Ovarian Imaging and Ovarian Cancer

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Objectives

1) Introduction to ovarian cancer
2) Indications for ovarian imaging
3) Basic ovarian ultrasonography
4) Imaging in advanced disease
5) Imaging in screening and prognosis
Statistics

- 3rd leading gynecologic cancer
- >50% of GYN cancer deaths
- 1995: 26,000 new U.S. Cases
  14,500 U.S. Deaths
Risk factors

- Age (peak incidence 6th decade)
- Nulliparity
- North American or Northern European descent
- Personal history breast, endometrial, colon CA
- Family history ovarian CA
- Familial ovarian CA syndromes
Lifetime risk of ovarian CA

- 1.4% for all women
- 5% for women with 1\textsuperscript{st}-degree relative with ovarian cancer
# Ovarian CA subtypes

<table>
<thead>
<tr>
<th>Type</th>
<th>% of ovarian neoplasms</th>
<th>% of malignant ovarian neoplasms</th>
<th>examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface epithelial stromal cell tumours</td>
<td>65-70</td>
<td>90</td>
<td>Serous, mucinous, endometrioid, clear cell, Brenner</td>
</tr>
<tr>
<td>Germ cell tumors</td>
<td>15-20</td>
<td>3-5</td>
<td>Teratoma, dysgerminoma, choriocarcinoma</td>
</tr>
<tr>
<td>Sex cord stromal tumors</td>
<td>5-10</td>
<td>2-3</td>
<td>Fibroma, granulosa-theca cell</td>
</tr>
<tr>
<td>Metastases to ovaries</td>
<td>5</td>
<td>5</td>
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</tbody>
</table>
Presenting Signs/Sx

- Pelvic pain
- Pelvic mass
- Weight loss
- Abdominal distention
- Early satiety
- Urinary symptoms
Presenting Signs/Sx (cont.)

• Ovarian torsion presenting as acute abdomen

• Pelvic mass on vaginal exam in asymptomatic woman
Ovarian Ultrasound

Transabdominal

3.5-5.0 MHz transducer
full bladder as acoustic window

Transvaginal (TVS)

5.0-7.5 MHz transducer
empty bladder!
Indications for TVS (v. transabdominal)

- Uncertain transabdominal findings
- Better characterization of lesion
- Strong FH ovarian CA
- Retroverted, retroflexed uterus
Who gets ultrasound?

1) Women with symptoms described earlier

2) Women with acute lower quadrant or periumbilical pain

3) Asymptomatic women with pelvic mass on vaginal exam

4) Women with familial ovarian CA syndrome, annual TVS until age 35
Ultrasound terminology

• Echogenic or hyperechoic
  – This means grey or white!
  – Solid organs

• Echolucent or hypoechoic
  – This means black!
  – Fluid or cysts
Normal ovary
Normal ovary

- Ellipsoid
- Central echogenic medulla
- Homogeneous echotexture
- Position variable
- Anechoic follicles may be seen in cortex

- Ovarian volume = \((0.523 \times \text{length} \times \text{width} \times \text{height})\)
- Normal volume:
  - Premenopausal: 9.8 +/- 5.5 cc (upper limit nl as high as 22 cc)
  - Postmenopausal: 1.2-5.8 cc (>8.0 cc definitely abnormal)
Normal ovary

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- TVS detects 20-90% of postmenopausal ovaries
More normal ovaries
Differential diagnosis of ovarian masses:

• Functional cyst
• Follicular cyst
• Corpus luteum cyst
• Hemorrhagic cyst
• Hematoma
• Abscess

• Cystadenoma
• Cystadenocarcinoma
• Endometrioma
• Ectopic pregnancy
• Teratoma/Dermoid
Let’s review some patients with adnexal pathology
Patient A: right adnexa

- History: 32 yo woman with 3 mo h/o right adnexal pain
Patient A: right adnexa

FILM FINDINGS
There is a right adnexal mass which is:
• Anechoic
• Has well-defined, thin walls
• Shows posterior acoustic enhancement

Diagnosis:
Classic functional ovarian cyst

*Functional cysts are the most common cause of ovarian enlargement in young women
Patient A: left adnexa

BIDMC files
Patient A: left adnexa

FILM FINDINGS

- Heterogeneous left ovarian mass with through transmission
- Characteristic cystic mass with echogenic mural nodule ("dermoid plug")

Diagnosis:
Left ovarian teratoma (a.k.a. ovarian dermoid)
Patient B: right ovary

History: 34 yo woman with 1 wk h/o RLQ pain
Patient B: right ovary

FILM FINDINGS

- Right ovarian mass; low level internal echoes with enhanced through transmission

Diagnosis:
Endometrioma
Patient C: left ovary

History: 19 yo woman with RLQ pain, dyspareunia
Patient C: left ovary

FILM FINDINGS
Left adnexal mass featuring:
• Hyperechoic (“lace-like” pattern)
• Smooth posterior wall
• Posterior acoustic enhancement
Diagnosis:
Hemorrhagic cyst

Hemorrhagic cyst may show septations and reticular pattern as clot hemolyzes, or may mimic a solid mass
Patient D: left adnexa

History: 86 yo woman with recent onset fatigue, weight loss, early satiety

FILM FINDING: there is an irregular cystic lesion of the left ovary
Ultrasound findings suggestive of malignancy in cystic lesions of the ovary:

- Irregular walls
- Thick, irregular septations
- Mural nodules
- Solid echogenic elements
Patient D’s ultrasound is consistent with that of ovarian neoplasm:

- Irregular walls
- Mural nodules
Complex cysts may be benign or malignant.
So, how do we tell the difference?

• Pre-test probability
  – It is uncommon for younger women to have some forms of ovarian neoplasms—but not impossible!
  – So, we can not categorically r/o malignancy based on Hx and Sx alone.

• Repeat TVS imaging?
Recommendations:

Premenopausal

- If unilocular cyst:
  - Repeat TVS in 4-6 wks to demonstrate resolution
  - Premenopausal woman with simple cystic adnexal mass <6-10 cm diameter, 70% will resolve spontaneously

Postmenopausal

- Simple, unilateral cyst, asymptomatic, nl gyn exam, nl Pap, nl CA-125:
  - <3 cm, follow with TVS
  - >3 cm, laparoscopy

- Laparotomy indicated:
  - Cyst >5 cm
  - Cyst with internal septations and/or solid nodules
  - Symptomatic
  - High CA-125
A suspicious ovarian cyst should NEVER be percutaneously drained or aspirated!
Call gyn onc!
FIGO staging of ovarian CA:

- Stage I—limited to ovaries
  - Ia—one ovary, no ascites with + cytology, no tumor on external surface, capsule intact
  - Ib—both ovaries, no ascites with + cytology, no tumor on external surface, capsule intact
  - Ic—tumor stage Ib or Ic but with ascites, or + peritoneal washings, or capsule rupture
- Stage II—pelvic extension
  - IIa—uterus and/or fallopian tubes
  - IIb—other pelvic tissues
  - IIc—tumor stage IIa or IIb but with ascites, + peritoneal washings, or capsule rupture
FIGO staging (cont.):

- **Stage III**—peritoneal mets/superficial liver mets/retroperitoneal nodes
  - IIIa—limited to pelvis, negative nodes, microscopic seeding of peritoneum
  - IIIb—peritoneal implants no larger than 2 cm diameter
  - IIIc—peritoneal implants >2 cm diameter, or + retroperitoneal or inguinal nodes
- **Stage IV**—pelvic extension
  - Distant mets (including pleural effusion, intrahepatic mets)
Staging:

- Ovarian CA is staged surgically

- 70% of women, when diagnosed, are advanced stage (stage III or IV)
Early stage disease:

- Stage Ia and Ib generally do not require chemoRx

- However, rupture or “spillage” of early stage tumor can theoretically advance tumor stage

- Implantation mets at laparoscopy trochar puncture sites (micrometastases seeding scar tissue)
5-year survival

- Stage I  73%
- Stage II  46%
- Stage III 17%
- Stage IV  5%
Patient E:
plain abdominal film

- History: 68 yo woman with several week h/o abdominal pain and constipation
Patient E

FILM FINDINGS:
(SUBTLE!)

1) Probable ascites (“ground glass” abdomen)

2) Suggestion of pelvic soft tissue density

3) No evidence bowel obstruction
DDx pelvic soft tissue mass:

**Common**
- Abscess
- Distended bladder
- Distended/filled bowel loop
- Feces in rectosigmoid
- Hematoma
- Ovarian cyst or neoplasm
- Pregnancy
- Fibroid, hydatid mole, other uterine neoplasm

**Uncommon**
- Anterior sacral meningocele
- Bone tumor
- Extraperitoneal neoplasm
- Hydatid cyst
- Pelvic kidney
- Pelvic lipomatosis

*Source: Felson’s Gamut*
Abdominal CT of Patient E confirmed....
Abdominal CT of Patient E confirmed… free fluid
But what’s this?
And this?
(from a lower axial section)
And this?
(from a lower axial section)

Answer:
Peritoneal implants from metastatic disease
Pelvic CT of the same patient:
Pelvic CT of the same patient:

FILM FINDINGS:
6x7 cm heterogeneous mass in right hemipelvis
Pelvic section from Patient E:
Pelvic section from patient E:

FILM FINDINGS:
Diffuse “omentum caking”:
Soft tissue nodules (mets) embedded in omental fat

Diagnosis:
Metastatic right ovarian cancer with omental cake, multiple peritoneal implants, and ascites
Common sites of metastasis in Ovarian Cancer:

- Stomach
- Large bowel
- Small bowel
- Pelvic ureter
- Liver

- Pelvic nodes
- Para-aortic nodes
- Peritoneum
  - Right subphrenic space
  - Greater omentum
  - Rectouterine pouch (of Douglas)
Different patients with metastatic disease:

Patient F

Ct showing calcified implants in
Stage IIIa papillary ovarian CA

Patient G

MR demonstrating peritoneal enhancement in
patient with metastatic serous tumor

Staging laparotomy

- TAHBSO
- Omentectomy
- Peritoneal biopsy
- Lymph node biopsy
Screening to detect early disease?

- Based on incidence, screening test with 99% specificity and 100% sensitivity would yield 1 in 21 women with disease (PPV 4.8%)

- 5-10% of women with suspicious adnexal mass will undergo surgery, and of these masses, only 13-21% will prove malignant

- Doppler sonography?
  - Malignant masses will have high diastolic flow
TVS screening in asymptomatic women: a study from Japan (Sato et. al., 2000)

- Primary screening of asymptomatic women >30 yo, who also underwent annual screening for cervical CA
- 10 year study
- 183,034 women underwent primary screening
  - 4 TVS views
  - Secondary screening including full TVS, tumor markers
- 320 women underwent laparotomy
  - 22 women diagnosed with ovarian CA

55
TVS screening in asymptomatic women: a study from Japan (Sato et. al., 2000)

• 17/22 had stage I disease (77%)
• 2/22 had stage II disease (9%)
• 2/22 had stage III disease (9%)
• 1/22 had stage IV disease (5%)
TVS screening in asymptomatic women: a study from Japan (Sato et al., 2000)

<table>
<thead>
<tr>
<th>Stage</th>
<th>Pre-screening</th>
<th>Post-screening</th>
</tr>
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<tbody>
<tr>
<td>I</td>
<td>29.7%</td>
<td>58.8%</td>
</tr>
<tr>
<td>II</td>
<td>13.5%</td>
<td>9.4%</td>
</tr>
<tr>
<td>III</td>
<td>43.3%</td>
<td>22.4%</td>
</tr>
<tr>
<td>IV</td>
<td>13.5%</td>
<td>9.4%</td>
</tr>
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</table>
TVS screening in asymptomatic women: a study from Japan (Sato et al., 2000)

Summary:

• screening TVS in asymptomatic women led to earlier stage diagnosis when compared with controls

• Detection of early stage disease may lead to an improved 5-year survival
CT in ovarian CA:

• Current uses of CT
  – Assess disease extent pre-op
  – Substitute for 2nd-look laparotomy

• High false negative rate for identifying residual disease post-chemo
CT as prognostic test in women with known disease?

- Amount of residual disease post surgical reduction and prior to chemo is important prognostic indicator (Goldie-Coldman hypothesis)

- How often does optimal surgical reduction occur?

• Goal: predict outcome of primary cytoreductive surgery

• 41 patients (MGH and JHU)

• Optimal result: <=1 cm maximal diameter residual disease

• 25 radiographic features as potential indicators of surgical outcome

• Results:
  – 3 patients with stage IIIb disease
  – 29 patients with stage IIIc disease
  – 9 patients with Stage IV disease

- CT features most strongly associated with surgical outcome:
  - Peritoneal thickening
  - Peritoneal implants $\geq 2$ cm
  - Bowel mesentery involvement $\geq 2$ cm
  - Suprarenal paraaortic nodes $\geq 1$ cm
  - Omental extension
  - Pelvic sidewall involvement/hydroureter

- Features assigned point value to generate Predictive Index score
- 9 different gyn onc surgeons
- Unnecessary exploration (NPV)—women who undergo laparoscopy and are in retrospect found to be poor surgical candidates by virtue of their tumor burden
- Inappropriate unexploration (specificity)—women who do not undergo laparoscopy, and who in retrospect are found to be appropriate surgical candidates by virtue of their tumor burden

<table>
<thead>
<tr>
<th>Predictive Index Score</th>
<th>Unnecessarily Explored (%)</th>
<th>Inappropriately Unexplored (%)</th>
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</thead>
<tbody>
<tr>
<td>&gt;=1</td>
<td>0</td>
<td>50.0</td>
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<tr>
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<td>&gt;=9</td>
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<tr>
<td>&gt;=10</td>
<td>37.5</td>
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Summary:

The ability of CT to quantify tumor burden may help to

1) identify women who will most benefit from laparoscopy

2) spare women with high tumor burden from unnecessary surgical morbidity
Summary:

We have covered:

- Introduction to ovarian cancer
- Indications for ovarian imaging
- Basic ovarian ultrasonography
- Imaging in advanced disease
- Imaging in screening and prognosis
References:

- Cotran et al, Robbins Pathologic Basis of Disease, W.B. Saunders Company, 1999
- Felson, Gamut
Acknowledgments

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