Ultrasound workup of adnexal masses

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Assessment of adnexal masses

- Patients symptoms
- Age
- Menstrual status
- Serum tumor marker levels

Symptoms

- Acute adnexal pain
  - Acute hemorrhage into a functional or corpus luteum cyst
  - Acute hemorrhage into an endometrioma
  - Infection
  - Ovarian torsion
- Vaginal bleeding / virilization
  - Hormone producing masses

Symptoms

- Symptoms suggestive of malignancy
  - Refractory abdominal or pelvic pain
  - Urinary urgency or frequency
  - Increase in abdominal girth
  - Anorexia

Age

- Premenopausal
  - 20-30 y/o
    - Simple or complex adnexal mass
      - Functional cyst
      - Hemorrhagic CL
      - PID (incidence decreases with age)
      - Cystic teratoma
      - Cystadenoma
      - Malignancy
        - Rare
        - Malignant germ cell tumor or granulosa cell tumor
  - > 40 y/o
    - Similar ddx
      - However
        - Cystadenomas more common
        - Malignant lesions are epithelial about 50% of the time.

Serum tumor markers

- CA – 125 is the most widely used in gyn onc
- > 80% will have elevated CA-125
- Increasing CA-125 correlates with tumor recurrence
- Caveats
  - Stage I ovarian CA
    - Only 50% have elevated CA-125
  - Not specific
    - Can be elevated in cirrhosis, early pregnancy, pancreatitis
### Assessment of masses

- **Simple cystic masses**
  - Round
  - Unilocular
  - Thin walled
  - Posterior acoustic enhancement
- **DDX**
  - Follicle
  - Functional cyst
  - Corpus luteum
  - Cystadenoma
  - If outside of ovary
    - Para-ovarian cyst
    - Hydrosalpinx

### Normal adnexa

- Adnexa refer to the ovaries, fallopian tubes, broad ligament, and ovarian and uterine vessels
- **Ovaries**
  - About 4 x 3 x 2 cm
  - Maximum of 5 cm in any one dimension
  - Can change morphology during the menstrual cycle

### Normal ovary

- Normal ellipsoid shape
- Scattered follicles seen throughout the ovary
- Dominant follicle present surrounded by smaller follicles

### Young vs. old

- **Ovary in a woman of childbearing age**
  - Follicles, normal size
- **Ovary in a postmenopausal female**
  - Small and without follicles

### Simple cystic masses

- Functional cysts
- Corpus luteum cysts
- Cystadenoma
- Paraovarian / paratubal cysts
**Functional cysts**

- In premenopausal women
  - Simple cyst < 2.5 cm = follicle
  - If > 2.5 cm, then functional cyst
    - Due to failure to rupture or regress
    - 50-60% of ovarian masses are functional cysts
    - 2-8 cm, up to 20 cm
    - Usually resolve in 2 menstrual cycles
      - Follow-up in 6 weeks with US

**Simple cyst**

- Asymptomatic 29 y/o
- Anechoic
- Thin walled
- Posterior acoustic enhancement

**Simple cyst**

- In post-menopausal women
  - Common
  - Seen in 10% of post-menopausal women
  - Malignancy incidence still low, but greater vs. pre-menopausal women
    - Usually > 5 cm
    - Small cysts usually benign
    - MRI could be helpful

**Functional cysts**

- Can demonstrate hemorrhage/clot with internal debris
- Appearance is reticular
  - “Fishnet, cobweb, or lacy”
  - Due to fibrin strands
  - No septations present

**Hemorrhagic cyst**

- Complex mass
- Lacy (reticular) appearance due to the presence of fibrin strands
- Resolution of cyst several weeks later

**Hemorrhagic cyst**

- Differentiating from endometrioma is often difficult
- Hemorrhagic Cyst
  - Usually single
  - Will resolve with time, endometrioma will not.
Hemorrhagic cyst with retracted clot

- Complex cyst with internal echoes; clot has concave margins (nodule = convex)
- Doppler shows no color flow with normal flow in the ovary.

Corpus luteum cyst

- Dominant follicle becomes a CL cyst after ovulation
- Variable appearance
  - Solid
  - Thick walled
  - Thin walled
  - +/- internal debris
  - Color doppler
    - Marked color flow
    - Ring of vascularity (92% of cases)
    - Indicates physiologic rather than neoplastic

Corpus Luteum cyst

- TV US with a thick walled cyst
- Ring like color doppler

Theca lutein cysts

- Association with increased levels of, or abnormal ovarian response to, β-hCG
- Bilaterally enlarged ovaries
- Multiple cysts of varying size
- Ovaries are typically 6-12 cm
- May be as large as 20 cm

Graphic shows enlargement of both ovaries due to multiple theca lutein cysts of varying size.
Axial CECT in the same patient shows bilateral enlarged ovaries (white solid arrow) composed of multiple cysts of different sizes separated by enhancing thin septa. Note also the expanded uterine cavity (white open arrow) with fine enhancing septa (white curved arrow).

**Cystadenoma**
- Epithelial neoplasm
- Serous > mucinous
- Occur in all age groups
- Bilateral in 20%
- US features
  - Thin walled
  - Unilocular or bilocular
  - No solid components
  - 10cm on average, up to 50cm

**Serous cystadenoma**
- TVUS shows a large cyst with incomplete septation
- DDX: hydrosalpinx

**Paraovarian / paratubal cysts**
- Ductal remnants
- Cannot differentiate between the two
- Can develop anywhere along the adnexa
  - Broad ligament
  - Mesosalpinx
  - Surface of ovary
  - Almost always benign

**Follow up of cystic adnexal masses**
- The Society of Radiologists in Ultrasound recommendations for asymptomatic adnexal cyst management.
- The following do not require follow-up:
  - Simple unilocular cysts < 4 cm in pre-menopausal
  - Complex unilocular cysts < 3 cm in pre-menopausal
  - Simple unilocular < 1 cm in post-menopausal
Follow up of cystic adnexal masses

- Pre-menopausal
  - Larger or complex cysts
    - Follow up in 2 menstrual cycles
- Post-menopausal
  - Larger or complex cysts
    - If elevated CA-125
      - Pelvic MRI or short term US

Complex masses

- Endometriosis
- Peritoneal inclusion cysts
- Hydrosalpinx
- Neoplasm
  - Cystic teratoma
  - Epithelial neoplasms

Complex masses

- US features
  - Turbid fluid
  - Septations
  - Calcifications
  - Solid components

19 y/o with pelvic pain/ mass

19 y/o with pelvic mass

Endometriosis

- Islands of functional extrauterine endometrial stroma
- Can occur anywhere
- Ovaries (endometriomas)
  - 55-80% of cases
  - Bilateral in up to 50%
Endometrioma

- US
  - Variable, depends on the amount of hemorrhage
    - Anechoic to solid
    - Septations
    - Multilocular
    - Generally
      - Hypoechoic with thru transmission
      - Homogenous (vs hemorrhagic cysts)
      - Persist over 3 months
      - Hyperechoic foci represent cholesterol deposits
  - Rarely undergo malignant transformation <1%

Bilateral endometriomas

Bilateral pelvic masses

T1 images of the pelvis shows bright masses adjacent to the uterus. [DIAG: Dermoid cyst, endometrioma]

Common sites for endometriosis

Pelvic and abdominal pain barium studies in 3 different patients

[IMAGES]

endometriosis
**Mature cystic teratomas**
- Aka dermoid tumors
- Most commonly excised tumors
- Mean age = 30
- Benign, slow growing
- Contain tissue from ectoderm, mesoderm and endoderm
  - Skin
  - Brain
  - Fat
  - Hair
  - Teeth
  - Muscle

**Teratomas**
- US characteristics
  - Unilocular
  - Bilateral in 10%
  - Hypovascular on doppler
  - Increased echoes with posterior acoustic enhancement (teeth)
- Fat / fluid levels
  - Fat is bright on US
  - Other bright foci
    - Sebum
    - Hair

**Dermoid cyst**
- US demonstrates area of increased echogenicity representing calcification
- Curved arrow demonstrates area of fat – fluid level
- Findings very typical of a dermoid cyst

**Mass in the pelvis**
- CT demonstrates a low density structure in the pelvis of this 28 y/o female
- Low density on CT
  - Fluid
  - Fat
- Hounsfield units showed this to be fat
- Diagnosis is dermoid cyst.

Based on these MRI findings, what is the most likely diagnosis for this mass?
- a. Cervical carcinoma
- b. Ovarian carcinoma
- c. Leiomyoma
- d. Teratoma or dermoid cyst
- e. Large nabothian cyst
Ovarian Cancer

- Worldwide 200,000 diagnosed
- 125,000 die
- More deaths than all other gynecologic cancers combined
- 1 in 78 American women

Risk factors
- Nulliparity
- Early menarche
- Late menopause
- White race
- Increasing age
- Residence in North America and Europe
- Personal history of breast cancer

Screening/early detection
- Society of Gynecologic Oncology (SGO) White Paper on Ovarian Cancer:
  - No proof that routine screening for ovarian cancer in either the general public or high risk populations with serum markers, US, or pelvic examinations decreases mortality, and there is no recommendations for routine ovarian cancer screening from any national organization

Effective screening
- Reasonably inexpensive
- High sensitivity
- High specificity
- PPV > 10%
- This is yet to be achieved for ovarian cancer screening

Signs/symptoms
- Abdominal and GI problems most common
  - N/V partial bowel obstruction
- Gynecological symptoms least common
  - Do s/sx occur too late to diagnose?
  - Goff et al showed 89% of stage I-II and 97% of stage III-IV recalled symptoms prior to diagnosis.
  - Unfortunately, ovarian cancer not part of dx
    - Menopause, aging, dietary changes, stress, etc

CA-125
- Integral in determining response to therapy and disease recurrence
- Not useful for screening
  - Too many false positives and negatives
  - Low prevalence of disease also significantly limits its use
    - Incidence of 1 in 2500 women
    - If test was 100% sensitive, 99% specific, then PPV would be 5%
    - 19 of 20 women going to surgery would not have ovarian CA
- CA-125 does not approach this
  - Sensitivity = 78% specificity = 95%
Ovarian Cancer

- TVUS alone
  - University of Kentucky Ovarian Cancer Screening Project in 1987
  - 35,327 women screened with US alone
    - 364 had persistent tumor
      - 313 benign
      - 51 malignant
  - National Ovarian Cancer Early Detection Program
    - 4526 women
    - 98 persistent masses
      - 11 were malignant (all stage III)
  - Screening asymptomatic women with US is not effective, even if they are high risk.
  - > $600,000 to detect one curable cancer

Ovarian Cancer

- CA-125 and TVUS
  - High false positive rate in premenopausal women
  - Prostate, Lung, Colorectal and Ovarian (PLCO) Trial
    - Four rounds of screening involving > 25,000 women per round
    - PPV about 1-2%
    - Surgery to cancer ratio was 19.5 : 1
    - 72 of screen-detected cancers were late stage
  - CA-125 and TVUS have not proven effective

Ovarian Cancer

- Surveillance for recurrent disease
  - CA-125 is the only biomarker recommended for monitoring of therapy as well as recurrence
  - Occasionally, CEA in patients with mucinous tumors can be used
  - Neither CT nor TVUS is more accurate than serial CA-125 in detecting relapse
  - PET-CT useful in patients with elevated CA-125 and negative conventional imaging

Ovarian Cancer

- Current recommendations for cancer screening
  - High risk patients
    - BRCA 1 and 2 mutation carriers
    - Combine pelvic, TVUS and CA-125 every 6 months at age 35, or 5-10 years earlier than when ovarian cancer diagnosed in family member
    - WOMEN BEING SCREENED SHOULD BE AWARE THAT IT HAS NOT BEEN DEMONSTRATED TO REDUCE MORTALITY.
    - RISK REDUCING SALPINGO-OOPHORECTOMY (RRSO) SHOULD BE CONSIDERED AFTER CHILDBEARING

Ovarian carcinoma

Routes of metastasis

1. LOCAL - direct invasion to surrounding organs
2. LYMPHATIC - Lymphatics to pelvic and para-aortic nodes
3. PERITONEAL - tumor cells shed from tumor surface and spreads through peritoneum (most common)
4. HEMATOGENOUS - (least common)
Objective assessment

- Scoring systems have been proposed to assess ovarian masses
  - Non-hyperechoic solid compartments
  - Central blood flow
  - Ascites
  - Thick septations
- Proved to be no better than subjective ‘gestalt’ approach

Limitations of US

- US is limited in the following
  - Staging of ovarian cancer
    - However, very good at evaluating ascites and hydronephrosis
    - Low sensitivity in finding peritoneal implants < 2cm
  - Recurrent ovarian cancer
    - Good at finding recurrent disease in the pelvis or around the liver
Epithelial neoplasms

• US characteristics of malignancy
  – Growth over time of partially cystic masses
  – Papillary projections
    • Vascular
    • Solid
    • Non-fatty
  – Thick septations > 2mm
  – Thick walls > 3mm
  – Ascites
  – Lymphadenopathy, omental caking

Doppler evaluation of malignant tumors

• Controversial
• If flow is present can be confirmatory of malignancy
• Neovascularity of malignancy
  – Tortuous vessels
  – AV shunts
  – Resistive index and pulsatility index
    • Quantifies the peak systolic and end diastolic velocities
    • Consider malignancy if < 0.4 RI and < 1.0 PI
    • However, with improved US technology, considerable overlap between benign vs. malignant

Ovarian mass

• Ovarian masses are not always specific on US
• In other words, it is difficult to determine if a mass is benign or malignant
• Follow-up is usually warranted
• If mass decreases in size, almost always benign
• If a mass increases or changes, must rule out malignancy
  – Characteristics of malignant ovarian masses
    • Solid consistency
    • Size greater than 10 cm correlates with a 64% risk of malignancy in postmenopausal women
    • Color flow US demonstration of blood vessels within septations
    • Age – risk increases with age
    • Extension of tumor outside the ovary
    • Ascites

Pitfalls

• Size
  – The larger the size, the more worrisome
  – However, in a study by Brown
    • Half of all excised malignant lesions were <4 cm
  – Some benign tumors can appear malignant
    • Thick septations and mural nodules
      – Hemorrhagic cysts
      – Cystadenofibromas
    • Solid but benign
      – Brenner tumors
      – Fibromas, fibrothecomas

Recurrent ovarian CA

Hydronephrosis of kidney
dilated distal ureter (short arrow)
soft tissue mass (long arrow)
Recurrent ovarian carcinoma

Large area of pelvic ascites
Complex appearing solid and cystic mass

57 y/o Recent diagnosis of breast cancer

- Minimal uptake in left breast from recent biopsy
- Activity noted in right adrenal region
- BRCA positive

Recent diagnosis of breast cancer

Dx: ovarian carcinoma

LS - 65 y/o female

- Recent diagnosis of ovarian CA
- Hysterectomy and BL SPO
- Ascites and Peritoneal thickening
- Bowel wall involvement
- Bilateral pleural effusions

miscellaneous

- Torsion
- PCOS
- TOA

LS - peritoneal mets

Peritoneal mets from ovarian carcinoma
Carcinoma - stage III
Ovarian torsion

- Ultrasound is modality of choice
- Features
  - Unilateral enlarged ovary – most common feature
  - Uniform peripheral cystic structures
  - Mass within the ovary
  - Free fluid
  - Reduced or absent arterial flow to the involved ovary suggests the diagnosis
- Flow in the ovary does not exclude torsion
  - Suggests the ovary may still be viable.
- Absence of flow may indicate the ovary is not viable.
- Overall, doppler evaluation is not always reliable b/c of variations of adnexal flow and intermittent torsion

Polycystic ovarian syndrome

- Clinical and biochemical diagnosis
- Clinically
  - Hirsutism
  - Amenorrhea
  - Infertility
  - Obesity
- US
  - Enlarged ovaries (B/L in 70%)
  - > 10 – 12 follicles per ovary, typically situated along the periphery
  - Normal ovaries in 30%
  - Not completely specific

Patient with infertility. Suspect prolactinoma

- O = optic chiasm
- P = pituitary gland
- CA = carotid artery

Post contrast image shows a microadenoma of the pituitary gland

Torsion

- Enlarged 7 cm ovary
- Essentially no flow within the ovary

Polycystic ovarian syndrome

- MRI of pelvis
- Numerous small peripherally located cysts of the left ovary
- Normal appearing central stroma

Tubo-ovarian abscess

- Ultrasound findings
  - Endometrial fluid (not specific)
  - Gas bubbles in the endometrium is diagnostic
  - Hydro-/ pyosalpinx
    - Cystic and tubular adnexal mass
  - Fibrosis and adhesions are seen endstage
- CT ordered more frequently to rule out other entities
  - Appy, diverticulitis, etc
Imaging review

- US is the initial modality for detection and characterization of an adnexal mass
  - Sometimes non-specific, follow up needed
- MRI is a problem solving modality in cases of indeterminate adnexal mass on US
  - Not frequently performed, but can add further information
- CT (or PET/CT) is most commonly used for pre-operative staging and follow-up after treatment

references

1. SGO White Paper on Ovarian Cancer: Etiology, Screening and Surveillance: Gynecologic Oncology Volume 119, Issue 1, October 2010, Pages 7-17