

Acute appendicitis¹

- Most common cause of abdominal surgical emergency in children. Age (> 3 y, mostly).
- Clinical presentation: Periumbilical pain started yesterday shifted to RLQ aggravated by movement, associated w/ fever and anorexia. RLQ tenderness, Rovsing's² +ve, No family member having same member.
- DDX:
 1. **Gastroenteritis:** Vomiting & diarrhea are the CC rather than pain. Hx of travel or eating outside, other family member having the same problem, no RLQ tenderness.
 2. **Mesenteric lymphadenitis:** Viral infection causing URTI → mesenteric lymph nodes enlargement (stretching mesentery causing visceral pain) + sore throat & enlarged tonsils.
 3. **Ovarian pathology:** ovulation, cyst rupture, torsion (Ischemia, very severe pain & vomiting, no SIR³).
 4. **UTI:** dysuria, high fever, high WBC, R/O by UA (high WBCs, bacteria on microscopy and nitrates). US (may show inflamed kidney), PEx (no RLQ tenderness, suprapubic in cystitis or renal angle in pyelonephritis).
 5. **Renal stone:** flank visceral pain radiates to genitals. Confirm by X-ray (KUB), US (fluids, stones).
 6. **Meckel's diverticulum:** exactly like appendicitis.
- Dx:
 - Clinical pic: if clear do nothing besides CBC w/ diff (sometimes WBCs is normal but neutrophils are high i.e bacterial infection).
 - US: available, good for (ovarian cysts, free fluid, stone, intussusception), not useful for (appendicitis, meckel's, volvulus), operator dependant, no sedation needed.
 - CT: Radiation, sedation, IV contrast, good for abscess or tumors.
- If Hx unsuggestive of appendicitis⁴: observation → re-evaluation → Tx.
 - Observation (admit, NPO, no analgesia/Abx)⁵, reevaluation (repeat PEx, CBC).
 - If appendicitis becomes more probable → appendectomy (laparoscopic/open, if normal look for other reasons)⁶.
 - Late (ruptured): missed or misdiagnosed may form abscess (Dx by CT, Tx by percutaneous drainage & IV Abx+NPO & IVF, once stable shift to oral feeding and Abx "covers -ve gram & anaerobes"), if 6 w w/o further abscess then interval appendectomy "if no fecalith no need").
 - If diffuse peritonitis (open/laparoscopic abdominal washout and appendectomy)
 - If appendicular mass, formed by fibrous exudate that sticks to the bowel (Abx w/o drainage).

¹ Pathogenesis: Obstruction of the proximal end of the appendix > leads to stasis of secretions > bacterial proliferation that invade all the mesothelium of the appendix >> may lead to Abscess formation (pus) >> perforation "free perforation in immunocompromised pts or extreme of age >> generalized peritonitis all over the abdomen (irritation of bladder causes dysuria, and of rectum causes diarrhea)". Fibrin exudates might cause appendicular mass.

² Pressure on the left lower abdomen "LIF" causes pain referral to the right lower abdomen "RIF"

³ Systemic inflammatory response: vitally unstable (fever, tachy), in appendicitis there is fever.

⁴ Summary: Resuscitate (NPO, NGT if vomiting, IVF bolus becuz pt hasn't been eating for hrs & SIR causing vasodilation and capillary leakage, reassess hydration by urine output) → IV Abx & Analgesics → definitive (Appendectomy).

⁵ If unconfirmed appendicitis, no analgesia nor Abx r given till confirmation of Dx is made (it might mask S&S), however Dr. nouh said u should give analgesia and ease the pain .. so I'm not sure.

⁶ Once Mcburney's incision is made, an appendectomy is to be performed.

Intussusception⁷

- Telescoping of the bowel, proximal bowel inside the distal (peristalsis direction).
- Most common site is: **ileocecal** due to congestion (mucus+blood) that gives characteristic **currant jelly stool**.
- Presentation:
 - Mother comes w/ (6 -18m) baby w/ previous Hx of URTI 1 week before or gastroenteritis, colicky abdominal pain on/off (infant cry when on, and calm when off), currant jelly stool (blood seen in PR).
 - Late: vomiting w/ intestinal obstruction (rare).
- Dx:
 - **US**: very accurate (target sign or donut sign).
 - **Contrast enema**: diagnostic and therapeutic, if not skilled to pick it by US.
 - X-ray is not useful.
- Rx:
 - **Pressure reduction** by (barium, water or AIR "most commonly used w/ least complications").
 - If failed (15%) → **OR, reduce** again, if can't be reduced → **resect**.
 - If the small bowel is filled with contrast or water or air it means the area is reduced successfully. Milk it in surgery and if necrosed resect and anastomose.

Perianal Sepsis⁸

- Very common in the first 18 months of life (less than 18 months) Abscess and fistula formation.
- You drain it in the picture of tract with 2 openings.
- **Fistula**:
 - Presentation: Acute red painful nodules beside the anus Or / Chronic painless discharging fistula from huge abscess over a long period of time.
 - Management:
 - > 18 m → R/O IBD (crohn's), Immune deficiency → do fistulotomy if present.
 - < 18 m → heals spontaneously (more common in boys).
 - Intersphincteric fistula: Mild, can be cut.
 - Transsphincteric fistula: Dangerous to cut, can cause incontinence.
 - Extrasphincteric & Suprasphincteric fistula: More dangerous because it's high.
- **Abscess**:
 - **Small** abscess (< 1 cm) → Treat with **Abx** only.
 - **Large** abscess (> 1 cm) → Drainage under GA & Abx.

⁷ Causes: Hypertrophied peyer patches (getting infected by a virus) causing submucosal lymphoid tissue growth. Pathological lead point (PLP - uncommon).

⁸ In crypts of morgangi → small openings (anal glands) secreting mucus that lubricate anal canal, helps in passing stool, the anal canal might get blocked, secretion will accumulate causing stasis and infection → abscess formation, it gets bigger then it will be opened or not.

Malrotation and Volvulus:⁹

- Malrotation¹⁰ leads (risk) to volvulus. Not common condition.
- Presentation: Infant, bilious greenish vomiting due to obstruction (lethal¹²).
- Pain: If baby is calm (not in pain) → malrotation + obstruction. If irritable baby → volvulus + ischemia.
- Sometimes bloody vomitus, lethargic, hypotensive, in pain and difficult to diagnose (volvulus).
- Dx: ER presentation of infant with green vomitus
 - **Upper GI series** (contrast):
 - will show spiral or corkscrew duodenum, proximal duodenum is often dilated (bird's beak), patient may present with only obstruction (ladd's band obstruction).
 - Proximal duodenal obstruction, no duodenal C-loop, duodenojejunal junction to rt of vertebrae, whirlpool/corkscrew sign (signs of volvulus).
 - US: FOR EXPERTS / not advisable in our healthcare system, can't r/o but can diagnose.
- Rx:
 - If we can't do Ix immediately (contrast, US) or pt is very sick with bilious vomiting, take to the OR and do exploratory laparotomy.
 - During surgery: untwist (anti-clockwise) → Assess viability, If small bowel is viable close and observe. And then do the ladd's procedure¹³ if applicable.
 - If extensive gangrenous (ischemic) don't resect, have a 2nd look in 24-48 h, if still gangrenous don't resect pt will die either way.

Ovarian torsion

- One of acute abdomen Ddx in Adolescents girls.
- Dx: US, Laparoscopy or Laparotomy.
- Tx: Derotate → Assess the viability (necrotic: remove, dark: leave it) → Fix the other side always (prevent infertility because what caused the first to rotate will cause the other to rotate).

⁹ Not common, babies' problem, malrotation predisposes to volvulus 75% in the first month of life and 90% in the first year.

¹⁰ small and large bowel are not fixed, narrow mesentery so most likely it'll turn around itself (ladd's band causing obstruction "volvulus")

¹¹ when the baby is born all large bowel is on the left side and all the small bowel on the right side, mesentery is long and ladd's band causes obstruction at the duodenal side due to malrotation leading to volvulus gangrene or ischemia due to obstruction so in this case treat by: Rotate anti-clockwise to relieve the ischemia.

¹² Dangerous might lead to death; short bowel gut syndrome due to surgical resection after obstruction and ischemia

¹³ Cut ladd's band → broaden midgut mesentery → place SB rt and colon lt "non=rotation position" → appendectomy (to not confuse the picture of appendicitis in the future).

Foreign body

1. Aspiration:

- Age (1-3) years (both aspiration & ingestion).
- One of the leading causes of sudden death. Foreign body Ex. (seeds, peanuts, toys pieces).
- Increase in summer time: watermelon seeds and usually witnessed choking (imp in Hx)
- S&Sx:
 - Start coughing (vigorous and non-stopping), getting cyanosed and choking with difficult breathing and decreased breath sounds (most prominent) and wheezing on the affected side, decreased chest expansion on the affected side. Most commonly the right lung (vertical main bronchus).
 - If no obvious symptoms as above: missed aspiration so might present with pneumonia.
- Ix:
 - CXR¹⁴: Early (air trapped, possible hyperinflation), Late (bronchiectasis as a result of bacteria and secretions accumulation, consolidation and pneumonia).
 - **Rigid Bronchoscopy**: diagnostic and therapeutic, It's an emergency case, once you're done with ABC (open airway first), do bronchoscopy.

2. Ingestion:

- Materials: food is very common, toys, batteries.
- Witness is important: A family member witnessed ingestion followed by a cough, drooling of saliva, can't swallow anymore, discomfort or pain.
- Late presentation: hematemesis, melena, chest pain due to mediastinitis, fever (all as a result of complications).
- Common sites: Esophagus areas of narrowing (UES "first common", Aortic crossing, LES), Stomach, Intestines¹⁵ (mostly if passed esophagus it will pass w/ stool).
- Complications: Local infection, perforation (due to mediastinitis and abscess), bleeding after erosion, stricture (after inflammation and subsequent healing).
- Rx:
 - If in esophagus → must be removed. in stomach → No need (90% will pass spontaneously, leave and follow up by Xray).
 - Pins and sharp objects: wait unless evidence of perforation.
 - Batteries: remove because they'll erode.
 - Management: NPO, IVF, ABx (standard), Rigid Endoscopy.

¹⁴ CXR only shows radiopaque materials (metals: not common) but not the radiolucent like (food and seeds)

¹⁵ Complications if in stomach or intestines are uncommon, once it passed through the esophagus, it will pass out 90% but uncommonly to perforate or obstruct.

Acute Scrotum:

- Characteristics¹⁶: Tender, large, red, sudden pain in the scrotum.
- DDX:
 - 1. Testicular Torsion:**
 - A 90-180 degrees rotation inside the scrotum → ischemia, severe sudden pain.
 - Risk factors: Bell Clapper deformity¹⁷ (12% of boys), Trauma and sport activity (causing torsion), Undescended testis (prone to torsion).
 - Presentation:
 - **Early:** A 12-18 years, sudden scrotal pain + swollen tender scrotum, irritable baby, and high riding testis (feature of testicular torsion).
 - **Late:** In babies or handicapped, only pain, so many develop hydrocele (from hematoma or inflammation), empty scrotum (might be the first presentation).
 - **Management:**
 - NPO, IVF, Abx (if late with signs of gangrene) and Analgesia.
 - If late presentation for more than 6 hours → necrosis, if **dark fix** it and **if black remove** it and fix the other side.
 - **Doppler US:** Very accurate will show no blood supply reaching the testis, if + Doppler → derotate (open book) inside out¹⁸ then repeat doppler (to confirm derotation).
 - If Doppler is not available: take to the OR for Scrotal exploration and bilateral Orchiopexy (both testes).
 - 2. Appendix testis¹⁹:** inflamed mass near the testis , Doppler with normal blood supply.
 - During exploration : you'll see the Remnant of Mullarian duct and appendix is inflamed.
 - 3. Incarcerated hernia:**
 - Hx of hernia or on/off swelling: indirect hernia, Inguinoscrotal swelling (not only scrotal) if extended to inguinal canal (reduction and next day OR).
 - Confirmed by Doppler US > Good blood supply unless the vessels are pressed > losing testis.
 - 4. Epididymorchitis:** Uncommon in children unless they have UT anomalies (more in adults with STD).

¹⁶ Davidson's:(p:421) Torsion of the cord can occur where the visceral layer of the tunica vaginalis completely covers the testis so that it lies suspended within the parietal layer. The patient, usually a teenager, presents with sudden onset of testicular pain and swelling. There may be a history of minor trauma, or previous episodes of pain due to partial torsion. On examination there is a red, swollen hemiscrotum that is usually too tender to palpate. Misdiagnosis of the swelling as epididymo-orchitis, which is rare in teenagers, is a serious error. Torsion of the testis is a surgical emergency; if the blood supply is not restored within 12 hours, the testis infarcts and must then be excised. If at operation the testis is found to be viable, it is sutured to the parietal tunica to prevent recurrence. As the underlying abnormality of the tunica is bilateral, the other testis must be fixed at the same time.

¹⁷ long stalk inside scrotum, instead of being closed inside tunica vaginalis , it has long stalk which ease it movement , free movement > twist.

¹⁸ The torsion is usually from outside to inside so when you treat it do it from the inside out.

¹⁹ Remnant of Mullarian duct Exactly like testicular torsion

Meckel's Diverticulum²⁰

1. Rule of 2:

- 2% of the population.
- Within 2 feet of the ileocecal valve.
- 2 inches in length.
- 2 types of heterotopic mucosa, Presentation before the age of 2.

● Presentation:

- lower GI bleeding (most common presentation).
- Ectopic gastric mucosa (most common heterotopic mucosa)²¹.
- In NGT , it might be only clear aspirate but it doesn't exclude melena so you have to resuscitate by IV fluids and blood transfusion.

- Meckel's diverticulum can cause: Diverticulitis, intussusception, obstruction²², litre's hernia²³.

2. Investigations:

- In lower GI bleeding → **Meckel's scan** Tc99 (uptake by gastric mucosa in Meckel's).
- If negative scan and pt still bleeding prepare for upper GI scope and do Laparoscopy or Laparotomy.

● Rx:

- Resuscitate: IVF, NPO, Blood transfusion if severe bleeding.
- Generally speaking, remove the diverticulum in all situations. And during appendectomy in appendicitis cases remove the Meckel's diverticulum if found.

²⁰ One of the congenital anomalies result from incomplete regression of the omphalomesenteric duct (vitelline duct) (remnant of the duct) which usually decompress by week 7 of gestation.

²¹ No acid resistance normally occur in small bowel which results subsequently to ulceration and bleeding (melena).

²² Bowel is trapped between the fibrous band in front of the umbilicus and Meckel's diverticulum.

²³ Incarcerated in the inguinal or femoral or obturator hernia sac.

Approach to acute scrotum (OSCE)

★ Early recognition and prompt management are very important (within 6 hours). Because of the possibility of testicular torsion, as the etiology, to cause permanent damage to the testis.

A. History:

1. Timing (time of onset and length).
2. Pain character, onset and course (sudden vs gradual, constant vs intermittent).
 - Torsion > sudden\short length , epididymo-orchitis > gradual.
3. Location (testes, scrotum or abdomen), NOT radiation to these sites (as in renal colic) the pain has to be originally from these sites.
4. Quality (sharp, dull).
5. History of trauma.

B. Examination:²⁴

1. Overall inspection of patient and comfort level. RED, SWOLLEN, SEVERELY TENDER.
2. Abdominal, inguinal, and genital exam required.
3. Test the cremasteric reflex²⁵ first: not evident clinically in testicular torsion, because it's a very painful condition.
4. Begin with the unaffected side.
5. Palpate testes, spermatic cord, epididymis and inguinal region.
6. Evaluate the lie, size, masses and mobility of testis.

C. Investigations:²⁶

- Done when testicular torsion is difficult to diagnose.
 - Urine analysis. (to exclude UTI (if present > epididymo-orchitis).
 - US with color flow Doppler (sensitivity 90% specificity 99%).
 - Radio-nuclear imaging (Sensitivity 90-100%) more accurate.
- ★ Imaging studies should not delay scrotal exploration when there is high suspicion of torsion.

²⁴ In physical examination you may not feel the testis as a different organ, because everything is edematous and inflamed, if you can feel it and move it, it's not testicular torsion.

²⁵ Absence of reflex may be the most sensitive indicator of torsion of the testes.

²⁶ Make sure the investigation should be done within half an hour, any investigation take more than hour you shouldn't consider it at all.

Undescending testis (Cryptorchidism)

- The testis is arrested along its normal path of descent. In abdomen = abdominal testis, In inguinal canal = canalicular testis.
- Clinical presentation:
 - Empty scrotum, absence of one or both testes.
 - Swelling in the groin (testis or hernia).
 - On examination, hemi-scrotum is underdeveloped/hypoplastic.
 - Testis is palpable in the groin (inguinal canal) and fails to come down to the scrotum in 80% of cases.
 - Testis is impalpable/non-palpable in the remaining 20% of cases (intra-abdominal, atrophied or agenesis).
- Ix: nothing really useful, US/CT/MRI.
- **Management:**
 - Diagnostic laparoscopy (and therapeutic):
 - Surgery is indicated b/w 6 to 12 months.
 - If intra-abdominal testis → orchidopexy.
 - If atrophic (present deferens blood vessels) → inguinal exploration & excision.
 - If agenesis (only vas deferens) → nothing to be done.
 - **Indications of orchidopexy:**
 - To optimize fertility.
 - To decrease the risk of trauma since it is common at the groin, and repeated trauma would damage the testis.
 - To decrease the risk of torsion.
 - Psychological reasons.
 - To place testis in examinable position to detect malignancy early.

Hydrocele

- Its an abnormal collection of fluid in the processus virginals which fails to obliterate resulting in swelling in the scrotum and groin (patent processus vaginalis).
- Types of hydrocele: Communicating (fluid moves back and forth), Non-communicating²⁷.
- Clinical presentation²⁸:
 - Painless scrotal or groin swelling, but mostly scrotal.
 - Swelling is confined to the scrotum, unlike hernia which is up to the groin.
 - In hydrocele the child not irritable or in pain.
 - Increase in size following viral infection.
 - On examination:
 - Scrotal swelling, tense, overlying skin often has a blue tinge.
 - Not reducible, transilluminate, difficult to palpate the testis separately.
 - Examine the neck of the scrotum carefully to exclude an inguinal hernia as the cause of the swelling.
- Ultrasound is usually done if we're not sure with the diagnosis.
- If you have an inguinal hernia or hydrocele, you can't really differentiate between the two just by inspection, so in the pictures, they look very similar, so how can you differentiate between the two?
 1. Irritability and reducibility!
 2. Can I get above it ? if you can → this is probably just in the scrotum → hydrocele. If you can't → it is a continuation from the abdomen → hernia.
- Tx: Observation until age of 2 years, if still there:
 - Hydrocelectomy (non-communicating hydrocele).
 - High ligation (communicating hydrocele) of PPV)

²⁷ Could be of tunica vaginalis (most common), or of spermatic cord.

²⁸ Transillumination test is useless, it can't really differentiate between the two, normally you will expect it to be + in hydrocele and - in hernia, however, if trauma happened to the hydrocele, there will be blood (hematoma) so it will be -, and if the hernia was in small bowel, and there might be fluid there, it will appear +, so don't waste your time with it.

Hernia

- It is an outpouching of a hollow viscus from its surrounding wall.
- Types: Inguinal, umbilical.

Inguinal hernia²⁹

- What is the difference between hernia in adults and children?
 - Etiology: In Adults it could be direct (due to muscle weakness of the abdominal wall) or indirect. Whereas in children it's always indirect (congenital).
- Pathophysiology: Indirect hernia happens due to a patent processus vaginalis³⁰.
- Hx: hernia bulges if there is an increase in pressure as if the patient is coughing or crying. (reducible)
- This type of hernia will never EVER resolve spontaneously, all patients need surgery³¹.
- Complications:
 - Strangulation (ischemia).
 - Incarcerated (hernia went inside the inguinal ring and got stuck there) it's **irreducible**.
 - Presentation: abdominal distention, constipation, not feeding, vomiting, signs of pain (crying and irritability)
 - PEx: inspection (change in color), palpation (tenderness and irreducible mass).
 - Management: Reduce it by manual pressure, if irreducible → wait a day or two before operating³².

Umbilical hernia

- Causes: congenial³³.
- Complications: Strangulation and Incarcerated are rare unlike inguinal hernia.
- Management: Wait until the age of 2-5 years (most resolve spontaneously, and complications are rare).

Best wishes 🍊🥰

Adel Alshihri

²⁹ Which site is more common to have inguinal hernia? Right side (60-80%), left (20-40%), bilateral (10%). Why is the Right side more common? Unknown reason, however, there is a theory suggesting that it is because the Right testis descends before the left one.

³⁰ which is the normal way of descending of the testis. So the testis descends from deep inguinal ring to the inguinal canal to external inguinal ring to scrotum. This patent processus vaginalis should normally be closed before birth, so if it was still open after birth this will lead to an inguinal hernia, but if it was only narrow this will lead hydrocele.

³¹ So when is surgery of inguinal hernia should be done? This is NOT an emergency, however, due to the many possible complications the surgery should be done as soon as electively possible for the surgeon and the hospital, these patients should be on the top of the elective waiting list. And when you send these patients home you should inform them about the possible complications so if any developed, they should come to the ER.

³² it's now NOT ER case, it is better to wait because (1/the area is all edematous now and there will be a difficult anatomy if you tried to go for surgery, 2/ the recurrence rate is higher in this situation than in elective cases).

³³ Because the umbilical cord is where the fetus gets his nutrients from during pregnancy, which is connected to the umbilicus, and sometimes, it doesn't get closed properly after birth so whenever the child cries, it bulges.