

Specialty Versus Generalist Care of Children With Appendicitis: An Outcome Comparison

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Background/Purpose: Some Health Maintenance Organizations (HMO) limit access of their members to specialists to lower costs. The purpose of this study is to determine whether this policy affects the outcome of children with appendicitis.

Methods: At a large academic medical center, children 17 years or younger with appendicitis were treated either by an HMO Adult General Surgical Service (group A) or a Pediatric Surgical Service (group B). Board certified pediatric surgeons were not available on the HMO surgical service. Anesthesia, surgical residents, nursing, and ancillary support services were identical in both groups. Study parameters included imaging tests performed, operation type, complications, readmissions, and length of stay. Results were analyzed using χ^2 and Fischer's Exact tests.

Results: One-hundred seventy-five consecutive children underwent appendectomy, 96 in group A and 79 in group B. In patients with simple acute appendicitis, there was no signif-

icant difference between group A and group B for complications, readmissions, second operation, or length of stay. In patients with gangrenous or perforated appendicitis there was a significant difference between group A and group B for type of operation (laparoscopic appendectomy, group A, 4 of 27 v group B, 0 of 34; $P = .04$); complications (group A, 9 of 27 v group B, 3 of 34; $P = .025$); readmissions (group A, 6 of 27 v group B, 0 of 34; $P = .001$); second operation (group A, 6 of 27 v group B, 2 of 34; $P = .001$); and mean total length of stay in days (group A, 8.6 of 27 v group B, 5.4 of 34; $P = .05$).

Conclusions: Children with significantly perforated appendicitis have lower complication rates and shorter lengths of hospital stay when treated by pediatric surgeons as compared with HMO adult general surgeons.

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INDEX WORDS: Appendicitis, managed care, outcome study.

APPENDECTOMY for acute appendicitis is the most common abdominal operation performed in children. Each year an estimated 81,000 primary appendectomies are performed in children 0 to 14 years of age in the United States,^{1,2} with perforation rates ranging between 25% to 50%.^{1,2} Many of these procedures are not performed by pediatric surgeons. In fact, the growth of managed care has resulted in a shift of patient referrals away from pediatric surgeons in some areas of the country. The impetus for this has been the assumption by managed care providers that restricting patient access to pediatric surgical specialty care may lower costs without compromising quality of healthcare. The object of this study is to assess the validity of this assumption in children with appendicitis.

MATERIALS AND METHODS

We reviewed the records and conducted a telephone survey of 175 consecutive children 17 years of age or less who underwent emergency

appendectomy at The Cleveland Clinic Foundation and affiliate hospitals between March 1994 and December 1997. In January 1994, this hospital system contracted with a large, regional HMO to provide the use of its facility and basic services at a discounted rate. By agreement, the HMO retains its own adult general surgical staff, which provides service to its entire membership. Consequently, children with appendicitis who are in this HMO are treated by HMO surgical staff. Whereas all other children with appendicitis, including those insured by Medicaid or third-party payer, are treated by a separate Cleveland Clinic pediatric surgical staff.

The HMO surgical staff is comprised of 6 board-certified adult general surgeons each with greater than 5 years of experience (3 of these surgeons have more than 15 years of experience). During the study period, 96 children were referred directly to the HMO surgical staff who provided all of their surgical care (group A). By contrast, the pediatric surgical staff is comprised of 3 board certified pediatric surgeons with a minimum of 2 years of experience. Seventy-nine patients were referred directly to the pediatric surgical staff who provided all of their surgical care (group B). Both groups of patients underwent anesthesia by the same groups of pediatric anesthesiologists and received care on the same pediatric hospital floor by the same nursing staff and surgical residents.

Treatment of group A patients was individualized according to surgeon's preference. These patients were treated using a variety of surgical techniques, judgment, and antibiotic regimens that could not be satisfactorily categorized. Treatment of group B patients also was individualized; however, several guidelines generally were followed. In group B, all patients received preoperative intravenous antibiotics (cefazolin) that were converted to combination antibiotics (ampicillin, gentamycin, and clindamycin or zoasyn) if the appendix was found to be gangrenous or perforated. The appendix was removed by retrograde dissection through a short, transverse right lower quadrant incision, or

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by using 3-port laparoscopic technique. The appendiceal stump usually was left without inversion. In cases of gangrenous or perforated appendicitis, cultures were taken routinely, and copious normal saline lavage was used until the effluent was clear. The wound was irrigated with saline and closed primarily with interrupted subcuticular absorbable sutures. No drains were used unless a well-defined abscess cavity was found. Antibiotics were continued for 2 doses postoperatively for a normal appendix or simple acute appendicitis. Antibiotics were continued 3 to 5 days postoperatively for gangrenous or perforated appendicitis or until the following criteria were met: (1) the patient was afebrile, (2) the wound was healing without signs of infection, and (3) the ileus had resolved. In patients with gangrenous or perforated appendicitis, oral antibiotics based on culture results were prescribed to complete a 7- to 10-day course.

Data were collected for 175 patients: 96 patients in group A and 79 patients in group B. Groups were analyzed and compared taking into account the relative risk of complications in patients with simple acute appendicitis versus gangrenous or perforated appendicitis. Study parameters include imaging tests performed, operation type, complications, readmissions, and total length of stay.

Descriptive statistics were presented as means and ranges for continuous variables and as frequencies and percentages for categorical variables. Groups were compared using *t* tests, χ^2 tests and Fisher's Exact tests, as appropriate. Results were considered statistically significant at an alpha level of .05.

RESULTS

Emergency appendectomy was performed in 175 children with 100% survival rate. The mean age in group A was 13 years (range, 3 to 17 years) and in group B was 11 years (range, 1 to 17 years; *P* < .001). Sixty-five of 96 (68%) patients in group A were boys; and 48 of 79 (61%) patients in group B were boys (*P* value, not significant). Nine of 79 (11%) patients in group B had Medicaid insurance.

Mean duration of symptoms in group A was 1.8 days (range, 1 to 30 days) for acute simple appendicitis and 4.8 days (range, 1 to 30 days) for gangrenous or perforated appendicitis. Mean duration of symptoms in group B was 1.7 days (range, 1 to 10 days) for acute simple appendicitis and 3.0 days (range, 1 to 8 days) for gangrenous or perforate appendicitis. There was no significant difference between the 2 groups for duration of symptoms.

There were fewer patients with gangrenous or perforated appendicitis in group A compared with Group B. In Group A, 69 of 96 (72%) patients had simple acute appendicitis, and 27 of 96 (28%) patients had gangrenous or perforated appendicitis. In group B, 45 of 79 (57%) of patients had simple acute appendicitis, and 34 of 79 (43%) of patients had gangrenous or perforated appendicitis (*P* = .039).

Appendicitis was misdiagnosed in 3 of 96 (3%) patients in group A, and 2 of 79 (2.5%) patients in group B (*P* value, not significant). In group A, 2 of the 3 patients who had a misdiagnosis were found to have Meckel's diverticulitis, and 1 was found to have a histologically normal appendix. In group B, 1 patient whose disease

Table 1. Summary of Complications

	Group A (n = 69)	Group B (n = 45)	
Nonperforated			
Wound infection	0	1	
Intra-abdominal abscess	0	0	
Small bowel obstruction	0	0	
Other	0	0	<i>P</i> = NS
	n = 27	n = 34	
Perforated			
Wound infection	1	2	
Intraabdominal abscess	3	1	
Small bowel obstruction	4	0	
Other	1	0	<i>P</i> = .025

was misdiagnosed was found to have Meckel's diverticulitis, and 1 was found to have a jejunal perforation.

Imaging studies including ultrasound scan and computed tomography (CT) scan were used in both groups A and B. Overall, 19 of 96 (19%) patients in group A underwent ultrasound or CT scan, compared with 13 of 79 (16%) in group B (*P* value, not significant).

The most common type of operation was traditional open appendectomy performed in 164 of 175 (94%) patients overall. Of the remaining 11 patients who underwent laparoscopic appendectomy, 10 of 96 (10%) were in group A and 1 of 79 (1%) patients was in group B (*P* = .01). In group A, 6 of 10 patients who underwent laparoscopic appendectomy had simple acute appendicitis and 4 others had gangrenous or perforated appendicitis. The 1 patient in group B who underwent laparoscopic appendectomy had simple acute appendicitis.

Interval appendectomy was performed in several patients with perforated appendicitis after percutaneous drainage and intravenous antibiotics (group A, 4 patients), or a course of intravenous antibiotics alone (group B, 2 patients).

Overall, in group A, 9 of 96 (9%) patients incurred complications and in group B, 4 of 79 (5%; *P* = .28; Table 1). In patients with gangrenous or perforated appendicitis, 9 of 27 (33%) patients in group A had complications versus 3 of 34 (8%) patients in group B (*P* = .025). Six of 9 patients in Group A required readmission to the hospital versus 1 of 4 patients in group B (*P* = .001; Fig 1). In addition, 6 of 9 patients in group A required reexploration laparotomy, including 4 who underwent enterolysis (one who required ileal resection for traumatic injury to the bowel) and 2 others who underwent drainage of an intraabdominal abscess (including one who also required repair of fascial dehiscence). In group B, one patient required operative drainage of a subfascial wound abscess, and one underwent CT-guided percutaneous drainage of a postoperative intraabdominal abscess.

Laparoscopic appendectomy did not confer a higher

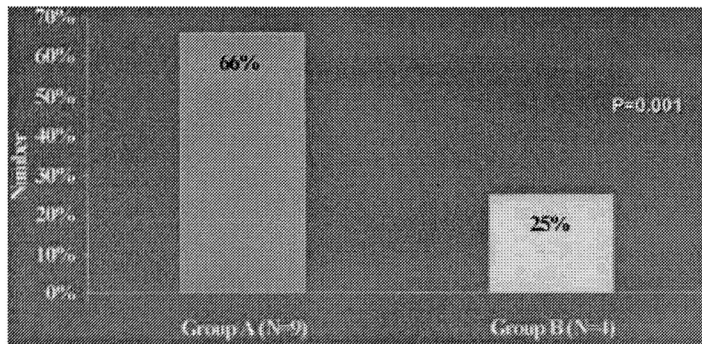


Fig 1. Percent hospital readmissions for patients with perforated appendicitis was significantly lower in group B.

risk of complications overall. In group A, only 1 of 10 (10%) patients who underwent laparoscopic surgery had a complication. This patient had a recurrent abscess and small bowel obstruction after laparoscopic drainage of a periappendiceal abscess. In group B, the one patient who underwent laparoscopic appendectomy incurred no complications.

Mean length of stay for acute simple appendicitis was 1.7 days (range, 1 to 6) in group A and 2.1 days (range, 1 to 8) in group B (P value, not significant; Fig 2). Mean total length of stay for a perforated appendicitis was 8.6 days (range 1 to 31) in group A and 5.4 days (range, 1 to 20) in group B ($P = .05$). Mean *total* length of stay for patients who underwent interval appendectomy was 9.5 days (range, 9 to 10) in group A and 7.5 days (range, 7 to 18) in group B ($P = .05$).

DISCUSSION

The treatment of children with appendicitis can be difficult and challenging. The clinical presentation of these patients often is atypical; further, there may be difficulties with communication and interpretation of physical findings.³ Children respond to abdominal infections differently than adults. Also, children are at higher risk than adults for perforation, with perforation rates in children ranging from 25% to 50%² and are thus more likely than adults to incur infectious complications after appendectomy.

Nonetheless, the published outcome of appendicitis in children has improved steadily because of advances in surgical technique, antibiotic therapy, and diagnostic imaging. Pediatric surgeons have reported infectious complication rates approaching 0% in children with acute simple appendicitis⁴ and 1% to 8% for patients with perforated appendicitis.⁵⁻¹⁰ Controversy still exists regarding specific management schemes such as timing and modality of surgery, choice of antibiotics, use of drains, and wound closure. Yet, by virtue of their training and experience, pediatric surgeons have assumed a leading role in the treatment of children with appendicitis.

At the same time, new healthcare delivery systems

have emerged in the United States that place a premium on cost-effective care. The value of specialty care is being questioned, and some HMOs have restricted patient access to specialty care to lower costs. In some areas of the country, this policy has prevented children with appendicitis from receiving care from pediatric surgeons. Despite these trends, there are no studies that compare the outcome of specialty versus generalist care in children. In particular, appendicitis is a common pediatric problem that may be treated by both pediatric surgeons and adult general surgeons depending on referral patterns or availability.

This study affirms the added value provided by pediatric surgeons to the care of children with perforated appendicitis. Although the study showed no difference in outcome between groups for simple appendicitis, children with perforated appendicitis had significantly fewer postoperative complications, readmissions, second operations, and a shorter mean total length of stay when treated by pediatric surgeons compared with HMO adult general surgeons. Anesthesia, resident, and nursing care were the same for both groups, leaving surgical expertise as the most likely explanation for this difference in outcome.

Surgical expertise is difficult to quantify, and encompasses such factors as training, experience, judgment, and technical ability as well as the application of protocols (or lack thereof) affecting choice of antibiotics, use of irrigation and drains, and techniques of wound closure. Although costs were not measured in this study, considering the large proportion of children at risk in this study and nationwide it is presumed that significant savings could be achieved if pediatric surgeons were permitted to care for these patients.

Similar to previous reports,^{11,12} the current study finds that HMO patients do not incur a higher risk of perforation than patients with indemnity insurance. This finding is contrary to another study from this region that suggested that "gatekeeper" controls may lead to delays in treatment and increased risk of perforation.¹³ In the current study, patients in the pediatric surgical group had

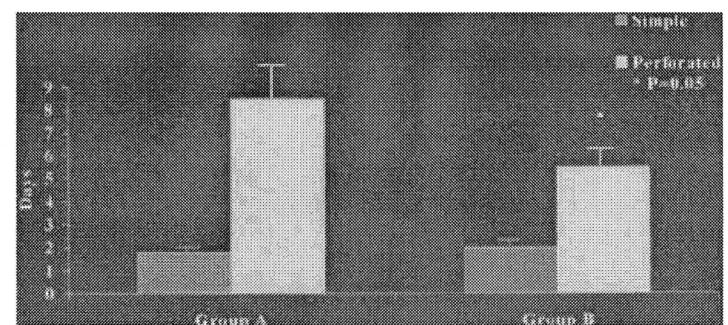


Fig 2. Length of hospital stay was equivalent between groups for simple appendicitis and significantly lower in group B for perforated appendicitis.

a significantly higher perforation rate than those in the managed care group. Possible explanations for this include: (1) a significantly lower mean age in the pediatric surgical group compared with the HMO group and (2) an 11% proportion of Medicaid patients in the pediatric surgical group. Both of these are known to be important risk factors for perforation related to the duration of symptoms.^{11,12,14} However, it is important to note that the mean duration of symptoms was not significantly different between the 2 groups in this study. Further, the fact that there were significantly fewer patients with perforation in the HMO group makes these findings all the more striking.

Although laparoscopic appendectomy was performed in a significantly larger number of patients of the HMO group compared with the pediatric surgical group, this did not appear to affect overall complication rate. In the managed care group, there was only 1 complication in 10 patients (10%) who underwent laparoscopic appendectomy. However, this complication did occur in 1 of the 4 patients (25%) in the HMO group who underwent laparoscopic appendectomy for perforated appendicitis. This is consistent with other studies that have shown a higher

rate of complications in pediatric patients who undergo laparoscopic appendectomy for complicated appendicitis.¹⁵ Not enough laparoscopic appendectomies were performed in the pediatric surgical group to permit a comparison of outcome between these 2 groups.

Finally, the overall outcome of children in the pediatric surgical group validates the protocol used in group B of this study. We have found that drains are not necessary for the treatment of gangrenous or perforated appendicitis unless a well-defined abscess cavity is present. In patients with both simple acute and gangrenous or perforated appendicitis, primary wound closure with subcuticular sutures is attended by a very low rate of wound infection. In addition, once the patient is afebrile, the wound is healing without signs of infection, and the ileus is resolved, the child may be discharged on oral antibiotics guided by intraoperative cultures with an extremely low risk of readmission.

This study shows that children with perforated appendicitis incur significantly fewer complications and a shorter length of hospital stay when managed by pediatric surgeons as compared with HMO adult general surgeons.

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