MRI - Female Pelvis
Normal anatomy
Congenital uterine anomalies

- Sequelae of developmental abnormalities of the Müllerian duct system
- Wide variety of clinical presentations
  - Difficult to diagnosis clinically
- Actual incidence and prevalence not definitively known
  - Range 0.1-4% for general population
  - Up to 10% in patients with recurrent pregnancy loss
### Congenital uterine anomalies

<table>
<thead>
<tr>
<th>I</th>
<th>Hypoplasia/agenesis</th>
</tr>
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<tbody>
<tr>
<td>(a)</td>
<td>Vaginal</td>
</tr>
<tr>
<td>(b)</td>
<td>Cervical</td>
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<tr>
<td>(c)</td>
<td>Fundal</td>
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<tr>
<td>(d)</td>
<td>Tubal</td>
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<td>(e)</td>
<td>Combined</td>
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<table>
<thead>
<tr>
<th>II</th>
<th>Unicornuate</th>
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<tbody>
<tr>
<td>(a)</td>
<td>Communicating</td>
</tr>
<tr>
<td>(b)</td>
<td>Non Communicating</td>
</tr>
<tr>
<td>(c)</td>
<td>No cavity</td>
</tr>
<tr>
<td>(d)</td>
<td>No horn</td>
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<thead>
<tr>
<th>III</th>
<th>Didelphus</th>
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<tbody>
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<tr>
<td>(a)</td>
<td>Complete</td>
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<tr>
<td>(b)</td>
<td>Partial</td>
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<table>
<thead>
<tr>
<th>IV</th>
<th>Bicornuate</th>
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<table>
<thead>
<tr>
<th>V</th>
<th>Septate</th>
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</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Complete</td>
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<tr>
<td>(b)</td>
<td>Partial</td>
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<tr>
<th>VI</th>
<th>Arcuate</th>
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<th>VII</th>
<th>DES drug related</th>
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Figure 2. Classification system of Müllerian duct anomalies developed by the American Fertility Society (43).
13 yo F, primary amenorrhea

Sag T2

Ax precontrast T1

T2 hi-res

Sag precontrast T1
Cervical agenesis; uterus torsed
22 yo F, uterus and vaginal agenesis
25 yo F, uterine didelphyis
17 yo F, didelphyis - obstructed horn

http://www.atlasofpelvicsurgery.com/
Septate vs bicornuate

- Typically defined by depth of indentation of the fundal contour
  - Bicornuate: > 1.0 cm indentation
  - Septate: < 1.0 cm indentation

- Arbitrary designation based on subjective assessment by gynecologists at laparoscopy
Septate vs bicornuate

- **US literature**: measurement of fundal indentation relative to straight line between tubal ostia


33 yo F, septate uterus
Septate uterus
23 yo F, uterine septum (complete) with bicornuate configuration
52 yo F, bicornuate uterus
Surgical therapies

- Metroplasty
- Hysteroscopic resection of septum
Metroplasty
Septoplasty
62 yo F, unicornuate uterus
41 yo F, arcuate uterus
Endometrium - normal
Endometrium - menstrual changes

Precontrast
Postcontrast
Postcontrast - hi res
Sag T2
T2 space
Endometrial polyps

- Focal protrusion of the endometrium
  - Composed of benign endometrial glands and stroma
  - Unresponsive to progesterone stimulation
  - Frequent cystic change of endometrial glands in polyp

- MRI
  - Cystic change within the polyp
  - Central fibrous core (low signal T2W images)
  - +/- stalk of connection with endometrium

61 yo F, endometrial polyp

Sag T2

T2 space

Postcontrast
30 yo F, endometrial polyp
Endometrial cancer

- Most common malignancy of the female genital system
  - Risk factors: estrogen stimulation
- Pathology: tumor composed of malignant glandular cells
  - Multiple subtypes: endometroid (most common), clear cell, adenosquamous, papillary serous
Staging

- FIGO staging system revised in 2010

- IA: Tumor confined to uterus, \leq 50\% myometrial invasion
- IB: Tumor confined to uterus, \geq 50\% myometrial invasion
- II: Cervical stromal invasion, not beyond uterus
- IIIA: Tumor invades serosa or adnexa
- IIIB: Vaginal/parametrial involvement
- IIIC1: Pelvic nodal involvement
- IIIC2: Para-aortic nodal involvement
- IVA: Tumor invasion into bladder/bowel mucosa
- IVB: Distant metastases (including abdominal/inguinal lymph nodes)

http://info.cancerresearchuk.org/cancerstats/types/uterus/syptomsandtreatment/
FIGO 1B

T2 hi-res

Precontrast  Venous  Delayed

Sag T2
FIGO 3

Sag T2

T2 hi-res

Postcontrast
Endometrial carcinoma (serous papillary) - metastatic
Endometrial carcinoma
Endometrial polyps versus cancer

Endometrial carcinoma

Endometrial polyp
Endometrial polyps versus cancer

- Controversies in potential for malignant change
  - 8.5% polyps associated with endometrial carcinoma
- Factors associated with coexistent carcinoma:
  - Symptomology (uterine bleeding)
  - Age (postmenopausal)
Uterine leiomyoma

- Benign tumor of the uterus
  - Extremely common cause of pelvic symptoms
    - Pain, abnormal bleeding

- Pathology:
  - Smooth muscle tumors interlaced with connective tissue
**Uterine leiomyoma - Imaging**

- Ultrasound frequently used
  - Poorly defined
  - Difficulty in distinguishing fibroids from adenomyosis
- MRI provides optimal evaluation, especially for pre-procedure planning
  - Well-circumscribed uterine lesions
  - T2 hypointense
    - Reflective of muscular component
  - Variable vascularity
41 yo F, fibroids
Fibroid embolization

- Effective method of controlling symptoms of uterine fibroids
- **UAE vs myomectomy**
  - Razavi et al (*AJR 2003*) found UAE better at pain and bleeding control, while myomectomy perhaps better at relieving symptoms of mass effect
  - Mara et al (*Cardiovasc Interven Radiol 2008*) - randomized trial, found UAE to have shorter hospital stay and recovery, similar outcomes
- Long term fibroid symptom relief with UAE
  - 13-15% ultimately go to hysterectomy
40 yo F, fibroids and adenomyosis
Adenomyosis - US and MRI
37 yo F, focal adenomyosis
72 yo F, degenerating fibroid

Ax T2 hi-res

Sag T2

Postcontrast
37 yo F, degenerating fibroid

Sag T2

Ax T2 hi-res
44 yo F, leiomyosarcoma
44 yo F, recurrent leiomyosarcoma
Ovarian Neoplasms

- Main differential
  - Surgical vs. non-surgical

- Questions:
  - Neoplastic septations?
  - Cystic neoplasm versus functional cyst
  - Enhancing elements?
    - surgical; carcinoma is primary consideration
Ovarian lesions - non-tumor

- Ovarian follicles/PCOD/corpus luteum
- Hemorrhagic cysts
- Endometriomas
- Pelvic inclusion cyst
22 yo F, functional cyst

3 months later
Polycystic ovarian syndrome
32 yo F, hemorrhagic ovarian cyst
43 yo F, hemorrhagic cyst

Initial

3 mo FU
54 yo F, ovarian lesion

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Precontrast

Delayed

Ax T2

Ax T2 FS
Endometrioma

Precontrast

Delayed

Ax T2

Ax T2 FS
Endometriomas

Hemorrhagic cyst (ruptured)
37 yo F, abdominopelvic pain
Ruptured endometrioma
Clear cell CA in endometrioma

Precontrast  Arterial  Delayed

Hi-res T2
51 yo F, bleeding
51 yo F cervical cancer
51 yo F right adnexal met in endometrioma
44 yo F, pelvic inclusion cyst
Ovarian Masses - tumor

- **Epithelial (65%)**
  - Serous/Mucinous/Endometrioid/Clear Cell/Brenner

- **Germ Cell (25%)**
  - Dermoid (younger)/ Malignant transformation (older) / Dysgerminoma*/Embryonal*/Chorio*/Mixed*  
    *solid/young/~fat/~calcium/AFP/HCG

- **Stromal (5%)**
  - Thecoma (estrogen)/Fibroma (Meigs)/Granulosa Cell Tumor (estrogen +hemorrhage-complex)/Sertoli/Leydig Cell Tumors

- **Gonadoblastoma (5%)**
Surface epithelial tumors

- Typically cystic
  - Neoplastic septations

- Solid elements = Surgical
  - Borderline tumor versus carcinoma
73 yo F, ovarian cyst on US
Serous cystadenoma
Serous cystadenomas
58 yo F, serous papillary carcinoma
Serous cystadenoma (borderline)
46 yo F, ovarian serous cystadenoma, retroperitoneal
33 yo F, mucinous cystadenoma
29 yo F, mucinous cystadenoma
33 yo F, mucinous cystadenoma-borderline
Sex cord stromal tumors

- Tumors in this category composed of cells that resemble:
  - Female/male endocrine apparatus
    - Granulosa cells, theca cells, sertoli/leydig
    - Other stromal elements (fibroblasts)
  - Overlap!
  - Hormonally active
40 yo F, ovarian fibroma
61 yo F, fibroma
27 yo F, granulosa cell tumor
**Germ cell tumors**

- Except for dermoids, these are typically aggressive tumors
  - Frequently mixed type

- Tumor subtypes: Dysgerminoma, embryonal carcinoma, endodermal sinus tumor, choriocarcinoma
42 yo F, dermoid
Dermoid: In and Out-of-Phase
24 yo F, metastatic embryonal cell CA
4 yo F, dysgerminoma, torsed ovary
Summary

- MRI provides most detailed analysis of congenital uterine anomalies, which may be mixed and complex.
- Distinction between endometrial CA and polyp is mostly straightforward, though there may be overlap of imaging features.
- Ovarian tumors are typically best assessed with MRI, especially regarding diagnostic specificity.