Gynecologic Ultrasound

Sujata Ghate, MD
Associate Professor of Radiology
Duke University Medical Center
Objectives

• Understand work-up of endometrial abnormalities

• Show examples of uterine and endometrial abnormalities

• Recognize features of benign and malignant adnexal lesions and understand work-up of ovarian masses

• Review algorithms for management
Uterus and Endometrium
Uterine (myometrial) Masses

- Leiomyoma (fibroid)
- Lipoleiomyoma—very rare
- Leiomyosarcoma—rare (1.3%) similar in app. to rapidly growing or degenerating fibroid
- Adenomyosis
Uterine (myometrial) masses

• **Leiomyoma** (fibroid)

  - “Venetian blind” shadowing
  - Degenerating fibroid
Uterine (myometrial) masses

- Lipoleiomyoma
Uterine (myometrial) masses

• Focal adenomyosis
  - Focal heterogeneity on US
  - Symptoms: pain and or bleeding
  - MRI—gold standard for dx
Endometrium

- Normal cycle

- Early proliferative
- Midcycle
- Secretory
Endometrium

What is abnormal?

- Focally thickened
- $\geq 5$ mm in postmenopausal women with bleeding or $\geq 8$ mm if on unopposed HRT
- No data on upper threshold in premenopausal women
- Controversial for asymptomatic postmenopausal women (some use $\geq 5$ mm, others use $\geq 8$ mm)
Endometrium

Note: Focal thickening is always abnormal

DDX Focal thickening

- Polyps
- Fibroids
- Blood clot
Endometrium

Note: Clinical history is extremely important for accurate DDX

DDX Diffuse thickening

- Hematometrocolpos
- Endometritis—postpartum, fever, chills, etc
- Tamoxifien therapy—on Tamoxifien
- Endometrial hyperplasia—premen bleeding
- Endometrial carcinoma—postmen bleeding
Endometrium Diffuse Abnormality

- Hematometrocolpos
  - Thickened endometrium
  - Fluid level

- Accumulation of blood/secretions in endometrial canal
Endometrium
Diffuse Abnormality

• Hematometrocolpos

• Congenital causes (vaginal web, imperforate hymen, etc)

• Acquired causes (usually iatrogenic)
Endometrium Diffuse Abnormality

• Tamoxifen therapy

- Symptoms of vaginal bleeding—needs endometrial biopsy
- Incidental finding—no intervention needed
Endometrium-SIS

Indications:

- Evaluate endometrium in pts with persistent abn bleeding
- Determine focal vs diffuse abn.
- Characterize focal abn.
**Endometrium-SIS**

**Technique:**

- Use 5F or 7F flexible catheter
- Flush catheter with sterile NS
- Introduce fluid, sagittal and axial images, coronal reformats
SIS: Polyp

Homogeneous, echogenic mass

Narrow stalk with vessel

? Focal abn
SIS: Submucosal fibroid

- Broad based
- "Venetian blind" shadowing
- Internal flow
Adnexal lesions
Adenexal Lesions

Approach:

- Identify normal structures
- Determine if lesion is ovarian or extra-ovarian
Extra-ovarian Lesions

DDX:

• Pedunculated or broad ligament leiomyoma
• Hydrosalpinx
• Peritoneal inclusion cyst
• Para-ovarian cyst
• Non-gyn lesion (inflamed appendix, colon, etc)
Extra-ovarian Lesions

Hydrosalpinx

- Anechoic, tubal shape, infolding
- Benign finding, usually incidental. Gyn consult if symptomatic
Extra-ovarian Lesions

Peritoneal inclusion cyst

- Adnexal fluid collection bound by adhesions; geometric margins, ovary at edge of collection
- Contains ovulated fluid
Extra-ovarian Lesions

Paraovarian/paratubal cyst

- Wolffian duct remnant
- Simple cyst, round
- F/up not necessary if <3 cm in size
Normal Ovarian Cycle

Follicular phase

Dominant follicle
By Day 10

Luteal phase
Classically Benign Ovarian Lesions

- Functional cyst (follicular cyst, corpus luteal cyst)
- Hemorrhagic cyst
- Endometrioma
- Dermoid
Benign Ovarian Masses

Functional cyst: follicular cyst

- Unilocular, anechoic
- Smooth borders
- Resolve in 1-3 cycles
- ? Thin septation ok
Benign Ovarian Masses

Functional cyst: follicular cyst

Management:

Premen:
- <5 cm = benign
- 5-7 cm — annual f/up, prob benign

Postmen:
- < 1 cm benign
- >1-7 cm prob benign, annual f/up

Both: >7 cm — gyn consult or MRI
Benign Ovarian Masses

Functional cyst: corpus luteum

• May be cystic, solid, thick walled
• Rim of blood flow
Benign Ovarian Masses

- Hemorrhagic cysts
  - Mostly corpus luteal
  - Variable appearances: reticular/trabeculated echoes, layering blood, broad based, no flow
Benign Ovarian Masses

- Hemorrhagic cysts

- Variable appearances: Mobile echoes, geometric, mobile solid component, no flow

- Management: 6 wk f/up if doesn’t meet all criteria for benign
Benign Ovarian Masses

- Benign mature teratoma (dermoid)

- Mixed solid/cystic, echogenic component, “tip of iceberg” sign, fat/fluid level
Benign Ovarian Masses

Dermoid management:

- Malignant transformation rare (0.2-2%) and usually squamous cell type
- Age > 50, size >10 cm risk factors
- Sonographic suspicious features: central flow, isoechoic branching structures, solid areas with flow

- If typical appearance, follow initially at 6 mths, then yearly if not removed; look for growth, other change

Benign Ovarian Masses

Endometrioma

- Low level homogeneous echoes with post. acoustic enhancement, “ground glass”
- No internal flow, septations/clots possible
Benign Ovarian Masses

Endometrioma management

• 1% risk of malignant transformation
  – Endometroid or clear cell carcinoma
  – Age >45, size >9 cm (rare in lesions <6 cm)
  – Mean latency period=4.5 yrs

  ▪ If typical appearance, yearly follow-up (look for growth, change in architecture)

Other Ovarian Masses

- Serous cystadenoma
- Mucinous cystadenoma
- Borderline/low malignant potential
- Malignancy
Unilocular cyst

Solid component, max diameter <7mm

Acoustic shadows

Smooth multilocular tumor, max diameter <100mm

No blood flow (color score 1)

Irregular solid tumor

Presence of ascites

≥4 papillary structures

Irregular multilocular solid tumor, max diameter >100mm

Very strong blood flow (color score 4)

Timmerman et al., BMJ 2010
### Predictive Value of Each Sonographic Feature

<table>
<thead>
<tr>
<th>Ultrasonic features</th>
<th>Predictive value</th>
</tr>
</thead>
<tbody>
<tr>
<td>For predicting a malignant tumour (M features)</td>
<td></td>
</tr>
<tr>
<td>M1—Irregular solid tumour</td>
<td>96 (88 to 98); 64/67</td>
</tr>
<tr>
<td>M2—Presence of ascites</td>
<td>97 (93 to 99); 157/162</td>
</tr>
<tr>
<td>M3—At least four papillary structures</td>
<td>88 (80 to 93); 75/85</td>
</tr>
<tr>
<td>M4—Irregular multilocular solid tumour with largest diameter ≥100 mm</td>
<td>84 (77 to 90); 103/122</td>
</tr>
<tr>
<td>M5—Very strong blood flow (colour score 4)</td>
<td>88 (82 to 92); 131/149</td>
</tr>
<tr>
<td>At least one M feature</td>
<td>87 (84 to 90); 340/389</td>
</tr>
<tr>
<td>For predicting a benign tumour (B features)</td>
<td></td>
</tr>
<tr>
<td>B1—Unilocular</td>
<td>99 (98 to 99); 673/681</td>
</tr>
<tr>
<td>B2—Presence of solid components, of which largest solid component has largest diameter &lt; 7 mm</td>
<td>100 (90 to 100); 33/33</td>
</tr>
<tr>
<td>B3—Presence of acoustic shadows</td>
<td>95 (92 to 97); 223/234</td>
</tr>
<tr>
<td>B4—Smooth multilocular tumour with largest diameter &lt;100 mm</td>
<td>99 (97 to 100); 190/191</td>
</tr>
<tr>
<td>B5—No blood flow (colour score 1)</td>
<td>98 (96 to 99); 615/629</td>
</tr>
<tr>
<td>At least one B feature</td>
<td>97 (96 to 98); 1083/1112</td>
</tr>
</tbody>
</table>

**Rule 1:** If one or more M features are present in absence of B feature, mass is classified as malignant.

**Rule 2:** If one or more B features are present in absence of M feature, mass is classified as benign.

**Rule 3:** If both M features and B features are present, or if no B or M features are present, result is inconclusive and second stage test is recommended.
An Approach…

Proposed by IOTA group

- “Simple” approach for distinguishing benign from malignant ovarian lesions
- “M” (predictive of malignancy)
- “B” (predictive of benignity)

Likely malignant—if one or more M-features in absence of B-feature

Likely benign—if one or more B-features in absence of an M feature

If both M and B features or if no features, the mass cannot be classified
An Approach...

- Features Predicting Benign Lesion (B-features)
  - B1: Unilocular
  - B2: Presence of solid components where the largest component has diameter <7mm
  - B3: Presence of acoustic shadows
  - B4: Smooth multilocular with largest diameter <100mm
  - B5: No blood flow

IOTA Group, 2009
Serous Cystadenoma

- Tend to be anechoic, unilocular, no malignant features
Mucinous Cystadenoma

- Tend to have low level echoes, no malignant features
Malignant/Borderline Tumors

- Features Predicting Malignant Tumor (M-features)
  - M1: Irregular solid tumor
  - M2: Presence of ascites
  - M3: At least 4 papillary structures
  - M4: Irreg., multilocular, solid with largest diameter $\geq 100$mm
  - M5: Very strong blood flow

*IOTA Group, 2009*
Mucinous Borderline

- Irregular, thick septations, multi-loculated, flow in septation, \( \approx 10 \text{ cm in size} \)
Serous Borderline (Stage I-C)

- Papillary projections, flow in solid areas, irregular mass
Endometroid Carcinoma

- >4 Papillary projections, flow in solid areas, irregular mass
Mucinous Carcinoma

- Solid, irregular mass with blood flow
Ovarian Masses Unique to Pregnancy

- Ectopic/heterotopic pregnancy
- Theca lutean cysts
- Luteoma of pregnancy
Theca Lutein Cysts

- Bilateral, association with molar pregnancy, multiple gestations or fetal hydrops
- Elevated bHCG
- Similar appearance to ovarian hyperstimulation syndrome
Luteoma of Pregnancy

- Unique to pregnancy, resolve after delivery
- Cystic or solid, bilateral in one third of cases
- Associated with hyperandrogenism in 25% (maternal and fetal)
- Blood flow, similar to malignancy
Management of Ovarian Masses in Pregnancy

- Benign vs Malignant
- Expectant Management
- Surgery
Expectant Management

- Preferred if benign features
- Expectant Management
  - Spontaneous resolution
    - Most cysts <6cm in size resolve on their own
  - Torsion
    - Not common (Occurred in 15% of masses managed expectantly)
    - Masses 6-8 cm had greater risk of torsion, most occurred b/w 10-17 weeks gestation
    - If torsion did not occur by 20 weeks gestation, risk decreased to <5.9%

Grimes et al., AJOG 1954, Hogston et al., BJOG 1986, Thornton et al., Obstet Gynecol 1987, Yen et al., Fert Ster 2009
Surgery

- Elective
  - Optimally performed 16-20 weeks gestation
  - Laparoscopy preferred method
- Emergent
  - Symptoms of torsion
- Outcomes of pregnancy not different
  - Most gynecologists favor conservative/expectant management even with risk of emergent surgery later

Future Directions of Gyn US...

- Awaiting mortality data from screening trials
- New serum markers (none so far proven to be better than CA-125)
- Subspecialized screening centers
- Improved imaging—?MRI, US with contrast, etc
Thank you!
Algorithms For Management of Endometrial and Adnexal Abnormalities
Work-up of *Endometrial Thickening and abnormal bleeding*

*Pre or postmenopausal patients*

- **Routine**
  - TVS
  - US

  - Diffuse, focal
  - or normal

  - **SIS**
Work-up of Asymptomatic *Diffuse Endometrial Thickening*

*Pre or postmenopausal* patients

- **Premenopausal**
  - Routine TVS US

- **Postmenopausal**
  - >5-8 mm *
  - *Gyn Consult*
  - *threshold and management is controversial*

*Likely Physiologic Do Nothing*
Management of Ovarian Cysts

SRU expert panel 10/09:

• Panel members: radiologists, gynecologists including gyn oncologists, pathologists, etc

• Drafted a consensus statement on management of ovarian lesions

• Publication:

**Work-up of Ovarian Masses**

*Premenopausal patients*

**Routine**
- TVS
- US

**Simple cyst**
- \( \leq 3 \text{ cm} \):
  - Benign
  - Do nothing
- \( > 3 \text{ and } \leq 5 \text{ cm} \):
  - Describe in report
  - As benign
- \( > 5 \text{ and } \leq 7 \text{ cm} \):
  - Describe in report
  - As prob benign;
  - Rec yearly f/up US
- \( > 7 \text{ cm} \):
  - MRI or surg. consult

Work-up of Ovarian Masses

Premenopausal patients

Routine TVS US

Hemorrhagic cyst

≤3 cm

Benign Do nothing

>3 and ≤5 cm

Describe in report
As benign

>5 cm

Describe in report
As prob benign;
6-12 wk US f/up until resolution

On f/up, preferably image in follicular phase (days 3-10)

Work-up of Ovarian Masses

*Premenopausal* patients

- **Routine TVS US**
  - **Complex or solid Mass**
    - No flow in solid areas or septations (less risk of malignancy)
    - + flow in solid areas or septations (higher risk of malignancy)
- **Could it be a hemorrhagic cyst?**
  - Yes → Follow-up US in 6 weeks
  - No → MRI or Surg Consult
Work-up of Ovarian Masses

Postmenopausal patients

- **Routine TVS US**
  - **Simple cyst**
    - ≤ 1.0 cm
    - ≥ 7 cm
      - MRI or Surg Consult
  - >1.0 cm and <7 cm
    - Describe in report; Yearly f/up
- + Describe in report: no f/up
Work-up of Ovarian Masses

Postmenopausal patients

Routine TVS US

Complex or solid Mass

- No flow in solid areas or septations
- + flow in solid areas or septations

Gyn consult