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Acute appendicitis: should the laparoscopic approach be proposed as the gold standard? Six-year experience in an Emergency Surgery Unit

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SUMMARY: **Acute appendicitis: should the laparoscopic approach be proposed as the gold standard? Six-year experience in an Emergency Surgery Unit.**

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Acute appendicitis is common in an Emergency Surgery Unit. Although the laparoscopic approach is a method accepted for its treatment, no strong data are available for determining how many procedures must an experienced surgeon carry out for obtaining all the advantages of this technique and if this approach can become the gold standard in the activity of a general emergency unit with senior surgeons variously skilled on the basic laparoscopy.

142 patients that underwent appendectomy (90 laparoscopic, 52 conventional) for acute appendicitis were enrolled in this institutional retrospective cohort study. The surgeons were classified with a descriptor-based grading and divided in two groups regarding the skill. The only relevant result of our study was the significant reduction of conversion rate in case of laparoscopic approach. No strong differences were found concerning the duration of the procedure and the hospital stay between the two groups. The rate of complications were very low in both groups.

In conclusion, the experienced surgeons can easily perform a laparoscopic approach independently from the specific skill in this approach.

KEY WORDS: Appendicitis - Laparoscopic approach - Gold standard.

Introduction

Acute appendicitis (AA) is a common occurrence in the practice of an Emergency Surgery Unit (ESU) and the most common indication for emergency abdominal surgery with an estimated lifetime prevalence ranging around 10% (1-3). The conventional, laparotomic approach is still accepted, as reported in some studies based on surgical expertise (4). Many studies suggest that the laparoscopic approach for performing appendectomy (LA) has many advantages like faster recovery, less postoperative complications, better cosmetic impact, less postoperative pain and shorter hospital stay (5, 6). At first these advantages had been demonstrated in uncomplicated appendicitis (7). More recent experience (experiences) showed several advantages of LA even in complicated appendicitis, which should be considered, such as a minimally sized incision associated with a significantly lower incidence of surgical site infection (8, 9). The impact of the learning curve in the safety and effectiveness of LA has been evaluated (10), and it could be concluded that it is an optimal approach, but this study focused on how many procedures a surgeon may have to carry out before performing it independently; moreover, it concerns the learning curve of the residents and does not consider the skill of the senior surgeons in performing a laparoscopic procedure. In fact, in a realistic perspective, not all senior emergency surgeons achieve during their activities an acceptable level of competence in laparoscopic approach of abdominal emergencies even if they are not difficult to carry out. Laparoscopic approach in a Unit with frequent alternation of the surgical teams could be performed by competent surgeons and, on the contrary, avoided by less experienced operators. In our experience, laparoscopic approach of acute appendicitis is increasingly being favored following an internal audit since 2006 and progressively performed by all 6 senior surgeons of our Unit. The main aim of this study is to verify if this approach can become the

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gold standard in the activity of a general emergency unit with a variety of senior surgeons with different skills on the basic laparoscopy.

Study design

The present institutional retrospective cohort study included patients who have been preoperatively evaluated in case of emergency and scheduled for appendectomy within 24 hours after recovery.

The main goal is to evaluate if the laparoscopic appendectomy on the whole is an advantageous procedure in a team consisting in senior surgeon who are mostly dedicated at a different kind of surgery, having different skills in laparoscopic surgery, and if those different skills affect the results. We performed a review of available data of patients who underwent appendectomy during the period in which the data of the surgical procedures were registered in the institutional electronic database (Intranet).

Methods

The present retrospective study was carried out from January 2010 to June 2016 in the Unit of General and Emergency Surgery of the "Policlinico P. Giaccone" - University of Palermo (Italy) and concerned the appendectomies performed by 6 senior surgeons working at the Unit during the whole period of observation. The activity of the surgeons that turned up successively in the team, and those who came out was excluded from this study. We included the appendectomies carried out with the conventional three-port laparoscopic approach or the Mac Burney incision for the conventional open approach. The midline xiphoid-pubis incision and the umbilicus-pubis laparotomy were excluded if carried out as first-choice approach. On the contrary, these were taken into consideration if a standard (laparotomic/laparoscopic) technique was converted to an open technique through a wide abdominal access (s).

The surgeons were classified with a generic descriptor-based grading (Table 1), related exclusively to general laparoscopic skills and accepted by mutual consent of all operators (11). It should be underlined that the three "skilled" surgeons attended, during their career, a formal course of laparoscopy, on the other hand (contrary) the surgeons classified as "level 3" did not. The severity of acute appendicitis was classified according to the Disease Severity Score described by Garst et al. (12), reported on the Table 2. The surgical procedures were the conventional laparotomic appendectomy performed through a Mac-Burney incision or the three-port laparoscopic approach. The conventional, laparotomic approach was performed with a 2-5 cm long Incision along a Langer line at the junction of lateral one-third and medial two-third of right anterior superior iliac spine and umbilicus. Then, the superficial abdominal fascia is incised. Once the lateral margin of the rectum abdomen muscle is visualized it is medially retracted and the deep fascia incised, or rectum muscle is incised along the direction of its fibers. Then, the external oblique muscle is also incised and transversalis fascia visualized. After this fascia and the peritoneum were incised, the appendix is localized and removed. A suture was placed on the cecum in order to sink the appendicular stump. The laparoscopic technique was performed after a Hasson trocar was placed through the umbilical scar with the open technique. Once the camera was conducted into the abdomen through this trocar, two more trocars were positioned, the first one (5-mm) in the midline just upon the pubis and the second one (10 mm) in the left iliac fossa, in a point on the left-side perfectly symmetrical to the Mac Burney point. After coagulating the appendicular artery with a bipolar electrocautery, the procedure was completed by using two Endoloops (ready-made or handmade) and the appendix extracted with an endobag. The procedures were chosen by each surgeon fortuitously or according to the availability of a complete equipment for the laparoscopic procedure. No specific selection criteria were applied for chosing one of the two techniques. The conversion was usually the right pararectal laparotomy for the "open" appendectomy and the umbilicus-pubic incision after laparoscopic approach. The patients were discharged after the passage of flatus. The aim of this study is to evaluate the results of appendectomies performed with the laparoscopic technique by a team of surgeons with different specific skills in laparoscopy in comparison with the conventional approach. General patients demographics (age, gender), ASA score, surgeons's skills, severity of the appendicitis, operative time, conversion rate, hospital stay and complications were evaluated for each group. Given the retrospective nature of the study, no ethical board approval was needed. The study complied with the Helsinki declaration.

Statistical analysis

The data were analyzed with the Graphpad QuickCalcs® (GraphPad Software, Inc. 7825 Fay Avenue, Suite 230 La Jolla, CA 92037 USA), a software commonly available online.

The Chi-square test or the Fisher's Exact test were used for analyzing categorical variables; a t-student's test was applied to compare the means of two groups. The p-value <0,05 was considered the limit for statistics significance. The data were collected in a dedicated database (Microsoft Excel® Version 2011 for Mac, 14.3.0).

Results

The study concerned 142 patients (68 males, 74 females) that underwent appendectomy (90 laparoscopic-LA, 52 conventional-CA) for acute appendicitis. The patients were divided into two groups concerning the surgeon's specific laparoscopic skills: the three surgeons of the group 1 (able to perform basic and advanced laparoscopic procedures unsupervised and manage complications; attended a formal laparoscopy course) performed a total of 82 procedures (62 laparoscopic, 20 conventional); the three surgeons of the group 2 (able to perform basic laparoscopic procedures with minimal occasional supervision especially in the presence of complications; no formal laparoscopy course) performed 60 procedures (28 laparoscopic, 32 conventional). The two groups were comparable in terms of age and gender and similar concerning the ASA score and the appendicitis severity (Table 3). The results considering the duration of the procedures, the hospital stay and the conversion rate are summarized in the Table 4. Only two complications were described: a stump dehiscence in the group of the laparoscopic appendectomy and a postoperative bleeding in the group of the conventional procedure.

TABLE 1 - LEVELS OF PROCEDURE-BASED ASSESSMENT.

0	Insufficient evidence to support a judgement
1	Unable to perform basic laparoscopic procedures, even if under supervision
2	Able to perform basic lapasroscopic procedures under supervision
3	Able to perform basic laparoscopic procedures (minimal supevision could be occasionally needed, expecially in the presence of complications)
4	Able to perform basic and advanced laparoscopic procedures unsupervised and manage complications. A formal Course in Laparoscopic Surgery has been attended

TABLE 2 - ACUTE APPENDICITIS DISEASE SEVERITY SCORE (FROM GARST E COLL, 2013).

Grade 1	Inflamed
Grade 2	Gangrenous
Grade 3	Perforated with localized free fluid
Grade 4	Perforated with regional abscess
Grade 5	Perforated with diffuse peritonitis

TABLE 3 - DEMOGRAPHICS.

		Group 1 (82)	**Group 2 (60)**	**p-Value**
Age		32,01±12,15	34,33±17,58	0,35 (n.s.)
Gender		35 M	29 U	
		47 F	31 D	0,6 (n.s.)
ASA score	1	44	34	
	2	31	21	
	3	6	5	
	4	1	0	
AA severity	1	7	6	
	2	33	28	
	3	30	21	
	4	10	4	
	5	2	1	

Discussion

The appendectomy is one of the most frequent procedures in an Emergency Surgery Unit (3). During the 20° Century the differential diagnosis, in some cases, was a challenge for the clinician, and it was necessary taking into consideration several diseases, such as nephrolithiasis, Crohn's Disease, bowel perforation, Intestinal Ischemia, etc. (13-22). The pitfalls of this disease are the doubtful diagnosis in its early stage in which it can be mimicking different digestive diseases, even functional, (23-27) and, subsequently, a possible evolution in severe peritonitis and sepsis (28-31). As a consequence, although the appendectomy is considered a simple and safe procedure, a reliable diagnosis and a safe and correct surgical procedure are needed (32). It is reported that laparoscopic appendectomy is associated with a higher complication rate and higher charges regardless the conventional procedure (33), although the advantages of the laparoscopic approach (optimal abdominal cavity exploration, fast recovery) are emphasized elsewhere (6). The different techniques proposed in literature for both approaches can obviously change the results in terms of patient's comfort, complications and costs (2, 4-8). The open technique we proposed is commonly adopted in many cases (34, 35), as well as the three-port laparoscopic procedure, used for appendectomy and other abdominal procedures (36-39). It can be adopted in all stages of severity of acute appendicitis, including diffuse peritonitis (40). Moreover, the use of an endoloop, especially handmade, reduces the costs in comparison with the use of a linear stapler (41, 42).

As an alternative of the bipolar coagulator, the dissection of the appendicular vascular pedicle was performed with an energy-based device available in our insitution, such as thermal or ultrasonic device (43, 44). The results obtained during our experience, differently from other experiences reported (45) demonstrated that the

TABLE 4 - RESULTS.

Items	Group 1 (82)	Group 2 (60)	p-value
Duration of LA procedure	52,8±8,79	53,6±11,77	0,7 (n.s.)
p-values ◊	0,25 ◊	< 0,02 ◊	
Duration of CA procedure	49,7±13,8	45,6±11,67	
Hospital stay LA procedure	2,44 ±1,37	2,54±0,74	0,7 (n.s.)
p-values ◊	0,007 ◊	0,6 ◊	
Hospital stay CA procedure	3,37±0,90	2,64±0,90	
Conversion LA procedure	0	2	
p-value ◊			<0,005
Conversion CA procedure	5	3	0.17 (n.s.)

The column on the right side indicates the p-values of the comparison of the same item between Group 1 and Group 2. The p-values between two techniques of the same item (duration of the procedure, hospital stay, indicated with the symbol ◊) concern the comparison into the same group. The p-value between the item "conversion" (LA and CA procedures) concerns the comparison of the entires groups.

two procedures are similar in terms of length of surgery and hospital stay.

Those data can be explained by the subsets of patients taken into consideration in which all procedures were performed within 24 hours from hospitalization. In this context, the laparoscopic approach has allowed an optimal visualization of the operative field contrary to the Mac Burney incision, minimizing the initial disadvantage related to the preparation. Moreover, the surgeons involved in the present study are senior surgeons with a remarkable experience and high skilled and laparoscopic approach allows a wide exploration of the surgical field, which could be useful for experienced surgeons.

A very important result that should be emphasized is the significant reduction of conversion rate in case of laparoscopic approach, which allows to perform in a safe way even "difficult" appendectomies as retrocecal or infrahepatic appedicitis. Possible complications of an abdominal incision, especially if it is large and in conditions of contamination of surgical field, are very well known (46, 47). In our experience there is a low rate of complications which are related to the dehiscence of appendix stump in the AL group and a postoperative bleeding because of dehiscence of mesenteriolum ligature in CA group. Those data are too limited to reach firm conclusions. No postoperative intraabdominal abscess formation occurred during our experience, so we cannot to contribute to the hypothesis that laparoscopic approach may increase the incidence of intra-abdominal abscesses secondarily to insufflation (48). One aspect that has not been considered in this work, but has been widely reported in the literature, is the facility of LA in obese patients compared to the CA (5).

Conclusions

AA is a very common disease in surgical units dedicated to the urgency-emergency.

The laparoscopic approach, as demonstrated from our experience, is a step forward in the treatment since it makes it easier to explore the abdominal cavity. It also improves in a significant way some parameters such as the rate of conversion to a "wide" laparotomy. Our study has demonstrated that experienced surgeons can easily perform a laparoscopic approach, independently from a wider experience in this kind of approach in other fields of surgery. For this category of surgeons, the learning curve is probably not a matter for choosing LA or CA. Further studies can be applied with the aim to demonstrate the eventual advantages in more selected subsets of patients (eg: obese patients, pediatric age, female). The aspect related to the charges, deliberately not evaluated in this study, could possibly be considered in case of complications consisting in the necessity to enlarge sometimes the "classic" McBurney incision.

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