Factors Leading to Long-Term Hospitalization After Laparoscopic Appendectomy

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ABSTRACT

Background: Randomized studies demonstrate that laparoscopic appendectomy yields better results compared with open techniques. We sought to identify factors that determine an extended hospital stay among patients undergoing laparoscopic appendectomy.

Methods: This was a prospective study including 669 patients undergoing laparoscopic appendectomy. We analyzed variables that can predict the length of hospital stay.

Results: Of 669 patients undergoing laparoscopic appendectomy, 141 stayed in the hospital for ≥5 days (Group 1), and 97 stayed in the hospital for ≥1 day after surgery (Group 2). The univariate analysis demonstrated that fever (P < 0.0001), nausea and vomiting (P = 0.060), leukocytosis (P < 0.0001), gangrened or perforated intraoperative appearance of the appendix (P < 0.0001), and appendix position behind the ileocecal junction (P < 0.001) were related to a longer hospital stay. The multivariate analysis through logistical regression showed that the factors independently and significantly associated with an extended hospital stay were presurgical fever, appendix position behind the ileocecal junction, and intraoperative gangrened or perforated appearance of the appendix.

Conclusion: Fever, appearance, and position of the appendix are factors related to an extended hospital stay.

Key Words: Appendectomy, Appendicitis, Laparoscopy, Length of stay, Surgical outcome data.

INTRODUCTION

The development of laparoscopic surgery has decreased the length of hospital stay and its costs. Several randomized studies have assessed and discussed the advantages and disadvantages of laparoscopic appendectomy compared with those of conventional surgery.1–5

Most of the analyses are based on comparative results between the laparoscopic and conventional accesses6–9 and classified as positive, when one procedure has more advantages, or negative, when no difference is evident between the procedures.7,8

Randomized studies had similar results for both techniques, but most showed positive results for the less invasive surgery. Positive results include shorter hospital stay, less postsurgical pain, and earlier return to routine activities.1,2,7,10,11

One of the main aspects analyzed in these studies was the length of hospital stay after appendectomy, comparing both techniques.6–9 Nevertheless, studies that could predict the length of hospital stay of patients who underwent laparoscopic appendectomy were not found.

We sought to identify factors that determined long-term hospital stay of patients undergoing laparoscopic appendectomy.

METHODS

A prospective study was conducted from August 1992 to July 2003 at the São Rafael Hospital – Monte Tabor Foundation, Salvador, Bahia, Brazil. All the patients underwent laparoscopic appendectomy, performed by the same medical team following standard techniques. Long-term hospital stay was defined as a hospitalization of 5 or more days after surgery.

The data obtained included age, sex, period of symptoms, evolution of symptoms measured in hours, American Society of Anesthesiologists (ASA) Classification grade, intraoperative appearance of the appendix, appendix position, as well as the occurrence of postsurgical fever (underarm temperature over 38°C), vomiting and nausea,
diarrhea, bowel obstruction, leukocytosis (over 12,000 white blood cells/mm$^3$), rebound tenderness, mass in the right iliac fossa, and previous abdominal surgery.

All patients signed an informed consent. The work was analyzed and approved by the hospital’s ethics committee.

**Statistical Analysis**

We used SPSS software for Windows (version 10.0) for statistical analysis. For the univariate analysis, the described variables were analyzed using the chi-square test or Fisher’s exact test, when appropriate. Continuous variables were analyzed with the Student t test. Data were accepted as statistically significant when $P<0.05$. An association between 2 category variables was considered when the confidence interval to the odds ratio did not include 1.0.

A logistical model was created including variables whose differences were significant at the 5% level and variables whose differences were close to statistical significance, $P<0.06$ (Table 1). The latter were considered significant from a pathophysiological or surgical point of view. Statistical significance was assumed when the comparison had a value of $P<0.05$.

**RESULTS**

During the study period, 669 patients underwent laparoscopic appendectomy. The patients were divided into 2 groups: those who stayed at the hospital for ≥5 days, 141 patients (Group 1), and those who stayed at the hospital for ≤1 day after surgery, 97 patients (Group 2). The patients who stayed at the hospital for 2, 3, or 4 days after surgery were excluded from the analysis because the objective of the study was to compare cases where patients had an early leave, defined as ≤1 day after surgery, with cases where patients stayed at the hospital for a prolonged time, ≥5 days after surgery.

In Group 1, 76 patients (53.9%) were females, and in Group 2, 43 (44.3%) were females ($P=0.187$). Patients from both groups were 30 years old on average (range, 7 to 80). We had only 8 patients under 18. The average length of hospital stay was 3.56 days (range, 1 to 17). The average length of symptom evolution was 48 hours (range, 2 to 192).

Fever was a symptom for 77 patients (54.6%) from Group 1 and 13 patients (13.4%) from Group 2 ($P<0.0001$). Symptoms such as nausea and vomiting were observed in 93 patients (66%) from Group 1 and 52 patients (53.6%) from Group 2 ($P=0.060$). Leukocytosis was seen in 98 patients (73.1%) from Group 1 and 47 (49%) patients from Group 2 ($P<0.0001$). The intraoperative appearance of the appendix was normal or edematous in 52 patients (37.1%) from Group 1 and 78 patients from Group 2 (84.4%). The appearance was purulent in 25 patients (17.9%) from Group 1 and 17 (17.5%) patients from Group 2. It was gangrened or perforated in 63 patients (45%) from Group 1 and 2 patients (2%) from Group 2, with $P<0.0001$ (Tables 2 and 3). Appendix position behind the ileocecal junction was present in 25 patients (18.5%) from Group 1 and 17 patients (18.4%) from Group 2 ($P<0.001$).

Statistical differences were found among the following analyzed variables: history of presurgical fever, presence of nausea and vomiting, leukocytosis, intraoperative appearance, and appendix position.

The multivariate analysis through logistic regression showed that presurgical fever as well as the position of the appendix behind the ileocecal junction and intraoperative gangrened or perforated appearance of the appendix

| Variable                  | Beta   | $P$     | Exp (B) | Lower | Upper  |
|---------------------------|--------|---------|---------|-------|--------|
| Fever                     | -1.8725| <0.0001 | 0.1537  | 2.5602| 14.9588|
| Vomit and nausea          | -0.512 | 0.8858  | 0.9501  | 0.4291| 1.9986 |
| Leukocytosis              | -0.6290| 0.0878  | 0.5331  | 0.5963| 2.9226 |
| Intraoperative aspect     | -1.1863| <0.0001 | 0.3053  | 2.1051| 7.1933 |
| Appendix position         | -0.3946| 0.0016  | 0.6739  | 1.0727| 1.8903 |
| Constant                  | 3.8246 | <0.0001 |         |       |        |
were independently and significantly associated with an extended hospital stay.

**DISCUSSION**

Although some controversial results can be found, prospective randomized studies comparing open and laparoscopic techniques for appendectomy have shown that the less invasive surgery reduces the length of hospital stay compared with the conventional technique.\(^7\)

The results presented in this study attempt to predict the length of hospital stay of patients who underwent solely laparoscopic appendectomy, based on pre- and intraoperative records. From the analyzed data, it can be observed that, despite a statistical difference in the univariate analysis, vomiting and nausea and leukocytosis did not have the same significance in the multivariate analysis of logistical regression. The differential white blood cell count was not analyzed. The presence of fever and the intraoperative appearance and position of the appendix are related to a longer period of hospital stay. These findings can be useful for the surgeon and patient in estimating the period of hospital stay.

Moreover, it has become increasingly important to predict the length of hospital stay of patients, especially with the recent tendency of package payments by private health insurance companies.

A possible criticism of this work is the fact that, once the surgeon knew that the intraoperative appearance of the appendix suggested a more advanced stage, he would instantly postpone the release for a few days. However, it would not be possible to conduct a blind study, in which the surgeon who released the patient was not the one who performed the surgery and did not know of the intraoperative appearance of the appendix.

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| Signs and Symptoms                          | Group 2 1 day or less | Group 1 5 or more days | \(P\)  |
|--------------------------------------------|----------------------|------------------------|-------|
| Female sex                                 | 43 (44.3%)           | 76 (53.9%)             | 0.187 |
| Fever                                      | 13 (13.4%)           | 77 (54.6%)             | <0.0001 |
| Vomiting and nausea                        | 52 (53.5%)           | 93 (66%)               | 0.060 |
| Diarrhea                                   | 18 (18.6%)           | 25 (18.0%)             | 1     |
| Bowel obstruction                          | 4 (4.2%)             | 13 (9.4%)              | 0.199 |
| Leukocytosis                               | 47 (49%)             | 98 (73.1%)             | <0.0001 |
| Rebound tenderness                         | 58 (60.4%)           | 86 (64.7%)             | 0.580 |
| Abdominal mass                             | 6 (6.4%)             | 17 (12.9%)             | 0.124 |
| ASA* classification 3 or 4                 | 0 (0%)               | 7 (5.3%)               | 0.021 |
| Previous abdominal surgery                 | 12 (12.4%)           | 22 (15.9%)             | 0.768 |
| Appearance of appendix (gangrenous or perforated) | 01 (01%)           | 31 (22%)               | <0.0001 |
| Appendix position (behind ileocecal junction) | 17 (18.4%)         | 25 (18.5%)             | <0.001 |
| Total                                      | 97                   | 141                    |       |

*American Society of Anesthesiologists Classification grading.

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| Length of Stay                          | Edematous | Purulent | Gangrenous | Perforated | Total  |
|-----------------------------------------|-----------|----------|------------|------------|--------|
| Group 2 ≤1 day after surgery            | 78 (80.4%)| 17 (17.5%)| 1 (1.0%)   | 1 (1%)     | 97 (100%)|
| Group 1 ≥5 after surgery                | 52 (37.1%)| 25 (17.9%)| 31 (22.1%) | 32 (22.9%) | 140 (100%)|
| Total                                   | 130 (54.9%)| 42 (17.7%)| 32 (13.5%) | 33 (13.9%) | 237     |
CONCLUSION
This study shows that a previous history of fever, gangrenous or perforated appearance of the appendix, and appendix position behind the ileocecal junction are factors related to an extended hospital stay (over 5 days) in patients who undergo laparoscopy appendectomy.

References:
1. Kazemier G, de Zeeuw GR, Lange JF, Hop WC, Bonjer HJ. Laparoscopic vs open appendectomy: A randomized clinical trial. Surg Endosc. 1997;11:336–340.
2. Long KH, Bannon MP, Zietlow SP, et al. A prospective randomized comparison of laparoscopic appendectomy with open appendectomy: clinical and economic analyses. Surgery. 2001;129:390–400.
3. Merhoff AM, Merhoff GC, Franklin ME. Laparoscopic versus open appendectomy. Am J Surg. 2000;179:375–378.
4. Naver LP, Kock JP, Bokmand S. Primary experiences with laparoscopic appendectomy [in Danish]. Ugeskr Laeger. 1994;156:3775–3777. [in Danish].
5. Nazzal M, Ali MA, Turfah F, et al. Laparoscopic appendectomy: a viable alternative approach. J Laparoendosc Adv Surg Tech A. 1997;7:1–6.
6. Anderson DG, Edelman DS. Laparoscopic appendectomy versus open appendectomy: a single institution study. JSLS. 1997;1:323–324.
7. Slim K, Pezet D, Chipponi J. Laparoscopic or open appendectomy? Critical review of randomized, controlled trials. Dis Colon Rectum. 1998;41:398–403.
8. Sosa JL, Sleeman D, McKenney MG, Dygert J, Yarish D, Martin L. A comparison of laparoscopic and traditional appendectomy. J Laparoendosc Surg. 1993;3:129–131.
9. Azaro EM, Amaral PC, Ettinger JE, et al. Laparoscopic versus open appendectomy: a comparative study. JSLS. 1999;3:279–283.
10. Ozmen MM, Zulfikaroglu B, Tanik A, Kale IT. Laparoscopic versus open appendectomy: prospective randomized trial. Surg Laparosc Endosc Percutan Tech. 1999;9:187–189.
11. Sauerland S, Lefering R, Holthausen U, Neugebauer EA. Laparoscopic vs conventional appendectomy—a meta-analysis of randomised controlled trials. Langenbecks Arch Surg. 1998;383:289–295.