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Role of ultrasonography and magnetic resonance imaging in evaluation of female pelvic masses from reproductive organs with histopathological correlation

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Abstract

Female pelvis houses urological and reproductive organs with perplexing pathologies often because of poor clinical characterization of lesion as it poses overlapping clinical features and difficulty in physical examination. Histopathology is considered gold standard, however the radiological imaging modalities revolutionized the diagnostic and presurgical workup with superior characterization of the lesion, guiding procedures and defining the extensions. In the present study we evaluated different pelvic pathologies using ultrasonography and MRI and these radiological findings were correlated with histopathology findings.

This is a prospective study involving 50 female patients with complaints of lower abdominal pain and irregular bleeding were selected. These patients had undergone trans abdominal sonography (transvaginal when needed) and MRI pelvis imaging. Subsequently these findings were correlated with the histopathological findings, whenever needed. Age range of 18-87 were included which showed benign lesions (USG – 43, MRI – 36 and Histopathology – 31) and malignant lesions (USG – 7, MRI – 14 and Histopathology – 19). Most common solid malignant uterocervical lesions are cervical and endometrial cancer and most common malignant cystic adnexial lesions are ovarian neoplasms.

The data was statistically analyzed using SPSS software which showed USG (sensitivity – 26.3%, specificity – 93.5%, PPV – 80.3%, NPV – 55.9% & Accuracy – 68%) & MRI (sensitivity – 73.6%, specificity – 100%, PPV – ∞, NPV – 79.1% & Accuracy – 90%).

Conclusion: The poor ultrasound sensitivity in the present study can be attributed to the low study population, considering the indeterminate lesions as non-malignant and difficulty in analyzing the small cervical and small adnexial pathologies.

MRI showed superior soft tissue resolution, better characterization of lesion compared to Trans abdominal and Trans vaginal sonography. High specificity, high accuracy, low radiation exposure would definitely make MRI pelvis the best imaging modality in diagnostic as well as in presurgical evaluation. On the other hand, ultrasonography with decent specificity and accuracy can be used as first line investigation for its cost efficiency, reproducibility and lack of radiation.

Keywords: ultrasonography, MRI, histopathology, benign, malignant

Introduction

Female pelvis harbors different important genito urinary structures, gastro intestinal structures and several mesenchymal supportive structures – vascular, lymphatic and connective tissue elements [1, 2]. There are wide range of benign and malignant lesions arising from these structures [3]. Complete clinical assessment is always a herculean task due to anatomical limitations in physical examination and various overlapping clinical presentations [4]. Even though histopathology is considered gold standard investigation, patients cannot be put to unnecessary surgeries for benign pathologies [5]. Thus the radiological investigations revolutionized the diagnosis of complex pelvic masses in characterizing the lesion completely and defining its extensions, staging them accurately and thus helping in diagnosis as well presurgical work up and follow up evaluation [6, 7].

Ultrasound is traditionally used as first line investigation [8] in evaluating abdomen and pelvic pathologies for its wide availability, broad acceptance, lack of radiation exposure, cost affordability, reproducibility, real-time assessment, vascular evaluation and its role in guiding procedures [9]. The short comings being operator and skill dependency, limited field of view, patient size limitations, bowel gas, less sensitive in parametrial lesion evaluation.

Even though it is used as first line investigation in evaluating abdominal and pelvic pathologies, it has got its limitations in proper characterization, finding organ of origin for large lesions, parametrial invasion and staging of malignancy and so on. Thus to overcome these limitations and to assess the indeterminate and miscellaneous lesions the optimal imaging modality used in MRI pelvis.

MRI is increasingly used in assessing female pelvic pathologies as it is free of radiation exposure & iodinated contrast usage, has got greater field of view, contrast resolution, multiplanar imaging capabilities, good tissue characterization and ability to differentiate recurrence and residual from post-operative scarring. Thus its role is well established in diagnostic, prognostic, planning management and follow up imaging of different pelvic pathologies [10-12].

The cytological and particular histopathological evaluation would help in coming to a definite diagnosis and thus in the present study the radiological findings from ultrasonography and MRI imaging are correlated with the pathological findings and the post test variabilities are assessed used a standard SPSS statistical software.

Patient Preparation and Method of Examination

This is a prospective study conducted at kamineni institute of medical sciences, Narketpally for a duration of 1 year after hospital ethical committee clearance, involving 50 female patients of 18-87 age range, who came with complaints of lower abdominal pain and irregular bleeding. Proper informed consent was taken for all patients involved in the study.

Philips HD Clear vue ultrasonography machine was used to conduct trans abdominal and selected trans vaginal sonography examination. TAS was performed on full bladder using curvilinear probe of medium frequency (5MHz), TVS study was performed with proper consent and patient on empty bladder using appropriate drape. Patient is kept in lithotomy position and study conducted with a higher frequency probe (7-9MHz).

For MRI pelvis we used Siemens MRI 1.5 T machine. Patient is kept supine in gantry, phased array coil was used. Standard Mri pelvic protocol sequences were used – T1W, T2W in axial, sagittal and coronal planes, STIR coronal, DWI in axial planes.

Selected patients had undergone USG – abdomen and pelvis using both grey scale and Doppler (trans abdominal and trans vaginal, when needed) and subsequently the MRI imaging to look for various features to further delineate and characterize the lesion(shape, size, margins, internal architecture, extent of involvement of surrounding structures, visceral metastasis, omental, mesenteric involvement and ascites. These features help in narrowing down the differential diagnosis to benign or malignant type.

Cases were further followed up for histopathological diagnosis which was considered gold standard in the present study. The USG and MRI findings were compared to histopathological findings and were tabulated. The acquired statistical data was analyzed using SPSS software.

Results

The study includes 50 patients of age range 18-87 years. There were 18 patients of <35 years, 17 of 35-49 years range and 15 of > 50 years.(Table 1).

The ultrasound and Mri characterization of the lesions in to benign and malignant was done and the data was tabulated in Table 2 which showed Benign lesions in – USG at 43(16 of <35 yrs, 17 of 35-49 yrs and 15 of >50 yrs), MRI at 36 (17 of <35 yrs, 14 of 35-49 yrs and 5 of >50 yrs) and Malignant lesions in - USG at 7(2 of <35 yrs, 0 of 35-49 yrs and 5 of >50 yrs), MRI at 14 (1 of <35 yrs, 3 of 35-49 yrs and 10 of >50 yrs) which were compared to the histopathological findings which showed benign lesions at 31(15 of <35 yrs, 12 of 35-49 yrs and 4 of >50 yrs) and malignant lesions at 19(3 of <35 yrs, 5 of 35-49 yrs and 11 of >50 yrs).

The collected data was tabulated and analysed using SPSS software. The sensitivity, specificity, positive predictive value, negative predictive value and Accuracy for the Ultrasonography and MRI examination were calculated separately comparing with the gold standard investigation of histopathology.

The ultrasonography showed sensitivity – 26.3%, specificity – 93.5%, PPV – 80.3%, NPV – 55.9% and Accuracy – 68% (table 3); whereas MRI showed sensitivity – 73.6%, specificity – 100%, PPV – ∞, NPV – 79.1% and Accuracy – 90%

Table 1: Age distribution of study population

Age	Total no
<35	18
35-49	17
>50	15

Table 2: Age - Frequency distribution of benign and malignant lesions on USG, MRI and Histopathology respectively.

Age	Usg - B	Usg - M	Mri - B	Mri - M	Histo - B	Histo - M
<35	16	2	17	1	15	3
35-49	17	0	14	3	12	5
>50	10	5	5	10	4	11

Table 3: Statistical analysis of the USG data comparing with histopathology

Usg	malignant	benign	Total
M	5	2	7
B	14	29	43
total	19	31	50
Sensitivity	26.3		
Specificity	93.5		
PPV	80.3		
NPV	55.9		
Accuracy	68		
P value	<0.05		

Table 4: Statistical analysis of the MRI data comparing with histopathology

MRI	malignant	benign	Total
M	14	0	14
B	5	31	36
total	19	31	50
Sensitivity	73.6		
Specificity	100		
PPV	∞		
NPV	79.1		
Accuracy	90		
P value	<0.05		

Table 5: Frequency of different Benign and Malignant tumors studied.

Benign pathologies studies	Malignant pathologies studied
Leiomyoma	Endometrial carcinoma
Adenomyosis	Cervical carcinoma
Endometrial Polyp / cervical polyp	Serous cystadenocarcinoma
Simple ovarian cyst	Mucinous cystadenocarcinoma
Paraovarian cyst	Sertoli leydig cell tumor
Tubulo ovarian mass	Ovarian lymphoma
Peritoneal inclusion cyst	Ovarian metastasis
Polycystic ovarian disease	Krukenberg's tumor
endometriosis	
Ovarian teratoma	
Ovarian cystadenoma	

Discussion

Complete characterizing a female pelvic pathology is always a challenging task and radiological investigations help in better doing this by using various imaging modalities. Ultrasonography and MRI pelvis were the widely used investigations and the present study correlates these findings with histopathology findings [13-15].

In the present study, the age range of 18-87 years female patients were included who presented with various clinical presentations - lower abdominal pain, irregular bleeding and micturating difficulties. The predominant frequency of malignant lesions are seen in age > 50 years which were 11/19, out of which 5 were identified on USG and 10 on MRI and < 50 years there were 8/19 patients, out of which 2 were identified on USG and 4 on MRI.

The overall malignant lesions identified were 19 on histopathology, out of which 5 (true positive) were identified on USG and 14(true positive)on MRI. Out of 31 definite benign lesions diagnosed on histopathology, 29 (true negative) were picked on USG and 31(true negative) on MRI.

The present study would confer a sensitivity of 26.3%, specificity of 93.5%, PPV of 80.3%, NPV of 55.9% and accuracy of 68% to ultrasonography and the same way a sensitivity of 73.6%, specificity of 100%, PPV of ∞, NPV of 79.1% and accuracy of 90% to MRI pelvis examination.

The study conducted by sohaib SA *et al* found an overall accuracy of 91% on MRI in distinguishing benign from malignant adnexial lesions [16].

Studies conducted by Mughleri FN *et al.* [17] and Kashin J *et al.* [18], comparing USG and MRI investigations in characterizing adnexial lesions had found comparable results were sensitivity, specificity, PPV, NPV and Diagnostic accuracy of TA USG were around 85.18%, 80.56%, 86.79%, 78.38% and 83.33% respectively while for CE MRI were 94.83%, 87.50%, 93.22%, and 92.22% respectively.

Sultana N *et al.* [19] in a similar study found TA USG sensitivity, specificity, PPV, NPV were 100%, 54%, 58.5% and 100%, respectively while for CE MRI were 95.8%, 86.4%, 82.1% and 96.9% respectively. Similarly Abbas T *et al.* [20] in his study showed TA USG sensitivity, specificity,

PPV, NPV at 77%, 86.8%, 85.3% and 81.9% respectively.

The utero cervical benign lesions we encountered in our study were predominantly leiomyoma, adenomyosis, endometrial polyps and cervical polyps and those belong to adnexial region were predominantly ovarian benign solid and cystic lesions, extra uterine fibroids and tuboovarian inflammatory masses.

The predominant malignant lesions encountered in uterocervical region are endometrial carcinoma, cervical carcinoma and leiomyosarcoma, where as in adnexial region the malignant lesions were ovarian malignant epithelial lesions, germ cell and stromal cell tumors and metastatic lesions.

Ultrasonography is sensitive in characterizing large >5cm cystic as well as solid lesions, however it is difficult to assess the small lesions, complex pathologies, fat containing lesions, hemorrhagic component in the lesions which are considered in determinant (however not considered malignant unless proven on histopathology) due to technical limitation are still put under benign lesions in the present study.

The focal part of benign lesion (leiomyoma and endometrial polyp) showing dysplastic changes and suspicious for malignancy are missed on ultrasonography, as well on MRI, however diagnosed accurately on histopathology.

The cervical cancers were not characterized properly on ultrasonography due to the limitations of the sound waves in reaching the deeper structures, adjacent bowel gas and patients lack of cooperation for Trans vaginal examination. However are diagnosed and staged majority of the lesions accurately on MRI.

The majority of ovarian malignant cystic lesions were suspected for malignancy on ultrasonography and referred for MRI study, which further characterized the contents of the lesions – Fat (dermoid), hemorrhage, vascularity and frond like, papillary projections and other enhancing solid components. Along with that MRI also helped in staging of these tumors based on their extension with in the pelvis, adjacent structures, peritoneal cavity – omentum & mesenteric structures, lymphnodes and distant visceral metastasis to liver.

Some Representative Cases

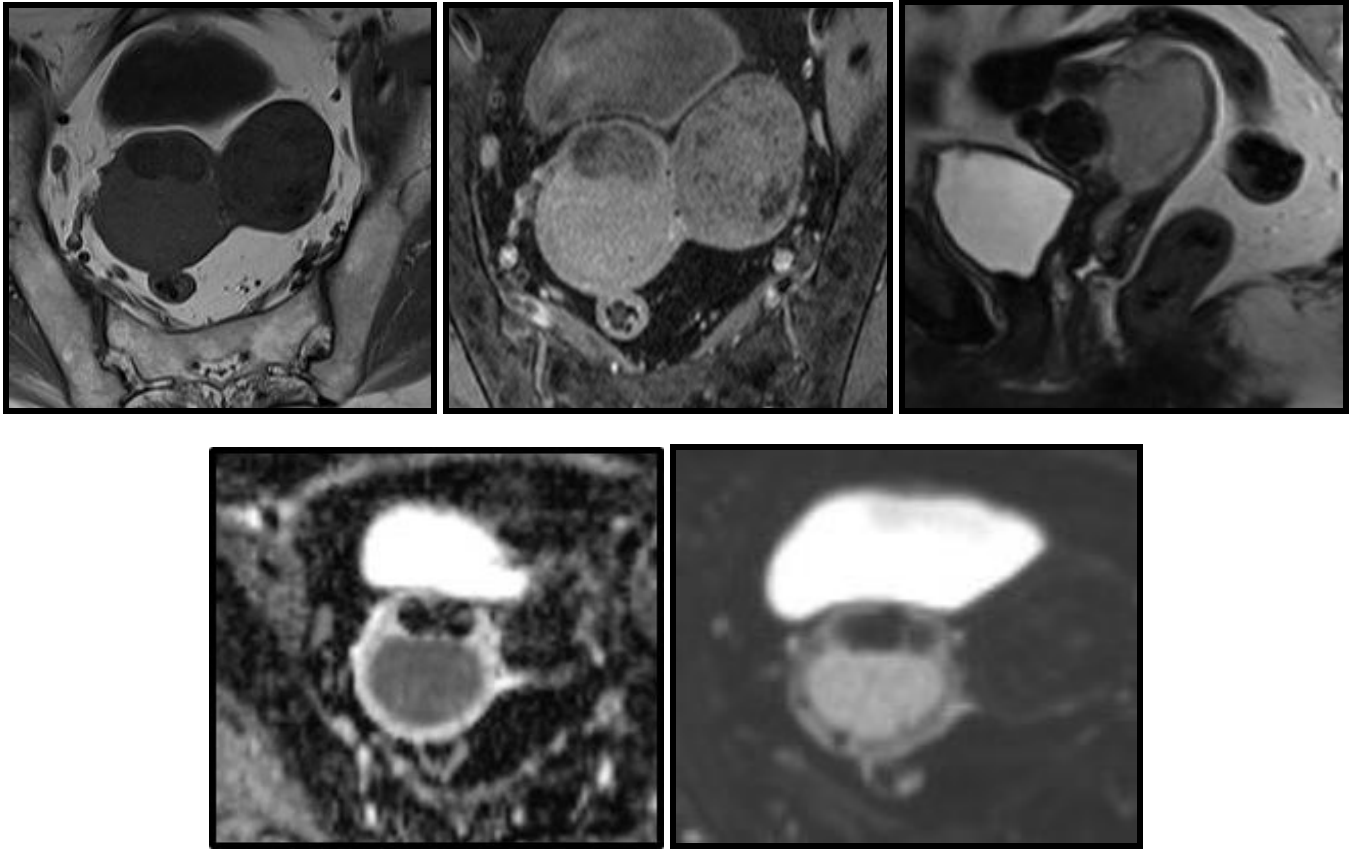


Fig 1: Malignant endometrial neoplasia with myometrial fibroids and T1/T2 hypointense lesion in left adnexa - subserosal/ broad ligament fibroid.

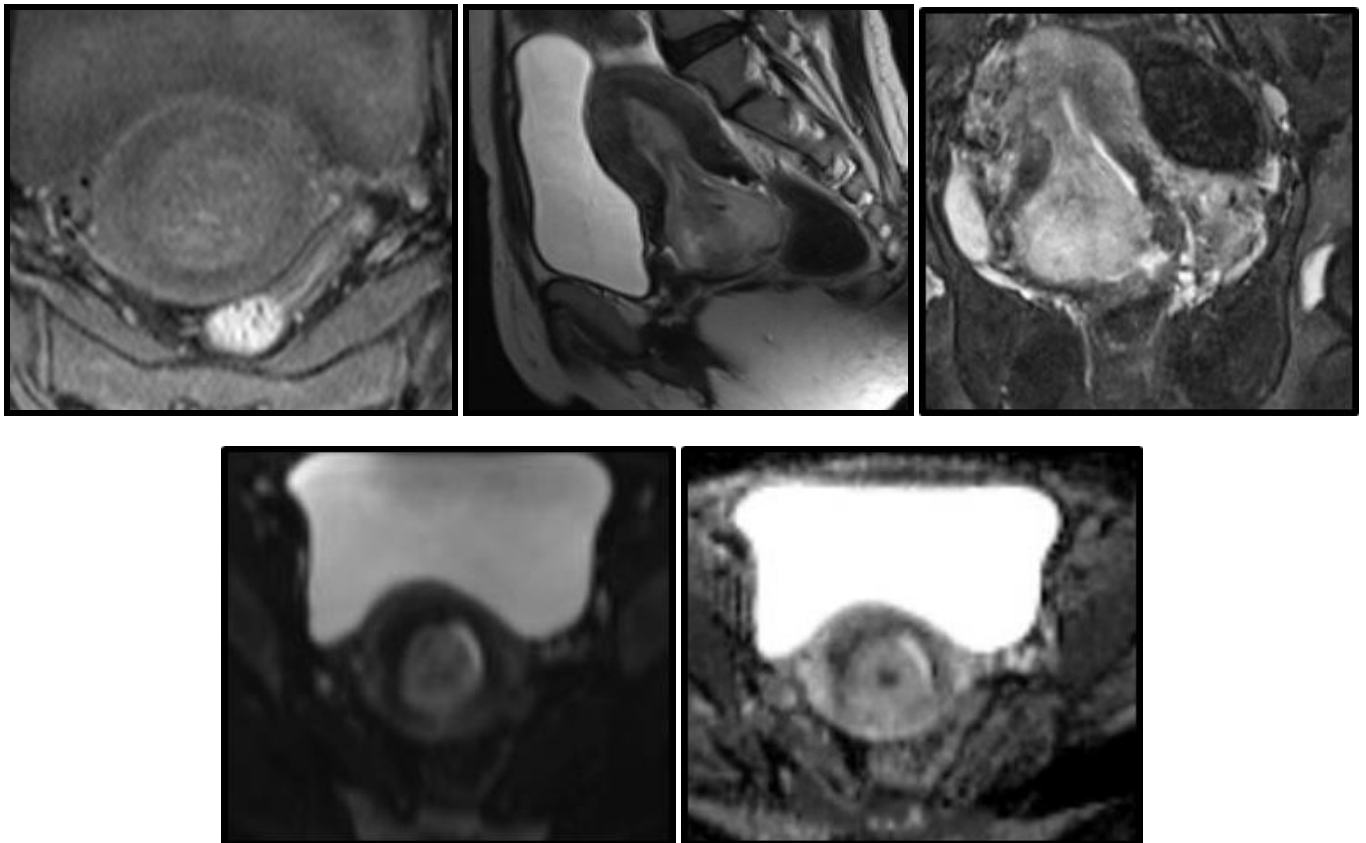


Fig 2: Pendunculated, polypoidal lesion arising from anterior wall of uterus & extending into cervix. Possible differential diagnosis were pendunculated sub mucosal fibroid, endometrial polyp. Histology report confirmed endometrial polyp with areas of dysplasia – suggesting carcinomatous changes.

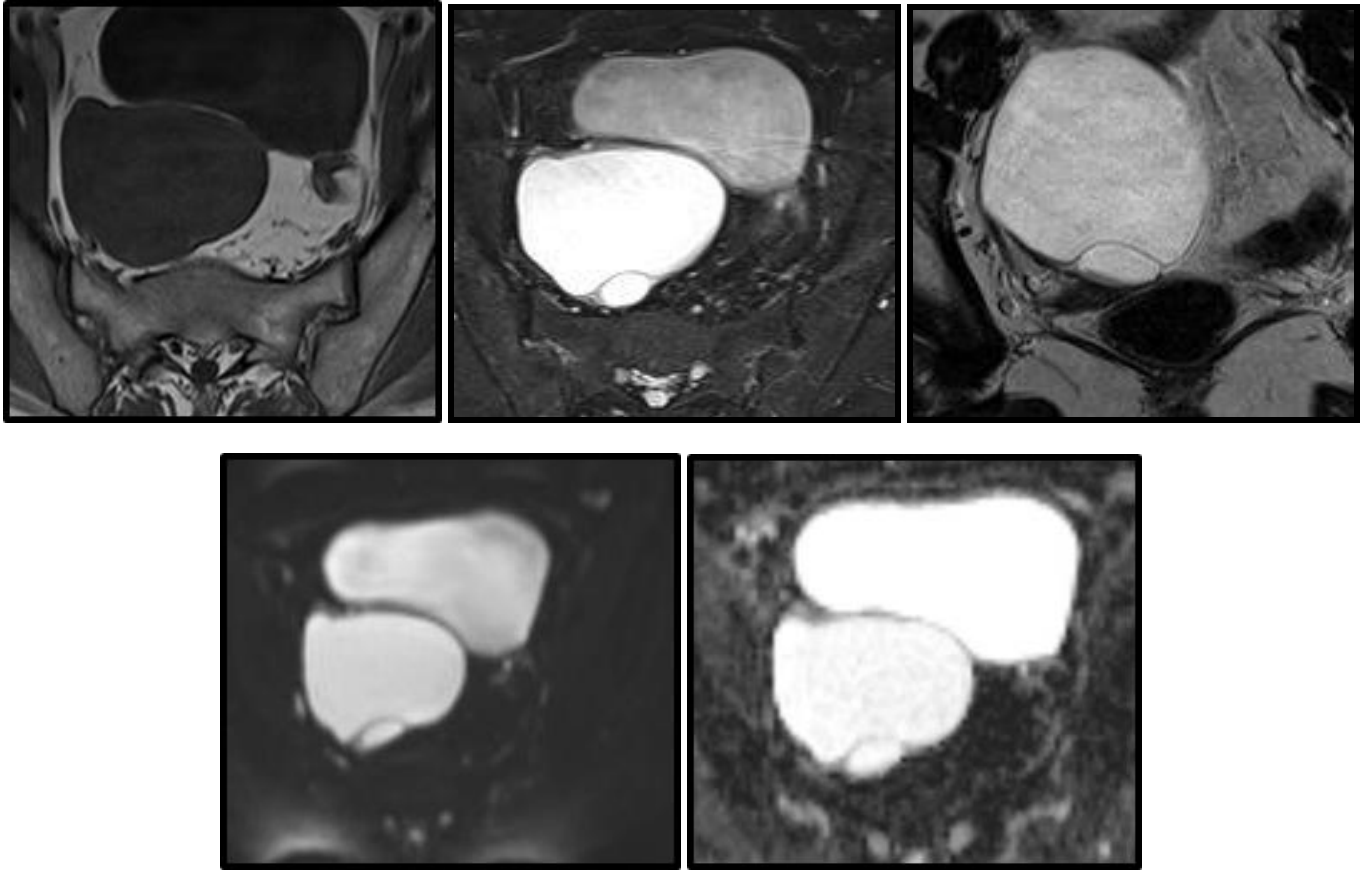


Fig 3: Benign right adnexal cyst - most likely right ovarian

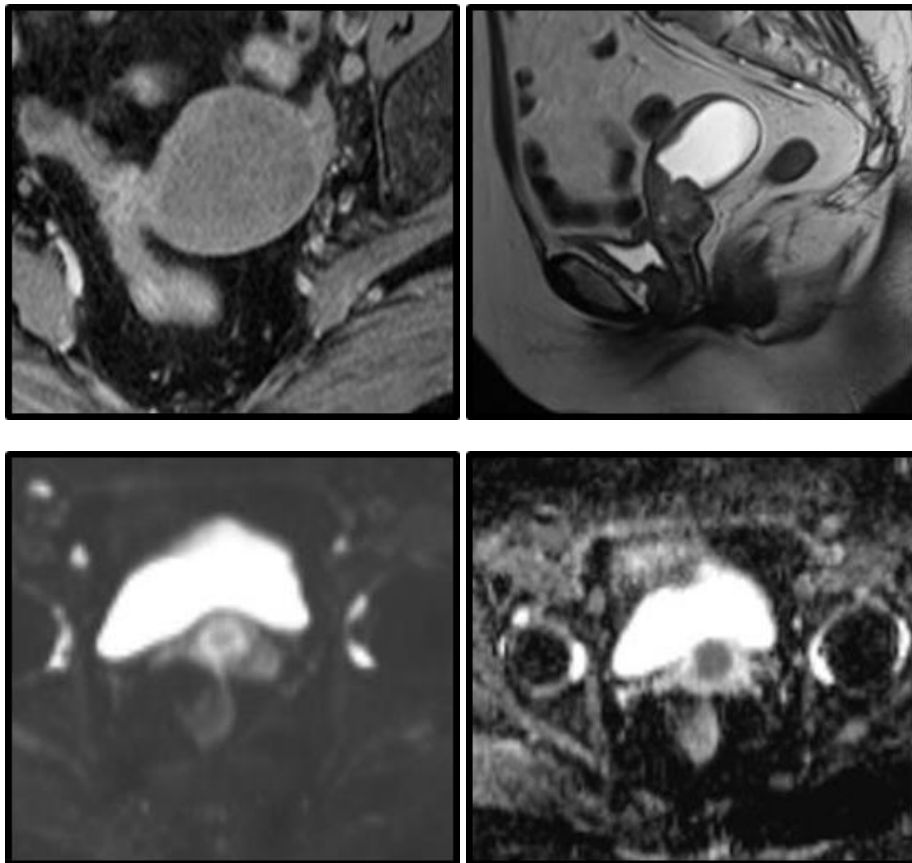


Fig 4: Ill-defined altered signal intensity lesion noted involving cervix lower uterus and upper 1/3 part of vagina with extensions as above - Malignant cervical neoplastic lesion with vaginal extensions and Pyometra.

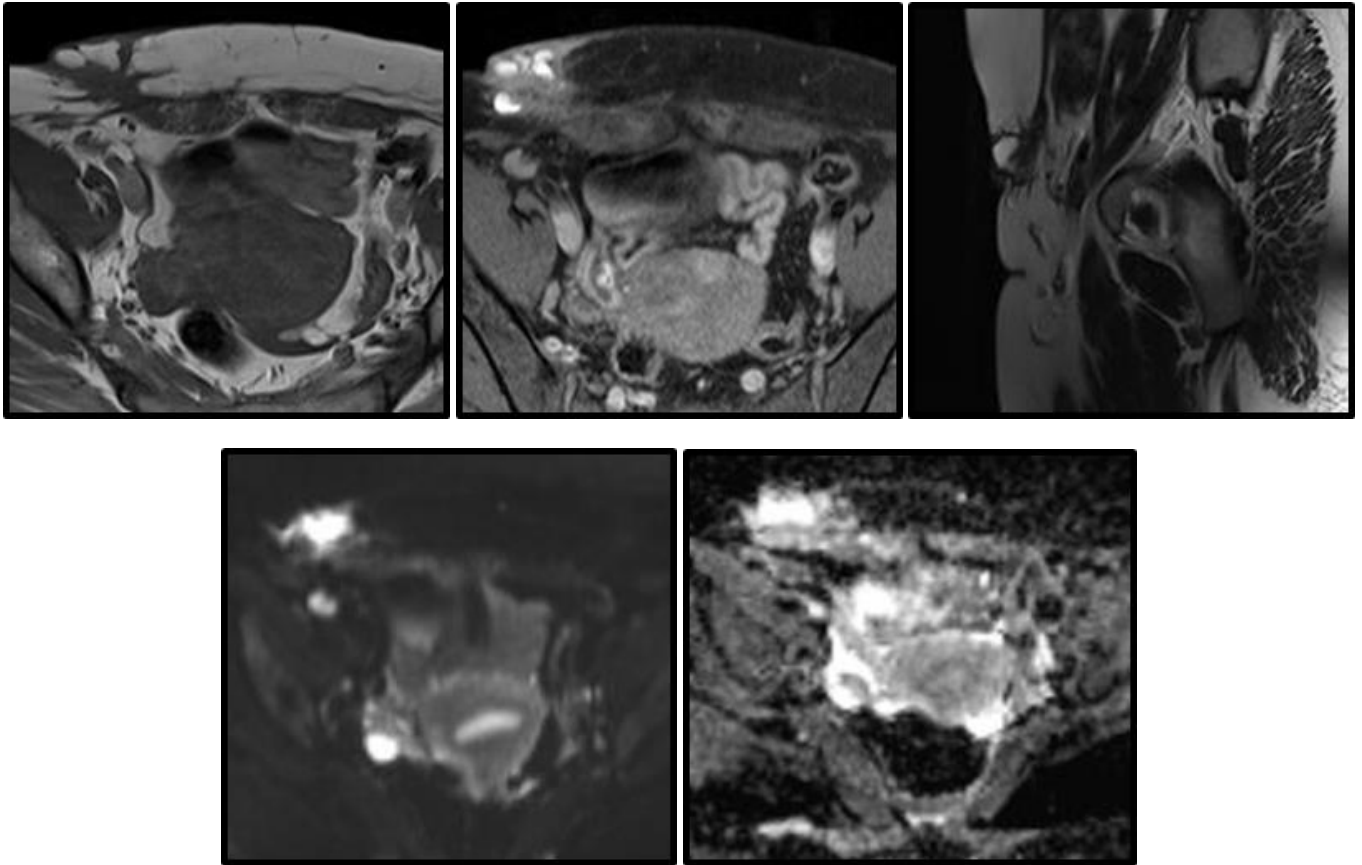


Fig 5: Abdominal wall endometriosis with no pelvic endometriosis.

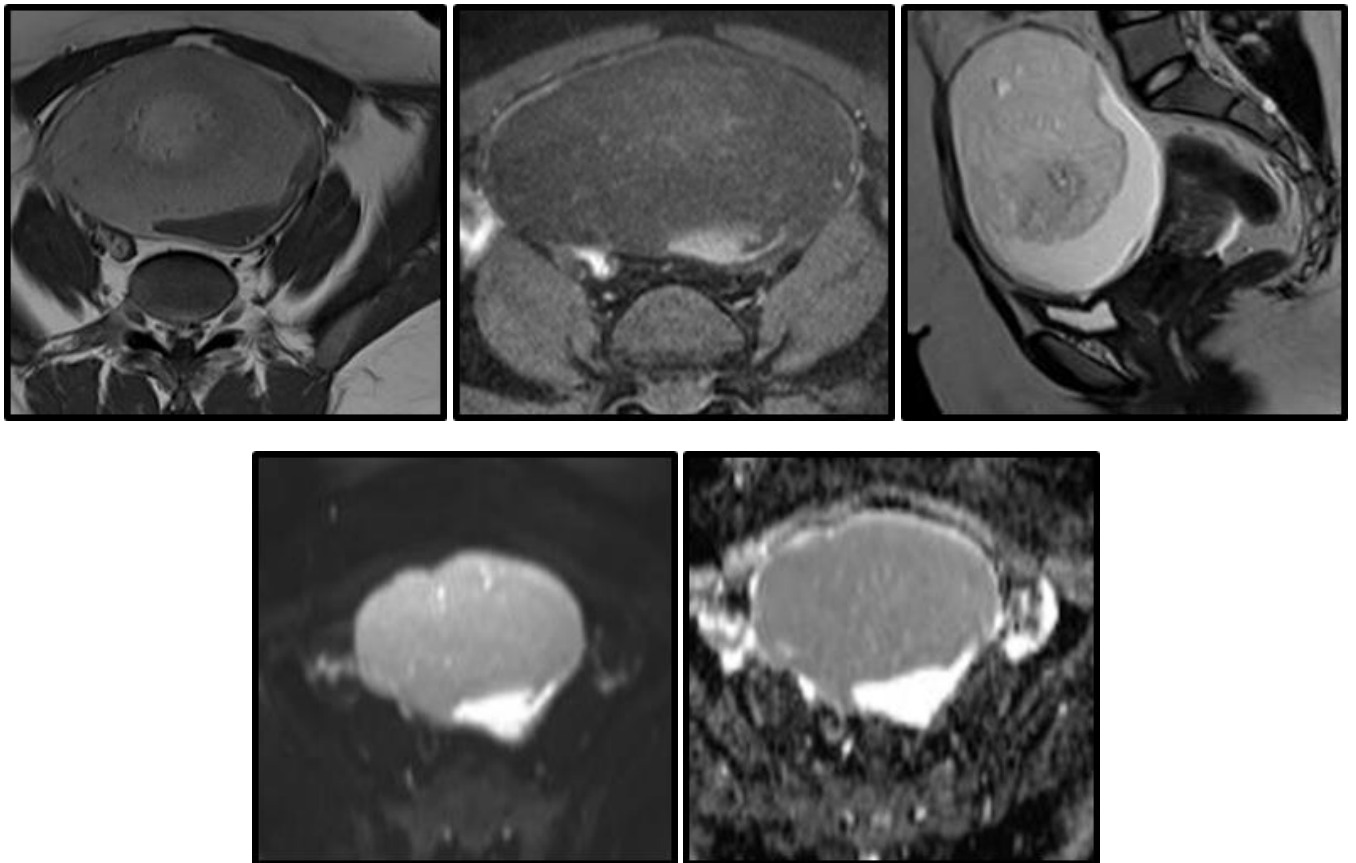


Fig 6: Dermoid cyst.

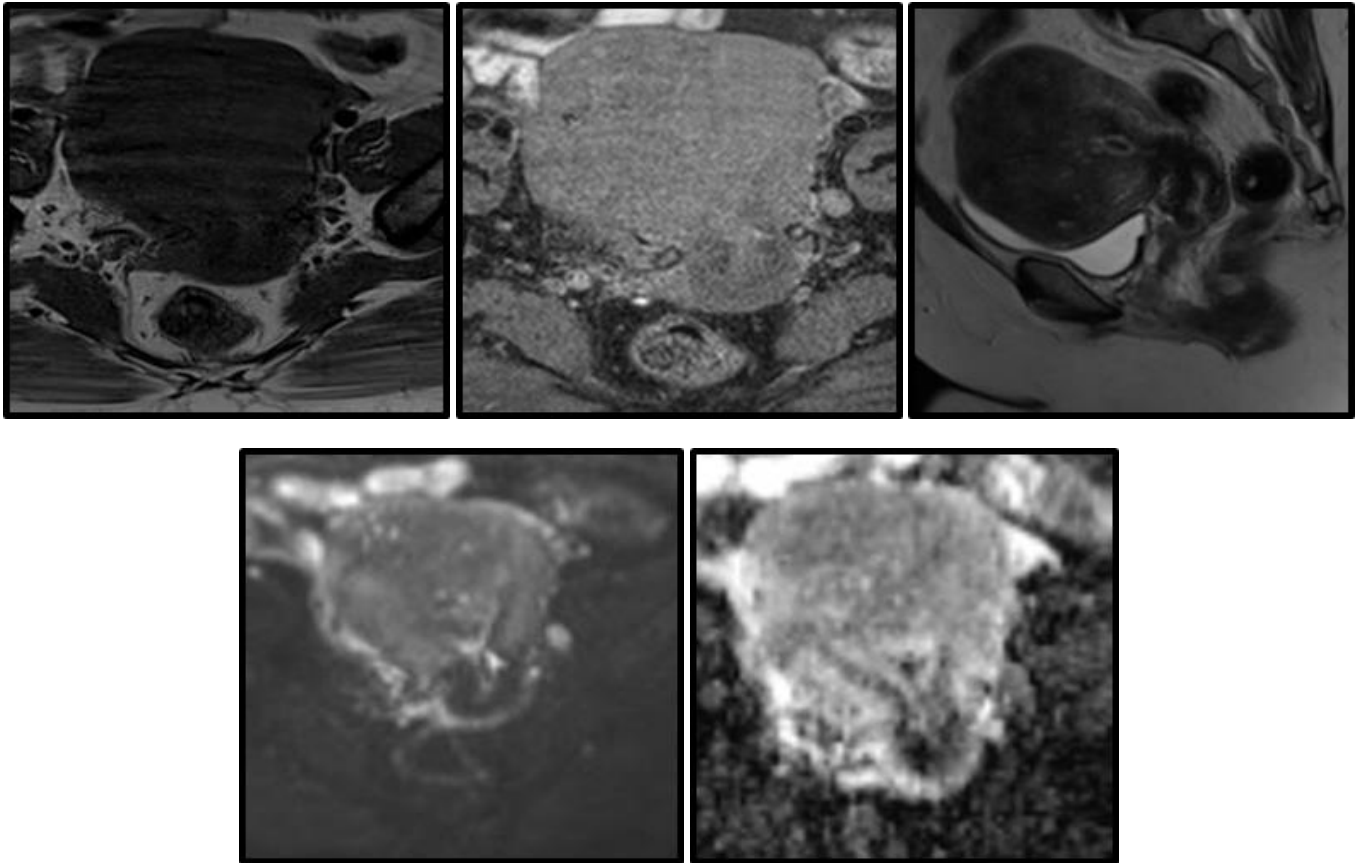


Fig 7: Diffuse uterine adenomyosis

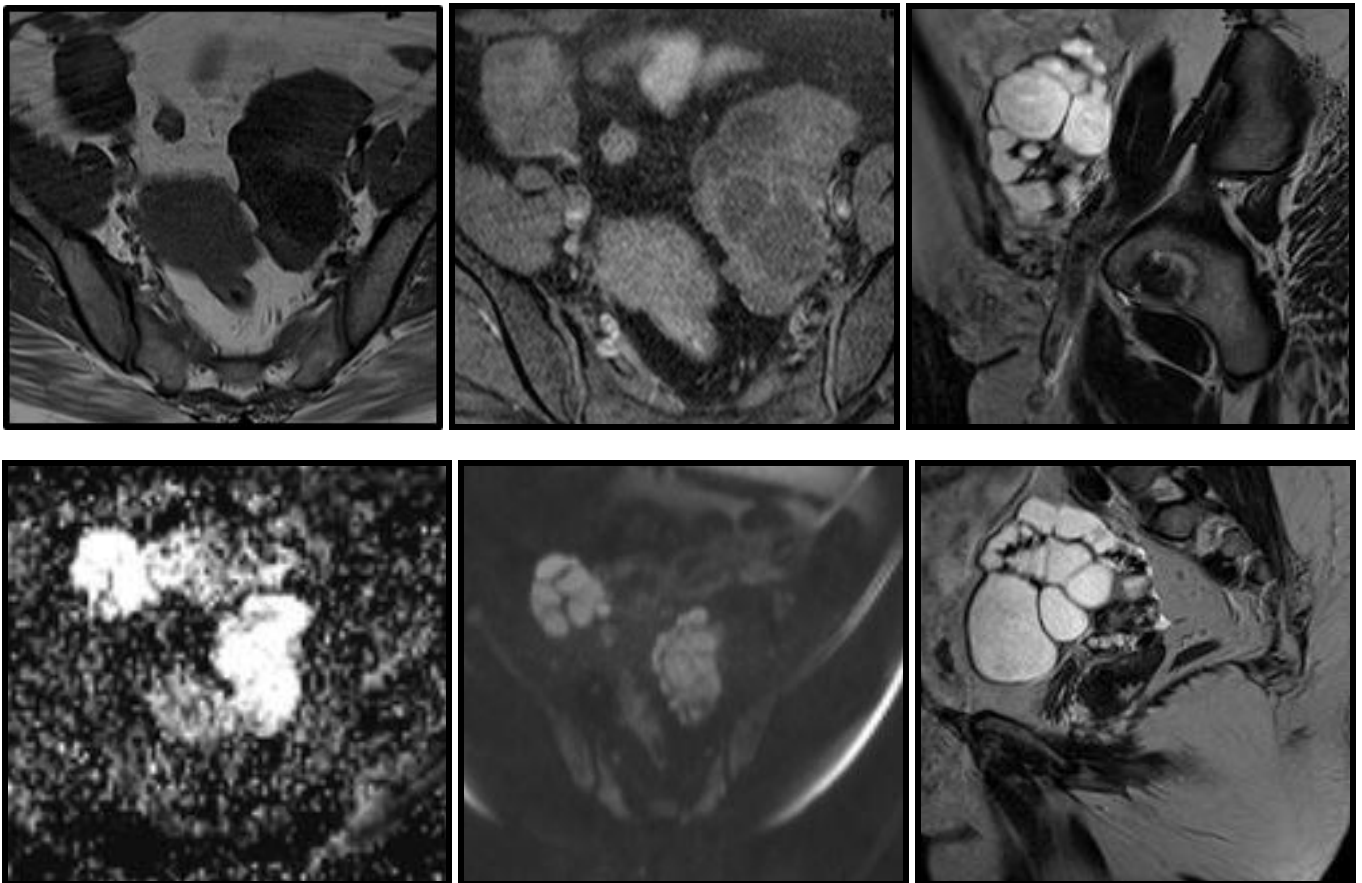


Fig 8: Bilateral multicystic mass lesions are noted arising from both ovaries with thick enhancing septations.
F/S/O Bilateral surface epithelial neoplasms – Krukenberg’s tumor

Conclusion

This study concludes by proposing that malignant lesions are common pathologies in elderly female patients. Keeping the technical limitations of sonography in view, the in determinant lesions, clinical dilemma cases, evaluating high risk patients should be further evaluated on MRI to further characterize the lesion properly and the chances of missing malignant lesions can be reduced drastically.

Even though MRI is relatively safe and has got superior soft tissue resolution and better in characterizing the lesion as benign and malignant, than ultrasonography, it is not used as a primary first line investigation in all the cases due to its cost affordability and lack of availability in most of the places, where in ultrasonography scores better than MRI.

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