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PHOTO ESSAY

Value of MRI in Characterizing Adnexal Masses

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About the Author

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Abstract Magnetic resonance imaging (MRI) increases the specificity of imaging evaluation for adnexal masses, especially when they are indeterminate on ultrasound, very large or when further imaging is required to establish tissue characteristics. This article is a pictorial essay describing the value of MRI in characterizing adnexal masses.

Keywords MRI · Pelvis · Adnexal masses

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Introduction

Adnexal masses, both incidental and symptomatic, pose a challenging diagnostic problem because many times, the imaging features on ultrasound may overlap. Thus, once an adnexal lesion has been detected, the goal of MRI imaging is accurate tissue characterization [1, 2].

Normal Anatomy

The uterus is seen as a homogenous, medium-signal intensity structure, with the myometrium and endometrium being separated by a junctional zone.

The ovaries are demarcated by the presence of bright follicles in the reproductive age group on T2WI (Fig. 1). The fallopian tubes unless enlarged or diseased are not distinctly visualized on MRI.

Ovarian Cysts

Ovarian cysts larger than 7 cm need further imaging, either as a prelude to intervention, or for better characterization.

MRI usually shows signals suggestive of clear fluid, similar to serous cystadenomas, while mucinous cystadenomas present as multilocular (honeycomb-like locules) lesions with thin regular walls with septae.

Paraovarian cysts can also be easily differentiated by visualizing the normal ovary separately next to the cyst (Fig. 2).

Pedunculated or Subserous Uterine fibroids

Pedunculated uterine subserosal and broad-ligament fibroids frequently present as adnexal masses, and ultrasound is usually adequate for diagnosis. In indeterminate cases, MRI is useful in showing their extraovarian location, displacement of surrounding structures, and their connection to the uterus or broad ligament [1, 3] (Fig. 3).

Endometriosis

MRI is superior to ultrasound in identifying sites of disease: T1WI fat-suppressed sequence increases the detection of small implants by allowing better definition and differentiation between hemorrhagic and fat components (dermoid) [1, 4] (Fig. 4), as well as detection of pelvic deposits in the pouch of Douglas (POD) (Fig. 5).

Hemorrhagic cysts have similar MRI appearances, and their interval resolution differentiates the two.

Dermoid

Dermoids are usually commonly diagnosed by ultrasound, but the need for MRI may arise when ultrasound cannot differentiate it from an endometriotic cyst, especially when the mass is complex (Fig. 6), and when torsion is suspected (Fig. 7).

Ovarian Tumors

Solid Ovarian Tumors

Most solid primary ovarian tumors include the sex cord-stromal or germ-cell tumors. Sclerosing stromal tumors show typical early peripheral enhancement with centripetal progression. While most germ-cell tumors have a heterogeneous solid and cystic appearance, dysgerminomas can be solid (Fig. 8).

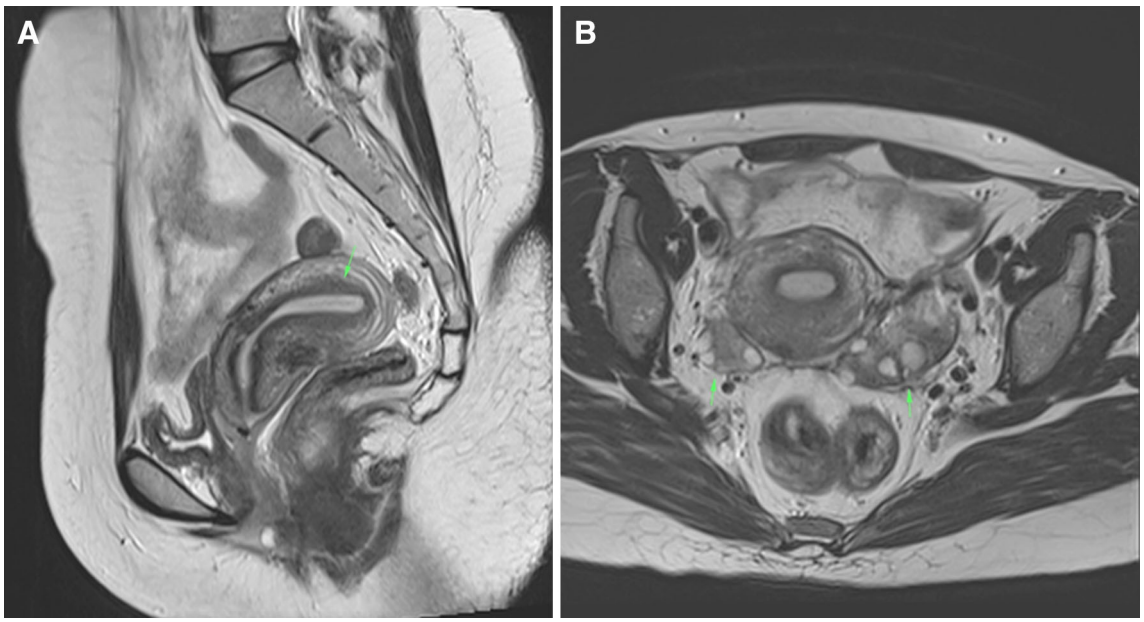

Fig. 1 Normal anatomy: **a** Sag T2WI reveals intermediate signal intensity in the uterine myometrium with high signal intensity in the endometrium. The junctional zone (*arrow*) is a low signal intensity zone separating the endometrium from the outer myometrium. **b** Axial T2WI reveals the ovaries (*arrows*) as intermediate signal intensity structures with bright (hyperintense) follicles within

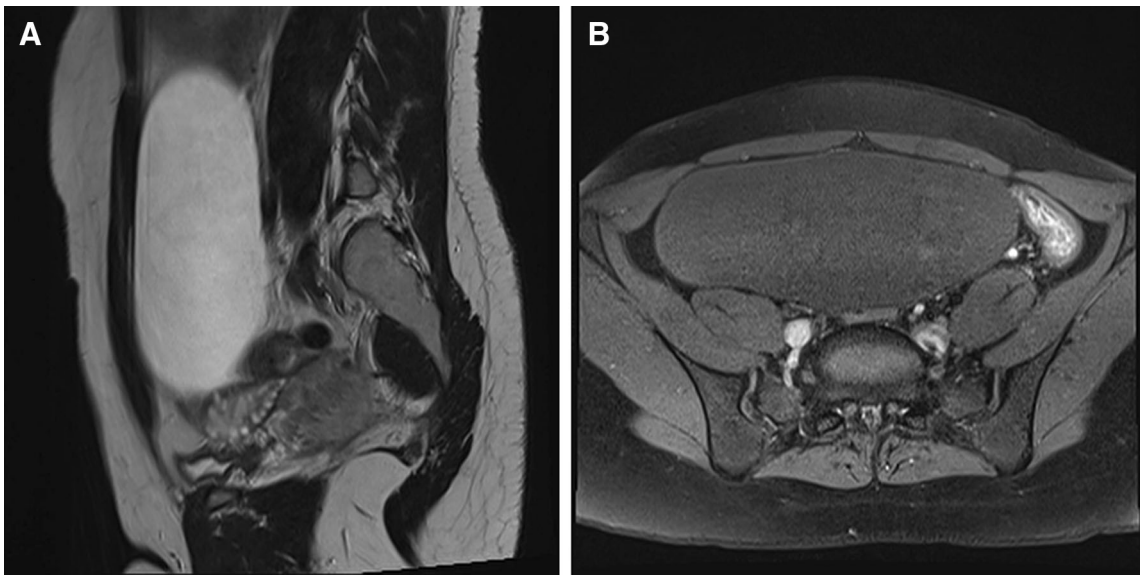

Fig. 2 Simple paraovarian cyst: **a** Sag T2WI reveals a hyperintense lesion in the left adnexa suggesting the cystic nature of this lesion. The left ovary is seen separate and inferior to this lesion. **b** Contrast-enhanced axial T1 fat-suppressed image reveals no internal or peripheral enhancement suggesting that the lesion is a simple cyst

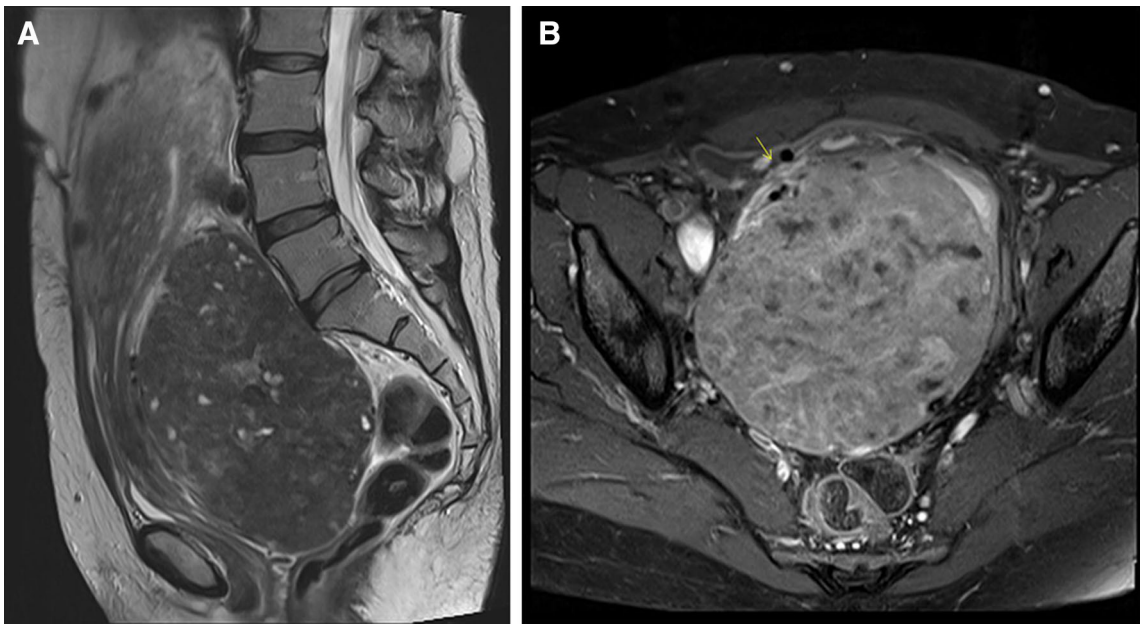

Fig. 3 Subserous fibroid: **a** Sag T2WI reveals a large well-marginated intermediate signal intensity lesion in the pouch of Douglas (POD) displacing the cervix anteriorly. **b** Prominent vessels (*arrow*) are seen anteriorly and to the right of this lesion at its interface with the uterus suggesting a vascular pedicle as is seen in a subserous fibroid

Malignant Surface Epithelial Tumors

Ovarian cystadenocarcinomas are usually solid and cystic and show variegated enhancement on contrast and are distinguished from other common benign lesions because they originate from the ovary (unlike fibroids), show heterogeneous tissue signal and enhancement (unlike fibrothecoma), and show no fatty tissue (unlike dermoids) [1, 5] (Fig. 9). Vault recurrence can also be determined on MRI along with parametrial extension (Fig. 10).

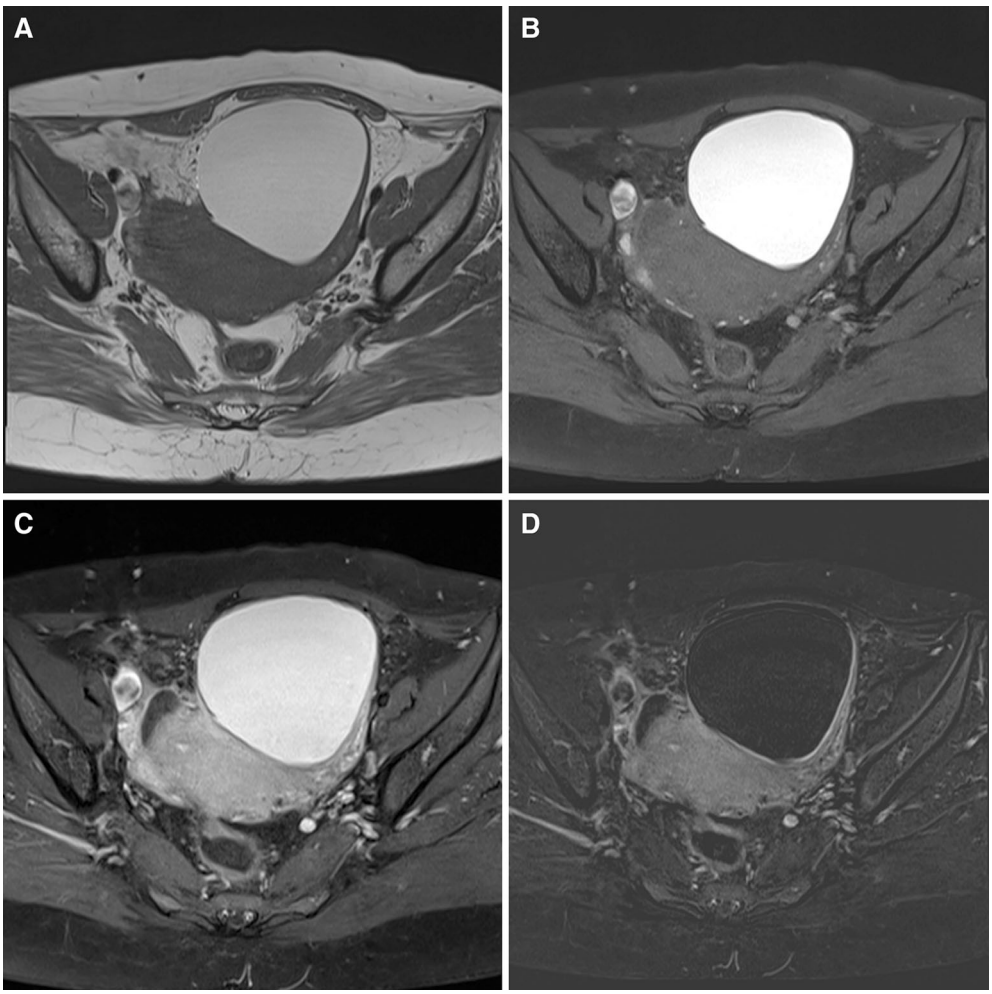

Fig. 4 Endometrioma: **a** Axial T1 non-fat-suppressed image reveals a hyperintense signal within a left ovarian cyst. **b** T1 fat-suppressed image reveals no change in the hyperintense signal of the left-sided ovarian cystic lesion, while the rest of the fat signal in the pelvis is suppressed, and this suggests that the lesion contains blood and not fat. **c** Post-contrast image reveals no internal enhancement in this lesion. **d** Subtracted post-contrast image further helps to determine the extent of enhancement especially when the lesion is bright on pre-contrast T1 images

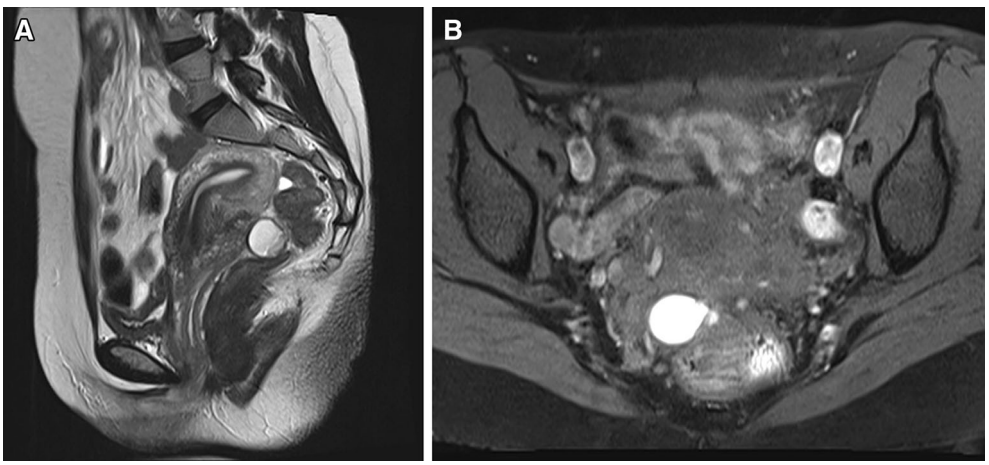

Fig. 5 Endometriosis with POD deposit: **a** Sag T2WI image reveals a small hyperintense lesion in the POD in a known case of endometriosis. **b** Hyperintense (*bright*) T1W signal within this lesion suggests the presence of blood, and in a known case of endometriosis, this suggests an endometriotic deposit in the POD

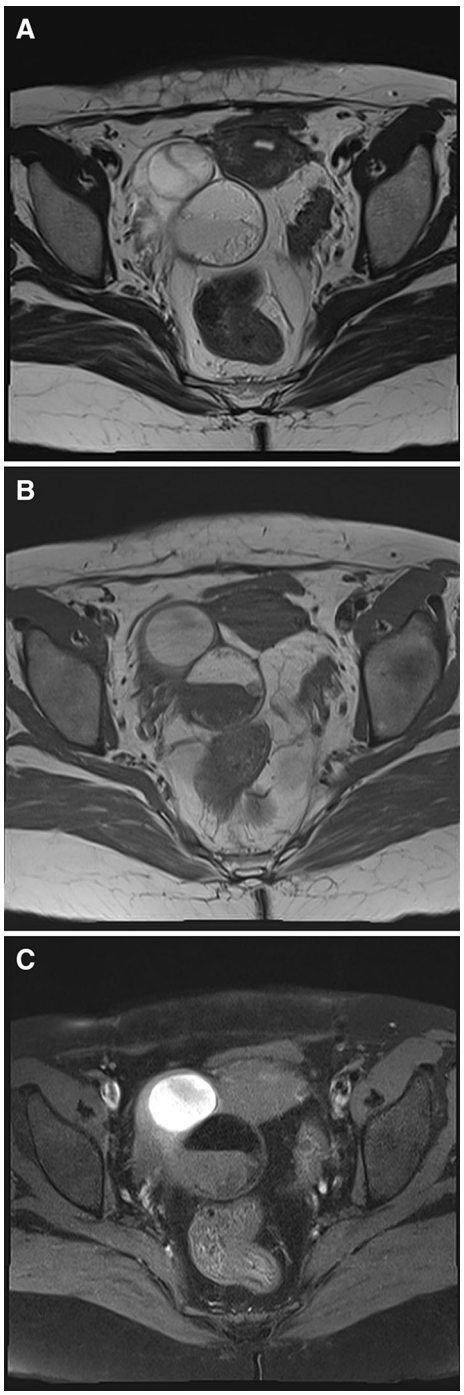

Fig. 6 Dermoid with haemorrhagic cyst: **a** Axial T2WI reveals presence of two well-defined hyperintense lesions in the right ovary suggesting the cystic nature of these lesions. **b** Axial T1 non-fat-suppressed image reveals uniformly hyperintense signal in the anterior lesion and a fluid–fluid level in the posterior lesion. **c** Axial T1 fat-suppressed image reveals persistent uniformly hyperintense signal in the anterior lesion suggesting that this lesion contains blood (hemorrhagic cyst); the posterior lesion shows suppression of the bright signal seen in the nondependent portion, suggesting that this lesion contains fat within—characteristic for a dermoid cyst

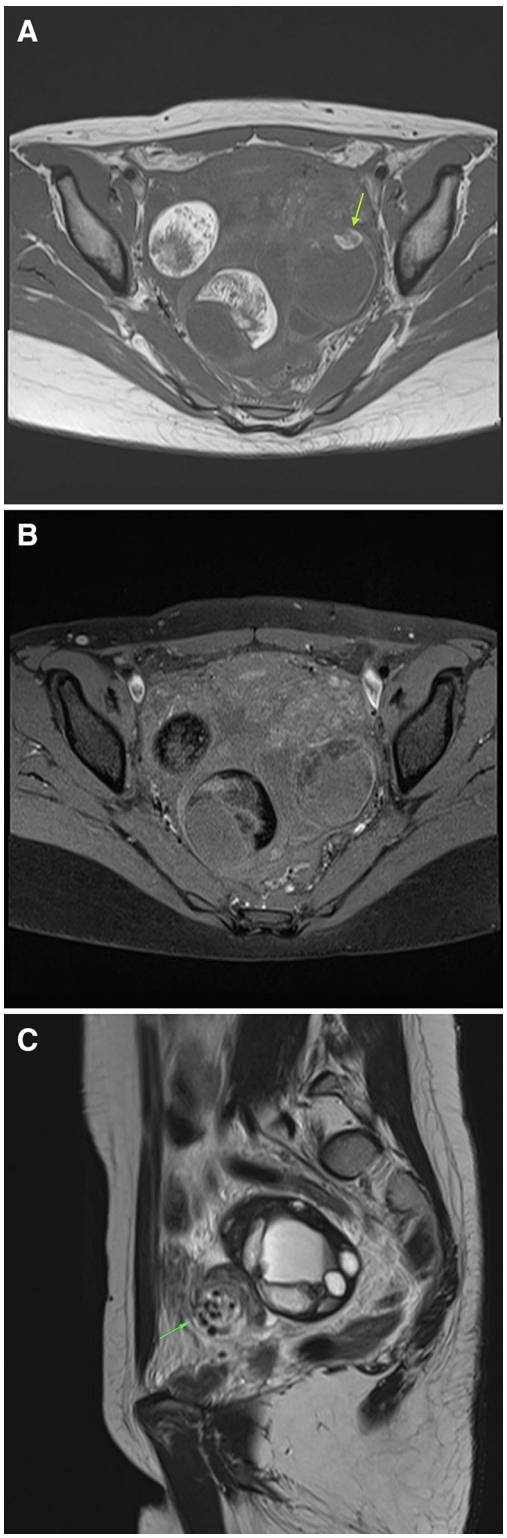

Fig. 7 Dermoids with ovarian torsion: **a** Axial T1 non-fat-suppressed image reveals bilateral ovarian lesions with a hyperintense signal within the lesions on the right and a small hyperintense focus on the left (*arrow*). **b** Axial T1 non-contrast fat-suppressed image reveals signal loss within these lesions on fat suppression suggesting the presence of fat in bilateral ovarian dermoid cysts. **c** Sag T2WI reveals a classic twisted pedicle (*arrow*) anterior to the left ovary confirming torsion

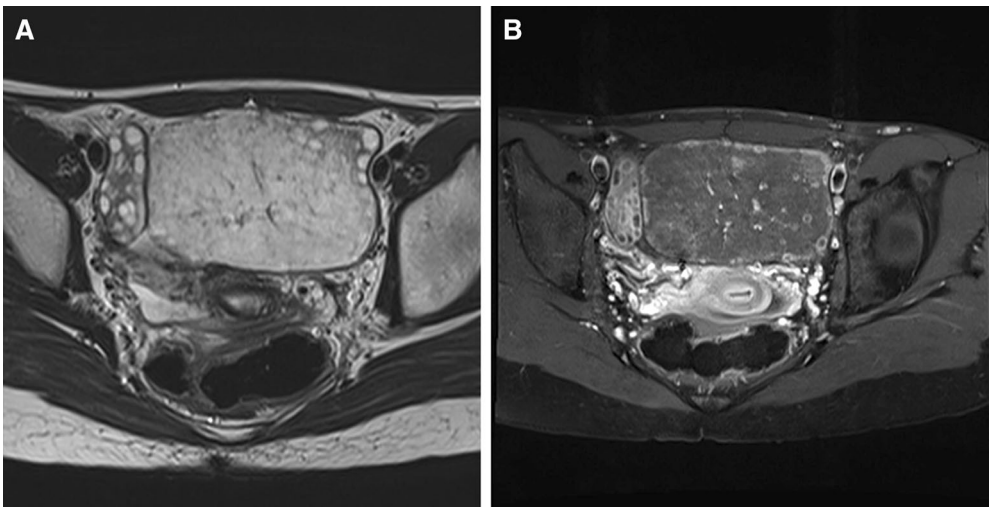

Fig. 8 Solid ovarian tumor: **a** Axial T2WI reveals a moderately hyperintense mass lesion in the left ovary almost involving the entire ovary with few follicles displaced at the periphery. The normal right ovarian parenchyma is seen adjacent to the enlarged left ovary. **b** Contrast-enhanced axial T1 fat-suppressed image reveals enhancing fibrovascular septae within the lesion with predominantly low enhancing stroma. This morphology has been described in dysgerminomas

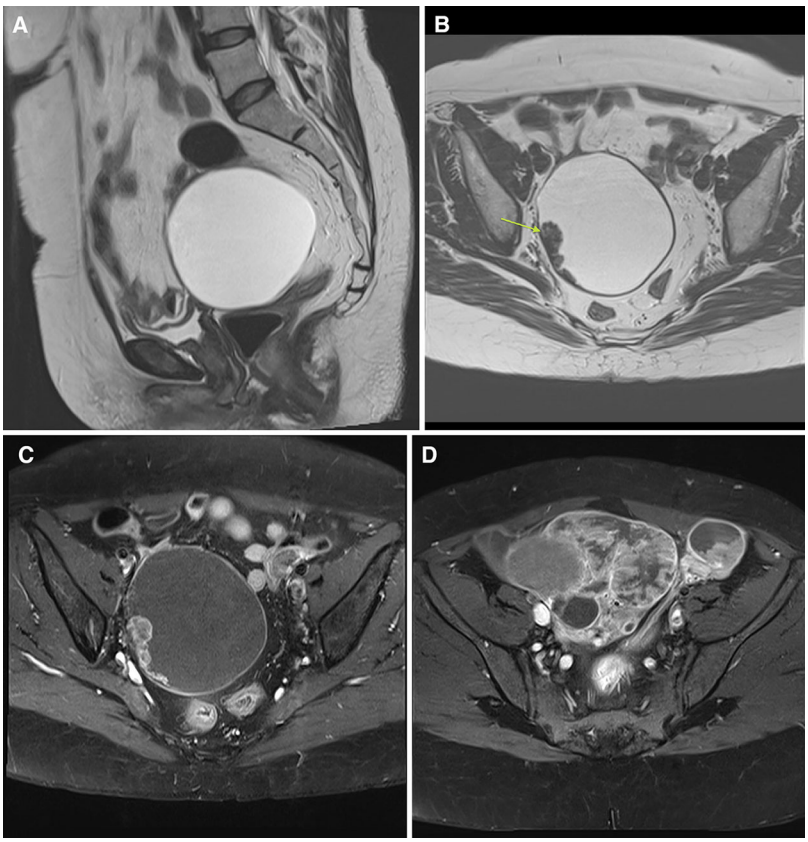

Fig. 9 Ovarian cystadenocarcinoma: **a** Sag T2WI reveals a hyperintense lesion in the pelvis above the vaginal vault in a hysterectomy patient. **b** Axial T2WI reveals an irregular hypointense mural nodule along the right lateral wall (*arrow*) of this lesion. This was mistaken to be a simple cyst on the ultrasound. **c** Contrast-enhanced axial T1 fat-suppressed image reveals enhancement within the mural nodule, and this sign is important for differentiating a cystadenocarcinoma from a simple cyst. **d** Bilateral solid cystic ovarian masses—serous cystadenocarcinoma. This is another case, with contrast study revealing bilateral heterogeneously enhancing ovarian lesions with enhancing solid papillary areas and septae, and nonenhancing cystic areas. Bilateral lesions are more common in serous cystadenocarcinoma

Fig. 10 Vault recurrence: **a** Sag T2WI reveals a mildly hyperintense mass in the POD seen arising from the vaginal vault in a patient previously operated for endometrial carcinoma. There is loss of fat planes with the posterior wall of the bladder, which suggests infiltration. **b** Contrast images reveals heterogeneous enhancement in the mass with loss of fat planes with the bladder (*arrow*)

Fig. 11 Tubo-ovarian mass: **a** Cor T2WI reveals a large tubular right-sided tubo-ovarian adnexal mass lesion with a hyperintense signal, suggesting the cystic nature of this lesion. The left ovary is seen separately (*arrow*). Also noted are multiple uterine fibroids. **b** Contrast image reveals peripheral enhancement and dependent T1 hyperintense signal—suggestive of proteinaceous contents

Pelvic Inflammatory Disease

Acute pelvic abscesses are uncommon, and contrast MRI will show rim enhancement to confirm its presence. Chronic pelvic inflammatory conditions can also be easily diagnosed by identifying the tubal lesion, the presence of free fluid in the POD and associated ovarian cystic lesions (Fig. 11).

Tail Gut Cyst

Tail gut cysts are rare congenital anomalies that display fluid characteristics on MRI, but may display a heterogenous appearance on T2WI due to the presence of mucin, hemorrhage, or proteinaceous material within the cyst [1, 5] (Fig. 12).

Fig. 12 Tail gut cyst: Sag T2WI reveals a hyperintense lesion in the pelvis, displacing the urinary bladder, cervix, and the rectum anteriorly suggesting a presacral cystic lesion. Also note that the sacral vertebrae appear normal and there is no intraspinal communication, thus differentiating this from an anterior meningocele

On ultrasound, these can be mistaken as adnexal masses, and MRI helps in determining its presacral location.

Anterior Sacral Meningocele (ASM)

ASM is a rare congenital anomaly, characterized by herniation through a defect in the anterior aspect of the sacrum [6] and can mimic ovarian or paraovarian cysts (Fig. 13).

Conclusion

For lesions indeterminate on ultrasound, MRI increases the specificity of imaging evaluation, especially if a predominantly solid lesion requires more tissue-specific characterization for diagnosis.

Large ovarian and adnexal masses, whether cystic or solid should be imaged by MRI, while the role of CT has moved toward imaging of advanced ovarian cancers, extrapelvic extension, and staging.

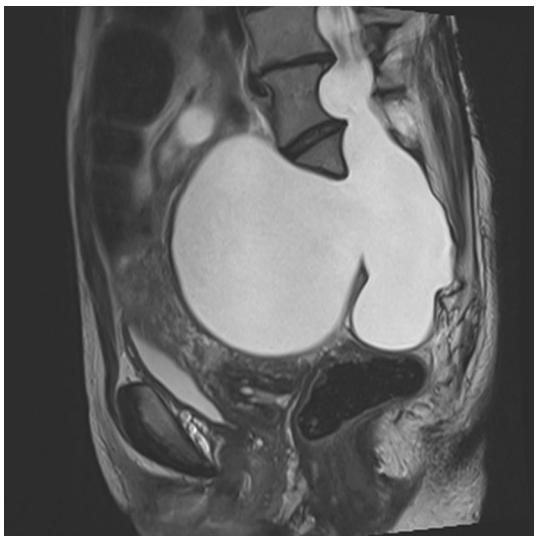

Fig. 13 Anterior meningocele: Sag T2WI reveals a hyperintense lesion in the pelvis, located anterior to the sacral vertebrae and displacing the urinary bladder and uterus anteriorly. The lesion shows communication with an enlarged sacral subarachnoid space suggesting an anterior meningocele

Conflict of interest None.

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