The American Journal of Surgery (2016) 212, 493-500

The American Journal of Surgery®

Clinical Science

Unplanned readmission after appendectomy

Zhobin Moghadamyeghaneh, M.D., Grace Hwang, M.D., Mark H. Hanna, M.D., Joseph C. Carmichael, M.D., Steven Mills, M.D., Alessio Pigazzi, M.D., Ph.D., Michael J. Stamos, M.D.*

Department of Surgery, University of California, Irvine, School of Medicine, 333 City Boulevard West Suite 1600, Irvine, CA, 92868, USA

KEYWORDS:
Unplanned readmission;
Readmission;
Appendectomy

Abstract

BACKGROUND: Unplanned readmission of patients who undergo appendectomy is a relatively frequent occurrence. Our aim was to report the most common reasons and the predictors of unplanned readmission after appendectomy.

METHODS: The National Surgical Quality Improvement Program database was used to examine the clinical data of patients undergoing emergent and/or urgent appendectomy during 2012 to 2013. Multivariate regression analysis was performed to identify the predictors of unplanned readmission.

RESULTS: We evaluated a total of 46,960 patients who underwent appendectomy. Of these, 18.5% had perforated appendicitis. Overall, 1,755 (3.7%) of patients had an unplanned readmission. The most common reasons for readmission were intra-abdominal infection (27.3%), nonspecific abdominal pain (7.9%), and paralytic ileus (4.6%). Factors such as perforated appendicitis (adjusted odds ratio [AOR], 1.38; $P < .01$), preoperative sepsis (AOR, 1.30; $P < .01$), and dirty surgical wound (AOR, 1.91; $P < .01$) were associated with unplanned readmission.

CONCLUSIONS: Overall, 3.7% of patients who underwent emergent appendectomy had an unplanned readmission. Intra-abdominal infections and nonspecific abdominal pain are the most common reasons for readmission. Unplanned readmissions are predominantly related to postoperative complications and severity of disease.

Hospital readmission with an incidence rate of 4% to 13% after appendectomy is relatively common in children.[1–3] Readmission significantly increases hospital costs and is closely associated with morbidity after appendectomy.[1,2] More important, hospital readmission is a marker for quality of care which is attributed to substandard care during the index hospitalization, poor resolution of the main problem, and inadequate postdischarge care.[4] Recently published studies show that 12% to 75% of readmissions may be preventable by predischarge assessment, patient education, and postdischarge care.[4] Investigation of factors associated with hospital readmission will improve hospital care and clinical outcomes.

A number of recent studies have reported relatively high rates of hospital readmission after appendectomy in children (8% to 13%).[1,2] Numerous factors including the disease stage and management approach (such as appendectomy, drainage, and antibiotics therapy only) have

The authors declare no conflicts of interest.

Presented as a poster presentation at the Society for Surgery of the Alimentary Tract/Digestive Disease Week, May 17, 2015.

* Corresponding author. Tel.: +1-714-456-6262; fax: +1-714-456-6377.

E-mail address: mstamos@uci.edu

Manuscript received April 25, 2015; revised manuscript July 26, 2015

0002-9610/$ - see front matter © 2015 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.amjsurg.2015.08.018

been reported to be associated with readmission after appendectomy in children. However, there are limited published data investigating readmission after appendectomy in adults. This study aims to investigate and report predictors of unplanned readmission after appendectomy in adults.

Methods

A retrospective study was conducted using the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database during 2012 to 2013. American College of Surgeons NSQIP is a nationwide outcome-based database which provides preoperative to 30-day postoperative information of surgical patients based on clinical data in the United States.[5] We analyzed the available data on patients with acute appendicitis who underwent urgent and/or emergent appendectomy. To be eligible for the analysis, patients were required to have the diagnosis of acute appendicitis based on the International Classification of Diseases, 9th Revision, clinical modifications (ICD-9-CM) codes of: 540.0-540.9. The ICD-9 code of 540.0 was used to find patients with acute appendicitis with perforation with or without peritonitis. The ICD-9 code of 540.1 was used to find patients with acute appendicitis with perforation and peritoneal abscess, and the ICD-9 code of 540.9 was used to find patients with acute appendicitis without perforation, rupture, or peritonitis with or without gangrenous. Patients who had ICD-9 codes of 540.0 or 540.1 were considered to have a perforated appendicitis with or without peritonitis or abscess. We only included patients who underwent appendectomy based on the current procedural terminology codes of 44,950, 44,960, 44,970, and 44,979. We excluded all patients who underwent appendectomy concomitant with other major procedure and patients who had elective operation. Unplanned readmission was defined based on the original NSQIP variable which was readmission (to the same or another hospital), for any reason, within 30 days after the principal operative procedure. The readmission has to be classified as an "inpatient" stay by the readmitting hospital, or reported by the patient and/or family as such.

Numerous patient and operative factors were analyzed including: demographic data (age, sex, and race); comorbid conditions, such as chronic steroid use, congestive heart failure, renal failure with need for dialysis, diabetes mellitus, severe chronic obstructive pulmonary disease, ascites, and hypertension requiring medication. Other factors analyzed included: American Society of Anesthesiologists class score, body mass index, operation length, hospitalization length, preoperative white blood cell count, surgical approach (open vs laparoscopic), presence of complications (peritonitis or peritoneal abscess), and wound classification (clean, clean-contaminated, contaminated, and dirty). The primary end points investigated were prevalence, reasons for, and predictors of unplanned readmission.

Statistical analysis

The statistical analysis was conducted using the SPSS software statistical package Version 22 (SPSS Inc., Chicago, IL). Multivariate statistical analysis using logistic regression was conducted to estimate the association between perioperative factors and unplanned readmission. Multivariate logistic linear regression analysis was used for linear outcomes. Risk adjustment was done for all variables of the study including demographic data, all comorbid conditions, hospitalization length, body mass index, disease stage, wound classification, surgical approach (open vs laparoscopic), preoperative white blood cell count, and operation length. The adjusted odds ratio with a 95% confidence interval was calculated, and P values less than .05 indicate statistical significance.

Results

A total of 46,960 patients underwent appendectomy for acute appendicitis were identified during 2012 to 2013. The median age was 36 years, and most the patients were Caucasian (83.6%) and male (51.8%). The most common comorbidities included hypertension (16.4%) and diabetes mellitus (4.8%). Demographics of the patient population based on unplanned readmission are described in Table 1.

Among all the patients who met inclusion criteria, 81.5% had acute appendicitis without peritonitis, 5.7% had acute appendicitis with peritoneal abscess, and 12.8% had acute appendicitis with generalized peritonitis. Laparoscopic approach was used for 90.4% of patients, and 9.6% of laparoscopic procedures were converted to open surgery. Overall, 1,755 (3.7%) of patients had unplanned readmission within 30 days of operation. Of these, 82% of unplanned readmissions were directly related to the appendectomy procedure.

Overall, 1,755 (3.7%) of patients had unplanned readmission within 30 days of operation. Of which 81.8% of unplanned readmissions were directly related to the appendectomy procedure. Patients with unplanned readmissions doubled their risk of mortality compared with patients without (adjusted odds ratio, 2.62; $P = .01$). The most common reasons for unplanned readmission after appendectomy are reported in Table 2, with intra-abdominal infections (27.3%), unspecified abdominal pain (7.9%), and paralytic ileus (4.6%) being among the most common causes.

Table 3 describes the associations between perioperative variables and unplanned readmission. Factors such as open surgery, perforated appendicitis, hospitalization more than 3 days, preoperative sepsis and/or septic shock, bleeding disorders, chronic steroid use, and operation length were associated with unplanned readmission.