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Evaluation of Uterine Masses using USG and MRI – with HPE Correlation

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ABSTRACT: Ultrasonography and MRI were two extensively utilised for diagnosing uterine mass lesions in these days and they are also becoming widely available. The objective was to find out the diagnostic ability of ultrasonography and MRI for various uterine mass lesions in comparison to HPE. The present study was cross-sectional study carried out in the department of radiodiagnosis in tertiary care hospital between February 2021 and April 2022. All the participants who came with symptoms of uterine mass lesions during the study period were included into the study. A pretested semi structured proforma was used to record the data. The sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy for each parameter was calculated. 95% confidence interval for all the diagnostic parameters were estimated. The sensitivity for diagnosing adenomyosis for TA USG, TV ISG and MRI were 35.7%, 50% and 78.5%, respectively. The specificity was 66.6%, 75% and 88.8% for the three. The diagnostic accuracy was higher for MRI (86%) followed by TV USG (68%) and TA USG (58%). The sensitivity was 100% for MRI, 90% for TV USG and 75% for TA USG. The specificity for MRI, TV USG and TA USG were 93.3%, 83.3% and 80%, respectively. The diagnostic accuracy of MRI was 96%, TV USG was 86% and TA USG was 78%. The sensitivity for diagnosing tumour mass for TV USG and MRI were 69.2% and 84.6%, respectively. The specificity was 91.8% and 86.4% for MRI and transvaginal USG, respectively. The diagnostic accuracy for MRI was 90% while that of TV USG was 82%. MRI was found to be more accurate tool for diagnosing uterine mass lesions followed by transvaginal USG and transabdominal USG.

Keywords: Uterine mass lesions, adenomyosis, fibroids, Transvaginal USG, transabdominal USG, MRI, tumour mass.

INTRODUCTION

Uterus is a hollow organ that is pear shaped (Ellis, 2011). It was reported that 15 to 20% of women in the reproductive age group 15 to 45 years suffer from uterine mass lesions (Padubidri and Daftary 2014). These mass lesions are very diverse and they could arise from any part of the uterus including the endometrium, the myometrium and the cervix. Newer imaging methods like trans abdominal USG, trans vaginal USG, hysterosalpingography, colour doppler, CT and MRI were introduced to aid in diagnosis. All the above has tried to increase the accuracy of diagnosing uterine mass lesions. Ultrasonography and MRI were two extensively utilised for diagnosing uterine mass lesions in these days and they are also becoming widely available (Mihuand Mihu 2011).

In an ultrasound image, uterus will be visualised and its size, shape and position can be determined. The myometrium will be seen as a homogenous structure with linear echoes. Myometrium will be of similar intensity to a muscle. The myometrium and endometrium will be seen separated by cavity line. With the change in endometrial cycle, it gets reflected in the endometrial thickness. In a MRI, both myometrium and endometrium will be presented as high intensity signals. The junctional zone between them will be indicated by low intensity line (Mallampati 2010; Okamoto *et al.,* 2003).

Leiomyomas otherwise called fibroids are benign neoplasms (Styer and Rueda 2016). In an USG, fibroids appear as concentric hypoechoic masses (Wozniak and Wozniak 2017). In a T2 weighted MRI, they appear as low intensity signals in comparison to myometrium (Wilde and Scott-Barret 2009). The endometrial

invasion into myometrium is called adenomyosis (Cunningham *et al.,* 2018). Some of the features of adenomyosis in ultrasonography includes heterogenous myometrium, myometrial cysts and echogenic linear striations (Koothan *et al.,* 2016). A diffuse or focal thickening in junctional zone of MRI indicate adenomyosis (Tamai *et al.,* 2005).

Localised intrauterine overgrowth of endometrium is called endometrial polyp. In a transvaginal ultrasound, a hyperechoic lesion within lumen indicates endometrial polyp. In a T2 weighted MRI too, the polyp will be indicated by low intensity signal (Salim *et al.,* 2011; Hase *et al.,* 2012). With regard to carcinoma either endometrial or cervical, ultrasonography is often utilised to study regarding the size of lesion and the depth of invasion. The role of MRI in case of carcinomas is as similar as to that of an ultrasonography. It is known fact that MRI had an excellent soft tissue contrast (Patel *et al.,* 2010; Mezrich, 1994).

In the present era of evidence-based medicine, it is essential for every practitioner to know regarding the diagnostic accuracy of the modalities that they are employing and also their advantages and disadvantages. The present study was done in the radiodiagnosis department of tertiary care hospital with an objective of evaluating MRI characteristic of uterine mass lesions, to compare sensitivity of MRI, trans abdominal and trans vaginal ultrasound in characterising uterine mass lesions and to assess accuracy in staging uterine mass lesions. Similar kind of study was not undertaken in the institute before. The study will through a light on the diagnostic ability of ultrasonography and MRI for uterine mass lesions and also helps one to understand the advantages and disadvantages of utilizing them.

MATERIAL AND METHODS

The present study was cross-sectional study carried out in the department of radiodiagnosis, Vinayaka mission's kirupanandavariyar medical college and hospital, Salem between February 2021 and April 2022 among patients suspected to have uterine mass lesions who had attended to the radiodiagnosis department. Any patient who had not given consent and were not willing to undergo the radiological tests were not included into the study. Convenient sampling was done. A pretested semi structured proforma was used to record the data.

All the participants attending to the radiodiagnosis department with uterine mass lesions during the study period and fulfilling the inclusion and exclusion criteria were included into the study. Informed consent was obtained from all the participants in the study. A pretested semi structured questionnaire was used to collect and record the data among the participants. The data collected involves age of the participants, parameters of clinical examination, transabdominal ultrasound findings, transvaginal ultrasound finding and MRI findings. The patients' histopathological report from the obstetrics and gynaecology department was also obtained to arrive at the final diagnosis of uterine mass lesion the patient was suffering from.

A. Ultrasound examination

A preliminary abdominal examination, per speculum and per vaginal examination was done. Transabdominal ultrasound was done in full bladder with optimal settings. Bladder is emptied after transabdominal ultrasound then transvaginal ultrasound done. In both the ultrasound examinations the following uterine parameters were noted including the size of the uterus, Contour either regular or lobulated, Endometrium either homogenous or heterogenous, echogenic or hypoechoic comparing to the myometrium, Endometrial thickness measured from myometrial-endometrial junction (outer echogenic layer) to the opposite myoendometrial junction, Presence or absence of endometrial cavity fluid, Any mass lesion within endometrium, if mass present single or multiple and its characteristics were noted, Myometrium was observed as either homogenous or inhomogeneous echotexture, Anterior and posterior wall symmetry or asymmetry was noted, Presence of any myoma to be noted and its location like submucous, intramural and subserosal, number of lesions, echogenicity of the lesions, areas of calcification, cystic changes within the lesion and shadowing were noted, Presence of any cyst within the myometrium, if so single or multiple and location like anterior or posterior myometrium were noted. Is the lesion causing indentation on the bladder wall, Whether the cervix is normal or abnormal, if abnormal is there Nabothian cyst, polyps and if mass is present the extension of the mass and associated any endometrial collection were seen, Bilateral adnexa to be visualised and ovary whether normal or abnormal, if so any mass or cystic lesions were also noted and Finally, routine screening of abdominal organs was done and any positive findings were noted for presence of hydronephrosis, ascites and lymphadenopathy.

B. MRI pelvis

Patient was placed in supine position in MR gantry. A scout coronal section was obtained to plan for sagittal views. Oblique coronal and oblique axial sections were planned using sagittal slices (along the axis of uterus and perpendicular to it).

The sequences used –

a. T1 weighted sagittal

TR 700ms	TE 10ms
Number of slices 22	Slice thickness 4mm
FOV 300	Matrix size 256 × 256

b. T2 weighted sagittal, coronal and axial

TR 3250ms	TE 97 ms
Number of slices 22	Slice thickness 4 mm
FOV 300	Matrix size 256 × 256

Optical sequences – Fat saturation in case of endometriosis and ovarian dermoid.

C. MRI evaluation

In addition to the findings noted in the ultrasonogram, in MRI the maximal junctional zone thickness was measured and junctional zone to myometrial thickness ratio was calculated. For this, single layer of junctional zone was measured at the level of maximum thickness and the myometrial thickness was measured at the same level. Intensity of the lesions in both T1 and T2

weighted images, number and location of the lesions were noted.

In case of endometrial lesions, level of myometrial invasion noted and in case of carcinoma cervix, extent of the lesions was also noted.

D. Statistical analysis

The data collected were entered into Microsoft excel 360 and master chart was created. The master chart was then loaded into SPSS version 26 for analysis. The data consisted of both quantitative variables and qualitative variables. The quantitative variables were expressed using mean and standard deviation. The qualitative variables were expressed using frequency and percentages.

To find out the agreement between the diagnostic method in question and the gold standard method, cohen's kappa test was applied. A P value of less than 0.05 was considered to be statistically significant. The sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy for each parameter was calculated using Medcalc's diagnostic test evaluation calculator. 95% confidence interval for all the diagnostic parameters were estimated.

RESULTS AND DISCUSSION

Out of the 50 participants, 48% were in the age group less than 40 years and 22% were in the age group 41 to 50 years. 68% were in the pre menopause period and 32% were post menopause. 60% had pain, 44% had dysmenorrhoea, 34% had bleeding PV and 32% had discharge PV. 40% were diagnosed to have fibroids, 28% to have adenomyosis, 20% with carcinoma cervix, 6% with carcinoma endometrium, 4% with endometrial polyp and 2% were normal (Table 1).

Among the 14 diagnosed to have adenomyosis, 35.7% were diagnosed correctly by transabdominal USG, 50% were diagnosed correctly by transvaginal USG and 78.5% were diagnosed correctly by MRI. The degree of agreement among the three was higher for MRI, which had a substantial agreement (Table 2).

The sensitivity for diagnosing adenomyosis for TA USG, TV ISG and MRI were 35.7%, 50% and 78.5%, respectively. The specificity was 66.6%, 75% and 88.8% for the three. The PPV of TA USG was 29.4% while that of TV USG was 43.7% and MRI was 73.3%. The NPV was 72.7%, 79.4% and 91.4% for TA USG, TV USG and MRI, respectively. The diagnostic accuracy was higher for MRI (86%) followed by TV USG (68%) and TA USG (58%) (Table 3).

Among the 20 participants diagnosed to have fibroids, 75% were correctly diagnosed by TA USG, 90% by TV USG and 100% by MRI. The degree of agreement between HPE and the diagnostic modalities studied was higher for MRI (0.918) followed by TV USG and TA USG (Table 4). The sensitivity was 100% for MRI, 90% for TV USG and 75% for TA USG. The specificity for MRI, TV USG and TA USG were 93.3%, 83.3% and 80%, respectively. With regard to PPV, MRI was found to have 90.9% followed by TV USG with 78.2% and for TA USG it was 71.4%. The NPV of MRI was 100% followed by TV USG (92.5%) and TA USG (82.7%). The diagnostic accuracy of MRI was 96%, TV USG was 86% and TA USG was 78% (Table 5).

Table 1: Baseline characteristics among the participants.

Variable		Frequency (n=50)	Percentage (%)
Age group (In years)	<40	24	48
	41-50	11	22
	51-60	9	18
	>60	6	12
Menopause status	Premenopause	34	68
	Post menopause	16	32
Presenting complaints	Pain	30	60
	Bleeding PV	17	34
	Discharge PV	16	32
	Mass abdomen	4	8
	Loss of weight/appetite	5	10
	Dysmenorrhoea	22	44
Final diagnosis	Adenomyosis	14	28
	Fibroid	20	40
	Ca cervix	10	20
	Ca endometrium	3	6
	Endometrial polyp	2	4
	Normal	1	2

Out of the 13 participants diagnosed to have tumour mass, TV USG diagnosed correctly in 69.2% and MRI in 84.6%. The degree of agreement was 0.746 and 0.544 for MRI and transvaginal USG, respectively (Table 6). The sensitivity for diagnosing tumour mass for TV USG and MRI were 69.2% and 84.6%, respectively. The specificity was 91.8% and 86.4% for MRI and transvaginal USG, respectively. The PPV for MRI was 78.5% and TV USG was 64.2%. The NPV for MRI and TV USG were 94.4% and 88.8%, respectively. The diagnostic accuracy for MRI was 90% while that of TV USG was 82% (Table 7).

Table 2: Agreement in diagnosis of ultrasound and MRI with regard to HPE for diagnosing adenomyosis.

Investigation		Histopathological examination				Kappa value	P value
		Positive		Negative			
		N=14	%	N=36	%		
Transabdominal USG	Positive	5	35.7	12	33.3	0.022	>0.05
	Negative	9	64.2	24	66.6		
Transvaginal USG	Positive	7	50	9	25	0.240	<0.05
	Negative	7	50	27	75		
MRI	Positive	11	78.5	4	11.1	0.660	<0.05
	Negative	3	21.4	32	88.8		

Table 3: Diagnostic evaluation of ultrasound and MRI for diagnosing adenomyosis.

	Sensitivity	Specificity	PPV	NPV	DA
Transabdominal USG	35.7 (12.7 – 64.8)	66.6 (49.1 – 81.4)	29.4 (10.3 – 55.9)	72.7 (54.4 – 86.7)	58 (43.2 – 71.8)
Transvaginal USG	50 (23.1 – 76.9)	75 (57.8 – 87.8)	43.7 (19.7 – 70.1)	79.4 (62.1 – 91.3)	68 (53.3 – 80.4)
MRI	78.5 (49.2 – 95.3)	88.8 (73.9 – 96.8)	73.3 (44.9 – 92.2)	91.4 (76.9 - 98.2)	86 (73.2 – 94.1)

Table 4: Agreement in diagnosis of ultrasound and MRI with regard to HPE for diagnosing fibroids.

Investigation		Histopathological examination				Kappa value	P value
		Positive		Negative			
		N=20	%	N=30	%		
Transabdominal USG	Positive	15	75	6	20	0.545	<0.05
	Negative	5	25	24	80		
Transvaginal USG	Positive	18	90	5	16.6	0.715	<0.05
	Negative	2	10	25	83.3		
MRI	Positive	20	100	2	6.6	0.918	<0.05
	Negative	0	0	28	93.3		

Table 5: Diagnostic evaluation of ultrasound and MRI for diagnosing fibroids.

	Sensitivity	Specificity	PPV	NPV	DA
Transabdominal USG	75 (50.9 – 91.3)	80 (61.4 – 92.2)	71.4 (47.8 – 88.7)	82.7 (64.2 – 94.1)	78 (64.1 – 88.4)
Transvaginal USG	90 (68.3 – 98.7)	83.3 (65.2 – 94.3)	78.2 (56.3 – 921.5)	92.5 (75.7 – 99.1)	86 (73.2 – 94.1)
MRI	100 (83.1 – 100)	93.3 (77.9 – 99.1)	90.9 (70.8 – 98.8)	100 (87.6 – 100)	96 (86.2 – 99.5)

Table 6: Agreement in diagnosis of ultrasound and MRI with regard to HPE for diagnosing tumour mass.

Investigation		Histopathological examination				Kappa value	P value
		Positive		Negative			
		N=13	%	N=37	%		
Transvaginal USG	Positive	9	69.2	5	13.5	0.544	<0.05
	Negative	4	30.7	32	86.4		
MRI	Positive	11	84.6	3	8.1	0.746	<0.05
	Negative	2	15.3	34	91.8		

Table 7: Diagnostic evaluation of ultrasound and MRI for diagnosing tumour mass.

	Sensitivity	Specificity	PPV	NPV	DA
Transvaginal USG	69.2 (38.5-90.9)	86.4 (71.2 – 95.4)	64.2 (35.1 – 87.2)	88.8 (73.9 – 96.8)	82 (68.5 – 91.4)
MRI	84.6 (54.5 – 98.1)	91.8 (78.1 – 98.3)	78.5 (49.2 – 95.3)	94.4 (81.3 – 99.3)	90 (78.1 – 96.6)

Uterine mass lesions are very diverse and they could arise from any part of the uterus including the endometrium, the myometrium and the cervix. The diversity of lesions makes it very difficult to arrive at a particular diagnosis. Hence for accurate diagnosis and also for non-invasive mode to do so one should rely up on radiological modalities. Ultrasonography and MRI were two extensively utilised for diagnosing uterine mass lesions in these days and they are also becoming widely available (Mihu and Mihu 2011).

The present study was a cross sectional study carried out in the department of radiodiagnosis, Vinayaka Mission's kirupanandavariyar medical College and Hospital, Salem between February 2021 to April 2022.

The present study was done with objective of evaluating the MRI characteristics of Uterine mass lesions, to find out the sensitivity of MRI, transabdominal ultrasound and transvaginal ultrasound in characterising uterine mass lesions and to find out the accuracy in staging the malignant mass lesions. Ethical clearance for the study was obtained from the institute's ethics committee. Total participants recruited into the study was 50. 28% were diagnosed with adenomyosis, 40% with uterine fibroids, 20% with Ca cervix, 6% with Ca endometrium and 4% with endometrial polyp.

For the diagnosis of adenomyosis, transabdominal USG was found to have sensitivity of 35.7%, specificity of 66.6%, positive predictive value of 29.4%, negative predictive value of 72.7% and diagnostic accuracy of 58%. For transvaginal USG the sensitivity, specificity, PPV, NPV were 50%, 75%, 43.7% and 79.4%, respectively. The diagnostic accuracy was found to be 68%. The MRI was found to have 78.5% sensitivity, 88.8% specificity, 73.3% positive predictive value, 91.4% negative predictive value and 86% accuracy in diagnosing adenomyosis. Out of the three modalities explored, MRI was found to be a better diagnostic modality for adenomyosis.

Exacoustus *et al.* (2011) reported the accuracy of 2D-TVS for diagnosing ultrasonography. The study stated diagnostic accuracy to be 83%. Sensitivity to be 75%, specificity to be 90%, PPV to be 86% and NPV to be 82%. While for a 3D-TVS, the diagnostic accuracy was 89%, sensitivity was 91%, specificity was 88%, PPV was 85% and NPV was 92%.

Ascher *et al.* (1994) reported that MRI was more useful a tool in diagnosing adenomyosis than TVS. The former diagnosed adenomyosis in 88.23% correctly while the latter diagnosed it in 52.94% correctly. The present study also reported a similar finding. In contrary to the present study, Reinhold *et al.* (1996) reported that TVS was as similar to MRI in diagnosing adenomyosis. He found similar sensitivity, specificity, PPV and NPV with no significant difference between them. Dueholm and Lundorf (2007) while comparing TVS with MRI discussed that with MRI one could overcome observer error. MRI could add up more information and the diagnostic performance will also increase.

For diagnosing fibroids, Transabdominal USG was found to have a sensitivity of 75%, specificity of 80%, PPV of 71.4%, NPV of 82.7% and diagnostic accuracy of 78%. Transvaginal ultrasound was found to have 90% sensitivity, 83.3% specificity, 78.2% PPV, 92.5% NPV and 86% accuracy. MRI was found to have sensitivity of 100%, specificity of 93.3%, PPV of 90.9% and NPV was 100%. The diagnostic accuracy for MRI was 96%. Of the three MRI could be considered a better diagnostic modality for fibroids in comparison to transabdominal and transvaginal USG.

Schwartz *et al.* (1998) reported a sensitivity of 95% and diagnostic accuracy of 69% for fibroids. Levens *et al.* (2009) reported a sensitivity and PPV of 80% and 91%, respectively for MRI. Levens *et al.* (2009) finding was similar to that of the present study.

Pertaining to the diagnosis of tumour mass, transvaginal USG was found to have sensitivity of 69.2%, specificity of 86.4%, PPV of 64.2%, NPV of 88.8% and accuracy of 82%. For MRI, the sensitivity was 84.6%, specificity was 91.8%, PPV was 78.5%, NPV was 94.4% and diagnostic accuracy of 90%. For operative assessment, MRI is ranked to be the most accurate tool. The accuracy of MRI was reported at 83% to 92%. MRI have excellent soft tissue contrast. In case of Magnetic resonance imaging, a T2 weighted image in high resolution where the images are taken from both sagittal and oblique plane will aid in finding the up to which the myometrium and cervix have been invaded (Patel *et al.*, 2010).

Tsuda *et al.* (1997) compared the diagnostic accuracy of USG and MRI for diagnosing endometrial invasion. The study reported an accuracy of 85% for both the tools. Ueda *et al.* (2001) reported that MRI could aid in diagnosing both endometrial carcinoma and endometrial stromal sarcoma. Chung *et al.* (2007) had reported the accuracy of MRI in diagnosing myometrial invasion, the study had found the sensitivity to be 50.6%, specificity to be 89.2% and the accuracy to be 62.5%. For differentiating between the deep and superficial disease the accuracy was found to be 83.3%.

Hricak *et al.* (1988) compared MRI with surgical finding in case of invasive carcinoma of cervix. The study reported that MRI had 91% accuracy for determining tumour location, 70% accuracy for tumour size, 93% accuracy for vaginal extension and 88% accuracy for parametrial extension. The overall accuracy was determined to be 81%. MRI also aided in accurately assessing lower uterine segment involvement and degree of stromal penetration. The accuracy of MRI was estimated to be 99% for the above lesion (Kim and Han 2013). The above findings were similar to the present study.

One of the strengths of the present study was its objective where three diagnostic modalities, TA USG, TV USG and MRI were compared against HPE in diagnosing uterine mass lesions. The present study have compared the strengths and weakness of each modality in relation to agreement, sensitivity, specificity, PPV, NPV and diagnostic accuracy. The limitations of the study lies in the fact that it is a single centre study where the type of population of more uniform. The generalizability of results have to be done cautiously.

CONCLUSIONS

MRI was found to be more accurate tool for diagnosing uterine mass lesions followed by transvaginal USG and transabdominal USG. For certain lesions like fibroids, the sensitivity was 100% and diagnostic accuracy was 96%. The diagnostic accuracy for tumour mass was 90% and that of adenomyosis was 86% in case of MRI.

FUTURE SCOPE

MRI as identified in the present study could aid in diagnosing uterine mass lesio9ne more accurately.

Conflict of Interest. None.

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