Impact and sustainability of outpatient management following appendectomy

Johns Hopkins All Children’s Hospital
Presenters: Cristen Litz MD and Nicole Chandler MD
March 21, 2017
Objectives

• To describe the implementation of a fast-track protocol for uncomplicated appendicitis

• To discuss our randomized controlled trial of same day discharge for suppurative appendicitis

• To review the national NSQIP outcomes for pediatric appendectomy and compare to institutional outcomes

• To discuss the efficacy of antibiotic powder in reducing surgical site infections after appendectomy
Appendectomy is the most common urgent pediatric surgical procedure.

There are approximately 71,000 appendectomies performed annually in the United States in children younger than 15 years of age.

It incurs an estimated $680 million dollars in hospital utilization charges annually.
Background

• Postoperative management is highly variable across the US
  o Complicated admitted for IV antibiotics
  o Uncomplicated admitted for 24 to 48 hours

• Many operations that once required inpatient admission are now routinely being performed as ambulatory cases\textsuperscript{1,2}

• However, many surgeons remain resistant to the concept of outpatient appendectomy
Background: Definitions

**Complicated**
- **Perforated** - hole in the appendix, fecalith outside the appendix
- **Gangrenous** - gray/black discoloration of wall without hole or fecalith outside the appendix
- **Suppurative** - non-perforated, fibrinous exudate, turbid fluid

**Uncomplicated**
- **Acute** - hyperemia, dilation, or inflammation without fibrinous exudate, peritoneal fluid or perforation
- **Interval** - appendectomy 6-8 wks after medical management of perforated appendicitis
Fast-track protocol for uncomplicated appendicitis
Goals

1. To develop an evidence-based protocol for the same day discharge following appendectomy for uncomplicated appendicitis

2. To study outcomes after implementation and standardization of the protocol
Traditional treatment pathway for appendicitis
Fast-track pathway

1. Presents with appendicitis
2. Observation unit or pre-op
3. OR
4. PACU
   - Discharge

Fast-track pathway

**Pre Operative Inclusion**
- Patients under 21 years of age undergoing appendectomy for acute appendicitis or interval appendectomy

**Pre Operative Exclusion**
- Complex appendicitis
- Complex medical condition
- Admission to inpatient unit
- Social indications
- Late operation

**Intra Operative Exclusion**
- Intraoperative findings of suppurative, gangrenous, or perforated appendicitis

**Post Operative Exclusion**
- Fever
- Hemodynamic changes
- Unable to void
- Poor oral intake
- Inadequate pain control
Protocol development

- Anesthesia
  - Implement enhanced recovery protocols
- Administration
- Multidisciplinary Approach
- Emergency Medicine
- Surgery

Support Resources

Family education
- Protocol development
- Monitoring QI

Family education
- Use of area for observation unit
Protocol development

- Patient flow process
- Handoffs
- Preoperative, postoperative, follow up guidelines
- Discharge Education
- Pain control measures

Preoperative, postoperative, follow up guidelines
349 Patients presenting for appendectomy

303 Patients meeting inclusion criteria

206 Patients with acute appendicitis or interval appendectomy

185 (90%) Patients discharged from PACU
Fast-track pathway LOS

Length of stay (hrs)

Pre-protocol: 31 hrs
Fast track: 10 hrs
Fast-track pathway complications

<table>
<thead>
<tr>
<th>Incidence of complications</th>
<th>Fast track</th>
<th>Historical controls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.7%</td>
<td>[VALUE]%</td>
</tr>
</tbody>
</table>
Cost savings of fast-track pathway

- 349 Patients presenting for appendectomy
- 185 Patients successfully discharged from PACU
- Cost savings of $4111 per patient
- Total savings of $760,535 over 1 year
National implications

**Pediatrics**
- 71,000 Appendectomies per year
- 53% of patients may be eligible for early discharge
- Total savings of $155 million over 1 year

**All Ages**
- 300,000 Appendectomies per year
- 53% of patients may be eligible for early discharge
- Total savings of $654 million over 1 year

Pediatrics

All Ages
Same day discharge in children with suppurative appendicitis: A randomized controlled study
Background

- Review of fast-track protocol: 25% had suppurative appendicitis with a mean postoperative LOS of 39 hrs

- No evidence existed for same day discharge of patients with suppurative appendicitis

- **Purpose**: perform a prospective, randomized controlled trial (RCT) comparing traditional management to a fast-track pathway for suppurative appendicitis
Purpose and methods

• Primary objective: To determine if implementation of a fast-track protocol for same day discharge of patients with suppurative appendicitis results in decreased post-operative length of stay

• Secondary objective: 30-day complication rate
Purpose and methods

• Sample size of 18 patients per group
  - Historical LOS for suppurative appendicitis- 38.8 hrs
  - Targeted LOS for same day discharge- 3.96 hrs
  - Achieve power of 0.90 accounting for 20% loss to follow up

• Inclusion criteria
  - Age 5-18 years old
  - Diagnosis of appendicitis, scheduled for appendectomy between 0600-2000
  - Intraoperative findings of suppurative appendicitis

• Exclusion criteria
  - Pregnancy
  - Complex medical history
Traditional treatment pathway: suppurative appendicitis

1. Presents with appendicitis
2. Observation unit or pre-op
3. OR
4. PACU
5. Inpatient Unit
6. Discharge
7. PO Antibiotics
8. IV Antibiotics
Fast-track pathway: suppurative appendicitis
192 Patients screened for inclusion

145 Met inclusion criteria

101 Patients consented

36 Patients enrolled

18 Traditional Pathway
18 Fast Track Pathway

2 patients admitted:
1 = Inadequate pain control
1 = fever

16 (88.9%) Discharged same day

Inclusion not met (N=47):
23 = Late OR
10 = Age < 5 years old
6 = Admitted pre-op
5 = Complex medical condition
3 = Pre-operative fever

Patients not consented (N=44):
28 = Family declined
8 = Missed
3 = Parent not available
2 = Consented but late OR
2 = Out of state
1 = Social

65 patients excluded:
Intraoperative findings of acute, gangrenous or perforated appendicitis
## Results: Demographics and clinical information

<table>
<thead>
<tr>
<th></th>
<th>Admit</th>
<th>Fast-track</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patients</strong></td>
<td>18</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td><strong>Age (yrs)</strong></td>
<td>11.6 ± 3.5 (5.3-17.5)</td>
<td>10.8 ± 3.4 (5.1-17.6)</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td>0.49</td>
</tr>
<tr>
<td>Males</td>
<td>13 (72%)</td>
<td>10 (56%)</td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>5 (28%)</td>
<td>8 (44%)</td>
<td></td>
</tr>
<tr>
<td><strong>Weight (kg)</strong></td>
<td>40.7 ± 20 (21-76.2)</td>
<td>41.4 ± 15.4 (22-69)</td>
<td>0.9</td>
</tr>
<tr>
<td><strong>WBC</strong></td>
<td>15.4 ± 4.9 (5.9-25.2)</td>
<td>16.7 ± 4.7 (7.7-25.5)</td>
<td>0.43</td>
</tr>
<tr>
<td><strong>Operative time</strong></td>
<td>30.1 ± 8.4 (18-44)</td>
<td>27.7 ± 8.6 (17-46)</td>
<td>0.41</td>
</tr>
</tbody>
</table>
Fast-track pathway postoperative LOS

<table>
<thead>
<tr>
<th></th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional</td>
<td>23.4</td>
</tr>
<tr>
<td>Fast-track</td>
<td>8.2</td>
</tr>
</tbody>
</table>

*p=0.002
# Fast-track pathway complications

<table>
<thead>
<tr>
<th></th>
<th>Traditional</th>
<th>Fast-track</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>30-day complications</strong></td>
<td>1 (8%)</td>
<td>2 (18%)</td>
<td>0.58</td>
</tr>
<tr>
<td>Superficial SSI</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Intra-abdominal abscess</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Admit for fever, ab pain</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>30-day readmissions</strong></td>
<td>1 (8%)</td>
<td>1 (9%)</td>
<td>1</td>
</tr>
</tbody>
</table>
Conclusions of RCT

• 89% of patients with suppurative appendicitis were successfully discharged from PACU following appendectomy

• Patients discharged following a fast-track protocol had a decreased postoperative LOS without significant differences in complication or readmission

• Based on the results of this study, patients with suppurative appendicitis were subsequently included in our fast-track protocol
NSQIP outcomes
American College of Surgeons National Surgical Quality Improvement Program (NSQIP)

• Multi-institutional program of pediatric surgical patients

• Systematic sampling system- 35 cases meeting inclusion/exclusion criteria sampled for each 8-day cycle

• Certified clinical reviewers collect preoperative and intraoperative variables and 30-day postoperative outcomes
NSQIP outcomes

Part I: Trend in institutional outcomes (2014-2016)
Results: Cases sampled

<table>
<thead>
<tr>
<th>Year</th>
<th>Total # appendectomies</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>105</td>
</tr>
<tr>
<td>2015</td>
<td>189</td>
</tr>
<tr>
<td>2016</td>
<td>181</td>
</tr>
</tbody>
</table>
Results: Outpatient rate

<table>
<thead>
<tr>
<th>Year</th>
<th>Percent outpatient</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>69%</td>
</tr>
<tr>
<td>2015</td>
<td>76%</td>
</tr>
<tr>
<td>2016</td>
<td>77%</td>
</tr>
</tbody>
</table>
Results: Length of stay

<table>
<thead>
<tr>
<th>Hospital LOS</th>
<th>Surgical LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2014</strong></td>
<td><strong>2015</strong></td>
</tr>
<tr>
<td>2.4</td>
<td>1.3</td>
</tr>
<tr>
<td>1.5</td>
<td>0.9</td>
</tr>
</tbody>
</table>
## Results: Outcomes

<table>
<thead>
<tr>
<th></th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wound occurrences</strong></td>
<td>8 (7.6%)</td>
<td>10 (5.3%)</td>
<td>10 (5.5%)</td>
<td>0.69</td>
</tr>
<tr>
<td><strong>Superficial SSI</strong></td>
<td>3 (2.9%)</td>
<td>3 (1.6%)</td>
<td>6 (3.3%)</td>
<td>0.55</td>
</tr>
<tr>
<td><strong>30-day readmission</strong></td>
<td>8 (7.6%)</td>
<td>9 (4.8%)</td>
<td>6 (3.3%)</td>
<td>0.26</td>
</tr>
</tbody>
</table>
NSQIP outcomes
Part II: Institutional vs national outcomes for uncomplicated appendicitis (2015)
## Results: Cases sampled

<table>
<thead>
<tr>
<th></th>
<th>JHACH</th>
<th>National</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No. patients</strong></td>
<td>154</td>
<td>4973</td>
<td>____</td>
</tr>
<tr>
<td><strong>Operative duration (min)</strong></td>
<td>29 ± 9.4</td>
<td>41 ± 26.6</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>
Results: Outpatient rate

Percent outpatient

JHACH 2015

National 2015

[VALUE]%

* *p<0.0001
Results: Length of stay

* \( p < 0.0001 \)

<table>
<thead>
<tr>
<th>Length of stay (days)</th>
<th>Hospital LOS</th>
<th>Surgical LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.8</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>1.3</td>
<td>1.1</td>
</tr>
</tbody>
</table>

- JHACH 2015
- National 2015
## Results: Outcomes

<table>
<thead>
<tr>
<th></th>
<th>JHACH</th>
<th>National</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wound occurrences</strong></td>
<td>8 (5.2%)</td>
<td>105 (2.1%)</td>
<td>0.02</td>
</tr>
<tr>
<td><strong>Superficial SSI</strong></td>
<td>3 (1.9%)</td>
<td>48 (1.0%)</td>
<td>0.20</td>
</tr>
<tr>
<td><strong>30-day readmission</strong></td>
<td>5 (3.2%)</td>
<td>131 (2.6%)</td>
<td>0.61</td>
</tr>
<tr>
<td><strong>30-day readmission related</strong></td>
<td>4 (2.6%)</td>
<td>94 (1.9%)</td>
<td>0.54</td>
</tr>
</tbody>
</table>
Impact of antibiotic powder on surgical site infections
Background

• Single-incision laparoscopic appendectomy (SILA) is preferred by some surgeons due to its improved cosmesis, decreased postoperative pain, and ability to easily perform concurrent procedures\(^3\)

• Reported to have a higher incidence of wound infections compared to multiport laparoscopic appendectomy\(^4\)

• Neurosurgeons at ACH found a significant decrease in shunt infections with the application of topical antibiotic powder\(^5\)
Background

- Topical vancomycin may reduce sternal wound infections and deep infection after spinal surgery\(^6\)

- 26 yr prospective review of wound infection prophylaxis after open appendectomy\(^7\)
  - Preop IV antibiotics + cefoxitin powder had lowest wound infection rate
  - Cefoxitin powder- ideal coverage of aerobes and anaerobes
Methods

• Antibiotic powder placed in the umbilical wound prior to skin closure from April 2015-November 2016
  ▪ Cefoxitin chosen based on efficacy and cost effectiveness ($2.61 for 1 gm of powder)
  ▪ Inclusion: aged 0-21 years, underwent SILA for acute appendicitis
  ▪ Exclusion: antibiotic allergies, complicated appendicitis, concurrent procedures, converted to multiport laparoscopic or open technique

• Retrospective review comparing patients who received powder to a historical cohort who underwent SILA (4/2014-3/2015)
<table>
<thead>
<tr>
<th></th>
<th>Powder (n=126)</th>
<th>Historical (n=108)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, yr</td>
<td>12.2 ± 3.7</td>
<td>11.5 ± 3.6</td>
<td>0.15</td>
</tr>
<tr>
<td>Female, n (%)</td>
<td>57 (45%)</td>
<td>51 (47%)</td>
<td>0.80</td>
</tr>
<tr>
<td>BMI percentile</td>
<td>58.8 ± 27.8</td>
<td>57.6 ± 30.7</td>
<td>0.84</td>
</tr>
<tr>
<td>Presenting WBC</td>
<td>13.7 ± 4.7</td>
<td>13.7 ± 4.6</td>
<td>1.0</td>
</tr>
<tr>
<td>Case time, min</td>
<td>29.7 ± 8.9</td>
<td>26.5 ± 7.5</td>
<td>0.004</td>
</tr>
<tr>
<td>LOS, d</td>
<td>0.1 ± 0.4</td>
<td>0.2 ± 0.4</td>
<td>0.06</td>
</tr>
</tbody>
</table>
## Results: Outcomes

<table>
<thead>
<tr>
<th></th>
<th>Powder</th>
<th>Historical</th>
<th>p-value</th>
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<tbody>
<tr>
<td><strong>Superficial SSI, n (%)</strong></td>
<td>0</td>
<td>5 (4.7%)</td>
<td>0.02</td>
</tr>
<tr>
<td><strong>Intraabdominal abscess, n (%)</strong></td>
<td>1 (0.8%)</td>
<td>1 (0.9%)</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>30 day ED visits, n (%)</strong></td>
<td>10 (8%)</td>
<td>8 (7%)</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>30 day readmit, n (%)</strong></td>
<td>3 (2%)</td>
<td>5 (5%)</td>
<td>0.48</td>
</tr>
</tbody>
</table>
Discussion & Conclusion
Discussion

• Standardized protocols impact delivery of care by reducing patient handoffs, inpatient admissions, and length of hospital stay

• One-third of sentinel events are associated with handoff communication failures⁷

• Our protocol reduced patient handoffs by 40%
Discussion

• Same day discharge benefits patients, families, and the healthcare system

• Successful implementation centers on:
  • multidisciplinary approach
  • focused awareness of patient flow processes and handoffs
  • patient and family education
  • strict adherence to protocol
Conclusions

• Appendectomy for uncomplicated and suppurative appendicitis can be performed safely as a same day surgery.

• Standardization and implementation of procedure-specific protocols has the potential to improve the quality and effectiveness of national health care delivery.
References


Thank you

• Presentations:
  www.childrenshospitals.org

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