Evaluation of Ovarian Masses: A Practical Approach

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Objectives:

• Discuss the role of US in the evaluation of ovarian/adnexal masses

• Offer a pattern recognition/algorithmic approach for diagnosing benign ovarian/adnexal masses

• Describe morphologic features worrisome for ovarian/adnexal malignancy
What is Expected of Us as Imagers?

• “The sonologist who merely measures the size of a mass and subsequently offers a differential diagnosis that includes nearly every adnexal abnormality, including malignancy has failed in his or her opportunity to contribute meaningfully to the care of the patient”


What is Expected of Us as Imagers?

• Offer a reasonable diagnosis/differential diagnosis based on:
  – Age/menopausal status
  – Sonographic appearance/pattern recognition
  – Clinical and laboratory findings
• Recommendations for further management
  – Benign mass- offer specific diagnosis
  – Need for MRI or laparoscopy
  – Malignant mass- referral to GYN oncology for staging laparoscopy
Benign Masses We Can Diagnose

- Simple cyst in the pre- and postmenopausal woman
- Paraovarian cyst
- Hydrosalpinx
- Theca lutein cysts associated with hyperstimulation syndrome or gestational trophoblastic disease
- Hemorrhagic ovarian cysts
- Endometrioma
- Mature cystic teratoma- ovarian dermoid
- Peritoneal inclusion cyst

Masses That Need Further Imaging and or Laparoscopy

- Predominantly solid masses
- Complex masses
- Cystic masses with thick septations, papillary projections and irregular walls
- Flow on CDUS in septations or solid components
  - Low resistance/ high diastolic flow
  - Tumor vessel angiogenesis
US Features Suggesting Benign Mass

- Cystic, anechoic mass
- Thin wall
- None or simple thin (< 3mm) septations
- No flow on CDUS or
- Minimal high resistance flow (RI > 1)
- US appearance compatible with dermoid, endometrioma or hemorrhagic cysts

Management of Asymptomatic Ovarian and Other Adnexal Cysts Imaged at US: Society of Radiologists in Ultrasound Consensus Conference Statement

The Society of Radiologists in Ultrasound convened a panel of specialists from gynecology, radiology, and pathology to arrive at a consensus regarding the management of ovarian and other adnexal cysts imaged sonographically in asymptomatic women. The panel met in Chicago, Ill, on October 27–28, 2009, and drafted this consensus statement. The recommendations in this statement are based on review of current literature and common practice strategies, and are thought to represent a reasonable approach to asymptomatic ovarian and other adnexal cysts imaged at ultrasonography.

*SRSA, 2009*

- Expert panel met in Chicago, Ill, on October 27–28, 2009

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Management of Asymptomatic Ovarian and Other Adnexal Cysts Imaged at US
Society of Radiologists in Ultrasound Consensus Conference Statement
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Methods and Conference Preparations

• Discussion limited to asymptomatic, nonpregnant, adult women with ovarian or other adnexal cysts
• Appropriate follow-up of cysts with respect to
  – Patient age
  – Menopausal status
  – Cyst size
  – Cyst morphology
  – Doppler and grayscale US findings
US Technical Aspects - Color and Power Doppler US

• Evaluation of most complex cysts
• Ensure absence of flow in seemingly solid areas or septations
• Most important Doppler feature = presence of flow in solid element
• PI and RI - insufficient advantage of over morphological assessment

US Technical Aspects – Cyst Size Measurements

• Use maximum diameter (measurements taken in three orthogonal directions)
• Vaginal probe can modify cyst size (increases variability, decreases accuracy)
US Reporting - Management

- No follow-up for normal and clinically inconsequential findings
- Cyst aspiration is *not* a reasonable approach in asymptomatic patients
  - Low sensitivity of cyst fluid cytology for malignancy
  - Many cysts will recur after aspiration

Postmenopause

- Defined as 1 year or more of amenorrhea since last menstrual period (LMP)
- Two stages
  - Early postmenopause (1-5 years)
  - Late postmenopause (5+ years since LMP)
Normal Ovary, Reproductive Age

- Varying appearance throughout menstrual cycle
  - Multiple developing follicles
  - Dominant follicle
    - Follicles and simple cysts up to 3 cm maximal diameter considered normal and physiologic

Normal Ovary, Reproductive Age

- Corpus luteum
  - Cyst with diffusely thick walls
  - Crenulated inner margins
  - Less than 3 cm in maximal diameter
  - Usually internal echoes
  - Ring of hypervascularity
  - “Ring of fire”
Normal Ovary- Menopause

- Small and homogeneous
- Early menopause, cysts
  - Ovulatory event
  - Paraovarian or tubal cysts
- Late menopause
  - Small simple cysts up to 1 cm seen up to 21%

Malignant Potential of Ovarian Cysts

- Surgically removed simple ovarian cysts
  - Usually larger cysts or cysts in postmenopausal women
  - 84% serous cystadenomas

- Malignant potential of cystadenomas
  - Cystadenoma and cystadenofibroma may be precursor lesions for borderline tumors and low-grade carcinoma
  - Exceedingly slow rate of transformation
  - Therefore, can be considered benign
Malignant Potential of Ovarian Cysts – Borderline Tumors

- Small subset of US simple cysts found to be **borderline tumors**
  - Low risk and rate of malignant transformation
- Short-term US follow-up unlikely to demonstrate detectable change
- **Mucinous** borderline tumors
  - Stay confined to ovary even when intraepithelial carcinoma present
- **Serous** borderline tumors
  - May progress to low-grade carcinoma
  - Rare transformation from borderline to high-grade malignancy (genetically distinct lesions)
  - Risk for transformation associated with peritoneal implants

Benign Cysts, Simple Adnexal Cyst

- Round or oval
- Smooth thin walls
- Posterior acoustic enhancement
- No solid component or septation
- No internal flow
- Up to 10 cm at any age highly likely benign
- Malignancy rate <1%
Simple Adnexal Cyst - Differential

- Non-neoplastic cyst
  - Physiologic **
  - Paraovarian cyst *
  - Paratubal cyst
  - Small hydrosalpinx
- Benign neoplastic cysts
  - Serous and mucinous cystadenoma

Recommendations for Simple Cysts

- Women of reproductive age
  - ≤3 cm
    - Normal, ±describe
    - no f/u
  - >3 and ≤7 cm
    - Describe as almost certainly benign
    - >3 and ≤5 cm, no f/u
    - >5 and ≤7 cm, yearly US f/u
  - >7 cm
    - Difficult to assess completely with US
    - MRI or surgical evaluation recommended
Recommendations for Simple Cysts

- **Postmenopausal women**
  - ≤1 cm (up to 3cm)
    - Clinically inconsequential
    - No f/u needed
  - >1 and ≤7 cm
    - Describe almost certainly benign
    - Initially: yearly US follow-up
    - May opt to continue f/u or decrease frequency
  - >7 cm
    - Further imaging with MR or surgical evaluation should be considered

Recommendations for Simple Paraovarian and Paratubal Cysts

- **Paraovarian and Paratubal cysts**
  - Common, usually simple cysts on US
  - Very unlikely to be malignant
  - Often not distinguished from ovarian cysts in the literature
  - Not likely to resolve
  - Generally inconsequential in asymptomatic women
  - Panel decision: same size threshold as for ovarian cysts
Hemorrhagic Ovarian Cyst

- **Classic findings:**
  - Complex cystic mass
  - Reticular pattern of internal echoes (fishnet, cobweb, spiderweb, lacy appearance; generally due to fibrin strands)
  - and/or solid-appearing area with concave margins
  - No internal flow
  - Usually circumferential flow in the cyst wall
  - Variable wall thickness
- Typically resolve within 8 weeks

Hemorrhagic Ovarian Cyst - Recommendations

- Women of reproductive age
  - Cysts $\leq 3$ cm
    - $\pm$ describe
    - No follow-up
  - $>3$ and $\leq 5$ cm
    - Describe in report
    - No follow-up
  - $>5$ cm
    - Describe in report
    - Short interval US follow-up (6-12 weeks) to ensure resolution
Endometrioma

- Typical US appearance
  - homogenous ground glass or low-level echoes
  - No internal flow or wall nodules
- Differentiation from hemorrhagic cyst
  - Multilocularity
  - Tiny echogenic wall foci
- If differentiation from hemorrhagic cyst not possible in menstrual age woman
  - Short-interval follow-up (6-12 weeks) to ensure that not mistake hemorrhagic cyst for endometrioma

Endometriomas: US Findings

- Echogenic foci in wall
Endometrioma

• Classic US findings of endometrioma present
  – US follow-up if no surgical removal
  – At least **yearly** US follow-up (interval based on patient age, pain)
• 1% malignant transformation (endometroid or clear cell carcinoma)
  – Rapid enlargement or internal changes (development of solid elements exhibiting Doppler flow)
  – Uncommon if <6 cm
  – Most occur in >9cm lesions

Endometrioma: Mural Nodules

• Cave mural irregularities or nodules!
  – clot uncommon in endometriomas
  – ↑ incidence of clear cell & endometroid Ca

![Clear Cell Carcinoma](Courtesy Dr. Scourt)
Ovarian Teratoma - Dermoid

• Most common ovarian tumor in premenopausal woman
• Germ-cell tumor, 10-15% bilateral
• Characteristic pattern with 100% positive predictive value if at least two characteristic features present

Dermoid- US Features

• Echogenic ovarian mass
• Ovarian mass with bright linear echoes (dermoid mesh)
• Cystic mass with echogenic nodule and shadowing (dermoid plug)
• Cystic mass with floating echogenic mass(es) with shadowing
• Fat/liquid level
Dermoid- US Appearance

- Mature cystic teratoma of the ovary
- **Classic features**
  - Focal or diffuse hyperechoic components
  - Hyperechoic lines and dots (dot-dash-dermoid mesh)
  - Area of acoustic shadowing without internal flow
- **Additional findings**
  - Floating spherical structures
  - Fat/fluid level

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Dermoid

- Shadowing mass: tip of the iceberg sign
- Fat and calcium containing mass on CT
Dermoid

- Echogenic foci with shadowing
- Echogenic mass with posterior sound attenuation

Dermoid mesh sign: dots and dashes
Dermoid

Mildly echogenic midline mass with calcification

CT: fatty mass with calcification

Fat containing mass on CT

Dermoid mesh: dots & dashes
Dermoid

Fat-fluid level

- Multiple echogenic masses

Tongsong, J Ultrasound Med: 2006
Dermoid

• If a classic dermoid is found on US
  – No additional imaging needed
  – Follow-up US initial 6-12 months (regardless of age), if the dermoid is not removed
    • Ensure stability (size and internal architecture)

Hydrosalpinx

• Criteria for confident diagnosis:
  – Tubular cystic mass
  – Endosalpingeal folds
    • Beads on a string = short round projections <3 mm
    • Cog-wheel sign
  – Waist sign
    • Indentations on opposite sides
  – Incomplete septation sign
  – Separate from ipsi-lateral ovary
Bilateral Hydrosalpinx

Bilateral serpiginous cystic masses

Incomplete septation
Waist sign

Peritoneal Inclusion Cyst

• Associations
  – Prior pelvic surgery
  – Endometriosis
  – Pelvic inflammatory disease
• Classical US features
  – Cystic mass with ovary either at the edge or suspended within it
  – Usually septations present
  – Usually follow contour of adjacent pelvic organs
  – Septations may demonstrate flow
• Management
  – No further imaging for diagnosis
  – Follow-up determined by age and clinical symptoms
Peritoneal Inclusion Cyst

Indeterminate but Probably Benign Cysts

- US features seen in both benign and malignant masses
  - Raise concern for malignancy
  - Not predictive enough for confident determination
Indeterminate but Probably Benign Cysts

- Almost always benign
  - Single thin septation (<3mm)
  - Small wall calcification
  - Follow-up similar to simple cyst (patient age and cyst size)

- Indeterminate features
  - Multiple thin septations without flow
  - Solid nodule without flow and not echogenic like dermoid
  - Irregularity or tiny areas of focal thickening of the cyst wall
  - Management: consider MRI or surgical evaluation

Bilateral Cystadenofibromas

Bilateral multiseptated cystic masses
**Consensus Statement**

- Substantial likelihood of **malignancy**
  - Thick septations
  - Nodules with blood flow
  - Focal wall thickening
  - Further imaging (MRI)
  - Strongly consider surgical evaluation

**Suspicious Cysts**

- Very worrisome for malignancy
  - Thick septations (≥3mm)
  - Solid elements with flow
  - Focal areas of wall thickening (≥3mm)
  - Cyst with a **nodule with internal blood flow**
- Supporting findings
  - Omental/ peritoneal masses
  - Moderate to large pelvic ascites
Cystic Epithelial Neoplasms

- Peak incidence 60-75 yrs
- Up to 20% bilateral
- Cystadenomas & cystadenocarcinoma
- **Serous** tend to have papillary projections
- **Mucinous** tend to have septations
  - different locules may have different levels of echogenicity

Mucinous Cystadenoma

Large pelvic mass (27 cm), multiple avascular septations
Variable echogenicity in multilocular cyst
Serous Cystadenofibroma

Large 10 cm cystic mass - postmenopausal patient

Borderline Mucinous Cystadenocarcinoma

Thin septations with flow

Courtesy Dr. Scoutt
Mucinous Custadenocarcinoma in Mature Cystic Teratoma

Complex adnexal mass with internal vascularity

Borderline Serous Cystadenocarcina

Papillary projections with vascularity  Courtesy Dr. Scoutt
Borderline Serous Cystadenocarcinoma

Multiloculated cystic mass with solid components  
Flow on CDUS

Serous Cystadenocarcinoma

Complex Ovarian mass  
Thick septations and flow
Ovarian Cystadenocarcinoma

Complex adnexal mass with low-velocity flow on CDUS

Ovarian Carcinoma and Peritoneal Carcinomatosis

Complex ovarian mass
Pelvic sidewall and bowel implants, complex ascites
Ovarian Carcinomatosis

Pelvic sidewall implants with tumor vascularity

Ovarian Cystadenocarcinoma

Complex right ovarian mass  Tumor vascularity on CDUS
**Ovarian Cystadenocarcinoma**

CT: complex right adnexal mass - axial and coronal CT

**Metastatic Ovarian Cystadenocarcinoma**

Left Supraclavicular lymphadenopathy  
FDG Avid on PET Scan
Solid Ovarian/Adnexal Masses

- Considered neoplastic
- Sometimes just enlarged ovary- use Color Doppler US to delineate mass
- May represent benign lesions
  - Ovarian fibroma
  - Pedunculated fibroid- use CDUS to demonstrate vascular connection to uterus
- Ovarian metastases

Solid Ovarian Mass

| Ovarian Carcinoma | Brenner Tumor |
Solid Ovarian Mass

- Ovarian Carcinoma
- Fibrothecoma

Solid/Complex Ovarian Mass

- Granulosa Cell Tumor
- Fibrothecoma
Exophytic Leiomyoma (Fibroid)

Solid left adnexal mass  Vascular connection to uterus

Exophytic Leiomyoma (Fibroid)

Solid right adnexal mass  Solid left adnexal mass
Exophytic Leiomyoma (Fibroid)

Bilateral Vascular Connection to Uterus

Ovarian Fibroma

Solid left adnexal mass

Minimal internal flow
Ovarian Fibroma

Solid left adnexal mass

No vascular connection to uterus

Ovarian Fibroma

- Confirm with MRI - low signal
Ovarian Metastases

- 5-15% of ovarian neoplasms
- Breast and gastrointestinal tract tumors most common - Krukenberg tumor
- Usually bilateral solid masses (breast, stomach, uterus)
- May be complex (colon and rectum)
- Lymphoma: hypoechoic mass(es) - often bilateral

Krukenberg Tumor

Right adnexal mass on US and CT - Metastasis from gastric carcinoma
Ovarian Metastasis: Colon Ca

Ill defined left adnexal mass  US guided biopsy

Metastatic Colon Carcinoma

Complex right adnexal mass  Peripheral & central vascularity
Metastatic Lung Cancer to Ovary

- Solid mass left ovary
- Normal right ovary

Metastatic Lung Cancer to Ovary

- Left adnexal mass
- Left lung mass
Conclusion

- Gyn US accurate tool to diagnose variety of ovarian/adnexal masses using a pattern and algorithmic approach
- If US appearance is not diagnostic consider MRI for further categorization
- If both US and/or MRI pattern are inconclusive surgical exploration will be necessary

Thank You!!

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