International Journal of Research in Medical Sciences
Goyal A et al. Int J Res Med Sci. 2020 Jun;8(6):2173-2179
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20202262

Original Research Article

A comparative study between magnetic resonance imaging and transvaginal sonography for evaluation of uterine fibroid using histopathology as a gold standard

Alka Goyal[1], Deeksha Mehta[2]*, Naresh K. Mangalhara[1], Sunita Poonia[1]

[1]Department of Radiodiagnosis, [2]Department of Surgery, SMS Medical College and Hospital, Jaipur, Rajasthan, India

Received: 28 March 2020
Accepted: 29 April 2020

***Correspondence:**
Dr. Deeksha Mehta,
E-mail: deeksha_doc@yahoo.co.in

ABSTRACT

Background: Uterine fibroids constitute a substantial bulk of patients presenting to Gynaecology department. Many newer imaging modalities have evolved for their correct evaluation, but in a developing country like India, ultrasound is still being used as a screening as well as diagnostic modality. So, this study was done to compare ultrasound and magnetic resonance imaging for evaluation of uterine fibroids in terms of their sensitivity, specificity Trans vaginal and positive predictive value using Histopathology as a gold standard so as to improvise on current clinical practices in this country.
Methods: An ethically approved prospective study was done upon 50 patients with suspected uterine masses at SMS Hospital Jaipur. All included patients underwent Trans vaginal Ultrasound (TVS) and Magnetic resonance imaging (MRI) and were accordingly treated surgically. Histopathology report was traced postoperatively. Data was collected and subjected to various statistical tests including Cohen's kappa.
Results: Most of the patients were <50 years and presented with complains of pain abdomen. Among total 50 cases, the sensitivity of TVS and MRI was 44% and 92%, specificity was 96% and 88%, PPV was 91.67% and 88.46%, NPV was 63.16% and 91.67% respectively, kappa was 0.40 and 0.80 i.e. agreement between TVS and MRI v/s HPE was 40% and 80% respectively. The diagonal agreement between transvaginal USG and MRI, was 63%.
Conclusions: TVS is a good screening modality but MRI is definitely better for proper characterization and localization of fibroids enabling clinicians to select the most appropriate management in everyday clinical practice.

Keywords: Histopathology, Magnetic resonance imaging, Myoma, Transvaginal ultrasound, Uterus

INTRODUCTION

Mass lesions in the uterus are a commonly encountered problem all over the world. Over the years many imaging modalities like Transabdominal ultrasound, Transvaginal ultrasound (TVS), Colour Doppler, Hysterosonosalpingography, Computerised Tomography, Magnetic Resonance Imaging (MRI) have been tried to characterise fibroids. But, even today ultrasound is the screening imaging modality of choice. Definitive characterisation of the lesion is important to decide on the treatment modality. For example, in case of myoma, myomectomy or hysterectomy can be done depending upon its characteristics.[1,2] This states the need for a definitive preoperative diagnosis.

In cases of submucosal fibroid, if the endometrial surface circumference is more than 50% it can be resected hysteroscopically, otherwise it should be resected laparoscopically. Similarly, for intramural fibroids, depending on the number and site of the lesion, laparoscopic resection or hysterectomy can be planned. It states the need for exact location and extent of the lesion by various measurements like size and circumference.[2]

The continuing need for better imaging modality for definitive characterisation of uterine mass lesions led to the use of MRI as a diagnostic tool in preoperative evaluations. MRI is a recently devised modality which is done in sagittal, axial and coronal planes using body surface coil in T1 and T2 weighted sequences.

This study involved the detailed evaluation of uterine fibroids like number, location, size, other measurements, degenerative changes and their extent using TVS and MRI.

The study further aimed to assess and compare these two modalities in characterising uterine fibroids and to compare their sensitivity and positive predictive values for diagnosis using Histopathology (HPE) as a gold standard.

METHODS

A prospective hospital based descriptive type of observational study of 50 patients with suspected uterine masses referred from attached hospitals of Obstetrics and Gynaecology was done in department of radio-diagnosis and modern imaging at SMS medical college and attached hospitals, jaipur. This study confines to the ethics and was done with the informed written consent and full co-operation of the patients.

All patients were subjected to Transvaginal Ultrasound and MRI examination. Then depending upon the final diagnosis, patients underwent endometrial curettage, myomectomy or hysterectomy. Final histopathological report was taken as a gold standard to compare the findings and the final diagnosis of each imaging modality.

Grey scale Transvaginal Ultrasound was performed using a nemio XG Toshiba machine; equipped with 5.0-8.0 megahertz Transvaginal probe. MRI was performed using PHILIPS 3 tesla MRI machine.

Transvaginal Ultrasound was done with empty bladder and the following uterine parameters were noted:

- The size of the uterus
- Contour
- Endometrial thickness and any indentation
- In the myometrium, presence of any myoma, if so location like submucous, intramural and subserosal, number of lesions, echogenicity of the lesions, areas of calcification, cystic change within the lesion and shadowing were noted (Figure 1a, 2a and 3a).

MRI pelvis

Patients were placed in supine position in MR gantry. Various MRI characteristics of uterine fibroids noted same as in TVS with additional descriptors like relation to endometrium, cystic degeneration and number (Figure 1b, 2b and 3b).

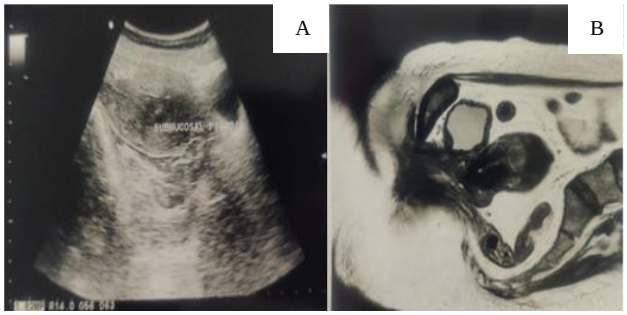

Figure 1: (A) Small submucosal fibroid on TVS (B) T2 weighted sagittal image showing mixed intensity submucosal fibroid.

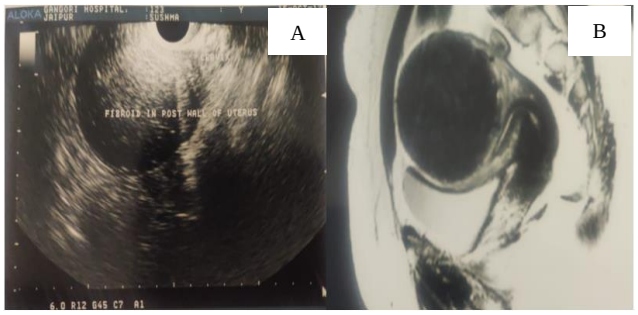

Figure 2: (A) Large subserosal fibroid on TVS in posterior uterine wall, (B) Homogenously T2 hypointense fibroid in posterior wall in fundo-carpal region.

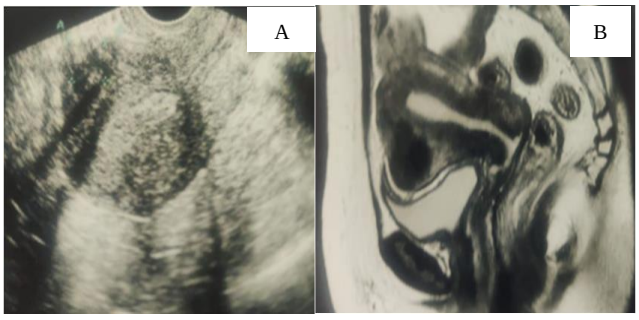

Figure 3: (A) Small intramural fibroid in anterior wall on TVS, (B) T2 hypointense fibroid in anterior uterine wall in sagittal image.

Technique used

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) (Figure 4, 5, 6).

Inclusion criteria

- All patients referred from attached hospitals of Gynaecology and Obstetrics suspected to have

uterine mass lesions willing to undergo TVS were included in the study.

- All patients having uterine Fibroid on TVS and willing to undergo MRI and surgery were included in the study.

Figure 4: Saggital plan.

Exclusion criteria

- Patients who didn't undergo both TVS and MRI.
- Not operated or non-availability of the histopathological examination report.
- Patient with MR incompatible devices or implants.
- Patients with Claustrophobia.

The ability of MRI and TVS to characterize and diagnose the uterine fibroids were compared with histopathological findings and were analysed, using various statistical tests. MR characteristics of each lesion were also evaluated. The final histopathological findings after hysterectomy, myomectomy or fractional curettage were accepted as the reference standard against which the transvaginal ultrasound and MRI imaging findings were compared.[11-13]

Figure 5: Oblique coronal plan.

Figure 6: Oblique axial plan.

Table 1: The sequences used were.

Sequences	Repitition time (TR)	Echo time (TE)	FOV	No. of slices	Slice thickness	Matrix size
T1 weighted axial	529	8	300	22	5	256X256
T2 weighted axial	2402	100	300	22	5	256X256
T2 weighted coronal	2609	90	300	22	5	256X256
T2 weighted sagittal	2321	90	240 (AP) 240 (FH) 119 (RL)	22	5	256X256
T2 weighted STIR axial	3254	80	300	22	5	256X256

Diagonal agreement, Cohen's Kappa were calculated comparing two modalities like Transvaginal USG and MRI, in detecting mass lesions in the uterus. Percentage of diagonal agreement implies number of cases detected as same final outcome regarding the presence of mass in both the modalities. Sensitivity, specificity, positive predictive values, negative predictive values and Kappa values were calculated for each modality for all cases coming under each final diagnosis and finally compared.

Cohen's Kappa is used to compare the correlation between the modalities. The values of Kappa were classified as <0.4 poor correlation, 0.4-0.8 good correlation and >0.8 excellent correlation (Table 2).

Table 2: Strength of correlation as per Kappa values.

Kappa value	<0.4	0.4 - 0.8	>0.8
Correlation	Poor	Good	Excellent

RESULTS

Data was subjected to the above mentioned materials and methods and the following results were obtained.

Starting from the chief complaints of the patients, most common presenting complaint was noticed as pain followed by menorrhagia followed by lump abdomen (Table 3).

Table 3: Distribution of patients in relation to complaints.

Presenting Complaints	Total	Percentage
Menorrhagia	30	58
Pain	41	82
Mass	16	34

Secondly, the age of the patients was noted and it was found that most of the patients in this study were young (<50years) and premenopausal (Figure 7).

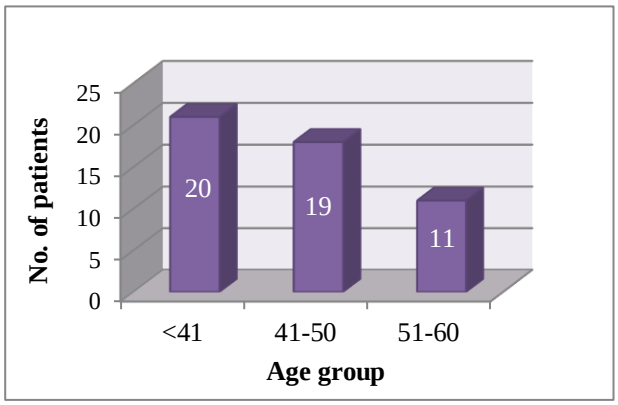

Figure 7: Distribution of patients in relation to age.

Now, the two modalities, i.e. TVS and MRI were compared to each other with respect to their ability to detect the total number of fibroids individually keeping HPE as the gold standard.

It was noted that fibroids detected on TVS were far less than those detected on MRI and proven on HPE. Significant number of fibroids were missed on TVS while MRI picked up most of the lesions (Table 4). The possible reason behind this observation may be due to less coverage area i.e. field of volume (FOV) of TVS and operator as well as patient dependence of this modality as compared to MRI. While in MRI, a larger FOV and higher spatial resolution allows to pick up subserosal lesions and smaller intramural/submucosal lesions.

Table 4: Distribution of cases as per final diagnosis on TVS, MRI and HPE.

Final diagnosis	TVS	MRI	HPE
Fibroid	12 (24%)	26 (52%)	25 (50%)
Total	50	50	50

Finally, the data of each of these modalities was individually subjected to various statistical tests and analysis to calculate their individual sensitivities, specificities, negative and positive predictive values as well as their diagonal agreement to each other.

Table 5: Detection of uterine fibroid by TVS.

Fibroid	HPE		
TVS	**Present**	**Absent**	**Grand Total**
Present	11	1	12
Absent	14	24	38
Grand Total	25	25	50

As per the data depicted above, true positives detected by TVS came out to be 11 while true negative came out to be 24. 1 case was false positive i.e. suggested as fibroid on TVS but same was not proved on HPE, focal adenomyoma was interpreted falsely as fibroid and 14 cases were missed on TVS (false negatives) (Table 5).

Table 6: Various statistical calculations for uterine fibroid detection on TVS.

Variables	Value (95% Confidence Interval)
Sensitivity	0.4400 (0.2442 to 0.6510)
Specificity	0.9600 (0.7965 to 0.9990)
Positive Predictive Value	0.9167 (0.6151 to 0.9979)
Negative Predictive Value	0.6316 (0.4599 to 0.7816)
Cohen's Kappa	0.400 (good)

This indicates that TVS has remarkably poor sensitivity (44%), high specificity (96%) and good correlation with HPE (kappa-0.4) (Table 6).

Table 7: Detection of uterine fibroid by MRI.

Fibroid	HPE		
MR	**Present**	**Absent**	**Grand Total**
Present	23	3	26
Absent	2	22	24
Grand Total	25	25	50

As per the data depicted above, true positives detected by MRI were 23 while true negatives were 22. 3 cases were

false positives i.e. suggested as fibroids on MRI but same were not proved on HPE indicating that they were either focal nonspecific signal changes /alternative diagnosis like focal adenomyoma and 2 cases were missed on MRI (false negatives) (Table 7).

Table 8: Various statistical calculations for uterine fibroid detection on MRI.

Variables	Value (95% Confidence Interval)
Sensitivity	0.9200 (0.7396 to 0.9902)
Specificity	0.8800 (0.6878 to 0.9746)
Positive Predictive Value	0.8846 (0.6986 to 0.9755)
Negative Predictive Value	0.9167 (0.7298 to 0.9897)
Cohen's Kappa	0.800 (excellent)

This indicates that MRI has high sensitivity (92%), fairly good specificity (88%) and excellent correlation with HPE (kappa value-0.8) (Table 8).

When comparing Transvaginal USG and MRI in uterine fibroid detection, the diagonal agreement was found to be 63% in the present study. Percentage of diagonal agreement implies number of cases detected as same final outcome regarding the presence of mass in both the modalities.

DISCUSSION

In this study 15 to 20% of women in the reproductive age group have uterine fibroids.[1] Although many newer and advanced diagnostic techniques have come up over the years but transvaginal USG still remains the screening modality in economically challenged country like India with magnetic resonance imaging being a close second option in complex clinical circumstances.[3]

In the present study, most of the patients presenting were young (<50 years) and premenopausal as was also reported by Shankar M P S, Kumar S R, Dhar T, Venkateshwaran K N, Balaji R.[4]

Among total 50 cases, the sensitivity of TVS in detecting fibroid is 44%, specificity is 96%, PPV is 91.67%, NPV is 63.16% and kappa is 0.40 (0.4-0.8,good correlation) i.e. agreement between TVS and HPE is 40%, $p<0.01$ stating that it is statistically significant.

In MRI the sensitivity is 92%, specificity is 88%, PPV is 88.46%, NPV is 91.67% and kappa is 0.80 ($\geq$0.8, excellent). Ultrasound fared surprisingly poorly, with only 44% correlation. MRI showed an 87% correlation with the final diagnosis. This observation very well correlates with study done by Aubel S, Wozney P, Edwards RP on "clinical utility of magnetic resonance imaging (MRI) in the diagnosis of gynecologic masses "stating that MRI provided significant clinical management information with greater accuracy than did ultrasound .[5]

Similarly, Eric D. Levens, MD, Robert Wesley, PhD, Ahalya Premkumar, MD, Wendy Blocker, MSN, and Lynnette K. Nieman, MD Stated that the sensitivity of MR imaging was two-fold greater than US for the detection of uterine fibroids (MR imaging: 80%; US: 40%) using pathological specimens as a gold standard. However, when fibroids were identified, the positive predictive value for MR imaging and US were similar. Even after excluding small fibroids $\leq 0.52 cm^3$ (diameter equivalence: $\leq$1cm) from consideration, the sensitivity of US remained low (47%). This observation suggests that MR imaging be considered as the best modality for the detection of uterine fibroids in clinical research, especially considering its superior ability to detect smaller lesions. This correlates well with this study in which the sensitivity of MR imaging was two-fold greater than TVS for the detection of uterine fibroids (MR imaging: 92%; TVS: 44%). However, the positive predictive value for MR imaging and TVS were almost similar (MR imaging: 88.46%; TVS: 91.67%).[6]

When comparing transvaginal USG and MRI in uterine fibroid detection, the diagonal agreement was found to be 63% in the present study. It means only 63% of the fibroids seen on MRI were actually seen on TVS. On looking up the recent literature, it was found that Jagannathan D and Subramanian AD had reported a diagonal agreement of 96% between the TVS and MRI for the detection of myometrial mass lesions. Further they found that in classifying the site of myometrial mass lesions, the diagonal agreement between TVS and MRI was 67%.[7]

Results of the present study correlate very well with Stamatopoulos CP et al, study on "Value of magnetic resonance imaging in diagnosis of adenomyosis and myomas of the uterus" stating that in the diagnosis of myomas, MRI demonstrated sensitivity of 94.1%, specificity of 68.7%, PPV of 95.7%, and NPV of 61.1%. The PPV of MRI in the diagnosis of myomas of the uterus is high .Sensitivity and Positive predictive value of MRI in this study were 92% and 88.46% respectively.[8]

On reviewing the literature,some studies even showed a result which was contrary to the present study. Dueholm M, Lundorf E, Hansen ES, Ledertoug S, Olesen Fstated that the presence of myomas was detected with the same high level of precision by both methods (magnetic resonance imaging: sensitivity, 0.99; specificity, 0.86; transvaginal ultrasonography: sensitivity, 0.99; specificity, 0.91). Transvaginal ultrasonography is as efficient as magnetic resonance imaging in detecting myoma presence, although the above study also stated that MRI is way better than USG for exact mapping especially in large and multiple myomas as was found by

the present study.[9] Localizing the site of lesion and number of lesions is best with MRI. It gives

Visual picture to the surgeon. Out of total 6 subserosal fibroids, TVS diagnosed only 2, misdiagnosed as intramural in 2 cases while remaining two were missed. Similarly out of 6 submucosal fibroids, TVS correctly diagnosed only in three cases, two were misdiagnosed as intramural while one was missed. MRI accurately localised most of the fibroids and misdiagnosis was made in only two cases being diagnosed as focal adenomyoma while on HPE these were submucosal and intramural fibroid. The above data of this study, correlates with results of study done by Shankar M P S, Kumar S R, Dhar T, Venkateshwaran K N, Balaji R, stating that to localize, characterize, and evaluate the number of uterine lesions, MRI has been found to be more precise in comparison to USG.[4]

Zawin M, Mc carthy S, Scout LM, Comite F et al, studied high-field MRI and USG evaluation of pelvis in women with leiomyomas of 23 women. They have observed accurate determination of uterine volume was possible in all cases by MRI, but was limited on USG in uterus larger than 140 cc. Marked enlargement obscured the visualization of contour abnormalities in USG. MRI detects more submucosal (14) lesions and concluded that MRI is superior to the ultrasound in pelvic examination of women with leiomyoma. This correlates with the present study in which TVS detected 3 out of 6 submucosal lesions, misdiagnosed other 2 as intramural and 1 was missed while MRI accurately localised 5 lesions and I lesion was misdiagnosed as focal adenomyoma.[10]

Results of the present study correlate with Margit Dueholm, Erik Lundorf, Estrid S Hansen, Susanne Ledertoug, Frede Olesen study which states that the sensitivity for identification of submucous myomas by MRI was 100%, by TVS was 83%, and by hysteroscopy was 82%, thus showing that MRI was the most accurate for the evaluation of submucous myomas, and MRI was superior in evaluation of exact submucous myoma in-growth.[9]

These results were further corroborated in a study done by Shankar M P S, Kumar S R, Dhar T, Venkateshwaran K N, Balaji R stating that MRI was better than USG in detection of number of fibroids predominantly submucosal and small sized fibroids.[4]

In almost all fibroid cases having either cystic or calcific degeneration, presence of cystic degeneration was identified on both TVS and MRI. Only one case was there which was having cystic degeneration on HPE but was missed on MRI, the same fibroid was not picked upon TVS. For detection of calcification, TVS is better as compared to MRI as out of all 5 common cases having calcification, MRI detected in only 2 cases while TVS detected in all 5 cases. This result again correlates well with the study done by Jagannathan D and Subramanian A D stating that for picking up cystic degeneration within the fibroids TVS and MRI are useful and for calcification TAS or TVS more useful.[7]

CONCLUSION

To conclude, high spatial resolution MR imaging with CP spine Array coil is accurate for detection, characterisation, localisation and evaluation of the benign uterine mass lesions such as uterine fibroid.

TVS can be used as a screening modality for initial evaluation of uterine masses like fibroid. Calcific degeneration is better identified by Transvaginal USG. Cystic degeneration is correctly identified with both Transvaginal USG and MRI in most cases. Submucosal and Subserosal lesions are better characterised by MRI than Transvaginal USG.

MRI seems to be a useful technique in everyday clinical practice in the diagnostic approach of these common conditions, enabling clinicians to select the most appropriate management.

Thus, pelvic MR imaging compared to TVS is a well-tolerated, non-invasive and accurate modality to characterize benign uterine mass lesions such as fibroid with excellent histopathological correlation. It is therefore an ideal and accurate preoperative imaging modality for characterising, localizing and detecting number and extent of uterine fibroids.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Padubidri VG, Daftary SN. Shaw's text book of gynaecology. In: Kumar S, eds. 17th ed. India: Elsevier-Saunder, Mosby, Churchill; 2018: 344-368.
2. Murase ES, Outwater EK, Rere Z, Jaffe LO, Tureck RW. Uterine leiomyomas histopathologic features, MR imaging findings, differential diagnosis and treatment. Radiographics. 1999;19(5):1179-97.
3. Khan AT, Shehmar M, Gupta JK . Uterine fibroids: current perspectives. Int J Womens Health. 2014;6: 95-114.
4. Shankar MPS , Kumar SR, Dhar T, Venkateshwaran KN, Balaji R. Role of Magnetic Resonance Imaging in Evaluation of Uterine Pathologies and its Correlation with Ultrasound. Int J Anat Radiol Surg. 2019 Apr;8(2):28-32.
5. Aubel S, Wozney P, Edwards RP. MRI of female uterine and juxta-uterine masses: clinical application in 25 patients. Magn Reson Imaging. 1991;9(4):485-91.

6. Levens ED, Wesley R, Premkumar A, Blocker W, MSN, Lynnette KN. Magnetic resonance imaging and transvaginal ultrasound for determining fibroid burden: implications for clinical research. Am J Obstet Gynecol. 2009 May;200(5):537e1-7.
7. Jagannathan D, Subramanian AD. Comparison of The Diagnostic Accuracy of Magnetic Resonance Imaging (MRI), Transabdominal Ultrasound (TAS), Transvaginal Ultrasound (TVS) In Characterizing The Uterine Mass Lesions. J Dent Med Scie. Feb. 2017;16(2):65-74.
8. Stamatopoulos CP, Mikos T, Grimbizis GF, Dimitriadis AS, Efstratiou I, Stamatopoulos P, et al. Value of magnetic resonance imaging in diagnosis of adenomyosis and myomas of the uterus. J Minim Invasive Gynecol. 2012 Sep-Oct;19(5):620-26.
9. Dueholm M, Lundorf E, Hansen ES, Ledertoug S, Olesen F. Accuracy of magnetic resonance imaging and transvaginal ultrasonography in the diagnosis, mapping, and measurement of uterine myomas. Am J Obstet Gynecol. 2002 Mar;186(3):409-15.
10. Zawin M, McCarthy S, Scoutt LM, Comite F. High field MRI and US evaluation of the pelvis in women with leiomyomas. Magn Reson Imag 1990;8(4):371-6.
11. Adam A, Dixon A, Gillard J, Prokop CS, Grainger R. Grainger & Allison's Diagnostic Radiology: A Textbook of Medical Imaging. 6th ed. New York, NY: Elsevier; 2014: 1061-1063
12. Baret AL, Heuck FH W, Youker JE. Radiology of the female pelvic organs. 1st ed. New York, NY: Springer;1998: 134-140
13. Fleischer AC, Manning FA, Jeanty P, Romero R. Sonography in obstetrics & gynaecology: Principles and Practice. 6th ed. Europe: McGraw Hill; 2002: 245-250.

Cite this article as: Goyal A, Mehta D, Mangalhara NK, Poonia S A comparative study between magnetic resonance imaging and transvaginal sonography for evaluation of uterine fibroid using histopathology as a gold standard. Int J Res Med Sci 2020;8:2173-9.