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Postoperative timing of computed tomography scans for abscess in pediatric appendicitis

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ABSTRACT

Background: One-quarter to one half of pediatric appendicitis patients present with ruptured appendicitis and about 3%–25% go on to form postoperative intra-abdominal abscesses. The optimal timing of postoperative imaging for suspected abscess formation has been a subject of debate.

Methods: All patients who underwent appendectomy for complex appendicitis and were not discharged before postoperative day (POD) #5 from April 2012–October 2014 were identified. Patients were stratified into groups for comparison as follows: group 1 had postoperative computed tomography (CT) scans before POD#7 ($n = 26$) and group 2 did not ($n = 169$). Group 2 was further divided into those who were afebrile (group 2a, $n = 106$) or febrile (group 2b, $n = 63$) at POD#5.

Results: A total of 195 patients met criteria. Early use of CT scans resulted in more drainage procedures (group 1, 73.1% *versus* group 2b, 28.6%, $P < 0.001$) and a higher recurrent CT scan rate (38.5% *versus* 9.5%). The groups had equivalent lengths of stay (11.9 *versus* 9.8 d, $P = 0.10$) and readmission rates due to abscesses (19.2% group 1 *versus* 6.3%, group 2b, $P = 0.12$) with no septic events. In total, 130 of the 169 patients (76.9%) in group 2 had resolution of symptoms before discharge without intervention with readmission for abscess in only 5.9%.

Conclusions: Waiting until POD#7 before scanning led to fewer drainage procedures and recurrent CT scans without increasing length of stay or readmission rates. Most complex appendicitis patients still admitted at POD#5 had resolution of symptoms without need for intervention.

1. Introduction

Appendicitis is the most common cause of urgent surgical intervention in children and leads to thousands of admissions annually with significant morbidity [1,2]. Patients with ruptured appendicitis often have long hospital lengths of stay (LOS) and are more likely to develop postoperative complications, including both superficial and deep surgical site infections [3]. Rates of presentation with a perforated appendicitis range in the literature from 23%–50% [3–6] with

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abscess formation ranging from 3%–25% [7]. The initial work-up for appendicitis often includes computed tomography (CT) scans with their associated costs and radiation [8]. Patients with perforated appendicitis often receive additional imaging including abdominal ultrasounds and CT scans if fevers or other symptoms persist after the first few postoperative days. The optimal timing for postoperative CT scans is controversial. Some authors advise a minimum of seven postoperative days before scanning [9]. Early CT scans may identify fluid collections of uncertain clinical significance leading to interventions such as drain placement or fluid aspiration in patients where symptoms may have resolved with antibiotic therapy alone. Others dispute this timetable, but there is little evidence to provide guidance [10]. Given current efforts to improve care while reducing costs and morbidity, the question of the appropriate timing of CT scans in pediatric patients with complex appendicitis has important implications.

2. Methods

As part of our ongoing institutional quality improvement efforts, all patients admitted to our hospital with appendicitis are followed and entered into a database for continuing review. We performed a retrospective review of our institutional appendicitis database from the beginning of April 2012 to the end of October 2014. All patients with complex appendicitis who underwent appendectomy and were not discharged before postoperative day (POD) #5 were included. Complex appendicitis was defined as having ruptured or gangrenous appendicitis as determined by the surgeon at the time of operative intervention. Early postoperative fevers were common after appendectomies for complex appendicitis. On review of our appendicitis patients, it was noted that most patients had a resolution of fevers after the first few postoperative days. Patients that were still admitted by POD#5 were typically either still experiencing fevers or had significant issues with pain and ileus, which were both concerning for possible abscess development. The cutoff of POD#5 was selected to identify patients at our hospital who were at the highest risk of abscess formation.

Patients were classified into two groups as follows: those who had a postoperative CT scan looking for an abscess before POD#7 (group 1, $n = 26$) and those who did not (group 2, $n = 169$). The division of patients into those who were scanned before and after POD#7 was based on historic guidelines in the literature that CT scanning before day 7 was not advised due to inadequate time for abscess formation [9,10]. Patients who did not have a CT scan before POD#7 were further classified into those who were afebrile (group 2a, $n = 106$) or febrile (group 2b, $n = 63$) at POD#5. Fever was defined as a temperature >37.5°C. The low fever cutoff of 37.5°C was selected initially as part of a large postoperative protocol to try to reduce the number of patients with postoperative abscess. This conservative number was selected as a starting point for fever cutoff to assure that patients were adequately afebrile before discharge. The aim of this practice was to try to identify at-risk patients and reduce the number of postoperative abscesses.

All patients were tracked to follow ultimate outcomes including abscess formation, drain placement and/or abscess aspiration, abscess culture results, recurrent CT scans, septic events, LOS, and readmission rates. Septic events were defined as an infection associated with an abscess leading to a diagnosis of shock during the index admission or on readmission. Recurrent CT scans were defined as CT scans performed in addition to those used for initial diagnosis of abscess, and rate of recurrent CT scans was determined by dividing the number of additional CT scans per group by the number of patients in that group. Chi-square analysis of categorical variables was performed unless the total event counts were less than five, in which case Fisher exact tests were performed with significant results being defined as $P < 0.05$. The mood's median test was used to compare LOS data with significant results being defined as $P < 0.05$.

After initial analysis of data from April 2012–February 2014, a change in practice was made to wait until at least POD#7 before obtaining a CT scan evaluating for an abscess. This practice change went into effect in March 2014. Statistical Process Control methodology with a p-chart was used to track both our prepractice change and postpractice change CT scan rates for postoperative appendectomy patients. Of note, per our complex appendicitis protocol, all patients with a diagnosis of ruptured or gangrenous appendicitis are treated with IV antibiotics (usually piperacillin and tazobactam or ciprofloxacin and metronidazole) until discharge. Before discharge, they must be afebrile for 24 h and must tolerate and eat at least 50% of the three regular meals. A white blood cell count is obtained before discharge and, if it is elevated, they are sent home with a course of antibiotics orally.

3. Results

Demographics for the complex appendicitis patients mirror the local patient populations and were similar between groups (Table 1). Over the 2.5-y period from 2012–2014, a total of 195 patients undergoing appendectomy for complex appendicitis with hospital LOS of ≥5 d were identified. There were 26 patients who underwent a postoperative CT scan before POD#7 (group 1, 13.3%) compared with 169 patients (group 2, 86.7%) who did not undergo scanning before POD#7. The median postoperative days before CT scans for group 1 were 5 d compared with 7.5 d for group 2b ($P < 0.001$) with first postoperative CT scans ranging from as early as POD#3 in group 1 to as late as POD#16 in group 2b.

Most patients in group 2 had a resolution of symptoms without intervention or CT scanning (97 of 106 patients in group 2a, and 32 of 63 patients in group 2b). By definition, all patients in group 1 underwent CT scanning postoperatively compared with just 30 of 63 (47.6%, $P < 0.001$) in group 2b. Group 1 had a recurrent CT scan rate of 61.5% (16/26) compared with 12.7% (8/63) for group 2b ($P < 0.001$). Ultimately, 19 patients (73.1%) in group 1 underwent abscess drainage with growth seen in 73.7% of cultures compared with abscess drainage in 18 patients in group 2b (28.6%, $P < 0.001$) with an abscess growth rate of 77.8% ($P = 1.000$; Table 2). Group 1 and group 2b had similar rates of both fever and ruptured