When to Call a Pediatric Surgeon

Kim Ruscher
Wife, Mom, Pediatric Surgeon
Objectives

- Indications for management of undescended testicles
- Describe chest wall deformities and indications for repair / bracing
- Work up of Non accidental trauma
- Current evidence on management of appendicitis
My groin looks funny!

Hernias, Hydroceles, Undescended testicles
Mom,
what’s a hernia???
Spectrum of problems

1. Abdominal cavity
2. Non-communicating hydrocele
3. Communicating hydrocele
4. Hydrocele of the cord
Repair – Before
Cryptorchidism

**Undescended**

- Abdominal
- Inguinal
- Suprascrotal

**Ectopic**

- Prepenile
- Superficial ectopic
- Transverse scrotal
- Femoral
- Perineal
FIGURE 1.

Evaluation and Treatment of Cryptorchidism

Boy with undescended testis

- Bilateral, nonpalpable
  - YES: Consult specialist to evaluate for DSD
  - NO: Reassess at 6 months (corrected for gestational age)

  - NO: Older than 6 months (corrected for gestational age)
    - YES: Refer to surgical specialist
      - PALPABLE: Retractile
        - Monitor yearly
      - NON-PALPABLE: Orchiopexy - Scrotal vs Inguinal
        - Undescended
          - Abdominal exploration - Laparoscopic vs open
            - Testis identified
              - Orchiopexy - Single stage - Fowler Stephens (1 or 2 stage)
            - Vessels entering internal ring
              - Inguinal exploration
            - Blind ending vessels
              - Close

  - PALPABLE: Orchiopexy - Scrotal vs Inguinal

Examination under anesthesia

- NON-PALPABLE: Consider inguinal/scrotal exploration if nubbin palpable +/- contralateral hypertrophy

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Chest wall deformities

NOT just cosmetic
Chest wall deformities

- Pectus Carinatum
- Pectus Excavatum
Pectus carinatum
Pectus Carinatum

Figure 1. Different anatomical types of pectus carinatum. A, Keel-chest (keel-chest either with sternal elongation or sternum elevatum). B, Asymmetrical pectus carinatum. C, Bilateral protrusion of the costal cartilages.

Pectus Carinatum

- Second most common defect
- More common in Hispanics, but seen in all races
- May not develop till puberty
- Characterized by a protrusion of the lower rib cartilage
- May be symmetric or one sided
- Usually the right side more affected
Treatment: BRACING

http://www.hamiltonhealthsciences.ca/body.cfm?id=2290
Bracing for Pectus Carinatum

- Safe – minimal risks
- Bracing WORKS! – if the kid wears it
  - Often see good results in 6 months
  - Most with resolution by 2 years
- Issues
  - Defect still growing after 2 years
  - Compliance
  - Failure
When does bracing fail?

- Non-compliance
  - Hard to operate on someone who could have fixed it non-operatively
- Started too late
  - Cannot generate enough force with the brace to correct
- True failures
  - Require surgery
Pectus excavatum

http://priorityortho.com/products/pectus-braces/
Pectus Excavatum

- Most Common chest wall deformity*
- Often appears at puberty…sometimes earlier
- Not a cosmetic deformity
- Boys 5:1
- Grading: Haller Index
  - Transverse intrathoracic distance/AP distance
Haller index

- Normal: 2.5
- Significant $\geq 3$
<table>
<thead>
<tr>
<th>Physiologic effects</th>
<th>Cardiac</th>
<th>Pulmonary</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cardiac compression</td>
<td>Decreased</td>
</tr>
<tr>
<td></td>
<td>RV</td>
<td>Vital capacity</td>
</tr>
<tr>
<td></td>
<td>Decreased stroke volume</td>
<td>Forced vital capacity</td>
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<tr>
<td></td>
<td>ECG abnormalities</td>
<td>Total lung capacity</td>
</tr>
<tr>
<td></td>
<td>RBB block</td>
<td>FEV1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FEV</td>
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</table>
Treatment of Pectus Excavatum 2015

- Implants
  - Fill in the depression
- Vacuum bell
  - External traction
- Magnets
- Ravitch repair
  - Same as pectus Carinatum
- Nuss procedure AKA Minimally invasive repair of pectus excavatum (MIRPE)
Conservative treatment: Magnets

Magnetic Mini-Mover Procedure (3MP)

- FDA trials
- Outpatient surgery to implant “magnimplant”
- Long term success: under study

http://pedsurg.ucsf.edu/conditions--procedures/magnetic-mini-mover-procedure.aspx
What’s the ‘best’ treatment?

- There is no evidence from randomized controlled trials to conclude what is the best surgical option to treat people with pectus excavatum.
Pectus Excavatum
Thoracoscope to watch bar pass.

Sternum is elevated.

Path in front of heart with steel bar.
Pectus Excavatum
Pectus Excavatum: pre/post
Nuss procedure for Pectus excavatum

- Minimally invasive
- Usually* covered by insurance
- 3-7 days in hospital
- 2-4 weeks out of school
Cardiac: effects of Nuss procedure

<table>
<thead>
<tr>
<th></th>
<th>Pre-op</th>
<th>Post-op early</th>
<th>Post-op late</th>
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<tbody>
<tr>
<td><strong>Cardiac compression</strong></td>
<td>Present</td>
<td>Eliminated</td>
<td>Sustained improvement</td>
</tr>
<tr>
<td><strong>Stroke volume</strong></td>
<td>Decreased</td>
<td>Restored</td>
<td>Sustained improvement</td>
</tr>
<tr>
<td><strong>ECG abnormalities</strong></td>
<td>Present</td>
<td>Eliminated</td>
<td>Sustained improvement</td>
</tr>
</tbody>
</table>

Effects of Nuss procedure

- Improvements at 3 months:
  - $\text{FEV}_1$
  - Total lung capacity
  - Diffusing lung capacity
  - $\text{O}_2$ pulse
  - $\text{VO}_2$ max
  - Respiratory quotient

My belly hurts!

Acute Appendicitis
Acute Appendicitis

- Appendectomy: Major public health advance
- 2015: 60-70% Single incision
- Discharge within 12 hours
- No recurrence rate
Non-operative management

- The new trend
- Diverticulitis – non-operative
- Potential cost savings
“Appendectomy remains the standard of care for most patients with uncomplicated acute appendicitis”
Cochrane Review

- “Appendectomy remains the standard treatment for acute appendicitis”
  - BUT: November 2011!

Wilms I et al (2011) Appendectomy versus antibiotic treatment for acute appendicitis
Cochrane Library
JPS 2015 Non-operative management of early, acute appendicitis in children: Is it safe and effective?

- 12 patients
  - 2 early failures
  - 1 late failure

- Non-operative management
  - Longer LOS
  - More ED visits
JPS 2016: Nonoperative treatment of acute appendicitis in children: A feasibility study

- 24 patients
  - 3 early failures
  - 2 late failures
  - 2 elected interval appendectomy
  - 70% non-op at 14 months
Non operative management
Safe, not better
Does a patient have to have imaging to have an appendectomy?
NAT

My kid shouldn't have this bruise
Definition: Child abuse and neglect

Any recent act or failure to act on the part of a parent or caretaker which results in death, serious physical or emotional harm, sexual abuse or exploitation; or an act or failure to act, which presents an imminent risk of serious harm.

- Child Abuse Prevention and Treatment Act (CAPTA), (42 U.S.C. §5101)

Scope of the problem: Oregon

- 69,972 reports made FFY 2015
- 32,682 reports investigated
- 6,708 founded for abuse or neglect
  - 10,402 victims
- 2014: 654 workers

NAT = Non accidental trauma

- = TRAUMA patients
- New multi disciplinary team at RB
- All NAT consults
  - Surgical team ‘first call’
  - Co-management surgeons and hospitalists
- Evidence-based work-up / management algorithm
Workup, 0-6 months

- Noncontrast head CT in all
  - MRI if neurologically stable but needs NAT workup, or to follow-up head CT
- Skeletal survey in all
  - consider follow-up in 10-14 days if diagnosed or suspected NAT
- Abdomen/Pelvis CT w/IV contrast if AST/ALT greater than 80, and/or if history/exam findings suggestive abdominal trauma (not FAST)
- CBC, CMP, Lipase, Utox, PT/PTT (if extensive bruising or ICH), UA
- Ophthalmology to perform dilated fundoscopic exam
  - if neuro imaging indicates injury
Prevention
Great topic for prevention
Button batteries
Button battery ingestions

- Clinical emergency- if it is in the Esophagus
  - Scarier than trauma?

- Easy to get guidance…
  - Google “button battery”
  - National Poison Center Guidelines first link
  - http://www.poison.org/battery/guideline.asp
Key points: Treat like a TRAUMA

- X ray as soon as possible
- Operating room within 2 hours- if in the Esophagus
- Rigid esophagoscopy, possible bronchoscopy
- Treat hearing aid ingestion like small battery ingestion
- Magnets
Suspect a battery ingestion in these situations

"Coin" ingested. Check AP x-ray for battery’s double-m or halo-effect and lateral view for step off.

Battery ingestion known or suspected

NPO until esophageal position ruled out by x-ray.

Take up to 5 minutes to determine imprint codes (or diameter) of companion or replacement battery.

Patient ≤ 12 years

Consult National Battery Ingestion Hotline at 202-625-3333 for assistance with battery identification and treatment.

TIPS, PITFALLS & CAVEATS

- 3 “N’s”. Negative – Narrow – Necrotic. The negative battery pole, identified as the narrowest side on lateral x-ray, causes the most severe, necrotic injury. The negative battery pole is the side opposite the “+” and without the imprint.
- 20 mm lithium coin cell is most frequently involved in esophageal injuries; smaller cells lodge less frequently but may also cause serious injury or death.
- Definitive determination of the battery diameter prior to passage is unlikely in at least 45% of ingestions.
- Assume hearing aid batteries are < 12 mm.
- Manage ingestion of a hearing aid containing a battery as an ingestion of a small (< 12 mm) battery.
- Do not induce vomiting or give cathartics. Both are ineffective.
- Assays of blood or urine for mercury or other battery ingredients are unnecessary.

NOTES:

1 NPO. Anesthesia may be required for removal.

2 X-ray abdomen, esophagus and neck. Batteries above the range of the x-ray have been missed. If battery in esophagus, obtain AP and lateral to determine orientation of negative pole. If ingestion suspected and not visualized on x-rays, check ears and nose.

3 If battery diameter is unknown, estimate it from the x-ray, factoring out magnification (which tends to overestimate diameter).

Symptomatic patient, no ingestion history. Consider battery ingestion:

- Airway obstruction or wheezing
- Drooling
- Vomiting
- Chest discomfort
- Difficulty swallowing, decreased appetite, refusal to eat
- Coughing, choking or gagging with eating or drinking

Immediately remove batteries lodged in the esophagus. Serious burns can occur in 2 hours. Do not delay because patient has eaten. Prefer endoscopic removal (instead of retrieval by balloon catheter or magnet affixed to lula) for direct visualization of tissue injury. Inspect mucosa for extent, depth and location of tissue damage. Note position of battery and direction negative pole faces.

After removal, if mucosal injury was present, observe for and anticipate delayed complications: tracheoesophageal fistula, esophageal perforation, mediastinitis, vocal cord paralysis, tracheal stenosis or tracheomalacia, aspiration pneumonia, hemorrhage, lung abscess, pneumothorax, spontaneous pneumothorax or exanguination from perforation into a large vessel.

Anticipate specific complications based on injury location, battery position and orientation (negative pole). Determine length of observation, duration of esophageal rest, need for serial imaging or endoscopy/bronchoscopy based on severity and location of injury. Monitor patients at risk of perforation into vessels as infants with serial imaging and blood tests. Intervene early to prevent death. Monitor for respiratory symptoms, especially those associated with swallowing, to diagnose TE fistulas early. Expect perforations and fistulas to be delayed up to 28 days after battery removal and esophageal strictures delayed weeks to months.
Closing thoughts

- Chest wall deformities
  - Are diverse and need surgical consultation
- Undescended testicles
  - Fix at 6 months
- Non accidental trauma patients
  - Are first and foremost trauma patients
- A kid who swallowed a button battery
  - Might try to die in the waiting room
## When to refer

<table>
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<tr>
<th>Condition</th>
<th>When</th>
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<tbody>
<tr>
<td>Hydrocele</td>
<td>One year old</td>
</tr>
<tr>
<td>Inguinal hernia</td>
<td>At diagnosis</td>
</tr>
<tr>
<td>Undescended testicles</td>
<td>Six months old</td>
</tr>
<tr>
<td>Lumps and bumps (and tumors)</td>
<td>At diagnosis (call first if desired)</td>
</tr>
<tr>
<td>Chest wall deformities</td>
<td>Age 10-12</td>
</tr>
<tr>
<td>Appendicitis</td>
<td>Before you send to ED</td>
</tr>
<tr>
<td>Non accidental trauma</td>
<td>At diagnosis</td>
</tr>
<tr>
<td>Umbilical hernia</td>
<td>Age 3</td>
</tr>
<tr>
<td>Airway / GI Foreign Body / Pyloric stenosis</td>
<td>At diagnosis (At diagnosis)</td>
</tr>
</tbody>
</table>

### Contact Information

Call 24/7 with questions / concerns
541-222-6135 (Pediatric Surgery)
541-222-3000 (Access)