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Laparoscopy utilization and outcomes for appendicitis in small children ☆,☆☆

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Abstract

Purpose: To examine the trends in laparoscopic appendectomy (LA) utilization and outcomes for children 5 years or younger.

Methods: We studied 16,028 inpatient admissions for children 5 years of age or less undergoing an appendectomy for acute appendicitis in 2000, 2003, and 2006 using the Kids' Inpatient Database (KID). Laparoscopy frequency, hospital length of stay, and complications were reviewed.

Results: In 2000, 2003 and 2006 appendectomies were done laparoscopically 11.4%, 18.7% and 31.3% of the time, respectively. Children were more likely to undergo LA at a children's hospital ($P<0.001$). LA complications were less likely overall (OR: 0.80, CI: 0.70–0.92, $P=0.002$) and in perforated cases (OR: 0.78, CI: 0.67-0.91, $P=0.001$). LA decreased hospital length of stay by 0.54 days for all patients and 0.70 days for perforated cases ($P<0.001$).

Conclusions: Open appendectomy has historically been the standard in children 5 years of age and younger. Laparoscopic appendectomy has slowly gained acceptance for the treatment of appendicitis in smaller children. The use of laparoscopy has increased significantly at all facilities. Furthermore, laparoscopic appendectomy in this age group has a comparatively low complication rate and short hospital length of stay, and is safe in complicated perforated appendicitis cases.

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Over the past 2 decades the laparoscopic approach for appendicitis has evolved to become preferred for many surgeons. Previous studies have shown a mix of outcomes for laparoscopic appendectomy (LA) [1–11]. Heterogeneity of outcomes for both approaches has led to controversy regarding the superiority of either approach. A 2010 Cochrane review comparing LA and open appendectomy (OA) supports LA despite the "mediocre quality" of the data analyzed [10].

In very young children, appendicitis has largely been managed via OA. Few studies comparing LA and OA include

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children under the age of 5. This is likely related in part to the fact that approximately 50% of children aged 5 years or younger will present with perforated appendicitis [9]. A study inclusive of this younger age group could potentially clarify a difference in outcomes based solely on approach. This is a demographic where many general surgeons may become uncomfortable with laparoscopy and consider OA an equal alternative with regard to safety, outcomes and cosmesis. The purpose of this study was to analyze the use of laparoscopy in community and children's hospitals for children under age 5 as well as its effects on overall outcomes.

1. Methods

The Kids' Inpatient Database (KID), Healthcare Cost and Utilization Project (HCUP), Agency for Healthcare Research and Quality was queried for inpatient admissions for children age 5 or younger undergoing an appendectomy for acute appendicitis in 2000, 2003, and 2006 [12]. The database is weighted by discharges based on American Hospital Association criteria to allow for the creation of national estimates. Based on these estimates, there were 16,028 appendectomies performed in this age group during the three separate years analyzed, or approximately 5000 appendectomies per year. All patients had a principal diagnosis of appendicitis and an appendectomy listed as one of the first five procedures performed during the incident hospitalization (*International Classification of Diseases, 9th Revision, Clinical Modification* [*ICD-9-CM*] diagnosis codes 540.0, 540.1 and 540.9 and procedure codes 47.01 and 47.09). Perforated status, complications, and abscess drainage procedures were defined by their respective *ICD-9* codes (Tables 1 and 2). Hospitals were categorized by the database as either general hospitals or children's hospitals based on criteria set forth by the National Association of Children's Hospitals and Related Institutions (NACHRI). The database further characterized hospitals as teaching or non-teaching institutions. These two hospital criteria were combined to create four subdivisions: non-teaching general hospitals (NTGH), teaching general hospitals (TGH), non-teaching children's hospitals (NTCH), and teaching children's hospitals (TCH).

Descriptive statistics were compared using *t* tests for continuous variables and the χ^2 test for categorical variables. Binary logistic regression was used to analyze complication data adjusting for age, gender, children's hospitals, teaching hospitals, perforation status, and use of laparoscopy. Length of hospital stay was compared between OA and LA using

Table 1 *ICD-9* codes for complications and percent of OA and LA with listed complication.

Complications	Code	All patients (%)		Perforated (%)	
		OA	LA	OA	LA
Postoperative infection	998.5	0	0	0	0
Other postoperative infection	998.59	2.9	1.3	4.3	1.9
Unspecified complication of procedure	998.9	0	0	0	0
Other specified complications	998.89	1.7	1.1	2.0	1.3
Cardiac complications	997.1	0.2	0.1	0.3	0.2
Respiratory complications	997.3	1.0	0.4	1.2	0.5
Other respiratory complications	997.39	0	0	0	0
Digestive system complications	997.4	5.5	5.1	7.7	7.6
Postoperative shock	998.0	0.1	0.1	0.1	0
Hemorrhage or hematoma	998.1	0	0	0	0
Accidental puncture or laceration	998.2	0.4	0.3	0.6	0.4
Disruption of wound	998.3	0.1	0	0.2	0
Disruption of surgical wound	998.32	0.1	0	0.2	0
Foreign body left	998.4	0	0	0	0
Infected postoperative seroma	998.51	0	0	0	0
Persistent fistula	998.6	0	0	0	0
Acute reaction to foreign substance	998.7	0	0	0	0
Incisional hernia	553.21	0	0	0	0
Incisional hernia with gangrene	551.21	0	0	0	0
Incisional hernia with obstruction	552.21	0	0	0	0
Postoperative hypotension	458.29	0	0	0	0
Postoperative obstruction	560.81	1	0.9	1.6	1.3
Postoperative blind loop	579.2	0	0	0	0
Anemia due to blood loss	285.1	0.3	0.3	0.5	0.3
Reopening of laparotomy site	54.12	0.4	0.2	0.6	0.3

Abbreviations: *ICD-9*, *International Classification of Diseases, 9th Revision*; LA, laparoscopic appendectomy; OA, open appendectomy.