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A Study of Open Versus Laparoscopic Appendicectomy in Government Medical College

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Abstract
Objective: *The authors compare open and laparoscopic appendicectomy in a randomized fashion with regard to length of operation, complications, hospital stay, and recovery time.*
Methods: *Adult patients (older than 16 years of age) with the diagnosis of acute appendicitis were randomized to either open or laparoscopic appendicectomy from October 2013 to December 2016 in Government Medical College Bettiah. All patients received preoperative antibiotics. The operative time was calculated as beginning with the incision and ending when the wound was fully closed. Patients that were converted from laparoscopic to open appendicectomy were considered a separate group. Return to normal activity and work were determined by questioning during postoperative out-patients department (OPD).*
Results: *There was a total of 312 patients randomized, 162 to the open and 150 to the laparoscopic group. The groups were similar demographically. Of the 150 laparoscopic patients, 24 (16%) were converted to open. In the open group, 130 patients (80.24%) had acute appendicitis and 32 (19.75%) had perforative appendicitis. In the laparoscopic group, 115 patients (76.6%) had acute appendicitis and 18 (12%) had perforative appendicitis. There was no statistical difference in the return to activity or work between the laparoscopic and open groups. The operative time was significantly longer in the laparoscopic group (72.8 minutes vs. 55.4 minutes, $p < 0.01$). The hospital stay of 2.3 days in the laparoscopic group and 4.5 days in the open group was statistically different ($p = 0.007$). There was no difference in the hospital stay for those with acute appendicitis (1.95 days vs. 2.69 days, $p = 0.067$) compared with those with a normal appendix but with pelvic inflammatory disease (1.3 days vs. 2.1 days, $p = 0.11$). There was a significant difference in patients with perforative appendicitis (2days vs. 10 days, $p < O.01$). There were no increased complications associated with the laparoscopic technique.*
Conclusion: *Laparoscopic appendicectomy is comparable to open appendicectomy with regard to complications, hospital stay, return to activity, and return to work. There was a greater operative time involved with the laparoscopic technique. Laparoscopic appendicectomy does not offer any significant benefit over the open approach for the routine patient with appendicitis.*
Laparoscopic techniques have been used therapeutically for a variety of intra-abdominal problems and is accepted treatment for cholelithiasis. 3 It is surprising that the first reported laparoscopic appendicectomy was done in 1982 and the efficacy and indication for this procedure are still debated. . We undertook this prospective randomized evaluation of open versus laparoscopic appendicectomy to clarify the use of this technique.

Methods

Adult patients (older than 16 years of age) with the presumptive diagnosis of acute appendicitis were randomized to have surgery performed using the conventional open, or laparoscopic technique. Before randomization, patients were informed of the risks and benefits of each procedure and signed a consent form to participate in the study, which extended from October 2013 to December 2016. Appendicectomy performed during diagnostic laparoscopy for another indication and incidental appendicectomies were excluded.

All patients received 1 g of ceftriaxone preoperatively, and the antibiotics were continued based on the clinical course. Patients randomized to the open appendicectomy group had a McBurney or Grid-Iron right lower quadrant muscle splitting incision. Laparoscopic appendicectomies were done using a standardized approach involving an open technique for trocar insertion. A 10-mm Hassan trocar was placed in the periumbilical area with a 10-mm trocar placed in the right midabdomen and a 5-mm trocar placed in the suprapubic location. The mesoappendix was divided using Liga-Sure/ Bipolar cautery and the appendix was divided using an Endo-Loop The specimen was placed in glove and removed through the 10-mm port. The procedures were performed by the authors. Operative time was calculated from the time of incision until the time of wound closure and did not reflect the time required to set up the laparoscopic equipment.

Table 1 Patient Distribution

	Laparoscopic	Open
Male:female	1.5:1	1.6:1
Acute appendicitis (p = 0.38)	115 (76.6%)	130 (80.24%)
Perforated appendicitis (p = 0.08)	18(12%)	32 (19.75%)

The postoperative course was monitored for number of hospital days, use of antibiotics, and complications. For determination of when patients returned to normal activity and work, they were questioned during follow up OPD. Due to the nature of the patient population, some patients did not have conventional employment, and we used the time they returned to full-time work-related activity.

The data were analyzed using the Student's t test or analysis of variance. The actual probability value is reported unless it was less than 0.01, in which case it is reported as such. Statistical significance was determined to be a probability value less than 0.05.

Laparoscopic appendicectomy was converted to an open procedure in 24 patients (16%). In this group, fifteen patients had acute appendicitis, seven patients had perforative appendicitis, and two patients had a normal appendix with evidence of pelvic inflammatory disease. The reasons for conversion to an open procedure included inadequate exposure secondary to adhesions in nineteen patients (79%), inadequate exposure due to perforation in three patients (12.5%), and excessive bleeding due to inflammation in two patients (8 .4%), which included the patient with a normal appendix and pelvic inflammatory disease.

The results for the laparoscopic and open groups are Summarized in Table 2. The mean operative time in the open appendicectomy group was 55.4 minutes; for the laparoscopic group, 72.8 minutes ($p < 0.01$). The converted patients required 92.8 minutes for the completion of surgery, and when these patients are considered as a separate group, the time of laparoscopic appendicectomy is 76 minutes ($p < 0.01$ compared with the open group). The overall hospital stay was 4.13 days in the open group and 2 .3 5 days in the total laparoscopic group ($p < 0.01$).

Table 2 Comparison of All Laparascopic Patients and Open Patients

	Laparoscopic	Open	pValue
No. of patients	150	162	
OR minutes	72.8	55.4	0.0002
Hospital days	02.35	4.13	0.0007
Days to normal activity	12.6	13.2	0.92
Days to work	22.8	23.2	0.99

However, when the converted laparoscopic patients are excluded, the length of stay for the patients who underwent the complete

laparoscopic procedure was 1.94 days ($p < 0.01$). The converted patients had a length of stay of 4.5 days, which is similar to that of the patients having an open appendicectomies. When the open and laparoscopic groups are divided into subsets based on disease, the advantage in terms of early discharge is lost for those patients who had acute appendicitis or a normal appendix (Tables 3 and 4). The operative times were longer in the laparoscopic group with acute appendicitis than in the open group ($p = 0.007$). The mean hospital stay of 1.95 days in the laparoscopic group and 2.69 days in the open group was not statistically different ($p = 0.067$). Considering those patients who had a perforated appendix (Table 5), there was no difference in operating time, but the hospital stay was significantly shorter in the laparoscopic group, 2.5 *versus* 10 days ($p < 0.01$). Those patients who had their perforated appendix removed laparoscopically also received fewer days of antibiotics than those who had an open appendicectomy: 1.3 days *versus* 7.3 days ($p < 0.01$). There were no significant differences between the patients in the laparoscopic and open groups regarding time required for return to normal activity (12.6days *vs.*13.2 days) or work (22.8 days *vs.* 23.2 days) overall or in any of the groups based on pathology except for return to activity in those patients with a normal appendix (10.1 days *vs.* 16.7 days, $p = 0.02$).

Table 3 Patients with Acute Appendicitis

	Laparoscopic	Open	pValue
OR minutes	71.6	52.4	0.007
Hospital days	1.95	02.69	0.067
Antibiotic days	01.21	02.26	0.34
Days to normal activity	12.6	13.2	0.18
Days to work	21.8	23.2	0.5

Table 4 Patients with A Normal Appendix

	Laparoscopic	Open	pValue
OR minutes	65.4	50.4	0.23
Hospital days	1.3	02.1	0.11
Antibiotic days	0.67	01.2	0.28
Days to normal activity	10.1	16.7	0.02
Days to work	20.2	27.2	0.09

There was one intraoperative complication in the laparoscopic group involving an abdominal well hematoma at the site of a 5- mm trocar port, which was treated conservatively. There were ten readmissions in the open group and nine in the laparoscopic group, an average of 4.2 days and 8. 7 days after discharge, respectively. One patient in the laparo- scopic converted group was readmitted 6 days after discharge. Cause for readmission was nausea or inability to tolerate a diet for five patients and for a total of 15 infectious complications in both groups. Wound infections occurred in six open and three laparoscopic patients, and intra-abdominal abscesses occurred in three open and three laparoscopic patients (p = NS). Each of the intraabdominal abscesses was treated successfully by percutaneous drainage, except for one pelvic abscess in a patient who had an open perforated appendix and underwent transrectal drainage without complication. There were no deaths in either the open or the laparoscopic group.

Table 5 Patients with Perforated Appendicitis Laparoscopic Open p value

	Laparoscopic	Open	pValue
OR minutes	872	67.6	0.13
Hospital days	01.5	09.5	0.00004
Antibiotic days	01.3	07.3	0.00008
Days to normal activity	13.5	07.6	0.43
Days to work	24	21.8	0.77

Discussion

Despite the success of conventional appendicectomy, there have been numerous attempts to improve the diagnostic accuracy and outcome of patients with acute appendicitis, because the negative appendicectomy rate in most series is still in the range of 20% to 30%. [14] Additionally, the recovery time after an open appendicectomy can be significant. Initially, laparoscopy was used as a diagnostic tool to decrease the rate of negative appendicectomy while minimizing complications. The surgical technique for laparoscopic appendicectomy is

now well described, and several methods have been developed.

These involve a 3- or 4-trocar technique, and the base of the appendix can be divided by intracorporeal or extracorporeal suturing, Endoloop placement, clip application, or stapling device. We undertook this prospective randomized study to evaluate the time of operation, hospital stay, return to activity and work, and incidence of complications. There was no statistical difference between the open and laparoscopic patients. We had a 16% rate of conversion from laparoscopic to open procedure during the study. This seems excessive when compared with the results of Pier et al., [9] who reviewed 625 laparoscopic appendectomies in 678 patients with presumptive appendicitis, with 2% requiring conversion to an open procedure. However, others have documented higher conversion rates. Richards et al." had a conversion rate of 11 % due to inability of the surgeon to dissect the appendix, and Scott-Conner et al. [22] reported 16 patients undergoing laparoscopic appendicectomy, with success in 12 patients and 2 patients (12.5%) undergoing conversion to open for bleeding or perforation. Although the rate of conversion to an open procedure contributes to the increased costs often associated with laparoscopic surgery, the safety of the procedure is of paramount importance. In our series, there was only one intraoperative complication in the laparoscopic group, and this was not due to dissection in the area of the appendix, but rather to trocar insertion.The mean operative time in the laparoscopic group was significantly longer than in patients undergoing an open procedure (72.8 *vs.* 55.4 minutes). This is much longer than the reported operative times of 15 to 20 minutes.[9] However, this is comparable to the results of Frazee et al., [23] who found an operative time of 87 minutes for the laparoscopic patients and 65 minutes for the open patients, which was statistically significant in their study. In our series, all operations were performed by authors. There was no difference in the staffing between the open and laparoscopic cases, so the times are probably comparable. [24]

Schirmer et al. [25] reviewed 122 nonrandomized patients who had either diagnostic laparoscopy and open appendicectomy or laparoscopic appendicectomy and found no difference in hospital stay, mortality, complications, between the two procedures. They concluded that a randomized study would be needed to avoid selection bias, because their study did not show any significant benefit to laparoscopic appendicectomy over the open procedure.

Nowzaradan et al. [10] reviewed 43 patients with suspected appendicitis without perforation who had laparoscopic appendicectomy and found that they had less postoperative pain, a shorter hospital stay, a faster return to activity, a lower morbidity rate, and a better cosmetic result that those who had an open appendicecctomy during the same time period. However, those patients with perforative appendicitis were excluded from the laparoscopic group, and this undoubtedly influenced the outcome.

Ortega et al. [26] reviewed 253 patients randomized to three groups to compare laparoscopic and open appendicectomy. They concluded that laparoscopic appendicectomy produced less pain and more rapid return to normal activity (9 vs. 14 days, $p < 0.001$) and required a shorter hospital stay (2.16 days *vs.* 2.83 days when the appendix was stapled, $p < 0.05$). Our results showed a significant overall decrease in the number of hospital days in patients who underwent a laparoscopic appendicectomy. However, when the groups were examined based only on the patients who had acute appendicitis or a normal appendix, there was no statistical difference,

whereas the patients with perforated appendices were discharged significantly earlier in the laparoscopic group. The open perforated patients received a much longer course of postoperative antibiotics than did the laparoscopic patients (7.3 days *vs.* 1. 3 days, $p < 0.01$), which has been found by others to account for increased length of stay in open appendicectomy patients.[17] Additionally, those patients who had a laparoscopic appendice-ctomy and perforation may have had less inflammation than those having an open procedure. When the lengths of stay in other studies are examined based on the pathologic findings, the differences may not be as significant as when the total group is analyzed. Although others[23] have shown a more rapid return to normal activity and work after laparoscopic appendicectomy compared with open appendicectomy, our data did not support this. The mean time to return to normal activity was between 1 and 2 weeks in both groups. These results are similar to those reported for laparoscopic appendicectomy, [23] but the patients who had an open procedure seemed to return to activity more rapidly (12.8 days) than reported.

In the study by Frazee et al.,[23] the patients in the open appendicectomy group required 25 days to return to full activity. Also, the patients in both groups reported returning to work after approximately the same time period. This is similar to a report by Richards et al., who were unable to measure any advantage regarding return to physical activity after laparoscopic appendicectomy.[21]There was one intra-operative complication in the laparoscopic group involving trocar insertion and an abdominal wall hematoma. Gaining access to the abdominal cavity is the most common time for complications to occur during laparoscopic surgery.[27] For this reason we have used the open technique exclusively and visualize each trocar during insertion. There were no other intraoperative complications in this group. The rate of readmission to the hospital was equal in the open and laparoscopic groups, with wound infection or intra-abdominal abscess being the predominant reason. There were three intra-abdominal abscesses in each group, and although there were six wound infections in the open group and three in the laparoscopic group, this was not a significant difference. The rate of intra-abdominal abscesses is thought to be roughly equal for both laparoscopic and open procedures. [9] However, Bonanni et al. [28] found that in patients undergoing laparoscopic appendicectomy with perforation, 45.5% required readmission to the hospital for infectious complications *versus* only 3% in the open group. The readmission rate overall was 10.6% in the laparoscopic group and 1 % in the open group. The reasons for readmission in the laparoscopic group were pelvic abscess in four patients, and also included one phlegmon, one hepatic abscess, and one patient with urinary retention. In the open group, there were two cases of pelvic abscess and one case of deep vein thrombosis.

Additionally, Ortega et al.[26] noted six intra abdominal abscesses in laparoscopic and 0 in open appendicectomy patients (p = NS), although wound infections were more common among open appendicectomy patients (11 *vs.* 4),($p < 0.05$). The researchers believed that this may be a major advantage of the laparoscopic technique. Others have found that the rate of wound infection after laparoscopic appendicectomy is low compared with that of the open procedure. [9 29] In the technical part of the laparoscopic procedure, incidence of wound infection can be reduced by placing the appendix in a bag or drawing it into the trocar for removal and not allowing the specimen to remain in contact with the wound.

Laparoscopic appendicectomy can be performed with similar morbidity to open appendicectomy

and may actually have a decreased wound infection rate. However, in the routine patient with the clinical diagnosis of acute appendicitis, it does not seem to offer any maor advantages. The length of hospital stay is decreased over the open procedure when all patients are considered together, but when the patients are stratified according to pathologic findings, these differences do not seem to be significant. Additionally, the operative time is increased with laparoscopic appendicectomy, and there is no benefit regarding hospital cost. Further, the time required for full physical recovery did not appear to be different. In the patients with vague clinical findings, especially women of child-bearing age or obese patients, diagnostic laparoscopy may be useful, but based on our findings; we cannot recommend this procedure routinely.

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