Gynecologic Ultrasound: An Evidence Based Review

Anna K. Sfakianaki, MD, MPH
Gynecologic Ultrasound Program
Maternal-Fetal Medicine
Department of Obstetrics, Gynecology and the Reproductive Sciences
Yale University School of Medicine

Objectives

• To critically evaluate the literature regarding the utility of ultrasound in the evaluation of select gynecologic pathologies
• To describe gynecological pathology by transvaginal ultrasound
• We will cover Mullerian anomalies, uterine/endometrial pathologies, adnexal evaluation

The Evidence Pyramid

Congenital Uterine Anomalies (Müllerian Anomalies)

MRI or 3DUS?

Speroff: Clinical Gynecology, Endocrinology and Infertility
Kupesic, J Perinatal Med 2002
- 3850 women with infertility or RPL; gold standard hysteroscopy
- 3DUS successful in all
- 894 surgically addressed findings: septate (17.9%), submucous myoma, polyp, adhesions
- 3DUS detected 684/689 septate anomalies
  - 2 with polyps, 2 with fibroids, 1 with synechiae missed
  - Sensitivity 99.27%, specificity 100%

Ghi, Fertil Steril 2009
- 284 nulliparous women with ≥3 miscarriages; fibroids/polyps excluded (n=28)
- 3DUS successful in all
- 230 with normal US → all confirmed on office hysteroscopy
- 54 with suspected Mullerian → all confirmed on laparoscopy/hysteroscopy
  - 52 concordant diagnoses: 92.3% accurate
  - arcuate mistaken for subseptate; bicornuate mistaken for septate
Bermejo, Ultrasound Obstet Gynecol 2010

- 286 women with uterine malformation on 3DUS; abdominal US in 3 with intact hymen; +speculum

- 65 underwent MRI
  - 4 discrepancies in diagnosis → concordance kappa 0.880 (95% CI 0.769, 0.993) – bicornuates on 3D, septate on MRI
  - 2 discrepancies on associated findings → concordance k=0.878 (0.775, 0.980)
    - 1 bicornuate – 3DUS missed a cervical septum
    - 1 septate with cervical septum – 3DUS diagnosed 2 cervixes instead

No other studies directly compare 3DUS to MR for diagnosis of Mullerian anomalies

Abnormal Uterine Bleeding Reproductive-Aged Women

ACOG Bulletin No. 128: July 2012

The primary imaging test of the uterus for the evaluation of AUB is transvaginal ultrasonography. If transvaginal ultrasonographic images are not adequate or further evaluation of the cavity is necessary, then sonohysterography (SIS) or hysteroscopy (preferably office) is recommended.

Myomas: Dueholm, AJOG 2002

- Prospective, double-blind, observational study
  - 106 consecutive premenopausal women undergoing hysterectomy for benign pathology
  - Underwent TVUS and MR

- Sensitivity 99%, Specificity 91%

- Transvaginal ultrasound is first line

- Consider MR when exact mapping is desired, esp if:
  - Multiple myomas: > 4
  - Enlarged uterus: > 375 mL
Intracavitary Lesions

- Myomas, polyps, synechiae
- TVUS alone:
  - sensitivity 56-75%
  - specificity 68-80%

**NEXT STEP** = Saline infusion sonohysterogram

Guven, Int J Gynecol Cancer 2004
Kelecki, Fertil Steril 2005
Botsis, J Clin Ultrasound 2006

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**SHG is superior to TVUS for intracavitary pathology**

Better able to assess:
- Submucous fibroids
- Polyps
- Focal endometrial thickening
- Size and location

<table>
<thead>
<tr>
<th>Author</th>
<th>Design</th>
<th>Year</th>
<th>Population</th>
<th>Gold standard</th>
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<tbody>
<tr>
<td>Farquhar</td>
<td>Systematic review</td>
<td>2003</td>
<td>2917 premenopausal</td>
<td>Histopathology (hysterectomy, hysteroscopy)</td>
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<tr>
<td>Guven</td>
<td>Prospective, randomized</td>
<td>2004</td>
<td>130 premenopausal, 67 postmenopausal</td>
<td>Histopathology (hysterectomy, hysteroscopy, D&amp;C)</td>
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<tr>
<td>Kelecki</td>
<td>Prospective</td>
<td>2005</td>
<td>Premenopausal: 36, AUB: 24; no AUB</td>
<td>Hysterectomy</td>
</tr>
<tr>
<td>Botsis</td>
<td>Prospective</td>
<td>2006</td>
<td>150 premenopausal</td>
<td>Histopathology/hysteroscopy</td>
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<tr>
<td>Alborzi</td>
<td>Prospective</td>
<td>2007</td>
<td>81</td>
<td>Hysteroscopy</td>
</tr>
</tbody>
</table>

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**SHG in abnormal uterine bleeding:**
Systematic review & Meta-analysis

- 24 studies, including 2278 procedures
- Pooled sensitivity = 95% (0.93-0.97)
- Pooled specificity = 88% (0.85-0.92)
- Overall success rate = 93%
  - Lower in postmenopausal (86.5%) vs. premenopausal (95%)

We conclude that saline contrast hysterosonography, in combination with an endometrium aspiration if necessary, can become the standard diagnostic procedure in women with abnormal uterine bleeding.

De Kroon, B&O 2003

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**SIS: Fibroid**
3DUS in AUB

- Few comparative studies
  - Heterogeneous populations
  - Varying gold standards
- Comparable accuracy to hysteroscopy
- Compared to HSG → more cost effective
- Offline evaluation not optimized (yet)
- Further research/systematic review needed

Adenomyosis: Ultrasound Features

- Globular uterus – enlargement in absence of fibroids
- Small, anechoic cysts scattered throughout
- Subendometrial linear striations radiating out
- Heterogeneous echotexture of the myometrium
- Asymmetric uterine enlargement (posterior ≠ anterior wall)
- Indistinct endometrial-myometrial interface
- Absence of circular vascularization at the border of the lesion

*most predictive
*most common
Meredith, AJOG 2009

- Meta-analysis: 14 trials, 1895 subjects
- Histologically confirmed adenomyosis
- TVS: varying sonographic criteria
- Overall prevalence = 27.9%

**95% CI**

- **Sensitivity** 82.5% [77.5-87.9]
- **Specificity** 84.6% [79.8-89.8]
- **Positive LR** 4.7 [3.1-7.0]
- **Negative LR** 0.26 [0.18-0.39]

Champaneria, Acta Obstet Gynecol 2010

- 6 articles included in meta-analysis
  - 3 MR, 6 TVUS
  - Histologically confirmed adenomyosis

**95% CI**

- **Sensitivity** 72% [65-79]
- **Specificity** 81% [77-85]
- **Positive LR** 3.7 [2.1-6.4]
- **Negative LR** 0.3 [0.1-0.5]

- MR: sens 77%, spec 89% - not significantly different

Postmenopausal Bleeding

- Women with PMB may be assessed initially with **either endometrial biopsy** or TVS; initial evaluation does not require both tests.
- For endometrial thickness of less than or equal to 4 mm, endometrial sampling is not required.
- Meaningful assessment of the endometrium by US is not possible in all patients. In such cases, alternative assessment should be completed.
- The significance of thickness >4mm in asymptomatic patients is unclear; this finding need not routinely trigger additional evaluation.

ACOG Opinion 440, 2009, Reaffirmed 2011

- Systematic review of 32 studies 11, 100 women
- Mean ET = 2.9 mm (2.6-3.3)

**Cut-off** | **Sensitivity** | **Specificity**
---|---|---
5mm | 83% | 72%
6mm | 80% | 80%

Breijer, UOG 2012

Endometrial Thickness is NOT useful in

1. **Asymptomatic, postmenopausal women not on HRT**
   - Systematic review of 32 studies 11, 100 women
   - Mean ET = 2.9 mm (2.6-3.3)

2. **Premenopausal women with AUB**
   - Prospective study: 206 SIS with ET performed prior
   - 80 subjects: ET < 5mm – 11 polyps, 5 fibroids
Adnexal Masses

A simple cyst = ALL of the below

• Unilocular
• Hypoechoic fluid
• No papillary protrusions, excrescences, nodularity
• No solid component
• Thin and regular cyst wall
• Little to no Doppler flow

Risk of malignancy in unilocular ovarian cystic tumors <10cm

• U Kentucky Ovarian Cancer Screening Program
• 15,106 asymptomatic women >50 y
• Mean follow up = 6.3 years
• 18% with unilocular cysts
  – 69.4% resolved spontaneously
  – 16.5% developed a septum
  – 5.8% developed a solid area
  – 6.8% persisted as unilocular
• No woman with an isolated unilocular cyst developed cancer

ACOG: Management of Adnexal Masses

• In asymptomatic women with pelvic masses, whether pre- or post-menopausal, transvaginal ultrasonography is the imaging modality of choice. No alternative imaging modality has demonstrated sufficient superiority

• Simple cysts up to 10 cm on US are almost always benign and may be safely followed without intervention, even in postmenopausal patients

ACOG July 2007, Reaffirmed 2011

Modesitt Obstet Gynecol 2003
When the mass is not a simple cyst...

Assigning a Diagnosis

IOTA: ‘Conclusive’ Diagnoses

- European multi-center study: 9 centers
- Women with at least one adnexal mass
- Experienced ultrasound examiners
- Pattern recognition
- Gray-scale + Doppler

- 1066 women – histologic standard
  - 800 benign, 266 malignant
  - 60% premenopausal
  - 84% specific diagnosis

Sokalska, Ultrasound Obstet Gynecol 2009

IOTA: ‘Conclusive’ Diagnoses: Dermoid

| Accuracy | 97% |
| Sensitivity | 86% (79-91) |
| Specificity | 99 (98-99) |

IOTA: ‘Conclusive’ Diagnoses: Endometrioma

| Accuracy | 94% |
| Sensitivity | 77% (77-82) |
| Specificity | 98 (97-99) |

IOTA: ‘Conclusive’ Diagnoses: Hydrosalpinx

| Accuracy | 98% |
| Sensitivity | 86% (65-95) |
| Specificity | 98 (97-99) |

When the mass is not a simple cyst, but we can’t assign a specific diagnosis ... Discriminating Benign From Malignant
Sonographic Signs of Malignancy

- Mixed echogenicity
- Thick (>2 mm) septations
- Papillary protrusions or wall thickening >2-3 mm esp if vascular
- Solid components with vascular flow
- Free fluid in the pelvis/ascites
- Low resistance central Doppler flow

Possible Variables in Detection

<table>
<thead>
<tr>
<th>Variable</th>
<th>Finding</th>
<th>Study</th>
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</table>
| Experience of the examiner | Operator experience and quality of ultrasound correlate with accuracy | 1. Van Holsbeke, 2010  
2. Yazbek, 2008  
3. Timmerman D, 1999  
| Specialty of the examiner | Specialty does not affect accuracy | 1. Kinkel, 2000 |
| Confidence of the examiner | Accuracy depends on the degree of certainty | 1. Yazbek, 2010 |
| Real time v. static | Real time more accurate | 1. Van Holsbeke, 2008 |
| 3D ultrasound | Gray scale 3D not superior; 3D power Doppler may be beneficial | 1. Alcazar, 2011  
2. Alcazar, 2003  
4. Kurjak, 1999 |
| Doppler measurements | RI and PI ranges overlap between benign and malignant and are not diagnostic | 1. AHQR, 2006 |

Risk Scoring Systems

- Combinations of TVS, Doppler, exam, patient characteristics, tumor markers using statistical methods
- >80 models exist - <10 have been validated
- Cut-offs within models vary
- Trade-offs between sensitivity and specificity
- Risk of Malignancy Index (RMI)
- IOTA – LR1, LR2, Simple rules

No Model Is Better Than Subjective Assessment by an Experienced Ultrasound Examiner...

- Valentin, Ultrasound Obstet Gynecol Oct 1999
- Valentin, Ultrasound Obstet Gynecol Nov 1999
- Valentin, Ultrasound Obstet Gynecol 2001
- Timmerman, Best Pract Res Clin Obstet Gynaecol 2004
- Valentin, Gynecol Oncol 2006
- Valentin, Ultrasound Obstet Gynecol 2006
- Van Calster, JNCI 2007
- McDonald, Obstet Gynecol 2010
- Timmerman, BMJ 2011
- Campbell, UOG 2012
Forming an Impression

- Conclusive diagnosis? State it.
- Lack of conclusive diagnosis?
  - Summarize ultrasound findings
  - Give overall assessment of nature of mass
  - Refer to more experienced examiner

Conclusions

- 3DUS can be used as an initial diagnostic test in the evaluation for congenital uterine anomalies
- TVUS can be used safely as the initial diagnostic test in the evaluation of women with AUB
- SHG/SIS is a better test than TVUS for intracavitary pathology
- TVS is an accurate method to assess for adenomyosis
- The ET is used in postmenopausal bleeding

Conclusions

- In asymptomatic women with pelvic masses, TVS is the imaging modality of choice
- Simple cysts are strictly defined and are almost always benign
- An orderly approach to pelvic masses can tailor the differential diagnosis; subjective assessment is still the most discriminating tool
- Differentiating benign from malignant masses is operator-dependent

Thank you!

Any questions?

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