Original Article
DOI: https://doi.org/10.70749/ijbr.v3i4.2599

INDUS JOURNAL OF BIOSCIENCE RESEARCH
https://ijbr.com.pk
ISSN: 2960-2793/ 2960-2807

Sensitivity of Ultrasonography in Diagnosing Uterine Leiomyoma in Females Presenting with Menorrhagia Taking MRI As Gold Standard

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ARTICLE INFO

Keywords: Imaging, Ultrasonography, Uterine Leiomyoma.

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Declaration
Authors' Contribution
Both authors equally contributed to the study and approved the final manuscript

Conflict of Interest: No conflict of interest.

Funding: No funding received by the authors.

Article History
Received: 10-01-2025 Revised: 06-04-2025
Accepted: 18-04-2025 Published: 30-04-2025

ABSTRACT

Objectives: To determine the diagnostic accuracy of ultrasonography in diagnosing uterine leiomyoma in females presenting with menorrhagia taking MRI as gold standard. **Study type:** cross-sectional validation. **Settings:** Department of Radiology, CMH, Gujranwala. **Study duration:** January 2023 to December 2023. **Materials & Methods:** A total of 108 patients of 18-70 years of age with menorrhagia were included. Women with gynecological conditions like adenomyosis, endometrial polyps, endometriosis, h/o hypersensitivity to contrast agents, and contraindication to magnetic resonance imaging were excluded from the study, as were patients with chronic renal failure, use of IUCDs, or a history of bleeding disorders or PID. First, all the patients underwent trans-abdominal sonography and then magnetic resonance imaging for uterine leiomyoma. Ultrasonography and MRI results were correlated. **Results:** MRI results showed that 54 patients (True Positive) had uterine leiomyoma, but six patients (False Positive) did not. Of the 48 patients with negative USG results, 6 (False Negative) had uterine leiomyoma on MRI, but 42 (True Negative) did not (p=0.0001). With a sensitivity of 90.0%, specificity of 87.50%, PPV of 90.0%, NPV of 87.50%, and diagnostic accuracy of 88.89%, USG was able to identify the uterine leiomyoma. **Conclusion:** According to the study's findings, ultrasonography is a straightforward, affordable, and easily accessible modality with a fairly high diagnostic accuracy for uterine leiomyoma.

INTRODUCTION

Uterine fibroids, sometimes called leiomyomas or myomas, are the most common uterine neoplasms and the most common tumor of the uterus and associated pelvic organs. A major public health concern is leiomyoma of the uterus. It is the most common benign gynecologic tumor in premenopausal women.[1] They are benign tumors that originate from smooth muscle and contain different amounts of fibrous connective tissue. Fibroids can sometimes be found in the cervix, broad ligament, or ovaries, but they usually form in the myometrium. Uterine myomas or fibroids are the most common gynecologic tumor, affecting 20% to 50% of women. Depending on their size and location, they might or might not be symptomatic. Ultrasonography (USG) is frequently used to check the female pelvic first.[2,3]

In fact, the majority of uterine fibroids are unintentionally discovered during routine gynecological exams or imaging for other issues that could cause infertility or pelvic pain. Fibroids can range in size, location, and number from as small as a dime to as large as a soccer ball.[4] The majority of fibroids are intramural and located in the myometrium, and symptomatic fibroids are typically found in women between the ages of 35 and 55, with an average age of 40. Menorrhea, metrorrhea, pain, and submucosal fibroids that distort the uterine cavity are some of the symptoms they present.[5] Many women who visit the gynecology clinic complain of severe anemia and pain due to fibroid degeneration, with complaints of having excessive by passage and spotting for extended periods of time.[6] As fibroids grow in size, some patients may experience pressure symptoms, even though they are asymptomatic. Many of these patients will require surgery, such as a hysterectomy or myomectomy.[7]

Since the 1970s, USG has been used to diagnose leiomyomas, and when transvaginal scans were added in the 1980s, this method swiftly rose to prominence. Nowadays, USG is the main imaging method used to detect and assess endometrial leiomyomas. Leiomyomas are commonly observed as distinct, solid, concentric, hypoechoic masses with variable levels of acoustic shadowing during an ultrasound examination.[8] Depending on the amount of fibrous tissue and/or the degree of calcification, leiomyomas can be either hyperechogenic or echogenic, with differing echogenicity. Ideally, the process would involve both transvaginal and transabdominal scanning.[9,]

Just as well as histology, ultrasound can identify abnormal uterine bleeding. Around the world, studies have been conducted to compare the findings of histology

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and ultrasonography in order to identify abnormal uterine bleeding. Nevertheless, very little study is conducted in this field in our country. Thus, our study's goal is to compare the findings of MRI and ultrasonography in order to diagnose uterine leiomyoma.

METHODOLOGY

This cross-sectional validation study was conducted on 108 menorrhagia patients (aged 18–70 years) who had been referred by a clinician to the radiology department of CMH, Gujranwala for ultrasonography and had a history of increased menstrual flow (i.e., a prolonged menstrual period lasting more than seven days) or increased blood loss (>35 ml) during menstruation. A 95% confidence level has been established for the sample size of 108 cases, based on the assumption that the expected prevalence of uterine fibroids is 65.1%[2] with an 8.0% precision level. Uterine fibroids can be detected with a sensitivity of 92.9% and a specificity of 93.3%[8] using the USG. Women with gynecological conditions like adenomyosis, endometrial polyps, endometriosis, h/o hypersensitivity to contrast agents, and contraindication to magnetic resonance imaging were excluded from the study, as were patients with chronic renal failure, use of IUCDs, or a history of bleeding disorders or PID.

All individuals were evaluated utilizing transverse and sagittal planes during ultrasound imaging using a curvilinear transducer (3-5 MHz) while supine, following the acquisition of informed consent and pertinent medical history. Endometrial thickness, cavity distortion, and the existence, quantity, position, and echogenicity of broids were among the important factors noted. Uniform, concentric, solid, hypoechoic masses with identifiable borders was categorized using the FIGO classification system on ultrasonography.

Figure

Classification of uterine fibroids by anatomical positioning

FIGO	Subtype	Positioning
0	Submucosal - Subtype 0	100% endometrial cavity or intracavity
1	Submucosal - Subtype 1	> 50% intramural
2	Submucosal - Subtype 2	< 50% intramural
3	Intramural	In contact with the endometrium
4	Intramural	100% intramural
5	Intramural	Subserosal >50% intramural
6	Subserosal	Subserosal <50%

According to ward policy, all patients had MRIs. A semi-filled bladder and four hours of fasting were prerequisites for this examination. Pictures were taken both before and after a gadolinium injection at a dose of 0.01 mmol/kg utilizing a 1.5 Tesla (GE Health Care Machine) through the pelvic coil but not the endovaginal coil. Axial, coronal, and sagittal T1- and T2-weighted images were used in the technique to record anatomical and pathological information. Additionally, the T1 axial and sagittal fat saturation approach was carried out both with and without contrast. High signal in T1-weighted images and low signal in T2-weighted pictures were indicative of endometriosis. An expert operator who was blinded assessed each MRI scan. The MRI data and the ultrasound results were linked.

IBM SPSS.20 was used to enter and evaluate the data. Age and symptom duration were examples of numerical data that were presented as mean + SD. Frequencies and percentages were shown for categorical data, such as MRI and USG results. A contingency table of (2x2) was used to calculate the sensitivity, specificity, NPV, PPV, and diagnostic accuracy of USG for the diagnosis of uterine leiomyoma. Age and symptom duration were used as post-stratification diagnostic accuracy measures to address the effect modifiers; the findings were displayed in tables and charts.

Uterine leiomyoma on MRI

	+	-
+	A	B

Uterine leiomyoma on USG

Diagnostic Accuracy: The following criteria were used to calculate it:

Using MRI, **sensitivity** was defined as the USG ability to accurately identify subjects with uterine leiomyoma out of all patients with the condition.

Using MRI, **specificity** was defined as the ability of a USG to accurately identify subjects who do not have Uterine leiomyoma out of all patients.

The **positive predictive value** is the chance that a person who has a positive screening test will have the disease.

The probability that patients with negative screening test results will not develop the disease is known as the **negative predictive value**.

True Positive: Patients who receive a positive diagnosis from both a USG and MRI.

True Negative: Patients who receive a negative diagnosis from both a USG & MRI

Patients who have a positive USG but a negative MRI are said to have a **false positive**.

False Negative: When a patient has a positive MRI but a negative USG.

RESULTS

Participants in the study were between the ages of 18 and 75, with a mean age of 47.77 ± 9.77 years. Table I reveals that 96 patients, or 88.89%, were in the 41–70 age range. The symptoms persisted for an average of 4.66 ± 2.11 months. Table I displays the distribution of patients with different factors.

MRI results showed that 54 patients (True Positive) had uterine leiomyoma, but six patients (False Positive) did not. Of the 48 patients with negative USG results, 6 (False Negative) had uterine leiomyoma on MRI, but 42 (True Negative) did not (p=0.0001), according to Table II. With a sensitivity of 90.0%, specificity of 87.50%, PPV of 90.0%, NPV of 87.50%, and diagnostic accuracy of 88.89%, USG was able to identify the uterine leiomyoma. Table III displays the diagnosis accuracy stratified by age and illness duration.

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Table I

Distribution of patients with other confounding variables (n=108)

Confounding variables		Frequency	%age
Age (years)	18-40	12	11.11
	41-70	96	88.89
Duration of symptoms (months)	≤3	48	44.44
	>3	60	55.56

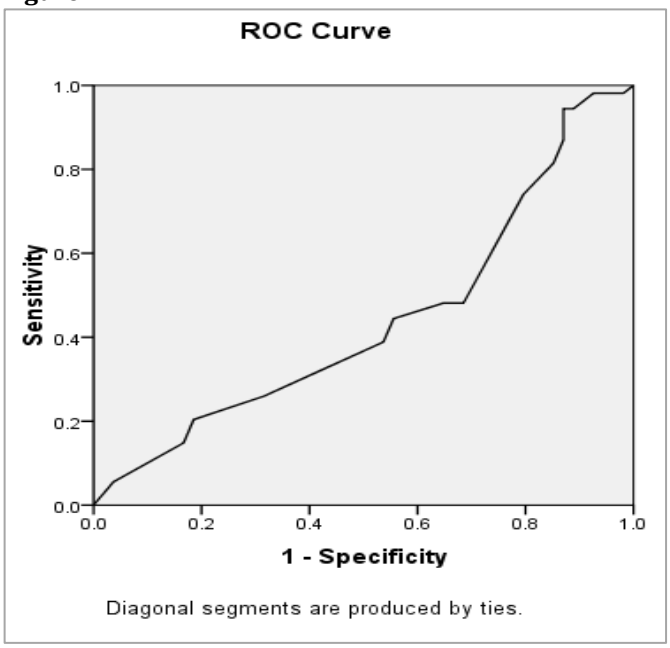
Table II

Diagnostic accuracy of USG for the diagnosis of uterine leiomyoma keeping MRI as gold standard.

	MRI (+ive)	MRI (-ive)	P-value
USG (+ive)	54 (True positive)	06 (False Positive)	0.0001
USG (-ive)	06 (False negative)	42 (True Negative)	

Sensitivity: 90.0%
Specificity: 87.50%
Positive Predictive Value (PPV): 90.0%
Negative Predictive Value (NPV): 87.50%
Diagnostic Accuracy: 88.89%

Figure 1



Area under the curve = 0.441

Table III

Diagnostic accuracy stratification according to age and symptom duration.

		Sensitivity	Specificity	PPV	NPV	DA	
Age (years)	18 - 40	88.14 %	88.89 %	91.23 %	85.11 %	88.46 %	0.001
	41 - 70	97.25 %	80.43 %	92.17 %	92.50 %	92.26 %	0.001
Duration (months)	≤3	92.91 %	88.10 %	92.19 %	89.16 %	90.99 %	0.001
	>3	97.56 %	76.47 %	90.91 %	92.86 %	91.38 %	0.001

DISCUSSION

The most prevalent kind of pelvic and uterine tumors are leiomyomas. They can be extremely painful, but they are not harmful. Endometrial polyps and submucosal fibroids are examples of intrauterine benign lumps that are occasionally misinterpreted, leading to inadequate therapy and possible patient injury. In order to determine whether abnormal uterine bleeding in perimenopausal women is due to a leiomyoma, ultrasound is essential. Ultrasound is the first line of treatment for ladies who are bleeding excessively because it is noninvasive. It is also more generally accessible, safer, and less costly.[11-13]

The uterine leiomyoma in this study was identified by USG with a diagnostic accuracy of 88.89%, a sensitivity of 90.0%, a specificity of 87.50%, a PPV of 90.0%, and an NPV of 87.50%. This result is in line with earlier research by Hossain et al. that examined the differences between transabdominal ultrasonography and magnetic resonance imaging in the diagnosis and assessment of uterine fibroids.[14]

Given the significance and characteristics of each device as well as the abilities of the technician and radiologist, who have a significant impact on the examination results, the accuracy of magnetic resonance imaging and ultrasound scanning for detecting uterine fibroids was specifically compared here in terms of the number of tumors, their size, and their location. This result was also consistent with the research.[15] This study's high level of uterine fibroids detection by US and MRI is consistent with that of Dueholm et al. Both techniques were able to detect the existence of myomas with the same high degree of accuracy (transvaginal ultrasonography: sensitivity, 0.99; specificity, 0.91; magnetic resonance imaging: sensitivity, 0.99; specificity, 0.86).[16] Diameter measures were equally accurate and high in patients with 1–4 myomas.[16]

From November 2022 to October 2023, 219 married women aged 25 to 59 who had abnormal uterine bleeding and were admitted for a diagnostic hysteroscopy at the Obstetrics and Gynecology Department of Apollo Hospital in Bilaspur, Chhattisgarh, participated in an observational prospective study.[7] When it comes to identifying myoma, ultrasonography's sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy are 100%, 69.5%, 23.75%, 100%, and 72.14%, respectively.[7]

The current study demonstrated a 63% diagonal agreement between transvaginal USG and MRI in uterine fibroid identification. This indicates that only 63% of the fibroids observed on MRI were also observed on USG. When searching the latest literature, Jagannathan D and Subramanian AD discovered that the TVS and MRI showed a 96% diagonal agreement for detecting myometrial mass lesions. Additionally, they discovered that there was a 67% diagonal agreement between TVS and MRI in identifying the location of myometrial mass lesions.[17]

Between January 2010 and December 2011, a cross-sectional study[18] was conducted in the Radiology & Imaging department of Mymensingh Medical College Hospital. In this study, 40 consecutive patients with suspected uterine fibroids were followed up with from the time of admission till the tissue diagnosis of uterine

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fibroids for histological correlation. They also received MRI and transabdominal ultrasonography. The validity of transabdominal ultrasonography and magnetic resonance imaging (MRI) in the diagnosis of uterine fibroids was computed. USG demonstrated 88.2% sensitivity, 66.7% specificity, 85.0% accuracy, 93.8% positive predictive values, and 50% negative predictive values in the diagnosis of uterine fibroids. However, when it came to predicting uterine fibroids, MRI was 97.1% sensitive, 83.3% specific, 95.0% accurate, 97.1% positive, and 83.3% negative. According to the study, MRI is a more effective diagnostic technique than transabdominal ultrasonography for identifying and assessing the existence of uterine fibroids.[18]

Another important benefit of MRI is its improved ability to characterize fibroid degeneration. This information can help distinguish degenerating fibroids from other diseases and predict how well a patient would respond to specific therapies, including uterine artery embolization. Despite these benefits, MRI's affordability and accessibility should be taken into account, particularly in environments with limited resources.[19,20] Because of its widespread availability, affordability, and real-time imaging capabilities, ultrasound is still a useful first-line imaging modality. According to our findings, the majority of clinically relevant fibroids can still be found with ultrasonography. This study's prospective design, blinded image interpretation, and use of standardized imaging methods are among its strong points. However, drawbacks include the possibility of selection bias because women with suspected fibroids were included, and the absence of surgical or histological confirmation of all imaging results.

CONCLUSION

According to the study's findings, ultrasonography is a straightforward, affordable, and easily accessible modality with a fairly high diagnostic accuracy for uterine leiomyoma. Therefore, in order to diagnose uterine leiomyoma in every patient with menorrhagia, we advise consistently using this straightforward, non-invasive, affordable, and readily available imaging technique.

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