MRI of Endometriosis with Pre and Post-Operative Correlation

Shannon P. Sheedy, Candice A. Bookwalter, Wendaline M. VanBuren
Mayo Clinic Rochester, Department of Radiology

SCBT-MR - Nashville, TN
September 10, 2017 at 10:15
Relevant Financial Relationships
None

Off-label/Investigational Uses
None
I. BACKGROUND

- Functional endometrial glands and stroma outside of uterine cavity and myometrium
- Ectopic endometrium responds to hormonal stimulation
  - various degrees of cyclic hemorrhage: inflammation, fibrosis, adhesion formation
- Physical manifestations are protean: asx to disabling pelvic pain/infertility
BACKGROUND

• Estimate prevalence of 5-10% (asx and sx)
  • Much higher in patients with chronic pelvic pain and infertility
  • Other sxs depend on location/organs of involvement

• Symptoms not necessarily correlative w/ disease severity

• Associated with adenomyosis, but distinct:
  • No racial predilection
  • Increased prevalence in families – likely genetic role
Chronic pelvic pain
Dyspareunia
Infertility

Obstructive Mullerian duct anomalies

5%
Replacement estrogen therapy

Reproductive Age

< 17 yo

Post menopausal
BACKGROUND

• 3 forms:
  • Ovarian endometrioma
  • Superficial peritoneal lesions or non-invasive implants
  • Deep (or solid) infiltrating endometriosis
    • Invasion of endo glands & stroma ≥5 mm beneath the peritoneal surface

Intraoperative images courtesy of Tatnai Burnett, MD
Understand proposed theories of pathogenesis

Optimize MR protocols for the detection of DPE

Understand MR appearance: endometriomas, serosal peritoneal implants, DPE, extraperitoneal implants and complications

Become familiar with a standardized approach of interpretation & reporting

Understand how MR interpretation and MDT affect therapeutic considerations
THEORIES OF PATHOGENESIS

Metastatic theory
  a. Retgrograde menstruation
  b. Lymphatic spread
  c. Hematogenous spread

Metaplastic theory
  d. Coelomic metaplasia

Induction theory

Other: GFs, impaired immuned response, genetics, stem cells, embryonic rest

Woodard et al., RadioGraphics 2001 21:1, 193-216
<table>
<thead>
<tr>
<th>LOCATION</th>
<th>IMPLANTS</th>
<th>ADHESIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ovaries</td>
<td>76%</td>
<td>39%</td>
</tr>
<tr>
<td>CDS</td>
<td>69%</td>
<td>13%</td>
</tr>
<tr>
<td>Broad lig</td>
<td>47%</td>
<td>43%</td>
</tr>
<tr>
<td>USL</td>
<td>36%</td>
<td>7%</td>
</tr>
<tr>
<td>Uterus</td>
<td>11%</td>
<td>3%</td>
</tr>
<tr>
<td>FTs</td>
<td>6%</td>
<td>26%</td>
</tr>
<tr>
<td>Sigmoid</td>
<td>4%</td>
<td>12%</td>
</tr>
<tr>
<td>Ureter</td>
<td>3%</td>
<td>2%</td>
</tr>
<tr>
<td>SB</td>
<td>0.5%</td>
<td>3%</td>
</tr>
</tbody>
</table>

MRI PROTOCOL

- Sagittal, Axial & Coronal T2W FRFSE
- Axial SE T1W
- Axial SE T1W FS+
- IP & OP
- DWI (b=0, 500, 800)
- Axial pre and multiphase 3D T1W GRE FS+ C+
ENDOMETRIOSIS PROTOCOL

<table>
<thead>
<tr>
<th>Cor SSFSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sag T2 FSE</td>
</tr>
<tr>
<td>Ax T2 FSE</td>
</tr>
<tr>
<td>Ax T2 FSE FS+</td>
</tr>
<tr>
<td>Cor T2 FSE</td>
</tr>
<tr>
<td>Ax T1 (option I/O phase)</td>
</tr>
<tr>
<td>DWI (b = 0, 500, 800)</td>
</tr>
<tr>
<td>Ax and/or sag pre contrast 3D T1W GRE FS+</td>
</tr>
<tr>
<td>Multiphase and multiplanar post contrast 3D T1W GRE FS+</td>
</tr>
</tbody>
</table>

Optional: imaging of the abdomen, including pre and post T1W GRE FS+
MRI PELVIC ANATOMY

Anterior compartment

- Bladder
- Prevesical space
- Vesicouterine pouch
- Vesicovaginal septum

Coutinho, A., RG (2011); 31:549-567
MRI PELVIC ANATOMY
Middle compartment

https://clinicalgate.com/intra-abdominal-pelvic-anatomy/

Intraoperative images courtesy of Tatnai Burnett, MD
MRI PELVIC ANATOMY

Posterior compartment

- Perineal body
- Torus uterine
- Rectovaginal septum
- Rectovaginal pouch
II. ENDOMETRIOMA

- Ovaries most commonly affected
- Cyclic hemorrhage into a deep ovarian implant
- Often bilateral, multifocal

**US: classic (<30%)**
- diffuse & homogeneous low level internal echoes (95%)
- uni or multilocular
- punctate peripheral echogenic wall foci
  - 35% endometriomas vs 6% other cysts
- no internal BF
- stable over time

Patel et al., Radiology (1999); 210(3): 739-745
ENDOMETRIOMA

- **Cystic teratoma:** 10-15% of ovarian tumors
  - 90% unilateral, usually unilocular
  - Ca2+ (30%)
  - Hyperechoic areas/nodules of varying echogenicity and some with focal acoustic impedance ("tip of iceberg" and dermoid plug/Rokitansky nodule)
  - fat-fluid layer (may shift)
  - hyperechoic lines and dots (hair)

- **Hemorrhagic cyst:**
  - evolve/resolve, fibrin strands thinner, retracting clot, weaker reflectors
  - Cystic neoplasm
ENDOMETRIOMA
ENDOMETRIOMA

**MR**

- Hyperintense on T1WI
- Hyperintense on T1WI FS+
- T2 shading
  - S/S : 90-92% / 91-98% ¹
  - Diagnostic accuracy 91-96% ¹
  - S/S : 93% / 45% ²
- T2 dark spot
  - Discrete, markedly hypointense foci within the cyst, not within the wall itself
  - S/S endometrioma vs hemorrhagic cyst: 36% / 93% ²

¹ Glastonbury CM, Radiology 2002;224(1):199-201
T2 SHADING
“KISSING” OVARIES
ENDOMETRIOSIS ASSOCIATED MALIGNANCY

• Malignant Transformation is a rare complication (<1% of women with an ovarian endometriosis)

• Clear cell (14.8%) and endometrioid (66.7%) carcinomas

• 75% ovarian, 25% extraovarian

• Younger age onset (10-20 yrs), earlier stage and lower grade → better overall survival

• MR imaging
  • CE+ mural nodules (most sensitive)
  • Disappearance of T2 shading – dilution of hemorrhagic fluid by tumor secretions

McDermott, S,. RG 2012;32:845-863
DECIDUALIZED ENDOMETRIOMA

RIGHT OVARY

LEFT OVARY
DECIDUALIZED ENDOMETRIOMA
III. DEEP INFILTRATING ENDOMETRIOSIS

• subperitoneal invasion by endometriotic lesions
  • >5 mm in depth
  • “fibromuscular hyperplasia that surrounds sparse ectopic endometrial glands”
    • Responds to hormonal stimulation
    • Various degree of cyclic bleeding
    • Variable inflammatory response and fibrous reaction
Deep Infiltrating Endometriosis

• MR appearance
  • Solid nodules
    • Intermediate T1W, low T2W, irregular and stellate margins due to presence of abundant fibrous tissue and smooth muscle proliferation
  • Soft tissue thickening – T2W hypointense
  • T2W hyperintense foci – corresponds to dilated ectopic endometrial glands
• Variable
  • Intrinsic T1W
  • Enhancement
  • Diffusion weighted images
Report Template

- Anterior Compartment
- Middle Compartment
- Posterior Compartment
- Additional Sites

prevesicular space
vesicouterine pouch
vesicovaginal pouch
rectovaginal septum/pouch
Anterior Compartment

- Prevesicular space
- Bladder
- Ureters
Anterior Compartment

• Bladder
  • Extrinsic involvement
  • Intrinsic involvement
• Symptoms
  • irritative voiding symptoms
  • suprapubic pressure
  • cyclic hematuria
• history of pelvic surgery in 43%–50% of cases
Anterior Compartment

- Bladder - history of pelvic surgery in 43%–50% of cases
Anterior Compartment

- Ureters
  - Extrinsic most common
  - Never above the pelvic brim
Middle Compartment

- Uterus
- Uterine Ligaments (broad and round)
- Vagina
- Fallopian Tubes
- Ovaries
Middle Compartment

- Uterus
  - Serosal implants
Middle Compartment

• Uterus
  • C-section scar
Middle Compartment

• Fallopian Tube
  • 28% of women with endometriosis
  • Most common on the serosal surface
  • Transmural or mucosal involvement less common
  • Hematosalpinx $\rightarrow$ high correlation with endometriosis
Middle Compartment

- Broad ligament
Posterior Compartment

- Rectum
- Torus Uterinus
- Uterosacral Ligaments
- Pouch of Douglas
- Additional Sites: Posterior vaginal fornix and rectovaginal septum
Posterior Compartment

• Rectum
  • Rectosigmoid most common site of bowel involvement
• Serosal or deep
  • Rarely invades mucosa
• Obliteration of the pouch of Douglas
• Findings:
  • Adhesions, bowel strictures and GI obstruction
Posterior Compartment

- Torus uterinus
  - Not seen unless pathologically thickened
  - T2W hypointense thickening and nodularity

Sag T2W
Posterior Compartment

- Uterosacral ligaments
Other

• Appendix
• Lymph nodes
• Free Fluid
• Kidneys
• Outside the pelvis
  • Cecum, small bowel, inguinal canal, sciatic nerve, anterior abdominal wall, liver, diaphragm, and upper abdomen
Standardized Report

- Anterior Compartment
  - Bladder

- Middle Compartment
  - Uterus, uterine ligaments, vagina, ovaries, fallopian tubes

- Posterior Compartment
  - Rectum, torus uterinus, uterosacral ligaments, pouch of Douglas, posterior vaginal fornix, rectovaginal septum

- Additional sites: appendix, lymph nodes, kidneys, ureters, cecum, small bowel, inguinal canal, anterior abdominal wall, diaphragm, and upper abdomen
IV. EXTRAPERITONEAL LOCATIONS

- Thorax/pleura
- Abdominopelvic wall/ scar
- Inguinal
- Hernia
- Brain?
51 year old female with shortness of breath
Aug 2012
Treatment?
41 year old female with previous talc pleurodesis on the right
Umbilicus
Perihepatic...a spectrum
63 year old female
Inguinal canal
45 year old female with cyclical pain at her C-section scar
Treatment?
• Injection of 25cc ethanol
• Two year follow-up…
47 year old female…DDx?
VI. Surgical considerations/treatment
Superficial Endometriosis

• Treatment: cauterization, evaporation, resection

• Generally not visualized on MRI, but may occasionally seen restricted diffusion or punctate T1 hyperintensity
• Superficial endometriosis: cauterization, evaporation, resection
Deep Infiltrative Endometriosis (DIE)

• Bowel:

DIE involving one layer of bowel at most: shaving

DIE 1-3 cm nodule, <50% circumference, single nodule: discoid resection

DIE nodule >3 cm or multifocal DIE: segmental resection

DIE often requires Surgical Oncology or Colorectal Surgery involvement
Partial thickness shaving
49. Year old female with rectal bleeding and failed medical management

Robotic low anterior resection performed with colorectal surgery
31 year old female with obstructive symptoms and rectal bleeding

In case there is need for reassurance…
Flexible Sigmoidoscopy followed by Lower EUS
VII. Multidisciplinary rounds
Multidisciplinary Rounds: How we do it!

- Pre-operative MRI scans are reviewed
- All anatomic areas of interest from the report template are discussed
- Post-operative MRI scans are reviewed and compared to the surgical and pathologic findings
- Intraoperative video and photos serve as a teaching guide
- Concordance between the pre-operative MRI and the post-operative findings are made
How this helps Radiology

• We learn about the our accuracy in describing disease with various presentations (i.e. hemorrhagic or fibrotic) and with respect to their various locations

• Unique circumstances such as the post-operative pelvis, patients with Crohn’s disease or PID may have overlapping presentations, creating limitations

• We are able to optimize our imaging protocol and develop longitudinal development of interpretive abilities

• We understand better the medical and surgical management of disease
How this helps Gynecology

- They recognize that pre-operative MRI can greatly assist with operative planning (presence of Deep Infiltrative Disease, bowel and bladder involvement, and obliterated cul-de-sac)
- Awareness of extent of disease may alter the surgeons performing the case, the surgical location, and reduce the risk of residual disease
- Develop a relationship with radiology to manage complex cases that may undergo medical management and require surveillance
How this helps the patient

• A cohesive, inter-disciplinary care team that learns from a large volume of case, brought together by many physicians

• Better treatment options for coinciding conditions if recognized in advance (i.e. Mulerian duct anomalies and endometriosis)

• Ultimately earlier recognition of the disease process with more successful surgical outcomes and fewer repeat operations
Just to let you know your work is appreciated!