Everyday Pediatric Surgery: What's New?

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Learning Objectives

- Understand new concepts in the management of children with perforated appendicitis
- Describe new minimal invasive surgical techniques for the care of common surgical problems

Perforated Appendicitis

- 320,000 appendectomy in children annually
- 25-30% are perforated at presentation
  - 80% or higher in children < 3 years old
  - Mortality rate is 0.1-1%
    - 10-20% 50 years ago
  - Morbidity rate is 10-20%
    - Intra-abdominal abscess, sbo

Perforated Appendicitis

- Presentation
  - Symptoms > 48 hrs
    - Pain, N/V, fever, diarrhea
    - Difficult to determine in young children

Perforated Appendicitis

- Physical Exam
  - General state of health
  - Localized vs. diffuse tenderness
  - Abdominal distension
  - Palpable mass

Perforated Appendicitis

- Labs and diagnostic studies
  - WBC > 15K
  - US and/or CT
    - Sensitivity, specificity, accuracy comparable

Perforated Appendicitis

- CT
  - Easily accessible
  - Less operator dependent
  - Provides more thorough exam of abdomen
  - Increases cancer risk

Perforated Appendicitis

- Management
  - Survey of APSA members
    - 79% favor abx/interval appendectomy
      - 60-70% tended to use CT-guided drainage
    - 21% favor immediate appendectomy

Perforated Appendicitis

- Immediate appendectomy may be more complicated technically
  - Tissue planes less clear due to inflammation, potential for bleeding and injury to adjacent organs
- Questionable benefit to immediate appendectomy

Perforated Appendicitis

- *Initial laparoscopic appendectomy versus initial nonoperative management and interval appendectomy for perforated appendicitis with abscess: a prospective, randomized trial*
  - *St. Peter SD, et al.; Kansas City*
  - *Journal of Pediatric Surgery 2010*

Initial Appendectomy vs. Abx/Interval Appendectomy

- Methods:

Children with well-defined abdominal abscess (CT)
2 year study with 40 patients accrued

Immediate lap appy

IV abx with perc drainage (when possible)
Followed by interval lap appy 10 weeks later

Initial Appendectomy vs. Abx/Interval Appendectomy

- Methods:

Immediate appendectomy
↓
5 days abx (ceftriaxone/metronidazole)
↓
Fever/symptoms/leukocytosis ↔ Afebrial, asymptomatic, nl WBC
↓ ↓
2 days abx, Then repeat WBC → Discharged
↓
Fever/symptoms/leukocytosis → 3 days abx, Then repeat WBC, CT may be done after POD 7

Initial Appendectomy vs. Abx/Interval Appendectomy

- Methods:

IV abx with perc drainage (when possible)
↓
2 weeks abx (ceftriaxone/metronidazole)
↓
Symptoms/pain/mass ↔ Afebrial, asymptomatic
↓ ↓
1 week abx and reassess, CT may be done → D/C abx, Interval appy at 10 weeks

Table 1 Patient characteristics at the time of admission

	Initial operation (n = 20)	Initial nonoperative management (n = 20)	*P*
Age (y)	10.1 ± 4.2	8.8 ± 4.2	.31
Weight (kg)	37.0 ± 16.2	37.1 ± 20.8	.98
Body mass index (kg/cm^2)	18.0 ± 4.5	19.5 ± 5.5	.39
White blood cell count	17.4 ± 6.6	16.9 ± 6.8	.84
Maximum temperature	37.8 ± 1.0	37.7 ± 0.9	.95
Maximum axial area of abscess (cm^2)	29.2 ± 29.7	26.2 ± 21.1	.75

Values are expressed as mean ± SD.

Initial Appendectomy vs. Abx/Interval Appendectomy

- Initial lap appendectomy group
  - 1 conversion to open due to fragmented appendix
  - 1 lap assisted ileocecectomy for inflammatory mass

Initial Appendectomy vs. Abx/Interval Appendectomy

- Abx/interval appendectomy group
  - 14 had percutaneous drainage
  - 4 failed abx therapy and operated on prior to 10 weeks
    - 1 for progression of peritonitis (day 2)
    - 1 for persistent obstruction (day 6)
    - 1 for persistent symptoms (3 weeks)
    - 1 for persistent nausea and occasional emesis (7 weeks)

Table 2 Outcomes comparing initial operation and initial abscess drainage followed by interval appendectomy

	Initial operation (n = 20)	Initial nonoperative management (n = 20)	*P*
Operation time (min)	62.1 ± 38.7	42.0 ± 45.5	.06
Total length of hospitalization (d)	6.5 ± 3.8	6.7 ± 6.6	.92
Recurrent abscess after initial treatment (%)	20%	25%	1.0
Doses of narcotics	9.7 ± 4.0	7.1 ± 15.8	.47
Total health care visits	2.8 ± 1.1	4.1 ± 1.0	<.001
No. of CT scans	1.5 ± 0.7	2.1 ± 1.1	.04
Time to goal intake (h)*	74.8 ± 53.9	23.3 ± 36.9	.002
Total charges	$44,195 ± $19,384	$41,687 ± $18,483	.68

Values are expressed as mean ± SD, unless otherwise indicated.
* Time to regular diet after drain placement or evaluation by interventional radiology in the initial nonoperative group.

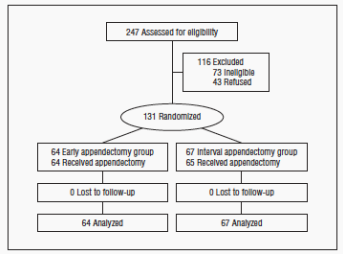
Perforated Appendicitis

- *Early vs Interval Appendectomy for Children with Perforated Appendicitis*
  - *Blakely ML, et al.; Memphis*
  - *Archive of Surgery, 2011*
- Primary outcome: time away from normal activities

Early vs Interval Appendectomy

- Eligible: children with clinical diagnosis of perforated appendicitis
  - Excluded: children initially treated at another hospital; delayed presentation with well-formed abscess or mass; family transient to the area or unable to complete follow-up
  - Diagnosis made by history, exam, labs, and imaging results (116 of 131 had CT)

Early vs Interval Appendectomy



Early vs Interval Appendectomy

- Antibiotics and discharge criteria same for both groups
- Antibiotic regimen: ceftazidime and clindamycin
- Discharged when tolerating feeds, had good pain control, ambulating well, afebrile for 48 hours with normal WBC and differential

Early vs Interval Appendectomy

- Primary outcome: time away from normal activities
  - Assessed by objective and subjective criteria
    - Hospital days and outpatient IV abx day
    - Activity log; phone and clinic follow-up
    - Time to return to school

Characteristic	No. (%) Early (n=64)	Interval (n=67)	*P* Value
Age, mean (range), y	10.5 (1.8-16.6)	9.9 (2.6-17.3)	.29
Male sex	40 (63)	33 (49)	.13
Race			.60
Black	30 (47)	28 (42)	
Hispanic	13 (20)	12 (18)	
White	20 (31)	26 (39)	
Other	1 (2)	1 (1)	
Duration of symptoms, mean (range), d	3.4 (1-14)	3.4 (1-17)	.93
ED temperature, mean (range), °C	38.0 (36.2-39.8)	38.4 (36.2-40.2)	.01
Admission WBC count, mean (range), No. ×10³/μL	17.6 (5.2-34.3)	16.8 (5.6-28.7)	.38
Abdominal CT performed at initial assessment	55 (87)	61 (91)	.49
IAA at admission	25 (39)	26 (39)	.98
ICU admission	2 (3)	3 (4)	>.99

Early vs Interval Appendectomy

- Early appendectomy group (64 patients)
  - 55 lap appendectomy, 6 open
  - 3 lap converted to open
  - 7 did not have perforated appendicitis
    - 5 acute, 1 ileal volvulus, 1 primary peritonitis

Early vs Interval Appendectomy

- Interval appendectomy group (67 patients)
  - Average time to appendectomy was 51 days
  - 60 lap; 3 open; 2 lap converted to open
    - 2 did not return for appendectomy
  - 23 had appendectomy earlier than planned
    - 10 bowel obstruction, 5 persistent symptoms, 6 recurrent appendicitis, 1 unresolved abscess, 1 parental demand
  - 1 did not have perforated appendicitis

Early vs Interval Appendectomy

- Primary outcome of time away from normal activities:

  13.8 vs 19.4 days, p < .001

Table 2. Health Care Use After Early Appendectomy or Interval Appendectomy

Outcome	Early (n=64)	Interval (n=67)	*P* Value
Received central venous catheter, No. (%)	28 (44)	58 (87)	<.001
Discharged with central venous catheter, No. (%)	6 (9)	29 (43)	<.001
Underwent IR procedure, No. (%)	13 (21)	15 (23)	.77
Total antibiotic duration, mean (range), d	13 (3-30)	15 (6-33)	.10
Operative time, mean (range), min	113 (39-213)	112 (48-295)	.95
CT scans during study period, mean (range), No.	1.3 (0-5)	1.7 (0-6)	.06
Hospital length of stay, mean (range), d	9 (2.6-23.9)	11.2 (3.3-40)	.03

Table 3. Adverse Events After Early or Interval Appendectomy

Event	No. (%) Early (n=64)	Interval (n=67)	RR Associated With Interval Appendectomy (95% CI)	*P* Value
Any adverse event	19 (30)	37 (55)	1.86 (1.21-2.87)	.003
Intra-abdominal abscess	12 (19)	25 (37)	1.99 (1.10-3.62)	.02
Small bowel obstruction	0	7 (10.4)		.01
Wound infection	6 (9.4)	6 (9.0)	0.94 (0.32-2.76)	.91
Unplanned readmission	5 (8)	21 (31)	3.94 (1.59-9.84)	.01
CVL-related adverse event	1 (1.6)	4 (6.0)	0.88 (0.21-3.72)	1
IR procedure-related adverse event	0	1 (1.5)		1
Recurrent appendicitis	0	6 (9)		.01

Early vs Interval Appendectomy

- Discussion
  - Design of study is not clean
    - No equipoise
    - Data unclear
  - High failure rate (34%)
    - Bowel obst, recurrent appendicitis, persistent symptoms

Pediatric versus general surgeon

- *Specialty versus generalist care of children with appendicitis: an outcome comparison*
  - *Alexander F, et al; Cleveland, OH*
  - *Journal of Pediatric Surgery*

Pediatric versus general surgeon

- Academic center with 2 services
  - Pediatric Surgical Service
  - HMO Adult General Surgical Service
- Identical anesthesia, residents, nursing, and ancillary support services

Pediatric versus general surgeon Gangrenous or Perforated appendicitis

- Pediatric Surgical Service
  - 34 patients
    - Complications 3
    - Readmissions 0
    - Second operation 2
    - LOS 5.4
- HMO Adult General Surgical Service
  - 27 patients
    - Complications 9
    - Readmissions 6
    - Second operation 6
    - LOS 8.6

Failure in the nonoperative management

- UAB/Children's study
- Retrospective review of 75 children over 4 years who were treated with abx and intent for interval appendectomy

Failure in the nonoperative management

- 9/75 failed nonoperative management
  - 7 for persistent significant pain
  - Absence of abscess and presence of appendicolith were predictors of failure

Our Protocol

- Clinical diagnosis and confirmed by imaging
  - Phlegmon/abscess
- Initiate abx (piperacillin/tazobactam)
- Place PICC
- Percutaneously drain abscess if possible
- Start PO when ready and home abx when possible
- 10-14 day course with follow-up in clinic
- Interval appendectomy at 6-8 weeks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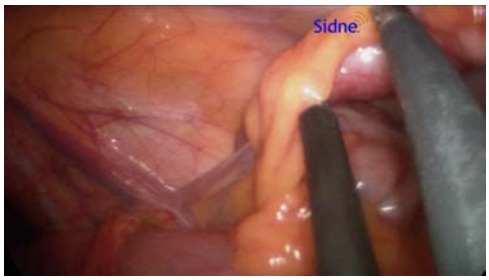
Sidne

SIPES Appendectomy-Our Data

- Prospectively enrolled/collected
- Two year period (March 2009- May 2011)
  - 328 appendectomies performed
  - 60 perforated (18%)
  - 310 SIPES (95%)
  - Median Op times 37.4 +/- 13.8 minutes

SIPES Cholecystectomy

- Early experience showed technically feasible and safe
  - Over 90 patients
- No increased complications


SIPES

- Ablative surgery easier than restorative but not prohibitive
- Splenectomy (12)
- Nissen Fundoplication (10)
- Bowel resection, colectomy, pyloromyotomy
- Still evolving-surgeon and technology