MRI Female Pelvis: Ovary/Adnexa

Dr. Dheeraj Reddy Gopireddy MD MPH MBA
Interim chair Department of Radiology
Vice chair of Quality and Clinical Operations
Division chief of Abdominal and Cardiac Imaging
Associate Professor of Radiology
University of Florida, Jacksonville.
Ovarian Neoplasms

- Main differential
  - Surgical vs. non-surgical
  - Burden of the metastatic disease

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
Ovarian anatomy: Notice the peripherally oriented follicles and intermediate signal stroma
22 yr F, functional cyst/follicle: 3 months later
Polycystic ovarian syndrome
32 yr F, hemorrhagic ovarian cyst:
Intermediate signal of acute blood on T2
43 yr F, hemorrhagic cyst: Notice layering T2 dark signal in the cyst

Initial

3 mo FU
54 yr F, ovarian lesion: Uniform High T1 signal on pre-contrast T1: Please do subtraction
Endometrioma: Please look for deep pelvic endometriosis.
OVERVIEW & IMAGING FINDINGS

- Endometriosis represents a cause of abdominopelvic pain that frequently persists unrecognized with a delayed diagnosis.
- Using non-contrast MRI, the diagnosis can be accurately achieved and distinguished from other similar etiologies such as hemorrhagic ovarian cysts.

**ENDOMETRIOMA**
- Non-contrast T1-weighted sequences signify the key sequences for MRI diagnosis of endometriosis.
- T1: Inherent and homogeneously intense T1 signal, the so-called “light bulb bright” sign.
- T2: Typically homogeneously low to intermediate signal.
- Extra-ovarian implants helps to solidify the diagnosis of endometriosis.

**HEMORRHAGIC OVARIAN CYST**
- T1: Heterogeneous T1 signal and frequently demonstrates a progressive gradient of intensity with layering of the T1 bright blood products.
- T2: Typically demonstrate T2 layering.
- On all imaging modalities, hemorrhagic ovarian cysts will typically resolve in 6-8 weeks.
**Endometrioma**

- 19 year old female with pelvic pain
- MRI findings are consistent with endometrioma
- Look for deep pelvic endometriosis
Endometriomas

Haemorrhagic Cyst (ruptured)
A young female presented with right sided abdominal pain and concern for appendicitis. Rapid ED MRI protocol diagnosed the cause of her pain as endometriosis with implants lining the right adnexa.

Coronal + axial T2, Coronal + Axial T2-fat sat, Coronal MRCP, Axial Trufisp, Sagital T2 of the pelvis, and a Dixon acquisition for in phase, out of phase, and water only (T1) can be obtained in X minutes as a rapid ED protocol.
37 yo F, abdominopelvic pain
Ruptured endometrioma
This case nicely demonstrates multiple endometriomas on both ovaries, with a large hemorrhagic cyst on the left ovary. Note the heterogeneity and laying T1 signal of the hemorrhagic cyst, compared to the intense homogeneous T1 signal of the endometriomas.
Malignancy Risk: Clear cell CA in endometrioma
Endometrioma with malignant transformation

**Figure A:** Axial non-contrast T1w fat saturated

**Figure B:** Coronal non-contrast T1w fat saturated

**Figure C:** Axial post-contrast T1w fat saturated with suppression
51 yr F, Vaginal bleeding:
51 yr F right adnexal met in endometrioma: Nodule in the endometrioma
44 yr F, pelvic inclusion cyst: Notice the insinuation of the cyst, do not touch lesion
Additional Cases: Infection
Additional Case
Additional Case: Tumor or infection?
**PID case:** Notice the inflamed pelvic fat and normal ovaries.
**PID case:** Notice the enhancing fluid collection in the cul de sac
**PID case:** Notice the enhancing posterior live capsule:
Quiz case: 49 yr old pelvic pain
Quiz case:

Axial T2 and high Res T2 SE sequence: Notice the pelvic fat edema

Axial T2 fs T2 SE sequence: Notice the pelvic fat edema
Tubo-ovarian Abscess:

- Tubo-ovarian abscess
  - Presents with fever, elevated wbc count, abdominal pain, vaginal discharge
  - Frequently a late complication of pelvic inflammatory disease

MRI pearls:
- Single shot fast spin echo sequence in different planes
- Identify the ovaries and scan the adnexa for enlarged tubes
- Evaluate for pelvic edema as evident by “dirty” fat confirmed on T2 FSE
- Post contrast for enhancement of the tubes and pelvic peritoneum
- DWI will help to look for abscess that restrict
- Evaluate the liver capsule for peri hepatitis

- Diverticular abscess
- Hemorrhagic 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: MRI features

- Typically cystic
  - Neoplastic septations (thickening and enhancement)

- Solid elements (nodules and mass like) = Surgical
  - Borderline tumor versus carcinoma
  - Evaluate peritoneal membrane and omentum
73 yr F, ovarian cyst on US: concerning features?
Serous cystadenoma: Evaluate the septa carefully on T2 and post contrast images.
Serous cystadenomas: Complex cystic lesion
58 yr F, serous papillary carcinoma: Evaluate local and distant invasion
Serous cystadenoma (borderline): Evaluate the cyst wall carefully
46 yr F, cyst on ultrasound: ?
Serous Cystadenocarcinoma: Nodular

- 55 year old female with a left ovarian mass
- Pathology proven serous cyst-adenocarcinoma

Axial T2w 3D TSE with variable flip angle
Coronal T2w
Axial T1w pre-contrast
Axial T1w 180 sec delayed
33 yr F, mucinous cystadenoma
29 yr F, mucinous cystadenoma
33 yo F, mucinous cystadenoma-borderline: Evaluate the peritoneum
Mucinous Cystadenoma: No nodularity

- 36 year old female with a left ovarian mass
- MRI findings complex cyst with multiple daughter cysts.
Sex cord stromal tumors: GCT/Thecomas

- 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
Sex cord-Stromal Tumors

- Fibromas and fibrothecomas are benign sex cord-stromal tumors that comprise 4% of all ovarian neoplasms.
- Arise from mesenchymal fibroblast cells of the embryonic gonads.
- Accurate diagnosis potentially avoids an invasive surgical resection with its associated morbidity in the case of smaller and more indolent appearing masses.
Sex cord-Stromal Tumors

- Large stromal tumors are considered for surgical resection secondary to increased risk for ovarian torsion
- Accurate imaging diagnosis prior to surgery benefits the treating physician’s plan of care and provides peace of mind to the patient
- US and CT findings are nonspecific for fibromas and fibrothecomas
- MRI is an accurate method for diagnosing fibromas and fibrothecomas
MRI Characteristics of Fibromas/Fibrothecomas

- Ovarian stromal tumors contain a significant fibrous component which manifests on MRI as:
  - Pronounced hypointense signal on T2w imaging
  - Hypointense signal on pre-contrast T1w imaging
  - Progressively delayed enhancement on dynamic T1w imaging
40 yo F, ovarian fibroma
61 yo F, fibroma case 1

Ax pre

Arterial

Cor T2

Delayed
Ovarian Fibroma Case 2

73 year old female with an indeterminate left ovarian mass seen on CT
Ovarian Fibroma Case 2

T2 dark signal with mild delayed enhancement is consistent with ovarian fibroma
Ovarian Fibroma Case 3

51 year old female with pelvic pain and mass
T2 dark signal with mild delayed enhancement is consistent with ovarian fibroma
Ovarian Fibroma Case 4

61 year old female with abdominal pain and an indeterminate right ovarian mass seen on CT
Ovarian Fibroma Case 4

T2 dark signal with mild delayed enhancement is consistent with an ovarian fibroma versus fibrothecoma.
Ovarian Fibroma Case 4

The right ovarian mass was resected and pathology proven to be a fibroma.

Ovarian fibroma demonstrates closely packed spindle cells in a storiform pattern with scattered collagen deposition.
Ovarian Fibrothecoma

The 61 year old female of Case 3 also had an indeterminate left ovarian mass seen on CT
Ovarian Fibrothecoma

T2 dark signal with mild delayed enhancement is consistent with an ovarian fibroma versus fibrothecoma.
Ovarian Fibrothecoma

The left ovarian mass was resected and pathology proven to be a fibrothecoma.

Ovarian fibrothecoma demonstrates spindle cells with moderately pale cytoplasm. Intervening stroma has collagen deposition.
Mimics

- Other stromal tumors
  - Sertoli-Leydig tumor
- Brenner tumors
- Pedunculated uterine fibroids
Pedunculated Uterine Fibroid

- 44 year old female with right pelvic pain
- On the T2w sequence the mass demonstrates signal characteristics similar to those of an ovarian fibroma
- On delayed phase imaging the mass demonstrates enhancement identical to the uterus identifying the lesion as a pedunculated subserosal uterine fibroid
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

Ax T2

Ax T2 FS

SSFP

Out of phase

In phase
Dermoid Cyst

- 52 year old female with pelvic pain
- CT findings are consistent with a right ovarian dermoid cyst
Dermoid

- 52 year old female with pelvic pain
- CT findings are consistent with a right ovarian dermoid cyst
Dermoid Cyst

- 24 year old female with pelvic pain
- Pathology proven dermoid cyst (mature cystic teratoma)
Dermoid with Ovarian Torsion
Dermoid with Ovarian Torsion
Dermoid with Ovarian Torsion
25 year old female presenting with severe right adnexal pain and a positive beta-HCG refusing an ultrasound due to intolerable pain.

Figures A-D demonstrates a gravid uterus with a T2 hypointense fundal fibroid. Figures B and C show an enlarged, edematous right ovary with peripherally located follicles. Twisting of the ovarian pedicle is noted in figure D. The ovarian follicle do not demonstrate peripheral T2 dark signal (hemorrhage) indicating the ovary remains viable (8). Findings are consistent with right a viable ovarian torsion.
Companion Case B
26 yo F, LLQ pain
Ovarian torsion: Ovarian stromal edema
4 yo F, dysgerminoma, torsed ovary
24 yo F, metastatic embryonal cell CA
Metastatic Disease: Primary?

- 88-year-old female with abdominal pain and elevated Ca19-9
- Outside CT showed a large pelvic mass (red arrow)
- The colon cancer was missed on the outside CT (yellow arrow)
Metastatic Disease

- MR imaging
- Pathology proven Krukenberg tumors in the ovaries (red arrows) metastasized from a sigmoid colon adenocarcinoma (yellow arrow)
Summary

- MRI provides most detailed analysis of ovarian lesions, providing reliable distinction between neoplastic and non-neoplastic entities.

- MRI provides high diagnostic specificity to differentiate among the main categories of ovarian tumors.