

Modifications of Laparoscopic Cholecystectomy

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ABSTRACT

Aims: More than 30 different ways of performing laparoscopic cholecystectomy (LC) are described in the literature. These were developed by surgeons with the aim to improve postoperative and esthetic outcome following LC. The modifications included reduction in port size and/or number than what is used in standard LC. The aim of this literature review was to evaluate the technical feasibility of the modifications of LC without compromising safety and the benefits associated with these modifications in terms of safety, postoperative pain, cosmesis, early recovery, and patient satisfaction.

Materials and methods: Literature review was performed on articles describing different techniques of LC, variations in port number and size, and their advantages over one another. The search was made by using search engines like Google, PubMed, Springer link, and HighWire Press.

Observation: Reduction in number of ports and port size especially in epigastric site gave advantages in terms of decreased postoperative pain score and esthesia. There was an increase in the number of transumbilical single-site surgery (TUSS) being performed in recent years with advantages like decreased postoperative pain and increased patient acceptance being documented in various studies. Hybrid technique of using additional ports during single-site laparoscopic surgery (SSLS) may be used as a bridge to single-site surgery while the surgeon is in a learning curve from a multiport surgery to SSLS. Currently NOTES cholecystectomy is under evaluation and not routinely performed. But current literature does not provide enough evidence of any clear benefit of any of these modifications over standard LC.

Conclusion: This literature review showed that even though there are some advantages in postoperative pain score, esthetic outcome, and patient acceptance while doing the different types of LC in selected patients, there is no evidence of any clear benefit over conventional LC. It is not acceptable to compromise the vision and increase the risk of bile duct injury to the patient while doing LC. Hence, modified LC may be performed by surgeons only after gaining enough experience and in selected group of patients without violating the basic principles of laparoscopic surgery.

Keywords: Laparoscopic cholecystectomy, Miniport laparoscopic cholecystectomy, NOTES, SILS, Single-site laparoscopic surgery, Three-port laparoscopic cholecystectomy, Transumbilical single-site surgery, Two-port cholecystectomy.

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INTRODUCTION

Professor Dr. Med Erich Muhe of Boblingen, Germany, performed the first laparoscopic cholecystectomy (LC) on September 12, 1985. Currently, it is the most commonly performed laparoscopic procedure and the procedure of choice for gallbladder diseases. Apart from the standard technique of performing LC, several surgeons have come up with their own versions of doing LC by reducing the size and/or number of ports with the aim of improving cosmetic and postoperative outcomes. The most recent modification of this procedure is the single-site laparoscopic cholecystectomy (SSLC).

Standard Laparoscopic Cholecystectomy (4 Ports Standard LC) (Fig. 1)

The four ports in standard LC are:

1. One 10 mm optical port through the umbilical area – 10 mm 30° telescope is routinely used.
2. 10 mm operating port on the epigastric area.
3. 5 mm operating port in right subcostal region in midclavicular line.
4. 5 mm assistant port in right subcostal anterior axillary line to retract the fundus.

Operating ports and camera follows base-ball diamond concept. With left hand Hartmann's pouch is retracted

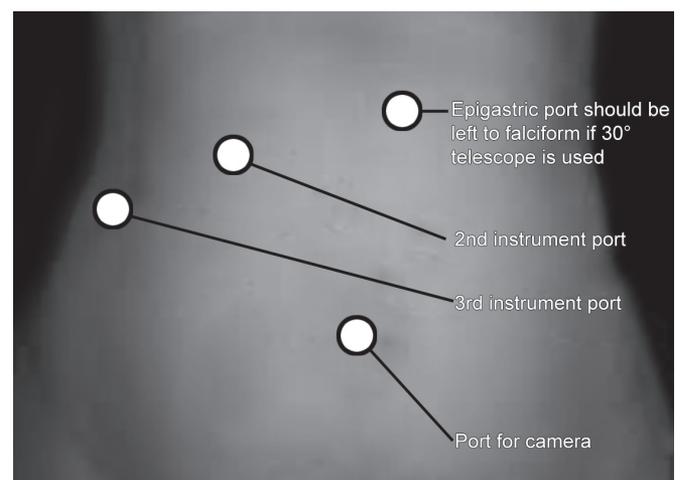


Fig. 1: Ports in standard LC

and with right hand posterior and anterior windows are created by dissecting in Calot's triangle. Critical view of safety is of utmost important to prevent bile duct injury. Clipping of the cystic duct and cystic artery is achieved from 10 mm epigastric port. Gallbladder extraction is generally done from either epigastric or umbilical port.

Reduced Port Size Laparoscopic Cholecystectomy

The size of epigastric trocar is reduced from 10 to 5 mm and this is claimed to reduce the pain and improve the cosmesis. This requires bipolar coagulation of the cystic artery and 5 mm clip applicator for clipping the cystic duct or ligation of cystic duct with an extra corporeal knot. At the end of the procedure the gallbladder is extracted through the umbilical port. Another variant of this technique is where a 5 mm telescope is used at the umbilicus and a 10 mm epigastric trocar is used for standard clip ligation of the cystic duct and epigastric extraction of the gallbladder.¹

Miniport Laparoscopic Cholecystectomy (Fig. 2)

This is done by a 10 mm umbilical port, 2 mm subcostal and lateral ports (MiniSite, US Surgical), and a 5 mm epigastric port (US Surgical). In addition, 2 mm graspers (MiniSite EndoGrasp; US Surgical) were used. A 5 mm clip was used on the cystic artery and duct; a 5 mm 30° laparoscope was placed through the epigastric port to remove the specimen through umbilical port.

Reduced Port (Number) Laparoscopic Cholecystectomy

Attempts were made by surgeons to reduce the port number from 4 to 3, but the vision was quite different, and hence many of them continued to do standard four-port

LC. A three-port LC can be performed by using a suture for fundal traction, so that the vision of the Calot's triangle is not compromised. The traction suture is inserted from the right lower chest wall taking care it does not penetrate the pleura or the lung in the right anterior or mid-axillary line with a straight needle inserted percutaneously or by a free thread inserted into the abdomen and withdrawn by a prolene loop inserted through a standard 18 G needle, an epidural needle, or the verrees needle. We can also use figure of eight suture on fundus to apply gentle traction.¹ This avoids the complication of occasional minor bile leak while using a traction suture. One can also make use of stryker mini alligator to provide traction on fundus of the gallbladder.

STRYKER MINI ALLIGATOR

Some studies show no major advantage in reducing one 5 mm right lumbar port as it neither reduces pain nor alters the postoperative recovery and it is cosmetically not superior to the traditional standard four-port LC. Some other studies have showed advantage of three ports LC over four ports LC² in terms of less pain,^{3,4} shorter hospital stay,³ and fewer surgical scars.⁵ Thus in few selected patients, three-port LC is possible without endangering patient's safety.

Techniques with Reduced Port Size with Reduced Port Numbers in LC

One can use a 5 mm umbilical telescope and a 10 mm epigastric trocar with a 5 mm retraction trocar in the right abdomen with or without suture traction of gallbladder fundus. This technique has little rationale as 10 mm epigastric port presumably causes more pain and avoiding a 10 mm incision in umbilicus has no cosmetic advantage.¹

One can also use microlaparoscopic instruments, i.e., 3 or 2 mm instruments for performing reduced port

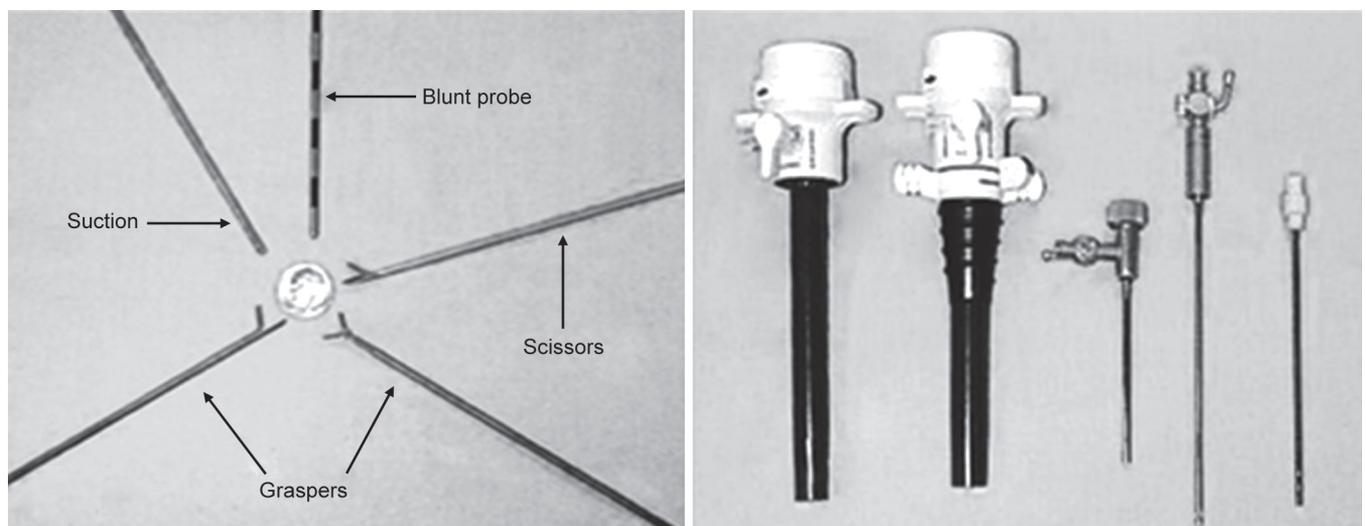


Fig. 2: Instruments in miniport laparoscopic cholecystectomy

(number) LC.⁶ Good quality 3 mm instruments, especially dissectors, suction as well as 3 mm telescope for extraction of gallbladder from the 10 mm umbilical port are needed. Only intracorporeal ligation of cystic duct is possible with this technique. The alternative is use of 10 mm clip applicator with 3 mm telescope.

For selected straightforward cases, two-port LC can be done by using two traction sutures; one on the fundus of gallbladder and another on the Hartmann's pouch. Thus with traction on the right lumbar suture, anterior dissection of Calot's triangle is possible, while with an epigastric suture traction posterior dissection is possible. But the quality of traction and countertraction will not be the same as with instrument, as the traction is more or less fixed in axis rather than variable and has a fixed direction of traction (Fig. 3).



Fig. 3: Stryker mini alligator

Some studies have shown that two-port laparoscopic cholecystectomy resulted in less individual port-site pain and similar clinical outcomes but fewer surgical scars compared to four-port laparoscopic cholecystectomy.⁷

Single-site Laparoscopic Surgery or Trans-umbilical Single-site Surgery (TUSS) (Fig. 4)⁸

In single-site laparoscopic surgery all ports are placed at single site; here it is, in or around the umbilicus. Using a single skin and sheath incision, one of the port devices, such as SILS port (Covidien), Tri port or Quad port (Olympus) or X cone (Storz) is introduced. This typically requires a larger skin incision, at least 20 mm.

Several variations in design and types of instruments are available. Instruments are roticulated and will be crossed inside to achieve triangulation. Vision achieved is tubular and violate some principles of base-ball diamond concept



Fig. 4: Single site Laparoscopic surgery

of port positioning in laparoscopy. There is also evidence that there are more chances of incisional hernia when the incision around umbilicus is large. But there are literature to support easy tissue retrieval, decreased pain score,⁹ and better patient acceptance compared to standard LC.

Some studies have demonstrated that single-incision LC is a safe procedure for the treatment of uncomplicated gallstone disease, with postoperative outcome similar to that of standard multiport LC.¹⁰

Hybrid Laparoscopic Cholecystectomy

To get the advantages of triangular dissection of standard multiport LC, some surgeons have developed a hybrid technique¹ of traditional multiport surgery and single-site surgery. In this technique three trocars are placed into the umbilicus, and additional trocars or mini instruments are used in different positions to aid in retraction or dissection. This technique may be used as a bridge to single-site surgery while the surgeon is in a learning curve from a multiport surgery to SSLS.

NOTES Cholecystectomy

Various techniques that have been used are transvaginal,¹¹ transgastric, or transcolonic.^{12,13} One 3 or 5 mm port is placed in the umbilicus as an initial guide to puncture the peritoneum and at the end to assist in closure of the defect. The transgastric and the transcolonic techniques use the flexible endoscope to perform the surgery with a double-channel endoscope for at least two instruments. The major limitation is the light and visual axis travel in the same instruments arm which makes this an unstable platform.

In transvaginal technique a long angle telescope 45° or even a flexible endoscope is used. The umbilical trocar would also assist in retraction or dissection. The final extraction is through the vaginal port and then sutured. The limitations are in terms of instrumentations, the risk of sepsis, dyspareunia in the long-term, and ethical dilemmas in using vagina.¹ Injury to rectum during vaginal puncture has also been reported. Currently NOTES cholecystectomy is under evaluation and not routinely performed.

CONCLUSION

In the era of laparoscopic surgery, less postoperative pain and early recovery are major goals to achieve better patient care and cost effectiveness. Several studies demonstrated that less postoperative pain was associated with reduction in either size or number of ports. But while performing modified LC, whether it is in reduction in number of ports or the size of port it is

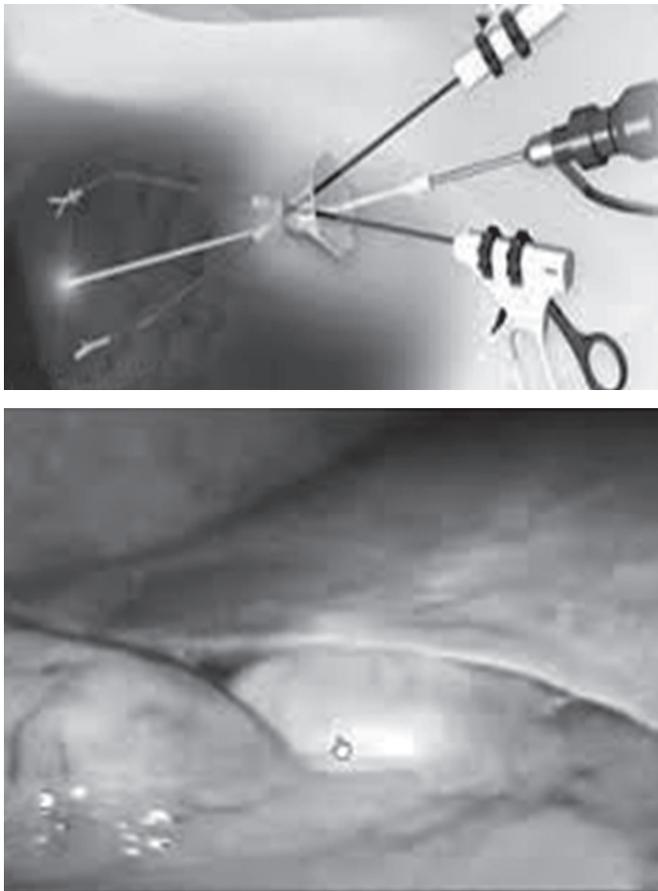


Fig. 5: First view of gall bladder

very important that the standard established principles of LC should not be violated. Compromising the vision and increasing the risk of bile duct injury to the patient with a presumable advantage of better esthetic outcome is not acceptable.

The decision to perform a modified LC may be taken after placing the telescope through first trocar and evaluating the liver and gallbladder, including the Calot's area. The First View (Fig. 5) described by Dr. RK Mishra in his lectures may be helpful in deciding to perform modified LC, i.e., once you enter into the abdomen look for:

- Inferior margin of the liver: If thin and wavy means no fatty infiltration and retraction will be easy.
- Fundus of GB: If projected beyond the inferior edge of the liver, holding and pushing it toward the diaphragm will be easy. In intrahepatic gallbladder retraction will be difficult.
- Distance between the anterior surface of liver and ribcage: If more than 6 cm, more space for retraction.

It is also important that during modified LC if any difficulty is encountered, timely decision should be taken to add an additional trocar or convert to standard LC.

Thus modified LC should be performed by surgeons only after gaining enough experience and in selected group of patients.

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