

Laparoscopic versus Open Appendicectomy: A Comparative Study

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ABSTRACT

There are many questions regarding the advantages and disadvantages of a videolaparoscopic approach in the treatment of acute appendicitis. The authors present the results of a non-randomized, prospective study with 496 patients admitted between January 1992 and March 1998 by the General Surgery Service of São Rafael Hospital – Salvador – BA – Brazil. The patients were submitted for appendicectomy by video laparoscopy or by the traditional open method, and variables such as surgery duration, morbidity, mortality, costs, and length of stay (LOS) were compared. The results demonstrate that laparoscopic appendicectomy is a safe alternative for treatment of acute appendicitis; however, there are several disadvantages that gradually must be overcome.

Key Words: Appendicitis, Appendicectomy, Videolaparoscopy.

INTRODUCTION

Since it was first described by Semm¹ in 1983, laparoscopic appendicectomy has gained acceptance as a diagnostic and treatment method for acute appendicitis. Appendicitis constitutes a nosologic entity whose incidence is about 7%² in industrialized countries; a USA report shows approximately 300,000 cases/year, with the greatest incidence falling in the 2nd and 3rd life decade and with a rate of 3-4:1 among men and women during puberty. Even with a thorough clinical examination, it may be difficult to diagnose appendicitis. About 40%^{2,3} of cases of appendicitis are incorrectly diagnosed in women during their reproductive years, and approximately 20-30%^{2,3} of patients submitted to surgical interventions do not show any inflammatory alterations of the appendix.

Many surgeons have demonstrated that a videolaparoscopic approach (VLA) to acute appendicitis is possible during several stages of the inflammatory process, depending upon the surgeon's experience. There are absolute and relative contra-indications given by surgeons, which include previous operations on the lower abdomen and situations where a pneumoperitoneum may have deleterious hemodynamic effects.

As for traditional, or open, appendicectomy, some authors state that it is simple and efficient. Nonetheless, they omit data regarding morbidity and mortality of Davis and McBurney's technique.

Regarding questions concerning the advantages and disadvantages of a videolaparoscopic approach in the treatment of acute appendicitis, the authors propose establishing a comparative parallel study between videolaparoscopic and traditional appendicectomy, giving priority to duration of surgery, morbidity and mortality evaluation, costs and duration of hospitalization.

PATIENTS AND METHODS

Between January 1992 and March 1998, 496 patients were admitted by the General Surgery Service of São Rafael Hospital (Salvador City – Bahia State, Brazil) with signs and symptoms of acute appendicitis and with indi-

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cations for appendectomy. Of the 496 patients, 332 (66.9%) were submitted to the videolaparoscopic approach (Group 1); 164 (33.1%) to the traditional, or open, technique; and 18 (5.4%), initially to the videolaparoscopic technique, and a posteriori converted to the traditional technique (Group 2), due to the occurrence of adherences, necrosis of the appendix stump or hemodynamic instability. Patients whose status did not permit a videolaparoscopic procedure underwent open surgery.

The traditional (open) appendectomy technique involved utilizing a McBurney's incision or a para-rectal incision.

Videolaparoscopic surgery was performed with the patient in the dorsal decubitus position, slightly inclined to the left side, and securely bound to the operating table. Table positioning was utilized to facilitate abdominal retraction. The surgery staff was positioned on the patient's left side, while video equipment was positioned on the right. The videolaparoscopic technique utilized three trocars placed 1) in the umbilical region with a 10 mm optic. (After having acquired the 5 mm optics, we started using the 5 mm trocar.), 2) in the left-side fossa iliac (10 mm), and 3) 2 cm above the pubis (5 mm), after having initiated pneumoperitoneum with the aid of a Veress needle. The upper limit of induced intra-abdominal pressure was limited to 12 mm Hg.

After a general examination of the abdominal cavity, the tip of the cecal appendix was secured, and the mesoappendix was sectioned. The appendicular artery was secured by means of metal clips or bipolar scalpel. The appendix was sectioned between "endoloop" ties, two of the ties placed proximally near the base of the appendix, and a third on the distal part. Stump invagination was not performed. The appendix was deposited in an endobag or surgical glove when there was a possibility of rupture and extracted via a 10 mm trocar.

The studied variables were sex, age, signs and symptoms presented upon admission (preoperative), antibiotic therapy, position and aspect of the appendix, cavity drainage and surgery duration (intraoperative), time of presentation of flatulence and bowel sounds, postoperative complications, and postoperative length of stay.

Statistical analysis of the results obtained from this prospective, non-randomized study was done by means of Kruskal-Wallis and Mantel-Haenszel tests, considering a difference among values whose p is less than or equal

to 0.05 ($p \leq 0.05$), as statistically significant.

RESULTS

Among the 496 patients operated on, 251 (50.6%) were males and 245 (49.4%) were females, with a mean age of 29.8 years (**Table 1**).

If symptoms referred upon admission are taken into account, 41 patients (8.3%) presented with intestinal obstipation, 72 (14.5%) had diarrhea, 253 (51%) had a fever, and 313 (63.1%) had nausea and vomiting (**Table 2**). Blumberg's sign was present in 342 patients (69%); plastron was detected upon examination of 24 patients (4.8%), while 339 patients (68.3%) presented with a leucocyte count $>10,000$ (**Table 3**). As regards anaesthetic risk, utilizing the American Society of Anesthesiologists

Table 1.
VLA vs Open-Surgery: Sex and Age.

Age		VLA	OPEN
		07-75 (29 yrs)	12-82 (30 yrs)
Sex	Men	146 (44%)	105 (64%)
	Women	189 (56%)	59 (36%)

Table 2.
Symptoms Referred Upon Admission.

Symptoms	VLA	Open
Fever	114 (43.4%)	109 (66.5%)
Nausea and Vomiting	212 (63.9%)	101 (61.6%)
Diarrhea	43 (13%)	29 (17.7%)
Obstipation	25 (7.5%)	16 (9.8%)

Table 3.
Signs Found Upon Admission.

Signs	VLA	Open	p
Blumberg	208 (62.6%)	134 (81.7%)	0.0000159
Plastron	11 (3.31%)	13 (7.9%)	0.02428
Leucogram $>10,000$	210 (63.25%)	129 (78.66%)	0.00052

(ASA) criteria, 365 patients (80.8%) were ASA 1, 75 (16.6%) were classified as ASA 2, 11 (2.4%) patients were considered as ASA 3, and 1 case (0.2%) was ASA 4. **Table 4** shows the anaesthetic risk, taking into account both videolaparoscopic and traditional approaches.

The appendix was found in the subhepatic position in 5 cases (2.2%), in the iliac position in 10 cases (4.4%), in the pelvic position in 19 cases (8.5%), and in the fore (anterior) position in 22 cases (9.9%); it was retrocecal in 66 cases (29.4%) and internal lateral in 102 cases (45.5%) (**Table 5**). As regards anatomopathological aspects, 243 patients (50.5%) presented with an edematous appendicitis, 120 (24.9%) with a purulent appendicitis, 84 (17.5%) with necrosis of the appendix, and 34 (7.1%) with perforation. Fifteen cases were excluded as pathologic references were not made (**Table 6**). Drainage of the abdominal cavity was carried out in 30 patients (9%) belonging to Group 1 and in 43 patients (26.2%) belonging to Group 2, this difference being statistically significant ($p = 0.006$).

The average surgical time of videolaparoscopic appendectomy was 84.4 minutes, while the time referring for the traditional open procedure was 59 minutes. Antibiotic prophylaxis consisted of Mefoxin (2 g intravenously as a single dose at induction of anesthetic) and was utilized in 306 patients (92.2%) from Group 1 and in 153 patients (93.3%) from Group 2 (**Table 7**).

Postoperatively, 1.3 and 1.4 days were the average times required for the appearance of flatulence in patients submitted to appendectomy through videolaparoscopy and the open traditional method respectively. No statistically significant difference ($p = 0.78$) could be verified between the two values. From Group 1, 23 patients (6.9%) presented with postoperative complications (**Table 8**), while 30 patients (18.3%) from Group 2 presented with postoperative complications. Emphasis was given to abdominal wall infection, noted in three cases

Table 4.
VLA vs Open Surgery: Anaesthetic Risk.

RISK	VLA	OPEN	P
ASA 1	250 (87.7%)	115 (73.2%)	0.21836
ASA 2 – 4	82 (15.3%)	49 (26.8%)	0.21836

Table 5.
Positions of the Appendix.

	VLA	OPEN	p
Internal lateral	87	15	0.00000998
Retrocecal	45	21	0.81737528
Iliac	8	2	0.37546935
Pelvic	17	2	0.03339459
Subhepatic	4	1	0.53296125
Anterior	20	2	0.001458268

Table 6.
Anatomopathological Aspects of the Appendix.

	VLA	OPEN
Edematous	192 (59.1%)	51 (32.7%)
Purulent	76 (23.4%)	44 (28.2%)
Necrotic	40 (12.3%)	44 (28.2%)
Perforated	17 (5.2%)	17 (10.9%)

Table 7.
VLA vs Open surgery: Surgical Time and Antibiotic Prophylaxis.

	VLA	Open	p
Surgical Time	20 – 220 min 84.4 min	15 – 180 min 59 min	0.07979
Antibiotic Prophylaxis	306 (92.2%)	153 (93.3%)	0.6539923

Table 8.
Postoperative Complications.

Complications	VLA	Open
Atelectasy	3	2
Fever	5	10
Respiratory Infection	2	3
Respiratory Insufficiency	1	3
Urinary Tract Infection	7	1
Abscess	3	6
Eventration	0	1
Sepsis	1	4
Bleeding	1	0
Total	23 (6.9%)	30 (18.3%)

among patients submitted to the laparoscopic approach and in six cases among those submitted to the traditional procedure.

Finally, patients submitted to appendectomy through videolaparoscopy stayed in the hospital for an average of 3.9 days, while those submitted to the open procedure remained for an average of 5 days, the difference between these two values being statistically significant ($p = 0.006$).

DISCUSSION

The use of videolaparoscopy for treating acute appendicitis has gained acceptance after the development of laparoscopic cholecystectomy. Since 1983, when Semm¹ first described the laparoscopic removal of an appendix, a number of studies have been developed with the aim of clarifying the advantages and disadvantages of the laparoscopic surgical approach. In 1991, for example, Pier and colleagues,⁴ from Linnich, Germany, reported on 625 laparoscopic appendectomies performed in that year, showing excellent results. Zaninotto et al⁵ and Laine et al⁶ proved the advantage of using laparoscopy in female patients during their reproductive years. Comparing traditional appendectomy (open surgery) and the videolaparoscopic approach, several recent papers have identified areas of concern that included duration of the operation, length of hospitalization, global costs, as well as postoperative complications, with emphasis given to abdominal wall infection.

From our results described above, no statistically significant difference emerged relative to the age of patients submitted for videolaparoscopy or traditional open surgery. Most patients, either men or women, were able to undergo the videolaparoscopic procedure. As regards surgical risk, there was no significant difference between the appendectomized patients, be it through the laparoscopic procedure or the traditional method.

The conversion rate of laparoscopic appendectomy to laparotomy has averaged 9.3% (0 to 30.4%). Cox et al⁷ mention a 15% average, McAnena et al⁸ a 13.5% average, Schroder et al⁹ and Attwood et al¹⁰ a 7% conversion average. These conversions took place in situations when there was appendiceal perforation, perforation with fecal soilage, retrocecal appendix, unclear anatomy, presence of plastron, abscess and intraoperative bleeding. Our conversion rate was 5.4%, somewhat better than the aver-

age quoted in the literature. As laparoscopic experience has grown, the conversion rate has been noted to drop.

Considering the variable of "surgery duration," McAnena et al⁸ and Schroder et al⁹ demonstrated that there is no statistically significant difference between the duration of videolaparoscopic appendectomy and appendectomy performed through open surgery. Attwood et al¹⁰ showed that, on average, 51 minutes were needed to complete an open procedure, while 61 minutes were needed to complete the laparoscopic approach. Our results demonstrated that traditional surgery was faster (59 minutes) when compared to videolaparoscopy (84.4 minutes), with confirmation that a longer operative time is a disadvantage of the laparoscopic method. There is evidence in the literature suggesting that laparoscopic appendectomy reduces postoperative pain, since the trocar orifices are less traumatic than incisions with muscle division, and there is, therefore, a smaller amount of tissue trauma.¹¹ Our results also showed that postoperative complications of patients submitted to laparoscopic surgery are less frequent than with those submitted to open surgery. One should also point out that infection is significantly less,¹¹ due to lack of contamination to the abdominal wall. On the other hand, Richards et al¹² do not confirm a reduction of intra-abdominal abscesses in patients who have been submitted to videolaparoscopic appendectomy. For some authors,¹¹ laparoscopic appendectomy for perforated appendicitis was associated with an increase of abscess formation. We found a statistically significant reduction in the number of complications presented in patients belonging to Group 1 (6.9%), when compared to patients of Group 2 (18.3%).

Patients who underwent videolaparoscopic appendectomy typically had a shorter length of stay (3.9 days), according to our results. McAnena et al,⁸ Attwood et al,¹⁰ Ortega et al,¹¹ and Cox et al⁷ presented similar results in their work. On the other hand, Kum et al,¹³ Zaninotto et al,⁵ and Minne et al¹⁴ did not find any difference.

One limiting aspect of laparoscopic appendectomy is hospitalization costs. According to Fritts/Orlando,¹⁵ hospital costs for performing videolaparoscopic appendectomy are US\$6,711, while hospital costs for open surgery amount to only US\$6,369. Schroder et al state US\$6,213 and US\$8,683 as the respective costs for open versus laparoscopic appendectomy. In our area, hospital costs for performing open appendectomy are approximately US\$2,300, while those for the videolaparoscopic

approach correspond to approximately US\$2,915. Hospitalization costs seem to be somewhat higher for laparoscopic appendicectomy.

In short, we have demonstrated that laparoscopic appendicectomy is a safe alternative for treating acute appendicitis. Furthermore, it presents advantages such as a shorter hospitalization period and less morbidity, with a smaller rate of abdominal wall infection. Analyzing more recent studies, there is an indication that laparoscopy is becoming the first-choice method for management of acute appendicitis. For this reason, disadvantages such as longer duration of surgery, higher costs, as well as technical limitations must be overcome.

References:

1. Semm, K. Endoscopic appendicectomy. *Endoscopy*. 1983;15:59-64.
2. Adiss DG, Schaffer N, Fowler BS, et al. The epidemiology of appendectomy in the United States. *Am J Epidemiol*. 1990;132:910-925.
3. Whitworth CM, Whitworth PW, Sanfilippo J, et al. Value of diagnostic laparoscopy in young women with possible appendicitis. *Surg Gynecol Obstet*. 1988;167:187-190.
4. Pier A, Gotz F, Bacher C. Laparoscopic appendectomy in 625 cases: from innovation to routine. *Surg Laparosc Endosc*. 1991;1:8-13.
5. Zaninotto G, Rossi M, Anselmino M, et al. Laparoscopic versus conventional surgery for suspected appendicitis in women. *Surg Endosc*. 1995;9:337.
6. Laine S, Rantala A, Gullichsen R, et al. Laparoscopic appendectomy – is it worthwhile? A prospective, randomized study in young women. *Surg Endosc*. 1997;11:95.
7. Cox MR, McCall JL, Toouli J, et al. Prospective randomized comparison of open versus laparoscopic appendectomy in men. *World J Surgery*. 1996;20:263.
8. McAnena OJ, Austin O, Fitzpatrick J. Laparoscopic vs open appendectomy: a prospective evaluation. *Br J Surg*. 1992;79:818-820.
9. Schroder DM, Lathrop JC, Lloyd LR, et al. Laparoscopic appendectomy for acute appendicitis: is there really any benefit? *Am Surg*. 1993;59:541-547.
10. Attwood SEA, Hill DK, Stephens RB. A prospective randomized trial of laparoscopic versus open appendectomy. *Surgery*. 1992;112:497-501.
11. Miguel PR, Reusch M, Rosa ALM, Carlos JRCB. Appendicectomia Laparoscópica. *Rev Científica da SOBRACIL*. 1997;1.
12. Richards W, Watson D, Lynch G, et al. A review of the results of laparoscopic versus open appendectomy. *Surg Gynecol Obstetr*. 1993;177:473-480.
13. Kum CK, Ngoi SS, Goh PM, et al. Randomized controlled trial comparing laparoscopic and open appendicectomy. *Br J Surg*. 1993;80:1599.
14. Minne L, Varner D, Burnell A, et al. Laparoscopic vs open appendectomy. Prospective randomized study of outcomes. *Arch Surg*. 1997;132:708.
15. Fritts LL, Orlando R. Laparoscopic appendectomy: a safety and cost analysis. *Arch Surg*. 1993;128: 521-524.