Outpatient Laparoscopic Appendectomy: Feasible in a Public County Hospital?

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BACKGROUND: Outpatient laparoscopic appendectomy is being used increasingly as a treatment option for acute, uncomplicated appendicitis. This was a prospective validation study in a large, urban, public safety-net hospital.

STUDY DESIGN: From 2014 to 2016, all patients undergoing laparoscopic appendectomy for acute, uncomplicated appendicitis were enrolled in a prospective observational trial. Standard baseline perioperative practice (control group) was documented for 1 year. An outpatient appendectomy protocol was then introduced. Inclusion criteria required intraoperative confirmation of uncomplicated appendicitis and strict discharge criteria, including physician assessment before discharge. Data collection then continued for 1 year (outpatient group). The outcomes measures examined included complications, length of stay, nursing transitions, emergency department visits, readmissions, and patient satisfaction.

RESULTS: The study enrolled 351 patients (178 control, 173 outpatient). Of the 173 candidates for outpatient appendectomy, 113 went home. Reasons for admission included surgeon discretion due to intraoperative findings/medical comorbidities and lack of transportation home. The outpatient group had shorter operative time (69 vs 83 minutes; p < 0.001), longer time in recovery (242 vs 141 minutes; p < 0.001), fewer nursing transitions (4 vs 5; p < 0.001), and shorter postoperative length of stay (9 vs 19 hours; p < 0.001). There was no difference in complications, emergency department visits, or readmissions. In the outpatient group, none of the patients sent home from recovery had postoperative complications or required readmission. Satisfaction surveys revealed no change in satisfaction with either protocol.

CONCLUSIONS: Outpatient appendectomy is safe in a public hospital and results in shorter hospital length of stay and decreased healthcare costs. Strict criteria for discharge are important to identify patients who should be admitted for observation. (J Am Coll Surg 2017;224:862–867. © 2017 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)

Laparoscopic surgery has many well-known benefits, such as decreased length of stay, less postoperative pain, and earlier resumption of oral diet.1,2 Because of this, laparoscopic appendectomy has become the preferred surgical technique for acute appendicitis.3,4 Historically, patients would be admitted for inpatient observation after laparoscopic appendectomy for uncomplicated appendicitis.5,6 Outpatient laparoscopic appendectomy for uncomplicated appendicitis has been examined as a treatment strategy and its use is increasing.7–9

Success of an outpatient appendectomy approach hinges on patient education, clear communication of expectations, and reliable follow-up. In a large public safety-net hospital that provides care to an underserved population, these factors are not always easily attainable. We sought to determine whether outpatient appendectomy for uncomplicated appendicitis was an effective and appropriate approach in a large public safety-net hospital. We hypothesized that with a well-defined protocol consisting of strict inclusion and exclusion criteria, clear patient instructions, and close observation to identify...
patients that would not succeed with the outpatient appendectomy treatment strategy, outpatient appendectomy would be feasible without worsening patient outcomes or satisfaction.

**METHODS**

From 2014 to 2016, all patients 18 years and older who underwent laparoscopic appendectomy for acute, uncomplicated appendicitis were enrolled in an IRB-approved prospective observational trial of outpatient laparoscopic appendectomy. Our institution, at which this trial was enrolled, is a large county teaching hospital that primarily takes care of a poor, underserved population. Patients who were pregnant or wards of the county penitentiary were excluded and not enrolled. The first year of the study consisted of an observation period to document standard baseline perioperative practice (control group). All data were collected prospectively. An outpatient appendectomy protocol was then introduced for patients who met strict intraoperative and discharge criteria to be discharged from the post-anesthesia care unit (PACU). This included intraoperative confirmation of no evidence of gangrene or perforation. A finding of suppurative appendicitis (purulent fluid within the abdomen) without evidence of gangrene or perforation did not exclude the patient from the protocol. Discharge criteria included normal vital signs; adequate pain control; ability to urinate, ambulate, and tolerate oral intake; and physician assessment that the patient was stable for discharge. After a transition period of 1 month, data collection continued for 1 year (outpatient group). These 2 groups were analyzed for differences in demographics, length of stay, nursing transitions, complications, readmissions, and patient satisfaction. Total length of stay was defined as time spent in the hospital from walking into the emergency department. Hospital length of stay was defined as time spent in the hospital after leaving the PACU. Significance was set at $p < 0.05$ and tested using Fisher’s exact test for nominal data, Mann-Whitney test for nonparametric ordinal data, and t-test for parametric ordinal data. Multivariate regression was performed using total length of stay as an end point, adjusting for age, operative time, PACU time, postoperative length of stay, and being in the control vs outpatient group.

**Protocol**

The diagnosis of acute appendicitis was made on an individual basis by a combination of clinical and radiologic criteria; there was no diagnostic standard imposed. Once a diagnosis was made, the patient was given an appendicitis information sheet that contained information about a laparoscopic appendectomy. The patient was counseled extensively that they would be going home from the PACU if the intraoperative findings confirmed the diagnosis of uncomplicated appendicitis. They were asked to arrange for a ride home preoperatively. If there were any intraoperative findings of gangrene or perforation, then they understood that they would require admission for additional observation. They were given a postoperative clinic follow-up appointment and asked to provide a working telephone number to contact for a postoperative survey.

If there was no availability for immediate surgery in the operating room, the patient would be brought to the surgical observation unit (an extension of our emergency department to observe surgical patients without necessitating admission) until it was time for surgery. Before entering the operating room, a narcotic prescription was given to the PACU nurse to fill with the hospital pharmacy (during daytime hours) or assist the family to locate a 24-hour pharmacy (during night-time hours). During surgery, any findings of gangrene or perforation would exclude the patient from the study protocol, as would conversion to open appendectomy. Any surgical complications or adverse events necessitated admission, although the patient would still be included in the final analysis. At all times, the protocol could be broken and a patient could be admitted at the discretion of the attending surgeon. All procedures used a 3-trocar technique performed by surgical residents under direct supervision of surgical attendings. The use of local and general anesthetic was not standardized.

After surgery, the patient recovered in the PACU. Once the patient was alert and assessed by the PACU nursing staff to be suitable for discharge, the operating resident physician assessed the patient. The patient would be approved for discharge if they passed the following criteria: heart rate <100 beats/min; systolic blood pressure >110 mmHg; pain well controlled (<4 on 1 to 10 scale); ambulatory; urinated since surgery; demonstrated oral intake; dressings dry without evidence of bleeding; and physician has assessed that the patient is ready for discharge, writes a discharge order, and confirms a pain medication prescription and follow-up appointment.

All patients were given follow-up clinic appointments 2 weeks after their surgery, at which time they completed a patient satisfaction survey adapted from the standardized Hospital Consumer Assessment of Healthcare Providers and Systems Survey. If the patient did not appear for their clinic appointment, then they were contacted by telephone to check on their clinical status and to complete the survey. Extensive preoperative instructions in the
appendicitis information sheet ensured that the patients understood strict return precautions to the emergency department in case of any sign or concern for postoperative complication. This sheet was available in both English and Spanish.

RESULTS
The study consisted of 351 patients (178 control and 173 outpatient) during the 2-year study period. Mean age was 34 years (range 18 to 75 years). The sample consisted of 62% males, 35% had medical comorbidities, 19% had previous abdominal surgery, and mean duration of preoperative symptoms was 2 days. There were no differences in demographics between the 2 groups except for age (Table 1). All patients had a pathologic finding of acute appendicitis. There were 217 patients excluded from the study based on operative findings (118 from the control group and 99 from the experimental group). Of these, 214 patients had gangrenous or perforated appendicitis (116 control, 98 experimental). Three patients underwent an open appendectomy from the outset (2 control, 1 experimental). There were 7 conversions from laparoscopic to open due to findings of large phlegmon or perforation (4 control, 3 experimental).

Of the 173 candidates for outpatient appendectomy, 113 (65%) actually went home. Sixty (35%) patients in the outpatient time period did not go home due to several reasons. These reasons included no transportation (18 patients); did not pass discharge criteria (14 patients); concern for intraoperative findings, such as suppurative fluid or extensive adhesions (13 patients); age/medical comorbidity (10 patients); and homelessness (5 patients). Of the 18 patients who did not have a ride, 6 were ready to be discharged between 6 PM and 12 AM. The remaining 12 patients were ready to be discharged between 12 AM and 6 AM. Comparing the outpatient and control groups, the outpatient group had significantly older patients (age 36 vs 32 years; \( p = 0.01 \)), shorter operative time (69 vs 83 minutes; \( p < 0.001 \)), longer time in PACU (242 vs 141 minutes; \( p < 0.001 \)), fewer nursing transitions (4 vs 6; \( p < 0.001 \)), and shorter postoperative length of stay (9 vs 19 hours; \( p < 0.001 \)) (Table 2). There was no difference in complications, post-discharge emergency department visits, or readmissions. Within the outpatient group, none of the patients who were sent home from PACU had postoperative complications or required readmission. Multivariate linear regression showed that institution of an early discharge protocol resulted in a reduction in total length of stay (\( p = 0.004 \)).

Satisfaction surveys using a Likert scale (range 1 to 4, with a score of 1 indicating extreme disagreement and 4 denoting extreme agreement) were distributed to all patients at their 2-week follow-up appointment or via phone. Responses from both groups showed no statistically significant difference and the median response scores of both groups were identical. The survey covered ability to resume daily activities (median 3 for both groups), pain control (median 4), and understanding of their treatment plan (median 4). Same-day discharge patients were asked if they were nervous about the protocol (median 3), if they were happy with the protocol (median 3), and if they would want a same-day discharge if they could do it over again (median 3). Overall ranking of the hospital (scale 1 to 10) yielded a median score of 9 in both the control and outpatient groups. Response rate for the satisfaction surveys was 55%.

DISCUSSION
There is much debate in the surgical literature about the optimal way to treat acute appendicitis. Options include surgical management with postoperative admission for observation, surgical management with same-day discharge after surgery,\(^7,8,10-13\) and nonoperative management.\(^14-19\) Although there is interest in treating acute appendicitis with antibiotics alone, the current data are unclear, and the standard of care remains appendectomy at this time.\(^16\) Laparoscopic surgery has many advantages over open surgery; studies over time have consistently shown decreased length of stay, earlier tolerance of oral diet, and decreased pain.\(^12\) Laparoscopic appendectomy has become the preferred surgical technique for acute appendicitis.\(^3,4\)

Although many laparoscopic procedures have been transitioned to outpatient procedures, outpatient

### Table 1. Demographic Characteristics of Control and Outpatient Groups

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total ((n = 351))</th>
<th>Control group ((n = 178))</th>
<th>Outpatient group ((n = 173))</th>
<th>(p) Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y, mean ± SD</td>
<td>34.4 ± 11.8</td>
<td>32.4 ± 11</td>
<td>36.6 ± 12.2</td>
<td>0.01*</td>
</tr>
<tr>
<td>Sex, male, n (%)</td>
<td>217 (61.8)</td>
<td>114 (64)</td>
<td>103 (59.5)</td>
<td>0.44</td>
</tr>
<tr>
<td>Comorbidities, n (%)</td>
<td>121 (34.3)</td>
<td>66 (37)</td>
<td>55 (31.8)</td>
<td>0.33</td>
</tr>
<tr>
<td>History of surgery, n (%)</td>
<td>65 (18.5)</td>
<td>34 (19)</td>
<td>31 (17.9)</td>
<td>0.79</td>
</tr>
<tr>
<td>Duration of symptoms, d, median (range)</td>
<td>2 (1–12)</td>
<td>2 (2–11)</td>
<td>2 (2–12)</td>
<td>—</td>
</tr>
</tbody>
</table>

*Statistically significant.
appendectomy has not undergone such a universal paradigm shift. Potential benefits include decreased length of stay, decreased cost, and avoiding an admission. Opponents of outpatient appendectomy voice concerns for increase in morbidity, readmissions, emergency department visits, and decreased patient satisfaction. In a system where bundled payments and patient satisfaction can play an increasing role, these are very real concerns. In one of the earliest reports of outpatient appendectomy, Jain and colleagues found success in the selective use of outpatient appendectomy for 35 of 75 patients with acute uncomplicated appendicitis without an increase in complications. This has also been seen in the pediatric population; Alkhoury and colleagues successfully treated 80% of 158 eligible patients with outpatient laparoscopic appendectomy, resulting in decreased length of stay without increases in complications and with good parent satisfaction with the technique. In a similar study, Putnam and colleagues reported 332 pediatric patients (58% outpatient) treated without an increase in complications, but they did report an increase in readmission rates (4.2% outpatient vs 1.2% admitted postoperatively). With regard to the adult population, DuBois and colleagues reported instituting an outpatient appendectomy protocol during a span of 161 patients (45% outpatient). They found a decreased length of stay and mean cost savings of $323.46 per patient without increase in complication rate or postoperative emergency department visits. Finally, in their most updated publication of their experience with outpatient appendectomy, Frazee and colleagues report their experience with 563 patients (86% managed outpatient). Postoperative morbidity occurred in 6.7%, and 1.2% of patients required readmission.

Our institution is a public county teaching hospital that serves a large population that typically does not have a primary care physician. Because of this, there are often long waiting room times in the emergency department (reflected in our data). In addition, operative times for a laparoscopic appendectomy for uncomplicated appendicitis might take longer than expected, given that junior trainees are performing these cases under attending supervision. In an effort to gain more efficiency, our administration is taking steps to give our patients access to primary care and streamline emergency department visits by improving triage. In that spirit, the surgeons are trying to do their part to improve efficiency as well, hence the introduction of this protocol.

Before initiation of the outpatient appendectomy protocol, the standard practice was to admit overnight for observation after laparoscopic appendectomy for uncomplicated appendicitis. The favorable literature about outpatient appendectomy caused us to question whether we should adopt this practice, as the potential cost savings were clear. In a large, safety-net teaching hospital caring for an underserved public population, there were concerns among our surgeons that this protocol would not be effective. Lack of communication, follow-up, and patient education were all cited as reasons that would cause this protocol to result in more postoperative complications and readmissions, negating any potential cost savings. In an effort to make sure our patients were best prepared to succeed with an outpatient appendectomy, we carefully created a protocol designed for our system. After 2 years of data collection, our results uniformly show that outpatient appendectomy can be successful in a public safety-net hospital. As seen in Table 1, the 2 groups (control and outpatient) differ in mean age only. It is unclear why this difference exists, but the difference between ages 32 and 36 years is unlikely to have any significance clinically, particularly given that there is no difference.

| Table 2. Transition Times and Outcomes Comparing Control and Outpatient Groups |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| Variable        | Total (n = 351) | Control group (n = 178) | Outpatient group (n = 173) | p Value |
| Transition time |                 |                 |                 |                 |
| Time in ED, h, mean ± SD | 11.6 ± 5.7 | 11.8 ± 5.6 | 11.3 ± 5.8 | 0.24 |
| Time in SOU, h, mean ± SD | 4.4 ± 5.8 | 4.2 ± 5.6 | 4.5 ± 5.1 | 0.08 |
| Operative time, h, mean ± SD | 1.3 ± 0.4 | 1.4 ± 0.4 | 1.2 ± 0.4 | <0.001* |
| Time in PACU, h, mean ± SD | 3.2 ± 2.0 | 2.4 ± 1.2 | 4.0 ± 2.4 | <0.001* |
| Nursing transition, n, median (range) | 5 (3–7) | 6 (5–7) | 4 (3–5) | <0.001* |
| Outcome         |                 |                 |                 |                 |
| Complication, n (%) | 10 (2.8) | 4 (2.2) | 6 (3.4) | 0.54 |
| Post-discharge ED visit, n (%) | 21 (6) | 10 (5.6) | 11 (6.3) | 0.83 |
| Total LOS, h, mean ± SD | 39.2 ± 47 | 42.7 ± 19.1 | 35.8 ± 63.9 | <0.001* |
| Hospital LOS, h, mean ± SD | 14.3 ± 14 | 19.3 ± 13.2 | 9.3 ± 12.9 | <0.001* |
| Readmission, n (%) | 6 (1.7) | 3 (1.7) | 3 (1.7) | 1 |

*Statistically significant.
ED, emergency department; LOS, length of stay; PACU, post-anesthesia care unit; SOU, surgical observation unit.
in patient comorbidities. Because these patients are similar, it is reasonable to compare their outcomes.

Interestingly, the operative time in the outpatient group was, on average, 14 minutes shorter (Table 2). It is unclear why this occurred, but would not have any effect on our conclusions, as operative time was not included in hospital length of stay. Interestingly, the time spent postoperatively in the PACU was, on average, 100 minutes longer for the outpatient group than the control group. This can be attributed to the adoption of a new protocol. Once our outpatient appendectomy protocol was initiated, it was a different process than the standard postoperative admission. We purposely did not want to rush the discharge process to ensure our patients and families had all questions answered and were comfortable leaving the hospital. As the protocol continued, the amount of time in the PACU decreased. The number of nursing transitions was cut down by 2, as there was no postoperative admission. This leads to cost and time savings.

We found time of discharge to have an impact on patients’ ability to obtain a ride, which has been seen in other work. All of the patients who were unable to obtain a ride home were ready for discharge between 6 PM and 6 AM. This certainly increased our length of stay, as this necessitated inpatient admission. There were only 18 patients, however, that were admitted due to inability to find a ride home. Given the patient population we serve, we found this number to be extremely low. We credit our success to our extensive preoperative planning for same-day discharge and communication with patients.

For outcomes, there was no difference seen in postoperative complications, emergency department visits, or readmissions. Our low overall complication and readmission rates of 2.8% and 1.7% are in line with the experiences of others who have instituted an outpatient appendectomy protocol. In addition, of the patients from the outpatient appendectomy group who were discharged home from PACU, there were no postoperative complications or readmissions. Although some of this might be due to chance, we attribute this mostly to our rigorous protocol of patient education and preparation. As mentioned, we wanted to give our patients the best chance to succeed. In the control and experimental groups, 32% and 34% of patients, respectively, did not make their follow-up appointment. It is possible that our postoperative patients presented to other hospitals for management. However, we believe that this is unlikely, as it was stressed to patients verbally and in their information sheet that they should return to our institution’s emergency department for any problems. In addition, because our hospital serves a patient population of low socioeconomic status and often without health insurance, our public hospital is often the only hospital to which they would present. As expected, because the experimental group received surgery on an outpatient basis, we did see statistically significant reductions in length of stay. We were unable to calculate a cost savings from this protocol, but previous literature has estimated a day of hospitalization at $1,900 and adoption of a national outpatient appendectomy program could result in savings of $921,500,000.

Previous work has been criticized for not measuring patient satisfaction to see whether patients were happy with an outpatient appendectomy protocol. Our response rate was low at 55%, which is a limitation. This is not surprising in our patient population, however, as one-third of our patients did not come for their follow-up appointment. Our standardized questions showed that patients were not less satisfied with the outpatient protocol. Specific questions for the outpatient group asking if they were happy with the outpatient protocol and if they would want it again also yielded positive reviews. To our knowledge, this is the first study of outpatient appendectomies that has used satisfaction surveys. This is a real strength of our study and a critique of previous studies. It is possible that there is some bias in these surveys because the low number of responders indicates those happy with the results would be the ones who answered the survey. However, nearly all patients who returned for their postoperative clinic visit completed the questionnaire. Many patients who returned had postoperative questions or symptoms. It is possible that those who did not present were comfortable with their recovery and did not have a need to follow-up. As mentioned earlier, it is also possible that these patients presented elsewhere (although, as mentioned, we think this is unlikely).

In sum, the outpatient and control groups were similar in demographics and valid to compare. Differences in age and operative time seen in our study are interesting but unlikely to be clinically relevant and would not affect our outcomes. The outpatient group showed clear gains in terms of decreased length of stay, nursing transitions, and number of overnight stays, without any difference in postoperative complication, emergency department visits, readmissions, or patient satisfaction. This would result in considerable hospital cost savings. This is the first study of its kind to be conducted in a public county hospital. The results clearly show that an outpatient appendectomy protocol can be executed successfully in our patient population.

CONCLUSIONS
Outpatient appendectomy is safe in a public hospital and results in shorter hospital length of stay and decreased
healthcare costs. Strict criteria for discharge and an emphasis on patient education and understanding are important to identify patients who would likely fail the protocol and should be admitted for observation.

**Author Contributions**

Study conception and design: Rosen, Inaba, Ault
Acquisition of data: Rosen, Oh, Gutierrez, Cala
Analysis and interpretation of data: Rosen, Inaba, Strumwasser, Biswas, Ault
Drafting of manuscript: Rosen, Inaba, Oh, Gutierrez, Strumwasser, Biswas, Cala, Ault
Critical revision: Rosen, Inaba, Oh, Gutierrez, Strumwasser, Biswas, Cala, Ault

**REFERENCES**