Objectives

As a result of this lecture, you should be able to:

1. Generate a differential diagnosis for abdominal pain in the early pregnant patient
2. Select the appropriate abdominal imaging modality in the pregnant patient

Case

• HPI: 32 yo F G2P1 @ 7 wk with 5 d of recurrent, RLQ abd pain, intermittent N/V, and chills
• ROS: NO vaginal bleeding or loss of fluid, uterine cramps, diarrhea, fever
• PMH and obstetric hx: unremarkable, no prenatal visit yet

Differential Diagnosis?
Changes in pregnancy causing abdominal pain

GI
GERD
nausea/vomiting
constipation
↑ cholelithiasis

Kidneys:
↑ urolithiasis
↑ UTI

Uterus enlarges
to 20x normal size

Conditions Due to Pregnancy

EARLY (<24 wk)

- Threatened abortion
- Ectopic pregnancy
  - Corpus luteal cyst rupture
  - Septic abortion
  - Round ligament pain
  - Acute urinary retention due to retroverted uterus

- Can look like an ectopic (hypotension, surgical abdomen, lots of FF on U/S)
- Fever/chills, abd or back pain, heavy VB and discharge
- 2nd trimester
- Sharp, shooting pain, lasting only few seconds, groin/leg radiation
- R sided > L sided
- If can’t cath, push the cervix inward to relieve pressure

Ectopic pregnancy

- THE leading cause of non-traumatic pregnancy-related deaths
- Incidence ↑6x since 1970
- 2% of pregnancies
- Risk factors: prior ectopic, assisted reproduction, h/o tubal surgery or pathology, IUD use, h/o PID
- Beware of heterotopics in ART patients (1/100-1/400)

3 categories:
1. Obstetric
2. Gynecologic
3. Non OB/GYN

DDx of Abd Pain in Pregnancy
**Ectopic pregnancy**

- Classic triad (<50%): abd pain, amenorrhea, VB
- Other sx: shoulder pain, urge to defecate, N/V, diarrhea
- Potential pitfalls:
  - 30%: no vaginal bleeding
  - 36%: no adnexal tenderness
  - 10%: palpable adnexal mass

**Serial β-hCGs**

- Old days: normal rise = doubling in 48 hrs
- Now: minimum rate of acceptable rise in hCG levels - ↑53% in 48 hr
- Median rate of rise: ↑124% in 48-72 hrs
- Get the β-hCG drawn at the same lab!

- Normal rise in hCGs does not exclude SAB or ectopics.
- An ectopic can occur at any β-hCG level (even < 5)!
- 3% of ectopics will have negative serum hCG!

**Gynecologic conditions**

- Ruptured ovarian cyst
- Adnexal torsion
- Pelvic inflammatory disease
- Fibroids and degenerating myoma

**DDx of Abd Pain in Pregnancy**

3 categories:
1. Obstetric
2. Gynecologic
3. Non OB/GYN
Adnexal torsion in pregnancy

- ↑ 5x incidence in pregnancy (1/800)
- 1 in 5 torsions occur in pregnancy
- Right > Left (3:2)
- Most frequently in 1st trimester
- Risk factors: induction of ovulation
- Presentation: abrupt onset, unilateral severe lower abd pain, N/V (66%), low grade fever
- Exam: tender adnexal mass (90%)

Ovarian Torsion

- Enlarged ovary
- No color Doppler flow within the ovary
- Pelvic free fluid
- Ovarian mass
- Multiple small follicles on the periphery
- Ovaries may be hard to find in 2nd or 3rd T → MRI

Torsion can have normal flow!

- Arterial waveforms may be present in torsion!
- Theory: incomplete torsion – partially twisted vascular pedicle, dual blood supply, or only venous thrombosis
- Incomplete torsions – risk of hemorrhagic rupture and gangrenous infection
- Normal ovaries don’t usually torque

DDx of Abd Pain in Pregnancy

3 categories:
1. Obstetric
2. Gynecologic
3. Non OB/GYN
Conditions incidental to pregnancy

**GI**
- Acute appendicitis
- Small bowel obstruction
- Acute cholecystitis
- Acute pancreatitis
- Pancreatic pseudocyst
- Toxic megacolon
- Diverticulitis
- Herniation
- Bowel perforation
- Hepatitis
- Gastroenteritis
- Peptic ulcer
- Splenic rupture

**Pulmonary**
- Pulmonary embolism
- Pneumonia

**GU**
- Ureteral stone
- Ureteral obstruction
- Cystitis/Pyelo

**Vascular**
- SMA syndrome
- Thrombosis/infarction
- Ruptured aneurysm
- Aortic dissection

**Systemic**
- DKA
- Sickle cell disease
- Porphyria

**Trauma**
- SMA syndrome
- Thrombosis/infarction
- Ruptured aneurysm
- Aortic dissection

Acute appendicitis in pregnancy

- #1 reason for non-obstetric emergency surgery in pregnancy
- Incidence not increased; 1/1500 pregnancies
- ALL 3 trimesters
- Perforation rate
  - Pregnancy: 25-43% (vs. 20%)
  - ~66% if surgery > 24 hrs
  - Perf 2x more likely in 3rd T

Acute appy on U/S

Perforation = Bad

<table>
<thead>
<tr>
<th></th>
<th>Non-perforated appendix</th>
<th>Perforated appendix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fetal mortality</td>
<td>1.5%</td>
<td>5-20%</td>
</tr>
<tr>
<td>Maternal mortality</td>
<td>0.1%</td>
<td>1-4%</td>
</tr>
</tbody>
</table>

Acceptable negative laparotomy rate in pregnant patients: 35%

BOTTOM LINE: DON’T DELAY the diagnosis!

Appendicitis in pregnancy

**SYMPTOMS**
- RLQ abdominal pain
- Nausea/vomiting (75%)
- Anorexia less common

**SIGNS**
- Direct abdominal tenderness
- Less reliable exam
- Fever - 50%
- Tachycardia unreliable
Clinical Pearl: Adler sign

- Find point of maximal tenderness while supine
- Lie patient on left lateral decubitus position
- If point of maximal tenderness shifts medially → adnexal or uterine
- Positive Adler: point of tenderness remains in the RLQ even with rolling over

Case revisited

- 7 wk pregnant, no IUP documented
- RLQ pain x 5 days, +N/V
- Afebrile, HR 110, BP 90/60
- Abd: tender diffusely, no R/G
- Quantitative βhCG - 10,252
- What next?

Transvaginal ultrasound

IUP on U/S

= gestational sac + yolk sac + double decidual sign

Your bedside U/S shows:

Pseudogestational sac

- 20% of ectopics
- No yolk sac or embryo
- No double decidual sign

Discriminatory zones for IUP

TVUS: βhCG 1000-1500 mIU/ml
TAUS: βhCG 6500 mIU/ml
Is formal U/S needed if β-hCG < 1500?

– YES, ABSOLUTELY!
  • 730 pregnant ED patients with abd pain or VB with quantitative hCGs
  • β < 1500 - ↑2.24x risk of ectopic or abnormal pregnancy

2003 ACEP Clinical Policy – TVUS should be performed on all patients in whom ectopic is considered regardless of hCG levels.

Our patient’s labs

• WBC 18 (90% PMNs, 2% bands)
• Hct 34
• AST/ALT, Tbili, alk phos, lipase normal
• UA: 10 WBCs, + protein, + blood; no bacteria, neg LE/N

Leukocytosis can occur in normal pregnancy:

• 2nd/3rd T: WBC 10-16K
• Early labor: WBC 20-30K
• Normalizes by 1 wk postpartum
• Bandemia is not normal

Imaging Options

- Ultrasound
- MRI
- CT

Physiologic anemia (Hct usually > 32)
- Alkaline phosphatase may be elevated 3-4x normal in 3rd T from placental production
- Always treat asymptomatic pyuria or bacteruria to prevent pyelo → preterm labor

RLQ pain, ↑WBC, and +UA
### Imaging Modalities for Dx of Appy

<table>
<thead>
<tr>
<th>Modality</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>U/S</td>
<td>67-100%</td>
<td>83-96%</td>
<td>Cost and accessibility, safety profile</td>
<td>Limited assessment of alternative diagnoses, limited by body habitus, operator dependence, high rate of nonvisualized appendix</td>
</tr>
<tr>
<td>MRI</td>
<td>100%</td>
<td>94-100%</td>
<td>High sens/spec/accuracy, ability to identify alternative diagnoses</td>
<td>Cost and accessibility, long examination times</td>
</tr>
<tr>
<td>CT (helical)</td>
<td>93%</td>
<td>96-99%</td>
<td>High sens/spec/accuracy, ability to identify alternative diagnoses, accessibility</td>
<td>Ionizing radiation</td>
</tr>
</tbody>
</table>

### Ionizing radiation: the worry

2 main concerns:
- Teratogenesis
- Carcinogenesis

### Teratogenesis

- Non-stochastic effect
- **< 5 rads (50 mGy)** → NO increased risk of fetal death, malformation, or developmental delay
- Highest risk - week 2-15 (organogenesis)
- Potential effects
  - Radiation-induced mental retardation
  - Microcephaly, microophthlamia
  - Growth retardation
  - Behavioral defects
  - Cataracts

### How much radiation is too much?

![Radiation chart showing cumulative fetal dose in 5 rad](image)
Bottom line

Teratogenesis in pregnancy is not a major concern after a single diagnostic CT because the radiation dose is generally too low to cause such effects.

Carcinogenesis

<table>
<thead>
<tr>
<th>End-point</th>
<th>Baseline risk</th>
<th>Risk with 5 rad exposure (RR 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Childhood cancer</td>
<td>19/10,000 (0.2%)</td>
<td>38/10,000 (0.4%)</td>
</tr>
<tr>
<td>Fatal childhood cancer</td>
<td>5/10,000 (0.05%)</td>
<td>10/10,000 (0.1%)</td>
</tr>
<tr>
<td>Childhood leukemia</td>
<td>3.6/10,000 (0.036%)</td>
<td>5/10,000 (0.05%)</td>
</tr>
</tbody>
</table>

- 1st T exposure is the highest risk (RR 3.19)
- 2nd/3rd T exposure is less (RR 1.30)

Reducing Radiation in Pregnancy

- Xrays:
  - PA exposures – 2-4 mrad lower doses than AP
  - Lead shield to prevent external scatter
- CT:
  - ↓ kilovoltage and mA
  - ↓ the field of view
  - Avoid imaging in multiple phases
  - Lead-shield the mother (circumferential shield)
  - Internal barium shielding (30% oral barium sulfate)
  - Local quality assurance programs

Use of contrast in pregnancy

- Is IV iodinated contrast safe?
  - Yes, Category B class
  - ? damage to the fetal thyroid → Nah.
- Is PO contrast safe?
  - Yes!
- What about in lactating women?
  - No need to pump and dump after IV contrast or gadolinium
MRI in pregnancy

- Lack of ionizing radiation
- Excellent soft-tissue contrast
- High sensitivity and specificity (100%/94%) for diagnosing acute appendicitis
- Useful in identifying alternative causes of pain
- 2007 ACR policy: MRI is safe in pregnancy, irrespective of gestational age

Risks with MRI?

- Teratogenesis?
  - No evidence
- Acoustic damage in utero?
  - No evidence
- Gadolinium safety?
  - Class C, contraindicated during pregnancy, unless absolutely necessary, use only in 2nd/3rd T
  - Ok if lactating

How will you counsel her about CT?

<table>
<thead>
<tr>
<th>RISKS with CT</th>
<th>RISKS of Delayed Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk of teratogenesis</td>
<td>Risk of maternal death if appendix ruptures</td>
</tr>
<tr>
<td>0%</td>
<td>1-4%</td>
</tr>
<tr>
<td>Risk of childhood cancer</td>
<td>Risk of fetal loss if appendix ruptures</td>
</tr>
<tr>
<td>0.4% (from 0.2% baseline risk)</td>
<td>5-8% (maybe 20-30%)</td>
</tr>
<tr>
<td>Risk of fatal childhood cancer</td>
<td>Risk of fetal loss with laparoscopy (negative appy)</td>
</tr>
<tr>
<td>0.1% (from 0.05% baseline risk)</td>
<td>2-5%</td>
</tr>
<tr>
<td></td>
<td>15-45% risk of PTL 1 wk post-op</td>
</tr>
</tbody>
</table>
| CT can decrease the negative appy rate to 8%
Get a written consent!!            |

Final diagnosis

Perforated appendicitis

Summary: Key Points

- DDX – obstetric, gynecologic, non OB/GYN causes
  - Ectopic pregnancy can occur at any \( \beta \)-hCG and with normal rises in \( \beta \)-hCG
  - Adnexal torsion: increased incidence in pregnancy.
  - Appendicitis: biggest predictor for mortality is perforation; don’t delay the diagnosis
- Imaging: weigh radiation risks with risks to fetus with delayed diagnosis, obtain a written consent!