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Successful implementation of an appendectomy process improvement protocol

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ABSTRACT

Background A key component of a process improvement program is the institution of hospital-specific protocols to address certain disparities and streamline patient care. In that regard, we evaluated the implementation of an outpatient laparoscopic appendectomy (OLA) protocol at a tertiary military hospital. We hypothesized that OLA would reduce length of stay (LOS) without increasing complications.

Methods In August 2016, our institution implemented an OLA protocol—defined as discharge within 24 hours of surgery. Exclusion criteria included age <18 years old, grade 4 or 5 appendicitis, immunosuppression, current pregnancy, and no supervision during the first 24 hours postdischarge. To determine OLA's effect on LOS, analysis of variance was used to perform a comparison between the years 2014 and 2017. Successful outpatient appendectomies were recorded preprotocol and postprotocol, as well as readmission complications.

Results In 2017, the first full year of protocol implementation, 44 of 59 (75%) patients met the inclusion criteria, and all but 2 (42 of 44, 95%) stayed for less than 24 hours. Of the two outliers, one developed acute on chronic kidney disease and one had a slow return of bowel function following grade 3 appendicitis. Complications were low across all years (one per year). In 2017, the readmission was for percutaneous drainage of an abscess. Overall, protocol implementation produced a significant decrease in LOS.

Discussion OLA protocol decreased LOS at a military hospital and should be expanded to other department of defense (DoD) facilities. Further research is needed to identify cost benefit to the military health system.

Level of evidence III.

INTRODUCTION

Process improvement (PI) programs are becoming more important within surgical subspecialties. Key tenets of successful PI programs include improving resource utilization and enhancing overall patient experience. In 2016 our institution created a novel emergency general surgery (EGS) PI program in an effort to continuously scrutinize and strengthen the care provided to the acutely ill.[1 2] Within this program, we developed disease-specific protocols to minimize the variance in treatment and improve the overall efficiency of patient care.

In particular, we developed a protocol for the management of uncomplicated appendicitis because it was noted that perioperative antibiotics, pain management, and initiation of oral intake varied significantly among providers and impacted hospital length of stay (LOS). Previous research had found that laparoscopic appendectomy was associated with a median LOS greater than 2 days.[3] Since then, several civilian hospitals have successfully instituted protocols for early discharge after laparoscopic appendectomy in both the adult and pediatric population to reduce in-hospital morbidity, improve patient satisfaction, and decrease healthcare costs.[4–9]

Protocols for early discharge after appendectomy have not been previously studied in the military population. Questions remain about how translatable such a protocol would be in the military given the potential large catchment area for military hospitals and the unique jobs certain military service members hold. Despite these potential pitfalls, we implemented an outpatient laparoscopic appendectomy protocol at our tertiary military hospital and evaluated the outcomes after the initiation. We hypothesized that our outpatient laparoscopic appendectomy protocol could be safely implemented and would lead to reduced LOS without an increase in adverse events.

METHODS

In August 2016, our institution implemented an outpatient laparoscopic appendectomy protocol, defined as discharge on the day of operation or within 24 hours after surgery (figure 1). Prior to the development of this appendicitis protocol, postoperative care was managed at the discretion of the attending surgeon. Inclusion criteria for eligibility into this protocol were adults age ≥18 who had home support for 24 hours and were reliable for follow-up. Exclusion criteria included grade 4 or 5 appendicitis, history of immunosuppression, pregnancy, and lack of any supervision at home for the first 24 hours postoperatively (box 1). Appendicitis grading was based on the operative findings following the American Association for the Surgery of Trauma grading system, with grade 4 and 5 involving localized abscess, phlegmon, or gross purulence (table 1).[10]

The protocol included discussing the possibility of early postoperative discharge during the preprocedural informed consent process. A single preoperative dose of cefoxitin, or ciprofloxacin and metronidazole for penicillin-allergic patients, was given prior to surgery. The operation involved a standard three-port laparoscopic appendectomy using local anesthetic prior to port site incisions and administration of ketorolac at the end of the case, provided there were no contraindications to

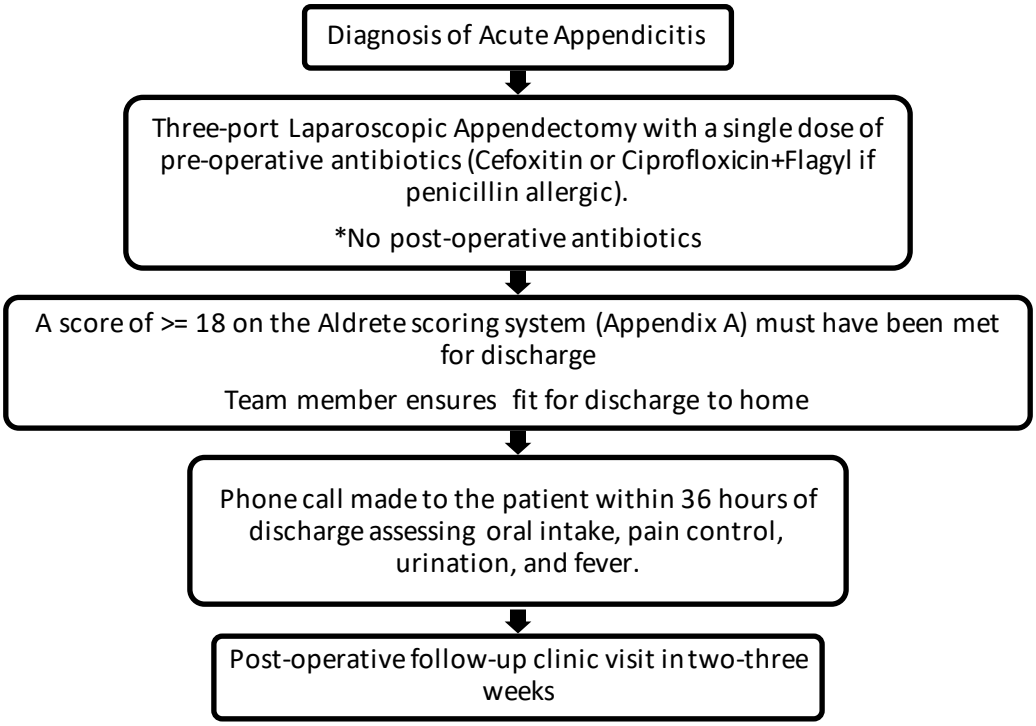

Figure 1 Flow diagram of outpatient appendectomy protocol.

non-steroidal anti-inflammatory agents. A score of 18 or higher on the Aldrete scoring system (online supplementary appendix A) must have been met prior to discharge.[11] All patients were discharged with a responsible adult escort, and a postoperative phone call was made to the patient no later than 36 hours after discharge. A standard 1-week convalescence period was given to each patient, which patients could to the fullest extent at their discretion.

Our EGS registry was reviewed for appendectomy cases from 2014, the year we routinely began collecting EGS data, through 2017. The total number and percent of successful outpatient appendectomies and all associated complications were recorded preprotocol and postprotocol implementation. Outcomes collected by our EGS registry included but were not limited to readmissions, deep and superficial soft tissue infections, organ space infection, pneumonia, urinary tract infection, sepsis, acute and progressive renal failure, return to the operating room (OR), unplanned admission to the intensive care unit, unplanned intervention, and venous thromboembolism.

Comparisons were made between the years 2014 and 2017, with 2017 being the first full year of protocol implementation. To determine if the outpatient appendectomy protocol had an effect on LOS, a one-way analysis of variance (ANOVA) was conducted between the 4-year study period. For further comparison, Student's t-tests were performed to compare LOS in 2017, the first postprotocol year, with each previous preprotocol year individually. In addition, Student's t-test was performed to compare 2017 mean LOS with the combined three previous years' mean LOS. Similar ANOVA comparisons were made between years to determine any variation in the demographics of age and gender. A p value of <0.05 was set as statistically significant. All statistics were performed in STATA V.13.1. Results were listed as means±SD or percentages.

Box 1 Inclusion and exclusion criteria for outpatient appendectomy protocol

Inclusion criteria.
- Age 18.
- Reliable for follow-up.
- Has support at home for the first 24 hours.

Exclusion criteria.
- Grade 4 and 5 perforated appendicitis.
- Age <18.
- Lack of supervision at home.
- Immunosuppressed, for example, transplant patient, chronic steroids and type 1 diabetes mellitus.
- Unable to meet the discharge criteria (see online supplementary appendix A).
- Pregnancy.
- Attending surgeon discretion.

RESULTS

Overall, total appendicitis cases increased during the 4-year period from 41 in 2014 to 68 in 2017. Conversely, the percentage of these cases meeting the inclusion criteria trended down over the time period (85% in 2014, 60% in 2015, 48% in 2016, and 65% in 2017). The total number of patients meeting the inclusion and exclusion criteria is listed in table 2. Prior to the full year of protocol implementation, an average of only 54% (59 of 110) of patients in the preceding 3 years who met the eligibility criteria stayed less than 24 hours. However, this

Table 1 American Association for the Surgery of Trauma grading system for acute appendicitis[10]

Grade 1	Inflamed without perforation.
Grade 2	Gangrenous without perforation.
Grade 3	Local inflammation without abscess or phlegmon.
Grade 4	Localized abscess or phlegmon.
Grade 5	Gross purulence and contamination.

Table 2 Comparison of demographics and length of stay between years

	2014	2015	2016	2017	P value
Age	41±3.0	38±2.0	40±2.3	37±2.4	0.78
Gender (% male/female)	69/31	53/47	71/29	57/43	0.27
Total appendicitis cases	41	57	58	68	
Total number meeting the exclusion criteria	6	10	30	24	<0.001
Total number meeting the inclusion criteria	35	47	28	44	1.00
Number of patients staying <24 hours	14	26	19	42	<0.001
Percent compliance with eligibility	40	55	68	95	
Total number of patients staying >24 hours	27	31	39	26	1.00
Percent of patients meeting the inclusion criteria staying >24 hours	60	45	32	5	<0.001
Average LOS protocol eligible (hours)	33±4.0	28±2.0	26±4.0	16±2.0	<0.001

LOS, length of stay.

percentage did increase each year from 40% in 2014 to 68% in 2016, the year the protocol was initiated two-thirds of the way through (table 2).

In 2017, 44 patients met the inclusion criteria for outpatient appendectomy protocol. The majority (89%) of these patients had grade 1 appendicitis, whereas one (2%) patient had grade 2 appendicitis and four (9%) had grade 3 appendicitis. Of these 44 patients, 42 (95%) stayed for less than 24 hours postoperatively. Of the two patients who stayed longer than 24 hours postoperatively, one had a history of chronic kidney disease (CKD) and developed acute kidney injury (AKI), which resolved by the time of discharge. The other patient had a slow recovery following grade 3 appendicitis. Of those 42 patients who had a postoperative stay less than 24 hours, three had a total LOS (preoperative and postoperative) longer than 24 hours, which was due to delays to the OR.

Overall, the majority of patients who met the inclusion criteria during the 4-year period were male (61%), with a mean age of 39±1.5. There was no significant difference between years with regard to age (F (3, 155)=0.36, p=0.78) or gender (F (3, 156)=1.3, p=0.27). From 2014 and 2017 the mean LOS decreased from 33 hours in 2014 to 16 hours in 2017. Statistically, there was a significant effect of the implementation of the protocol on LOS at the p<0.05 level for the 4 years captured (F (3, 156)=6.05, p<0.001) (table 2) when compared using ANOVA. Further comparison via Student's t-test of 2017, the first full year of protocol implementation and compliance, with each previous preprotocol year also demonstrated statistically significant differences in LOS (2017 vs 2014: 16 vs 33, p<0.001; 2017 vs 2015: 16 vs 28, p<0.001; 2017 vs 2016: 16 vs 26, p=0.02). Similarly, the mean LOS in 2017 compared with the combined LOS of the three previous years also revealed statistical significance (16 vs 29, p<0.001).

In general, postoperative complication rates were low (6% in 2014, 2% in 2015, 4% in 2016, and 2% in 2017; p=0.77). Two patients suffered complications in 2014, with one patient readmitted for percutaneous drainage of an intra-abdominal abscess, and the other one evaluated for rectal bleed. In 2015, one patient required bladder catheterization for urinary retention, whereas one patient in 2016 underwent a workup for fever and malaise. Similarly, in 2017 there was only one complication in a patient with a postoperative abscess requiring percutaneous drainage 12 days after discharge following an appendectomy in grade 1 appendicitis. Aside from these few complications, all patients actively working prior to the development of appendicitis were able to return to their respective workspace without issues after a standard 1-week convalescence.

Based on estimated hospital charges and reduction in hospital stay by nearly 24 hours during the study time period, the military health system could avoid annual costs of $3.98 million from direct care. Nationally, that annual figure is $416.1 million. The military health system (MHS figures are based on average patient volumes for direct care and TRICARE appendectomies in the MHS and the average ward costs for 1 day at a rate of $1742.47 from our survey of civilian hospitals (n=130).

DISCUSSION

Our military institution successfully implemented an outpatient laparoscopic appendectomy protocol resulting in a decrease in LOS without an increase in morbidity. This protocol was developed under the auspices of our EGS PI program. PI is a dynamic process that requires constant evaluation of procedures, algorithms, and management strategies for treating diseases.[12] High-quality, data-driven patient care can be rendered through continued assessment of performance measures such as time to OR, time to discharge, complications, and cost savings.

Earlier discharge, and thus return to duty, for our military population is important at both the individual and unit level given the unique jobs of certain service members. However, the logistics of arranging early discharge were initially challenging given that our military hospital serves a large tristate catchment area. Counseling upfront in the emergency room regarding expectations for discharge and ensuring available transportation allowed for a smooth transition into our outpatient protocol. All patients in our cohort were given a week of convalescence and, aside from the very few complications, all patients returned to work without issues.

Administering timely patient care is a core aim of PI.[13] However, what constitutes appropriate timing to the OR for appendicitis has been a point of debate. Proponents of early appendectomy have argued that it minimizes risk for rupture and postoperative complications.[14–16] Other investigators have found no association with in-hospital time to OR and perforation.[17–19]

There are several factors that can affect time to an operation. CT is often obtained to confirm the diagnosis of appendicitis, and this process can often take several hours to complete, especially at busy emergency rooms. Likewise, finding room availability during a hectic, high-volume operative period may prove challenging despite advocating for early appendectomy. In addition, staffing during the overnight shift may also cause delays to the OR. Although time to the OR was not captured with data presented here, personal experience and communication within our group identified three known patients who had unplanned

delays to the OR (greater than 12 hours) and provide an additional area for improvement at our institution. These cases appeared to be delayed due to case volume and current lack of a dedicated EGS operative room. Moving forward, time to the OR is being captured within our entire registry to determine if this is a modifiable variable and to provide data to support an EGS room.

An additional strategy employed to shortened LOS with laparoscopic appendectomies has been through the discharge of patients directly from the post anesthetic recover room (PACU).[9] This practice contributed to a shorter postoperative hospital stay, and thus shorter hospital LOS, by removing the potential lengthy process of transferring a patient from the PACU to a ward. Although the idea of discharging from the PACU may seem simple or inconsequential, it is not an easy process. It requires substantial institutional changes in policy, PACU staffing, and nursing practice for it to be successful. It remains to be seen if discharge from the PACU at our institution will lead to a considerable decrease in postoperative time, but this is an area for further PI for our group. However, as with any change, it will require time to implement.

Decreasing the economic burden of rising healthcare costs should be a focus of any PI program while still promoting exceptional patient care. Several authors have demonstrated a financial benefit to earlier discharge after appendectomy.[17 20] Likewise, others have found that maintaining a patient in an outpatient status with discharge from the PACU has also had a financial advantage.[9] However, as mentioned before, there are logistical and policy-related issues to overcome to retain a patient in an outpatient status from emergency room to discharge. It may take time to implement this procedure within our facility. Regardless, the possibility of expanding our protocol throughout the entire military health system, the largest healthcare network in the world, to reduce costs could result in a significant financial impact on healthcare costs.

CONCLUSIONS

An outpatient appendectomy protocol is safe and feasible in a tertiary military hospital. Further areas of PI should focus on whether time to the OR will enhance patient care. The cost benefit of this, and other EGS protocols, across the global military health system should be explored in more detail.

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Competing interests None declared.

Patient consent for publication Not required.

Ethics approval The study was approved as a process improvement initiative by the Walter Reed National Military Medical Center's Institutional Review Board (IRB) in compliance with all applicable Federal regulations governing the protection of human subjects.

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Data availability statement All data relevant to the study are included in the article.

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