ORIGINAL RESEARCH ARTICLE

Magnetic Resonance Evaluation & Characterization of Gynaecological Pathologies with their Ultrasound Correlation

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ABSTRACT

Introduction: The most common presenting complaints in females of reproductive age group are gynaecological. Imaging modalities such as ultrasound (USG), computed tomography (CT), magnetic resonance imaging (MRI) has been indispensable in the diagnosis and management of these pathologies, among which the most frequent in use are ultrasonography and magnetic resonance imaging. There are some inherent advantages and disadvantages associated with each modality which have an impact on the diagnostic accuracy of pelvic pathologies. Our primary aim was to determine the efficacy of MRI in the diagnosis of gynaecological pathologies as compared to ultrasound.

Material and methods: This was a prospective study carried out in 84 female patients who had an MRI study for various gynaecological complaints. Ultrasound examination was performed in those patients with positive findings and final histopathological correlation was done whenever possible.

Result: The sensitivity of ultrasound was 78.31% for accurate identification of female pelvic pathologies, whereas it was 98.8% for MRI.

Conclusion: Ultrasound still remains the screening modality of choice for diagnosis of gynaecological pathologies, however, MRI with its high sensitivity has a definite role in the diagnosis in case of equivocal ultrasound findings and when ultrasound findings do not correlate clinically.

Keywords: Female Pelvic Pathologies, Gynaecological Disease, Ultrasound, Magnetic Resonance Imaging (MRI).

INTRODUCTION

Imaging plays a crucial role in the diagnosis and management of gynaecological diseases. Modalities that are primarily used in the assessment of female pelvis include Ultrasonography (USG), Magnetic Resonance Imaging (MRI) and Computed Tomography (CT).[1]

Ultrasound has been the first line investigation of choice in the diagnosis of most gynaecological pathologies. The advantages are prompt availability, reduced cost, safety and simplicity of examination. It can also be used as a screening modality for detecting pelvic malignant lesions. However, it has limitations such as limited field of view, observer dependence, unsatisfactory evaluation in obese patients, etc.[2,3]

MR imaging with its high resolution and multi planar imaging has the capability of characterizing multiple lesions and is becoming the modality of choice to assess gynaecological pathologies.[4] MR imaging demonstrates anatomy and pathology of female pelvis in great detail. And so, it is an important tool in detection and accurate staging of gynaecological malignancies and decision making.

CT or MRI or combination of either with USG yield higher accuracy in the final diagnosis than USG alone.[5] However, ultrasound is still a satisfactory screening imaging technique in female gynaecological pathologies.[6,7]

The major advantage of MRI was in its ability to determine accurately the site of origin of a mass. It was also able to identify benign lesions. e.g. dermoid cyst, endometriomas, haemorrhagic cysts with high accuracy.[8,9] It also has a role in the staging of gynaecological malignancies, evaluation of suspected Mullerian duct anomalies and pre-surgical workup for uterine prolapse. This study was conducted to assess the accuracy of MRI in comparison to ultrasound in the evaluation of female pelvic pathologies.

MATERIAL AND METHODS

A prospective study was done on 84 female patients who were referred to radiology department with suspected pelvic pathologies. The study was conducted from period of June 2018 to December 2019 in Department of Radiology, AMCMET Medical College and LG Hospital, Maninagar, Ahmedabad. All patients were subjected to USG and MRI examination. Final correlation with histopathology was done in available subjects.

USG was performed using GE P5 USG machine.

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Transabdominal USG was done using a convex probe (3.5-5 MHz) and transvaginal USG was done using a linear probe (7 MHz). On USG, size and shape of uterus, endometrial thickness, uterine and cervical lesions if present were evaluated and characterized. The ovaries and adnexa were also studied in detail.

MRI was performed using 1.5 Tesla Siemens MagnetomeEssenza machine. Sequences obtained were T1WI, T2WI & T2WI fat sat and STIR in axial, coronal and sagittal plane. Contrast and other special sequences like gradient echo, diffusion imaging were used as and when required.

Inclusion Criteria

Women of reproductive age group with pelvic pathologies and giving consent for the study

Exclusion Criteria

- All patients who had normal imaging outcome
- Metallic implants of less than 6 months duration and patients with cardiac pacemakers
- Claustrophobic patients.

Limitation

- Majority of benign lesions could not be followed by histopathology.
- Lack of transvaginal sonography study in unmarried women and in cases of carcinoma cervix.

RESULTS

Among the 84 pathological cases detected on MRI, ultrasound was able to identify pathology in 83 cases. MRI failed to correctly identify pathology in one case with imaging diagnosis of ruptured fibroid, which on surgery turned out to be sigmoid perforation.

Ultrasonography of pelvis was able to accurately identify lesions with 78.31% sensitivity. While MRI correctly identified pelvic pathologies with 98.8% sensitivity. MRI was able to further characterize 22.08% of the lesions identified by ultrasound.

The mean age of presentation was 35 years. The most common presenting complaint was lower abdominal pain followed by complaint of menorrhagia.

The most common gynaecological pathology in the females leading to MR imaging evaluation was fibroid (19.28%) followed by haemorrhagic cysts (12.05%) and simple cysts (7.23%) Other pathologies that warranted the investigation include dermoid cyst, hydrosalpinx and pyosalpinx, adenomyosis, cervical carcinoma, ovarian carcinoma and congenital anomalies.

While ultrasound was able to detect majority of fibroids (87.5%) with accuracy, it had a limitation in detecting smaller pathologies. Smaller lesions measuring < 1cm were missed in two cases which were appreciated on MRI.

Next common pathology was haemorrhagic cysts. 40% lesions were missed on ultrasound, which MR imaging was able to characterize.

3 cases of adenomyosis were detected on MRI, among which ultrasound failed to identify the pathology in 1 case (33.33%). USG and MRI were equally effective in identifying cervical mass lesions, dermoid cysts, simple ovarian cysts, serous cystadenoma, endometriomas, hydrosalpinx and arteriovenous malformations.

Out of 2 cases of ovarian torsions, ultrasound failed to accurately depict torsion in 1 case (50%), which was detected on MRI. (Table 3)

Sr No.	MRI Findings	USG	MRI
1	Fibroid	14	16
2	Arteriovenous malformation	2	2
3	Bicornuate uterus	2	2
4	Adenomyosis	2	3
5	Endometrial Mass	2	4
6	Placenta Previa with foetal intraventricular haemorrhage	1	1
7	Cervical Mass	3	3
8	Hypoplastic uterus and absent ovaries	2	3
9	Absent uterus	1	1
10	Uterine collection	1	1
		30	36

Table-1: USG and MRI detection of uterine pathologies

Sr No.	MRI Findings	USG	MRI
1	Para ovarian cyst	0	2
2	Broad ligament fibroid	0	2
3	Pyosalpinx	0	1
4	Hydrosalpinx	4	4
5	Scar endometriosis	3	3
		7	12

Table-2: USG and MRI detection of adnexal and other pathologies

Sr No.	MRI Findings	USG	MRI
1	Dermoid cyst	7	7
2	Simple ovarian cysts	6	6
3	Haemorrhagic cyst	6	10
4	Ovarian Mass	4	6
5	Ovarian Torsion	1	2
6	Serous cystadenoma	3	3
7	Endometrioma	1	1
		28	35

Table-3: USG and MRI detection of ovarian pathologies

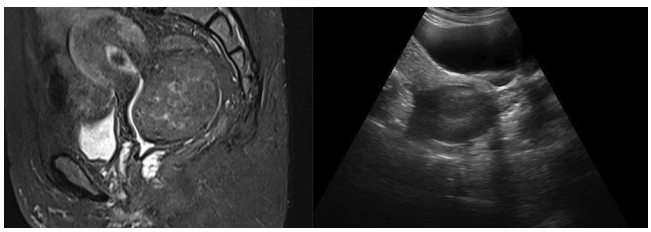

Figure-1(A): FLAIR MRI sequence in a case of fibroid shows a predominantly hypointense mass arising from posterior wall of cervix and lower uterine cavity. **Figure 1(B):** Corresponding ultrasound image revealed a well-defined hypoechoic mass in posterior wall of lower uterine segment.

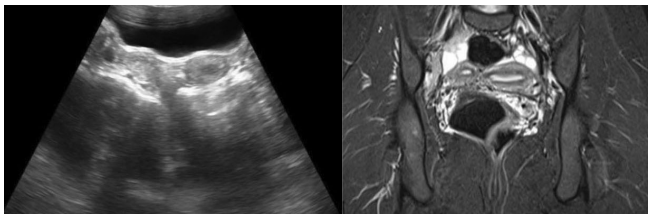

Figure-2(A): Axial ultrasound image demonstrates two separate endometrial cavities in a case of bicornuate bicollis uterus. **Figure 2(B):** Coronal FLAIR MRI reveals the two cavities in more elaborate detail.

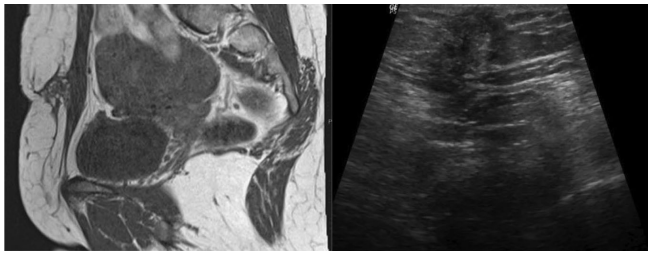

Figure-3(A): T1W MRI reveals a subcutaneous hypointense lesion with mixed intensity on T2WI and FLAIR (not shown) in a case of scar endometriosis with a prior history of LSCS. **Figure 3(B):** Corresponding ultrasound image shows ill-defined subcutaneous lesion of mixed echogenicity.

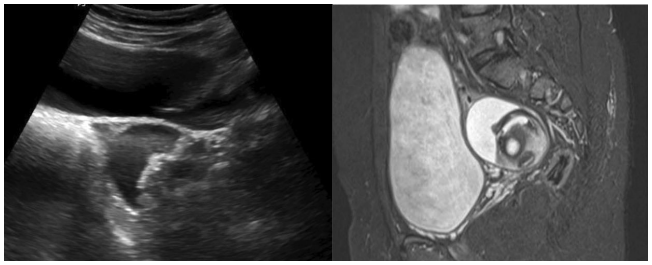

Figure-4(A): Ultrasound shows a cystic lesion with internal solid component with post acoustic shadowing suggesting possibility of a dermoid cyst. **Figure 4(B):** FLAIR MRI revealed fat, fluid and solid foci within the lesion and confirmed the diagnosis.

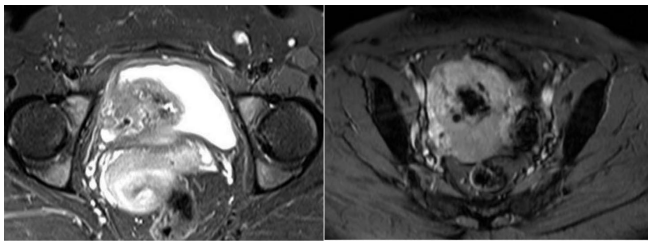

Figure-5(A) and (B): T1W fat suppressed image and T2W images revealed serpentine parametrial lesion extending into myometrium with flow voids in a case of arteriovenous malformation.

DISCUSSION

Leiomyomas are the most common uterine tumours. These benign tumours are found in up to 40% of women in their reproductive years. They are usually multiple and may be subserosal, intramural or submucosal in location.

The most common appearance on ultrasound is that of a well-marginated, hypoechoic rounded or oval mass within the uterine body. Calcification when present appears as shadowing echogenic foci.[10] On T1-weighted images, leiomyomas most commonly present as well circumscribed round lesions with intermediate signal intensity often indistinguishable from adjacent myometrium. Optimum contrast is achieved on T2 weighted images where the tumour is of low intensity relative to the myometrium or endometrium. The presence of calcification usually results in areas of signal void on both Tl and T2 weighted images.Fat saturation Tl-weighted images may be helpful in cases of haemorrhagic degeneration.[11]

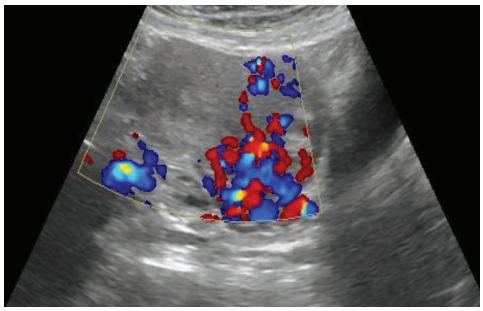

Figure-5(C): Colour doppler ultrasound images revealed tubular anechoic lesions with markedly raised vascularity with turbulent flow.

Changes of adenomyosis appear on USG as enlargement of the uterus, myometrial cyst, distorted and heterogenous echotexture and globular or asymmetric uterus. On MRI, it is defined by 1) A large asymmetric uterus 2) Endometrial-myometrial junctional zone thickness of 12mm or more 3) punctate high signal myometrial foci on T2WI.[12]

Follicular and corpus luteal cysts appear as well-defined anechoic cystic lesions without internal septations, calcification or solid components. On MRI they show characteristic low signal on T1W MRI and high signal on T2W MRI.[10,11]

Haemorrhagic ovarian cyst has a spectrum of sonographic appearance and can mimic a solid ovarian mass such as teratoma. However, in most cases of haemorrhagic ovarian cysts, the degree of through transmission is greater than in truly solid masses and the cyst regresses in size over a 2-3 weeks period.[10]

Haemorrhagic cyst is intermediate to high signal intensity on T1-weighted images and low signal intensity on T2-weighted images. The cyst wall is thin and smooth and demonstrates intense enhancement after gadolinium administration.[11]

Serous cystadenoma is benign epithelial tumour arising from the surface epithelium of the ovary and constitutes about 22% of benign ovarian neoplasms measuring between 5 and 10 cm in size. On ultrasound it is usually seen as a smooth, unilocular or multilocular cyst filled with serous fluid and may contain thin septations.

MRI shows multiseptated cystic lesion in the adnexa. T2-weighted images reveal hyperintense fluid with multiple hypointense thin septae. T1-weighted images show hypointense signals and post-contrast MRI confirms thin septae.[13]

Dermoid cyst is a mature benign form of teratoma and occurs in women in their reproductive years. It is a common cause of adnexal mass accounting for approximately 20% of all ovarian neoplasms.

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The classic Ultrasound appearance is a complex cystic mass with solid mural component called "dermoid plug". The dermoid plug usually contains hair, teeth or fat and is usually echogenic and frequently casts an acoustic shadow. A fat fluid or hair fluid level may be seen and is considered specific.[10,11]

On MRI, signal intensity of the fat component of mass (or part of it) is sointense to subcutaneous fat on both T1 and T2 weighted images. On fat saturation sequence, suppression of signal that was of high signal intensity on T1-weighted sequence, confirms the presence of fat within the mass.[11]

Ovarian torsion is an acute condition requiring prompt surgical intervention caused by partial or complete rotation of the ovarian pedicle on its long axis. It is most commonly associated with an adnexal mass, usually a dermoid cyst, but may also occur spontaneously.

On ultrasound, the salient finding is unilateral ovarian enlargement which is oedematous with multiple small cystic structures at the periphery, which is due to transudation of fluid into the follicles from circulatory impairment. Small amounts of fluid may be seen in the cul-de-sac secondary to obstructed veins and lymphatic. Colour Doppler may facilitate specific diagnosis by demonstrating lack or severe restriction of arterial flow. The arterial waveform may exhibit a lack of diastolic flow with a "spike" configuration of the systolic peak.

The MR imaging appearance of ovarian torsion depends on the severity and chronicity of vascular compromise. If a twisted ovary remains untreated, it can progress to haemorrhagic infarction. On MRI, imaging appearance of an ovary with haemorrhagic infarction is that of an enlarged ovary with displaced follicles and low signal intensity on T2-weighted images due to interstitial haemorrhage. A thin rim of high signal intensity on T1-weighted images that demonstrates no enhancement after administration of contrast material may also be seen.[14]

Endometriosis is the presence of endometrial epithelium and stroma outside of endometrium and myometrium.

On ultrasound, endometriomas appear as cystic masses with diffuse low-level echoes. They appear hyperintense on T1-weighted images and heterogeneously hyperintense on T2-weighted images. The use of fat suppression increases the conspicuity of endometriosis.[10,11]

Endometrial cancer is the fourth most common cancer in females and the most common malignancy of the female reproductive system.The most common sonographic appearance of endometrial cancer is nonspecific thickening of the endometrium. In postmenopausal women, the threshold value for serious endometrial abnormalities is 5 mm. For evaluation of myometrial invasion, the presence and continuity of the hypoechoic halo that surrounds the outer layer of the endometrium is assessed (i.e. intact, focally disrupted, or totally disrupted).

On unenhanced T1-weighted images tumours are usually isointense with the normal endometrium. Although high signal intensity maybe demonstrated on T2-weighted sequences by endometrial carcinoma, more commonly it is heterogeneous and may even be of low signal intensity. Following administration of IV contrast, endometrial carcinoma enhances slower than the adjacent myometrium which allows identification of even small tumours, even those contained by the endometrium.[15]

Cervical cancer is the third most common malignancy involving female reproductive tract. Abnormal uterine bleeding (especially after intercourse) and vaginal discharge may be symptoms leading to the diagnosis. On ultrasound, the cervix appears as an enlarged, irregular, hypoechoic mass that may mimic a cervical myoma.

MRI can accurately determine tumour location (exophytic or endocervical), tumour size, depth of stromal invasion and extension into the lower uterine segment. On T1-weighted images tumours are usually isointense with the normal cervix and may not be visible. On T2-weighted images, cervical cancer appears as a relatively hyperintense mass and is easily distinguishable from low signal intensity cervical stroma.[15]

Approximately 90% of ovarian carcinomas are of epithelial origin. Epithelial tumours are subtyped as serous (50%), mucinous (20%), endometroid (20%) clear cell (10%), or undifferentiated(1%). Ultrasound reveals large complex mixed echogenic solid cystic lesion with or without thick septa and irregularly thick walls.

Primary MRI criteria for malignancy includes 1) Size larger than 4 cm, 2)Cystic lesion with a solid component, 3) Irregular wall thickness greater than 3 mm, 4) Septa greater than 3 mm and / or the presence of vegetations or nodularity, 5) A solid mass with the presence of necrosis. Ancillary criteria for malignancy include 1) Involvement of pelvic organs or sidewall, 2) Peritoneal, mesenteric or omental disease, 3) Ascites or 4) Adenopathy. Utilizing unenhanced T1, T2 and contrast enhanced Tl- weighted sequences, the presence of at least one of the primary criteria coupled with a single criterion from the ancillary group correctly characterizes 95% of malignant lesions.[16]

Ramachandran et al, in his study stated that 51.1% of the cases (23 out of 45) had more significant imaging findings with better image characterization on MRI as compared to ultrasound.[17] In our case, in 32.53% cases (27 out of 83), MRI study helped in accurate detection of the lesions and further characterization of lesions correctly identified by ultrasound such as site of origin, degenerative changes in a fibroid, extent of malignant mass, presence of haemorrhage within cysts, fat components within cysts etc.

In equivocal cases, MRI can better delineate the site of origin of the lesions. In 5 cases, what appeared to be mass lesions of adnexal origin on ultrasound, turned out to be large uterine fibroids in 4 cases and a broad ligament fibroid in 1 case on MRI study.

Ultrasound has the advantage of:[18,19,20]

- Does not utilize ionising radiation, allowing application in pregnant women.
- Quicker, takes less time.
- Less expensive.
- No known adverse effects.
- Dynamic

However, it has its own limitations. Limited field of view, obesity, bowel gas, requirement of full bladder are few of the factors that may hamper the diagnosis. It was less reliable in the staging of pelvic mass lesions. MRI with a sensitivity of 98.8% was a superior modality and it can overcome the

difficulties faced by ultrasound and can help in accurate diagnosis with detailed characterization of the lesions. In the staging of mass lesions, it remains the investigation of choice.

CONCLUSION

Although ultrasound still remains the screening modality of choice in suspected pathologies of the female pelvis, MRI should be considered in equivocal cases for better delineation and characterization of the lesions. It is far superior in the accurate staging of pelvic mass lesions and detection of residual tumour or recurrence in post-operative cases.

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