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The Accuracy of Ultrasound Shear Wave Elastography in the Diagnosis of Adenomyosis

Obstetrics & Gynecology

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ABSTRACT

Background: Adenomyosis is characterised as benign endometrial invasion into the myometrium in endometrial glands and stroma surrounded by hypertrophic and hyperplastic smooth muscles. To summarise the uterine adenomyosis diagnostic modalities that could be used: clinical diagnosis, TVS, MRI, elastosonography, and the gold standard method, which is pathological investigation of hysterectomy samples.

Aim of the work: To assess the accuracy of shear wave elastography in the diagnosis of adenomyosis compared to MRI.

Patients and methods: This is a pilot study conducted on 118 premenopausal patients planned for total hysterectomy at Al-Hussein Obstetrics and Gynecology Hospital, due to benign pelvic conditions.

Results: Twenty seven patients (54%) had histopathological diagnosis of uterine adenomyosis. The clinical manifestations that may be related to uterine adenomyosis were AUB (43%) and chronic pelvic pain (44%). The specificities of TVS, shear wave elastography (SWE) and MRI are comparable, while, the sensitivity of TVS is non-significantly less than those of either SWE or MRI. The sensitivity of SWE and MRI were comparable. This study shows that the prevalence of uterine adenomyosis is 54% in premenopausal patients treated by hysterectomy for some gynecological disorders. This prevalence is overestimation because of indication- bias and because women who need treatment by hysterectomy do not represent the general women population.

Conclusion: Shear Wave Elastography is a new diagnostic approach that analyses the mechanical properties of tissue. It is non-invasive, simple to conduct and interpret, does not considerably increase TVS examination time, and has a short learning curve to become experienced in the operation.

Keywords: *Adenomyosis; Shear wave elastography; Ultrasound; TVS.*

INTRODUCTION

The presence of ectopic endometrial glands and stroma within the myometrium is known as adenomyosis.[1] It is an inner myometrium illness caused by infiltration of the basal endometrium into the underlying myometrium, resulting in smooth muscle hypertrophy and hyperplasia. Although everyone agrees on the basic criteria, the exact depth of endometrial invasion required to make a diagnosis is still up for debate.[2] They went on to say that the majority of articles relate to a depth of about 3 mm or one low power field below the basal endometrial layer.

According to several research, the prevalence of adenomyosis ranges from 10% to 70%.[3] This large range is owing to a lack of preoperative diagnostic tools. None of the common symptoms associated with uterine adenomyosis, such as abnormal uterine haemorrhage, secondary dysmenorrhoea, and an enlarged painful uterus, are pathognomonic for this illness.[2] Because adenomyosis is usually combined with other pelvic disorders, it might be difficult to isolate symptoms to this condition.

The majority of uterine adenomyosis diagnoses and treatments are hysterectomy. Until a safe and consistent way of diagnosing this illness is developed, adenomyosis can only be diagnosed surgically by removing the uterus. [2]

A more accurate estimate of the prevalence of uterine adenomyosis can help us comprehend the disease's impact, identify women at risk of developing the condition, and promote the development of preventive methods and successful treatment.[4] In clinical practise, early identification of uterine adenomyosis is critical. Conservative treatment may be ineffective in advanced situations.[5] Non-invasive or minimally invasive diagnostic approaches are required to avoid needless hysterectomy due to incorrect clinical diagnosis and to study non-surgical alternatives.

The preliminary MRI results for adenomyosis diagnosis were favourable. Togashi et al.[6] used MRI to correctly diagnose 16 patients of adenomyosis before surgery. According to Agostinho et al.[7], MRI is an accurate tool for adenomyosis diagnosis, and the most established MRI finding is JZ thickening more than 12 mm. They also mentioned that high-

signal intensity myometrial foci on T2- or T1-weighted images are a feature. According to Guarnaccia et al.[2], the expense of MRI may prevent its widespread use as a diagnostic tool for adenomyosis.

Shear wave elastography is becoming more prominent in the diagnosis of several organs and systemic illnesses.[8] The growth of adenomyotic foci within the interfacial compartments of connective tissue between the fasicles of hypertrophied smooth muscle cells, accompanied by hyperemia, edoema of perivascular myometrial tissue, and myometrial perifocal hyperplasia around adenomyotic foci, are known to be characteristic changes of the myometrial structures in cases of adenomyosis.

These tissue alterations may alter the stiffness of the myometrium, which can be identified with ultrasonic elastography.[3] According to the preliminary findings of Tessarolo et al.[9], elastosonography could be considered a useful tool in the diagnosis of uterine adenomyosis because it is non-invasive, simple to understand, simple to perform, causes no significant extension of examination time, and has a short learning curve to becoming skilled at the procedure.

This study aims to assess the accuracy of shear wave elastography in the diagnosis of adenomyosis compared to MRI.

PATIENTS AND METHODS

In the current comparative study, 118 premenopausal patients planned for total hysterectomy at El Hussein University Hospital, Obstetrics and Gynecology Department, due to benign pelvic conditions were enrolled.

Inclusion criteria for the study were: women in reproductive age with abnormal uterine bleeding who had failed medical treatment, women with endometriosis and patients having chronic pelvic pain with failed medical treatment for more than six months. Also, some patients included in the study had hysterectomy performed due to CIN 3 or vaginal prolapse. The exclusion criteria were women before age of menarche, or after menopause, fibroid uterus, and women in whom vaginal examination cannot be done (virgin or patient refusal).

Approval of the study was obtained before its initiation. Only the usual consent for hysterectomy was needed. No consent for entering the study.

Six cases were excluded from the study due to postponed surgery; 4 cases were excluded because patients refused operation. They changed their decision and asked for Mirena insertion. 8 more cases were excluded because the operation was done before completing the imaging procedures.

The remaining hundred patients comprised the study group. Each one of the study patients had TVS, SWE and MRI done between day 7 and 14 of the menstrual cycle and the hysterectomy operation was done within 2 months from imaging.

Total hysterectomy was done abdominally in 78 cases and vaginally in 22 cases. One stitch was put at each cornu on anterior uterine wall for orientation, the uterus was bisected longitudinally, fixed in formalin, and sent to pathology department.

TVS and SWE were done in El Hussein University Hospital, Ultrasound and Special Care Unit for the Fetus Department by use of Samsung HS60. Uterine adenomyosis was diagnosed, according to Sun et al., in the presence of one or more of the following sonographic features: subendometrial echogenic linear striations, intramyometrial cysts 2-7 mm in diameter, a heterogenous myometrial echo- texture, poor definition of endometrial myometrial interface, globular uterus or myometrial antero - posterior asymmetry.

The shear wave elastography mode was triggered after the transvaginal sonographic examination. The process was carried out as suggested by Acar et al.[3]. The transducer was placed vaginally at a depth of three centimetres. Scanning was performed without the use of additional compression by moving the hand and transducer. Color mapping and determining the Young's modulus value were performed in a 5 mm diameter area of interest (AOI). In the absence of suspected pathology, the ultrasonography area of interest was placed in the anterior uterine wall. Adenomyosis was diagnosed if the Young's modulus value was greater than the cut off value of 34.6 Kpa proposed by Acar et al.

Adenomyosis was identified by magnetic resonance imaging when one or more of the following criteria were present: JZmax equal or greater than 12 mm, JZdiff greater than 5 mm, and JZmax / total myometrial thickness greater than 40%.7 The MRI protocol used was that proposed by Agostinho et al. 7. T2-WI sagittal, axial, and coronal planes were used in this protocol, as well as T1 3D fast suppressed axial and coronal planes. Contrast, as proposed by Acar et al., was not required for suspected adnexal lesions.

The histopathologist was asked to check for uterine adenomyosis without knowing the imaging results (no comment was needed for extent or severity of the lesion). Fundus, anterior wall, posterior wall, left lateral wall, right lateral wall, and macroscopically questionable myometrial region histopathological sections were investigated. If ectopic endometrium was detected at 2.5 mm or greater from the basal endometrium, uterine adenomyosis was identified.[10]

The histopathological findings were utilised to determine the prevalence of uterine adenomyosis in the study population as well as the values of risk factors previously identified (age, gravidity, parity, history of uterine surgery, smoking, depression, oral contraceptive usage, and IUD insertion).

The results of histological examination were also utilised as a reference to investigate the diagnostic usefulness of the procedures used to diagnose uterine adenomyosis: TVS, SWE, and MRI.

The elastogram demonstrates a soft adenomyotic lesion (red) surrounded by rigid myometrial tissue (blue).

Statistical Analysis:

Data were analysed using IBM c SPSS c Statistics version 26 (IBM c Corp., Armonak, NY) and Version 2016.02.28451 (Addinsoft c, Paris, France). Diagnostic accuracy of TVS, MRI or SWE is calculated using histopathology as the gold - standard for diagnosis. The following diagnostic indices are calculated: sensitivity, specificity, positive and negative predictive values, positive and negative likelihood ratios and correct classification and misclassification rates. The McNemar test is used to compare sensitivities or specificities of different modalities. Inter - method agreement is examined using Cohen Kappa coefficient (k), Scott's bias - adjusted kappa coefficient (BAK) and Bennett's prevalence and bias - adjusted Kappa coefficient (PABAK). The coefficients of agreement (k, BAK and PABAK) are interpreted as follows: values less than 0.5 are indicative of poor agreement, values between 0.5 and 0.75 indicate moderate agreement, values between 0.75 and 0.9 indicate good agreement and values greater than 0.9 indicate excellent agreement. $P < 0.05$ is considered statistically significant.

RESULTS

Variable		Count	Percentage
Age*	<50 years	74	74.0%
	≥50 years	26	26.0%
Gravidity	G2	8	8.0%
	G3	20	20.0%
	G4	30	30.0%
	G5	28	28.0%
	G6	14	14.0%
Parity	P2	12	12.0%
	P3	30	30.0%
	P4	32	32.0%
	P5	22	22.0%
	P6	4	4.0%
Frquency of previous abortions	Nil	78	78.0%
	1 Miscarriage	6	6.0%
	2 Miscarriages	12	12.0%
	3 Miscarriages	4	4.0%
Past obstetric history	CS	30	30.0%
	Miscarriage	24	24.0%
	D & C	22	22.0%
Past contraceptive history	Past history of OCP	32	32.0%
	Past history of IUD	24	24.0%
Past medical history	Smoking	0	0.0%
	Depression	0	0.0%
Presenting symptoms	AUB	34	34.0%
	Dysmenorrhea	44	44.0%
	Infertility	0	0.0%
	Asyptomatic	46	46.0%

*. Mean ± SD (minimum to maximum) = 46.8 ± 3.1 (42 to 52 years).

Table 1: Characteristics of the study population.

Table (1) shows the clinical characteristics of the study population. The clinical presentations (AUB, chronic pelvic pain and infertility) which are known to be present in cases with uterine adenomyosis. Chronic pelvic pain was present in 44% AUB was present in 34% and infertility was present in zero percent. The patients without any of these complaints comprises 46% of the study population.

Variable	No Adenomyosis (n=46)	Adenomyosis (n=54)	P-value*
Age (gears)	46.8 ± 3.1	46.6 ± 3.2	0.892†
Age category			0.526
<50 years	36 (78.3%)	38 (70.4%)	
≥50 years	10 (21.7%)	16 (29.6%)	
Gravidity			0.922‡
G2	4 (8.7%)	4 (47.4%)	
G3	12 (26.1%)	8 (14.8%)	
G4	8 (17.4%)	22 (40.7%)	
G5	14 (30.4%)	14 (25.9%)	
G6	8 (17.4%)	6 (11.1%)	
Parity			0.684‡
P2	4 (8.7%)	8 (14.8%)	
P3	16 (34.8%)	14 (25.9%)	
P4	12 (26.1%)	20 (37.0%)	
P5	12 (26.1%)	10 (18.5%)	
P6	2 (4.3%)	2 (3.7%)	
Past history of CS	14 (30.4%)	16 (29.6%)	0.951
Past history of D & C	12 (26.1%)	10 (18.5%)	0.520
Past history of OCP	16 (34.8%)	16 (29.6%)	0.697
Past history of IUD	8 (17.4%)	16 (29.6%)	0.313
AUB	8 (17.4%)	26 (48.1%)	0.022
Dysmenorrhea	10 (21.7%)	34 (63.0%)	0.003
Infertility	0 (0.0%)	0 (0.0%)	NA
Asyptomatic	32 (69.6%)	14 (25.9%)	0.002

Data are mean ± SD or number (%). NA = test not applicable.

*. Chi-squared test unless otherwise indicated. †. Independent samples t-test.

‡. Linear by linear association.

Table 2: Comparison of clinical variables in patients with or without adenoyosis

The clinical variables in patients with adenomyosis versus those without are shown in table (2). The only variables that have significant differences are AUB, chronic pelvic pain and asymptomatic cases.

Variable		Count	Percentage
TVUS diagnosis	No Adenomyosis	56	56.0%
	Adenomyosis	44	44.0%
MRI diagnosis	No Adenomyosis	46	46.0%
	Adenomyosis	54	54.0%
SWE diagnosis	No Adenomyosis	46	46.0%
	Adenomyosis	54	54.0%
Histopathological diagnosis	No Adenomyosis	46	46.0%
	Adenomyosis	54	54.0%

Table 3: Results of TVUS, MRI, SWE and histopathology.

	Histopathology		
TVUS	Adenomyosis	No Adenomyosis	Total
Adenomyosis	42	2	44
No Adenomyosis	12	44	56
Total	54	46	100
Statistic	Value	Lower bound (95%)	Upper bound (95%)
Correct classification	86%	76%	96%
Misclassification	14%	4%	24%
Sensitivity	78%	59%	90%
Specificity	96%	77%	100%
False positive rate	4%	0%	12%
False negative rate	22%	8%	37%
Prevalence	54%	40%	68%
Positive predictive value	95%	87%	100%

Negative predictive value	79%	63%	94%
Positive likelihood ratio	17.9	2.6	122.9
Negative likelihood ratio	0.23	0.11	0.47
Relative risk	4.5	2.3	8.8
Odds ratio	77.0	11.9	500.2

Table 4: Diagnostic accuracy of TVUS evaluated versus histopathology as the gold-standard test.

Table (4) shows the diagnostic accuracy of TVS evaluated versus histopathological diagnosis of uterine adenomyosis as the gold standard test. Sensitivity is 78%, specificity is 96%, PLR is 17.9 and NLR is 0.23.

	Histopathology		
MRI	Adenomyosis	No Adenomyosis	Total
Adenomyosis	48	6	54
No Adenomyosis	6	40	46
Total	54	46	100
Statistic	Value	Lower bound (95%)	Upper bound (95%)
Correct classification	88%	79%	97%
Misclassification	12%	3%	21%
Sensitivity	89%	71%	97%
Specificity	87%	67%	96%
False positive rate	13%	0%	26%
False negative rate	11%	0%	22%
Prevalence	54%	40%	68%
Positive predictive value	89%	77%	100%
Negative predictive value	87%	73%	100%
Positive likelihood ratio	6.8	2.4	19.7
Negative likelihood ratio	0.13	0.04	0.38
Relative risk	6.8	2.6	18.1
Odds ratio	53.3	10.8	262.5

Table 5. Sensitivity is 89%, specificity is 87%, PLR is 6.8 and NLR is 0.13.

Table 5: Diagnostic accuracy of MRI evaluated versus histopathology as the gold-standard test

The diagnostic accuracy of MRI evaluated versus histopathological examination is shown in

	Histopathology		
SWE	Adenomyosis	No Adenomyosis	Total
Adenomyosis	50	4	54
No Adenomyosis	4	42	46
Total	54	46	100
Statistic	Value	Lower bound (95%)	Upper bound (95%)
Correct classification	92%	84%	100%
Misclassification	8%	0%	16%
Sensitivity	93%	75%	99%
Specificity	91%	72%	99%
False positive rate	9%	0%	19%
False negative rate	7%	0%	17%
Prevalence	54%	40%	68%
Positive predictive value	93%	83%	100%
Negative predictive value	91%	80%	100%
Positive likelihood ratio	10.6	2.8	40.2
Negative likelihood ratio	0.08	0.02	0.31
Relative risk	10.6	3.3	34.5
Odds ratio	131.3	20.7	830.2

Table 6: Diagnostic accuracy of SWE evaluated versus histopathology as the gold-standard test.

Table (6) shows the diagnostic accuracy of SWE versus histopathological examination to diagnose uterine adenomyosis. Sensitivity is 93%, specificity is 91%, PLR is 10.6 and NLR is 0.08.

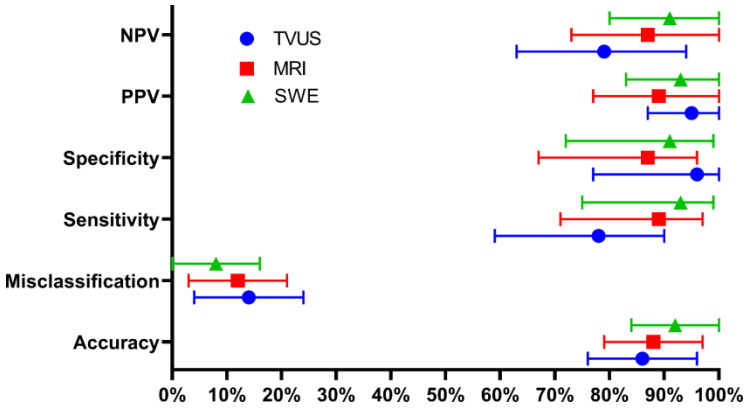

Fig. 1: Diagnostic accuracy of TVUS, MRI and SWE evaluated versus histopathology as the gold-standard test. Error bars represent the 95% confidence limits.

The diagnostic accuracy of TVS, SWE and MRI evaluated versus histopathological examination are shown in figure (1). The diagnostic accuracies of the three modalities are comparable.

DISCUSSION

In the current study, 54 of 100 patients (54 percent) who had hysterectomy for benign gynaecological disorders had histopathologically proven adenomyosis. The prevalence of uterine adenomyosis varied widely, ranging from 5% to 70%. [11] This huge range in prevalence could be attributed to one or more of the following factors: 1) the diagnosis is related to the pathologist's awareness of the condition and the number of tissue sections examined, 2) the use of different diagnostic criteria and differences in populations studied, 3) the co-existence of other gynaecological conditions such as endometriosis and leiomyomas increasing the heterogeneity of the available data, 4) the lack of shared definitions and classifications of the disorder, and 5) differences in racial and ethnic groups.[12]

Due to selection bias (diagnosis in hysterectomy specimens), the current study and the majority of prior investigations revealed a high prevalence. Adenomyosis has been found in up to 70% of hysterectomy specimens and is found in 30% of the general female population. [13]

In the current investigation, 14 of 54 uterine adenomyosis cases (25.9%) were asymptomatic. The reported asymptomatic instances ranged from 4.5 percent to 30 percent.[14]

The diagnostic accuracy of 2D-TVS for the diagnosis of uterine adenomyosis was demonstrated in the current investigation, with sensitivity, specificity, positive predictive value, and negative predictive value of 78 percent, 96 percent, 95 percent, and 79 percent, respectively. Several prior studies had demonstrated the utility of 2D-TVS as a diagnostic tool for this condition. These investigations exhibited sensitivity ranging from 80% to 86 %, specificity ranging from 50% to 96 %, and overall accuracy ranging from 68 % to 86 %. [15] According to Exacoustos [15], the statistics are lower when there is focal adenomyosis or a co-existing fibroid.

The majority of research that reported on the diagnostic accuracy of TVS for the diagnosis of uterine adenomyosis looked at women who had hysterectomy.[16] Those studies mostly recruited women with severe symptoms who were more likely to have adenomyosis than the general female population, and it is possible that the prevalence in those studies was overestimated.

The variation in TVS accuracy between studies, including the current one, may reflect changes in the study population, the amount of sonographic characteristics used for diagnosis, and/or technique.

When compared to MRI, TVS is more patient-friendly, repeatable, less expensive, and more widely available.[15] As a result, 2D-TVS may be the primary method for diagnosing uterine adenomyosis, with MRI reserved for cases when TVS is ambiguous or in the presence of large fibroids. [17]

In the current investigation, uterine adenomyosis was identified preoperatively using MRI if any of the following characteristics were found: JZmax of 12 mm or greater, JZdiff of 5 mm or greater, ratioJZ of 40% or greater, and microcysts 2-7 mm in diameter within the myometrium. Our study demonstrated the accuracy of MRI in diagnosing uterine adenomyosis: 89 percent sensitivity, 87 percent specificity, 89 percent positive predictive value, 87 percent negative predictive value, 6.8 percent positive likelihood ratio, and 0.13 percent negative likelihood ratio.

Many publications have demonstrated the accuracy of MRI in the diagnosis of uterine adenomyosis. According to Tamai et al. [18], MRI is an accurate non-invasive approach for diagnosing this gynaecological illness and is more beneficial than TVS in distinguishing adenomyosis from leiomyoma, which is possibly the most clinically important differentiation. According to Novellas et al. [19], adenomyosis can be diagnosed with 85 percent accuracy and the most diagnostic feature is JZmax greater than 12 mm.

Bazot et al. [20] prospectively investigated 120 consecutive patients referred for hysterectomy in a prospective study. By connecting imaging with histological findings, they compared TVS and MRI

for adenomyosis diagnosis. Thirty-three percent of patients had histopathological evidence of uterine adenomyosis. They concluded that TVS was equally effective as MRI in diagnosing adenomyosis in women without myoma, but that MRI should be used in patients with concomitant leiomyoma.

Bazot et al.[21] used preoperative MRI on 56 consecutive patients scheduled for hysterectomy to investigate diagnostic accuracy and inter-obsrver variability. Twenty-four (42.9) patients had histological evidence of uterine adenomyosis. The sensitivity amongst various observers ranged from 50 to 75 percent, the specificity ranged from 81 to 91 percent, the PPV ranged from 67 to 86 percent, and the NPV ranged from 68 to 83 percent. They concluded that MRI exhibited good accuracy and minimal inter-observer variability in diagnosing this gynaecological condition.

SWE was explored as a diagnostic method for uterine adenomyosis in the current investigation. According to Acar et al.[3], the Emean of the Young's module of 34.6 Kpa was utilised as the threshold at which adenomyosis is diagnosed. Adenomyosis cases diagnosed histopathologically were compared to non-adenomyotic instances. According to the current research, SWE is an accurate tool for diagnosing this gynaecological problem. The sensitivity is 93%, the specificity is 91%, the positive likelihood ratio is 10.6, and the negative likelihood ratio is 0.08. Our findings are consistent with those of Acar et al. [3], who concluded that SWE was useful in diagnosing uterine adenomyosis. Acar et al. discovered that uterine adenomyosis was identified with sensitivity, specificity, positive predictive value, and negative predictive value of 89.7 percent, 92.9 percent, 97.2 percent, and 76.5 percent, respectively, using Young's modulus Emean cut off value.

Vora et al. [22] also did a study to evaluate the role of SWE in characterising various uterine diseases (endometrial polyp, leiomyoma and uterine adenomyoma). They found that SWE is a possible supplement to ultrasound that can be used to characterise such lesions.

Tessarolo et al. [9] conducted a pilot research in 30 patients with suspected uterine adenomyosis to assess the utility of strain elastosonography (SE) in diagnosing the condition. They discovered that with SE, the adenomyotic tissue had more suppleness (red and green patches) than the surrounding normal myometrial tissue (blue). Furthermore, Stoelinga et al.[23] compared SE to histopathology-based and MRI-based diagnosis in 218 patients with suspected gynaecological disorders. They discovered that adenomyosis was lighter (softer) and fibroid was darker (sturdier) than the neighbouring normal myometrium. They concluded that elastosonography-based diagnosis could distinguish between normal myometrial tissue, fibroids, and adenomyosis. They also concluded that elastosonography-based diagnosis was in excellent agreement with MRI, but not with histological diagnosis, which was substantial but not ideal. Tessarolo et al. [9] and Stoelinga et al. [23] studies are not comparable to ours since they are subjective and qualitative, whereas ours is quantitative. The latest two investigations indicate that sonoelastography is a potential approach for diagnosing uterine adenomyosis.

Shear wave elastosonography has been used with proven accuracy in various obstetric situations and other specialisations. These studies are included here not for comparison, but to demonstrate that SWE is a promising method for determining mechanical tissue features that reflect various clinical states. SWE was employed by Hefeda and Zakaria [24] to analyse the placentas of normal and abnormal pregnancies. SWE revealed no significant difference in normal pregnant placentae between the second and third trimesters. The placentas of patients with PE/E, on the other hand, had elevated SWV in the second and third trimesters. Furthermore, placenta previa and placenta accreta have greater SWV than normal placentae. SWV measures, according to Hefeda and Zakaria[24], represent placental flexibility in both normal and high-risk pregnancies.

Muller et al. [25] conducted a cross-sectional study to predict preterm delivery using SWE of the cervix. They discovered that cervical SWE is modestly but considerably lower in patients diagnosed with preterm labour and in patients who actually delivered preterm, and they also discovered inter-observer repeatability.

Sande et al. [26] investigated the accuracy of SWE in the stage of hepatic fibrosis. They came to the conclusion that their research validated the use of SWE in the diagnosis and staging of liver fibrosis.

Chen et al. [27] conducted a study with 276 women who had breast lesions (174 malignant and 102 benign). Before surgical removal of the lesion, they performed conventional U/S and SWE. By using SWE, they were able to detect malignancy and more aggressive breast cancer. As a result, SWE can help to reduce the frequency of unnecessary biopsies.

Fu et al. [28] investigated the utility of transrectal SWE in the detection of prostate cancer. They found that SWE may provide extra information for the identification of prostate cancer, thereby increasing positive detection rates and reducing needless biopsies.

CONCLUSION

SWE, TVS, and MRI are all reliable non-invasive techniques for detecting uterine adenomyosis; however, TVS has a non-significantly lower sensitivity.

SWE is a new diagnostic approach that analyses mechanical properties of tissue. It is non-invasive, quick to perform, and straightforward to interpret. It does not considerably increase TVS examination time and has a short learning curve to become experienced in the operation.

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