Outcomes of laparoscopic resection of Meckel’s diverticulum are equivalent to open laparotomy☆☆☆

Brian Ezekian a,⁎, Harold J. Leraas b, Brian R. Englum a, Brian F. Gilmore a, Christopher Reed a, Tamara N. Fitzgerald a, Henry E. Rice a, Elisabeth T. Tracy a

a Department of Surgery, Duke University Medical Center, Durham, NC, USA
b Duke University School of Medicine, Durham, NC, USA

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Purpose: Meckel’s diverticulum (MD) is a common congenital anomaly caused by failure of involution of the omphalomesenteric duct. Enthusiasm for minimally invasive surgery (MIS) in children has burgeoned as technologies have advanced, but the outcomes of laparoscopic resection in comparison to open laparotomy for MD remain poorly defined. We queried a large national database to compare current practice patterns and clinical outcomes between surgical approaches for MD in the pediatric population.

Methods: The National Surgical Quality Improvement Program-Pediatric (NSQIP-Ped) database was queried for patients undergoing surgical intervention for MD (2011–2014). Patients were stratified by surgical approach. Baseline characteristics, intraoperative variables, and perioperative complications were compared by univariate analysis using Pearson’s χ2 test for categorical variables and Kruskall-Wallis test for continuous variables. Primary outcomes of interest were length of stay (LOS), rate of readmission, and 30-day mortality. Secondary outcomes included operative time, anesthesia time, postoperative complications, and rates of reoperation.

Results: A total of 148 cases of MD were identified, of which 73 (49.3%) were initially managed with a laparoscopic approach and 75 (50.7%) were managed with an open approach. We found a high rate of conversion from laparoscopy to an open approach (20/73 or 27.4%). The median age of the laparoscopic group was higher than the open group (8.3 vs. 2.5 years, p < 0.001). Operative and anesthesia time, LOS, 30-day mortality, postoperative complications, and rates of reoperation and readmission were similar between groups (all p > 0.05).

Conclusion: Nearly half of all resections for MD in children are now approached laparoscopically. This approach has equivalent outcomes to traditional open laparotomy. More widespread use of a hybrid approach with laparoscopy and exteriorization of the small bowel through an extended port site may facilitate avoiding open laparotomy. Routine conversion to open for palpation of the MD or segmental small bowel resection should be avoided in the absence of compelling intra-operative findings or operative complications.

Level of evidence: Level III (retrospective comparative study).

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Meckel’s diverticulum (MD) was originally described in 1598 by Fabricius Hildanus and later defined in greater detail by Johann Friedrich Meckel for whom the malformation became eponymous [1]. MD is the most common congenital anomaly of the gastrointestinal tract, with incidence ranging from 0.3–4.0% in various autopsy studies [2,3]. MD originates from remnants of the omphalomesenteric (vitelline) duct, which connects the midgut to the yolk sac in the fetus and typically undergoes complete involution between the fifth and sixth weeks of gestation as the bowel settles into normal anatomical position [4]. Persistence of the omphalomesenteric duct may result in several anatomic abnormalities including omphalomesenteric cysts, omphalomesenteric fistulae, fibrous bands from the diverticulum to the abdominal wall, or unattached diverticula [5].

Symptoms related to a MD such as bowel obstruction, intussusception, diverticulitis, gastrointestinal bleeding, or perforation often bring patients to the attention of a surgeon. Traditional operative management of MD involves exploratory laparotomy with either simple
Diverticulectomy or segmental small bowel resection. In the current era, several authors have described minimally invasive surgical (MIS) techniques for resection of MD in children [6–11]. Overall, these reports suggest that laparoscopic management of MD is feasible and safe. However, studies comparing the outcomes of various surgical approaches for MD are limited to small, single-institution series. Therefore, we queried a large national database to compare current practice patterns and clinical outcomes between surgical approaches for MD in the pediatric population.

1. Methods

The American College of Surgeons National Surgical Quality Improvement Program-Pediatric (NSQIP-Ped) participant user files for 2011–2014 were used for this analysis. The NSQIP-Ped is an outcomes-based dataset designed to improve the quality of surgical care in America. Data represent 44 participating medical centers within this database. All data included within NSQIP-Ped are de-identified and include patient demographics, operative characteristics, and short term outcomes for a large variety of surgical procedures. Our study used inclusion criteria of undergoing an operation for MD defined by CPT codes unique to this pathology (44,800, 44,820, 44,830, 44,899). Exclusion criteria included patients over 18 and patients without a MD-related procedure.

Patients were stratified by surgical approach (laparoscopic vs. open), which is a categorical variable included in this data set. Patients who were converted from laparoscopic to open were designated as Lap+. Baseline characteristics, intraoperative variables, and perioperative complications were compared by univariate analysis using Pearson’s χ² test for categorical variables and Kruskall-Wallis test for continuous variables. The primary outcomes of interest were length of stay, rate of readmission, and 30-day mortality. Secondary outcomes included other variables included as described in the NSQIP-Ped including operative time, anesthesia time, pneumonia, septic complications, infectious complications, and reoperation.

All statistical tests were two tailed with a significance level considered to be p < 0.05. All statistical analyses were performed using R, version 3.3.0 (R Foundation for Statistical Computing, Vienna, Austria).

2. Results

A total of 148 cases of Meckel’s diverticulum requiring surgical intervention were identified. Of these, 73 cases (49.3%) were initially approached laparoscopically, while 75 cases (50.7%) were initially approached using open laparotomy (Table 1). Eventually, 20/73 laparoscopic cases (27.4%) were converted to open.

A majority of patients in each group were male and Caucasian. The proportion of male patients in the laparoscopic group had a trend towards being higher than the open laparotomy group, though this did not reach statistical significance (83.6% vs. 70.7%, p = 0.068).

The median age and weight of the laparoscopic group were higher than the open laparotomy group (8.3 vs. 2.5 years and 61.4 vs. 30.4 pounds, both p < 0.001). Median body mass index (BMI) was also higher in the laparoscopic group (16.5 vs. 15.4, p = 0.022).

The proportion of urgent or emergent cases was comparable between approaches (72.6% laparoscopic vs. 66.7% open, p = 0.085). Time in the operating room was also equivalent between approaches (123 min laparoscopic vs. 111 min open, p = 0.403 and 71 min laparoscopic vs. 65 min open, p = 0.185, Table 2). Total length of stay and days from operation to discharge were similar between groups (4.0 vs. 4.0 days, p = 0.178 and 3.0 vs. 3.0 days, p = 0.146). Neither group had any 30-day mortalities. Post-operative adverse events were rare, and groups were comparable in terms of rates of wound infections, pneumonia, reintubation, cardiac arrest, bleeding, prolonged hospitalization > 30 days, re-operation, and re-admission (all p > 0.05).

3. Discussion

In this study, we provide the first direct comparison between laparoscopic and open approaches to resection of MD. Our major finding was...
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