

Role of Abdominal Ultrasonography as a Preliminary Imaging Technique in the Assessment of Female Pelvic Pathologies

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A B S T R A C T

Introduction: The essentiality of ultrasound as a screening technique in detecting pelvic pathologies has been decreasing, since the advent of advanced imaging modalities like Magnetic Resonance Imaging (MRI) and Computed Tomography (CT). Often, the physicians resort to prescribing MRI or CT study as the initial imaging investigation, which in fact should be the final decisive imaging modality. This original research article proves the point that ultrasound still has its own significance in the modern imaging era.

Material and methods: This was a retrospective study and was based on the usage of radiation-free modalities like ultrasound and MRI. Fifty women were scanned by using both trans-abdominal USG and MRI abdomen with pelvis. They presented with complaints of abdominal pain of varying degrees. Age range was 15-64 years of age [mean age= 33.4 years].

Results: Pelvic ultrasound and MRI of 50 patients were analyzed. The MRI study picked up pathologies in 5 patients who were reported to be normal with ultrasonography. Of 45 patients picked up by ultrasound, MRI study of the lesions in the 23 patients helped in the detailed characterization of the lesions. In the remaining 22 patients, the MRI results were in concordance with those of USG.

Conclusion: Magnetic Resonance Imaging plays a pivotal role in characterizing female pelvic pathologies and therefore can be used as a problem-solving tool in patients when the ultrasound is inconclusive or suboptimal. However, the superior imaging potential of MRI should not preclude the use of ultrasound as a screening tool.

Key words: Abdominal Ultrasonography, Preliminary Imaging Technique, Female Pelvic Pathologies, MRI Pelvis, USG Pelvis

INTRODUCTION

Imaging plays an important role in the management of gynecological diseases. There are three prime imaging modalities used in the assessment of female pelvis, namely Ultrasonography (USG), Magnetic Resonance Imaging (MRI) and Computed Tomography (CT).¹

- Ultrasound is the primary modality of choice in diagnosing pathologies involving female pelvis.
- Computed Tomography reveals good bony details of the female pelvis.
- Magnetic Resonance Imaging yields good soft tissue details thereby better diagnosis.

Ultrasound can be used as a screening modality for detecting pelvic malignancies. However it is inadequate in staging. CT and MR imaging are useful non-invasive tools for demonstrating anatomy and pathology of female pelvis. MRI is an important tool in detection and accurate staging in cases of cervical, endometrial and ovarian malignancies and plan the management accordingly.²

However, investigating the patient with advanced modalities like CT or MRI before a prior ultrasound examination is not recommended because of the premature decision to expose the patient to radiation (in the case of CT) or the costlier investigation (MRI). It is a well-known fact that CT or MRI or combined use of USG with either of the modalities yield higher accuracy in the final diagnosis.³ However, it should be borne in mind that ultrasound is still a sound enough preliminary imaging modality in detecting abdominal pathologies, especially female pelvic pathologies.^{4,5,6,7}

Ultrasound being an initial investigating modality, in general confers the following advantages.^{8,9,10:}

- The patient is never exposed to radiation during an ultrasound, allowing pregnant women to use this imaging technique.
- Most ultrasound exams are quicker.
- Less expensive.
- No known harmful effects to humans.
- If medically indicated it can be repeated again.

- Dynamic testing

The major contribution of MRI in evaluating pelvic pathologies lies in its ability to determine whether a mass is truly ovarian in origin and to accurately identify certain benign entities e.g. dermoid cyst, endometriomas, hemorrhagic cysts and fibromas. It precisely defines the internal architecture of ovarian masses.^{11,12}

Miscellaneous pelvic pathologies like teratoma, broad ligament fibroid, adenomyosis can be optimally diagnosed by MRI.

MRI has an established role in the pre and post-procedural assessment for uterine artery embolization¹³, diagnosis of adenomyosis, staging of known endometrial and cervical carcinoma, evaluation of suspected Mullerian ductal anomalies¹⁴ and pre-surgical workup for uterine prolapse.¹⁵ Study aimed to assess the role of Ultrasound as an initial imaging technology in the assessment of pelvic pathologies with the objectives to perform ultrasound pelvis and MRI pelvis in women and to analyze and assess the significance of ultrasound and MRI in the evaluation of female pelvic pathologies.

MATERIAL AND METHODS

This was a retrospective study conducted in the department of radiology, Sri Ramachandra Medical College and Research Centre. The study was based on the usage of radiation-free modalities like ultrasound and MRI; hence no risks were posed to the patients in terms of radiation hazards. The following imaging models were used: Ultrasound- GE

LOGIQ P9, Magnetic resonance imaging- GE Signa HD XT 1.5 Tesla and Siemens Magnetom Avanto 1.5 Tesla.

Subjects

Fifty women were scanned by using both trans-abdominal USG and MRI abdomen with pelvis. They presented with complaints of abdominal pain of varying degrees. Age range was 15-64 years of age [mean age= 33.4 years].

US and MR imaging protocols

Curvilinear probe (wide-band convex array) of 5.5 MHz frequency was used. MR imaging was performed with a 1.5-T MR imaging unit (Magnetom Avanto; GE Signa) using a 12-phased-array body coil. Patients were positioned in the supine position with arms raised above. Centering was placed on iliac crest. Contrast-enhanced MRI was done in patients who posed diagnostic dilemma with plain MR.

Inclusion criteria

Women of all age group

Exclusion criteria

- First trimester pregnancy
- Claustrophobic patients
- Metallic implants of less than 6 months duration

RESULTS

The results of the study are illustrated in tables 1 and 2. Pelvic ultrasound and MRI of 50 patients were analyzed. Of these 50 patients with pelvic pathologies, the ultrasound study picked up pathologies in 45 patients. The MRI study picked

S. No	Ultrasound findings	MRI findings	Correlation
01	Uterine wall fibroid	Intramural fibroid in uterus	Positive
02	Normal	Vaginal mass lesion	Negative
03	Heterogeneous endometrium	Malignant mass lesion in endometrium	Positive
04	Right adnexal cystic lesion	Right adnexal cystic lesion	Positive
05	Bulky ovary	Ovarian torsion	Positive
06	Bulky uterus with heterogeneous lesion	Malignant neoplasm in uterus	Positive
07	Bulky uterus with heterogeneous hyper echoic	Multiple uterine fibroids	Positive
08	Uterine fibroids	Uterine fibroids	Positive
09	Heterogeneous cervix	Carcinoma of cervix	Positive
10	Heterogeneous lesion in myometrium	Heterogeneous lesion in myometrium	Positive
11	Bulky cervix	Cervix mass	Positive
12	Complex adnexal cyst	Complex adnexal cyst	Positive
13	Ovarian cyst	Ovarian cyst with hemorrhage	Positive
14	Multiple uterine fibroids	Multiple uterine fibroids	Positive
15	Hypo echoic lesion adjacent to vaginal vault	Lesion in vaginal vault	Positive
16	Thickened endometrium	Carcinoma of endometrium	Positive
17	Enlarged ovary	Enlarged ovary	Positive
18	Thickened inhomogeneous endometrium	Malignant lesion invading myometrium	Positive
19	Enlarged ovary	Enlarged ovary	Positive
20	Uterine fibroids	Uterine fibroids	Positive
21	Heterogeneous lesion and enlarged uterus	Adenomyosis of uterus	Positive
22	Adnexal cyst	Adnexal cyst	Positive
23	Adenomyosis	Adenomyosis of uterus	Positive
24	Bulky uterus with intramural fibroids	Bulky uterus with intramural fibroids	Positive
25	Adnexal cyst	Adnexal cyst	Positive

Table-1: Ultrasound and MRI findings of patients 1-25.

S. No	Ultrasound findings	MRI findings	Correlation
26	Normal	Cervicitis	Negative
27	Bilateral ovarian cyst	Bilateral ovarian cyst	Positive
28	A heterogeneous area noted in the region of the cervix	Bulky cervix shows diffuse heterogeneous hypo intense infiltrating lesion	Positive
29	Normal	Bulky uterus with intramural fibroids endometriosis in Adnexa	Negative
30	Adnexal cyst	Para ovarian cyst causing ovarian torsion	Positive
31	Posterior wall uterine fibroids	Multiple uterine fibroids	Positive
32	Free fluid in the pelvis	Carcinoma of the vaginal wall	Negative
33	Para ovarian cyst	Para ovarian cyst	Positive
34	Ovarian cyst	Ovarian cyst	Positive
35	Para ovarian cyst with few internal septation	Polycystic ovaries with a benign appearing cyst in ovary	Positive
36	Normal	Right labia appears enlarged	Negative
37	Bilateral enlarged ovaries with large multiloculated cystic lesion	Bilateral enlarged ovaries with large multiloculated cystic lesion	Positive
38	Endometrium appears heterogeneous in echotexture	Carcinoma of Endometrium	Positive
39	Normal	Mass lesion in the vaginal cavity	Negative
40	Uterine fibroids	Malignant mass lesion in uterus	Positive
41	The vaginal appears distended with Fluid levels	Hematocolpos	Positive
42	Heterogeneous mass lesion with minimal vascularity in the pelvis	A large subserosal fibroids arising from the lateral wall of the uterus	Positive
43	Uterine Fibroids	Uterine fibroids	Positive
44	Heterogeneous mass lesion noted in the pelvis	Subserosal uterine fibroids Tubular linear cystic area in the pelvis	Positive
45	Heterogeneous mass in the cervix with minimal vascularity	A heterogeneous soft tissues mass lesion seen in cervix	Positive
46	Bulky uterus with an anterior myometrial fibroids	Large intramural fibroids	Positive
47	Cervix appears mildly bulky	Hyper intense mass in cervix	Positive
48	Thickened endometrial walls with fluid	Malignant neoplasm involving uterus	Positive
49	Enlarged ovaries	Bilateral malignant ovarian masses	Positive
50	Loculated collection with solid components in Endometrium	Bulky cervix and shows presence of a ulceroproliferative growth	Positive

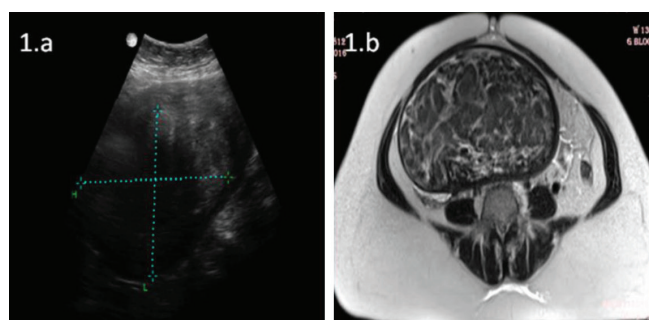


Figure-1a-b: Ultrasound pelvis of a 33-year-old female shows a large posterior uterine wall fibroid (a). Figure 1.b. MRI pelvis of a 33-year-old female shows a large intramural fibroid in the uterine fundus, causing retroflexed appearance of uterus(b).

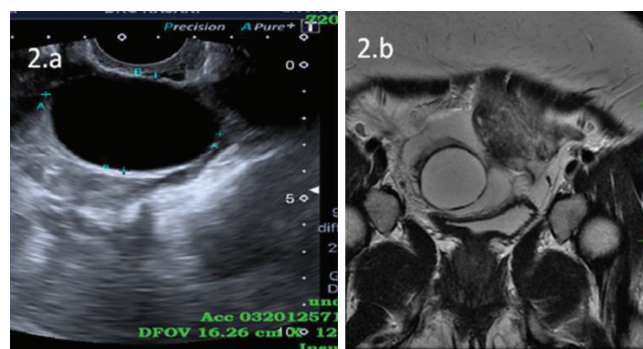


Figure-2a-b: Ultrasound pelvis of a 32-year-old female shows a large para ovarian cyst (a). MRI pelvis of a 32-year-old female shows a large para ovarian cyst with hemorrhage seen within and around the cyst (b).

up pathologies in remaining 5 patients who were reported to be normal with ultrasonography. Of these 45 patients picked up by ultrasound, MRI study of the lesions in the 23 patients helped in the detailed characterization of the lesions (for e.g. presence or absence of hemorrhagic component in a cyst, local infiltration of malignant mass, etc.).

From the collected data, it could be inferred that

ultrasonography of pelvis by itself, successfully picked up 90% of the lesions (45/50 * 100 = 90%), which MRI did. A modality with 90% accuracy is considered one deemed worthy of the title “screening modality”.

Figure 1 shows abdominal USG and MRI images of a 33-year-old woman with complaints of menorrhagia and abdominal pain for the past 3 months. Clinically she had a

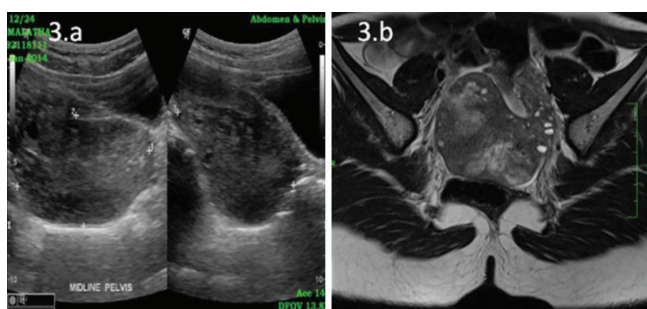


Figure-3a-b: Ultrasound pelvis of a 17-year-old female shows a large well-defined heterogeneous lesion seen in the midline with communication with the left ovary (a). MRI pelvis of a 17-year-old female shows an enlarged left ovary which shows peripherally placed follicles with hematoma in the center (b).

palpable abdominal mass. Ultrasonography revealed a large posterior wall fibroid. On further characterization with MRI, a large intramural fibroid was noted in the uterine fundus, causing a retroflexed appearance of uterus.

Figure 2 shows abdominal USG and MRI images of a 32-year-old mother (post-partum 3 months) presenting with complaints of lower abdominal pain. Per abdomen clinical examination revealed no significant abnormality. On ultrasonographic imaging, a large para-ovarian cyst was noted on the right side. Proceeding with MRI, the cyst showed hemorrhagic components within and around the cyst, providing a refined diagnosis of ruptured hemorrhagic cyst.

Figure 3 shows abdominal USG and MRI images of a 17-year-old girl with presenting complaints of secondary amenorrhea for 4 months. Clinical examination was normal. In USG, she was diagnosed to have a large well-defined heterogeneous lesion in the midline with communication with the left ovary. Her MRI pelvis revealed an enlarged left ovary which shows peripherally placed follicles with hematoma in the center, indicating left ovarian hemorrhagic cyst.

DISCUSSION

This retrospective study done on 50 patients showed that both Ultrasound and MRI are instrumental in female pelvic imaging. It was observed that the findings on MRI and ultrasound correlated in 45 patients. Various confounding factors such as partially distended urinary bladder (causing the formation of poor sonographic window), high BMI and excess bowel gas formation also lead to the minimal inaccuracy in the ultrasound study, indeed. The accuracy of this study could be improved by repeating the study on a mass scale, with well prepared bowel and adequately distended urinary bladder.

In the 23 of the 45 patients (51.1%), ultrasound and MRI had variable findings with more significant imaging findings on MRI with better image characterization, whereas in the remaining cases (48.9%), MRI findings concurred exactly with those of the ultrasound. This has also been the case for many previous studies as quoted below.

Mitchell et al¹⁶, in his study has stated that in 83.3% of the cases (25 out of 30 cases) MR imaging yielded additional

information such as demonstration of hemorrhage, fluid-fluid level in the cysts, etc. Despite 85.7% of the teratoma (6 out of 7 cases) were diagnosed accurately just with US, the detection of fat in MR reinforced the diagnosis.

Zawin et al¹⁷, in his study has stated that limited field of view was the single most major disadvantage of USG when compared to MRI. Also, US could not detect any of the 14 cases of submucosal leiomyoma. In his study, the minimum size of leiomyoma detected was comparable with both USG and MRI.

It is indeed evident that MRI evaluated pelvic pathologies better due to its supreme ability in soft tissue characterization. It could precisely determine if a mass is truly ovarian in origin and sets apart the benign entities like hemorrhagic cysts from the malignant ones. MRI is a better tool for accurately staging and it can also aid in differentiating recurrence / residual mass in post-operative scanning. MRI throws an added advantage in pelvis imaging due to its lack of ionizing radiation, high contrast resolution, capability of viewing the entire pelvis, multiplanar imaging options and good tissue characterizing.

Having mentioned the various advantages of MRI, however, ultrasound can still be considered as one of the efficient screening techniques for the detection of pelvic malignancies. Despite its inadequacy in being able to assess the staging, it plays a pivotal role in the evaluation of pelvic pathologies, as it is a dynamic study and can be repeated as many times as a radiologist needs. Technical advances, such as 3-D, color Doppler and real-time transvaginal dynamic US, make USG an effective imaging tool for gynecologic patients. The accuracy of US in picking up pelvic abnormalities is quite striking and also has a reasonably good level of characterizing the lesions. With the advent of contrast-enhanced ultrasonography, the role of US in assessing abdominal pathologies is even more crucial and vital.

CONCLUSION

Magnetic Resonance Imaging plays a pivotal role in characterizing female pelvic pathologies and therefore can be used as a problem-solving tool in patients when the ultrasound is inconclusive or suboptimal. However, the superior imaging potential of MRI should not preclude the use of ultrasound as a screening tool. Ultrasound remains the first line of imaging female pelvis, but, however, MRI should be considered for better evaluation and better characterization of pathologies when sonographic characteristics are not conclusive and also to determine the likelihood of malignancies.

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