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A single center experience

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AIM: *The aim of our study is to compare the pre, intra- and post-operative variables of the two surgical techniques, to demonstrate if laparoscopic appendectomy can be considered safer and associated to better outcome.*
MATERIAL OF STUDY: *A retrospective analysis of 175 patients has been carried out. Alvarado score, time of surgery, analgesic therapy and length of hospital stay calculated. Finally, postoperative complications were recorded.*
RESULTS: *From January 2011 - April 2016 175 patients were enrolled: 128pts underwent laparoscopic technique and 47pts open technique. The average value of Alvarado score is lower in LA group than in OA group just as the average time of surgery and the use of post-operative analgesic therapy.*
DISCUSSION: *LA has become the surgical technique mostly performed for the treatment of simple and complicated acute appendicitis. Our study shows that LA pts are younger with a statistically significant difference*
CONCLUSIONS: *Most of the emergency appendectomies were performed via laparoscopic technique, especially in young patients. Laparoscopy is safer and associated to better outcome.*

KEY WORDS: Alvarado Score, Laparoscopic appendectomy, Open appendectomy

Introduction

Each year 0.2% of the population in Italy is estimated to be affected by acute appendicitis and one person out of seven during lifetime. The interventions for acute appendicitis performed in Italy are about 55 to 60 thousand per year with a clear majority of appendectomies in childhood and adolescence among males, although all ages may be affected. Most of the cases occur between 15 and 20 years of age with a slight predominance of male patients (1.3-1.6). Acute appendicitis is one of the most common causes of acute abdomen that requires hospitalization and emergency surgery. Early diagnosis and surgery in urgency are essential to prevent complications and morbidity. The advent of laparoscopy introduced new and less invasive surgical options that have become the gold standard for many surgical diseases. LA is widely used in treatment of acute appendicitis; However the use of this technique is controversial in cases of complicated acute appendicitis. The aim of our study will be to compare the pre, intra- and post-operative variables of the two surgical techniques, to demonstrate if laparoscopic appendectomy allows a better patient outcome and can be considered safer and associated to better outcame.

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Material and Method

From January 2011 to July 2016, 175 patients were enrolled for this retrospective observational study in our General Surgery Unit" V. Bonomo" of University Hospital of Bari (Italy). Inclusion criteria belonging to emergency department with clinical signs of acute appendicitis. The decision whether to use laparoscopic or traditional technique was based on the previous laparoscopic experience of the surgeon on duty. We collected patients' characteristic (age, sex), history, clinical examination and laboratory tests. In surgical report we stated surgical procedure, operative time and rate of conversion. We also considered analgesic therapy, which was administered intravenously (ketoprofen, ketorolac, acetaminophen) and duration of treatment.
Hospital stay has been calculated as post-operative variables and post-operative complications were also recorded. Firstly, Alvarado score was calculated. Therefore all data were statistically compared through T-student test for age, Alvarado score, operative time, analgesics therapy, hospital stay; chi-square test was used for surgical site infections and postoperative complications. Statistical analysis was conducted using SPSS 17 program. Values of $p<0.05$ were considered statistically significant. Written informed consent was obtained from all patients. Laparoscopic procedure was performed via open Hasson technique, with a 10 mm trocar in left paraumbilical area and a 5mm one in suprapubic area. After coagulation and cut with laparoscopic electric scalpel of the mesoappendix, two endoscopic loop ligatures were applied at the base of the appendix (a linear stapler had been used only in case of grangrenous appendicitis); the appendix was removed introducing an extraction bag. Open procedure was performed via McBurney's incision, ligation and section with electric scalpel of the mesoappendix; the base of the appendix was tied with a Vicryl suture and the appendix was divided with a scalpel. The appendiceal stump was inverted within the lumen of the caecum using a purse-string suture. Peritoneal drain was placed in all cases of complicated appendicitis.

Results

From January 2011 to July 2016, 175 patients (pts) with acute appendicitis were enrolled for this retrospective observational study in our General Surgery Unit" V. Bonomo" of University Hospital of Bari (Italy). Among 175 pts, 128 (73.1%) underwent LA and 47 (26.9%) OA. The mean age of patients was 39.6 ± 18.4 years; in the LA group it was 34.4 ± 16.2 years, significantly lower than OA resulting 48.8 ± 18.7 years ($P = 0.000$). Male patients were respectively 67 (52,3%) and 34 (72.3%); female patients were 61 (47.7%) and 13 (27,7%). Elderly patients considered aged > 65 years old 15 pts: 7 in LA group (47%) and 8 pts in OA group (53%). Patients with comorbidities were 21: 8 in LA group (38%) and 13 in OA group (62%). All data collected can be appreciated in Tables I and II.
The median value of Alvarado score of all pts was 7 (range 3-9). The average of the LA group is 6.5 (range 3-9), in the OA group 7.3 (range 5-9), with a significant difference ($p = 0.008$).
The average operative time of all pts was 67.25 ± 30.5 minutes (range 20-160 minutes): in LA group it was 54.9 ± 21.2 minutes (range 20-150 minutes); in OA group it was 88.5 ± 33.1 minutes (range 40-160 minutes), with a statistically significant difference ($p = 0.001$). Only in one patient the conversion to open technique was required because of extensive abdominal adhesions (1.75%). The surgical findings, confirmed by pathology, showed 135 cases (77%) of simple appendicitis and 40 cases of complicated appendicitis (23%). In both groups there was a higher incidence of simple appendicitis: 105 (82%) for LA group, 30 (63.8%) for OA group with no statistical significant difference ($p = 0.7$). All data collected can be appreciated in Table III.
Postoperative analgesic therapy mean time was 2.4 ± 1.2 days (range 2-12 days); in LA group it was 2.1 ± 1.1 days compared to 2, 8 ± 1.2 days in OA group, with a statistically significance ($p = 0.005$). Post-operative complications were detected in 13 patients (7.4%). 6 pts (4.68%) in LA group: 5 Intra-abdominal abscesses and 1 acute pyelonephritis. 7 pts (14.9%) in OA group: 5 wound infections, 1 atrial fibrillation, 1 death. We report a case of 92-years old patient suffering from chronic renal failure, atrial fibrillation, ischemic heart disease, ischemic stroke outcomes, who underwent surgical emergency procedure for acute appendicitis with diffuse peritonitis and died a few hours after surgery for septic shock. There was no statistical significance between this groups difference for clinical complications ($p = 0.2$) but there was significance for surgical wound infections and intra-abdominal postoperative abscesses ($P = 0.013$ $p = 0.019$). No re-intervention was required. The mean hospital stay was 5.2 ± 2.3 days: in LA group it was 4.8 ± 2.5 (range 2 - 12 days), in OA group it was 5,7 ± 1.9 days (range 2 to 10 days), with statistically significant difference ($p = 0.034$). All data collected can be appreciated in Table III-IV.

TABLE I - *Patients' Characteristics*

	LA	OA	*p-value*
Patients (%)	128 (73.1%)	47 (26.9%)	
Male (%)	67 (52.3%)	34 (72.3%)	0.006
Female (%)	61 (47.7%)	13 (27.7%)	
Age (mean±SD)	34.4±16.2yrs	48.8±18.7 yrs	
Aged >65yrs (%)	7 (47%)	8 (53%)	0.134
Comorbidities	8	13	0.03

Table II - *Pre and intra operative data*

	LA	OA	P
Alvarado score (mean)	6,5	7,3	0.008
Mean operative time (±SD)	54.9 ± 21.2 min	88.5 ± 33.1 min	0.001
Complicated appendicitis (n-%)	23 (18%)	17 (36.2%)	0.7
Simple appendicitis (n-%)	105 (82%)	30 (63.8%)	

Table III - *Post-operative data*

	LA	OA	P
Analgesics Therapy (mean±SD; days)	2.1 ± 1.1	2.8 ± 1.2	0.005
Post-surgical hospital stay (mean±SD; days)	4.8 ± 2.5	5.7 ± 1.9	0.03

Table IV - *Post-operative complications*

	LA	OA
Mortality	0	1
Re-intervention	0	0
Acute pielonephritis	1	0
Wound infection	0	5
Intrabdominal Abscess	5	0
Atrial Fibrillation	0	1
TOT	6	7

Discussion and Comments

LA has become the surgical technique mostly performed for the treatment of simple and complicated acute appendicitis. The rate of LA in the period 1998-2008 increased from 20.6% to 70.8% [7], thus laparoscopic appendectomy represents the first surgical approach. Several studies report that, in addition to clinical benefits, LA allows a full exploration of the peritoneal cavity, thus representing an important diagnostic especially in case of only suspicions of acute appendicitis. Several diseases such as inflammatory pelvic, endometriosis, ovarian cysts, ectopic pregnancy, cholecystitis and colonic perforation may mimic appendicitis [8]. It is estimated that 50% of all cases of suspected acute appendicitis in young women do not present a certain diagnosis [9].

The decision and the preference for surgical procedure to be performed, LA or OA, depend on the skill of the surgeon, but for women in childbearing age, for elderly people and in cases of preoperative uncertain diagnosis LA is prefered [1,4,5]. The two groups that benefit more of the laparoscopic technique are the obese and the elderly because they have various comorbidities that cause a high intraoperative risk [1].

Finally, the results of the laparoscopic technique are controversial and the superiority of this technique is found only for specific indications and patient groups [1,25].

Our study shows that the number of LA pts was higher than OA ones, and in the four years survey of this study, its use was on average 70%. Our study shows that LA pts are younger with a statistically significant difference (p = 0.000). This result agree with most of the studies which showed, also, a better use of LA for patients with more advanced age [1,4].

Our data confirms that there is still a form of cultural resistance to the use of laparoscopic surgery in the elderly despite the fact that the literature does not show increased mortality or operative morbidity among these patients if operated laparoscopically as compared to OA. A higher incidence of postoperative complications among the elderly is observed because the cases of complicated appendicitis are often associated to several comorbidities.

As far as Alvarado score is concerned, the average of LA pts is lower than OA with statistical significance (p = 0.008). This result underlines that laparoscopic technique can be useful in cases of uncertain diagnosis and presumably less severe cases. Laparoscopic exploration is therefore essential to confirm the diagnosis, many cases demonstrate the undeniable usefulness of diagnostic laparoscopy in emergency surgery for acute abdomen management [1,3].

As regards operative time, it took a significantly shorter time (average of 55 minutes) in LA (P = 0.000). At the beginning learning curve, LA required larger operative time than OA due to the lack of an adequate surgical experience. Currently, most of the studies reported a non-significant difference between the two techniques in terms of operative time [4,6,11,12]. This depends on the experience of the surgical team performing a laparoscopic

procedure, especially in the case of complicated appendicitis [8]. Other studies report a reduction of the operating time for LA explained both by the greater ease and speed in the display of any adhesions and abscesses, especially for complicated appendicitis, but also by the standardization of the surgical procedure in surgical units that have been used laparoscopic technique for many years [13]. In fact Navarra et al report a longer operative time in OA than in LA but in LA group a shorter hospital stay and postoperative pain emerge [26].

In our study it was found that the laparoscopic technique has been used interchangeably with laparotomy in cases of simple or complicated appendicitis ($p = 0.7$). In literature, the definition of a complicated appendicitis is controversial: according to some authors it is a gangrenous or perforated appendicitis [10], according to others it is defined as a gangrenous appendicitis or perforated, with or without abscess [19], according to others it implies the existence of perforated or gangrenous appendix with peritonitis and intra-abdominal abscesses [20].

Another controversial issue is the role of LA in cases of complicated appendicitis, particularly on the risk of post-operative complications, especially infectiouones. Three meta-analysis published on the subject show that the LA has advantages over the other tecnique in terms of post-operative complications and length of hospital stay without increasing the occurrence of intra-abdominal abscesses [16,21,22]. However other studies show an association of the LA in complicated appendicitis with an increased risk of intra-abdominal abscesses, paralytic ileus, and postoperative complications [5,6,23,24]. In our series the mean time of analgesia showed a slight but significant reduction in the use of analgesics for the laparoscopic technique ($p = 0.005$), in literature a reduction in post-operative pain is reported, and also of the intake of analgesics for the LA [2], in other articles it is proved that there is no difference between the two groups since the post-operative pain varies according to the individual patient's pain threshold, age, sex, the complexity of the surgical context [4,25].

The absence of a surgical wound still contributes to reduce the duration and severity of post-operative pain. As it refers to the post-operative complications, we found a significant difference in the two groups regarding the number of wound infections and intra-abdominal abscesses. In the LA group it was observed only one surgical site infection. The 5 cases found are associated with complicated appendicitis ($p = 0.01$). This result agree with literature that consider the incidence of surgical site infections higher in complicated appendicitis performed laparoscopically [14,15].

Many scientific papers consider an important advantage of LA due to the way of appendix extraction. In fact in LA extraction needs a specific bag and that does not allow the direct contact with the abdominal wall [5,16]. In the LA group the formation of intra-abdominal postoperative abscesses in 9 patients was observed, but absent in the OA group ($p = 0.019$). This agrees with literature data that show how the CO_2 insufflation and direct dissection into the abdominal cavity after irrigation and aspiration of purulent fluid and other causes related to surgical technique contribute to increasing the growth of pathogenic microorganisms in the abdominal cavity [1,8]. In terms of post-operative length of hospital stay, there is a significant difference between the two groups ($p = 0.034$). Most of the studies show a reduction in hospital stay with LA technique, accompanied by a reduction in costs [2,6,8,17], this brings benefits to elderly patients and patients with comorbidities that have the possibility of a rapid return to their daily habits [18].

Conclusions

Our study confirms that the majority of emergency appendectomies were performed via laparoscopic procedure. Laparoscopy is most commonly used in young patients, regardless of the clinical situation and seriousness and in cases of uncertain diagnosis. Laparoscopic technique has shown a reduction in operative time and post-operative length of stay. A sensible objective can be reaching a greater use of laparoscopy in elderly patients. Our results show that the laparoscopic technique is safer and associated to better outcomes.

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Riassunto

L'appendicite acuta è una delle cause più comuni di addome acuto che richiede ospedalizzazione e intervento chirurgico d'urgenza. Lo scopo del nostro studio è confrontare variabili pre, intra e post operatorie tra le due tecniche chirurgiche, per verificare se l'appendicectomia laparoscopica è associata ad un migliore risultato per il paziente. I pazienti selezionati sono stati suddivisi in due gruppi in base alla tecnica chirurgica utilizzata per il trattamento dell'appendicite acuta, gruppo sottoposto ad appendicectomia laparoscopica (LA) e gruppo sottoposto ad appendicectomia open (OA). Per ciascun paziente sono stati raccolti dati anagrafici relativi all'età, è stato calcolato lo score di Alvarado, la durata dell'intervento chirurgico, la durata della terapia analgesica e della degenza postoperatoria. Sono state registrate infine le complicanze post-operatorie.

Da gennaio 2011 ad aprile 2016 sono stati valutati 175 pazienti: 128 (73,1%) con tecnica laparoscopica e 47 (26,9%) con tecnica laparotomica.

Il nostro studio ha confermato che la maggior parte delle appendicectomie in urgenza vengono eseguite per via laparoscopica, l'accesso laparoscopico è maggiormente utilizzato in pazienti giovani, indipendente dal quadro clinico di media o elevata gravità e nei casi di incertezza diagnostica. La tecnica laparoscopica ha mostrato una riduzione del tempo operatorio. I nostri risultati mostrano come la tecnica laparoscopica sia più sicura, e si associ ad un migliore risultato per i pazienti.

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