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(REVIEW ARTICLE)

Accuracy and correlation between magnetic resonance imaging and ultrasound in the diagnosis of uterine fibroids

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Abstract

The uterus, an essential female reproductive organ, is responsible for the menstrual cycle &fetal development during pregnancy. Fibroma, a non-cancerous growth in the uterus, can cause symptoms like constipation, irregular vaginal bleeding, pain, recurrent miscarriages, &frequent urination. MRI and Ultrasound imaging are used to evaluate fibroids, with small fibroids often not being diagnosed due to no symptoms.

Methods: The study aimed to analyze the accuracy &correlation between MRI &ultrasound in diagnosing fibroids in 100 women in Iraq from June to September 2023. The clinical sites of fibroids were classified into intramural, submucosal, submucosal pedunculation, subserosal, subserosal pedunculation, &cervical types. Data was collected f&analyzed using Stats Direct statistical package version 3.1.22.

Results: The study analyzed 100 cases of uterine fibroids, , The study found a statistical relationship between the variables using US &MRI efficiency. Kappa level was < 1, indicating substantial agreement between the model &variables. The efficiency for determining fibroid in intramural fibroid was 100%, with a PPV, NPV, sensitivity, specificity, &accuracy of 100 , while in cervix fibroid was 100%, with a sensitivity of 100%, specificity of 100%, &accuracy of 100%.

Conclusions:

- MRI is very accurate in diagnosis.
- Sensitivity, specificity, negative predictive value, and positive predictive value of US &MRI in the diagnosis of fibroids were determined and compared. MRI showed higher
- Advantages of ultrasound compared to MRI include its lower cost, easier access, faster process
- Benefits of MRI are superior accuracy, while disadvantages higher costs &longer examination times.

Keyword: Magnetic Resonance Imaging; Ultrasound; Fibroid; Uterus

1. Introduction

The uterus, an essential female reproductive organ, is responsible for the menstrual cycle and fetal development during pregnancy (1). Uterine fibroids may develop during pregnancy, affecting over 50% of women but causing no symptoms. Fibroid, a non-cancerous growth in the uterus, can cause symptoms like constipation, irregular vaginal bleeding, pain, recurrent miscarriages, and frequent urination (2). The age group between 30 and 50 is most common for this to occur.

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Females who have not yet had their first period are usually free of fibroids. It is also less common in those who have gone through menopause.

Risk factors for developing fibroids include a family history, high body weight, not having children, early menstruation, or late menopause. MRI studies (T1, T2, DW&ADC) and Ultrasound imaging (abdominal and/or TV US) are used to evaluate fibroids, with small fibroids often not being diagnosed due to no symptoms (3,4,5).

Uterine fibroids may develop as a mass or as a solitary, isolated growth and range in diameter from 1 mm to more than 8 inches. The lesion may sometimes be the size of a watermelon. fibroid can appear on the outside of the uterus, inside its main cavity, or inside its wall (5). So according to fibroids location, classified into intramural, submucosal, submucosal pedunculation, subserosal, subserosal pedunculation, and cervical types

This tumor can be malignant or benign, but a benign tumor cannot become malignant; Therefore, it must be examined with an MRI machine to be diagnosed as benign or malignant from the beginning (6,7).

There are several types of fibroid surgery(myomectomy). The location, size, and quantity of the fibroids will determine the type of surgery that might prove most effective treatment for patients: hysteroscopy, laparotomy,embolization and hysterectomy (8,9,10,11)

2. Similar articles

Collectively, studies and articles highlight the importance of uterine fibroids, or uterine leiomyoma's, which are the primary gynecologic tumors in up to 50% of women of reproductive age globally. Most women with primary fibroids had small fibroids. Through an 18-month follow-up of African American women, approximately 10% of fibroids were among those who did not develop fibroids (12).

MRI and dynamic ultrasonography scan (USS) of the pelvic floor are traditionally used to diagnose leiomyoma's, with TVUS scan being the standard confirmatory method due to its high sensitivity and specificity. Uterine fibroids have a 0.1 to 0.8% risk of turning into malignant sarcoma, which increases morbidity and risk of reproductive problems such as infertility and miscarriage. $P < 0.05$ was considered statistically significant. The apparent diffusion coefficient ADC of type 3 fibroids were significantly higher than those of type 1 ($P < 0.0001$, $P < 0.0001$) and type 2 fibroids ($P = 0.004$, $P < 0.0001$), respectively. Uterine smooth muscle tumors (fibroids) are the most common monoclonal benign tumors of the smooth muscle cells of the female reproductive tract. The study found that 68 patients who underwent (MRgFUS).

MRI scans, with 6 patients undergoing MRgFUS scans. Ten features, including maximum residual fibroblast thickness, showed predictive power for residual fibroblast regeneration. 282 patients with symptomatic uterine fibroids who underwent USgHIFU treatment were retrospectively analyzed. 82 patients with 282 symptomatic uterine fibroids who underwent USgHIFU treatment were retrospectively analyzed. Eligible participants were self-enrolled African American women living in the Detroit, Michigan area, aged 23–34 years at enrollment (23–35 years), with an intact uterus and no prior fibroid diagnosis. This retrospective study compared preoperative TVUS, preoperative contrast-enhanced MRI (Gadolinium), and LUS. Submucosal fibroids were identical in only 29.4% of cases, but for subserosal fibroids, it was 44.8%. Mapping fibroids in terms of number, size and location is essential. An ultrasound report of fibroids helps suggest the optimal treatment approach, be it hysteroscopy, laparoscopy, laparotomy or uterine artery embolization UAE (13,14,15,16,17,18,19,20,21,22,23,24).

3. Method and material

The study aimed to analyze the accuracy and correlation between MRI and ultrasound in diagnosing uterine fibroids in 100 women in Iraq from June to September 2023. This study was designed as a study-wide observational collaboration between the Department of Radiology and Medical Imaging at Basra Hospitals. The study was conducted in the Department of Surgery. Radiation oncology, obstetrics, and gynecology, regardless of their age, number of births, or nationality during this period. Patients were transferred from the gynecology department to The Radiology Department to diagnose and evaluate fibroids, regardless of their age, the number of times they were born, or their nationality during this period. this description includes both patients eligible for free care and private care patients. Patients with missing data or patients who underwent only one type of diagnostic method were excluded

To be included in the study, participants must provide informed consent. The patient must be at least 17 years old and must have a doctor's prescription for an ultrasound and MRI. To examine the uterus. The study excluded patients with

MRI claustrophobia, surgery or hysterectomy, known cases of adenomyoma, and pregnant women and who did not provide consent to participate in the study were also excluded from the study. Hysterectomy was performed within 1–3 weeks of the MRI study, all specimens were examined by a pathologist, and cross-sectional histopathology and microscopic examination were performed. Uterine examination of Fibroid was performed before fixation, all abnormal uterine masses were recorded and all specimens were evaluated as a result of ultrasound or MRI.

This study was approved by the Human Ethics Committee of the shahid beheshti University of Medical Sciences (SBUMC), ethical code (IR.SBMU.RETECH.REC.1402.803) and Basra Teaching Hospital Department of Radiology and Medical Imaging (Basra, Iraq).

Informed consent was obtained from each participant, ensuring their voluntariness Participation, and respect for independence. Confidentiality measures were implemented to protect personal information, by anonymizingh or encrypting data. Cultural Sensitivity was observed in adapting the questionnaire to the Iraqi context. Data security measures have been implemented to protect participant data. By adding these ethical principles, the study aimed to give priority to participants' rights, privacy, and well-being, ensuring the integrity and ethical conduct of the research process.

4. Results and Discussion

Data was collected from medical documents and analyzed using Stats Direct statistical package version 3.1.22(24,25).

The aim of this study was to compare MRI and Ultrasonography (US) in the diagnosis of uterine fibroids. When evaluating the distinct diagnostic capabilities of these two medical methods, it is crucial to rely on various studies and research that carefully and qualitatively analyze the accuracy of each technique independently. The stats Directs statistical can be utilized to analyze data extracted from these studies, including calculating the p value and the Kappa coefficient, as well as conducting comparative experiments between the two methods. The p-value is used to estimate the extent of the trend of the results and the influence of external factors. The Kappa coefficient evaluates the accuracy of the results and their consistency with reality. Thus, the connection between sensitivity, specificity, and the Kappa coefficient is contingent upon the statistical context of the study and the manner in which the data was analyzed.

The Kappa coefficient measures the extent to which the classification model agrees with the actual data. The Kappa value ranges between -1 and +1, where 1 indicates a perfect agreement between the model and the data, 0 indicates no agreement better than random chance, and -1indicates perfect disagreement. Accuracy: The accuracy value measures the correctness of the model's classification. The accuracy rate represents the ratio of correct predictions (True Positives + True Negatives) to the total number of all observations (27). Generally, the p-value is used to determine the presence of a statistical relationship, while the Kappa coefficient measures the agreement of a classification model, and accuracy determines how well the model performs.

US and MRI were performed on 100 patients referred to the radiology department with clinically suspected uterine abnormalities. The patients were evaluated, and among them, US identified 92 positive cases, while MRI identified 100 positive cases, along with their correlation.

In this study, US and MRI demonstrated a similarly high level of detection for uterine fibroids, consistent with the findings of Duhl et al (28). Measurements of fibroids showed a high level of accuracy using both US and MRI methods. Among the 100 patients, 92 were diagnosed with fibroids by US, and the diagnoses were confirmed by MRI, which correlated with surgical/pathological findings. The cause of uterine enlargement was correThe comparison between the accuracy of magnetic resonance imaging and ultrasonic scanning was specifically targeted at detecting uterine fibroids, considering factors such as the number, size, and location of tumors, as well as the capabilities and significance of each device.

Additionally, the skills of the radiologist and technician, who play crucial roles in the outcomes of the examinations, were taken into account ctly diagnosed on MRI images in 100 cases, leading to the conclusion that MRI is highly accurate in aiding diagnosis. MRI demonstrated high specificity and sensitivity.In this study, MRI demonstrated the same high level of detection of uterine fibroids as US, consistent with the study by Duholm et al (29). Our study found that MRI had a sensitivity and specificity of 100% for diagnosis. Of the 100 cases discovered by ultrasound, 92 cases were confirmed. This study explains that there is a significant difference in the diagnosis of fibrosis by US and MRI, with the mean distribution in US being 2.71, in MRI being 3.09, and the mean for surgery being 3.14. The mean rank in US was 1.60, in MRI was 2.17, and for surgery was 2.24, with surgery showing the greatest values

Our study found that the sensitivity of MRI reached 100%, indicating the success of the test in accurately detecting about 100% of true positive cases. The specificity was also determined to be 100%, indicating that the test correctly identified nearly 100% of true cases. These results demonstrate that MRI is a reasonably reliable tool for identifying and excluding the presence of benign uterine tumors. The possibility exists that an individual with a negative MRI result may actually have a tumor. A lower negative predictive value indicates a greater probability of error, suggesting that a negative MRI result does not necessarily rule out tumors. This could be attributed to the prevalence of this condition in the study population and the potential limitations of MRI technology in detecting certain types or sizes of tumors. However, the moderate level of agreement between MRI and US, as demonstrated by the kappa coefficient, supports the utility of MRI as a screening tool for benign uterine tumors. The data from the current study indicate that the sizes of uterine fibroids varied between MRI and US measurements. These findings are consistent with those of Audrey L. Spielmann et al.'s study (30), which compared MRI and sonography in the initial assessment for fibroid embolization.

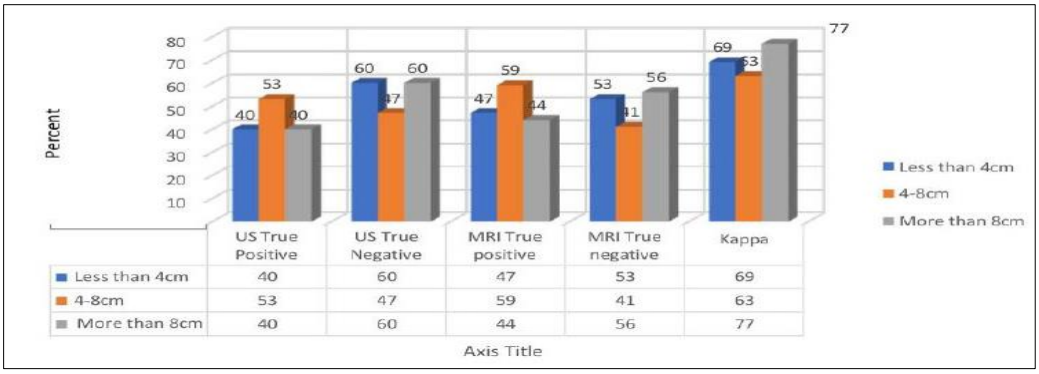


Figure 1 Agreement Between Techniques for Diagnosing Different Size of Uterine Fibroids

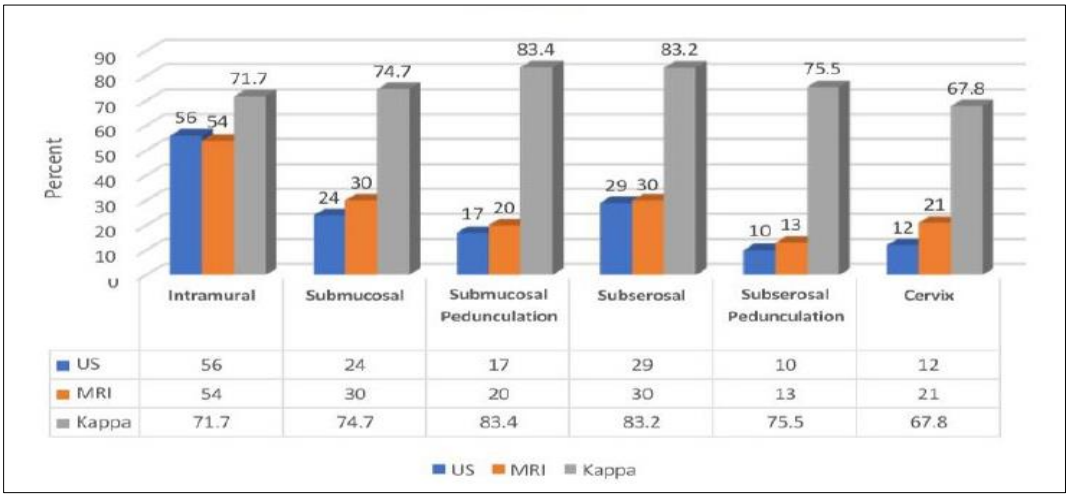


Figure 2 The difference between US and MRI in Diagnosing Uterine Fibroid based on location

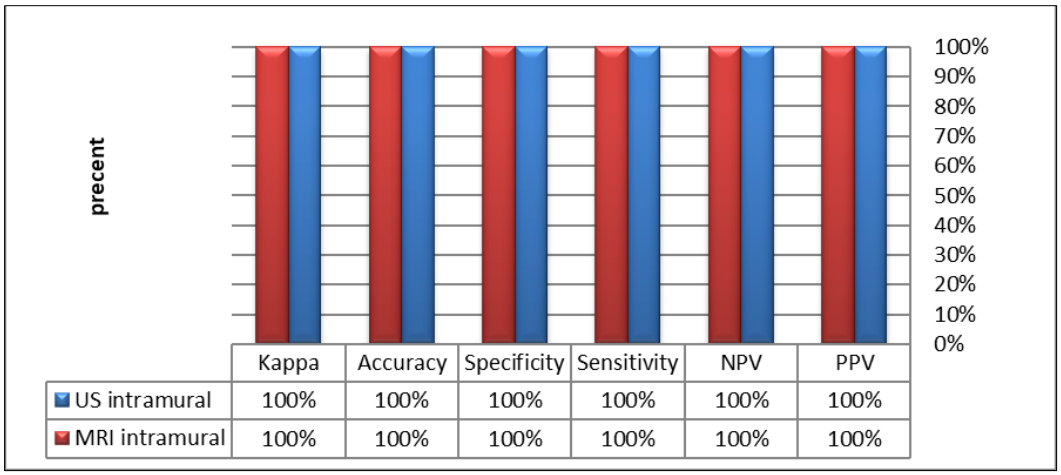


Figure 3 US and MRI efficiency for diagnosing of fibroid lesions in intramural layer

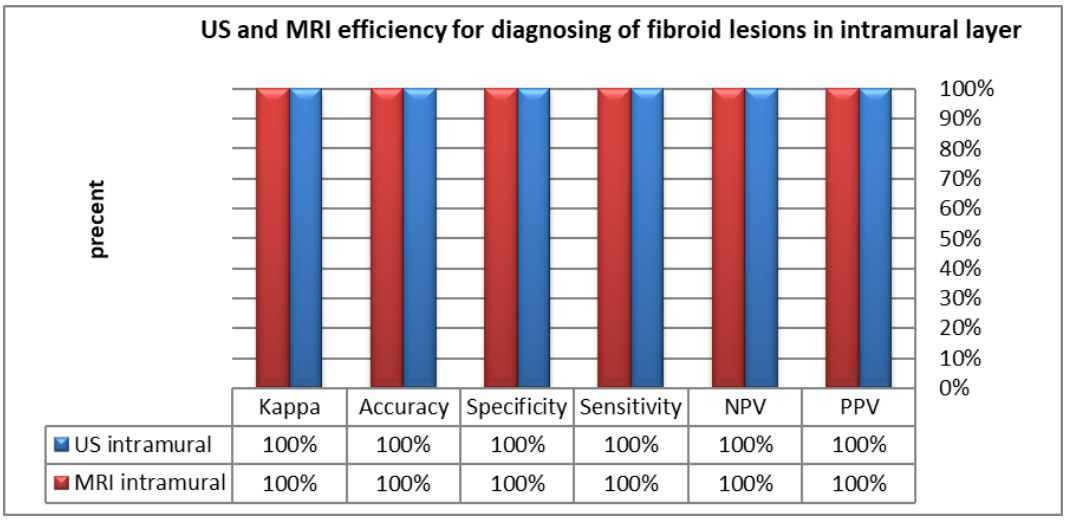


Figure 4 US and MRI efficiency for diagnosing of fibroid lesions in intramural layer

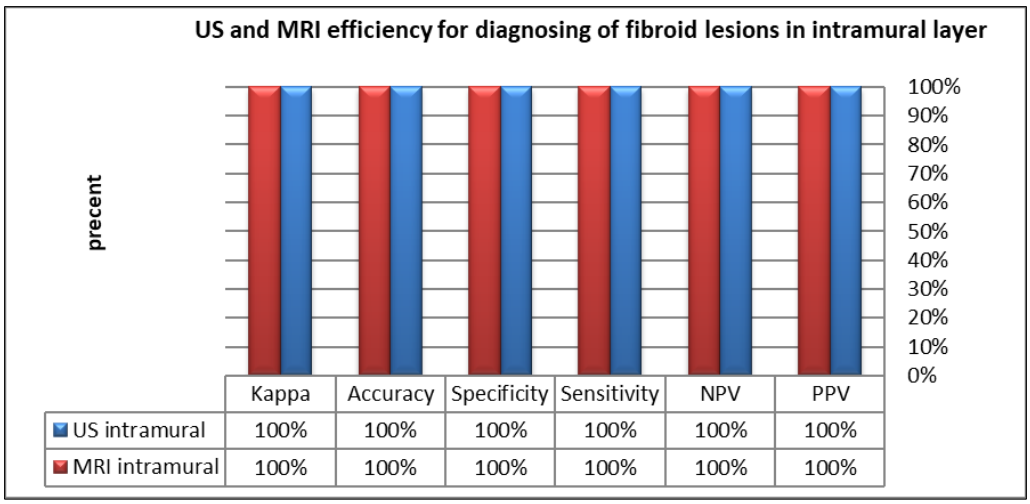


Figure 5 US and MRI efficiency for diagnosing of fibroid lesions in submucosal layer

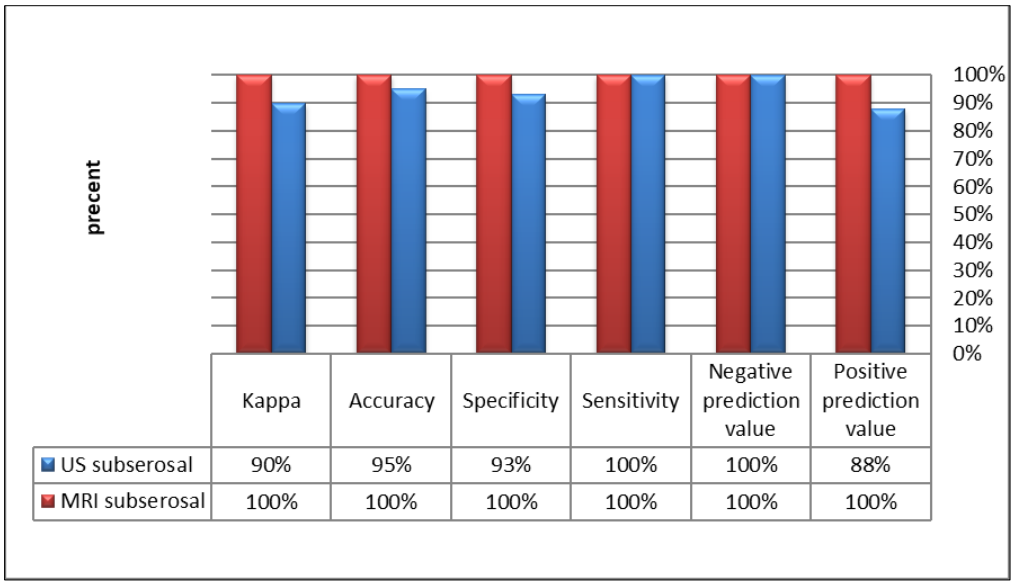


Figure 6 US and MRI efficiency for diagnosing of fibroid lesions in subserosal layer

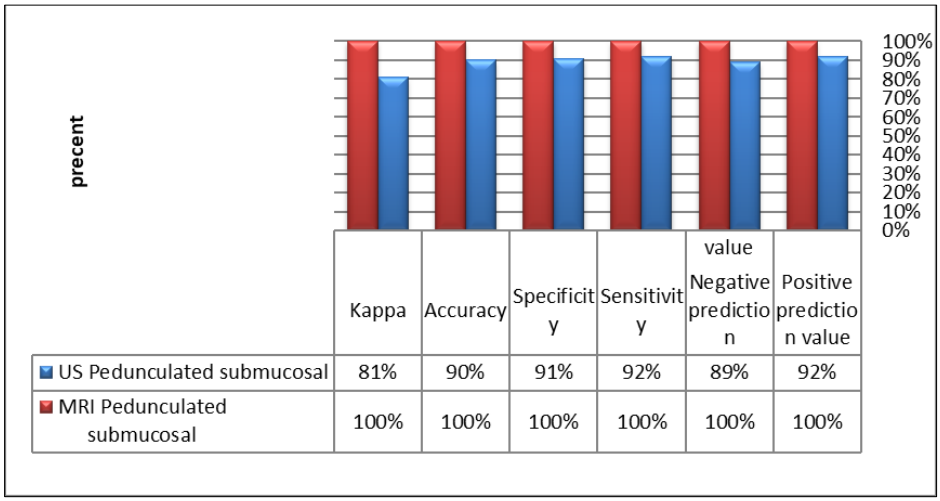


Figure 7 US and MRI efficiency for diagnosing Pedunculated submucosal fibroids

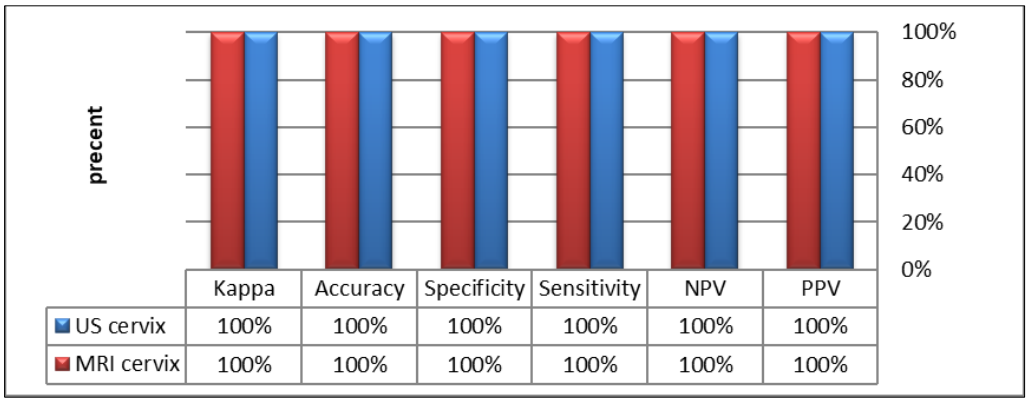


Figure 8 US and MRI efficiency for diagnosing of fibroid lesions in Cervix layer

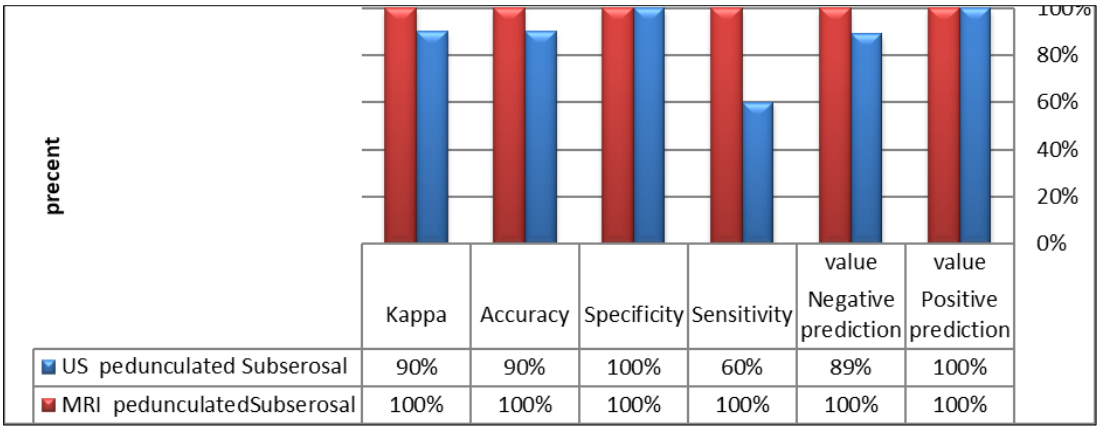


Figure 9 US and MRI efficiency for diagnosing of fibroid lesions in Cervix layer

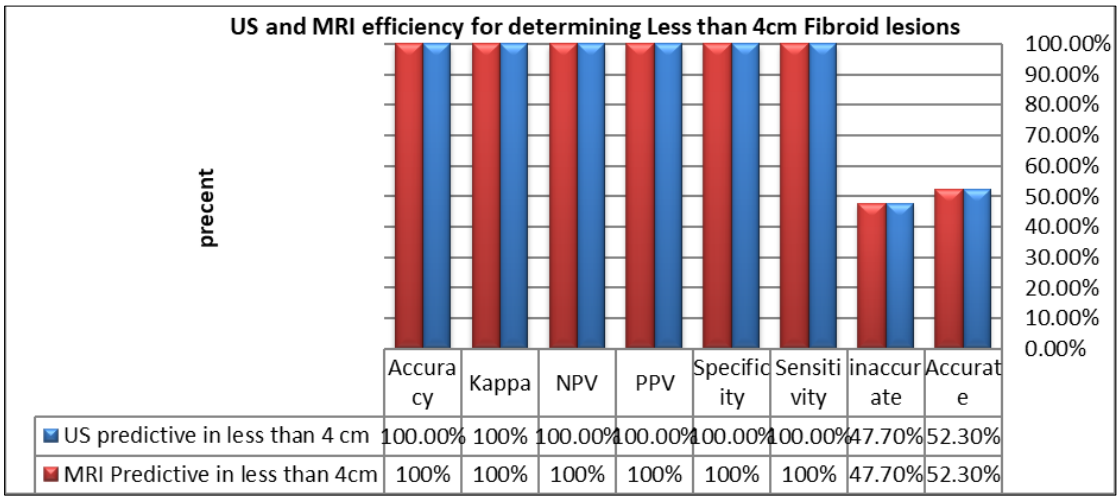


Figure 10 US and MRI efficiency for determining Less than 4cm Fibroid lesions

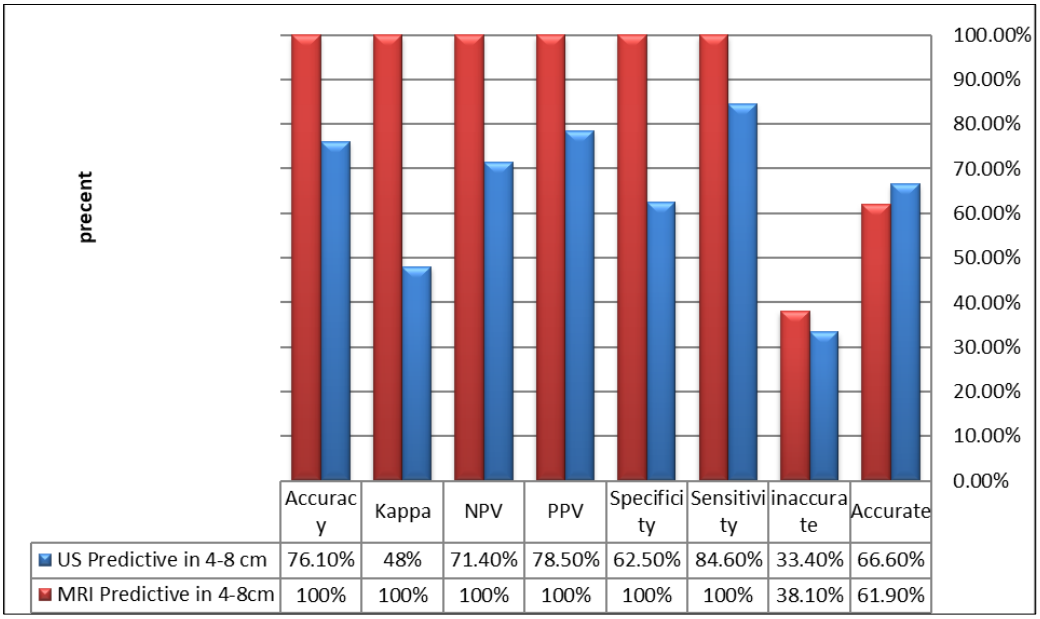
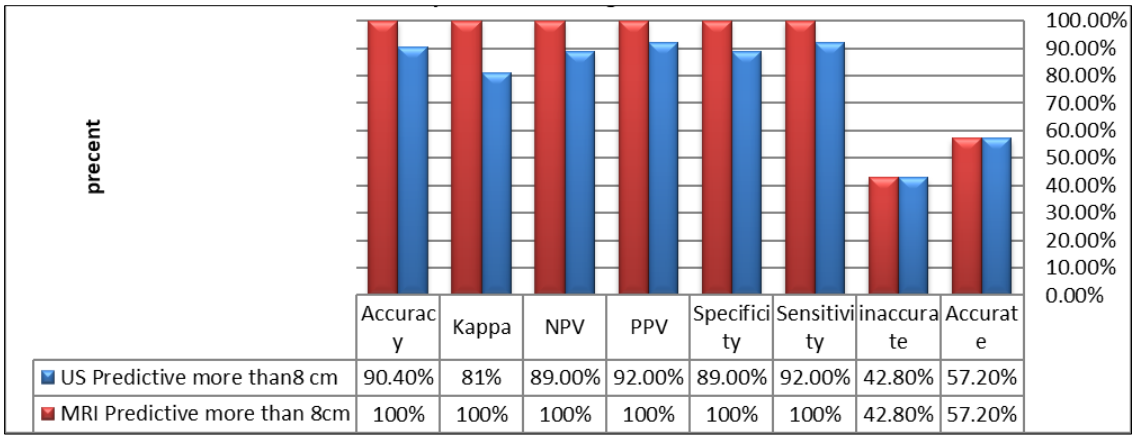


Figure 11 US and MRI efficiency for determining 4-8cm Fibroid lesions



	Accuracy	Kappa	NPV	PPV	Specificity	Sensitivity	inaccurate	Accurate
US Predictive more than8 cm	90.40%	81%	89.00%	92.00%	89.00%	92.00%	42.80%	57.20%
MRI Predictive more than 8cm	100%	100%	100%	100%	100%	100%	42.80%	57.20%

Figure 12 US and MRI efficiency for determining more than 8cm Fibroid lesions

5. Conclusion

- MRI is very accurate in diagnosis.
- The sensitivity, specificity, negative predictive value, and positive predictive value of US and MRI in the diagnosis of benign uterine fibroids were determined and compared. MRI showed high specificity and sensitivity.
- The knowledge and experience of the doctor and radiologist contribute greatly to the high accuracy of the test results.
- The advantages of ultrasound compared to MRI include its lower cost, easier access, and a faster process - both in terms of screening and obtaining results - although it requires specialized training.
- The benefits of MRI are its superior accuracy, while its disadvantages include higher costs and longer examination times.

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