

Can 4-port laparoscopic cholecystectomy remain the gold standard for gallbladder surgery?



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Kinyas Kartal, Mehmet Uludag

Department of General Surgery, Sisli Hamidiye Etfal Training and Research Hospital, Istanbul, Turkey

Can 4-port laparoscopic cholecystectomy remain the gold standard for gallbladder surgery?

Since the first laparoscopic cholecystectomy (LC), laparoscopic approach has been the focus of surgical authorities and continued its technical revolution. With increasing surgical experience, a trend toward even more minimally invasive approaches has led to laparoscopic surgery to new innovations. Current surgical procedures are: four ports (4PLC), still the gold standart technique, three ports (3PLC), two ports (2PLC) and single port laparoscopic cholecystectomy (SPLC). Robotic cholecystectomy (RC) and natural orifice transluminal endoscopic surgery (NOTES) are the other new techniques for performing cholecystectomy. This article aims to make an objective comparision between different types of laparoscopic cholecystectomies by using available medical literature.

KEY WORDS: Cholecystectomy, Laparoscopic, Technique

Introduction

Mühe, the first surgeon who performed the laparoscopic cholecystectomy (LC) on 12 Semptember 1985, recalled the technique as “like a magic” in his memories ¹. He first presented his experience at the Congress of the German Surgical Society (GSS) in April of 1986. Like many new inventions, Mühe’s presentation was met with skepticism and ridicule ². They called laparoscopic cholecystectomy as “Mickey Mouse surgery”. Six years after that Congress, in 1992, Mühe received their highest

award, the German Surgical Society Anniversary Award. In the same year, many surgical centers recognized laparoscopic cholecystectomy as the “gold standard” procedure for gallbladder removal ³.

Laparoscopic cholecystectomy, the hit song of the surgical techniques list, continued its technical revolution, more than any other laparoscopic procedures. While four trocars were being used in the beginning, with increasing surgical experience, it was argued that the fourth trocar may not be necessary, and LC can be performed safely without using it and thus three-ports LC was developed ^{4,5}. After this development, a trend toward even more minimally invasive approaches, such as smaller ports, mini- ports and reduced number of ports, has led to the advent of laparoscopic surgery ^{6,7}. Current techniques in laparoscopic cholecystectomy are: four ports (4PLC), still the gold standart technique, three ports (3PLC), two ports (2PLC) and single port (SPLC). And robotic cholecystectomy (RC), natural orifice transluminal endoscopic surgery (NOTES) are the other new techniques for performing cholecystectomy.

This article aims to make an objective comparison between different kinds of cholecystectomies (4PLC, 3PLC, 2PLC, SPLC, RC and NOTES) by using available medical literature.

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Correspondence to: Kinyas Kartal, Sisli Etfal Training and Research Hospital, General Surgery Department, Sisli, Istanbul, Turkey. (e-mail: drkinyaskartal@gmail.com)

HISTORY AND INDICATIONS OF CHOLECYSTECTOMY

Carl Johann August Langenbuch was the first surgeon who has performed the first successful cholecystectomy on July 1882. His patient was a forty-three year old man who had suffered from biliary colic for sixteen years. The patient had lost 80 pounds and hopelessly addicted to morphine because of the abdominal pain. In the first post operative day, the patient was afebrile, pain free and smoking a cigar. On the twelfth postoperative day, the patient was ambulatory. He left the hospital six weeks later, gaining weight and without pain⁸.

One hundred and thirty-three years after this surgery, today, an estimated number of 700,000 cholecystectomies (96% LC) are being performed in the USA each year⁹. And the gallstones are still the main indication for these cholecystectomies which is one of the most costly digestive diseases in the United States, with an estimated cost of \$5 billion^{10,11}.

The other common indications for laparoscopic cholecystectomies are biliary colic, acute cholecystitis, chronic cholecystitis, gallbladder polyps larger than 10 mm, and gallstone pancreatitis¹². The only contraindication of LC is gallbladder cancer¹³. Many studies have shown high risk of port side recurrences even after incidentally detected, low grade gallbladder cancer¹⁴⁻¹⁶. Patients with severe obstructive pulmonary diseases or congestive heart failure may not tolerate carbon dioxide pneumoperitoneum and may be better served with open cholecystectomy if cholecystectomy is absolutely¹⁷.

Technical approach to laparoscopic cholecystectomy. Four ports or fewer than four ports?

Four ports laparoscopic surgery is the gold standart technique for cholecystectomy since 1986¹⁸. 4PLC is usually performed by using two 10 mm ports, which one of them is for camera and the other port is for the instruments used in dissection; and two 5 mm ports which are used for the manipulation of the gallbladder. The fourth trocar (one of the 5 mm ports used for the gallbladder manipulation) is used to grasp the fundus of the gallbladder so as to expose Calot's triangle. With increasing surgical experience, laparoscopic cholecystectomy has undergone reduction in port sizes and numbers^{19,20}.

Several studies have reported that 3PLC is technically possible^{19,21,22}. 3PLC technique contemplates the port placement at umbilicus, a 10 mm optical port for camera, and two more working ports at epigastric region, a 10 mm port and a 5 mm port, in the right hypochondrium in the midclavicular line²³. Some surgeons claimed that 3PLC took a similar time to perform and caused less postoperative pain than the standard laparoscopic cholecystectomy^{13,24}.

A meta analysis designed by Sun et al. have searched

five studies that compares 4PLC and 3PLC with 591 patients and compared the two techniques according to the operation time, success rate, analgesia requirements and postoperative hospital stay²⁵. The results of this meta-analysis showed that there were no significant differences in operating time, success rate, analgesia requirements, or postoperative hospital stay between the three-port and four-port LC groups. But as Sun et al. said in the conclusion section, the methodological qualities of studies were not high. All of the 591 patients were selected from elective patients who(m) were surgically 'easy cases' for the treatment.

With increasing laparoscopic experience and technological progress, new techniques are continued to be defined. 2PLC technique is one of these new surgical techniques²⁶. This technique was designed as one 10 mm port to the umbilicus for camera and one 5 mm port to the epigastric region for the dissection tools. The purpose of the technical design was set up on the same bases as the other new inventions: reduced pain, improved cosmesis, early return of function with acceptable complication rates when compared to standart 4PLC.

Sreenivas et al.²⁷ have studied 116 consecutive patients who have operated electively and randomised to 4PLC/2PLC. They claimed that, 2PLC resulted in reduced pain, need for analgesia, and improved cosmesis without increasing the operative time and complication rates when compared to that in 4PLC. Poon et al.²⁸ also demonstrated similar results with Sreenivas, and mentioned that, although the rates were statistically insignificant, the 4PLC group had higher overall complication rate than the 2PLC group. In both of the studies all the patients were operated electively with benign gallbladder diseases.

The last of the surgical techniques that involves an incision is SPLC. It was first reported in 1997 by Navara et al. as "one wound laparoscopic cholecystectomy"²⁹. In the beginning, enthusiasm to SPLC was limited because of poor equipment and technical support. But, big healthcare manufacturers have seen this more cosmetic and less painful emerging market and new operative hardware began to develop for facilitating the SPLC³⁰. Despite SPLC involves an approximately 2 cm incision, its called 'scarless' as the wound is hidden within the umbilicus. Several advantages of SPLC have been proposed, including improved cosmesis, less incisional pain, and the ability to convert to standard multiport laparoscopic surgery if needed³¹. The largest case series reported up to date is by Gurcillo PG 2nd et al.³² with 297 patients. Gurcillo et al.³³ confirms that SPLC is comparable to 4PLC in terms of hospital stay, blood loss and complications but has an advantage on cosmesis. The SPLC technique was found to be significantly slower than the 4PLC nearly in every study^{34, 37}.

The bile duct injury (BDI) rates of SPLC is studied by Allemann et al in 2014³⁵. They searched 11 randomised controlled trials (RCT) including 898 patients and

60 non RCT with a number of 3599 patients with benign gallbladder diseases. The incidence of BDI was 0.4% for SPLC while it was 0% in 4PLC in RCT group, and % 0.7 for SPLC while it was %0 for 4PLC in non RCT group. The BDI rates were not statistically significant in both RCT and non RCT group. But Allerman pointed to the low quality (Jadad score ≥ 4) of the studies and call attention to the lack of larger retrospective data for the confirmation of the doubt about the safety of SPLC.

Another technical challenge for the SPLC is the use of large devices with multiple ports. These larger trochars increase the potential for the development of fascial defects and incisional hernias^{29,30}. Alptekin et al.³⁶ compared the postoperative port-site hernia rate of the 163 laparoscopically treated patients. Trochar site hernia rate was 1.8% in 4PLC while it was 5.8% in SPLC. The most criticized LC technique in the medical literature is SPLC. In a RCT, Ma J et al.³⁷ compared SPLC and 4PLC about advantages and disadvantages of the techniques. They found SPLC time longer and incurred more complications than 4PLC without significant benefits.

ROBOTIC SURGERY AND NATUREL ORIFICES TECHNIQUES

Well-known advantages of robotic surgery such as 3-dimensional view, magnification, tremor suppression, and the flexibility of the instruments have opened a new horizon to a variety of surgical procedures^{38,39}. But also, well-known disadvantages of the robotic surgery such as high costs of the robotic systems are the main obstacle in front of the gaining experiences in the different surgical procedures. Breitenstein et al.³⁹ have compared RC to 4PLC and found stunning results. While totaly RC costs for one patient was 7985.4\$, it was 6255.3\$ for the 4PLC group. They concluded their study as RC shows no benefits in clinical outcome over 4PLC.

Corvo et al.⁴⁰ have operated 100 consecutive patients with gallstones robotically and affirmed that RC can play an effective role in reducing conversions to open surgery and hereby they state that RC will decrease the morbidity, by reducing the conversion rates. As Breitenstein, Corvo was also mentioned the high costs of the robotic system Da Vinci.

The intention for minimizing the incision related complications dragged the surgeons into a new lane, called: Natural Orifice Transluminal Endoscopic Surgery (NOTES). In the beginning, Kalloo et al.⁴¹ and Kantsevov et al.⁴² showed that abdominal cavity can be achieved by peroral with a flexible endoscope. In an experimental animal study, Park et al.⁴³ showed that transgastric gallbladder surgery, including cholecystectomy and biliary anastomosis, is feasible.

The main handicap in NOTES procedures which are using the digestive system orifices are the potential for developing septic complications and the high risk of fis-

tula formation after the closure of the entrance. But transvaginal NOTES could provide an easy-access, direct-vision closure, with available instruments, through a wellknown access with reasonable disinfection possibilities. Because of these justified advantages, surgeons developed the transvaginal cholecystectomy method⁴⁴.

Although there are many different techniques available on NOTES, the most accepted two techniques by the authorities are totally vaginal NOTES (T- NOTES) and Hybrid NOTES (H- NOTES). Major difference between the two techniques is the use of an umbilical trocar ports in H- NOTES technique. Both of the techniques are performed by using rigid reusable instruments in the lithotomy position. In H- NOTES procedure a 12-mm Hg capnoperitoneum was established via an umbilical Veress needle. The dissection of the gallbladder, the cystic duct, and the cystic artery, and clipping and transecting of them, was done via the umbilical trocar while viewing through a transvaginal 10-mm optic. The gallbladder was transvaginally extricated through the 11-mm trocar incision in the posterior vault^{45,46}.

Zornig et al.⁴⁵ have operated 108 patients by H-NOTES technique and compared them with 4PLC. The H- NOTES procedure found significantly longer than 4PLC, but there were no significant differences with respect to reoperations, wound infections, consumption of analgesic drugs, length of hospital stay, and sick leave between the two techniques. They concluded their study, like the other innovative technical studies, as: H-NOTES leave no visible scar.

The downside to the transvaginal NOTES is that it is obviously possible in only females. Surgeons who advocate this technique can state that "gallstones is more frequent in women" or they can also say that "men do not care the insicon scars or men are not good customers for the cosmetic industry". Surgeons who advocate the transgastric, transvesical or transrectal NOTES have get rid of this criticism, but they need more advanced surgical closure techniques to avoid the septic complications.

Conclusion

AND THE OSCAR GOES TO...

Like many other surgical skills, cholecystectomy is still continuing its evolution.

Nowadays, less hospitalisation, less complication, less insicion scar, less pain, and more notions starting with "less" is the challenge for the surgeons. This challenge causes the emergence of new techniques. But which one of the mentioned techniques is the gold standart? Versi E. defines the gold standard term as: "not the perfect one, but merely the best available"⁴⁷.

Four ports LC is an unisex, much less painful and more aesthetic when compared to open surgery, cheap, easy to

learn and feasible procedure with low complication rates. Olariu et al. was also studied the safety of the procedure with 2000 patients and mentioned that LC is still the gold standard technique for elective cholecystectomy⁴⁸. New RCTs, new innovations, new technical devices, new surgical skills will show us the final stage of the evolution of cholecystectomy. Until that day, it seems that 4PLC will keep the gold standard title and it will serve as a basis for the comparison of surgical procedures for many years.

Riassunto

Fin dalla prima esecuzione di una colecistectomia laparoscopica (LC), questo approccio ha attratto l'attenzione di tutti i chirurghi per continuare quindi la sua rivoluzione tecnica.

Con l'aumentare dell'esperienza chirurgica si è sviluppata la tendenza verso approcci sempre meno invasivi ed ha comportato innovazioni nel campo della chirurgia laparoscopica. Le procedure chirurgiche correnti sono: l'approccio con 4 port (4PLC) che rappresenta tutt'ora il gold standard, l'approccio con 3 port (3PLC), quello con 2 port (2PLC) ed infine quello con un solo port (SPLC).

La colecistectomia robotica (RC) e la chirurgia eseguita endoscopicamente tramite orifici coporei naturali (NOTES) rappresentano le altre nuove tecniche per l'esecuzione dell'asportazione della colecisti.

In questo articolo ci si propone di fare un confronto obiettivo tra i diversi tipi di colecistectomia laparoscopica sulla base della corrente letteratura medica del settore.

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