Outline of Presentation

• Patient Presentation
• Anatomy of the female pelvis
• Differential diagnosis
• Basics of Pelvic Ultrasound
• Examples of US findings of ovarian pathology
• Index patient
  • Imaging modalities: US, Color Doppler Flow, CT
• Clinical Course and Summary
Our Patient: Clinical Presentation

• **HPI:** 21 yo F presents to ED with sudden onset of left lower quadrant pelvic pain that radiates down her leg and to her back. Pt has had multiple intermittent episodes of 5-6/10 severity pain that last 15-45 minutes with associated nausea. Episodes resolve spontaneously.

• **ROS:** Denies fever, vomiting, vaginal bleeding, abnormal vaginal discharge, dysuria, hematuria, diarrhea, CP or SOB.

• **PE:** Temp 99.9 HR: 118 RR: 18 O2 sat: 99%. Abdomen: soft, nondistended, no rebound/guarding. Slightly tender to palpation particularly in LLQ. Pelvic exam: **Left adnexal tenderness on exam, but no appreciable mass.** No CMT. Otherwise PE WNL.
In order to think systematically about what could be causing our patient’s LLQ pain and to develop a comprehensive differential diagnosis, we will start with a brief review of female pelvic anatomy.
Anatomy of the Female Pelvis

Anatomy of the Female Reproductive Organs

# Our Patient: Differential Diagnosis

## Overall ddx for LLQ pain
- Diverticulitis
- IBD
- Constipation
- Incarcerated hernia
- Ischemic bowel
- Urinary tract stone
- Cystitis
- Pelvic Infection

## Female-specific ddx for LLQ pain
- Pregnancy complications (ectopic)
- PID
- Endometriosis
- Uterine fibroids
- Ruptured/hemorrhagic ovarian cyst
- Ovarian torsion
- Ovarian neoplasm
Our Patient: Next Step for Further Evaluation

- Young female woman with concern for possible gynecologic source of pain, first step is Ultrasound.
  - Transabdominal or Transvaginal? Both?

- Other imaging modalities that play lesser role:
  - CT
  - MR
Before we review our patient’s ultrasound imaging results, we will take the next few slides to review the basics of ultrasound, including technique, terminology, and the different benefits and drawbacks of transabdominal vs transvaginal ultrasound in the setting of suspected pelvic pathology.
Ultrasound: The Basic Facts

• **How does it work?** Pulses of sound waves sent through tissues using transducer that both emits and receives sound waves; sound echoes off tissues with different tissues reflecting varying degrees of sound. These echoes are recorded and displayed as an image to the operator.

• **Benefits:** Real-time images; portable; inexpensive; no ionizing radiation

• **Drawbacks:** Bone and air interfere with image quality; limitations from pt physique (obesity); operator-dependent
Ultrasound Terminology

- Terminology: Spectrum of “brightness” or “echogenicity”
  - Hyperechoic: Bright
    * Sound waves mostly reflect back
    * Ex: Diaphragm, gallstone, bone
  - Hypoechoic: Dark
    * Sound waves mostly pass through
    * Ex: Soft tissue, solid organs
  - Anechoic: Black
    * All sound waves pass through
      - (devoid of echo)
    * Ex: fluid, blood

Ultrasound: Transabdominal vs Transvaginal

- Wide field of view
- Not as good for fine detail
- Upper abdomen may be assessed
- Need full bladder to serve as "acoustic window"

- Small field of view
- High resolution, good for detail of endometrial lining and ovarian structure
- GO TO for suspected gyn pathology!
- Empty bladder

Johns Hopkins Medicine, Health Library: Pelvic Ultrasound.
Ultrasound: Transabdominal vs Transvaginal

Look to the probe shape for help!

Flatter; larger

Cup-shaped

Transabdominal US

Transvaginal US

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Keeping this review of ultrasound basics in mind, next we will move on to briefly review the ultrasound findings for normal ovaries. We will follow this with a quick tour of ultrasound imaging results for other common ovarian pathologies by utilizing companion patients, before introducing the ultrasound imaging results of our particular patient.
Ultrasound Findings: Normal Ovaries

• Depends on age of woman
  • Postmenopausal: Smaller ovaries; absence of follicular structure; often difficult to find

• If premenopausal, depends on menstrual cycle
  • Pubertal ovary: numerous large cysts vs dominant follicle vs corpus luteum

• Overall: Relatively homogeneous echotexture with occasional anechoic regions representing follicles; size standards that vary with age/cycle stage
Companion Patient 1: Normal Ovary

Transvaginal Ultrasound: transverse (L) and sagittal (R)

- Ovary
- Homogeneous echotexture
- Anechoic Follicle

Measurement: 3.9x1.9x3.3 cm
Volume: (12.88mL)
Companion Patient 2: Simple Ovarian Cyst

Transabdominal Ultrasound: transverse view

- Anechoic fluid
- Imperceptible wall
- Posterior acoustic enhancement
Companion Patient 3: Hemorrhagic Cyst

Acute hemorrhage: area of increased echogenicity (arrow)

Reticular appearance; fine network of fibrin strands

Fluid level, from layering of blood products

Concave margin (arrowhead), indicating clot retraction

All images are transvaginal ultrasound views

Companion Patients 4,5: The Varying Appearances of an “Ovarian Mass”

Mucinous Cystadenocarcinoma

- Transabdominal Ultrasound, right ovary
  - Large, complex cystic and solid lesion (arrow)
  - Cystic component
  - Solid component

Krukenberg Tumor

- Transabdominal Ultrasound, right and left ovaries
  - Bilateral largely solid tumors with ascites
  - Ascites (anechoic)
  - Bilateral solid tumors

Now that we have reviewed the ultrasound findings for normal ovaries as well as several other of the most common ovarian pathologies, let us move on to view our patient’s imaging findings on ultrasound, as well as a brief review of the basic facts regarding ovarian torsion.
Transvaginal ultrasound of left ovary; transverse (L) and sagittal (R) views

- **Heterogeneous texture**
- **Anechoic follicles, peripheral**
- **Measurements: 5.6 x 5.4 x 3.2cm**
  - ***Volume: 51.58mL (normal <15mL)***

**Most concerning for: Ovarian Torsion**
Ovarian Torsion: Findings on Ultrasound Imaging

- Most common: Unilateral enlarged ovary with heterogeneous texture
  - Measurements cutoffs: >4cm, or >15mL
- May see morphology of underlying mass/lesion (cystic, solid, complex)
- Fluid in the cul-de-sac
- Multiple peripheral follicles (8-12mm)
- Twisted vascular pedicle
Ovarian Torsion: Underlying Pathophysiologic

Infundibulopelvic ligament with ovarian vessels is the KEY affected anatomy in ovarian torsion

Ovarian Torsion: Epidemiology and Causes

• Epidemiology:
  – Prevalence: 2.7% of female population
  – Predominantly in reproductive age women

• Causes: Associated with ovarian mass in 50-80% of cases
  – Most common: Underlying ovarian lesion
    • Benign: Follicular cyst, corpus luteum, theca lutean cyst, dermoid
    • Malignant neoplasm (older women)
  – Less common: Primary torsion/anatomic abnormality
    • Hypermobile adnexa
  – Other: ovarian hyperstimulation syndrome, pregnancy
Ovarian Torsion: Clinical Presentation and Treatment

• Presentation:
  – Acute onset abdominal/pelvic pain, often in lower quadrant
  – (+/-) nausea, vomiting, fever, leukocytosis, abdominal mass

• Treatment:
  – Surgical emergency!
    • Laparoscopic detorsion
    • oophoropexy
    • ovarian cystectomy
    • salpingo-oophorectomy
  – Time is everything to prevent possible resulting ischemia, infarction, and loss of ovary
Having reviewed our patient’s transvaginal ultrasound findings and the basic facts regarding ovarian torsion, we will move on to discuss the other potential imaging modalities utilized in the workup of ovarian torsion for our patient, including Color Doppler Flow Imaging and CT.
Ovarian Torsion: The Role of Color Doppler CDFI: detects arterial or venous flow in a vessel; direction of flow; and velocity of flow
- Can help demonstrate vascular obstruction and aids in differentiating torsion from a large complex cystic mass without torsion
- **Whirlpool sign**: twisting of vascular pedicle

Transvaginal ovarian ultrasound

Our Patient: Color Doppler Flow Imaging (1)

Transvaginal ultrasound, transverse left ovary
- Normal Doppler flow within left ovary

Key:
Red = toward transducer
Blue = away from transducer
Our Patient: Color Doppler Flow Imaging (2)

Transvaginal ultrasound, transverse left ovary
- Normal arterial waveform
- Normal venous waveform

Magnification of normal pulsatile arterial waveform
- Systole
- Diastole
Ovarian Torsion: The Limitations of CDFI

• When is CDFI useful?
  – Aids in the diagnosis of torsion if:
    • A. no flow is detected in arteries or veins, or
    • B. if arterial flow detected in systole without flow in diastole

• When is CDFI NOT useful?
  – If flow is detected it does **NOT** exclude ovarian torsion

Bottom line: Normal flow does **NOT** eliminate torsion
Ovarian Torsion: Causes of Normal Flow in Torsed Ovary

• Why might there still be doppler flow in a torsed ovary?
  – Ovary has dual blood supply
  – Intermittent torsion
  – Venous occlusion may lead to symptoms before arterial occlusion
  – Ovary does not have capsule; so can swell considerably and cause symptoms prior to detection of circulation effects

• Utility of CDFI may be in determining preoperative viability of the ovary
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Ovarian Torsion: The Role of CT and MR

- **CT:** often used in ED when ambiguous complaint of lower abdominal pain, may find signs of torsion when trying to rule out appendicitis
  - Can also be used if US findings ambiguous

- **MR:** limited use, occasionally useful in subacute cases with ambiguous presentation
Ovarian Torsion: CT Findings

• Diagnostic criteria for torsion on CT not well defined

• Nonspecific findings:
  – Enlarged, edematous unilateral ovary
  – Abnormal location of ovary
  – Fallopian tube thickening
  – Enhancement changes with IV contrast
    • Lack of enhancement; or delayed enhancement
  – Free fluid
Our Patient: Ovarian Torsion on CT (1)

- Right ovary
- Uterus
- Large, edematous, hypodense, heterogeneous left ovary, abnormal location
- Enhancement of left ovarian vasculature
- Compressed rectum
Our Patient: Ovarian Torsion on CT (2)

C+ coronal pelvic CT
- Right ovary
- Uterus
- Hypodense left ovary

C+ sagittal pelvic CT
- Bladder
- Uterus
- Compressed rectum
- Torsed left ovary; posterior location

PACS, BIDMC
Our Patient: Clinical Course

• Patient was taken by OBGYN team for diagnostic laparoscopy
• OR Findings: Left ovary torsed x3. No evidence of ischemia. No cystic masses.
• Procedure performed: Laparoscopic left ovary detorsion. Ovary was viable.
• Post-op visit: Asymptomatic, pain free
Summary of Presentation

• With this presentation we were able to review:
  – Female pelvic anatomy
    • With emphasis on ligaments of ovary and female reproductive organs, particularly infundibulopelvic ligament containing main ovarian vessels
  – Ddx for LLQ abdominal/pelvic pain
    • Including a by-systems approach covering GI, GU, and gynecologic causes of LLQ pain
  – Basics of US
    • Including proper terminology (hyperechoic; hypoechoic; anechoic) and benefits/drawbacks of transabdominal vs transvaginal imaging modalities
  – Ovarian torsion: including epidemiology, presentation, imaging modalities, US findings, CT findings, the role of CDFI and treatment.
Take Away Points

• Don’t forget gyn causes of lower abdominal pain in females!
• When in doubt about which imaging modality to use when there is possibility of gynecologic etiology, choose ultrasound
• CDFI aids diagnosis of torsion when arterial or venous flow is absent; but presence of flow DOES NOT rule out torsion
• Ovarian torsion presents nonspecifically clinically and can quickly progress to infarction and loss of the ovary; so must have a high index of suspicion and act quickly

Imaging plays a crucial role in the workup and management of ovarian torsion
References

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