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Original Research Article

PROSPECTIVE ANALYTICAL STUDY COMPARING DIAGNOSTIC ACCURACY OF TVS & MRI

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ABSTRACT

Background: To compare diagnostic accuracy of TVS & MRI and to study the advantages and drawbacks of MRI over TVS.

Material and Methods: Prospective analytical study, patient were imaged by TVS first than MRI to look for the various features; These include shape, size, margins, internal architecture (cystic/ solid), structures, absence or extent of metastatic involvement and presence of ascites or peritoneal implants. These features on complete assessment helped to make a diagnosis or at least narrow down the differential diagnosis.

Results: Results indicated higher diagnostic capability of MRI for pre-treatment assessment of malignancies, detection of intra-lesional haemorrhage. Regarding the accuracy of TVS and MRI for diagnosis of uterine pathologies, correct evaluation was possible in 88% cases with TVS while 100% cases with MRI. Statistical analysis of these findings revealed 88% sensitivity of TVS while 100 % sensitivity of MRI, in diagnosis of uterine pathologies in case of abnormal uterine bleeding.

Conclusion: MRI is relatively safe, non-operator dependent modality with high signal to noise ratio. It is an excellent modality for staging of uterine malignancies, it has superior soft tissue contrast & large field of view. All these features offer a distinct advantage over TVS in assessment of uterine pathologies.

Keywords: Uterine malignancies, TVS [Transvaginal Ultrasound], uterine pathologies, MRI [Magnetic Resonance Imaging]

INTRODUCTION

Abnormal uterine bleeding (AUB) is a common reason for women of all age groups to consult physicians. The most probable etiology of abnormal uterine bleeding depends on patient's reproductive age. The specific diagnostic approach depends on whether the patient is premenopausal, perimenopausal or postmenopausal. In premenopausal women with normal findings on physical examination, the most likely diagnosis is dysfunctional uterine bleeding (DUB) secondary to anovulation, and the diagnostic investigation is targeted at identifying the etiology of anovulation. In perimenopausal women cycles shorten and often become intermittently anovulatory.

Ultrasound is an important technique for imaging of soft tissues. It provides images in real time, so relative movements between different structures can be observed. Ultrasound has many advantages in routine imaging. It is relatively inexpensive, provides multiplanar views, is widely available and does not use ionising radiations. Patients readily accept an ultrasound examination because the preparation is minimal. TVS allows to identify endometrial diseases (atrophy, polyps or diffuse hyperplasia), endometrial carcinoma, myometrial disorders (adenomyosis, leiomyoma or vascular abnormalities), and adnexal disorders.

MR imaging is gaining widespread acceptance and, in many instances, is a cost-effective tool in the evaluation of abnormal uterine bleeding. The role of MRI in gynaecology has evolved during the last two decades. MRI is still relatively expensive.MRI provides sensitivity to the physio-chemical microenvironment of the protons by exploiting differences in the proton response in the radio-

frequency excitation varying according to proton density of tissue component. Advantages of MRI include superb spatial and tissue contrast resolution, nonuse of ionizing radiation, multiplanar capability and fast (i.e. Breathhold and breathing independent) techniques. MRI is the technique of choice for patients with allergies to iodinated IV contrast media or impaired renal functions.

Although ultrasonography remains the initial modality used in evaluating clinically suspected gynaecologic disease, MRI can offer supplemental diagnostic information in cases of suboptimal or equivocal ultrasound examination, and in patients in whom there is discrepancy between sonographic findings and physical examinations. As MR imaging is devoid of ionizing radiation, it has been used successfully to evaluate pregnant patients who have acute pelvic pain.

MATERIALS AND METHODS

Criteria for Selection -The study was conducted on 50 women with complaint of abnormal uterine bleeding, like polymenorrhoea, oligomenorrhoea, menorrhagia, visiting our diagnostic centre.

Study design-Prospective analytical study

Setting- Okay diagnostic and research centre Pvt. Ltd. Jaipur Rajasthan

Equipment -For USG GE Voluson 730PRO / ATL HDI 3500. For MRI imaging SIGNA 1.5T LX system with K4 magnet and SGI octane computer.

Patient preparation and method of examination

Transvaginal ultrasound examinations were performed to evaluate the uterine pathologies in case of abnormal uterine bleeding. TVS was done with empty bladder and transvaginal probe with higher frequency i.e. 7-9 MHz was used with consequent improved spatial resolution. The probe was covered with a protective sheath – usually a condom – and adequate coupling gel was applied, with the patient in the lithotomy position after having emptied her bladder.

For MRI, patients were imaged with an empty bladder after fasting for at least 4 hours. Imaging was performed with the patient supine. A phased array coil was used in most cases. In both T1W and T2W axial, sagittal, coronal planes were evaluated. T1W images offer excellent contrast between the pelvic organs and adjacent fat, allow optimal detection of lymphnodes and are necessary for tissue and fluid characterization (essential for haemorrhagic and fat containing lesions). T2W images sequences are needed to demonstrate the zonal anatomy of the uterus and vagina and to facilitate the identification of normal ovaries. In addition T2W images are usually superior in depicting pathologic conditions of uterus and ovaries.

Patient were imaged by TVS first than MRI (performed within a short interval of 1-2 days to avoid any change in the mass that might occur because of cyclical bleeding) to look for the various features; These include shape, size, margins, internal architecture (cystic/ solid), structures, absence or extent of metastatic involvement and presence of ascites or peritoneal implants. These features on complete assessment can help to make a diagnosis or at least narrow down the differential diagnosis.

RESULTS

Out of 50 patients, maximum no. of patients (29) were in age group > 45 years. Multipara were affected significantly more than nullipara. Common lesions encountered on imaging were benign uterine lesions (endometrial hyperplasia, endometrial polyp, fibroids & adenomyosis) and malignancies (endometrial carcinoma & cervical carcinoma).

Internal architecture of smaller lesions was better seen by TVS. In case of larger lesions MRI was best because TVS was less informative. By MRI in 54% cases we got newer information than TVS and in 46% cases similar information with improved imaging. Better pre-treatment assessment of malignancy was possible with MRI with evaluation of invasion, encasement, lymphadenopathy, ascites and peritoneal implants.

In case of abnormal uterine bleeding, uterine pathologies are more common in multipara than nullipara. In case of abnormal uterine bleeding, uterine masses and malignancies are more common in multipara than nullipara. Cervical carcinomas are more common in multipara than nullipara. Endometrial pathologies are more common in multipara than nullipara. Cervical pathologies are also more commonly seen in women with age group > 45 years. In our study, out of 17 cases of cervical pathologies, 70.5 % cases were seen in women with age group > 45 years. Only 5 cases of cervical pathologies were seen in age group < 45 years.

Regarding the accuracy of TVS and MRI for diagnosis of uterine pathologies, correct evaluation was possible in 88% cases with TVS while 100% cases with MRI. Statistical analysis of these findings revealed 88% sensitivity of TVS while 100 % sensitivity of MRI, in diagnosis of uterine pathologies in case of abnormal uterine bleeding. MRI provides new information in 62% cases of uterine masses and 54% of total uterine pathologies. In 37.9% cases of uterine masses MRI provides similar information with improved imaging. These informations are related to spread of lesion, internal consistency (such as fat, hemorrhagic content) in most of the cases. Two cases of adenomyosis were included in my study, both of which were diagnosed equally well on both TVS and MRI, suggesting that both modalities are equally and highly (100%) sensitive for diagnosis of adenomyosis.

Statistical Analysis

The collected data was summarized by using frequency, percentage, mean & S.D. To compare the qualitative outcome measures Chi-square test or

Fisher's exact test was used. To compare the quantitative outcome measures independent t test was used. If data was not following normal distribution, Mann Whitney U test was used. SPSS version 22 software was used to analyse the collected data. p value of <0.05 was significant.

In 50 cases of uterine pathologies, in case of abnormal uterine bleeding, 88 % were correctly diagnosed on TVS while incorrect diagnosis was made in 12% cases. sensitivity of TVS for uterine pathologies (in case of abnormal uterine bleeding) is 88 % while MRI showed 100 % sensitivity for this. [Table 2]

Ascites was detected in all 10 cases by both TVS & MRI. Invasion was detected in all 10 cases by MRI while in only 4 cases by TVS. Encasement was detected in one case by MRI, which was undetected on TVS. MRI detected distant metastases in all 9 cases, while none one of them was detected by TVS. [Table 3]

Sensitivity of TVS for detection of ascites is 100 % while for invasion it is only 40 %. None of distant metastases was detected by TVS. [Table 4]

In 50 cases of uterine pathologies (in case of abnormal uterine bleeding), MRI provided newer information in 54% cases and in 46% cases MRI gave similar informations with improved imaging. [Table 5]

In 37 cases of uterine masses, MRI provided newer information in 62% cases and in 38% cases MRI gave similar informations with improved imaging. [Table 6]

Table 1: Distribution of uterine pathologies according to parity

Parity	Uterine Pathology
Nulliparous-married	13(26%)
Multiparous	37 (74%)
Total	50

Table 2: Comparison of TVS and MRI sensitivity for diagnosis of uterine pathologies

	TVS	MRI
Correct diagnosis	44 (88%)	50 (100%)
Incorrect diagnosis	6 (12%)	0
Total cases	50	50
Sensitivity	88%	100%

Table 3: Comparison of TVS & MRI for staging of uterine malignancies

Staging features	TVS	MRI
Ascites	10	10
Invasion	4	10
Encasement	0	1
Distant metastases	0	9

Table 4: TVS sensitivity for various staging factors

	Ascites	Invasion	Distant metastases
Detected	10	4	0
Missed	0	6	9
Total	10	10	9

Table 5: Comparative features of TVS and MRI in uterine pathologies

	No. of cases
MRI provide newer information	27 (54%)
Similar information with improved imaging	23 (46%)

Table 6: Comparative features of TVS and MRI in uterine masses

	No. of cases
MRI provide newer information	23 (62.1%)
Similar information with improved imaging	14 (37.9%)

Table 7: Comparison between TVS and MRI on diagnostic accuracy for uterine pathologies

		TVS	MRI
Adenomyosis	Diagnosed	2	2
	Missed	0	0
Fibroids	Diagnosed	18	18
	Missed	0	0
Ch. cervicitis	Diagnosed	0	5
	Missed	5	0
Endometrial hyperplasia	Diagnosed	3	3
	Missed	0	0

DISCUSSION

MRI has become an important modality in the uterine imaging; USG remains the examination of choice in patients with suspected benign gynaecological disease, given its relative safety and lower cost. However, USG may be limited by technical considerations (e.g. operator dependence, patient's body habitus, low signal noise ratio) and is inadequate in staging pelvic malignancies. MRI is also safe because of no radiation exposure as is in the USG. MRI is considered the next step in the imaging assessment of benign disease of the uterus & adnexa and is becoming the primary imaging modality for evaluating gynaecologic malignancies. The multi-planer imaging capability of MRI, superior soft tissue contrast and large field of view offer distinct advantages over both USG and CT (Computer Tomography) in the assessment of gynaecologic abnormalities. Sonography is routinely used for evaluation of pelvic masses but the anatomy of the female pelvis is shown in exquisite detail by MR imaging. MR imaging also has clear indications for pretreatment assessment of uterine malignancies and tissue characterization of adnexal masses.

This study was aimed at comparing the role of TVS and MRI for evaluation of uterine pathologies in case of abnormal uterine bleeding. We evaluated 50 patients with abnormal uterine bleeding, referred to our centre. All patients underwent both TVS and MRI examination. Correlative study of all these patients was done. Final diagnosis was obtained by histopathological examination in those cases which underwent surgical procedures, while in others MRI findings were considered as final diagnosis.

OA Oguntayo et al conducted a retrospective study with 406 patients of gynaecological malignancies. The result was similar to our study that cervical carcinoma is associated with high parity. Endometrial pathologies as a cause of abnormal uterine bleeding were more common in multipara (94.1%) than nullipara (5.9%). Cecelia H Boardman et al reported that incidence rates of late-stage cervical cancer were highest among women aged 50-79 years .However, cervical cancer may be diagnosed in any woman of reproductive age. Their result supports our study. According to Christine H Holschneider, MD et al, occurrence of invasive cervical cancer is related to age, with a mean age at diagnosis of 47 years.

Elwood JM et al (1977),21 did a case-control study on cancer of the endometrium. 440 cases were drawn from nearly all hospitals in the area; controls were drawn at random from the general population. According to that study age-adjusted incidence rate was 18.1/100,000 woman-years, with a peak at ages 55-59 and a gradual decline thereafter. These results are similar to our study for endometrial cancers. In our study 7 cases of endometrial carcinomas were included and all of them (100%) were seen in post-menopausal women. 'P' value of this statistical analysis is < 0.05 suggestive of significant association between endometrial carcinomas and menopausal status.

Jing Wang Chiang et al studied epidemiology of uterine cancers, they concluded that 75% of endometrial carcinomas occur in post-menopausal patients. David M. Purdie et al (2003) studied epidemiology of endometrial cancer. According to him endometrial cancer is the commonest gynaecological cancer and it mostly affect women of the postmenopausal age group. These results also are like our study.

Marc bazot et al, did a prospective study with 120 consecutive patients, referred for hysterectomy. For adenomyosis sensitivity, specificity and positive and negative predictive values of TVUS were 92.8% and 73.8 and 88.8% respectively. Sensitivity, specificity and positive and negative predictive values of MRI were 77.5, 92.5, 83.8 and 89.2% respectively. No difference in accuracy was found between TVUS and MRI but sensitivity was lower with sonography in women with associated myomas. So they concluded that TVUS is as efficient as MRI for the diagnosis of adnomyosis in women without myoma, while MRI could be recommended for women with associated leiomyoma.

C Reinhold ET AL did a prospectively study with 119 consecutive patients undergoing hysterectomy. The endovaginal US scans and MR images were interpreted independently in a double-blind fashion. They concluded endovaginal US was as accurate as MR imaging in the diagnosis of uterine adenomyosis. Their result supports our study.C Reinhold, M Atri ET AL worked on "Diffuse uterine adenomyosis: morphologic criteria and diagnostic accuracy of endovaginal sonography." They performed endovaginal US in 100 consecutive women undergoing hysterectomy for a variety of benign and malignant conditions. Adenomyosis was diagnosed when a poorly defined area of abnormal echotexture (decreased or increased echogenicity, heterogeneous echotexture, myometrial cysts) was present in the myometrium. They concluded adenomyosis of the uterus can be accurately diagnosed with endovaginal US with use of specific sonographic criteria. This study also supports that TVS has high accuracy for diagnosis of adenomyosis.

Dueholm M et al did a study to evaluate and compare the accuracy of magnetic resonance imaging and transvaginal ultrasonography in myoma diagnosis, mapping, and measurement. That was a double-blind study of 106 consecutive premenopausal women who underwent hysterectomy for benign reasons. Magnetic resonance imaging and transvaginal ultrasonography myoma diameter measurements had equal and high accuracies in patients with 1 to 4 myomas. They concluded that transvaginal ultrasonography is as efficient as magnetic resonance imaging in detecting myoma presence, but its capacity for exact myoma

mapping falls short of that of magnetic resonance imaging, especially in large and multiple-myoma (>4).

Nishimura H, Zhang et al concluded in their study that since MRI features of most of soft tissue masses are non-specific, prediction of specific histological diagnosis remains challenge, however there are certain specific MRI appearance which are helpful for more accurate diagnosis such as myxoid stroma, collagen fibres, calcification, fat. These feature help in limiting differential diagnosis. Encasement, invasion of surrounding structure including parametrium, ureter, rectum and lateral pelvic wall musculature were better defined by MR Imaging for staging of carcinoma of cervix.

Bernard P, Buhler K, Shumacher, T. Kuper K. et al studied 30 cases of carcinoma cervix and concluded that the MRI is the only test that can be carried out before therapy to give a tri-dimension assessment of the size of tumour and whether it has spread into the parametrium or not.

In patients who have indeterminate ultrasound, MR imaging has high accuracy for detecting the cause of pain and usually requires no contrast material. Acute conditions that may be diagnosed on MR imaging include degenerating fibroids. Occasionally it may be impossible to determine the exact origin of the mass by the sonography and MRI may be helpful. A tailored MRI may be used to help clarify and confirm cases that are not as definitive sonographically. On MRI fibroids also present a variable appearance. They are usually low signal such that pedunculated ones can mimic feces However, degenerated fibroids can have moderately high signal intensity on T2w scans. There may even be a peculiar nodular appearance to massive myomas that can mimic an ovarian malignancy. The definitive diagnosis can be made by showing the stretching of myometrium around the base of lesion. This, the most definite sign. is much better appreciated on MRI than sonography.

CONCLUSION

Results indicated higher diagnostic capability of MRI for pre-treatment assessment of malignancies, detection of intra-lesional haemorrhage. MRI is relatively safe, non-operator dependent modality with high signal to noise ratio. It is an excellent modality for staging of uterine malignancies, it has superior soft tissue contrast & large field of view. All these features offer a distinct advantage over TVS in assessment of uterine pathologies.

Declarations

Funding: None **Conflicts of interest/Competing interests**: None **Availability of data and material**: Okay diagnostic and research centre Pvt. Ltd. Jaipur Rajasthan **Code availability**: Not applicable **Consent to participate**: Consent taken **Ethical Consideration**: There are no ethical conflicts related to this study. **Consent for publication**: Consent taken.

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