The American Journal of Surgery 217 (2019) 830–833

Contents lists available at ScienceDirect

The American Journal of Surgery

journal homepage: www.americanjournalofsurgery.com

Expedited discharge in uncomplicated acute appendicitis: Decreasing the length of stay while maintaining quality

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ARTICLE INFO

Article history:
Received 8 November 2018
Received in revised form
3 March 2019
Accepted 6 March 2019

Keywords:
Appendectomy
Discharge
Laparoscopic appendectomy
Patient satisfaction

ABSTRACT

Background: An expedited discharge protocol for uncomplicated appendicitis was developed at a Canadian academic hospital to determine if patients could be safely discharged home early without negatively impacting care and patient satisfaction.
Methods: A non-randomized prospective quality improvement project was completed between February 01, 2017 and January 31, 2018. The project included patients between 16 and 65 years with uncomplicated appendicitis managed with laparoscopic appendectomy. The primary outcome was average length of stay post PACU. 30 day ED visit, cross-sectional imaging and readmission rate were balancing measures. The CTM-3 tool was used to measure patient satisfaction.
Results: 450 patients had emergent laparoscopic appendectomy. 287 (63.8%) patients met the project inclusion criteria. The average length of stay decreased 41.0% to 13.1 h. The 30 day ED visit, cross-sectional imaging and readmission rate were 9.8%, 4.5% and 1.0% respectively compared with 8.1%, 4.5% and 2.5% at baseline. Patient satisfaction was 3.72/4 compared to 3.74/4.
Conclusion: An expedited discharge after an uncomplicated laparoscopic appendectomy is safe and feasible without a negative impact on 30-day ED visit, diagnostic imaging or readmission.

Introduction

Acute appendicitis is a common urgent surgical condition. The age and gender adjusted incidence of acute appendicitis in Canada is 75 per 100 000 annually with a slight male predilection of 1:1.4.[1] The median age of acute appendicitis patients is 26.[1] The incidence of acute appendicitis decreases dramatically after the age of 65.[1] The laparoscopic appendectomy is the preferred surgical approach in most centers with an associated short postoperative hospital stay and low complication rate.

Limited acute surgical beds is a common problem encountered in the Canadian healthcare environment.[2] Surgical patients can wait in the Emergency Department (ED) for prolonged periods of time and elective surgeries can be cancelled when appropriate ward beds are not available.[2] This has a negative impact on patient care and interferes with patient flow from the ED to the inpatient wards. Hospitals are focused on identifying strategies to discharge surgical patients home sooner while maintaining a high quality of care to build capacity.[3] Potential targets of these strategies are common surgical procedures performed on generally younger and otherwise healthy patients. The urgent laparoscopic appendectomy is the ideal procedure as the patient population frequently meets these criteria.[4] There are health centers in North America and Europe that successfully practice a same day discharge for uncomplicated laparoscopic appendectomy patients using a variety of interventions[3,5–13]. The available literature has shown that a same day or expedited discharge is feasible and safe when the appropriate patient population is identified. Common reasons for a prolonged admission following laparoscopic appendectomy include; lack of a ride home, time of surgery, nausea and vomiting, urinary retention, and pain.[5]

The enhanced recovery after surgery (ERAS) protocol has been validated in the colorectal literature to address surgical stress, postoperative physiologic function and accelerate recovery in patients undergoing major surgery.[14] The key components of the ERAS

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https://doi.org/10.1016/j.amjsurg.2019.03.007
0002-9610/

protocol include patient education, optimal fluid management, decreased Foley catheter use, opioid sparing analgesia, early mobilization and early progression of the diet.[14] This project applied the ERAS framework to acute appendicitis patients to identify potential interventions to improve care, build acute surgical inpatient bed capacity and decrease costs.

Methods

A non-randomized prospective quality improvement project was completed between February 01, 2017 and January 31, 2018 at the Foothills Medical Centre (FMC) in Calgary, Alberta. The Model for Improvement was used as the quality improvement framework to design and implement change ideas. A time series study design that introduced different interventions over a specific timeframe was initiated. Consecutive Plan-Do-Study-Act (PDSA) cycles were designed and applied to patients with uncomplicated acute appendicitis at FMC. The A pRoject Ethics Community Consensus Initiative (ARECCI) tool was used to classify the project. The Conjoined Health Research Ethics Board at the University of Calgary was consulted to confirm the project classification. The project was exempt from a research ethics review consistent with the standards set out in the TriCouncil Policy Statement 2014 (Chapter 2, Article 2.5).

The data set was created by querying the provincial electronic medical record (EMR) used by Alberta Health Services in the Calgary Health Zone. The Data Integration, Measurement and Reporting (DIMR) service in the Calgary Health Zone created a data set. The variables collected included the patient age, gender, patient care unit discharged from, admission date and time, PACU discharge date and time, and hospital discharge date and time.

The inclusion criteria for the project were patients aged 16–65 years, with uncomplicated acute appendicitis, undergoing a laparoscopic surgical approach, the patient lived within 1 h of a hospital, an adult caregiver was available for the first 24 h after discharge and good patient compliance. The exclusion criteria were pregnancy, immunosuppression, dialysis and insulin dependent diabetes.

Visits to the ED within thirty-days of discharge, readmission within thirty-days of discharge and diagnostic imaging performed with thirty-days of discharge were calculated using information available from the provincial EMR. Operative reports were reviewed to exclude patients with a perforated appendix or an intra-abdominal abscess. Patient comorbidities were determined by reviewing the relevant discharge summaries.

The 3 item Care Transitions Measure (CTM-3) tool was used to measure patient satisfaction after discharge.[15] Patient satisfaction is not routinely measured for appendicitis patients at FMC. We determined baseline patient satisfaction by contacting the patients undergoing a laparoscopic appendectomy in January 2017 before the project was initiated.

We performed an intention-to-treat analysis and a subgroup analysis of patients who were admitted for less than 12 h. For each analysis, we calculated the rates of the primary outcomes (imaging, readmission, and ED visits) and their exact binomial confidence intervals. In addition, we evaluated the associations of age, gender, day of the week, time of day, and discharge location with length of stay, imaging, readmission, ED visit, and average patient satisfaction score. Associations were evaluated using the Fisher's exact test for categorical variables, linear regression for continuous variables, and either Wilcoxon rank-sum test, Kruskal-Wallis test, or linear regression (with bootstrapped standard-error estimation) for patient satisfaction, as appropriate.

Results

To understand the current state of the management of uncomplicated appendicitis at our hospital, baseline data was collected and analysed for 12 months prior to the start of the project (January 01, 2016 to December 31, 2016). The project was completed from February 01, 2017 to January 31, 2018. The baseline and project demographics are represented in Table 1.

The primary outcome measures were average length of stay after discharge from the post anesthesia care unit (PACU), percentage of patients discharged home within 12 hours of leaving the PACU and patient satisfaction. The baseline average length of stay for a patient meeting the project's inclusion criteria was 22.2 hours with a range of 5.9 to 90.5 hours. The average length of stay during the project was 13.1 hours with a range of 2.5 to 39.0 hours (Table 2). The percentage of patients being discharged home within 12 hours of leaving the PACU was 11.9% at baseline and 50.2% during the project (Table 2). These differences were statistically significant. Patient satisfaction was calculated using the CTM-3 tool. The baseline patient satisfaction was 3.73/4 compared to 3.72/4 during the project (Table 2). This was not statistically significant indicating that patient satisfaction remained high before and after our interventions. If we include only the patients discharged within 12 hours of leaving the PACU (n=144), the average length of stay was 8.1 hours (2.5-12.0 hours) and patient satisfaction was 3.70 (Table 3).

The balancing measures included thirty day Emergency Department visit, cross-sectional imaging and readmission rates. The rates were 8.1%, 4.5% and 2.5% respectively at baseline. During the project, these rates were 9.8%, 4.5% and 1.0% (Table 4). These were not statistically different. No patients required reoperation in

Table 1
Patient demographics.

	Pre-intervention	Post-intervention Intention to treat	Post Intervention (discharged within 12 h)
Number of patients appendicitis	421	450	144
Meet project criteria	285 (67.7%)	287 (63.8%)	N/A
Average age	34.7 years (16–64)	35.9 years (16–64)	35.0 years (16–64)
Gender (M:F)	52.8:47.2	48.4:51.6	50.0:50.0

Table 2
Intention to treat: Average length of stay and patient satisfaction.

	Pre-intervention	Post-intervention	P value
Average LOS post PACU	22.2 h (5.9–90.5)	13.1 h (2.5–39.0)	<0.001
Percentage of patients discharged with 12 h	11.9%	50.2%	<0.001
Patient Satisfaction	3.73/4	3.72/4	0.69

Table 3
Patients discharged within 12 h: Average length of stay and patient satisfaction.

	Pre-intervention	Post-intervention	P value
Average LOS post PACU	22.2 h (59–90.5)	8.1 h (2.5–12.0)	<0.001
Percentage of patients discharged with 12 h	11.9%	100.0%	<0.001
Patient Satisfaction	3.73/4	3.70/4	0.69

Table 4
Intention to treat: Balancing measures.

	Pre-intervention	Post-intervention	P value
30 day ED	8.1%	9.8% CI (6.6–13.8)	0.28
30 day imaging	4.5%	4.5% CI (2.4–7.6)	0.89
30 day readmit	2.5%	1.0% CI (0.2–3.0)	0.13

Table 5
Patients discharged within 12 h: Balancing measures.

	Pre-intervention	Post-intervention	P value
30 day ED	8.1%	10.4% CI (5.9–16.6)	0.29
30 day imaging	4.5%	2.8% CI (0.8–7.0)	0.42
30 day readmit	2.5%	0.0% CI (0.0–2.5)	0.06

the baseline or project populations. The thirty day ED, cross-sectional imaging and readmission rates for the patient cohort discharged within 12 hours were 10.4%, 2.8% and 0.0% respectively (Table 5). During the study, 42.9% of patients presenting to the ED did not have cross-sectional imaging or require admission.

Several variables were assessed for a relationship with our primary outcomes and balancing measures. These included age, gender, time of surgery and weekend vs. weekday. Timing of surgery was defined as day (0700–1500) n = 64, evening (1500–2300) n = 122 and night (2300–0700) n = 101. There were 204 laparoscopic appendectomies performed on weekday and 83 performed on a weekend. Age was significantly associated with length of stay post-operatively. Every decade of patient age increased the length of stay by 0.69 h. This is not clinically important. There was no association between average length of stay and gender, time of day of surgery or weekday vs. weekend.

Data to support the average cost per hour of a hospital stay for patients with acute appendicitis is not available at our hospital; however, inpatient hospital bed utilization was used as an indirect measure of cost savings as a result of decreased hospital length of stay. In the pre-intervention cohort every patient utilized an inpatient hospital bed, but post-intervention 44 out of 287 (15.3%) patients avoided an inpatient hospital bed and were discharged directly from the Day Surgery unit. A Day Surgery procedure, such as an appendectomy, costs Alberta Health Services $1334 which includes perioperative care. This value represents the baseline cost of any appendectomy both pre- and post-intervention excluding the cost of an inpatient bed. Alberta Health Services charges $1906 for an inpatient hospital bed regardless of the number of hours occupied by the patient.[16] As a result, the decrease in inpatient bed utilization post-intervention equates to a net savings of $83 864. Pre- and post-intervention the thirty-day rates for readmission, emergency department visits and cross-sectional imaging were not significantly different resulting in no net effect on cost or savings. These variables were a proxy for cost of complication rates.

There were no identified costs of the intervention. There was no increase in pay to doctors, nurses or other health care providers. Education to front-line health care providers was not compensated with any additional funding. The net estimated cost savings post-intervention was therefore $83 864 or $292.21 per patient discharged from Day Surgery.

Discussion

The Model for Improvement is a quality improvement framework used to design and implement quality improvement projects.[17] We consulted with General Surgeons, Emergency Department physicians, ward nurses and hospital administrators to identify potential interventions that may decrease the length of stay, but ensure a high quality patient care. The most common themes preventing discharge were a lack of an appropriate ride home, time of surgery, post-operative pain, postoperative nausea and vomiting and nursing culture. Many of these are addressed using ERAS principles.[14] The first intervention was multi-pronged and included; 1. Education and presentations to the General Surgery staff and residents, and to nursing staff to bring awareness about the project 2. Discharge process was started in the ED 3. Patients were permitted to be discharged from Day Surgery, and 4. Expedited appendicitis worksheet was introduced. The staff and residents received the project very well and were keen to participate. The project was reinforced regularly through the General Surgery residents working on the acute care surgical service. The worksheet was housed in the Emergency Department. Discharging patients from Day Surgery prevented admission to a regular ward bed and placed patients in an environment where discharging uncomplicated post-operative patients is the mandate. Unfortunately, the worksheet was not successful. The worksheets were routinely discarded by the ED staff, not completed by the residents and misplaced in the charts. The worksheets were abandoned in the third month of the project due to poor utilization. The second intervention introduced an expedited acute appendicitis order set to the electronic patient record. The order set included early mobilization, early diet, oral pain medication, no post-op IV fluids and a conditional discharge home. This has been successful as patients are ready for discharge sooner and the bedside nurses are preparing the patients for discharge as soon they leave the PACU.

The majority of patients met the inclusion criteria for the project (63.8%). The main reasons for exclusion included older age and perforation.

There has been a clear improvement in the average length of stay and the percentage of patients discharged within 12 h of leaving the PACU. We will need continued data collection in the short term to ensure that our improvement is sustainable. We believe that further decreases in average length of stay are possible with diligence. The project team believes that our interventions are highly transferable to other hospitals in our city as well as elsewhere in Canada.

We chose balancing measures that may indicate that our interventions were having a negative impact on patient care and the healthcare system. Thirty day Emergency Department visit, cross-sectional imaging and readmission rates were not statistically different. Our results are very similar to other studies. A systematic review by Cosse et al. that included 13 studies reported an unexpected consultation rate of 0%–11.11%, readmission rate of 0%–5.1% and reoperation rate of 0%–2.5%.[5] The number of patients returning

to the ED and being discharged home without imaging or readmission (42.9%) suggests that better patient education may be beneficial. We have been reviewing and editing our patient discharge instructions to this end. We plan to give a copy of the discharge sheet at the time of admission to set the expectations for the hospital visit. The number of patients having cross-sectional imaging without requiring intervention of admission suggests that better education and communication with the Emergency Department may be of value. This poor use of resources adds a burden on the healthcare system with limited to no value to the patient.

A challenging barrier to continued improvement is the time of surgery. A significant portion of the appendectomies were performed in the evening hours outside the current policy of 0200 and 1830. These patients are not able to be discharged from the Day Surgery unit due to nurse staffing issues. Although not a statistically significant factor in discharging patients within 12 h of leaving the PACU, it is a barrier to further decreasing the length of stay as the patients must be discharged from the surgical ward. We are attempting to increase the hours that the Day Surgery unit will discharge patients. Negotiations regarding PACU staff discharging the patients when the Day Surgery unit have not been successful, but would be the next logical intervention. Potential solutions to this problem are being solicited.

Capacity and cost savings are common key components of quality improvement projects. Decreasing the average LOS by 41.0% not only results in a cost savings in patient care but builds capacity on the surgical wards by freeing beds for more appropriate patients. Eliminating 44 admissions alleviates some of the bed space pressures experienced each morning from the ED and the elective surgery slate. Decreasing the average length of stay by 9 h may improve flow from the ED to the surgical wards. Cost savings in a publicly funded single payer healthcare system can be difficult to measure. We showed a simplified cost savings approach that identified a savings of $83 864 or $292.21 per Day Surgery discharge. Additional cost savings from food services, medications and housekeeping were likely realized but difficult to measure accurately. In comparison, a Canadian study by Dubois et al., in 2009 described an overall cost savings of $323 per expedited discharge compared to the traditional hospital stay while an American study by Farach et al., in 2014 showed a substantial median reduction in hospital charges of $4111 per expedited patient.[10,13]

The next steps in the project are formally introducing our protocol to other hospitals in our city. This has started on a small scale with General Surgery residents applying the interventions when they are working on surgical services at other hospitals. An updated patient discharge sheet has been developed and is awaiting approval for usage. Finally, we are working with the PACU administrators to start discharging patients directly from the PACU. We believe this will decrease the average length stay further as seen in other centers.

Strengths of the project include the prospective design and the comprehensive electronic patient chart available for data collection. A limitation is the single health centre application of the project.

Conclusion

An expedited discharge after an uncomplicated laparoscopic appendectomy is safe and feasible. This protocol did not have a negative impact on 30-day re-admission, diagnostic imaging or ED visits. Moderate acute surgical inpatient bed capacity was created and the project was cost effective.

Conflicts of interest

None of the authors have any financial or personal, direct or indirect, conflicts with regard to this manuscript.

References

1. Al-Omran M, Mamdani MM, McLeod R. Epidemiologic features of acute appendicitis in Ontario, Canada. *Can J Surg*. 2003;46(4):263–268.
2. Eggertson L. ED problems result of bed shortages, doctors contend. *CMAJ (Can Med Assoc J)*. 2004;170:11.
3. Sabbagh C, Brehant O, Dupont WH, et al. The feasibility of short stay laparoscopic appendectomy for acute appendicitis: a prospective cohort study. *Surg Endosc*. 2012;26:2630–2638.
4. Hardin DM. Acute appendicitis: review and update. *Am Fam Physician*. 1999;60(7):2027–2034.
5. Cosse C, Sabbagh C, Grelpois G, Brehant O, Regimbeau JM. Day case appendectomy in adults: a review. *Int J Surg*. 2014;12:640–644.
6. Frazee R, Abernathy SW, Davis MD, et al. Outpatient laparoscopic appendectomy should be standard of care for uncomplicated appendicitis. *J Trauma Acute Care Surg*. 2014;76(1):79–83.
7. Gilliam AD, Anaud R, Attwood SE, et al. Day case emergency laparoscopic appendectomy. *Surg Endosc*. 2008;22:483–486.
8. Alverez C, Voitk AJ. The road to ambulatory laparoscopic management of perforated appendicitis. *Am J Surg*. 2000;179:63–66.
9. Grepois G, Dabbagh C, Cosse C, et al. Management of uncomplicated acute appendicitis as day case surgery: feasibility and a critical analysis of exclusion criteria and treatment failure. *J Am Coll Surg*. 2016;223:694–703.
10. Dubois L, Vogt KN, Davies W. Impact of an outpatient appendectomy protocol on clinical outcomes and cost: a case control study. *J Am Coll Surg*. 2010;211:731–737.
11. Cash CL, Frazee RC, Abernathy SW. A prospective treatment protocol for outpatient laparoscopic appendectomy for acute appendicitis. *J Am Coll Surg*. 2012;215:101–106.
12. Scott A, Shekherdimian S, Rouch J, et al. Same-day discharge in laparoscopic acute no- perforated appendectomy. *J Am Coll Surg*. 2017;224:43–48.
13. Farach SM, Danielson PD, Walford NE, et al. Same day discharge after appendectomy results in cost savings and improved efficiency. *Am Surg*. 2014;80(8):787–791.
14. Shida D, Tagawa K, Inada K, et al. Enhanced recovery after surgery (ERAS) protocols for colorectal cancer in Japan. *BMC Surg*. 2015;15:90.
15. Dedhia P, Kravet S, Bulger J, et al. A quality improvement intervention to facilitate the transition of older adults from three hospitals back to their homes. *J Am Geriatric Society*. 2009;57(9):1540–1546.
16. Alberta Health Services inpatient billing. Calgary Zone Rates Schedule. April 1, 2017.
17. Berwick D. A primer on leading the improvement of systems. *BMJ*. 1996;312(7031):619–622.