THE ROLE OF MAGNETIC RESONANCE IMAGING IN THE DIAGNOSIS OF GYNAECOLOGIC PELVIC TUMOURS

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ABSTRACT

Objective : To assess the role of magnetic resonance imaging in the diagnosis of gynaecological pelvic tumours.
Design: Prospective study.
Setting : Tanta University Hospitals .
Patients : The study included 49 women diagnosed clinically as having pelvic tumours.
Intervention: All the patients were subjected to history taking, physical examination, transabdominal and/or transvaginal ultrasound, pelvic MRI and pathological examination of the specimens.
Outcome measures: Specificity of MRI in diagnosis of gynecologic pelvic tumours.
Results: We found that the specificity of MRI in the diagnosis of uterine fibromyomata and adenomyosis was 100%. In cases of malignant uterine tumours, we found that MR was the imaging modality of choice in erarly diagnosis and staging of endometrial carcinoma as it exhibits if there is myometrial invasion or not. Ultrasound was false negative in 40% of endometrial carcinoma. Both ultrasound and MRI were equivocal in diagnosis of benign ovarian lesions, but MRI was superior to ultrasound in diagnosis of benign extraovarian lesions. MRI succeeded in diagnosis of the pathological pattern of benign ovarian lesions and in the discrimination between benign and malignant ovarian tumours.
Conclusion: MR imaging is a valuable modality in the evaluation of female pelvic tumours when the sonographic diagnosis is nonspecific.
Key words: MRI, US, female pelvic tumours

INTRODUCTION

Magnetic resonance (MR) imaging has been a clinical tool for the past 15 years; it has been primarily used for imaging the central nervous and musculoskeletal systems, with applications in body imaging lagging far behind[1].

MR imaging is becoming an increasingly important tool in the diagnosis of benign and malignant disease of the female pelvis. Although ultrasound (US) and hysterosalpingography (HSG) remain the primary forms of imaging, MR imaging is now routinely used in the diagnostic work-up of infertility, including mullerian anomalies, and chronic pelvic pain. Both CT and MR imaging can be used to determine the origin of and to characterize a pelvic mass. Staging of gynecologic malignancies can also be performed with both modalities. In obstetrics, MR imaging is used to assess maternal complications of pregnancy and to identify or confirm fetal anomalies[2].

MR imaging has become a valuable modality in the evaluation of the female pelvis. In many cases, it follows the performance of HSG or US. These cases include infertility and pelvic pain. In some cases, it should serve as the test of choice. This is true in the local staging of cervical cancer and the evaluation of pain or disability in the pregnant patient. Finally, in the evaluation of advanced gynecologic cancers, it is usually a secondary choice with CT preferred [3].

The noninvasive nature of MR imaging is beneficial in evaluations of what are probably benign diseases in

young women of reproductive age. Although MR imaging is believed to be safe even during pregnancy, a cautious approach that involves waiting until after 12 weeks' gestation is recommended[4].

MR is the diagnostic imaging modality of choice for many disorders of the female pelvis. Benign uterine disease is well-demonstrated using rapid sequences and minimal examination time, whereas evaluaiton of malignancy is best performed with high-resolution techniques[5].

Disadvantages of MR imaging are its high cost and long scanning time. Its excellent tissue contrast underscores its importance in the evaluation of adnexal masses, however, because it allows specific diagnoses of fat, blood, and fibrous tissue. Even if normal in size, an ovary may present with tiny foci of endometrial implants or dermoid cysts that are only identifiable on MR imaging; however, MR imaging is generally used as a problem-solving modality. When ultrasound results are inconclusive, the use of MR imaging may alter treatment decisions, eliminate the need for surgery, and result in reduced overall costs[5].

The aim of the work is to assess the role of magnetic resonance imaging in the diagnosis of different female pelvic organ lesions.

PATIENTS

This study included 49 patients; their age ranged from 15 to 65 years. Selected patients were having the following:

- Clinically enlarged uterus.
- Pelvic mass with its nature and origin are equivocal by trans-abdominal ultrasonography (TAS).
- Proved adnexal masses by US for further tissue characterization by MRI.

All patients were referred to the Radiology and Imaging Department, from the Gynecology & Obstetrics Department, Tanta University Hospitals during the period from June 2003 to June 2007.

METHODS

All patients were subjected to the following :-

1. History taking and clinical examination.
2. Routine laboratory investigations including complete blood picture, blood sugar, liver and renal function, and Serum CA 125 in patients who had ovarian malignancies.
3. Transabdominal and/or transvaginal US.
4. Pelvic MRI examination which was done for all the patients.
5. Pathological examination of the tumours.

RESULTS

The age of the studied patients ranged between 15 and 65 years with a mean age of 34.72 years.

The clinical presentations of the patients revealed that chronic pelvic pain was the main presenting symptom in 52.38%; it was the only complaint in 24.44% and associated with other symptoms in 40.00% of patients. Pelvic swelling was the main complaint in 46.66%, whereas 28.90% of patients presented with abnormal uterine bleeding.

DISCUSSION

The role of MRI in the diagnosis of gynecologic diseases has increased during the last two decades. Many reports indicate that MRI is useful in evaluating the female pelvis, and it has been recommended for further evaluation of ultrasonographically indeterminate pelvic masses. However, there are few published data demonstrating objective evidence that MRI is beneficial after an equivocal US examination[6].

The current study revealed that MRI was very useful in solving problems of the female pelvis that face other methods of investigations, and we found that clear visualization of the anatomic details of the uterus & ovaries particularly in T2 weighted images was depicted, and different sequences confidently identify the tissue of origin of deifferent lesions encountered in our study. This helps in the accurate diagnosis which

Table I: Clinical presentation of patients.

Presentation	Number	%
Chronic pelvic pain	11	24.44
Pelvic swelling	21	46.66
Abnormal uterine bleeding	13	28.90
Total number of patients	45	100 %

Table II : *MRI findings of the different pelvic lesions in the examined patients.**

Pathology	No. of patients	%
Benign uterine lesions	15	30.6
• Fundal interstitial myoma	2	
• anterior uterine wall interstitial & subserous myomas	3	
• Posterior uterine wall interstitial myoma	1	
• Interstitial posterior uterine wall myoma extending submucous	1	
• Posterior uterine wall subserous myoma	2	
• Uterine adenomyosis	6	
Malignant uterine lesions	10	20.4
• Endometrial carcinoma	5	
• Leiomyosarcoma	3	
• Malignant endometrial polyp	1	
• Cervical carcinoma	1	
Benign ovarian lesions	12	24.5
• Simple ovarian cysts	3	
• Serous cystadenoma	2	
• Mucinous cystadenoma	1	
• Ovarian torsion	1	
• Dermoid cyst	2	
• Endometriotic cyst	2	
• Bilateral PCO	1	
Benign extraovarian lesions	3	6.1
• Para-ovarian cyst	2	
• Broad ligament haematoma	1	
Malignant ovarian lesions	9	18.4
• Papillary serous cystadenocarcinoma	6	
• Mucinous cyst adenocarcinoma	2	
• Granulosa cell tumor	1	
Total	49	100

*These findings were confirmed by the pathological examination, the golden standard.

Table III: MR intensity pattern of uterine myomas.

Pathology	No.	MR signal characteristics		
		T1-weighted image	T2-weighted Image	Endometrial line
Fundal uterine myomas	2	Well defined intermediate signal intensity, one case showed bright dots corresponding to Hemorrhage.	Mixed medium signal intensity with bright areas	Seen pushed and compressed downward
Anterior uterine wall myomas	3	Hypo intense, Intramural	Hypo intense with bright areas corresponding to degeneration	Displaced posteriorly
Posterior uterine myomas	4	2 patients were intramural, one of these intramural extending submucous showed mixed SI, and 2 patients subserous all displaying hypointense SI	Heterogenous SI (Hypointense mixed with bright areas)	-Displaced anteriorly -Thinned and displaced anteriorly -No significant displacement

Table IV: MR findings in adenomyosis.

Pathology	No. of cases	MR signal characteristics			Other associated findings
		T1-weighted image	T2-weighted image	Mean Junctional zone	
Focal uterine adenomyoma	2	Well defined intramyometrial lesion with bright signal	Hypointense centre with marginal high SI	Normal width 12mm	Left ovarian endometriotic cyst
Diffuse uterine adenomyosis	4	Hypointense	Hyperintense foci and strands in the myometrium	18 mm	--

Table V: MR intensity pattern of malignant uterine lesions.

Pathology	No.	MR signal characteristics		
		T1-weighted image	T2-weighted Image	Additional findings
Endometrial carcinoma	6	Hypointense	In homogenous hyperintense	Myometrial invasion was seen in three patients
Malignant endometrial polyp	1	Intermediate SI surrounded with linear bright signal intensity	Hypointense	Multiple metastatic lymph nodes
Leiomyosarcoma	2	Heterogenous signal intensity mixed low with height signal intensities	Heterogenous intensity low SI with bright and medium SI areas	Endometrial line can not be distincted in two cases
Cervical carcinoma	1	Intermediate SI	Intermediate SI	Infiltrating the pericervical fat planes and UB base

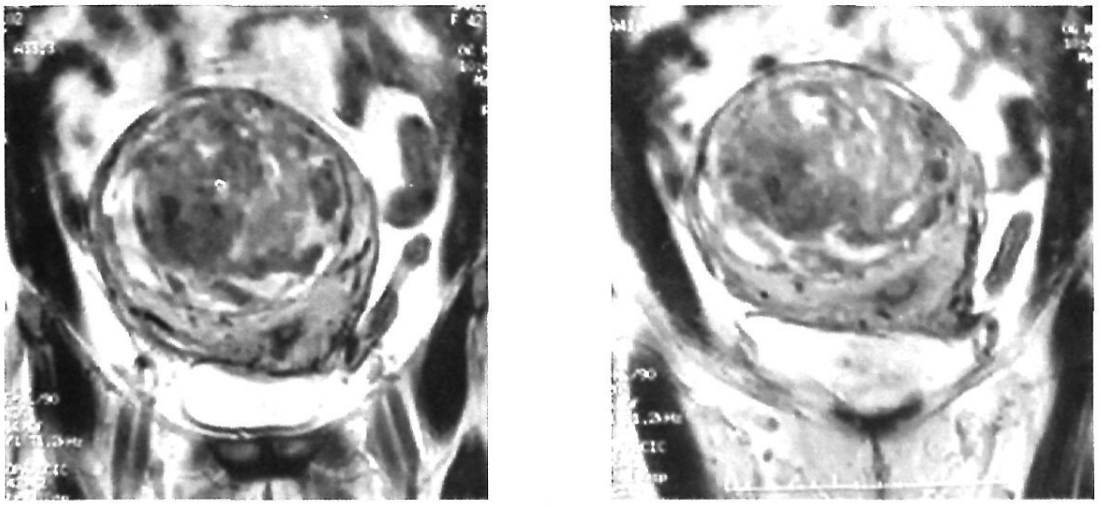

Figure 1. Coronal T2 weighted image showing posterior uterine wall myoma extending submucous, the endometrium lining is pushed to the right side.

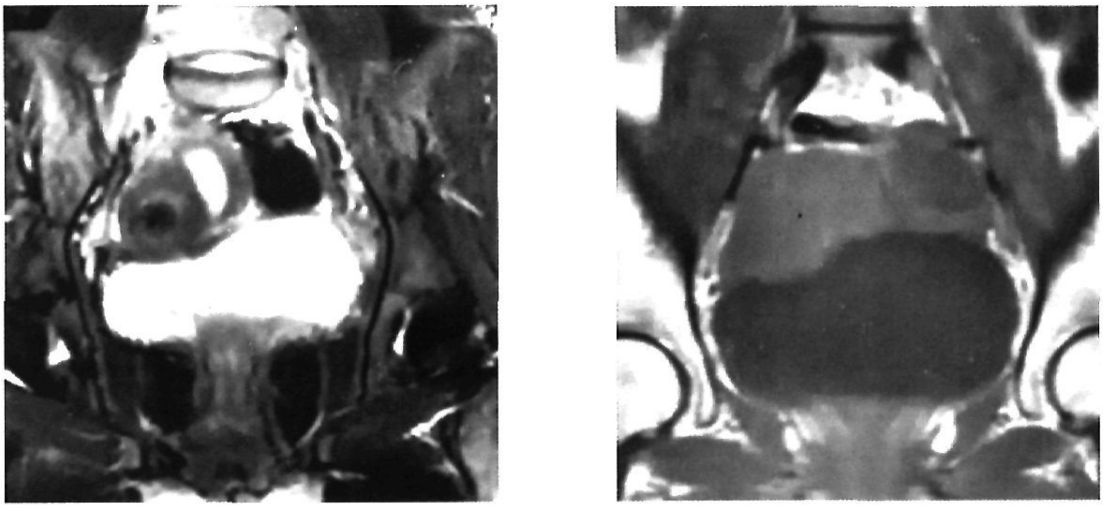

Figure 2. Coronal T2 weighted image showing focal adenomyosis and left ovarian endometrioma.

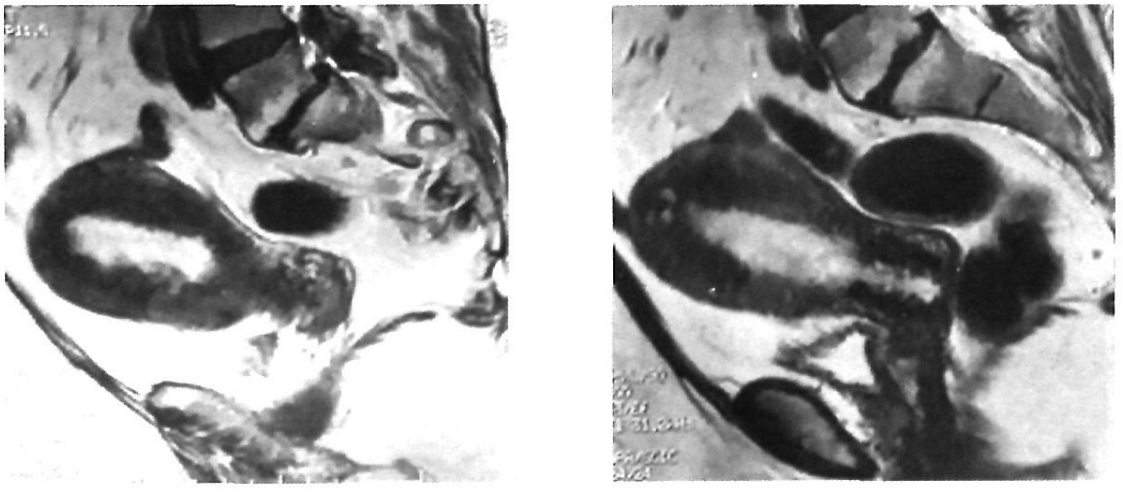

Figure 3. Invasive endometrial carcinoma extending to the cervix.

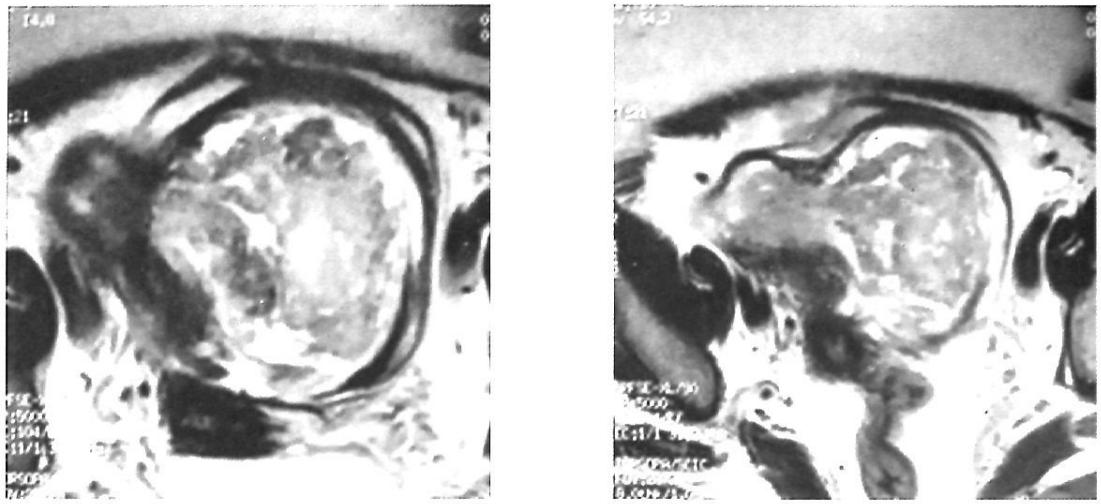

Figure 4. Uterine wall leiomyosarcoma

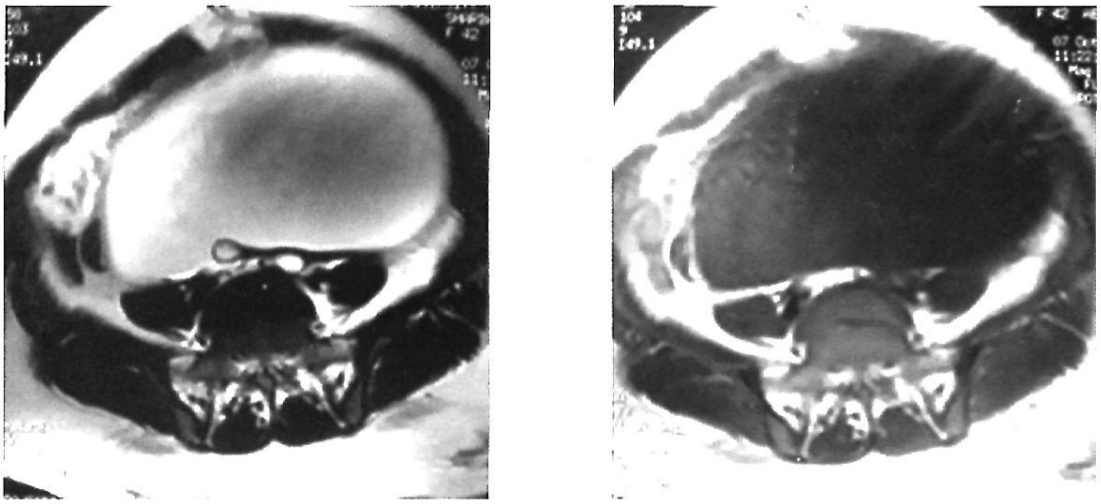

Figure 5. Ovarian serous cystadenoma

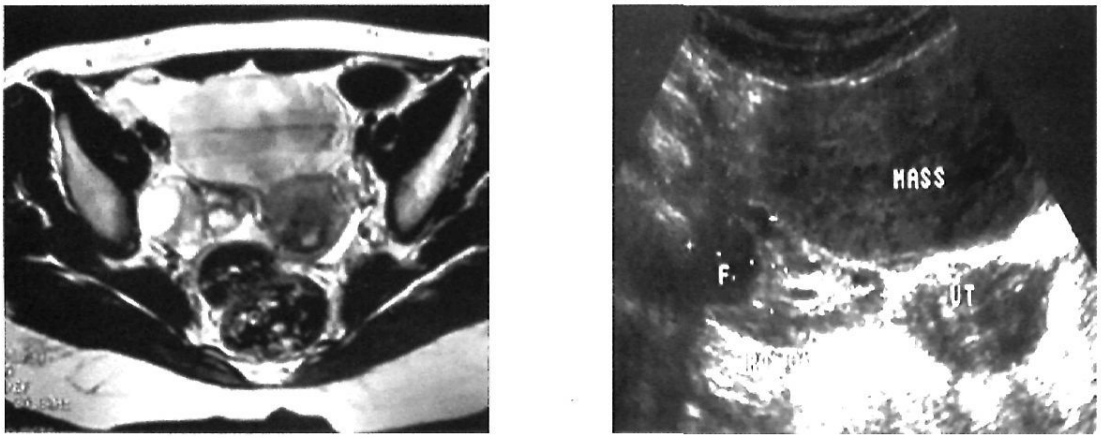

Figure 6. Ovarian torsion

reache up to 100% in benign uterine lesions, compared with pathological examination.

There is an agreement that MRI is an ideal non-invasive technique in the assessment of normal anatomy and tissue characterization of pelvic pathology. The excellent soft-tissue contrast and the ability to direct multiplanar imaging and to demonstrate blood vessels without the use of intravenous contrast make MRI superior to other imaging modalities in the evaluation of pelvic abnormalities. The anatomical relation of the visceral organs, the differential zonal anatomy of the corpus uteri and the cyclical endometrial changes during the menstrual cycle are well depicted with MRI[7].

Regarding the benign uterine lesions, we found 9 patients with leiomyoma and 6 patients with adenomyosis. All these cases were diagnosed by MRI, which is in agreement with Moghadam et al who found that MRI has a high specificity and more conclusive in diagnosing focal uterine adenomyoma thus differentiating between it and uterine myomas[9].

Diffuse adenomyosis is seen on T2 weighted sequences as diffuse or segmental thickening of the low signal intensity junctional zone to greater than 12 mm[10]. Punctate foci of increased signal within the affected junctional zone are characteristic and are thought to represent nests of endometrial glands and foci of hemorrhage. Occasionally focal adenomyosis is difficult to distinguish from a leiomyoma, because both lesions are of low signal intensity on T2 weighted sequences. However, focal adenomyosis is ovoid in shape rather than round, has indistinct margins without a pseudocapsule, and is frequently in continuation with the Junctional zone[11]

Levine reported that fibroids represent the most common uterine mass, and are present in up to 25% of women older than 35 years old. The diagnosis of a fibroid uterus is typically made by ultrasound. However, at times the uterus will be enlarged and focal fibroids will not be identifiable. Fibroids typically are round, well-defined, and of low signal intensity on T1- and T2- weighted imaging. Areas of increased signal intensity on either T1- or T2-weighted images in fibroids can be due to degeneration[12].

MRI sensitivity and specificity, respectively, are 96% and 100% for the diagnosis of subserosal leiomyomas [13]. These results concur with the results of the present study, as we succeeded in diagnosis of 9 cases of uterine myomas by MRI (100%), meanwhile US diagnosed only 8 cases (88.9%).

Compared with MRI, we found that there is a lack of specificity of US in daignosis of adenomyosis due to the similar appearance of adenomyosis and fibroids in ultrasound images. This finding is in agreement with that of other authors [14,15]. So, MRI is a quick and efficient way to further evaluate ultrasonographically indeterminate pelvic masses [16].

In the current investigation we found that endometrial carcinoma caused enlargement of the uterine lumen whereas leiomyosarcoma appeared as large intramural mass with indeterminate endometrial cavity. MR signal intensity of malignant uterine lesions in our study were low to intermediate signal intensity in T1 & intermediate to high signal intensity in T2, the same as reported by Siegel[17].

Endometrial carcinoma was diagnosed in 5 of our patients, 4 of them were confined to the uterine corpus and diagnosed with excellent tissue contrast by MR. Ultrasonography diagnosed myometrial invasion in 2 cases only (40%). MRI is significantly more valuable in the assessment of the size of the tumour, the depth of invasion, and the local-regional extent of the disease (direct invasion of the parametrium, pelvic side-wall, bladder, or rectum)[18].

Benign ovarian lesions were diagnosed in 12 patients in this study, which is consistent with Hany study[19].

The current study included 3 patients with simple ovarian cysts that had a uniformly thin wall surrounding a single cavity that contains clear fluid and no internal echoes and displayed low signal intensity in T1 & high signal intensity in T2; one patient presented with cystic lesion with thin wall but showed small strand like papillary projections that proved to be serous cystadenoma. A multilocular cyst with no solid parts and no hemorrhage proved to be mucinous cystadenoma; the same criteria as described by Lu et al[20]. These results are consistent with those of Loyer et al [21].

Endometriomas typically, exhibit high signal intensity on T1- weighted images and fat saturation images, the lack of reduction of signal intensity on fat saturation images is important in the distinction between endometriomas and dermoid cysts. A diagnosis of an endometrioma can be reliable if the lesion consists of multiple high-intensity cysts on fat saturation T1-weighted images. Another reliable sign of endometriotic cysts is a cyst that exhibits high signal intensity on a T1-weighted image and is of heterogeneous low intensity on a T2-weighted image. This pattern of signal intensity is called shading[22].

The studied endometriotic cysts in our study showed mixed signal intensity of the fluid content of the ovarian cysts, showed lo signal intensity mixed with intermediate signal intensity in T1, and showed bright signal intensity mixed with intermediate signal intensity in T2 weighted images, which is corresponding to blood content in different stages. These results differ from those of Togashi et al[22].

MRI evaluation of two patients with dermoid cysts in our study, displayed high signal intensity in T1 weighted image consistent with fat or fresh blood with basal area of signal void consistent with calcification; in T2 weighted images showed low signal intensity with fixed basal signal void, in fat suppression sequences the contents of the cyst appeared low signal intensity and this proved that it was fat content. Rha, et al proved that mature cystic teratoma is a commonly encountered ovarian tumour, constituting 20% of all ovarian tumorus in adults and 50% of all ovarian tumours in children. Mature cystic teratomas are composed of well-differentiated derivations of the three germ cell layers (ectoderm, mesoderm, and endoderm). In most cases, they are easily diagnosed on imaging studies because of their characteristic intramural fat component. Although typical imaging findings of mature cystic teratomas are well known to radiologists, various atypical imaging features can be particularly misleading. Atypical imaging manifestations of mature ovarian cystic teratomas depending on their tumour components and the presence of combined complications on CT and MRI. Rarely, mature cystic teratomas have a pure fat component on imaging without any other component. These tumours may mimic other uncommon lipid-containing pelvic tumours such as pedunculated lipomatous uterine tumour, benign pelvic lipoma, and liposarcoma[23].

Acute abdominal pain was the leading clinical presentation of ovarian torsion. Imaging findings vary according to the stage of torsion (eg, the extent of edema and ischemia). With hemorrhage and necrosis, torsion presents as a necrotic mass that lacks enhancement. At an early stage, a torsed ovary is swollen with multiple follicles separated by edematous stroma. In both stages, the common finding is the presence of a thick pedicle between the mass and the uterus[22]. Massive ovarian edema is likely to occurs with incomplete and intermittent torsion of the ovaries. MR imaging findings vary, probably reflecting different stages of this condition. Findings include masses that are not distinguishable from ovarian cancer and a prominently enlarged ovary embedded with multiple cysts[25].

The MRI findings of the case of ovarian torsion included in the current study showed swollen left ovary with multiple minute follicles arranged peripherally, the stroma of the ovary exhibited low signal intensity in T1, and high signal intensity in T2 weighted image denoting massive ovarian edema and this is consistent with early stage ovarian torsion as reported by Haque & Kramer[25].

The imaging findings of polycystic ovaries alone are not specific, but identification of multiple peripheral cysts beneath the capsule may help in the consideration of this condition. We found a great agreement regarding MRI appearance of the case of polycystic ovary in our study with that mentioned by Kimura [26].

We encountered adnexal extraovarian cysts in 2 of our studied cases. MR showed large unilocular cysts that displayed low signal intensity in T1 & high signal intensity in T2 with no solid parts of septations. These findigns agree wth those of Forstner and Kinkel [27].

Regarding ovarian masses, Hricak and Stevens stated that the primary advantage of MRI in evaluation of ovarian masses is the abiltiy to characterize tissues with MRI. The presence of fat, hemorrhage, mucin, fluid, and solid tissue within an ovarian mass can be determined by using MRI. The tissue characterizing ability with MRI is most useful in determining that a mass is definitely benign. to determine the potential of malignancy for epithelial tumours, assessing the internal architecture is useful. The presence of wall and septal thickness and irregularity, as well as enhancing nodules, suggests malignancy. Gadolinium enhancement is useful in this situation, for example, in differentiating solid papillary tissue (which can enhance) from clot or debris (which does not). Gadolinium enhancement is useful in evaluating the internal architecture of predominantly cystic lesions. In addition, if the mass is malignant, gadolinium enhancement may aid in depicting peritoneal implants[28].

The accuracy of gadolinium-enhanced MRI in the diagnosis of ovarian malignancy was 93%; the findings most predictive of malignancy are necrosis in a solid lesion and vegetations in a cystic lesion. In addition, ancillary findings on MRIs, such as ascites, peritoneal metastases, and hemorrhage, had a high predictive value for malignancy. The use of gadolinium-based contrast agents improves tissue characterization and increases the degree of confidence with MRI[29].

Nine patients with malignant ovarian masses were encountered in our study; 8 of them showed mixed cystic and solid components, and one patient showed a completely solid lesion. All lesions showed various degrees of enhancement of solid parts after contrast (gadolinium chelate) administration. Necrotic and degenerations were seen in the solid part of two patients, tow lesions showed thickened wall and septae. Ancillary finding was ascites in one case. These are suggestive of malignancy and are consistent with the findings of Hricak and Stevens study[28].

Togashi stated that serous and mucinous tumours are the most common surface epithelial tumours. They can vary from entirely cystic to entirely solid, but benign diagnosis should be applied only for lesions that do not have solid tissue on imaging findings; the serous cystadenoma is usually unilocular and contains fluid similar to that of simple fluid. The mucinous cystadenoma is typically multiloculated and shows a stained-glass appearance (with compartments of varying signal intensity) or daughter cysts. Thick , mucinous content that occasionally exhibits low intensity on T2- weighted images is also common in mucinous tumours. There is a close agreement between the present study and that of Togashi [22].

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