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Laparoscopic versus open appendectomy in children: the effect of surgical technique on healthcare costs

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Abstract

BACKGROUND: Reducing healthcare costs while maintaining quality of care is one of the challenges of the current healthcare system. The purpose of this study was to compare the hospital charges accrued following laparoscopic (LA) and open (OA) appendectomies in the pediatric population.

METHODS: We retrospectively reviewed all pediatric appendectomies (n = 264) performed from 2007 to 2013 at a single academic center. Subgroup analysis on charges and costs was performed on perforated and nonperforated LA and OA.

RESULTS: A total of 195 (73.9%) appendectomies were performed laparoscopically. LA in both perforated and nonperforated groups was associated with higher surgical supply, operating room, and total hospital charges compared with OA. Surgical supply costs to the facility were higher by an average of $1,000 for both nonperforated and perforated appendicitis in the LA group. Length of stay and postoperative complications were comparable within all groups.

CONCLUSIONS: In this study, LA is associated with significantly higher surgical costs and charges than OA without improvement in outcomes. Investigation into cost reduction strategies of laparoscopy should be a component of future clinical appendicitis research.

Appendectomy is the most commonly performed procedure in children, accounting for more than 250,000 annual cases in the United States.[1] Open appendectomy (OA) was the standard treatment for acute appendicitis and was gradually replaced by laparoscopic appendectomy (LA) after its introduction by Semm in 1984.[2] Over the last 2 decades, the laparoscopic approach has rapidly increased in popularity, particularly as published reports have associated LA with earlier recovery, shortened length of hospital stay, and decreased infectious complications.[3–5] Numerous studies have compared the clinical outcomes of OA and LA in the pediatric population; however, few have focused on the financial implications of choosing one approach over another.[6–8] This is especially relevant as the United States enters a period in which reducing healthcare costs while maintaining quality of care is a high priority.[3,9,10] Thus, the purpose of this study was to compare the surgical equipment charges of LA and OA in both perforated and nonperforated appendicitis in children.

The authors declare no conflicts of interest.

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Table 1 Demographics and outcomes of children undergoing OA and LA from 2007 to 2013

Variable	LA (n = 195)	OA (n = 69)	*P* value
Age (years)	10.2 ± 3.8	9.0 ± 4.5	.03
Female sex	92 (47.2)	24 (34.8)	.08
Perforated appendicitis	49 (25.1)	21 (30.4)	.56
Negative appendectomy	9 (4.6)	2 (2.90)	.36
Operating room time (min)	88.3 ± 26.4	72.9 ± 20.8	<.001
Hospital length of stay	3.0 ± 3.3	3.7 ± 4.3	.23
Surgical site infection	7 (3.6)	3 (4.4)	.78
Readmission	11 (5.6)	4 (5.8)	.96
Reoperation	1 (.5)	2 (2.9)	.11

Data are expressed as mean ± standard deviation or number (%).
LA = laparoscopic appendectomy; OA = open appendectomy.

Patients and Methods

After obtaining Institutional Review Board approval, data were collected on all patients less than 21 years old who underwent appendectomy by the pediatric surgery service at the Johns Hopkins Hospital over a 5-year period (July 2007 to June 2013). The following Current Procedural Terminology codes were retrieved from an administrative database: 44950 (appendectomy), 44960 (appendectomy for ruptured appendix with abscess or generalized peritonitis), and 44970 (LA). Demographics, patient characteristics, operating room (OR) times, and outcomes were collected from the electronic medical records, whereas charges and costs were captured from a billing database. Interval appendectomies, incidental appendectomies, and laparoscopic procedures that were converted to open were excluded. Patients were grouped and compared based on the surgical approach (open vs laparoscopic). Subgroup analysis of charges and costs was performed on patients with confirmed acute appendicitis and was based on perforation status on final pathology. The decision regarding whether to perform an OA or LA was made by surgeon preference.

The primary outcome was OR supply charges. Supply charges were defined as all OR equipment costs that were charged to the patient, including disposable and nondisposable surgical instruments. Secondary outcomes were surgical supply costs, OR time (defined as the total time the patient spent in the OR), OR charges based on the OR time, other charges (room and nursing care, medications, radiographic studies, laboratory studies, physical and occupational therapy, and other), total charges, total hospital length of stay (LOS), readmissions, and postoperative complications. Surgical supply costs were only available for the period of July 2011 to July 2013. Charge data for the calendar year 2013 at Johns Hopkins were collected for the disposable laparoscopic instruments, including ports and devices to isolate the appendix and mesoappendix. The charges of different techniques were then compared.

Data were reported as means or medians and percentages; charges as US dollars. We used Student *t* test for continuous parametric variables and Wilcoxon rank-sum (Mann–Whitney) test for continuous nonparametric variables. A *P* value less than .05 was considered statistically significant. STATA version 12.1 (StataCorp LP, College Station, TX) was used for the statistical analysis.

Results

A total of 264 patients met our inclusion criteria. LA was performed in 195 (73.9%) cases and OA in 69 (26.1%) cases. There were 11 pediatric surgeons who performed the appendectomies, of which a single surgeon performed all open procedures.

Demographics, presence of perforation, negative appendectomy rates, and hospital LOS were not statistically different between LA and OA groups with the exception of an age of 9.0 years in the OA group compared with 10.2 years in the LA group ($P = .03$) (Table 1). OR times were longer in the LA group by an average of 15 minutes (88.3 ± 26.4 vs 72.9 ± 20.8, $P < .001$). The surgical site infection (SSI) rate between the LA and OA was not significantly different (3.6% vs 4.4%, $P = .78$). Infectious

Table 2 Single institution comparison of outcomes, charges, and costs for LA and OA in children with nonperforated appendicitis from 2007 to 2013

Variable	LA (n = 122)	OA (n = 37)	*P* value
OR time (min)	82.4 ± 23.6	68.1 ± 19.6	.001
Hospital length of stay	1.7 ± 1.1	1.8 ± 1.2	.50
Charges ($)			
OR	1,717 (1,361–2,094)	1,593 (1,196–1,768)	.03
OR supply	1,971 (1,555–2,530)	275 (215–349)	<.001
Room/nursing	2,484 (2,013–3,837)	2,988 (2,115–4,504)	.14
Total hospital	8,534 (7,214–9,888)	6,899 (5,448–8,283)	<.001
OR supply costs ($)*	1,061 (835–1,435)	99 (90–106)	<.001

Data are expressed as mean ± standard deviation or median (interquartile range).
LA = laparoscopic appendectomy; OA = open appendectomy; OR = operating room.
*OR supply costs retrieved from 44 LAs and 17 OAs.