Magnetic Resonance Imaging of non ovarian adnexal lesions

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Learning objectives

1. Learn the various non-ovarian adnexal lesions and their clinical significance.

2. Demonstrate the key MR imaging and differential diagnostic features of non-ovarian adnexal lesions.

3. Understand an MR imaging based flowchart to determine the correct etiology of a non-ovarian adnexal lesion.

Background

MRI of the pelvis provides excellent tissue characterization and high contrast resolution. MRI can be utilized as a useful tool for diagnosis of non ovarian adnexal masses that are incompletely evaluated with pelvic ultrasound. Using high quality, multi-planar MRI, non ovarian adnexal masses may be evaluated in great anatomical detail. The radiologist should be aware of the wide range of pathologies presenting as non ovarian adnexal masses. Accurate identification of these lesions is important as treatment options differ widely and correct diagnosis is crucial to avoid treatment delay or unnecessary therapy. The presence of a normal ipsilateral ovary is the first step in determination of a non ovarian adnexal mass. If the ipsilateral ovary is not visualized, or it appears involved, then the mass should be presumed to be ovarian in origin, until proven otherwise. The next step is to determine whether the mass is a solid or a cystic lesion (Table 1). The following sub sections discuss the most common cystic and solid non adnexal lesions.

Table 1
**Imaging findings OR Procedure details**

**Tubo-ovarian Abscess (TOA)**

TOA is an infectious complex mass that involves the fallopian tube (1). One of the most common types of pelvic abscesses in women in reproductive age group is TOA(2). In patients presenting with clinical symptoms of Pelvic inflammatory disease, the presence of an adnexal mass, age greater than 42 years and elevated erythrocyte sedimentation rate > 50 mm/hour (Normal 0-10mm/hour) were associated with TOA (3). With the advent of broad-spectrum antibiotics, conservative treatment of TOA is usually successful (4). On MRI, TOA appears as multiloculated, multiseptated, complex cystic mass with thick or thin wall and with fluid-fluid or fluid-debris levels. The signal intensity depends on presence of proteineous contents and is usually hyperintense or heterogeneous on T2-weighted images and hypointense to the surrounding muscle and myometrium on T1-
weighted images (5). Enhancing septae /strands may be noted within the TOA and also in the pelvic fat planes (6) (Fig 1).

Fig. 1: Figure 1. Pyosalpinges (bilateral) and left tubo-ovarian abscess (TOA). 47 year-old-woman with abdominal pain, nausea and vomiting. (a) Axial T2-weighted and (b) Coronal post-Gd T1-weighted images show dilated fluid/debris filled tubular structures (*) in adnexae representing bilateral pyosalpinges. Tubo-ovarian abscess is seen as a septated adnexal cystic lesion (arrows) next to left fallopian tube.

References: S. K. Thawait; Shelton, UNITED STATES OF AMERICA

Ectopic Pregnancy

Implantation of the blastocyst at any site outside the endometrium is termed ectopic pregnancy. Adhesions and scarring from inflammation or fibrosis lead to delayed tubal transit of embryo and prevent implantation in the endometrium. Several risk factors have been identified such as previous ectopic pregnancy, previous tubal surgery, pelvic inflammatory disease, infertility and smoking (7, 8). The most common location is the fallopian tube (9). Levels of serum beta subunit of human chorionic gonadotropin is usually abnormally elevated (10). A heterogeneous or cystic mass with mixed signal intensity on T1- and T2-weighted images may be seen (Fig 2). MRI may also show additional findings such as hemosalpinx and bloody ascites (9). MRI can also depict invasive disease that may alter therapeutic management in patients with documented gestational trophoblastic disease (10).
Fig. 2: Figure 2. Interstitial (cornual) ectopic pregnancy. 35 year-old-woman with previous history of several ectopic pregnancies presents with amenorrhea, 1st trimester bleeding and severe pelvic pain. (a) Axial T1-weighted and (b) Axial T2-weighted images show thick-walled complex cystic lesion (arrows) in right adnexa in uterine cornu/interstitial portion of fallopian tube without intrauterine gestational sac. The right ovary is seen separately(*).

References: S. K. Thawait; Shelton, UNITED STATES OF AMERICA

Paraovarian Cyst

Paraovarian Cyst arise within the broad ligament or paraovarium as remnants of the Wolffian or mullerian ducts usually adjacent to the ovary. These cysts represent 10-20% of adnexal masses and may be bilateral or multiple (11). Non neoplastic simple cyst is usual etiology, however, neoplastic origin is also possible. Initial studies showed a low prevalence of valence of neoplastic lesions (2-5%) from all types of paraovarian lesions (12, 13). A more recent study showed a much higher prevalence of paraovarian cysts of neoplastic origin(14). On MRI these cysts are round or ovoid, demonstrate a thin wall and follow signal intensity characteristics of simple fluid (15). Normal ipsilateral ovary is identified separate from the lesion (Fig 3).
Fig. 3: Figure 3. Para-ovarian cyst. 28 year-old-woman with infertility. (a) Axial T2-weighted and (b) coronal T2-weighted image with fat suppression show small unilocular cyst (thick arrows) within left adnexa. The left ovary (long arrows) is seen separately. Note arcuate configuration of uterus on axial image.

References: S. K. Thawait; Shelton, UNITED STATES OF AMERICA

Peritoneal Inclusion Cyst

Localized peritoneal fluid contained by mesothelial lined adhesion is termed Peritoneal Inclusion Cyst. The entity requires two conditions for formation: an ipsilateral functioning ovary & adhesions (16). They are therefore, most often seen in women with prior abdominal surgery, trauma, PID, endometriosis. Peritoneal Inclusion Cysts do not have true walls as the boundaries are formed by surrounding organs (Fig 4). Hence the appearance is extremely irregular in shape and reflect the invaginations of surrounding structures in the cyst wall (17). On MR imaging, peritoneal inclusion cysts follow signal intensity of serous fluid. Occasionally, high signal intensity on T1-weighted images may be seen due to old blood products. No solid component is seen on contrast-enhanced T1-weighted images.
Fig. 4: Figure 4. Peritoneal inclusion cyst. 40 year-old-woman with pelvic pain 7 years after hysterectomy. (a) Axial T1-weighted and (b) Axial T2-weighted images reveal unilocular cystic lesion (*) in right adnexa. Note the intimate relationship with right ovary (arrows). There is no solid component. (c) Axial post-Gd T1-weighted image does not show any enhancing component.

References: S. K. Thawait; Shelton, UNITED STATES OF AMERICA

Hydrosalpinx / Hematosalpinx

Depending on the cause of the obstruction, serous fluid, hemorrhage, or pus may accumulate within the tube resulting in distention (18). A fallopian tube that is filled and distended with serous fluid is referred to as hydrosalpinx, and a tube filled with blood is referred to as hematosalpinx. The distended tube usually assumes a sausage shaped C or S shape, and this appearance can be easily confirmed by the multiplanar capacity of MRI (19). Simple fluid in a dilated fallopian tube shows low signal intensity on T1-weighted images and high signal intensity T2-weighted images (Fig 5). Hemorrhagic or proteinaceous tubal content may have high signal intensity on T1-weighted images and variable signal intensity T2-weighted images (Fig 6). Fallopian tube carcinoma should be suspected in the presence of an enhancing solid component (18).
**Fig. 5:** Figure 5. Hydrosalpinx. 66 year-old-woman with history of breast carcinoma. (a) Axial T1-weighted, (b) and (c) Axial T2-weighted images and (d) Sagittal T2-weighted images reveal a dilated fluid-filled tubular structure (arrows) in right adnexa.  
*References:* S. K. Thawait; Shelton, UNITED STATES OF AMERICA

**Fig. 6:** Figure 6. Hematosalpinges (bilateral). 35 year-old-woman with history of chronic pelvic pain and endometriosis. (a) Axial T1-weighted and (b) Axial T2-weighted images show dilated tubular structures (*) in adnexae with increased T1W SI and decreased T2W SI consistent with hemorrhagic fluid.  
*References:* S. K. Thawait; Shelton, UNITED STATES OF AMERICA

**Pelvic Congestion Syndrome / Varices**
Valvular incompetence resulting in blood pooling causing stretching and dilatation of the pelvic veins is considered the cause of pelvic congestion syndrome (20). Multiparous women of reproductive age are generally affected and complain of deep, dull pelvic ache made worse by activity or actions that increase intra-abdominal pressure (21). Pelvic congestion syndrome may be termed as primary if no anatomic obstruction is present. Secondary pelvic congestion syndrome may be caused by compression of ovarian veins by retroaortic left renal vein, superior mesenteric artery (Nutcracker phenomenon) or as a component of iliofemoral deep venous thrombosis in May-Thurner syndrome (22). Varices are usually low signal intensity on non contrast T1-weighted images as well as on T2-weighted images and are seen as dilated, serpiginous parauterine or paraovarian vessels (23). Varices show high signal intensity T1-weighted sequences with gadolinium and may be made more conspicuous on 3-dimensional volume rendering or maximum intensity projection image (Fig 7). Time resolved magnetic resonance angiography / venography is being used increasingly for confident diagnosis (20, 24).

**Fig. 7**: Figure 7. Pelvic congestion syndrome. 48 year-old-woman with chronic pelvic and vaginal pain. (a) Coronal post-Gd Maximum Intensity Projection (MIP) image and (b) Axial post-Gd T1-weighted images show dilated enhancing left ovarian vein and periuterine varices (arrows). Retrograde flow in left ovarian vein (image not shown here) was also demonstrated.

**References**: S. K. Thawait; Shelton, UNITED STATES OF AMERICA

**Tarlov Cyst / Perineural Sacral Cyst**

The estimated prevalence is between 5- 9% of the adult population (25). Dilated prominent nerve-root sleeve located in the space between the peri- and endoneurium of
the spinal posterior nerve root sheath at the dorsal root ganglion has appearance of cyst (26). The most common location is at S2 and S3 levels. On MRI the cysts follow signal intensity characteristics of cerebrospinal fluid with low signal on T1-weighted images and a high signal on T2-weighted images (25). Bone and pedicle erosion, sacral canal widening, and neural foramina enlargement may also be seen. Communication with the subarachnoid space of the thecal sac clinches the diagnosis (Fig 8).

**Fig. 8**: Figure 8. Tarlov cysts. 46 year-old-woman with history of irregular menses. (a) Axial T1-weighted and (b) Coronal T2-weighted image with fat suppression shows dilated tubular cystic lesions (short arrows) along the course of sacral nerves entering the pelvis in adnexal location. Note the expanded right sacral foramen (*). Also note the separate right ovary (long arrow in a).

**References**: S. K. Thawait; Shelton, UNITED STATES OF AMERICA

**Mucocele of Appendix**

A mucocele of the appendix may uncommonly mimic an adnexal lesion and should be considered in a woman with unexplained right lower quadrant abdominal pain (27, 28). Abnormal mucus accumulation and dilatation of the lumen of the appendix leads to appendiceal mucocele. The cause is fibrous obliteration of the proximal lumen due to inflammation and the subsequent dilatation of the distal lumen. The most common causative conditions of appendix are mucinous cystadenomas, mucosal hyperplasia, mucinous cystadenocarcinomas and retention cysts (29). On MRI a well defined, tubular, thin walled, cystic mass, invaginating into the cecum with rim enhancement or calcification may be seen (30). In absence of an active inflammatory process or hemorrhage, intermediate signal intensity on T1-weighted images and homogenous high
signal intensity on T2-weighted images is seen (Fig 9)(31). High SI on T1W images may be present due to high protein content.

Fig. 9: Figure 9. Appendiceal mucocele. 71 year-old-woman with right lower quadrant abdominal pain. (a), (b) and (c) Sequential Axial T2-weighted images demonstrate dilated blind-ending tubular fluid-filled structure (arrows) originating from cecal base (white circle) (d) Axial post-Gd T1-weighted image with fat saturation shows minimal peripheral rim enhancement.

References: S. K. Thawaid; Shelton, UNITED STATES OF AMERICA

Bladder Diverticulum

An outpouching of bladder urothelium through the muscularis propria of the bladder wall constitutes a bladder diverticulum. Bladder diverticula may be congenital or acquired. Congenital diverticula are believed to form as a result of insufficient backing of muscle at the ureterovesicular junction (32). Boys are commonly affected and the presentation is at an age younger than 10 (32); hence, the congenital diverticulum is not usually confused with an adnexal lesion. An acquired diverticula is more likely to mimic an adnexal lesion, however, these are also uncommon in women (33). Multiple diverticula are more common in acquired type and are usually found near the ureterovesical hiatus. MRI signal intensity is similar to the bladder on all pulse sequences. Diagnosis can be made with confidence in presence of homogeneous fluid signal intensity collection with thin wall without enhancement or adjacent fat stranding or edema. Associated syndromes are Ehlers-Danlos (34) and Menkes disease (35).

Pedunculated Uterine Fibroid / Broad Ligament Leiomyoma

An exophytic uterine mass may simulate an extrauterine adnexal mass. MRI may establish the myometrial origin of the mass by demonstrating splaying of the uterine
serosa or the myometrium and absence of fat plane between the mass & the uterus on T1-weighted images (36). A leiomyoma is sharply margined with low to intermediate signal intensity on both T1- and T2-weighted images (Fig 10) (37). In the absence of degeneration, contrast enhancement is usually not needed for the evaluation of leiomyoma (38). A degenerating leiomyoma demonstrates heterogeneous high signal intensity on T2-weighted images and contrast enhancement (39). Vascular structures crossing between the uterus and the exophytic mass are seen as curvilinear tortuous signal voids on MRI (Fig 11). This finding called the "bridging vascular sign" and has been shown to be present in about 80% of cases in one study (40).

Fig. 15: Figure 10. Pedunculated uterine leiomyoma. 43 year-old-woman with history of pelvic mass. (a) Axial T1-weighted image and (b) Coronal T2-weighted image with fat suppression show a large pedunculated low-intermediate signal intensity right adnexal mass (*) arising from the uterus (U). This is confirmed by "bridging vessel sign" of uterine artery flow voids between mass and uterus (long arrow). The right ovary is seen separately (short arrow). It is displaced and shows a cyst.

References: S. K. Thawait; Shelton, UNITED STATES OF AMERICA
Fig. 10: Figure 10(continued). Pedunculated uterine leiomyoma. 43 year-old-woman with history of pelvic mass. (c) Sagittal and (d) Axial T2-weighted images show a large pedunculated low-intermediate signal intensity right adnexal mass (arrows) arising from the uterus (U). (e) Axial post-Gd T1-weighted image with fat saturation again shows the enhancing vessels which traverse the mass and the uterus (arrow).

References: S. K. Thawait; Shelton, UNITED STATES OF AMERICA

Endometriosis

Endometriosis has an estimated prevalence of 5%-20% and affects women of reproductive age (41, 42). The presence of functional endometrial glands and stroma outside the uterine cavity may be either symptomatic or asymptomatic. Chronic pelvic pain, dysmenorrhea and deep dyspareunia are the most common symptoms (43). The presentation may vary from microscopic endometriotic implants to large cysts (endometriomas). MRI signal characteristics vary according to the age of hemorrhage, and endometriomas may have a mixed spectrum of appearances. Hypointensity on TI- and T2-weighted images may be due to acute hemorrhage and hyperintensity of both TI- and T2-weighted images may be seen with old hemorrhage (44). The finding of hypointensity on T2-weighted images and hyperintensity on T1-weighted images in an adnexal cyst is called the shading sign (45). Endometriomas are highly viscous and have
a high concentration of protein and iron from recurrent hemorrhage, causing shortening of T1 and T2 relaxation resulting in shading (46)(Fig 11). The accuracy of MRI for detection of endometriomas is increased even more using frequency selective fat suppression (47).

**Fig. 11**: Figure 11. Endometriosis. 37 year-old-woman with history of pelvic inflammatory disease. (a) Axial T1-weighted image and (b),(c) Axial T2-weighted images show a dilated fluid-filled thick-walled tubular structure (*) in right adnexa, consistent with hydrosalpinx suggesting chronic salpingitis. Several cystic structures are also seen (thick short arrows). These show higher signal intensity on T1-weighted and lower signal intensity on T2-weighted than simple fluid, consistent with endometriomas. The right ovary is seen separately (long thin arrow).

**References**: S. K. Thawait; Shelton, UNITED STATES OF AMERICA

**Fallopian Tube Carcinoma**

Fallopian tube malignancy is a rare disease entity and constitutes 0.3 - 1% of all gynecological cancers (48). Presentation is nonspecific with vaginal bleeding as the most common presentation (49). Imaging findings are also nonspecific (Fig 12). Typically the tumor is a small adnexal cystic mass with low signal intensity on T1-weighted images and high signal intensity on T2-weighted images, shape may vary from sausage to snail shape (50).
Pelvic Metastasis

The most common primary tumors that metastasize to the pelvis are breast, lymphoma, colorectal, lung, among others (51). The lesions are solid enhancing and demonstrate intermediate signal on T1-weighted images and high signal intensity on T2-weighted images. Presence of hemorrhage may lead to T1 shortening (52).

Conclusion

MRI is useful in the evaluation of non-ovarian adnexal lesions. By establishing the organ and/or tissue of origin, MRI may be able to characterize indeterminate adnexal masses and thus positively affect patient management. Using a systemic flowchart type of approach by distinguishing the adnexal lesion as cystic or solid, the radiologist can offer a diagnosis (Fig 13 and 14).

Flowchart for identification of a cystic adnexal lesion
Fig. 13: Flowchart for systematic evaluation of a non ovarian cystic mass.  
References: S. K. Thawait; Shelton, UNITED STATES OF AMERICA

Flowchart for identification of a solid adnexal lesion

Fig. 14: Flowchart for systematic evaluation of a non ovarian solid mass.  
References: S. K. Thawait; Shelton, UNITED STATES OF AMERICA
References


