

Mesoappendix and appendix stump treatment in laparoscopic appendectomy: a retrospective study in 1084 patients



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BACKGROUND: *Laparoscopic appendicectomy (LA) represents a standard but questionable approach in the treatment of acute appendicitis. The scope of this study is to show our experience using different methods in the mesoappendix and appendix stump treatment.*

MATERIALS AND METHODS: *A retrospective analysis of all patient with acute appendicitis that underwent to LA was obtained. The results have been analysed comparing the single techniques used in the treatment of mesoappendix and appendix stump.*

RESULTS: *The study included 1084 patients (M=648; F=436; mean age 28,4 years). During laparoscopic procedure we have founded in 296 cases a CAA (27.3%). The rate of conversion to open has resulted 3,2%; the mean operative time was 57,1; mean postoperative stay was 2,7 days. Eighteen patients have experienced surgical complications.*

From our data, in the treatment of mesoappendix (Clip =863, bipolar coagulation = 165, stapler = 22) and the appendix stump (endoloop =784; stapler = 265) we found no statistically difference about postoperative stay, and incidence of IAA; the operative time was longer (54,2 vs 66' p<0.05) when the surgeon preferred stapling the appendix stump; but in this group there was a higher incidence of CAA (35.2 % vs 18.7%).

CONCLUSIONS: *Laparoscopic appendicectomy is safe and effective. We judge that there isn't a better technique than others but various options that should be evaluated taking care about costs, the experience of the surgeon and the degree of inflammation of the appendix.*

KEY WORDS: Acute appendicitis, Appendix stump, mesoappendix

Introduction

Acute appendicitis (AA) is the most common surgical emergency. The laparoscopic appendectomy (LA) is a valid but debated technique for the treatment of AA.

The EAES (European Association for Endoscopic Surgery) guidelines of 2010 recommended to perform an explorative laparoscopy to all patients with symptoms and diagnostic findings suggestive of acute appendicitis (grade A) and if the diagnosis is confirmed to perform laparoscopic appendectomy (grade A).

Even the most recent SAGES (Society of American Gastrointestinal Endoscopic Surgeons) guidelines of 2009 indicate that LA is a safe and effective method both in the treatment of Simple acute appendicitis and in the perforated appendicitis (Level II, Grade B) in which it is probably the preferred approach (level III, grade C). Although LA is a relatively simple and widely practiced technique, there is variability among surgeons in regard

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of some details, in particular of the mesoappendix and appendix stump treatment.

Currently there are several techniques for the dissection of mesoappendix and to seal the appendix artery including clips, endostapler, monopolar or bipolar coagulation, radiofrequency coagulator and ultrasonic coagulation. The hemostatic effectiveness, the possibility of thermal injury to other viscera and costs of such devices are variable.

Also in regard of the treatment of appendix stump closure, it is possible to use a loop (loop Roeder, endoloop, intracorporeal knot) ^{4,5} made with absorbable or not absorbable materials. Alternatively, the endoscopic GIA stapling device may be employed for amputation of the appendix. We can also use ultrasonic or radiofrequency dissector, bipolar coagulation or polymeric clips ⁶⁻⁸.

Both the endoloop and the stapler are safe options but have some defects. The endostapler requires a 12 mm trocar and cases of bowel obstruction resulting from the presence of metal staples in the peritoneal cavity have been reported ^{9,10}.

The positioning of the loop is associated with a greater manipulation of the appendix stump, therefore it can generate necrosis of the appendix stump and as consequence the formation of abscesses or enteric fistulas ¹¹. In addition, the loop cannot be used in case of inflammatory involvement of cecum.

At our General and Emergency Surgery Unit for years we have been using a policy of "all comers" relative to the laparoscopic treatment of patients with AA. The purpose of this study is to present the results of our experience with the intent to analyze the results taking into consideration the type of treatment performed for the mesoappendix and appendix stump in order to highlight the differences between the several techniques used. A retrospective analysis of the data of 1084 patients with AA and treated with laparoscopic technique was performed.

Materials and methods

PATIENTS

From 2001, all patients with a suggestive diagnosis of AA and able to tolerate pneumo-peritoneum have been proposed for LA regardless of age, gender, BMI and severity of clinical symptoms. Clinical and personal data of all patients with confirmed diagnosis of AA at laparoscopy were included in a database and analyzed. The study covered 1084 patients (648 m – 436 f) with a mean age of 28.4 years (range 30-90 years). We excluded from the study all patients who underwent laparoscopic appendectomy for acute right abdomen but the diagnosis of acute appendicitis was not confirmed intraoperatively.

SURGICAL TECHNIQUE

The surgery was performed with the patient lying supine in Trendelenburg position, and in 10-15° left rotation.

The pneumoperitoneum was induced with Veress needle positioned in the umbilical area to achieve an intra-abdominal pressure between 10 and 14 mmHg. Typically we use 3 trocars, that means a 5/12 mm trocar at the umbilicus for the laparoscope (30°), a 5 mm port in the supra pubic area or right iliac fossa and a 5/12 mm port in the left iliac fossa. The mesoappendix was dissected with clips, stapler or bipolar coagulation. The appendix stump was closed with loop or with a stapler. The appendix was placed in a specimen retrieval bag and removed. After the appendix removal, contaminated areas of the abdominal cavity are copiously irrigated with saline solution and a drain is left in the Douglas pouch.

DEFINITIONS AND ENDPOINTS

On the basis of macroscopic evidence, appendicitis were classified into simple (SAA) and complicated (CAA). In the definition of CAA is included the presence of gangrenous, peri-appendicular abscess, peritonitis and/or perforation of the appendix.

The operative time, hospital stay and specific surgical complications were the main outcomes assessed in this study. These results were then compared according to the technique used for the treatment of mesoappendix and appendix stump.

For the discharge from hospital were observed the following criteria: 1) absence of temperature in the previous 24 hours, 2) tolerance of normal diet, 3) spontaneous walking with adequate pain control, 4) absence of leukocytosis. Abdominal abscesses were defined as intra-peritoneal collections identified by diagnostic imaging (ultrasound, CT) and associated with fever and/or leukocytosis.

STATISTICAL ANALYSIS

The data collected are entered into a database and analyzed using statistical software (Statview 5.01, SPSS, Carey, NC, USA) with "intention to treat." Continuous variables are reported as mean and compared by t Student test. The nominal variables were compared using the chi-square test. P values <0.05 were considered statistically significant.

Results

At laparoscopic exploration a SAA was found in 788 patients (72.6%) while a CAA in 296 (27.3%). The condition that most frequently made the acute appendicitis complicated was the gangrene of the appendix (n = 182, 16.7%) followed by peri appendicular abscess (n = 167, 15.4%), the perforation (n = 107.9, 8%) and peritonitis (n = 73, 6.7%).

Overall, it was necessary to convert to an open appendectomy in 3.2% (n = 35). This was linked to the impossibility of a secure isolation of the appendix due to intense peri-appendicular inflammatory reaction.

The mean operative time was 57.1 min (range 10-225 min).

The mean postoperative stay for patients laparoscopically treated (1049) was 2.7 days (range 1-17 days).

In 863 (82.2%) cases the appendix artery was sealed by clips application; in 165 (15.7%) by bipolar coagulation, and in 22 (2%) an endostapler was used.

The appendix stump in 784 (74.7%) cases was closed with endoloop, in 265 (25, 2%) we used endostapler.

In 1049 completely laparoscopic operations specific complications were recorded in 18 patients (1.7%) and especially intra-abdominal abscesses (IAA) (n= 12, 1.1%) , surgical wound infections (WI) (n= 2, 0.2%) and bleeding (n = 4, 0.4 %).

In all cases of IAA a CAA was present.

Thanks to be our a single-center, prospective, non randomized study, dividing all the patients according to the different techniques used for the dissection of mesoappendix, considering the presence of AAS or AAC, and comparing the two groups, it appears that there are no statistically significant differences in the operative time, postoperative stay and complications.

As far as the appendix stump closure is concerned , although in the group treated with endostapler there was a significantly higher proportion of AAC, we found no statistically significant differences in the postoperative stay and complications between the two groups (loop versus stapling). The operative time was longer in the endostapler group ($p < 0.01$).

Discussion and conclusions

The treatment of mesoappendix is possible with various methods (endostapler, radio frequency, ultrasound, clips, coagulation).

After the description of the use of radiofrequency coagulator for mesoappendix and the appendix stump by Yang ³ in 2005, Aydogan ¹² compared radiofrequency coagulator and endoclip and concludes that radiofrequency coagulator facilitates the mesoappendix dissection and reduces the mean total operative time (41 vs 54 minutes) and the conversion rate (9.4% vs 11.1%).

Sucullu ¹³ in a similar randomized comparison has shown the same results: a shorter operative time (49.06 vs. 59.69 P= 0.036)

Ponsky ¹⁴ reported his experience with 442 cases in whom the mesoappendix was only coagulated and reported only 1 case of postoperative bleeding (treated conservatively), and concluded that electrocoagulation is safe, effective and inexpensive.

In case of using endostapler, Tucker¹⁵ in order to prevent bleeding from the mesoappendix, advises to strengthen endostapler with bioabsorbable devices. In 33 cases, he reported an immediate and complete hemostasis of the "staple line".

The ultrasonic dissector was used both for the treatment

of mesoappendix and the appendix stump; Martin de Olmo ¹⁶ on his limited experience (3 cases) does not report complications and an average operative time of 42.3 min (range 32-49 minutes).

Lukish ¹⁷ compared in children two techniques for laparoscopic appendectomy: in the first the ultrasonic scalpel was used to dissect the mesoappendix (then using a endoloop on the appendix stump) and in the second a stapler was used both for the mesoappendix and the appendix stump. In the 2 groups of patients he did not report significant differences in outcome; the use of ultrasonic dissector is instead associated with longer operative times and greater costs.

Regarding of the treatment of appendix stump, a meta-analysis of Kazemier ¹⁸ conducted on four randomized controlled trials (427 patients) reported a shorter operative time ($p = 0.04$), a lower incidence of wound infections ($p = 0.01$) and ileum postoperatively ($p = 0.03$) when using the endostapler. He concluded that the clinical evidences on the closure of the appendix stump advises the routine use of endostapler.

Arcovedo ¹⁹ indicates that ligation of the appendix stump with extracorporeal knot technique is as safe as the endostapler. In addition the first technique has some economic advantages.

Beldi ²⁰, in a prospective analysis on 4489 cases of acute appendicitis treated with LA, reported a lower incidence of infections (intra-abdominal abscesses and wound infections) (0.7 vs. 1.7% $p = 0.004$) and lower re-admission rate (0.9 vs 2.1% $p = 0.001$) in patients treated with endostapler than endoloop.

Sajid²¹ analyzing data of 622 patients from 5 randomized trials concludes that there is no difference in hospital stay, perioperative complications and intra-abdominal abscesses between the two techniques (stapler versus loop).

In a recent publication ²², in selected cases, he has proposed a knotting technique with elastic rings placed through an endo-ring applicator.

A recent cost analysis, conducted by Wehrman ²³, confirms a significant economic advantage with endoloop technique compared to the stapler in the absence of statistically significant differences in outcomes.

Recently it was reported the use of polymeric clips ⁶⁻⁸ to secure the appendix stump and that author concluded that this technique is a safe alternative, effective and advantageous for the operative time and for the costs compared to the stapler and endoloop.

The bipolar coagulation ²⁴ of appendix stump demonstrated to be a safe , simple, economical technique. The results about the effectiveness of closure of the appendix stump have also been confirmed by experimental studies ²⁵.

From our results, we can conclude that there aren't any significant differences in operative time, hospital stay and complications according to the technique used for the treatment of mesoappendix. With regard to the appen-

dix stump closure, although in the group treated with endostapler there was a significantly higher proportion of AAC, we found no statistically significant differences in the postoperative stay and complications between the two groups (loop versus stapling).

Infective complications depend on the grade of intra-abdominal contamination (0,4 % in AAS vs 5 % in AAC) instead of different techniques used for the dissection of mesoappendix or appendix stump closure.

Therefore, in consideration of the costs, we do not consider that the use of devices such as staplers, radio frequency or ultrasound has some advantages for the dissection of mesoappendix. The use of bipolar coagulation allows a safe and adequate hemostasis and prevents thermal injury on the viscera. The use of endoclips, especially if disposable, is more expensive; however, it is a safe technique even if in our analysis it was associated, although not significantly, with a higher incidence of bleeding.

Ligation (loop) of the appendix stump, although is an economic, safe and effective technique, requires surgical experience because of the manipulation of more tissues than with an endostapler.

Endostapler has some advantages in all the cases where we have to perform retrograde appendectomy due to intense inflammatory reaction and in all the cases in which the base of the appendix is too large

In the initial phase of learning curve in laparoscopic appendectomy, endostapler can make the transection of the Appendix safer and easier than looping, that needs a greater practice and sensibility in the surgeon.

In conclusion, the surgeon must know that there are various technical options and from his experience and the situation encountered during the laparoscopic procedure, he will use the safest and most effective technique in his hands.

Riassunto

PREMESSA: L'appendicite acuta rappresenta la più frequente emergenza chirurgica ed attualmente la appendicectomia laparoscopica (LA) rappresenta una metodica altamente valida per tale patologia come confermato anche dalle più recenti linee guida della EAES e SAGES. Esiste comunque una certa variabilità spesso operatore dipendente per quanto riguarda le tecniche di trattamento del mesoappendice e del moncone appendicolare.

METODI: Presso la nostra U.O. sono stati arruolati da un'analisi retrospettiva 1084 pazienti sottoposti a LA. La valutazione in termini statistici della degenza media, tempo operatorio e tasso di complicanze in funzione del tipo di trattamento eseguito a carico del mesenteriole e del moncone appendicolare, ha rappresentato l'endpoint primario.

RISULTATI: Non abbiamo rilevato differenze statistiche in termini di degenza post-operatoria, durata dell'intervento

chirurgico e tasso di complicanze tra il gruppo in cui il mesenteriole è stato coagulato e in quello in cui l'arteria appendicolare è stata sezionata tra clip in titanio durante una LA per appendicite acuta. Per quanto riguarda il moncone appendicolare è stata soltanto evidenziata una maggior durata nei tempi operatori nel gruppo in cui è stata utilizzata la stapler rispetto all'endoloop.

CONCLUSIONI: la LA è una tecnica sicura e valida anche nella AAC; esistono differenti opzioni che il chirurgo deve conoscere e saper sfruttare in base alla sua esperienza ed alle variabili incontrate intraoperatoriamente tenendo in considerazione l'efficacia, la sicurezza e i costi.

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