

cholecystectomy is one of the most commonly performed elective surgeries all over the world. It has evaluated from conventional method to laparoscopic or even robotic versions in recent past. Even recently innovated laparoscopic cholecystectomy has been further modified from standard four ports access approach to three ports, two ports and single port surgery with variable results.[1-3] Moreover, with advances in equipment's and energy sources industry, control of cystic duct and artery have also been revolutionized from tools like metallic clips and knotting to harmonic scalpel and plasmakinetics.[1-4]

Metallic clip is the most commonly used method for cystic artery and duct closure all over the world.[12] However, metallic clips are not free from complications. Bile leaks has been reported in 0.2-0.27% of cases which might be due to slippage of clip, mismatch of clip arms with cystic duct lumen and pressure necrosis of duct.[4,13] Migration of clip may lead to biliary stone formation and clip embolization.[6,14,15] Most dreaded complications like inadvertently clipping of common bile duct and right hepatic artery have also been reported in literature5. Moreover, significant inflammatory reaction to metallic clips and artefacts on CT and MRI scans are other concerning issues.[6]

Harmonic scalpel can be used for safe closer and division of cystic duct upto a diameter of 6 mm.[7,8] It has advantages over electrocautery like less peak temperature, less lateral tissue damage and smokeless. Hence it is more safe and precise. It not only shortens duration of surgery but also avoids need for repeated instruments change. Despite a novel tool a high cost, risk of thermal injury and non-availability especially in peripheral government hospitals are limiting factors.

Plasma kinetic is another recently innovated energy tool for closure of cystic duct. But it can be used in selective cases of long and well dissected cystic duct due to risk of necrosis and bile leak due to energy overdose.[16,17] It has been tried mainly in experimental animals for closer of cystic duct but human studies are lacking.4Its use in humans has been questioned by most of the authors and recommended need for further research.[10,18,19]

The risk of lateral thermal injury in high- tech devices like harmonic and plasma kinetic may involve 0.5-2 mm of adjacent tissues.[20] Moreover excess traction on gallbladder and cystic duct during sealing process may burst tissues before sealing resulting in bile leak.[10] However, Shamiyeh and coworkers have also reported that use of harmonic scalpel and plasma kinetics may be contraindicated in cases of short cystic duct and acute cholecystitis due to high risk of complications.[4,19]

Ligation of cystic duct and artery is safe and time-tested method in conventional open cholecystectomy. The art of intra corporeal ligation is a worth to imbibe for excelling in advanced laparoscopy. It is not only free from complications of clips and energy sources but also quite economic and replicable. It is a boon especially in cases of wide and short cystic duct where metallic clips may fail due to inadequate size and space.

Although energy sources accomplish the job with handy results but surgeons were still missing reliable and satisfying jerks of ligation of classical cholecystectomy. Moreover, the risks like inadvertent thermal injury, clip dislodgement, inadvertent CBD clipping etc. was churning their souls to leap into the ligation faith resulting in the phylogenies of intra corporeal ligation. With the advent of this technique, it is not wrong to impress that the delight and reliance of ligation has been revisited.

Marane et al, in conducted a comparative study on outcome of intra corporeal ligation and endo clips in cystic stump closure and found that ligation of cystic artery and duct is safer and cost effective option without any significant difference in operative time.[20] Ibnouf et al in 2002 conducted a comparative study on 64 patients to study the cost effectiveness of vicryl ligature over endoclips.[10] Half of them had a wider diameter of cystic duct (group A) while others had normal cystic ducts (group B). They concluded that the vicryl ligature is safer, feasible and cost effective than metallic clip particularly in wider cystic ducts. It is of utmost importance in countries with meagre resources which cannot afford endo clips and other newer energy especially in its peripheral centres.

Sharma et al, conducted a prospective double blind randomized controlled study on 100 patients of symptomatic cholelithiasis which were divided into two

groups depending upon use of silk ligation or endo clips for cystic duct occlusion.[21] They also concluded that ligation can be safely used as a cost-effective alternative to clips and it is particularly handy in wide cystic ducts. Rajra et al, Andleo et al in same year also published similar results in their respective studies on ligation vsendo clips for cystic duct occlusion and recommended ligation in all difficult laparoscopic cholecystectomies.[9,22]

In the evolving surgical arena, where the recently launched energy sources have already replaced by latest versions, refinements in surgical techniques is aftereffect of these innovations. With the theme of "a safe, scotch and authentic surgery available to masses" it is desired that rare but fatal complications of clips and energy sources may be kept to the bays by adopting intra corporeal ligation peculiarly for technically challenging cases to avoid a nightmare. In complicated cases of cholecystitis, where clips and energy sources are on the receiving ends, intracorporeal knotting bears the torch of good hope by masses even at remote locations for gratifying results.

In present study, also we had operated about 36.6% cases with acute cholecystitis which were definitely challenging for clips and energy sources. Intra corporeal ligation not only has safeguarded us from complications in these difficult cases but also enabled us to keep a low conversion rate (3.8%) as compared to literature, (1.5-14%). Moreover, with the art of endo suturing and knotting cases of frozen callot's triangle were managed by subtotal cholecystectomy decreasing our conversions further. Although learning this skill definitely challenges patience of beginners, but once learnt, it empowers them for lifelong and reduces their dependence on energy sources and clips which matters a lot especially in developing countries.

Average duration of surgery (skin incision to closer) in chronic cholecystitis cases was 46.4 minutes while in acute cases, it was 71.2 minutes. Prolonged duration of surgery particularly in early part of study was due to poor practice of ligation apart from technical difficulties because of newly built team in our newly established rural hospital. However, operation time has drastically reduced after first 50 cases in our study by better team coordination and intra corporeal ligation practice. Similar results were reported by Rajra et al and Sharma et al in their respective studies.[9,21]

In present study, no case of bile duct, gut or vascular injury was reported reflecting safety and effectivity of the technique. Intraoperative gall bladder perforation and bile spillage was most common complication noted in 12.80% cases of cases. Sharma et al and Cuschieri et al reported a slightly higher rates of gall bladder perforation i.e 18% and 16% respectively while Muqim et al reported a incidence of 10.54% in their study.[25]

A relatively high proportion of acute cholecystitis cases and hence use of toothed grasper for handling thick walled gallbladder and slippage of knot from thickened gall bladder were responsible for this complication. Postoperative hemorrhage was also reported in 3.5% cases (upto 250 ml /day), all cases were managed conservatively with in situ sub hepatic drain. Other authors also reported comparable results in their studies. (MB) Bile leak from liver bed, minor liver injuries during manipulations of port and instruments and wound infection were also reported in about 6%of the cases.

CONCLUSION

Intra corporeal knotting is a versatile tool in hands of laparoscopic surgeons. It is not only free from complications of clips and high-tech energy devices but also economical and ubiquitous. Triple ligation technique can be a safe, replicable and handy gadget in armamentarium of laparoscopic surgeon world over. It can be learnt with practice and assiduity. It has a potential to drive a surgeon to the coliseum of advanced laparoscopy. With the theme of "a safe, scotch and authentic surgery available to masses" it is demanded that rare but fatal complications of clips and energy sources may be kept to the bays by adopting intra corporeal ligation peculiarly for technically challenging cases to avoid a nightmare. In complicated cases of cholecystitis, where clips and energy sources are on the receiving ends, intra corporeal knotting bears the torch of good hope for masses even at remote locations for gratifying results.

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