

Review Article

A 125-year journey and quest for better choice: OA or LA?

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ABSTRACT

Appendectomy is now 125 years old and we salute it. It is the operation for the removal of an inflamed symptomatic appendix to cure acute appendicitis (AA), the commonest surgical emergency world over. There are two variants of appendectomy: 1. Open and 2. Laparoscopic. Open appendectomy (OA) dominated the surgical world for about 85 years and in 1980 was challenged by the laparoscopic appendectomy (LA). Thirty years since then a pseudo controversy continues as to which is a better choice despite a lot of literature to support LA. Using the terms laparoscopic appendectomy, open appendectomy and appendicitis, a literature search was made using Medline and google. About 2100 citations were analyzed and several meta-analyses were studied to resolve the controversy. Laparoscopic appendectomy is worth recommending as an effective and safe procedure for acute appendicitis in both adults and children in all types of symptomatic appendicitis. Overall LA is more patient friendly than open appendectomy and deserves to be a gold standard surgical modality.

Keywords: Appendicitis, Appendectomy, Gold standard, Laparoscopic, Meta-analysis, Mc Burney point

INTRODUCTION

Appendectomy will witness its 125th Jubilee in 2019. The journey of appendectomy from 1894 to 2018 has gone a long way. Appendectomy is the operation for the removal of an inflamed symptomatic appendix to cure acute appendicitis (AA), the commonest surgical emergency world over.

Mc Burney described a new technique in 1894 (Mc Burney's procedure) for the treatment of acute appendicitis: this method is still used when an open approach is required.¹ Mc Burney's procedure for open appendectomy dominated the surgical arena and was considered the Gold Standard Surgery (GSS) for acute appendicitis until 1980. When the first fully laparoscopic appendectomy (LA) was carried out by Semm in 1980, a big storm shook the surgical world because a

revolutionary general surgical method was discovered by a gynecologist.^{2,3}

Laparoscopy was not easily accepted since it was not considered a safe procedure; nowadays laparoscopic surgery has a leading role in managing many surgical conditions.

The history of laparoscopic appendectomy is 5 years older than laparoscopic cholecystectomy (LC) because the first ever LC was performed in 1985 by Muhe of Boblingen, Germany, using Semm's technique. Despite this fact the LA could not gain the status of gold standard like LC till now. But when we analysed the data from 1980 to 2018 we found that LA has all the merits of a Gold Standard Surgery (GSS) for its most clinical indications and surgical community should accept it and welcome it as such. The transition from open to laparoscopic surgery has been associated with a marked reduction in the

degree of invasiveness, hence morbidity. Laparoscopy has several advantages over open technique such as shorter hospitalization period, less postoperative pain, earlier recovery of intestinal motility, less adhesions and less tissue trauma.^{3,4} On the other hand, factors such as higher costs, accessibility problems in emergency conditions and less surgical experience preclude the technique to be the standard surgical option as cholecystectomy.⁵

What is 'Gold Standard'?

According to the Mc Graw-Hill concise dictionary of modern medicine the gold standard is "the best or most successful diagnostic or therapeutic modality for a condition, against which new tests or results and protocols are compared". Now a days the experience and expertise of LA has reached such a height that it can be used to evaluate any new forthcoming procedure being developed to treat acute appendicitis such as Robotic-assisted appendectomy (RAA) or NOTES (Natural orifice transluminal endoscopic surgery) appendectomy.

The laparoscopic approach to appendectomy has gained wide acceptance over the last 30 years as a means of improving diagnostic accuracy, wound complication rate, recovery and hospital stay over the open procedure. Despite a mountain of data and widespread adoption of the technique, there continues to be controversy regarding the universal acceptance of this approach in the management of appendicitis in comparison to open appendectomy (OA). Still loyalists of OA see LA as an alternative to LA. Most accept LA as a better technique than OA but in conclusion they do not give it the rightful status of gold standard and hence a pseudo-controversy continues.

Although widely practiced, laparoscopic appendectomy (LA) has not gained universal approval. Several controlled trials have been conducted, many in favor, few not. We tried to evaluate whether laparoscopic appendectomy can be the Gold Standard Surgery (GSS) for acute appendicitis regarding the applicability, suitability and cost effectively. Using the terms laparoscopic appendectomy, open appendectomy and appendicitis, a literature search was made using Medline and Google. About 2100 citations were analyzed. Selected papers were screened for further information.

According to Wikipedia "a meta-analysis uses a statistical approach to combine the results from multiple studies in an effort to increase power (over individual studies), improve estimates of the size of the effect and/or to resolve uncertainty when reports disagree." It can be used to evaluate the existing literature, quantitatively and qualitatively, by comparing, integrating and analyzing the results of different studies, to clarify the outcome of interest. Therefore, we gone through and analyzed several meta-analyses to try to arrive at a conclusion.

REVIEW OF LITERATURE

In 2000 a group of surgeons advocated laparoscopic appendectomy in all cases of appendicitis in paediatric patients. In one prospective non-randomized trial 500 appendectomies were studied, 362 children underwent open procedure and 138 underwent laparoscopic appendectomy. There was no mortality in either group. Major complications were 3% in open group, but no major complications were seen in the laparoscopic group. Minor complications were 20% in open and 13% in laparoscopic appendectomy. Here again LA scored over OA.⁶

Sweeney KJ et al, predicted that laparoscopic appendectomy was all set to become the choice of therapeutic modality for appendicitis.⁷ It has been proved that laparoscopic appendectomy causes less post-operative pain than its conventional counterpart. In this study none of the literature reviewed found more pain after laparoscopic procedure. The post-operative narcotic use is less after laparoscopic appendectomy.

In one study done by Ortega et al, linear analogue pain scores were recorded in 135 patients blinded to the procedure of operation by special dressing and pain score was very less in laparoscopic group compared to open.

Most studies report a median hospital stay of 2-5 days of laparoscopic or open surgery, but some recent retrospective studies and reviews found laparoscopic appendectomy associated with significantly shorter hospital stay ($P < 0.1$).

Patients having laparoscopic appendectomy recovered more quickly than OA.⁸ Sauerland and others summarized the result of 28 randomized controlled trials and almost 3000 patients had reported a significant decrease in length of hospital stay.

Wound infection is the most common complication after appendectomy. A possible reason for this is that in open appendectomies the appendix is delivered directly through the wound, thereby promoting contamination, whereas in laparoscopic surgery the inflamed appendix is removed via a trocar or endobag.

Therefore, the risk of wound infection is less in laparoscopic appendectomy compared to the open procedure. A meta-analysis of randomized controlled trials has been reported with outcomes of 2877 patients included in 28 trials. It found low wound infection after LA (2.3% to 6.1%)⁹. Analysis on a large number of patients has shown that wound infections are lower in case of laparoscopic appendectomy if endobags are used regularly to retrieve specimen. This has been confirmed in a prospective randomized trial of laparoscopic versus open appendectomy.¹⁰ Some studies reported a significantly increased incidence of postoperative intra-abdominal abscess after laparoscopic

appendectomy in cases of perforated appendix.¹¹⁻¹⁴ But many reports tell that there is no increased incidence of intra-abdominal abscess formation after LA when compared to OA. In a trial on 930 patients (OA on 330 patients and LA on 554 patients) Barkhausen S et al, reported that the incidence of intra-abdominal abscess formation rate was same in both groups.¹⁵

Postoperative complications are usually considered in an assessment of any procedure's safety. The common complications of appendectomy are wound infection, intra-abdominal abscess, postoperative ileus and reactionary bleeding. One meta-analysis results showed that the overall incidence of postoperative complications in LA group was lower than in the OA group ($Z = 2.35$; $p = 0.02$).¹⁶

In response to findings in a small number of studies suggesting a trend toward increased infectious complications following laparoscopic appendectomy, Paik PS and others evaluated the incidence of post-appendectomy intra-abdominal abscess formation following laparoscopic and open appendectomies. Using the surgical database of the Los Angeles county-university of southern california medical center, they reviewed the records of all appendectomies.

A total of 2497 appendectomies (acute appendicitis: 1422 cases (57%), gangrenous appendicitis: 289 (12%), and perforated appendicitis: 786 (31%) were studied. They found no significant difference ($P < 0.05$) in the rate of intra-abdominal abscess formation between the groups undergoing open and laparoscopic appendectomies for acute, gangrenous or perforated appendicitis.¹⁷

In most literatures the operating time of laparoscopic appendectomy was found to be more than that of open appendectomy. The difference in mean operating time ranged from 8.3 to 29 minutes. Cox et al, defined operating time as the time from incision to wound closure. Tate et al, calculated the time from induction of anaesthesia to the administration of a reversal agent.^{18,19}

Generally, all laparoscopic procedures are more time taking due to the extra time for setup, insufflation, trocar entry under direct vision, and diagnostic laparoscopy. A meta-analysis of randomized controlled trial has been reported with outcomes for 2877 patients. The mean operating time was 16minutes longer for laparoscopic appendectomy.

A prospective randomized trial comparing laparoscopic appendectomy with open appendectomy was conducted in 158 patients by Hansen et al. They reported that despite of longer operating time, (63 versus 40minutes) the advantages of laparoscopy (such as fewer wound infection and earlier return to normal activity) make it a worthwhile alternative for patients with a clinical diagnosis of acute appendicitis.

Kazemier et al, reported a randomized clinical trial of 201 patients found that laparoscopic appendectomy is superior to open surgery regarding post-operative pain, and, post-operative complications, recovery time, and work days lost.²⁰ Adhesion formation is now one of the most common causes of morbidity and mortality after appendectomy. Adhesions are also held responsible for chronic abdominal pain in some patients after appendectomy. A study reported an adhesion rate of 80% after open appendectomy compared to 10% after laparoscopic appendectomy, when patients were again underwent laparoscopy three months later. Reduced adhesion formation is a big long-term advantage of laparoscopic appendectomy.²¹ These results strongly suggest that laparoscopic surgical techniques lead to fewer intra-abdominal adhesions by reducing tissue trauma, which in turn reduces circulating inflammatory mediators.²²

In a prospective, randomized study in subjects with acute calculous cholecystitis, complicated by bile peritonitis, who randomly underwent open or laparoscopic cholecystectomy, the effect of laparotomy and laparoscopy on mediators of inflammation and immunity were investigated. The results showed that after open cholecystectomy (OC) there was increased incidence of bacteraemia, endotoxaemia and level of inflammatory biomarkers (IL-1 and IL-6) when compared with the laparoscopic cholecystectomy (LC).

In the OC group there was a post-operative decrease in the HLA-DR of peripheral monocyte whereas LC group showed a normal level of HLA-DR expression. This study has shown that the immune status is better preserved, and the inflammatory response is less in the LC group than in the OC group.²³ Clearly laparoscopic surgery, here LA, is more patient friendly than open surgery, here OA.

Conversion to open surgery is said to be one of the drawbacks of laparoscopic surgery, however, it remains necessary at times, even for the most experienced laparoscopic surgeon. Risk factors for conversion from laparoscopic to open appendectomy included abscess, peritonitis, increased age, obesity, male gender, socioeconomic status and treatment at a non-specialist centre, and the overall rate is decreasing over time. Despite more than 30 year of experience in laparoscopy, the laparoscopic appendectomy (LA) conversion rate is reportedly 8-10%.

The conversion was more common in diabetic patients. The main intra-operative cause of conversion from LA to open was difficulty in identifying the anatomy as a result of mass formation and dense adhesions followed by hemorrhage from the appendicular artery.²⁴ Despite all these facts, in my opinion, any conversion from laparoscopic to open is not a drawback of that procedure rather it is a safety valve to save the patient life. Just like in a pressure cooker the safety valve is not a drawback

but a merit. No one will buy a pressure cooker without a safety valve.

Debate still exists about the cost comparison between laparoscopic and open surgery. Now most surgeons accept that laparoscopic appendectomy is cost effective when compared to OA because LA and cost saving intervention as a result of faster return to work.^{25,26} A retrospective cost-effectiveness analysis comparing OA versus multiport LA during 2013 in a developing country, Colombia, was performed. Effectiveness was determined as the number of days in additional length of stay (LOS) due to the complications saved. A total of 377 clinical histories were collected by the authors and analyzed for the following variables: surgery type, conversion to open laparotomy, complications (surgical site infection, reintervention, and readmission), hospital LOS, and total cost of hospitalization for initial surgery and subsequent complications-related hospitalizations. The total accumulative costs and LOS for OA and LA plus complications were estimated. An incremental cost-effectiveness ratio was calculated for OA as the comparator and LA as the intervention. The study concluded that LA is a cost-effective over OA with the cost of additional hospitalization due to complications saved. This is a situation in developing nations such as Colombia and the same is true for India also.²⁷

DISCUSSION

According to the 2010 Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) guideline, the following conditions as suitable for laparoscopic appendectomy:

- Uncomplicated appendicitis,
- Appendicitis in pediatric patients,
- Suspected appendicitis in pregnant women.

And laparoscopic appendectomy may be the preferred approach in the following cases:

- Perforated appendicitis,
- Appendicitis in elderly patients,
- Appendicitis in obese patients.²⁸

IPEG Guidelines observes that “what seemed to be more controversial is its (LA’s) application in complicated appendicitis. The concern for greater incidence of intra-abdominal abscess following the laparoscopic approach was reported in some studies but not supported by others.^{29,30}

Using non-operative treatment for complicated appendicitis followed by interval laparoscopic appendectomy obviates the need to manage the inflammatory situation in the acute stage”. Clearly there is no mention favoring OA in even complicated appendicitis. Population based studies of up to 150,000 cases for laparoscopic and open appendectomy have

shown that mortality rates for laparoscopic appendectomy were only 1/5 the rates of open appendectomy for patients older than 65.^{31,32} In a large series of laparoscopic appendectomy in children a French group in the early 1990s opined that LA was a ‘REASONABLE’ alternative in the treatment of appendicitis in paediatric population.^{33,34} The advantages of laparoscopic appendectomy, compared to open surgery, in children are similar to that of adult and include shorter hospitalization, fewer wound infections, earlier return to normal activities, better cosmesis, more effective lavage and better visualization of the peritoneal cavity.^{34,35} Sub-acute Intestinal obstruction suggests failure of nonsurgical treatment. For such cases interval laparoscopic appendectomy has shown to have the advantages of minimal morbidity and short hospital stay.³⁶

Sauerland et al, concluded that where expertise and equipment are available and affordable, diagnostic laparoscopy and LA (either in combination or separately) seem to have various advantages over OA.³⁷

Some of the clinical concerns of LA, however, are small and of limited clinical value. We would generally recommend using laparoscopy and LA in patients with suspected appendicitis unless laparoscopy itself is contraindicated or not feasible. Especially young female, pregnant, children, obese, and working patients benefit from LA. Therefore, the limitation of LA is economic not procedural or technical.

There are many grey areas also in LA such as: missed diagnosis, bleeding from the mesoappendix, omental vessels or retroperitoneum, visceral thermal Injury with monopolar cautery, incomplete appendectomy and port site hernia but most are due to lack of expertise and can be improved by improving skill and technology. The procedure per se cannot be blamed for most of these.

CONCLUSION

Compared with OA, LA in adults was associated with lower incidence of wound infection, fewer postoperative complications, shorter postoperative stay, and earlier return to normal activity, but a longer operation time. There was no difference in levels of intra-abdominal abscess and reoperation between the groups. Analysis in children did not reveal significant differences between the two techniques in wound infection, postoperative complications, postoperative stay, and return to normal activity.

Conversion to open surgery should not be regarded as a shortcoming but as a safety valve. LA is worth recommending as an effective and safe procedure for acute appendicitis in both adults and children. Overall, laparoscopic appendectomy is more patient friendly than open appendectomy.

I personally regard laparoscopic appendectomy as the "Gold Standard Surgery" (GSS) for management of symptomatic uncomplicated as well as complicated appendicitis in both adults and children because I am backed by the following landmark comment by none other than Alfred Cuschieri MD, ChM, DSc, FRSE, MedSci, FRSBiol, FRCS, FACS (Hon), University of Dundee School of Medicine:

In this issue of Surgical Endoscopy (1997;11:319-320), the Rotterdam Group reports the results of a prospective randomized controlled trial (RCT) comparing open appendectomy (OA) with laparoscopic appendectomy (LA) in patients with a clinical diagnosis of acute appendicitis. This is the ninth reported RCT on this subject and the present study is one of the largest to date, with 201 randomized patients. Collectively, the verdict gained from the majority of these studies is clearly in favour of LA on two counts-significant reduction in postoperative pain and significant reduction in the postoperative wound infection rate. By contrast only four such RCTs have documented a shorter hospital stay. This is not surprising since hospital stay must reflect the severity of the septic insult to the patient at the time of the emergency admission to hospital. There is no logic to back the opponents of LA that it does not confer any benefit simply because there are no significant reductions in the postoperative hospital stay.

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