



Three-dimensional Transvaginal ultrasonography versus hysteroscopy for the detection of intracavitary uterine abnormalities

Hamdi Alaa El-Din Ghorab M.Sc; Ahmed Tawfeeq Morsy Soliman M.D; Hesham Abdel-Aziz Salem, M.D and Dina Gamal El Din El Kholly M.D

Department of Obstetrics and Gynaecology, Faculty of Medicine, Tanta University.

Abstract: Objective: It was aimed at carrying out a comparative study between 3DTVUS and hysteroscopy in the accuracy of diagnosis of intrauterine cavity lesions. **Study design:** 3DTVUS was done followed by hysteroscopy for all cases (number=100). Data obtained were compared and analyzed to estimate the accuracy of 3DTVUS. **Results:** The comparison with using Hysteroscopy, the sensitivity, specificity, positive predictive value, negative predictive values and total overall accuracy of 3DTVUS for total abnormal findings were 95%, 88%, 99, 58% and 94% respectively. **Conclusion:** The three dimensional transvaginal ultrasound is a sensitive method to evaluate the uterine cavity abnormalities, before resorting to invasive procedures such as diagnostic hysteroscopy. But hysteroscopy allows direct visualization of the uterine cavity so it can detect small intrauterine lesions which could be missed by vaginal ultrasound.

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Keywords: 3DTVUS, hysteroscopy, uterine cavity

1. Introduction

Structural pathologies in the uterine cavity such as müllerian duct anomalies (MDAs) and intrauterine lesions (fibroids, polyps, synechiae) may have an important role in infertility, implantation failure, pregnancy outcome, dysmenorrhea and abnormal uterine bleeding. (1) Transvaginal 3DUS is a non-invasive imaging technique with the ability to generate accurate images of the endometrial cavity and of the external contour of the uterus and provides a volume of data and rapid reconstruction of images in the transverse, sagittal, and coronal planes. (2) The uterus will be examined in longitudinal & transverse planes (2D transvaginal ultrasound) and the 3 coronal planes (3D transvaginal ultrasound). (3) Hysteroscopy is the assessment of cervical canal and uterine cavity by direct endoscopic visualization. (4) Hysteroscopy is performed for the evaluation, or for the treatment of the uterine cavity, tubal ostia and endocervical canal in women with uterine bleeding disorders, Müllerian tract anomalies, retained intrauterine contraceptives or other foreign bodies, retained products of conception, desire for sterilisation, recurrent miscarriage and subfertility. (5) hysteroscopy allows for an accurate diagnosis in benign endometrial pathology. Hysteroscopy also allows directed biopsies of suspicious lesions, which is useful in malignant endometrial pathology. (6) Given their safety and efficacy, diagnostic and operative hysteroscopy have

become standards in gynecologic practice. (7) Many hysteroscopic procedures have replaced old, invasive techniques, such as dilatation and curettage. As instruments have reduced in size, office hysteroscopy has begun to replace operating-room procedures. (8)

Aim of study: The aim of this study was to compare the accuracy of 3DTVUS and hysteroscopy for the detection of intracavitary uterine abnormalities.

2. Patients and Methods

This prospective comparative study had been conducted on one hundred patients recruited from patients attended the department of Obstetrics & Gynecology in Tanta University Hospitals from the period of October 2018 to March 2019.

I. Patients Criteria of patient selection:

Inclusion criteria were as following:

1- Symptomatic patient presented with abnormal uterine bleeding, dysmenorrhea, recurrent miscarriage, infertility.

2- Suspicious intrauterine lesion detected on previous examinations with 2-DUS.

Exclusion criteria were as following:

- 1) Pregnancy
- 2) Pelvic infections
- 3) Active vaginal bleeding

II. An informed written consent

III. Methods

All patients had been subjected to the following:

1. Full history taking

2. Clinical examination

- a) General examination
- b) Any pelviabdominal masses (uterine fibroid)
- c) Pelvic examination:
 - **1-cervical and vaginal examination.**
 - **2-bimanual examination.**

3. Investigations

4. Exclusion of Pelvic Infection.

5. Imaging

a- 2D transvaginal ultrasound carried out to detect presence of any focal uterine lesion or adnexal masses.

b- Three dimensional vaginal ultrasound was done for all the patients with Samsung H60 Korean manufacturer.

6-Hysteroscopy:

Provision of Privacy:

There were adequate provisions to maintain privacy of participants and confidentiality of the data, the patient name has been replaced by serial number & her address was confidential.

Statistical Analysis

Data were statistically described in tens of mean ± standard deviation (± SD), and range, or frequencies (number of cases) and percentages when appropriate. Comparison of numerical variables between the study

groups was done using McNemar test. Agreement was tested using kappa statistic. Accuracy was represented using the terms sensitivity, specificity, +ve predictive value, -ve predictive value, and overall accuracy. p values less than 0.05 was considered statistically significant. All statistical calculations were done using computer program SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) release 15 for Microsoft Windows (2006).

Accuracy Calculations:

$$\text{Sensitivity} = \frac{T (+)ve}{T (+)ve + F (-)ve}$$

$$\text{Specificity} = \frac{T (-)ve}{T (-)ve + F (+)ve}$$

$$\text{Positive predictive value} = \frac{T (+)ve}{T (+)ve + F (+)ve}$$

$$\text{Negative predictive value} = \frac{T (-)ve}{T (-)ve + F (-)ve}$$

$$\text{Overall accuracy} = \frac{T (+)ve + T (-)ve}{\text{All sample}}$$

3. Results

This prospective comparative study was conducted on one hundred patients attending to Obstetric and Gynaecology department, Faculty of Medicine, Tanta University hospital The main clinical features of study group are shown in the following tables and charts.

Demographic study of the patients

Table (1): age in years, Body mass index (BMI, kg/m²), Gravidity & Parity of the patients among the study group.

	Number of cases	Minimum	Maximum	Mean	Standard deviation
Age	100	20	53	37	9.57
BMI	100	21	37	29.47	4.24
Gravidity	100	0	10	2.38	2.52
Parity	100	0	8	1.68	2.11

Table (2): Compliant among the study group.

	Frequency	Percent
1ry infertility	36	36 %
2ry infertility	15	15 %
Recurrent pregnancy loss	10	10%
2ry amenorrhea	5	5%
Menorrhagia	12	12 %
Menometrorrhgia	8	8 %
Metrorrhagia	8	8 %
Polymenorrhea	3	3 %
Postmenopausal bleeding	3	3 %
Total	100	100 %

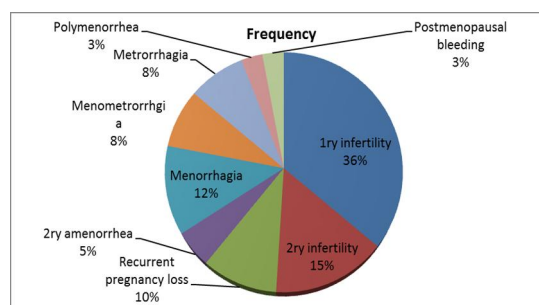


Figure (1): Pie chart presentation of compliant among the study group. Data from 3D transvaginal Ultrasonography

Table 2 shows that the compliant among the study group: 36 women presented with primary infertility (36%) while 15 women (15%) presented with secondary infertility, 5 women presented with secondary amenorrhea (5%), 10 women (10%) presented with recurrent pregnancy loss and 34

women (34%) presented with abnormal uterine bleeding, bleeding cases include menorrhagia 12 cases (12%), metrorrhagia 8 cases (8%), menometrorrhagia 8 cases (8%), 3 cases (3%) polymenorrhea and 3 cases (3%) were postmenopausal bleeding.

Table shows3 by 3D TVUS, the number of fibroid lesion was 23 (23%), the number of polyps was 20 (20%), the number of intrauterine adhesions was 6 (6%), the number of endometrial hyperplasia was 10 (10%), the number of uterine anomalies was 20 (20%) for septate, 8 (8%) for Arcute uterus.

Table (3): 3D transvaginal Ultrasonography findings among all studied females.

Abnormalities	No. Cases	Percent
Submucous fibroid	23	23%
Polyp	20	20%
Intrauterine adhesions	6	6%
Endometrial hyperplasia	10	10%
Septate uterus	20	20%
Arcute uterus	8	8%
Normal	13	13%
Total	100	100%

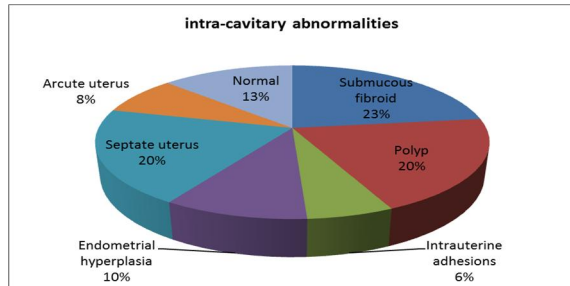


Figure (2): Graph presentation of 3D transvaginal Ultrasonography findings among all studied females.

Data from hysteroscopic examination:

Table (4): Detailed hysteroscopic findings among all studied females.

Abnormalities	No. Cases	Percent
Submucous fibroid	23	23%
Polyp	22	22%
Intrauterine adhesions	9	9%
Endometrial hyperplasia	10	10%
Septate uterus	20	20%
Arcute uterus	8	8%
Normal	8	8%
Total	100	100%

Table 4 shows that the hysteroscopic examination: the number of fibroid lesion was 23 (23%), the number of polyps was increased to 22 (22%), the number of intrauterine adhesions was increased to 9 (9%). the number of endometrial hyperplasia was 10 (10%), the number of uterine anomalies was 20 (20%) for septate, 8 (8%) for Arcute uterus.

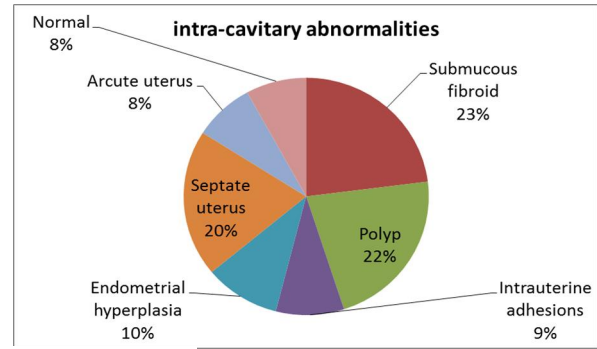


Figure (3): Graph presentation of detailed hysteroscopic findings among all studied females.

The differences between diagnostic capabilities of 3D- TVUS and hysteroscopy in our study were: we found 22 cases of endometrial polyps diagnosed by hysteroscopy that differ from 3D US, 2 of them were missed by 3D ultrasonography. We diagnosed 9 cases of intrauterine adhesions which were confirmed by hysteroscopy as intrauterine adhesions, 3 of them were missed by 3D ultrasonography.

Table 5 shows that the 3D transvaginal ultrasonography detected abnormalities in 87 cases representing 87% of cases, while 13 cases (13%) were free.

Table (5): Comparison between negative and positive finding of 3DTVUS

	Number	Percent
Negative	13	13%
Positive	87	87%

Table 6 shows that the hysteroscopy detected abnormalities in 92 cases representing 92% of cases, while 8 cases (8%) were free.

Table (6): Comparison between negative and positive finding of hysteroscopy.

	Number	Percent
Negative	8	8%
Positive	92	92%

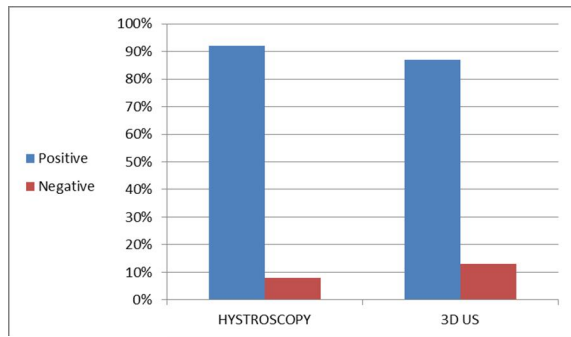


Figure (4): Graph presentation of comparison between negative and positive finding of 3D-TVUS and hysteroscopy.

Table 7 showed that hysteroscopic had higher values than 3D transvaginal Ultrasonography in the sensitivity, negative predictive value & accuracy.

Table (7): Sensitivity, specificity, predictive values and total accuracy of 3D transvaginal ultrasonography in relation to Hysteroscopy.

	Sensitivity	Specificity	PPV	NPV	Accuracy
3D US	95%	88%	99%	58%	94%

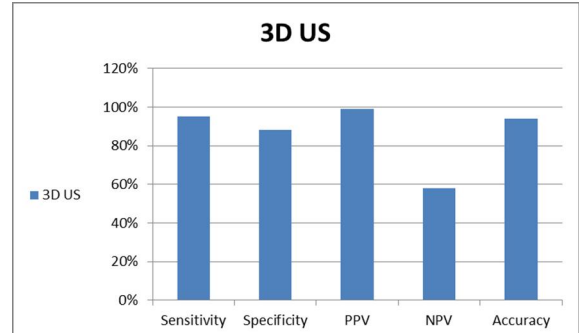


Figure (4): Graph presentation of sensitivity, specificity, predictive values and total accuracy of 3D-TVUS in relation to hysteroscopy.

Table 8 showed that hysteroscopy had higher values than 3D transvaginal Ultrasonography in the diagnosis of endometrial polyp and IU adhesions in the sensitivity, negative predictive value & accuracy.

Table (8): Sensitivity, specificity, PPV, NPV, and accuracy of 3D transvaginal Ultrasonography for different findings compared to hysteroscopic examination.

Abnormalities	Sensitivity	Specificity	(+)ve PV	(-)ve PV	Accuracy
Submucous fibroid	100%	100%	100%	100%	100%
End.Polyp	91%	100%	100%	97%	98%
IU adhesions	67%	100%	100%	97%	97%
End.Hyperplasia	100%	100%	100%	100%	100%
Septate uterus	100%	100%	100%	100%	100%
Arcuate uterus	100%	100%	100%	100%	100%

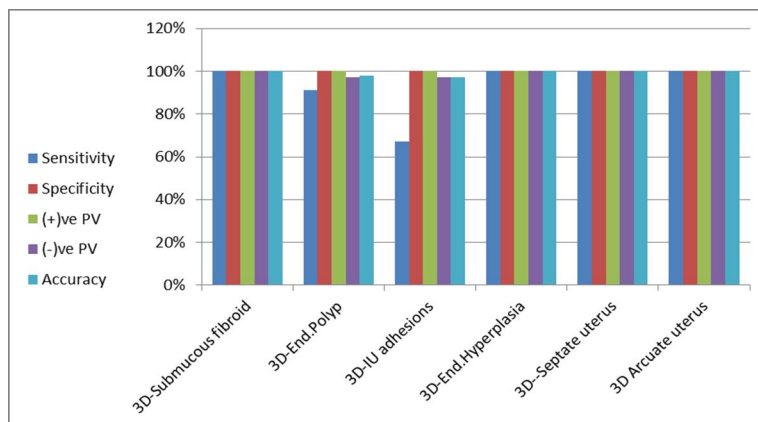


Figure (5): Graph presentation of sensitivity, specificity, PPV, NPV, and accuracy of 3D-TVUS for different findings compared to hysteroscopic examination.

4. Discussion

TVUS represents a practical approach for the initial evaluation of uterine pathologies. (9) 3DTVUS is a non-invasive imaging technique with the ability to generate accurate images of the endometrial cavity and of the external contour of the uterus and provides a volume of data and rapid reconstruction of images in the transverse, sagittal, and coronal planes. (2) One of the most useful scan planes obtained on 3DTVUS is the coronal view of the uterus, which is usually not obtainable on 2DUS because of anatomic limitations. (10) Hysteroscopy permits direct visualization of cervical canal and uterine cavity. Diagnostic hysteroscopy is both accurate and feasible in diagnosis of intrauterine abnormalities. (11) In this prospective comparative study 100 women presented with different complaints due to uterine intracavitary lesion or abnormality suspected by hysterosalpingography or conventional vaginal ultrasound were recruited. All patients were submitted to three dimensional transvaginal ultrasonography and hysteroscopy. Among this study, 36 women presented with primary infertility (36%) while 15 women (15%) presented with secondary infertility, 5 women presented with secondary amenorrhea (5%), 10 women (10%) presented with recurrent pregnancy loss and 34 women (34%) presented with abnormal uterine bleeding, bleeding cases include menorrhagia 12 cases (12%), metrorrhagia 8 cases (8%), menometrorrhagia 8 cases (8%), 3 cases (3%) polymenorrhea and 3 cases (3%) were postmenopausal bleeding. **Jais et al., 2006** in their study carried on 50 patients with abnormal uterine bleeding revealed the most common complaints were: menorrhagia 20 cases (40%), metrorrhagia 9 cases (18%), menometrorrhagia 7 cases (14%), polymenorrhea 4 cases (8%), hypomenorrhea 3 cases (6%). (12) Three dimensional transvaginal ultrasonography detected abnormalities in 87 cases representing 87% of cases, while 13 cases (13%) were free, out of the 13 normal cases, only 8 were confirmed by hysteroscopy while the rest were false negatives. Lesions detected by 3D TVUS were: uterine myomas were found in 23 cases (23%), intrauterine polyps were found in 20 cases (20%) and intrauterine adhesions were seen in 6 cases (6%). In addition, 10 cases (10%) Endometrial hyperplasia, 20 cases (20%) were uterine septum, 8 cases (8%) were arcuate uterus. for the evaluation of uterine cavity lesions or abnormalities considering that hysteroscopy is the gold standard in investigating the uterine cavity in our study showed the following results: 8 cases revealed to be free from lesions (8%), while 92 the rest of the cases (92%) revealed lesions or abnormalities as follows: 23 cases revealed submucous fibroids (23%), 22 cases revealed intrauterine polyps (22%), 9 cases revealed to suffer from intrauterine adhesions (9%), 10

cases revealed to suffer from Endometrial hyperplasia, 20 cases revealed uterine septum (20%), lastly 8 cases revealed arcuate uterus (8%)

The differences between diagnostic capabilities of three dimensional transvaginal ultrasonography and Hysteroscopy in our study were: we found 22 cases of endometrial polyps diagnosed by hysteroscopy, 2 of them were missed by 3D-TVUS. Hysteroscopy diagnosed 9 cases of intrauterine adhesions, 3 of them were missed by 3D ultrasonography. **Jais et al., 2006** on 50 patients with abnormal uterine bleeding, by TVS it detected 13 myomas (26%), 4 polyps (8%), 3 adenomyosis (6%), 10 hyperplasia (20%), 2 endometrial carcinoma (4%), 2 atrophic endometrium (4%), while hysteroscopy detected 17 myomas (34%), 9 polyps (18%), 2 adenomyosis (4%), 5 hyperplasia (10%), 2 carcinomas (4%), 1 atrophic endometrium (2%). (12) **Hemila et al., 2005** detected by 3D U/S 14 myomas (20%), 8 polyps (11.43%), and it could differentiate these myomas as 10 interstitial (14.29%) and 4 submucous (5.71%) in relation to the endometrial encroachment while by hysteroscopy detected 6 myomas (8.57%) which are all submucous, 11 polyps (15.72%) so 3D U/S localization is comparable to hysteroscopy. (13)

In this study, by comparing three dimensional transvaginal ultrasonography results in relation to hysteroscopy results, we found that: The sensitivity, specificity, predictive values and total accuracy of 3D-TVUS in relation to hysteroscopy for individual uterine anomalies were for myomas (submucous myomas) 100%. For endometrial polyps were 91%, 100%, 100%, 97%, 98% respectively. For intrauterine adhesions were 67%, 100%, 100%, 97% & 97% respectively. For endometrial hyperplasia were 100%. The sensitivity, specificity, positive predictive value, negative predictive values and total overall accuracy of 3DTVUS in relation to hysteroscopy for total abnormal findings were 95%, 88%, 99%, 58% and 94% respectively. Different studies were done comparing the findings of 3D-TVUS with those of hysteroscopy, some of them agree and others differ from our results. For myomas (submucous myomas) evaluation, 3D-TVUS we found 23 cases only (23%) to have submucous myomas, finally hysteroscopy diagnosed 23 cases (23%) to have submucous myomas. 3D-TVUS sensitivity, specificity, PPV, NPV and total accuracy for myomas (submucous myomas) were 100%. These results were in agreement with the results of **Balen et al, 1993** who found the capability of both 3D-TVUS and hysteroscopy to identify polypoid structures in the uterine cavity (endometrial polyps & submucous myomas), they were well documented with a sensitivity and specificity of 100%. (14) For uterine polyps evaluation, 3D-TVUS we found 20 cases only (20%) to have polypi, finally

hysteroscopy diagnosed 22 cases (22%) to have polypi. 3D-TVUS sensitivity, specificity, PPV, NPV and accuracy were 91%,100%,100%,97%, and 98% respectively.

This differs from the study of **La Torre et al, 1998** compared 2D & 3D US imaging with and without saline contrast injection. Standard 2D US demonstrated a relatively poor specificity (69.5%). This was improved to 94.1% when 2D US was used in conjunction with saline infusion. 3D US performed almost as well diagnosing the presence of polyps with a specificity of 88.8% and subsequently correctly identified all polyps when used in conjunction with saline infusion. (15) For intrauterine adhesions evaluation: by 3D-TVUS diagnosed 6 cases (6%) to have intrauterine adhesions, but by hysteroscopy 9 cases (9%) found to have intrauterine adhesions, 3 cases were missed by 3D TVUS, which shows how much the hysteroscope is highly sensitive method for diagnosis of the intrauterine adhesions. 3D- TVUS sensitivity, specificity, PPV, NPV and accuracy were 67%, 100%, 100%, 97%,97% respectively. these results disagree with study of **Knopman and Copperman, 2007** which stated that intrauterine adhesions (IUAs) were demonstrated on 3D ultrasound and HSG in all cases and confirmed by hysteroscopy. However, 3D ultrasound had a sensitivity of 100%. And this disagreement may be due to their selection of suspected IUAs patients. (16) For endometrial hyperplasia evaluation: by 3D-TVUS we found 10 cases (10%) to have endometrial hyperplasia, finally hysteroscopy diagnosed 10 cases (10%) to have endometrial hyperplasia. The sensitivity, specificity, positive predictive value, negative predictive value and total accuracy for 3D US were 100%. **M.N. el Tabbakh et al., 2002** who studied 255 patients with abnormal uterine bleeding by ultrasound, sonohysterography and hysteroscopy. Histological examination revealed endometrial hyperplasia in 70 patients where sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy were 77%, 94.6%, 84.4%, 91.6% and 89.8% for transvaginal ultrasound and 95.7%, 96.8%, 91.8%, 98.35% and 96.5% for sonohysterography and 75.7%, 97.3%, 91.4%, 91.45,91.4% for hysteroscopy. (17) For Müllerian anomalies evaluation, **Yu et al, 2014** who studied 62 patients with congenital uterine malformation confirmed hysteroscopically and/or laparoscopically. The patients were subjected to transvaginal two-dimensional ultrasound (2D- TVUS) and 3D-TVUS. The accuracy rate was compared between the two methods. The accuracy rate of 3D-TVUS was (98.38%, 61/62), higher than that of 2D-TVUS (80.65%, 50/62). (18) **Kupesic and Kurjak, 1998** compared 2D US, transvaginal color Doppler,

2D sonohysterography and 3D US in evaluation of septate uterus prior to hysteroscopic removal. The sensitivity and specificity of 3D US were 100 % which agree with our results. (145) 3D US in diagnosing congenital uterine anomalies, when compared with hysteroscopy it had 100% sensitivity, specificity, PPV, NPV and accuracy that reported by (**Wu et al, 1997**; (19) **Radonic et al, (20) 2000**; **Makris et al, 2006**; (21) **Makris et al, 2007**) (22) all four studies done for all congenital anomalies containing septum and all of them agree with our results. 3D offers 100% specificity for exclusion of uterine anomalies and was able to differentiate between different anomalies in four studies which compared the diagnostic accuracy of 3D US in evaluation of uterine cavity to hysteroscopy. And these agree with our results (**Raga et al, 1996(23)**), (**Wu et al, 1997(19)**), and (**Salim et al, 2003**). (2) For total abnormal findings, in our study the overall 3D-TVUS had sensitivity 95%, specificity 88%, PPV 99%, NPV 58% and total accuracy 94%. **Hemila et al., 2005** while comparing 3D US results against hysteroscopy on 70 patients complaining of abnormal uterine bleeding found that 3DUS has a sensitivity of 63.16% specificity of 80.77%, positive predictive value of 54.55 % and negative predictive value of 85.71%, accuracy of 76.1% this results are quite different with our results. (13) **Seuse et al., 2001** reported a sensitivity of 77.8%, specificity of 93.3%, positive predictive value of 88.9% and negative predictive value of 98.3% for TVS in diagnosing endometrial abnormalities in patients with abnormal uterine bleeding (150) while **Karample et al., 2001** reveals Sensitivity, specificity, positive predictive value, negative predictive value of 33.3%, 88.6%, 25% and 92.1% respectively. (24) **Giuseppe et al, 2001** investigated 134infertile women by both US and hysteroscopy. Hysteroscopy detected uterine lesions in 58 out of 134 cases (44%), while the US was in agreement with 50 out 58 of the findings diagnosed by hysteroscopy, US in comparison to hysteroscopy had 84.5% (49/58) sensitivity and 98.7 % (74/75) specificity, 98.0% (49/50) positive predictive value and these results agree with our results. (25)

Conclusion and recommendation

From our study we could conclude that three dimensional transvaginal ultrasound can be used in diagnosing uterine focal lesions with results comparable to hysteroscopy. In addition, three dimensional transvaginal ultrasound is relatively inexpensive, is not time-consuming, and can be performed in settings. 3D sonography has a high level of accuracy for most uterine anomalies. Thus, routine use of three dimensional transvaginal ultrasound is a sensitive method to evaluate the endometrial cavity lesions or abnormalities, before resorting to invasive

procedures such as hysteroscopy. But hysteroscopy allows direct visualization of the uterine cavity so it has can detect small localized intrauterine lesions which could be missed by vaginal ultrasound. We recommend that 3D TVUS, if available, to be performed routinely for all cases of uterine cavity anomalies.

Prior to laparoscopy and hysteroscopy as by reaching a correct and accurate diagnosis it may spare the patient from performing those procedures hence exempting patients from risks of anesthesia and surgery.

Prior to corrective uterine surgery as myomectomy as by the use of simultaneous display of the three perpendicular planes the exact location of myomas can be demonstrated within the uterus as well as their accurate size and precise relationship between each myoma and uterine cavity thus enabling the planning of correct type of myomectomy.

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