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Risk and outcomes of 24-h delayed and weekend appendectomies



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ABSTRACT

Background: Time interval from hospital admission to operative intervention has been suggested as a crucial risk factor for a number of surgical procedures. In this study, we aim to compare postappendectomy outcomes for operations performed 24 h after admission or on the weekend to within 24 h and weekday operations, respectively.

Material and methods: A cross-sectional study using the Nationwide Inpatient Sample database, 2004–2009. The study population included patients who underwent appendectomy for acute appendicitis.

Results: A total of 265,972 records were identified, of which 221,745 (83.4%) patients had appendectomy on the same day of admission, whereas 16.6% had the procedure the following day. Next day operations were more likely to be associated with postoperative complications (OR = 1.26, 95% CI = [1.19–1.33], $P < 0.001$). A hospital stay of >3 d was also more common for next day interventions ($P < 0.001$). Appendectomies performed on weekends had a higher risk of complications compared to other days (OR = 1.08, 95% CI = [1.02–1.14], $P = 0.005$). Teaching and urban hospitals were more likely to perform appendectomies on the day after admission ($P < 0.05$). Older patients (≥ 35 years), females, Blacks and Hispanics, and those on Medicaid or Medicare were all at higher risk of next day intervention ($P < 0.01$ each). The average cost of next day operations was higher compared to same day operations ($\$9890.11 \pm 119.64$ versus $\$8744.57 \pm 77.67$, $P < 0.001$).

Conclusions: Appendectomies performed 1 d after admission or on the weekend are associated with disadvantageous outcomes. Demographic factors, in addition to hospital attributes, place certain subpopulations at higher risk of next day appendectomies.

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Introduction

Appendectomy is one of the most frequent surgical interventions in the United States, accounting for 2.1% of all operative procedures.¹ Historically, emergent appendectomy was considered the gold standard therapy for acute appendicitis; however, in the last decade, several reports demonstrated that delaying appendectomy and optimization of patients with antibiotics is comparably safe.²⁻⁴ Moreover, several clinical trials recommended antibiotic therapy only in lieu of surgical intervention in selected patients.⁵⁻⁷ However, the literature still shows conflicting results regarding whether delaying appendectomy is an effective alternative in all patients. The incongruence among previous investigations is mainly related to different and small study populations, disagreement on what constitutes a delayed intervention, and the type of postoperative complications measured. In their study that included around 70,000 patients, Fair *et al.* reported that a 48-h delay of appendectomy was associated with a higher risk of complications.⁸

In this study, we aim to examine the characteristics of patients who underwent appendectomy 24 h after admission, and to examine postoperative outcomes of 24 h delayed and weekend appendectomies as compared to same day and weekdays procedures, respectively.

Material and methods

The study is a cross-sectional analysis using the Nationwide Inpatient Sample (NIS) database for the years 2004-2009. NIS is part of the Healthcare Cost and Utilization Project, sponsored by the Agency for Healthcare Research and Quality. This is the largest all-payer inpatient care database publicly available in the United States. It contains data from approximately 8 million hospital stays from about 1000 hospitals sampled to approximate a 20% stratified sample of U.S. community hospitals. The NIS database is publicly available de-identified data that is exempt from approval of the institutional review board.⁹ *International Classification of Disease, Ninth Revision (ICD-9)* was used in defining the diagnoses and procedures of interest.

The study population consisted of inpatients with appendicitis (ICD-9: 540-543) who underwent appendectomy (ICD-9: 47) as the primary procedure either on the same day of admission or on the following day. Patients with procedure code (ICD-9: 47.01) were considered to have undergone laparoscopic appendectomy, whereas patients with procedure code (ICD-9: 47.0, 47.09) were considered to have undergone open appendectomy.

The primary study objective is to compare appendectomies performed on the day after admission to those performed on the same day of admission in terms of (1) postoperative complications: none versus one or more of pulmonary, cardiovascular, renal, infectious, and wound complication (Appendix A); (2) length of stay (LOS): categorized based on the 75th percentile into short stay (≤ 3 d) and long stay (> 3 d); (3) and cost of health services. Cost was adjusted for inflation rate to reflect 2015 dollar value. The outcomes were further

assessed by applying stratifications based on the type of appendectomy (open or laparoscopic).

The secondary study objective is to compare appendectomies performed on weekends to those performed on weekdays for the patients who underwent appendectomy on the same day of admission and for the same outcomes mentioned above.

Other independent factors that were assessed as potential confounders included (1) Patient demographics: age (< 35 , $35- < 65$, ≥ 65 years old), gender, and race (white, black, Hispanic, Asian/Pacific Islander, Native American, other); (2) Economic factors: main payer of health service (Medicare, Medicaid, private insurance, self-pay, no charges, others); (3) Clinical factors: a modification of the Charlson Comorbidity Index Score (0, 1, ≥ 2 score)¹⁰; (4) Hospital characteristics: hospital geographic region (Northeast, Midwest, South, and West), hospital bed size (small, medium, large), hospital location (rural, urban), and hospital teaching status (nonteaching, teaching).

Statistical analysis used weighted data reflecting the national estimate. The records' weights are available in the NIS data and calculated based on the stratification variables that were used in sampling methodology. These variables are hospital geographic region, urban/rural location, teaching status, bed size, and ownership.

The association between each independent factor of interest and the main outcome was examined by applying a chi-square test. Factors that demonstrated significant association with the outcomes in the univariate model were considered confounders. Odds ratio (OR) and 95% confidence interval (95% CI) were calculated using logistic regression modeling. Student *t* test was used to test for differences in cost. Significance level was set as $\alpha = 0.05$. Statistical software, SAS 9.3, for Windows (SAS Institute Inc., Cary, NC) was used in performing all analyses.

Results

A total of 265,972 records were identified. Of those, 221,745 (83.4%) patients had appendectomy on the day of admission, whereas 16.6% had appendectomy on the day after admission (Table 1). The mean age of the study population was 32.9 (± 0.2) y. Most study sample was white (65.8%) and had private insurance (60.5%). More than half of the study population was male (56.7%). Laparoscopic appendectomies accounted for 58.5% of the appendectomies performed. The risk of postoperative complications was 3.8%. The average length of stay was 2.7 (± 0.02) d, whereas the average cost of appendectomy per case was \$8936.86 (± 79.51).

Older patients (≥ 35 years), females, and patients of Black or Hispanic backgrounds were more likely to undergo appendectomy 1 d after admission ($P < 0.05$ each; Table 2). Patients on Medicare (20.0%) or Medicaid (18.8%) were also more likely to have second day appendectomy as compared to those with private insurance (15.5%; $P < 0.001$). Laparoscopic appendectomies were more common on the second day than open procedure (17.1% versus 16.0%, $P = 0.007$). Hospitals located in the Northwest region of the United States, urban areas, large

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