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Laparoscopic Appendectomy: Why It Should Be Done

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ABSTRACT

Objective: Notwithstanding its widely perceived advantages, laparoscopic appendectomy has not yet met with universal acceptance. The aim of the present work is to illustrate retrospectively the results of a case-control experience with laparoscopic versus open appendectomy carried out at our institution.

Methods: Between January 1993 and November 2000, 555 patients (M:F = 210:345; mean age 25.2±15 years) underwent emergency or urgent appendectomy, or both. Of them, 322 (52%) were operated on laparoscopically, and 233 (48%) were treated via conventional surgery, according to the presence of a well-trained surgical team.

Results: The laparoscopic group conversion rate was 3.1% (10/322) and was mainly due to the presence of dense intraabdominal adhesions. Major intraoperative complications ranged as high as 0.3% (1/322) and 0%, respectively, in the laparoscopic and conventional groups (*P*=ns). Major postoperative complications were 1.6% (5/312) vs 0.8% (2/243), respectively (*P*=ns). Postoperative mortality was 0.3% (1/312) and 0.4% (1/243) in the laparoscopic and conventional subsets of patients. Reinterventions were 0.9% (3/322) in the laparoscopic patients versus nil in the open group (*P*=ns). Minor postoperative complications were observed in 0.6% (2/312) and 6.5% (16/243) of patients, respectively, in the laparoscopy and open surgery groups, and consisted mainly of wound infections (*P*=0.001). Flatus passage and hospitalization were significantly more rapid among the laparoscopic patients. The greater diagnostic accuracy of laparoscopy allowed the diagnosis of concurrent diseases in 12% (30/254) versus 1.5% (3/199) of patients with histology proven appendicitis treated via laparoscopy versus laparotomy (*P*<0.01). Similarly, among those patients without gross or microscopic evidence of appendicitis, or both gross and microscopic evidence, concurrent diseases were detected in 57.3% (39/68) of laparoscopic patients versus 8.8% (3/34) in the conventional ones (*P*<0.01).

Conclusion: Even if limited by its retrospective nature, the present experience shows that laparoscopic appendectomy is as safe and effective as conventional surgery, has a higher diagnostic yield, causes less trauma, and offers a more rapid postoperative recovery. Such features make laparoscopy a challenging alternative to laparotomy in premenopausal women referred for urgent abdominal or pelvic surgery, or both.

Key Words: Laparoscopy, Laparotomy, Abdominal emergencies, Appendicitis.

INTRODUCTION

Laparoscopy has emerged as the standard surgical approach to a wide host of diseases of the upper abdomen, but its role in the management algorithm of lower abdominal emergencies awaits definite clarification.[1] This is especially true for suspected appendicitis, a disease of huge epidemiological impact and several diagnostic challenges.[1,2] We report herein the results of a retrospective analysis of a case-control series of laparoscopic (LA) versus open appendectomies (OA) performed in our department from January 1993 to November 2000.

METHODS

From January 1993 to November 2000, 555 patients (M:F=245:310; mean age 25.2±15 years) underwent emergency or urgent appendectomy, or both. Of them, 322 (52%) were operated on laparoscopically, and 233 (48%) were treated via conventional surgery. Because minimally invasive surgery was not performed by all of the surgeons on our staff, patients admitted for suspected acute appendicitis were treated by laparoscopy or open surgery according to the presence of a well-trained surgical team and not randomly allocated to either treatment. Furthermore, at the beginning of our experience, we

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Table 1.
Results by Treatment Group

	LA n = 322	OA n = 233	*P*
Overall mortality	1 (0.3)*	1 (0.4)†	ns
Operative mortality	0	0	ns
Conversion‡	10 (3.1)	-	-
Major intraoperative complications (%)	1 (0.3)§	0	ns
Minor intraoperative complications (%)	0	0	ns
Reinterventions	3 (0.9)	0	ns

*Massive pulmonary embolism in an 84-year-old patient affected by perforated appendicitis and severe peritonitis.
†Massive pulmonary embolism.
‡Refer to Table 3.
§Iatrogenic lesion to the sigmoid mesentery requiring conversion.

decided not to use laparoscopy in patients with a history of previous abdominal malignancies, more than 2 major abdominal surgeries, massive bowel distension, and in those too ill to withstand pneumoperitoneum. The presence of diffuse peritonitis was not considered a formal contraindication to the use of a laparoscopic approach. Inevitably, our series reflects a selection bias in favor of laparoscopy as regards morbidity and mortality. Irrespective of the chosen approach, all patients underwent the same preoperative workup, including a chest x-rays, electrocardiogram, and routine blood tests. The outcome measures were the incidence of major and minor intraoperative complications, operative mortality, postoperative morbidity and mortality rates, the incidence of concurrent diseases, and the histology of the resected specimens. The statistical analysis was performed with the *t* test for independent samples for continuous variables and the chi-square test or Fisher's exact test for categorical values. The level of significance was set at 5%.

RESULTS

The overall mortality of the LA and OA groups are 0.3% (1/322) and 0.4% (1/243), respectively (*P*=ns) **(Table 1)**. Major intraoperative complications were observed in the LA group (0.3%) and consisted of 1 inadvertent lesion to the sigmoid colon requiring conversion. Reinterventions were as high as 0.9% (3/322) in the LA group versus nil in the OA group (*P*=ns) **(Table 1)**. The conversion rate was 3% (10/322) and due to dense adhesions in 8 patients, extrauterine pregnancy and an iatrogenic lesion to the sigmoid colon, both in 1 patient **(Table 2).** Postoperative complication rates were similar in LA and OA (1.5% vs 0.8%; *P*=ns) **(Table 3)**. Both cases of pulmonary embolism were fatal, while only 1 case of intraabdominal collection was observed in LA patients. The superior diagnostic yield of laparoscopy was observed in our series. The incidence of concurrent diseases in patients with proven appendicitis was significantly higher in LA (12%) versus OA (1.5%; *P*<0.01) **(Table 4)**. The most frequent conditions diagnosed at laparoscopy were adhesions (4.8%) and pelvic diseases (4.4%) **(Table 4)**. Similarly, even higher was the diagnostic yield of laparoscopy in patients without histology proven appendicitis. In such cases, laparoscopy allowed for identification of concurrent diseases in 57.3% versus 8.8% of patients **(Table 5)**. The most frequent conditions mimicking acute appendicitis were adhesions (19%), Graaf follicles (16%), and mesenteric lymphadenitis (5.8%).

Table 2.
Causes to Conversion

	LA n = 322
Iatrogenic lesion to the sigmoid mesentery (%)	1 (0.3)
Extrauterine pregnancy (%)	1 (0.3)
Dense adhesions (%)	8 (2.4)

Table 3.
Results by Treatment Group

	LA n = 312*	OA n = 243*	*P*
Pulmonary embolism (%)	1 (0.3)†	1 (0.4)†	ns
Pneumonia (%)	1 (0.3)	1 (0.4)	ns
Intraabdominal collections and sepsis (%)	1 (0.3)‡	0	ns
Bleeding (%)	2 (0.6)‡	0	ns
Total (%)	**5 (1.5)**	**2 (0.8)**	**ns**

*Converted laparoscopic cases are included in the open group.
†Fatal.
‡Requiring reintervention.

Table 4.
Incidence of Concurrent Diseases in Patients With Histology Proven Appendicitis by Treatment Option

Disease	LA n = 254	OA n = 199	*P*
Adhesions (%)	12 (4.8)	0	ns
Graaf follicle (%)	4 (1.6)	1 (0.5)	ns
Omental cyst (%)	4 (1.6)	0	ns
Ovarian cysts (%)	3 (1.2)	0	ns
Salpingitis (%)	2 (0.8)	0	ns
Umbilical hernia (%)	2 (0.8)	0	ns
Tubal cyst (%)	1 (0.4)	0	ns
Polycystic ovaries (%)	1 (0.4)	0	ns
Cholecystitis (%)	1 (0.4)	0	ns
Omental necrosis (%)	0	1 (0.5)	ns
Meckel's diverticulum (%)	0	1 (0.5)	ns
Total (%)	**30 (12)**	**3 (1.5)**	**<0.01**

Regarding the postoperative course, LA patients recovered more rapidly, with a significantly shorter hospital stay than OA patients had (4.4+1.2 vs 5+3.40 days; P=0.01) **(Table 6)** and flatus passing earlier (1.6+0.7 vs 2.2+1.2 days; P<0.01) **(Table 6)**. Furthermore, LA patients experienced far fewer wound infections (nil vs 6.6%; P<0.01) **(Table 6)**.

DISCUSSION

Laparoscopy has gained widespread acceptance in common surgical practice as a diagnostic and therapeutic tool.[3] Suspected appendicitis is still a diagnostic challenge to the general surgeon.[1-3] To plan the appropriate procedure or to avoid an unnecessary laparotomy, a correct diagnosis is crucial because of the various diseases that may be responsible for the same symptoms. Noninvasive diagnostic procedures are expensive and not always conclusive.[4] Laparoscopy is the only minimally invasive technique that allows concurrently an appropriate diagnosis and treatment and the best abdominal approach.

Herein, we wish to analyze the advantages of

Table 5.
Incidence of Concurrent Diseases in Patients With Histologically Normal Appendicitis by Treatment Option

Disease	LA n = 68	OA n = 34	*P*
Adhesions (%)	13 (19)	0	0.01
Graaf follicle (%)	11 (16)	0	0.03
Mesenteric lymphadenitis (%)	4 (5.8)	2 (5.8)	ns
Bleeding luteal cyst (%)	2 (3)	0	ns
Endometriosis (%)	1 (1.5)	1 (3)	ns
Ectopic pregnancy (%)	1 (1.5)	0	ns
Retroperitoneal leiomyosarcoma (%)	1 (1.5)	0	ns
Perforated diverticulitis (%)	1 (1.5)	0	ns
Perforated duodenal ulcer (%)	1 (1.5)	0	ns
Ileitis (%)	1 (1.5)	0	ns
Bleeding ovarian cysts (%)	1 (1.5)	0	ns
Omental necrosis (%)	1 (1.5)	0	ns
Cholecystitis (%)	1 (1.5)	0	ns
Meckel's diverticulum (%)	0	0	ns
Total (%)	**39 (57.3)**	**3 (8.8)**	**<0.01**

Table 6.
Postoperative Outcomes by Treatment Group

Outcome	LA n = 312*	OA n = 243*	*P*
Mean postoperative hospital stay (days)	4.4±1.2	5±3.40	0.01
Mean passing flatus (days)	1.6±0.7	2.2±1.2	<0.01
Wound infection (%)	0	16 (6.6)	<0.01
Urinary retention (%)	1 (0.3)	0	ns
Abdominal collections	1 (0.3)	0	ns

*Converted laparoscopic cases are included in the open group.

laparoscopy in the management of patients affected by suspected acute appendicitis as regards indications, morbidity, mortality, and its socioeconomic impact.

Indications

The absolute and relative contraindications to laparoscopy in the treatment of abdominal emergencies are the same as those for elective procedures.[5] Based on our experience with open surgery, we decided not to laparoscopically treat patients with previous malignant diseases, a history of more than 2 major abdominal surgeries, or both of these. As for peritonitis, concern exists that the CO_2 pneumoperitoneum may enhance bacteremia and endotoxemia due to the increased intraperitoneal pressure.[6] Only a few controversial data exist regarding this issue. In animal models of peritonitis, endotoxemia and the development of intraabdominal abscesses do not seem to be increased by CO_2 laparoscopy when compared with that in control laparotomy groups. Over the

past few years, an increasing number of reports[1-5] on the laparoscopic treatment of perforated appendicitis have shown favorable results. In our experience, we had only 1 case of postoperative pelvic collection in a girl operated on for perforated appendicitis **(Table 2)**. At the time of laparoscopy, the surgeon did not deem it useful to place a drainage tube, which could have been one of the causes of the observed complication.

Diagnostic Accuracy

The diagnostic accuracy of laparoscopy in our series was very high, which matches favorably with the 89% to 100% rate reported in the international literature.[2,3] The high diagnostic yield of laparoscopy is even greater if we consider all the concomitant diseases we found in patients without histology proven appendicitis (57.3% vs 8.8%, LA vs OA, respectively) **(Table 5)**. In agreement with other authors,[7] we always remove the appendix, even when it appears macroscopically normal. Histology revealed inflammation within the appendix wall in 24.6% of our patients with apparently normal appendices on gross inspection at laparoscopy. Furthermore, laparoscopy allows for a thorough exploration of the abdominal cavity and identification of concomitant diseases, such as Meckel's diverticulum. In our diagnostic laparoscopy experience, we operated on 3 cases of Meckel's diverticulum in patients who underwent prior laparotomy for acute appendicitis. A laparoscopic approach at the time of appendectomy might have spared them a second surgical procedure.

Treatment Options

Laparoscopy allows the undertaking of the same surgical procedures as those performed in open surgery, or even to schedule the appropriate medical therapy in the presence of concomitant diseases. The length of surgery is almost equal to that of open surgery, due to improvements in both equipment and the surgeon's learning curve, particularly when we consider the time spent for the treatment of diseases incidentally found on inspection of the abdominal cavity. The high teaching potential of this kind of minimally invasive procedure deserves full evaluation, as reported in the literature.[8] As in open surgery, appendectomy is the first surgical procedure to be performed by surgeons in training, and this usually costs time and money.

Conversion

In our experience, the most frequent causes of conversion were the presence of dense adhesions and obscure anatomy. Conversion should never be regarded as a defeat: even when forced to convert the procedure, a surgeon may choose the most appropriate incision to treat the patient.

Morbidity and Mortality

The results of our experience show the feasibility of laparoscopy for the treatment of suspected appendicitis with acceptable morbidity and mortality rates comparable to those reported for the open approach. The complications we observed occurred mainly at the beginning of our experience: a better patient selection and a surgeon with increased experience would undoubtedly lower the morbidity and mortality rates.

Hospital Stay

After laparoscopy, hospital stay is shorter, when compared with that in open controls, and patients experience a faster recovery.[2]

Costs

The advantage of laparoscopy does not consist only of cosmesis but also of a decrease in operative trauma.[2-4] This results in a reduced incidence of wound infections and incisional hernias. Therefore, although the exact economic impact of LA is difficult to assess, namely if direct costs (operating room occupancy, instrumentation, and others) are taken into account, earlier patient recovery and return to work should benefit the whole of society.[9] In computing the indirect costs of LA, diagnostic accuracy, the therapeutic potentials, the surgeon's training, and the reduced rate of long-term morbidity should also be evaluated. It has been reported in the literature[10] that women who underwent open appendectomy had an 80% risk of infertility and chronic abdominal pain compared with 10% for those treated laparoscopically.

CONCLUSIONS

Based on our experience in patients with suspected appendicitis, laparoscopy is feasible and effective. LA provides superior diagnostic accuracy as well as wider therapeutic potentials than does open surgery. Sparing

unnecessary laparotomies reduces postoperative pain, increases prompt recovery of gastrointestinal functions, shortens hospitalization, helps contain healthcare costs, and increases cosmesis. This approach appears to play a crucial role in the diagnostic and therapeutic algorithm for fertile women, obese patients, and in almost every abdominal emergency. On these grounds, we advocate wider adoption of laparoscopy and are confident it will become more important in common surgical practice.

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