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Specificity and Sensitivity of Ultrasound and Magnetic Resonance imaging in Uterine Anomalies

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ABSTRACT

To estimate the specificity and sensitivity of two - dimensional Ultrasound for diagnosing Uterine anomalies and Magnetic Resonance Imaging Ultrasound has 90 % sensitivity and 98 % specificity in detecting uterine anomalies. MRI has 100 % has 100 %sensitivity and 100 % specificity in detecting uterine anomalies. Patients with uterine anomalies present with Primaryamenorrhoea, infertility, menorrhagia, secondary amenorrhoea, repeated miscarriages and pelvic pain. Most common age at the presentation of symptoms is 21-30 yrs followed by 11 -20 yrs, 41-50 yrs and 31-40 yrs respectively. USG has only 12.5 % sensitivity in detecting unicornuate uterus, but in case of other uterine anomalies it has a good sensitivity. Thus MRI is considered better in diagnosing uterine anomalies and all those cases diagnosed with ultrasound and MRI were correlated with hysteroscopy and lap surgery.

Keywords: Magnetic Resonance Imaging, ultrasound andanamalies

1. INTRODUCTION

Uterine malformations make up a heterogenous group of congenital anomalies that can result from the underdevelopment of the Mullerian ducts, disorders in their fusion and/or alterations in septum resorption. The prevalence of uterine malformations is difficult to establish. They are estimated to occur in 0.4% (1,2) of the general population and in 4% of infertile women, and in patients with repeated spontaneous miscarriages the figures fluctuate between 3 – 38%.(3-7) The discrepancy among different publications stems from their use of different diagnostic techniques, heterogenous population samples and the clinical diversity of Mullerian anomalies.

There are several classifications of uterine malformation, but the most widely accepted is t hat established in 1988 by the American Fertility Society (AFS)(8), [now American Society of

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Reproductive Medicine] which is not only based on embryological factors, but also takes into account clinical factors, prognosis and treatment.

There are two techniques which is indeed relevant for the diagnosis: Magnetic Resonance Imaging (MRI) and Ultrasound. While MRI is a useful option in the diagnosis of Mullerian anomalies, with numerous studies having proved its excellent efficacy in this field (9-12), Ultrasound represents a valid alternative, because in addition to its lower cost and better tolerance by patients, it provides images of very similar quality in experienced hands, to those yielded by MRI (13)

There is a lack of studies comparing these 2 techniques for the diagnosis and categorisation of Uterine malformations. Hence the present study was done to determine the specificity and sensitivity of Ultrasound and Magnetic Resonance Imaging in diagnosing Uterine anomalies.

2. MATERIALS AND METHODS

SOURCE OFDATA

A prospective study was performed with 40 women between August 2016 and September 2018 (period of 2 years) who were referred to our hospital with clinical complaints of Infertility, Miscarriage, Primary amenorrhea . Informed consent was taken from each patient and they were instructed to be on fasting for atleast 4 -6 hrs before the scan time. Each patient underwent ultrasound examination, followed by MRI within a period of 1 week.

1) INCLUSIONCRITERIA

- Patients with clinically suspected Mullerianduct anomalies.
- Age group between 14 to 44years.
- Patients with Infertility , Miscarriage, Primary amenorrhoea
- Patients willing to undergo thisstudy

2) EXCLUSIONCRITERIA

- Any absolute contraindication for MRI like metal

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implants/ ferromagnetic substance in thebody.

- Patients who refused MRIexamination.

Magnetic resonance imaging of pelvis was performed with HITACHI APERTO machine. A pelvic phased array coil was used in most cases; in cases where lesions were large, a body coil was used for better coverage. The following sequences wereobtained:

1. Axial Tl-weighted spin echo images from the renal hilum to the symphysispubis (TR/TE 400 -640 ms/10- 14 s, slice thickness 5 - 8 mm, gap 1-2 mm,field of view 24-38 cm, NEX 1-2,matrix 256x192-256.
2. Axial T2-weighted fast spin echo images of the pelvis (TR/TE 4000-6000 ms/90-110 mseffective, echo train length 8, slice thickness 5 -7 mm, gap 1-2 mm, field of view 24-38 cm, NEX 2,512x256 matrix).
3. Sagittal T2-weighted fast spin echo images from one femoral head to the other (TR/TE 400O- 6000 ms/90- 110 ms, echo train length 8, slice thickness 5 -7 mm, gap 1-2 mm, field of view 24 - 32 cm, NEX 2, 512x256 matrix).

STATISTICAL ANALYSIS:

The US and MRI characterization of the subjects was compared with the final diagnosis based on hysteroscopy / laparoscopy. Data were analyzed with student t test/ z test. Chi square test was adopted (with the Yates correction as appropriate) for categorical variables. Descriptive statistical values including sensitivity, specificity, and positive and negative predicative values were determined.

3. RESULTS AND DISCUSSION

Table 1 – Age distribution

Table shows the distribution of age group amongst the patients taken for the study. It is observed that maximum cases fall under age group 21 -30 years (47.5%), followed by age group 11-20 years (35%). Maximum patients were under younger agegroup.

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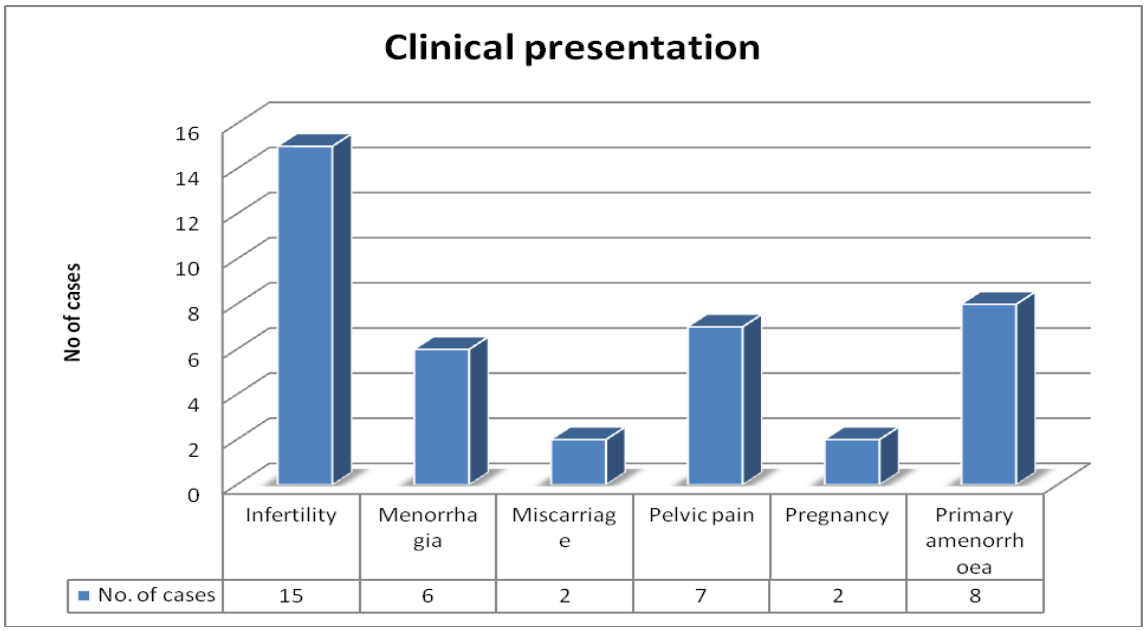
Age group (years)	No. of cases	Percentage
11-20	14	35%
21-30	19	47.5%
31-40	03	7.5%
41-50	04	10%
Total	**40**	**100%**

FIG 1: Clinical presentation

Graph showing incidence of clinical presentations in cases taken for thestudy



In our study 40 patients between the age of 11 -50yrs were selected. And 2D ultrasound was done for everyone. And 3D ultrasound was also done to confirm the uterine anomaly. Among 40 Cases 7 Cases were misinterpreted as normal by 2D ultrasound. But with thehelp of3D ultrasound we were able to find out the patients had unicornuateuterus.

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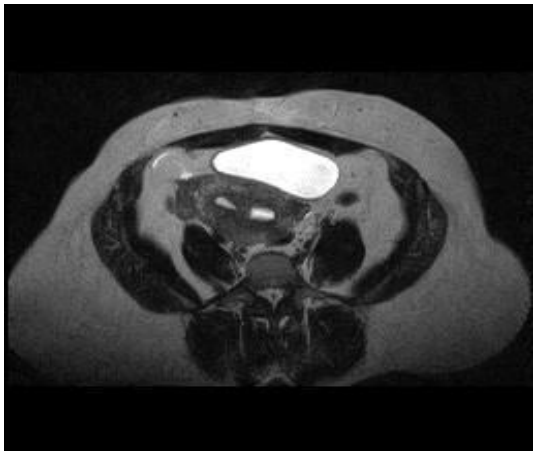
FIG 2: MRI T2w image axial section demonstrating two separate uterine cavities in a bicornuateuterus.



Then all the patients with uterine anomaly were screened with MRI. MRI study diagnosed all the 40 cases were having uterine anomalies, including the 7 cases with unicornuateuterus which was misinterpreted by 2D ultrasound as normal. Thus MRI is considered better in diagnosing uterine anomalies and all those cases diagnosed with ultrasound and MRI were correlated with hysteroscopy and lapsurgery.

FIG 3: **MRI T2w image coronal section demonstratestwo separate horns**

MRI T2w image coronal section demonstratestwo separate horns with two separate uterine cavities and a unilateral right sided kidney, Uterus didelphys withrenal anomaly.

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FIG 4: USG findings

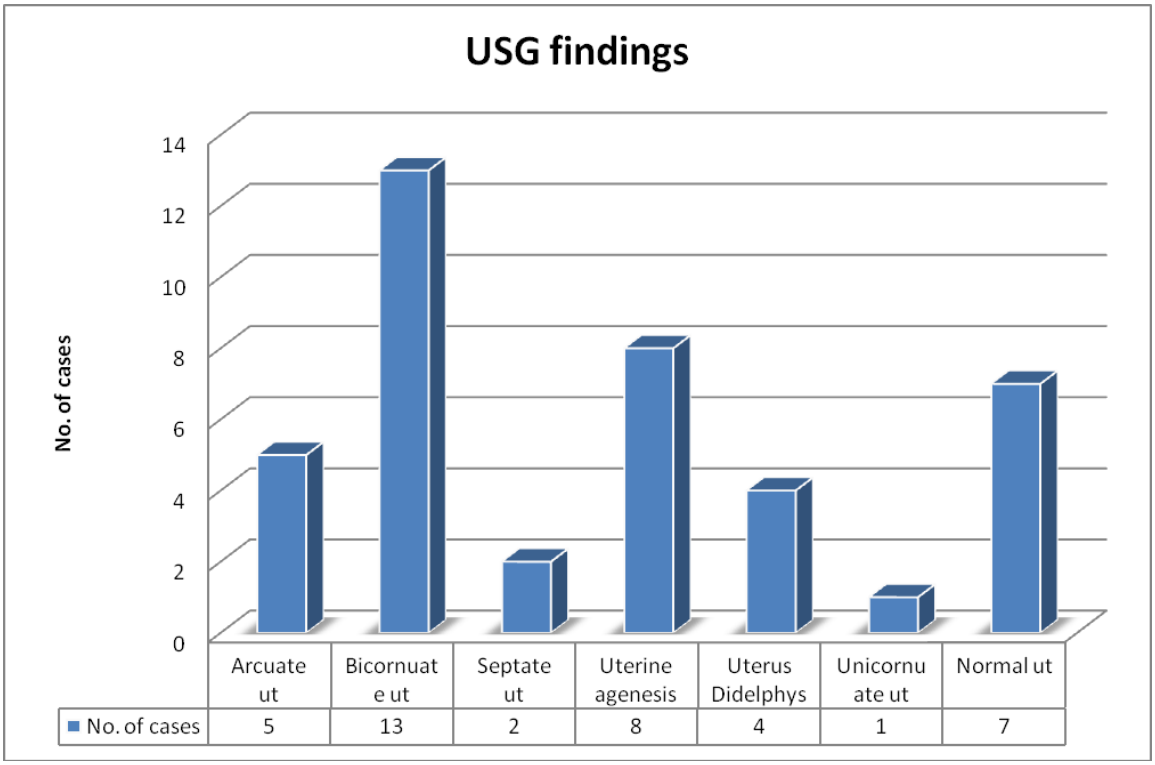

FIG 5: MRI T2w image coronal section demonstrates Bicornuate uterus.

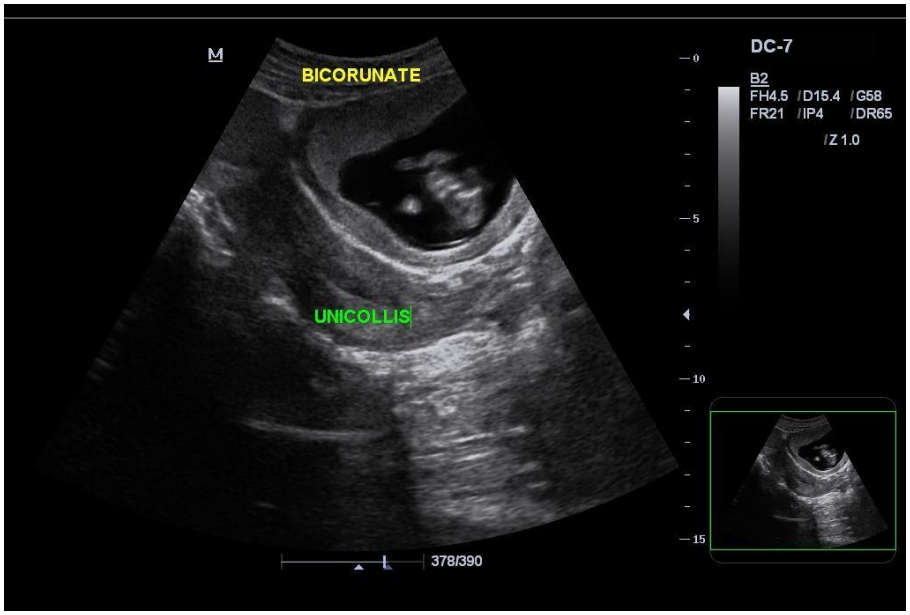

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Table 2: MRI findings

Findings	No. of cases	Percentage
Arcuateut	05	12.5%
Bicornuateut	13	32.5%
Septateut	01	2.5%
Uterine agenesis	08	20%
Uterus Didelphys	04	10%
Unicornuateut	08	20%
SubseptateUt	01	2.5%
Normal ut	00	0
Total	**40**	**100%**

FIG 6: MRI T2w image axial section demonstrates Arcuate uterus.

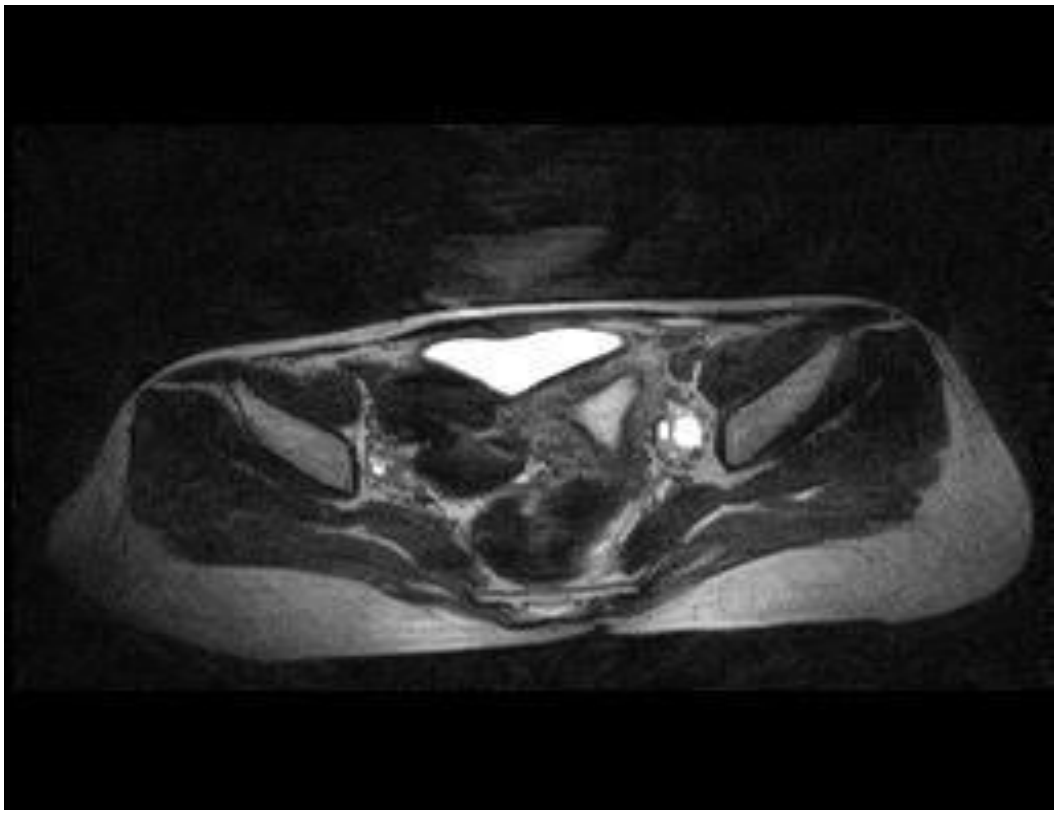

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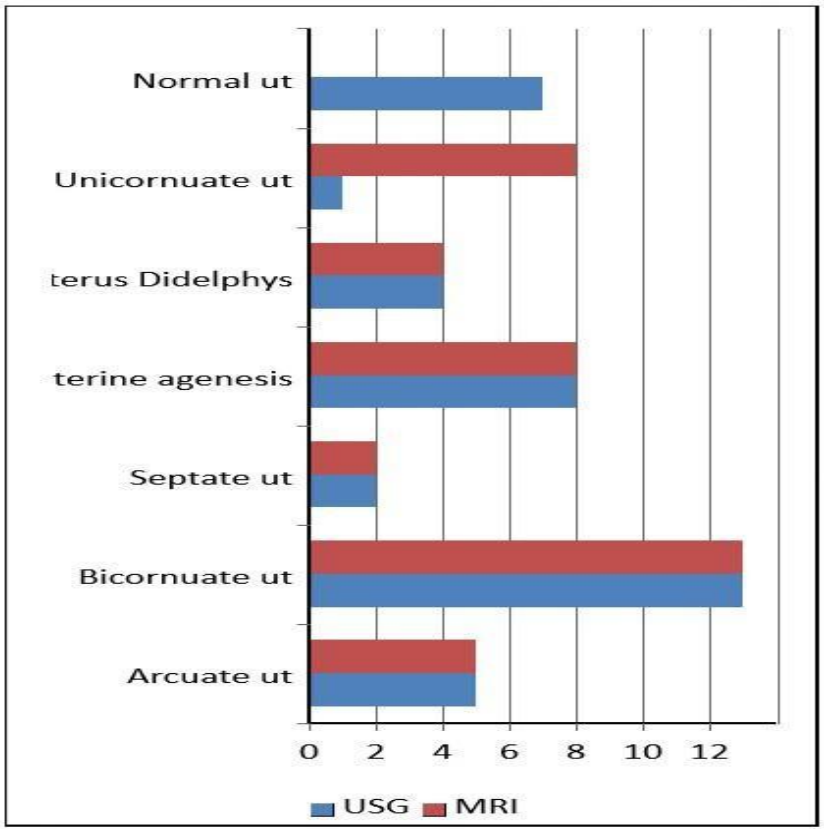
FIG 7: BarDiagram forcorrelation between Ultrasoundand MRIFindings



The Diagnostic Imaging Modalities used here in our study are Sonography Versus Magnetic Resonance Imaging were the two diagnosing modalities used in our present study.It has been shown that conventional transvaginal 2 - dimensional sonography is a good screening tool for the detection of uterine anomalies and has high sensitivity(90%–92%) for uterine anomalies (14) in adult women.

However, the ability of 2 -dimensional sonography to distinguish between different types of uterine abnormalities is limited and operator dependent.(15) Traditionally, patients have been initially screened by means of hysterosalpingography, which images only the uterine cavity. When indicated, patients would proceed to hysteroscopy, which has been considered the reference standard for assessment of the uterine cavity. Similar to hysterosalpingography, hysteroscopy does not provide information on the serosal surface of the uterus to make a clear distinction between a bicornuateand septate uterus. For this purpose, laparoscopic assessment of the external

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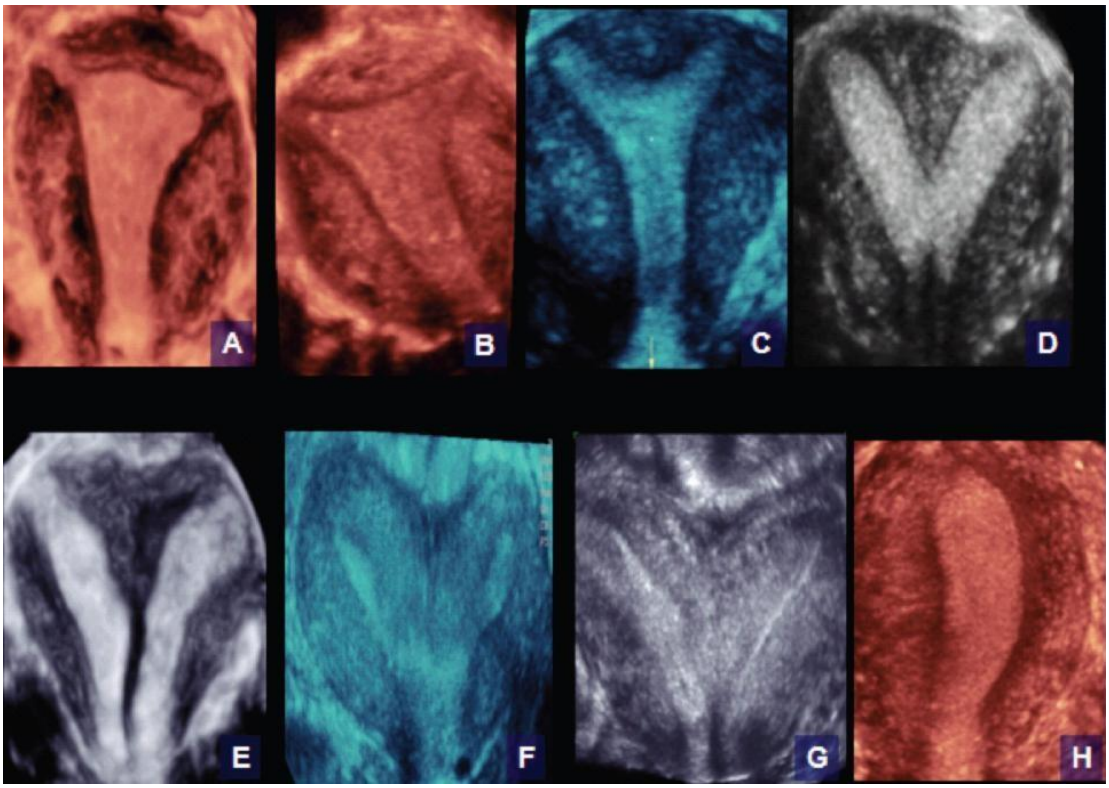
contour of the uterus would be required, making combined laparoscopy and hysteroscopy the reference standard for evaluation of mullerian anomalies.

Several authors have reported on the high accuracy of 3D sonography when comparing it with surgical findings in diagnosis of uterine anomalies.(16) Anomalies such as septate uterus, several authors reported 3D sonography to have 98% to 100% sensitivity and 100% specificity as well as positive and negative predictive values.(17,18) Jurkovic et al (19) reported 3D sonography to have 100% sensitivity for detection of a major uterine anomaly. The high degree of reproducibility of 3D sonography was evaluated by Salim et al(40) by having two blinded operators evaluate the same uterine volumes. These operators had nearly 100% agreement in the diagnosis of both normal and abnormal uteri, with only 1 disagreement in 83 cases (not statistically significant). Step 3. Place the reference/rotational point at the midlevel of the endometrial stripe in the transverse plane.

Figure 8: Coronal plane showing various congenital uterine anomalies. **A**and**B**, Normal uterus. **C**, Arcuate uterus. **D**, Subseptateuterus. **E**, Septateuterus. **F**, Bicornuateuterus. **G**, Didelphysuterus. **H**, Unicornuateuterus.



Step 4. Use Z rotation to align the endometrial stripe with the horizontal axis in the

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transverse plane of the uterus.

Step 5. After step 4, the midcoronal plane of the uterus will be displayed in plane C; apply the Z rotation on plane C to display the midcoronal plane in the traditional orientation.

Magnetic resonance imaging is similar to 3D sonography and the reference standard of laparoscopy and hysteroscopy in that it allows the physician to evaluate both the uterine cavity and the uterine fundus. Although costly,

patients) have evaluated the efficacy of MRI in detection of uterine anomalies. They concluded that MRI had 77% to 100% specificity and 33% to 100% sensitivity in the diagnosis of congenital uterine anomalies.(20-23) For a specific uterine anomaly such as a septate uterus, the sensitivity of MRI varied from 28% to 100%, with specificity of 66% to 100%.(49)

Three-dimensional sonography is a simple, quick, and noninvasive technique for detecting and diagnosing uterine anomalies without the use of ionizing radiation or the iodine contrast agents needed for hysterosalpingography, as well for differentiating intracavitary, submucosal, intramural, and subserosal abnormalities. It appears to be at least as accurate as MRI in the diagnosis of uterine anomalies with less expense and more tolerability.(24,25)

CONCLUSION

Though Ultrasound is the primary investigation which is easily available, cheap and non-radiation to screen and detect uterine anomalies, Magnetic Resonance Imaging is more specific and sensitive for detection of uterine anomalies than Ultrasound.

As MRI is not available in all centers , and is costly and some patients may complaint of claustrophobia, Ultrasound may be considered as an alternate modality to diagnose uterine anomalies. In the present study Ultrasound showed 90% sensitivity and 98 % specitficity. Whereas MRI showed 100% sensitivity and 100 % specificity.Patients with uterine anomalies present with primary amenorrhoea, infertility, menorrhagia, secondary amenorrhoea, repeated miscarriage and pelvic pain.Most common age at the presentation of symptom is 21-30 yrs followed by 11 -20 yrs and 41-50 yrs and 31-40 yrs respectively.

Most common symptom at the time of presentation is infertility followed by primary amenorrhoea, pelvic pain, menorrhagia and miscarriage. Most common uterine anomaly detected by ultrasound and MRI is bicornuate uterus. MRI has 100 % sensitivity in detecting uterine

anomalies. Ultrasound has 12.5 % sensitivity in detecting unicornuate uterus. Thus MRI is better in diagnosing unicornuate uterine anomaly.

Ultrasound failed to detect subseptate uterus which was detected by MRI. Thus MRI is considered better in diagnosing uterine anomalies and all those cases diagnosed with ultrasound and MRI were correlated with hysteroscopy and lap surgery.

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Ethical approval: The study was approved by theInstitutional Ethics Committee

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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