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Patient characteristics, outcomes and costs following interhospital transfer to a tertiary facility for appendectomy versus patients who present directly

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ABSTRACT

Background: Recent healthcare policy changes have emphasized pay-for-performance. Previous studies have not examined outcome differences between primary presenting appendicitis patients and transferred patients.
Methods: A retrospective cohort design examined appendicitis patients between March 2011 and 2013. Patients < age 18, were scheduled for an elective appendectomy, who were pregnant or had an interval appendectomy were excluded.
Results: The transfer cohort (n = 59) had more comorbidities, more severe American Society of Anesthesiologists status, a higher rate of pre-operative abscess/rupture as well as higher rates of perforation, gangrene, intra-operative drain placement and open conversion versus primary presenting patients (n = 622). After statistical regression adjustment, a higher open conversion rate in the transfer cohort, OR = 3.48 (95%CI: 1.04–11.61) and higher total costs $672.47 (95%CI: $68.75-$1276.19) remained.
Conclusions: Adjustments in clinical outcome/reimbursement metrics may be needed to address the complexity of transfers and the subsequent higher in-hospital costs on tertiary facilities.
Level of evidence: IV.

1. Introduction

Appendicitis is the most common emergent operation performed in the world and in the United States alone over 250,000 are performed per year. Patients with complicated appendicitis experience more postoperative complications, longer hospital stays and burden the healthcare systems with increased cost.[1–3]

A significant portion of appendectomies performed at our institution involve patients transferred from outlying emergency departments or rural hospitals. Previous research also suggests patients presenting to rural areas, have a higher rate of complicated appendicitis.[2,4] These patients are transferred to our tertiary healthcare facility for multiple reasons including surgeon and/or resource availability.

As part of recent and upcoming quality improvement mandates in healthcare, individual institutions and surgeons will be critiqued on certain objective outcomes such as postoperative complications, length of stay and readmission rates. However there is very little data available on outcome differences between patients presenting directly to a facility for appendectomy versus patients transferred to a tertiary facility for appendectomy.[5] Therefore, an analysis of patient outcomes who have been transferred for urgent surgical care, including appendectomy, is important to all stakeholders: the transferring hospital, the accepting hospital, the healthcare system and the patient. Our goal was to gauge the impact of transferred appendicitis cases on our institution. Identification of differences in clinical outcome metrics tied to reimbursement may provide support that adjustments are needed to address the complexity of transfers on tertiary facilities.

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2. Materials and methods

2.1. Study design

This was a retrospective cohort study approved by the OhioHealth Institutional Review Board. All patients admitted to our institution with a diagnosis of appendicitis identified via ICD-9 diagnoses (540, 540.0, 540.1, 540.9, 541 and 542), procedure codes (47.01, 47.09, 47.11 and 47.19) and Diagnosis Related Groups (338, 339, 340, 341, 342 and 343) in the administrative record between March 2011 and 2013 were eligible.

Patients under age 18 or who were pregnant were excluded. Patients who did not have surgery upon chart review, had an open procedure, were scheduled for an elective appendectomy, were transferred for image guided percutaneous drainage placement only or had an interval appendectomy were also excluded. Patients who presented to local acute care centers and were transferred to our institution were included in the direct admission group.

2.2. Demographics, comorbidities and pre-operative data

Demographic data included age, gender, race/ethnicity, insurance payor, BMI and comorbidities (smoking, diabetes, hypertension, COPD, history of transplant, dyslipidemia, coronary artery disease). Pre-operative data included symptom onset (in days), American Society of Anesthesiologists (ASA) physical status, symptoms of sepsis (heart rate > 90 beats/min, fever > 38.5 °C, body temperature < 35 °C and respiration rate > 20 breaths/min), presence of abscess/rupture and anti-coagulation status at time of presentation. Pre-operative data were assessed from CT scan reports and clinician notes in the medical record.

2.3. Intra-operative and post-operative outcomes

Intraoperative data included operating room time and complications (presence of perforation, gangrene, drain placement, laparotomy and conversion to an open surgical procedure). Postoperative data included re-operation, intra-abdominal abscess, pneumonia, urinary tract infection (UTI), length of stay and 30-day readmission. Post-operative data for all patients was gathered from hospital records as well as surgeon notes at the 2 week post-operative follow up clinic visit.

2.4. Hospital cost data

Hospital cost data were extracted via the administrative record for each patient encounter. Hospital costs, are the *actual* costs incurred by our institution and are calculated based on Relative Value Units (RVU), a standardized indicator of the value of services.[6] Fixed costs were based on overhead charges, fixed clinical salaries (i.e., the nurse manager salary on the floor providing care) and non-clinical hospital staff whose salaries are included in the care of every patient. Variable costs were based on calculations of the costs of staffing for the procedure (surgeon, RNs, PSAs), length of the procedure (OR time) and required equipment/medical supplies.

Total costs were then broken down by clinically meaningful cost centers for analysis. These groups included: surgery (pre admission, OR and PACU hospital costs based on staffing, supplies used and medications, but not surgeon salary), emergency (emergency department costs only), nursing (all nursing units), lab, pharmacy, radiology, ancillary services (cardiology, therapy, endoscopy, dialysis, neurodiagnostics and pulmonary) and administrative consistent with previously published appendicitis outcome research.[3,7]

2.5. Statistical analysis

Statistical analyses were conducted using IBM SPSS Statistics version 19.0 (Armonk, NY). STATA version 12.0 (College Station, TX) was used to calculate 95% CIs for event rate estimates in previous publications using overall sample sizes and sample sizes of patients with the observed events using the Wald method.

First, descriptive information (means, standard deviations and proportions) were tabulated and univariate comparisons were made via independent samples t-tests and χ^2 tests. For data that was not normally distributed (based on the Levene's test), Wilcoxon rank sum tests were conducted.

Next, differences in patient characteristics between the exposed cohort (transfer patients) and not exposed cohort (direct admission patients) that were significant at the $p < 0.05$ level in the univariate analyses were controlled for in a series of regression models (logistic and linear). These models accounted for demographics (race/ethnicity), comorbidities (current smoker, diabetes, hypertension, COPD, dyslipidemia and CAD), pre-operative clinical factors (ASA status, respiration rate and pre-operative abscess/rupture) and the primary surgeon on the case.

Multivariate outcome variables included intra-operative characteristics (perforation, gangrene, drain placement, conversion to an open procedure) and post-operative characteristics (length of stay and total hospital costs). Statistical significance was based on traditional two-sided tests with the alpha error set at 5%.

2.6. Sample size calculation

In preparation for the research, an a priori sample size calculation was conducted based on a previous published cost comparison data[3] which suggested a ratio of 5 exposed patients (transfers) per 1 not exposed patient (direct admission). The previously published cost data was relatively normally distributed with standard deviation $17,795. Based on the sample size calculation if the true difference in the exposed and not exposed patients mean costs were $6530 we needed approximately 68 exposed patients and 408 not exposed patients to be able to reject the null hypothesis with power set at 80% and a type I error rate set at 5%.

3. Results

The overall study population consisted of 837 patients, of which 156 were excluded, see Fig. 1. Of those included, 59 (8.7%) patients were in the transfer cohort and 622 (91.3%) were in the direct admission cohort. Ninety-seven % of our patient cohorts were laparoscopic (2.4% of transfers and 5.1% of direct admission had laparotomies) and all of the patients had surgery (none with pre-operative percutaneous drain placement were included). Follow up data was available for all patients.

Table 1 shows the two cohorts were similar on most demographic characteristics, except for race/ethnicity. The transfer cohort also had higher rates of current smoking, diabetes, hypertension, COPD, dyslipidemia and CAD. The transfer cohort came from 18 different institutions in the Central Ohio region with an average distance to our center of 52.7 miles (95%CI: 46.2–59.2, range 10.8–130.0). All transferred hospital patients came from institutions with access to a general surgeon.

Table 2 summarizes the pre-operative characteristics. There were no significant differences in the onset of appendicitis symptoms. The transfer cohort had more severe ASA physical status scores, increased respiration rate associated with sepsis and higher rates of pre-operative abscess/rupture as seen on CT scan.

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