Imaging in Gynecology: What is Appropriate
Francisco A. Quiroz, MD

- Appropriate
  - Right or suitable
  - To set apart for a specific use

- Appropriateness
  - The quality or state for being especially suitable or fitting
Imaging Modalities

- Ultrasound Pelvis
  - Trans abdominal
  - Transvaginal
    - Doppler
    - 3-D
  - Hysterosonogram
- Computed Tomography
- MR
- PET

Practice Guidelines

- Describe recommended conduct in specific areas of clinical practice. They are based on analysis of current literature, expert opinion, open forum commentary and informal consensus

Consensus Conference

- National Institutes of Health (NIH)
- U.S. Preventive Services Task Force
- Centers for Disease Control (CDC)
- National Comprehensive Cancer Network (NCCN)
- American College of Physicians
- American College of Radiology
- Specialty Societies
Methodology

- Steps in consensus development?
  - Formulation of the question or topic selection
  - Panel composition – requirements
  - Literature review
  - Assessment of scientific evidence or critical appraisal
  - Presentation and discussion

ACR Appropriateness Criteria

- Evidence based guidance to assist referring physicians and other providers in making the most appropriate imaging or treatment decision for a specific clinical condition
Appropriateness Criteria

- Expert panels
  - Diagnostic imaging
  - Medical specialty organizations
  - American Congress of Obstetricians and Gynecologists
  - Society of Gynecologic Oncologists
- Structured process for development of criteria

Clinical Information

- Availability
- Expertise
- Radiation
- Use of contrast
- Cost

ACR Criteria – Rating Scale

- Scale 1-9
- 3 Categories
  - 1 – 3 “usually not appropriate”
  - 4 – 6 “may be appropriate”
  - 7 – 9 “usually appropriate”
Usually appropriate

- Study indicated in certain clinical settings at a favorable risk-benefit ratio for patients, as supported by published peer-review scientific studies, supplemented by expert opinion

Clinical Scenarios

- Abnormal vaginal bleeding
- Acute pelvic pain
- Adnexal mass
- Staging and follow up of ovarian cancer
- Evaluation and follow up of endometrial cancer
- Cancer cervix

VAGINAL BLEEDING
Vaginal Bleeding

Endometrial sampling the most appropriate initial step in evaluation vaginal bleeding depending on clinical situation (Endometrial Bx, D&C)

Vaginal Bleeding

- Role of imaging
  - Screening
  - Detection and characterization of focal structural abnormalities
  - Direction appropriate patient care
  - Inconclusive biopsy results
  - Persistent bleeding despite negative findings
- Sampling error ~ 60% endometrial cavity curetted with D&C

Acta Obstet Gynecol Scand 2001

---

American College of Radiology
ACR Appropriateness Criteria

<table>
<thead>
<tr>
<th>Clinical Condition</th>
<th>Radiologic Procedure</th>
<th>Expert Consensus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gynecologic Imaging</td>
<td>CT, MR</td>
<td>1</td>
</tr>
<tr>
<td>Gynecologic Imaging</td>
<td>D &amp; C, biopsy</td>
<td>1</td>
</tr>
<tr>
<td>Gynecologic Imaging</td>
<td>MR, US, CT, PET</td>
<td>1</td>
</tr>
</tbody>
</table>

www.acr.org/Quality-Safety/Appropriateness-Criteria/Diagnostic
Pre Menopausal Bleeding

- Causes
  - Anovulatory bleeding
  - Endometrial and cervical polyps
  - Sub mucosal fibroids
  - Endometrial hyperplasia
  - Adenomyosis
  - Cervical and vaginal tumors
  - Uterine tumors
  - Coagulopathies
  - Pregnancy related complications

Vaginal Bleeding

- Pre menopausal patient
  - First exam
    - TVUS (9) TAUS (8) HSG (4) CT/MR (2)
    - Endometrium < 16 mm Follow up exam
      - HSG (6) TVUS (5) TAUS (4) CT/MR (2)
    - Endometrium ≥ 16 mm
      - TVUS (8) early proliferative phase HSG (7) MR (4)

Submucosal fibroid vs. polyp
Vaginal Bleeding

- Heterogeneous endometrium
- Suspected focal abnormality
- Endometrium not adequately visualized at transvaginal exam
  Hysterosonogram (Rating 8 ACR)
Heterogeneous Endometrium ? Focal Abnormality
Not adequately visualized

Pre Menopausal Bleeding
Doppler added value – further characterize endometrial abnormality

Blood flow in intracavitary lesion excludes retained blood clot

TAUS

- Wider field of view
- Increased depth of penetration
- Evaluation adjacent organs
  - Uterus in neutral position
  - Poor penetration by TVUS
  - Markedly enlarged fibroid uterus
    - Subserosal or pedunculated
    - Intolerance to vaginal probe

Uterine Leiomyoma
Vaginal Bleeding

- Post menopausal patient
  - First exam
    - TVUS (9)  TAUS (8)  HSG (6)  CT/MR (2)
  - Endometrium ≤ 5 mm
    - TAUS (4)  HSG (2)  CT/MR (2)
  - Endometrium ≥ 5 mm
    - HSG (8)  MR (5)  TAUS (4)

Post Menopausal Bleeding

PM patient with uterine bleeding ~ 10%
Endometrial atrophy most common etiology
**Post Menopausal Bleeding**

- Endometrioid endometrial Ca stage 1A

**Post Menopausal Bleeding**

- Endometrial Ca

  Hysterosonogram - (Rating ACR 8)

**Pre Menopausal Bleeding**

- Endometrial polyp
Thickened Endometrium with cysts

28 y.o dysfunctional bleeding.
Endometrium 8 mm

Nov 2008

Premenopausal Endometrial Bleeding  Endometrium < 16 mm F/U Dec. 2011

Submucosal fundal leiomyoma
Submucosal Leiomyoma

Problem solving when US not definite
- Evaluation endometrium when TVUS not possible or cannot be well visualized
  - Orientation
  - Coexisting abnormalities e.g. fibroids, adenomyosis
- Information fibroid number, size, location prior to uterine embolization or myomectomy – Rating ACR 5

MR

Uterine Leiomyomas
Evaluation Pre Uterine Embolization

Poorly visualized fibroids in US. Multiple pedunculated fibroids and closeness to endometrium prevents intervention.

AJR 2006;187:1499

Evaluation Pre Uterine Embolization

AJR 2006;187:1499

ACUTE PELVIC PAIN
Acute Pelvic Pain

- Obstetrical causes
- Gynecologic causes
  - Simple ovarian cysts
  - Ruptured or hemorrhagic ovarian cysts
  - Pelvic inflammatory disease
  - Ovarian torsion
  - Malposition of intrauterine devices

- Non gynecologic causes
  - Appendicitis
  - Inflammatory bowel disease
  - Diverticulitis
  - Urinary tract calculi
  - Pyelonephritis

Imaging

- Choice of Imaging modality determined by clinically suspected differential diagnosis
  - Clinical history
  - Physical exam
  - Laboratory tests
Imaging

- Pelvic Ultrasound (TAUS and TVS)
  Preferred modalities for initial evaluation when obstetric or gynecologic causes are suspected
- Computed Tomography or Magnetic Resonance (MR)
  Gastrointestinal or urinary tract etiology is suspected

Acute Pelvic Pain

- Reproductive age group
  • Gynecological etiology suspected
    - Positive serum β-hCG
    - Negative serum β-hCG
  • Non gynecological etiology suspected
    - Positive serum β-hCG
    - Negative serum β-hCG

Gynecological and non gynecologic etiology suspected and positive serum β-hCG

- TAUS/TVS – Rating ACR 9
  • Ectopic pregnancy
- MR Abdomen/Pelvis – Rating ACR 6
  • Appendicitis
  • MR Urography – detection obstructive uropathy vs. physiologic dilatation of pregnancy
Gynecological etiology suspected and positive serum β-hCG

- Pregnancy status with β-HCG
- Uterus findings
  - Pseudo gestational sac
- Adnexal findings
  - Extra uterine sac
  - Complex adnexal mass
  - Tubal ring
  - Free pelvic fluid

Gynecologic Etiology Serum β-HCG Negative

- Enlarged edematous ovary
- Midline position
- Heterogeneous stroma with echogenic areas (hemorrhage)
- Hypoechoic areas (edema)
- Peripheral displacement follicles
- Adjacent free fluid

Ovarian Torsion

- Variable Doppler findings
  - Lack of flow
  - Twisted vessels "whirlpool sign"
  - Normal arterial and venous flow (1/3)
Ovarian Torsion

- CT findings
  - Enlarged ovary with or without associated ovarian mass
  - Ipsilateral twisted pedicle – rare
  - Deviation uterus on twisted side
  - Sub acute ovarian hemorrhage
  - Abnormal enhancement with contrast

CT/MR rating ACR 4

Gynecologic Etiology Serum β-HCG

- Negative

Ruptured or hemorrhagic ovarian cyst.
Most common gynecologic cause acute pelvic pain

US – ACR 9

Hemorrhagic Ovarian Cyst

September 17

July 29
Hemorrhagic Ovarian Cyst

Gynecologic Etiology Serum $\beta$-HCG Negative

Pelvic Inflammatory Disease

Spectrum STD involves cervix, uterus, fallopian tubes and ovaries

US - ACR 9

PID - US

Tubo ovarian complex Tubo ovarian abscess
Pts with diffuse pelvic pain, peritonitis or difficult or equivocal US. Early or mild inflammatory changes may be better appreciated on CT.
Bilateral TOA

Rarely used in PID
Very sensitive to detection
inflammation
Complementary problem solving method

MR – ACR 6

Bilateral TOA TVUS Drainage

Image guided abscess drainage TVUS - CT

Bilateral TOA TVUS & CT Drainage
Intramural IUD

Patients often with pelvic pain
3D-US more accurate and sensitive than TVUS

IUD – PT with Pelvic Pain

Malposition IUD in lower uterine segment with intramural extension

- Chronic pelvic pain
  - Adenomyosis
  - Endometriosis
  - Pelvic congestion syndrome
Adenomyosis

Sub endometrial/myometrial cysts → dilated cystic glands

Echogenic linear striations heterotopic endometrium extending into inner myometrium

Decreased echogenicity endometrium → hyperplasia smooth muscle

Heterogeneity → small echogenic islands of heterotopic endometrial tissue surrounded by smooth muscle

Reinhold. RG 1999

Adenomyosis - MR

Diffuse/local thickening junctional zone → smooth muscle hyperplasia

Embedded bright foci T2W ectopic endometrial tissue + cystic dilatation glands
**Endometriosis US**

Unilocular homogenously hypoechoic cyst with diffuse low level echoes and increased through transmission. Echogenic mural foci.

**Endometriosis MR**

High signal intensity T1-T2 → blood products and concentrated protein

Shading – loss signal within lesion (chronic)

T1W

T2W

Woodward. RG 2001

**Pelvic Congestion Syndrome**

Tortuous dilated veins → incompetent valves

US/CT multiple dilated varicose veins surrounding pelvic organs
Non Gynecologic etiology serum β positive

- Pregnant + RLQ ? Appendicitis
  - TAUS/TVUS usually appropriate (ACR 9) no radiation but poor visualization appendix (normal appendix 13-50%), limited graded compression → variable sensitivity and specificity
  - MR without contrast (ACR 8) → no ionizing radiation > sensitivity and specificity than US
  - CT when US non diagnostic, MR unavailable or equivocal. Need prompt Dx of potentially life-threatening condition (ACR 4)

Non Gynecologic Etiology Serum β Positive

- US - ACR 9
- Normal appendix on MR - ACR 8

Non Gynecologic etiology serum β negative

- US - ACR 7
- Avoid radiation exposure younger patients
Non Gynecologic etiology serum β negative

- Appendicitis
- Diverticulitis
- Inflammatory bowel disease
- Litiasis ureteral

CT – ACR 9

19 y.o female RLQ pain
CT preferred modality for detecting bowel pathology

Non Gynecologic etiology serum β negative

- Crohn’s Disease

CT – ACR 9

Non Gynecologic etiology serum β negative

- Acute Pyelonephritis
- CT – ACR 9
ADNEXAL MASS

Adnexal Mass

- US exam of choice for evaluation patient with suspected adnexal mass
- Characterization mass as cystic, solid or complex
- Color/power Doppler adjunct to gray scale imaging
- Spectral Doppler not reliable in differentiate malignant from benign masses

Adnexal Mass

- Reproductive age
  - First exam
    - TVUS, TAUS, Doppler – (ACR 9), MR (ACR 6)
- Reproductive age
  - Complex or solid mass detected prior pelvic US. Follow-up recommendations
    - Ultrasound (ACR 9), MR (ACR 5)
Ovarian Cyst

Simple cyst benign process
100% pre menopausal women most resolve spontaneously
Simple cyst PM woman (17-24%)
≥ 5 cm rarely malignant

Ovarian Masses

Confidence characterization lesions such as cystic teratoma
Adnexal Mass

- Complex or solid mass detected by prior pelvic US getting smaller at short-term follow-up
  - TVUS (ACR 9) if resolved, no further imaging required
- Complex or solid mass persistent or enlarging on pelvic US at short term F/U
  - MR (ACR 8), US (ACR 5), CT (ACR 4) or surgery in the appropriate clinical setting

Adnexal Mass

- Reproductive age
  - Initial US large cyst > 5 cm apparently simple
    - TVUS (ACR 9) > 5 cm but ≤ 7 cm annual F/U
    - SRU Consensus Conf. Radiology 2010
  - MR (ACR 4) – indeterminate cyst or inadequate US
    - Origin of the mass
    - Characterization – benign vs. malignant features?
Adnexal mass

- Post menopausal patient
  - Initial evaluation
    - US (ACR – 9) MR (ACR 5)
  - Simple ovarian cyst > 1 cm by pelvic US
  - Follow-up recommendations
    - Annual F/U to ensure stability
    - > 7 cm consider MR
  - Complex or solid mass by pelvic US Follow-up recommendations
    - MR (ACR 5) – Consider surgical evaluation

Post menopausal Patient

Post Menopausal Patient
**STAGING AND FOLLOW UP OVARIAN CANCER**

**Staging & FU Ovarian Ca**
- Pre treatment staging of ovarian cancer
  - CT (ACR 9) MR (ACR 7) PET (ACR 4)
  - US (ACR 3)
- Rule out recurrence ovarian cancer
  - CT abd/pelvis (ACR 9) PET-CT (ACR 8)
  - CT c/a/p (ACR 6) MR (ACR 4)
  - US (ACR 3)

**Ovarian Carcinoma**

Bilateral ovarian tumors and peritoneal carcinomatosis
Ovarian Ca - Recurrence

EVALUATION AND FOLLOW UP ENDOMETRIAL CANCER

Evaluation & FU Endometrial Ca

- Newly diagnosed endometrial cancer when imaging is indicated for treatment planning
  - MR (ACR 8) highest accuracy for staging and treatment planning
- Assessing depth myometrial invasion
  - MR (ACR 9) US/SHG less accuracy (ACR 3-4)
Endometrial Carcinoma

Evaluation & FU Endometrial Ca

- Lymph node evaluation
  - PET-CT (ACR – 9)  CT (ACR 8)
  - MR (ACR -8) pre and post treatment
- Assessing endocervical extent
  - MR pelvis (ACR – 9)
- Post therapy evaluation in patients with clinically suspected recurrence
  - PET (ACR 9)  MR (ACR 8)  CT (ACR 8)

INVASIVE CANCER CERVIX
FIGO Classification

- Cervical CA is staged by the International Federation of Gynecology and Obstetrics (FIGO) classification, based on clinical examination including physical exam under anesthesia, colposcopy, endocervical curettage, hysteroscopy, cystoscopy, proctoscopy, intravenous urography, barium enema, and radiographs of lungs and skeleton.

Invasive Ca Cervix

- **Role**
  - Pre treatment evaluation
  - Assess tumor size and location
  - Detect involvement parametrium
  - Detect involvement sidewall and adjacent organs
  - Evaluate for lymph node metastases

FIGO Staging Cervix Ca

- **Stage IB** clinically visible lesions limited to the cervix or pre clinical cancers > than stage IA
- **IB1** clinically visible lesion < 4.0 cm
- **IB2** clinically visible lesion > 4.0 cm
Invasive Ca Cervix

- Pre treatment planning
  - FIGO stage 1b1, tumor size < 4 cm
    - MR (ACR – 8) PET-CT (8) CT (ACR 5) US (ACR 2)
  - FIGO stage 1b2, tumor size > 4 cm
    - MR (ACR – 9) PET-CT (ACR 9) CT (ACR – 5)
  - FIGO stage greater than 1b
    - MR (ACR – 9) PET-CT (ACR – 9) CT c/a/b (ACR – 7)

Ca Cervix

- Poorly differentiated neuroendocrine tumor

Ca Cervix – LT Iliac Lymphadenopathy

- Pre treatment
  - Nov 2012
- Post treatment
  - Feb 2013
Conclusions

- Gynecologic Imaging useful in wide variety of clinical presentations
- Ultrasound usually the most appropriate modality
- Modalities such as MR, CT are problem solving and improved characterization
- Major role of MR, CT and PET-CT in Gyn Oncologic imaging