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Laparoscopy reduces unnecessary appendicectomies and improves diagnosis in fertile women

A randomized study

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Abstract
Background: The aim of this study was to study the value of diagnostic laparoscopy prospectively in fertile women scheduled for acute appendectomy.
Methods: For this study, 110 women, with acute abdominal pain ages 15 to 47 years, in whom the surgeon had decided to perform an appendectomy, were randomized to either open appendectomy or diagnostic laparoscopy, then open appendectomy if necessary.
Results: Appendicitis was diagnosed in 66% of the women after open surgery, and in 73% after laparoscopy. During laparoscopy, was appendicitis misdiagnosed in only 7% of the women, from whom the appendix unnecessarily removed, whereas 34% in the open surgery group had a healthy appendix removed. No appendicitis was missed in the laparoscopic group. The relative risk of removing a healthy appendix in open surgery was 6.6 relative risk (range, 2–21 C.I.) as compared with laparoscopy. Among the women with a healthy appendix, a gynecologic diagnosis was found in 73% after laparoscopy, as compared with 17% after open surgery.
Conclusions: Laparoscopy reduces unnecessary appendectomies and improves diagnosis in fertile women.

Key words: Appendicitis — Fertile women — Laparoscopy

Appendectomy is one of the most common abdominal operations. It accounts for approximately 25% of hospital admissions, and more than 40% of all emergency laparotomies [1]. The lifetime risk of appendicitis is 8.6% for men and 6.7% for women, but the lifetime risk for appendectomy is 12% for men and 23% for women, indicating that the diagnosis is more difficult in women [1].

There are no reliable existing preoperative investigations to ensure the diagnosis of appendicitis, and the diagnostic accuracy is low. In a Swedish study of 3,000 patients, the diagnosis was correct in 79% of the men and 60% of the women [4]. When gynecologic and other abdominal disorders were taken into account, the rate of negative explorations in women younger than 60 years was more than double the rate in men [4]. The complication rate after open removal of a macroscopically normal appendix is 17% to 30% [12]. Late complications after appendectomy such as adhesions, ileus, and infertility have been reported but also questioned [2, 5, 9, 10]. Laparoscopy has been suggested to lower these complications [6]. The aim of this study was to study the value of diagnostic laparoscopy prospectively in fertile women scheduled for an acute appendectomy.

Materials and methods

Women ages 15 to 47 years with clinical signs of acute appendicitis were included in the study. Before randomization, the patients were examined by the surgeon on call, and also by the gynecologist. Patients with diffuse peritonitis or with suspicion of gynecologic disease or pregnancy were not included in the study. Other exclusion criteria ruled out women with severe adipositas, known intra-abdominal adhesions, and severe cardiovascular disease. Standard laboratory tests were performed on all patients. The surgeon decided whether the patient should be scheduled for appendectomy.

After admittance to the study, the patient was randomized by the anesthesiologic nurse either to open appendectomy or diagnostic laparoscopy. The randomization was performed by using sealed envelopes in blocks of 10 patients.

According to current routines, the appendix was removed from all women randomized to open surgery. In the case of a healthy appendix, the gynecologist was called, but the laparoscopy was performed by both the gynecologist and surgeon on call together. If the appendix was considered inflamed, or if it could not be visualized, the surgeon performed the ap-

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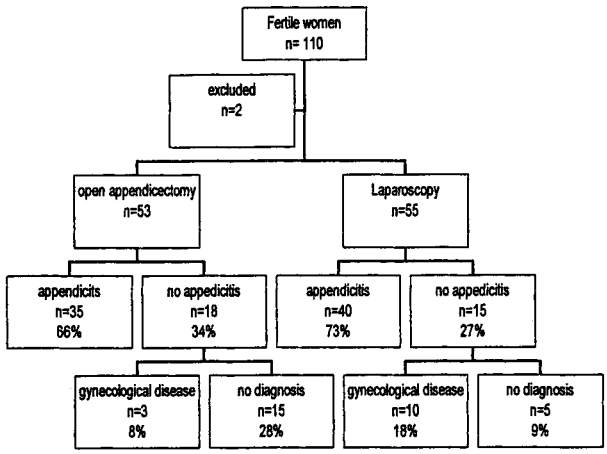

Fig. 1. Algorithm of study design and diagnosis comparing women who underwent open appendectomy or diagnostic laparoscopy.

pendectomy by the standard right lower quadrant incision. If the appendix was considered normal, it was left *in situ*. All patients received preoperative antibiotics with 1 g of metronidazole rectally. All the removed appendices were sent for pathologic examination.

Statistical analyses were performed by standard chi-square test, with the significance level set at a p value of 0.05. The relative risk was calculated with 95% confidence interval. The study was approved by the regional ethical committee.

Results

For this study, 110 women were randomized during 1991–1995. Two patients were excluded, one because of incomplete follow-up evaluation and another because of protocol violation, as she was scheduled for an explorative laparotomy regardless of the laparoscopic finding. Of the 108 remaining women, 53 were randomized for appendectomy by classical open surgery, and 55 were randomized to laparoscopy (Fig. 1). The groups were equal regarding age, fever, length of history, and white blood cell count (Table 1).

Findings showed that C-reactive protein was significantly increased in the laparoscopy group as compared with the open surgery group (65.9 vs 41.0 mean value of CRP, mg/liter; $p < 0.05$)). The accuracy in diagnosing appendicitis was 66% (35/53) in the open surgery group and 72% (40/55) in the laparoscopic group. In the laparoscopic group appendicitis was misdiagnosed in only four patients (7%), who had a healthy appendix removed, whereas 18 patients (34%) in the open surgery group had a healthy appendix removed. Regarding the four patients in the laparoscopy group that underwent an unnecessary appendectomy, one appendix could not be visualized during laparoscopy. The other three were suspected to be inflamed, but the pathologic examination showed otherwise. The relative risk of removing a healthy appendix in the open surgery group was 6.6 relative risk (range, 95% C.I. 2–21) as compared with the laparoscopic group.

Among the women with a healthy appendix, a gynecologic diagnosis was determined for 67% (10/15) in the laparoscopy group, as compared with 17% (3/18) in the open surgery group ($p < 0.01$). The gynecologic diagnoses were distributed in the two groups as follows: bleeding corpus luteum ($n = 2$), ovarian cyst ($n = 3$), endometriosis ($n = 2$), gynecologic infection ($n = 3$) in the laparoscopy group, and bleeding corpus luteum ($n = 1$) and ovarian cyst ($n = 2$) in the open surgery group. Only 9% (5/53) of the women in the laparoscopic group ended up without a specific diagnosis, whereas 28% (15/55) of the women in the open surgery group left the operation table without a specific diagnosis ($p < 0.05$).

Table 1. Background characteristics of the patients in the open surgery (appendectomy) and laparoscopy groups.

	Open surgery ($n = 53$) Mean ± SD	Laparoscopy ($n = 55$) Mean ± SD	Significance
Mean age	25 ± 8	24.9 ± 8.0	NS
Mean days of abdominal pain	1.9 ± 1.8	1.7 ± 1.1	NS
Mean body temperature	37.7 ± 0.6	37.9 ± 0.7	NS
Mean WBC	13.1 ± 3.7	12.8 ± 4.2	NS
Mean CRP	41 ± 35.6	65.9 ± 51.5	$p = 0.023$

SD, standard deviation; NS, not statistically significant; WBC, white blood cell count; CRP, C-reactive protein

Discussion

Appendicitis can be difficult to diagnose in fertile women. This study shows that laparoscopy reduces unnecessary appendectomies and improves diagnosis in fertile women. The rate of correct diagnosis in this study is comparable with both international and national studies [1, 4, 7, 8, 12]. Our findings are confirmed by a prospective nonrandomized study of 94 fertile women with suspected appendicitis. The rate of unnecessary appendectomies was substantially reduced as compared with historical data [11].

We chose to concentrate on women of fertile age because they have been supposed to benefit the most from laparoscopy with its possibility of a more accurate diagnosis. It is still controversial whether fertility is affected in young women undergoing an appendectomy. Some authors have described adhesions, ileus, and infertility [5, 9, 10], but the impact of appendectomy on fertility was questioned in a large Swedish retrospective study [2]. Fertility was studied in approximately 10,000 women who had been undergone surgery for appendicitis before the age of 15 years, and no negative fertility effects were found after appendectomy, as compared with controls. On the other hand, the consequences in terms of fertility could be catastrophic in the case of a missed appendicitis diagnosis [2].

The background characteristics were similar between the laparoscopy open appendectomy groups except C-reactive protein, which was significantly higher in the laparoscopy group than in the open surgery group, although it hardly represented any clinical significance, and the specific values were only slightly increased in both groups [3]. In five cases, the appendix could not be visualized during the laparoscopy. These five cases were among the first 25 laparoscopies and probably illustrate a learning curve. Four of these appendices were inflamed.

We found only two cases of mesenteric lymphadenitis in both groups. This diagnosis is often uncertain, and we added

our two cases to the "no diagnosis" group. Moberg et al. [8] found only a 1% incidence of mesenteric lymphadentitis in their recently publicized study of 1,043 patients who underwent diagnostic laparoscopy for suspected appendicitis [8]. It probably is more difficult to diagnose mesenteric lymphadenitis during laparoscopy than during open surgery because bimanual palpation of the glands is not possible.

Our study shows that we optimize the diagnosis of gynecologic disease in fertile women with suspected appendicitis when performing a diagnostic laparoscopy rather than the classical open procedure. Obviously, this is because laparoscopy affords a more complete vision of the deep pelvis. For this reason, endometriosis, especially, is more easily diagnosed during laparoscopy. Endometriosis is known to be associated with infertility. Because it is a treatable disease, the diagnosis might be of importance in young women.

In this study, both a gynecologist and a surgeon were present during the operations, mainly to improve the laparoscopic technique and the diagnosis of gynecologic diseases. This cooperation has developed into the creation of a laparoscopic unit at our hospital, and laparoscopic technique currently is routine in both the surgical and gynecologic departments. Doctors in both clinics are familiar with laparoscopic appendectomy. Our results justify the conclusion that women of fertile age with suspected appendicitis benefit from a diagnostic laparoscopy before appendectomy.

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