Radiologic evaluation and differentiation of adnexal masses

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Core Radiology Course
Harvard Medical School and
Beth Israel Deaconess Medical Center

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Agenda

- Case presentation
- Review of radiological choices for adnexal imaging
- Review of the anatomy of the ovary
- Differential diagnosis of adnexal masses based on radiological findings
- Examples of simple, complex and solid ovarian masses on pelvic ultrasounds
- Discussion on ovarian cancer
  --Borderline tumors of the ovary
Our patient: Clinical presentation

- 65 year-old G4P3 postmenopausal female
- Multiple year history of persistent RLQ pain with episodic nausea, which is increasing in severity
- Benign physical exam
- Past medical history includes diagnoses of irritable bowel syndrome, lactose intolerance, hypothyroidism, interstitial cystitis, and right breast papilloma
- Family history significant for mother who died from breast cancer
Our patient: Initial work-up and additional medical history

- Ongoing work-up for abdominal pain at outside hospital revealed right adnexal mass on CT (images not available)
- Patient referred to BIDMC for further assessment of mass
- Now pertinent OB/Gyn history:
  Menarche at age 13, menopause at 53
  Three spontaneous vaginal deliveries, one spontaneous abortion
  No history of sexually transmitted infections or abnormal Pap tests
Current recommendations for adnexal mass imaging

<table>
<thead>
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Rating Scale: 1=Least appropriate, 9=Most appropriate

*For all adnexal masses, ultrasound is best first modality of imaging and should always be your initial choice!"
Differentiating benign from malignant adnexal masses

Sensitivities and specificities of distinct testing modalities:

<table>
<thead>
<tr>
<th>Test modality</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
</tr>
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<tbody>
<tr>
<td>Bimanual exam</td>
<td>45</td>
<td>90</td>
</tr>
<tr>
<td>U/S morphology</td>
<td>86-91</td>
<td>68-82</td>
</tr>
<tr>
<td>MRI</td>
<td>91</td>
<td>87</td>
</tr>
<tr>
<td>CT</td>
<td>90</td>
<td>75</td>
</tr>
<tr>
<td>PET</td>
<td>67</td>
<td>79</td>
</tr>
<tr>
<td>CA-125(&gt;35 U/ml)</td>
<td>78</td>
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adapted from Myers et al. AHRQ Publication E06-2004.
Review of ovary anatomy

http://www.tarleton.edu/Departments/anatomy/ovary.html
Companion patient #1: Normal appearance of follicles on pelvic ultrasound

Reproductive age female
Transvaginal ultrasound

Features:
• Anechoic
• Size <3cm
• Thin and smooth walls
• Round or oval
• No blood flow

adapted from Levine et al. Radiology, 2010.
Companion patient #2: Normal appearance of corpus luteum on pelvic ultrasound

Reproductive age female
Transvaginal ultrasound with doppler

Features:
- Size <3cm
- Diffusely thick wall
- Peripheral blood flow
- +/- internal echoes
- +/- crenulated appearance

adapted from Levine et al. Radiology, 2010.

Companion patient #3: Normal appearance of postmenopausal ovary on pelvic ultrasound

Postmenopausal female

Transvaginal ultrasound

Features:
• Small
• Homogenous
• Atrophic without follicles


adapted from Levine et al. Radiology, 2010.
Companion patient #4: Simple ovarian cysts on pelvic ultrasound

Simple cyst with benign features

Transvaginal ultrasound

Typical features:
• Round or oval
• Anechoic
• Smooth, thin walls
• No solid components or septations
• No blood flow

Follow-up:
Reproductive age:
>5 &< 7 cm-- Yearly

Post-menopausal:
>1&<7cm-- Yearly

Any age:
>7 cm --MRI and/or surgical evaluation

adapted from Levine et al. Radiology, 2010.
Companion patient #5: Complex ovarian cyst on pelvic ultrasound

Complex cyst with features concerning for malignancy

Anechoic structure with thick walls, irregular septations and nodularity

Typical features:
- Thick-walled
- Thick (>3 mm), irregular septations
- Nodularity
- Vascularization

Follow-up at any age:
- Surgical evaluation


adapted from Levine et al. Radiology, 2010.
Companion patient #6: Complex ovarian cyst on pelvic ultrasound with doppler

Complex cyst with features concerning for malignancy

Transvaginal ultrasound with doppler

- blood flow within echogenic nodule of larger anechoic structure

Typical features:
- Thick-walled
- Thick (>3 mm), irregular septations
- Nodularity
- Vascularization

Follow-up at any age:
- Surgical evaluation

Follow-up at any age:
Surgical evaluation

adapted from Levine et al. Radiology, 2010.

Differential diagnosis of adnexal simple cysts based on sonographic morphology

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<tr>
<td>Follicular cysts</td>
</tr>
<tr>
<td>Corpus luteal cyst</td>
</tr>
<tr>
<td>Hydrosalpinx</td>
</tr>
<tr>
<td>Cystadenoma</td>
</tr>
<tr>
<td>Cysts of gastrointestinal origin</td>
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<tr>
<td>Bladder diverticulum</td>
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Differential diagnosis of adnexal complex cysts based on sonographic morphology

<table>
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<th>Malignant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endometrioma</td>
<td>Mucinous cytadenocarcinoma</td>
</tr>
<tr>
<td>Hemorrhagic cyst</td>
<td>Serous cytadenocarcinoma</td>
</tr>
<tr>
<td>Cystadenoma</td>
<td>Clear cell carcinoma</td>
</tr>
<tr>
<td>Cystic teratoma</td>
<td>Endometrioid carcinoma</td>
</tr>
<tr>
<td>Tubo-ovarian abscess</td>
<td>Granulosa cell</td>
</tr>
<tr>
<td>Fibrothecoma</td>
<td>Cystic teratocarcinoma</td>
</tr>
<tr>
<td>Peritoneal inclusion cyst</td>
<td>Metastases to ovary</td>
</tr>
<tr>
<td>Abscess</td>
<td></td>
</tr>
<tr>
<td>Hematoma</td>
<td></td>
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<tr>
<td>Lymphocele</td>
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**Differential diagnosis of adnexal solid masses based on sonographic morphology**

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Now let’s look at some images of complex cystic and solid adnexal masses with known etiology...
Companion patient #7: Tubo-ovarian abscess on CT

- Clinical history: 23 y/o F in ED presenting with severe right lower quadrant abdominal pain and nausea/vomiting.

Initial abdominal and pelvic CT (C-):

Serpiginous enhancing cystic structures bilaterally in adnexa
Companion patient #7: Tubo-ovarian abscess on pelvic ultrasound

Pelvic ultrasound of left adnexa prior to interventional radiology drainage of abscess:

5.6 cm x 2.7 cm hypoechoic fluid collection within distended fallopian tube
Companion patient #8: Live ectopic pregnancy on pelvic ultrasound

**Clinical history:** 35 y/o asymptomatic female presenting for an early OB ultrasound.

Sagittal view of uterus and adnexa on transabdominal ultrasound:

- Gestational sac in adnexa containing embryo with crown-to-rump length of 15 mm
- Free fluid around uterine fundus, consistent with hemoperitoneum

- CRL = 15 mm, corresponding to 7 weeks and 6 days. FHR = 165 bpm.
Companion patient #9: Ovarian torsion on pelvic ultrasound

**Clinical history:** 38 y/o F presenting to ED with sudden onset severe abdominal pain.

Transabdominal ultrasound:

- 5.7x5.8x3.2 cm hypoechoic ovoid structure just right of left ovary in midline, likely enlarged, edematous right ovary

Transvaginal ultrasound with doppler:

- No detectable blood flow to this ovoid structure
- Free fluid in surrounding area
Companion patient #10: Dermoid on pelvic ultrasound

• Clinical history: 24 y/o with ongoing abdominal pain.

Transvaginal ultrasound of left adnexa:

Transvaginal ultrasound, transverse view of left adnexa:

Hyperechoic mass measuring 4.8x3.9x 4 cm within cyst, consistent with a dermoid in left adnexa

• Dermoids are often characteristic on ultrasound because of a highly reflective dermoid plug, referred to as a Rokitansky nodule, containing hair follicles within the cyst.
Now back to our patient...
Our patient: Choosing an imaging modality for further work-up of adnexal mass

Imaging choices...

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*Relative Radiation Level

Our patient: Right ovary on pelvic ultrasound

Pelvic ultrasound +/- doppler: RIGHT ovary

1.4 x 1.4 x 1.5 hyperechoic area; favor solid>>cyst. Stable subcentimeter simple cyst also present (not pictured).

Pelvic ultrasound four months prior: RIGHT ovary

Subcentimeter anechoic structure, consistent with simple cyst.
Our patient: Left ovary on pelvic ultrasound

Pelvic ultrasound +/- doppler: LEFT ovary

Pelvic ultrasound four months prior: LEFT ovary

1.7 x 1.3 x 1.1 hypoechoic area with layering debris, likely complex cyst
Our patient: Four month follow-up pelvic ultrasound

Four month follow-up pelvic ultrasound +/- doppler: RIGHT ovary

1.4 x 1.4 x 1.5 hyperechoic area; no change in size.

Four month follow-up pelvic ultrasound +/- doppler: LEFT ovary

Persistent 1.7 x 1.3 x 1.1 hypoechoic area; no change in size. Still consistent with complex cyst.
In consultation with her gynecologist-oncologist, our patient decided to undergo surgical evaluation of these ultrasound findings, as malignancy could not be ruled out by imagine alone...
Our patient: Operative report

- Laparoscopic bilateral salpingo-oophorectomy.
- Frozen section pathology revealed findings in right ovary of "mixed/predominantly serous tumor, at least borderline".
- Case subsequently converted to open laparotomy, total abdominal hysterectomy, omentectomy, peritoneal washings and biopsies of the diaphragm.
- Grossly, no further evidence of disease outside of the right ovary was seen.
Our patient: Final pathology

- Right ovarian mixed mucinous and serous **borderline** tumor.
- Examples of the histology of low grade and high grade serous ovarian cancer from other patients:

```
Serous ovarian cancer
Low grade/borderline    High grade invasive
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Our patient: Staging and prognosis

pT1a (IA): Tumor limited to 1 ovary; capsule intact, no tumor on ovarian surface. No malignant cells in ascites or peritoneal washings. No lymph node involvement.


Our patient is now being followed clinically, with CA-125 levels and ultrasound imaging every 4-6 months, for any evidence of recurrence.
Ovarian cancer: Incidence and screening

- Leading cause of death from gynecological malignancy.
- 21,550 cases are diagnosed annually, with 14,600 deaths.
- Lifetime risk <2%, with peak age of diagnosis 50-59.
- Family history strongest risk factor; positive family history present in 10-15% women with ovarian cancer.
- Overall five-year survival is less than 45%.
- 90% of tumors are epithelial in origin.
- Early studies have not supported routine screening by markers or imaging, additional studies ongoing.

Chen and Berek. Epithelial ovarian cancer: Clinical manifestations, diagnostic evaluation, staging, and histopathology. UpToDate;
Sherman ME, et al. Cancer. 2004;100(5);
Eltabbakh GH, et al. Gynecol Oncol. 1999;74(1),
Borderline tumors of the ovary

- First described in 1929 as ‘semimalignant’, recognized by FIGO and WHO in early 1970s.
- Comprise approximately 15% of epithelial ovarian tumors.
- Mean age of occurrence 10 years younger than aggressive ovarian cancer.
- Serous or mucinous subtypes, most serous.
- Stage I disease: 15% recurrence rate, 5 year survival 100%, 10 year survival 90-95%.

Sherman ME, et al. Cancer. 2004;100(5);
Eltabbakh GH, et al. Gynecol Oncol.. 1999;74(1);
http://emedicine.medscape.com/article/258970-overview
Our discussion centered around a patient with interesting radiological findings and the subsequent diagnosis of borderline tumor of the ovary.

We reviewed radiological choices for adnexal imaging.

We refreshed our memory of the anatomy of the ovary.

We outlined a differential diagnosis of adnexal masses based on radiological findings.

Examples of simple, complex and solid ovarian masses on pelvic ultrasounds were shown.

A brief discussion on ovarian cancer, specifically borderline tumors of the ovary, followed.
Acknowledgments

- Deepa Cyriac, MD
- Gillian Lieberman, MD
- Maria Levantakis


BIDMC PACS and Online Medical Records.

Chen LM and Berek JS. Epithelial ovarian cancer: Clinical manifestations, diagnostic evaluation, staging, and histopathology. UpToDate.


