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Comparative Study between Three-Dimensional Transvaginal Ultrasonography and Hysteroscopy in the Diagnosis of Uterine Cavity Abnormalities

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ABSTRACT

Objective: It was aimed at carrying out a comparative study between three dimensional transvaginal ultrasonography and hysteroscopy in the accuracy of detecting intrauterine cavitary lesions.

Study design: Three dimensional transvaginal ultrasonography was done followed by hysteroscopy for all cases (number=50). Data obtained were compared and analyzed to estimate the accuracy of 3D transvaginal ultrasound.

Results: The comparison with using Hysteroscopy, the sensitivity, specificity, positive predictive value, negative predictive values and total overall accuracy of Three dimensional transvaginal ultrasonography for total abnormal findings were 89.13%, 100%, 100%, 44.44% and 90% respectively.

Conclusion: The three dimensional transvaginal ultrasound is a sensitive method to evaluate the endometrial cavity lesions or 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.

Keywords: 3D ultrasound, hysteroscopy, uterine cavity abnormalities.

INTRODUCTION

Detection of uterine abnormalities has been the focus of research in gynaecology. 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 and pregnancy outcome. As a result, screening for uterine abnormalities is considered a part of routine clinical investigations of women who have histories of infertility, recurrent miscarriages and early preterm labor[(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. Three-dimensional sonographic technology has become more widely available in clinical practice This technology entails acquisition of a volume of data and rapid reconstruction of images in the transverse, sagittal, and coronal planes [(2).]

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. If the procedure is done for the purpose of evaluating the uterine cavity only, it is called a diagnostic hysteroscopy. If the observed pathology requires further treatment, the procedure is called an operative hysteroscopy [(3).]

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 [(4).]

Given their safety and efficacy, diagnostic and operative hysteroscopy have become standards in gynecologic practice [(5).]

AIM OF THE WORK

The aim of the study was to compare between the diagnostic accuracy of the three dimensional transvaginal ultrasonography and hysteroscopy in the detection of intrauterine cavitary lesions.

PATIENTS AND METHODS

This comparative observational cross-sectional study was conducted on 50 females attending outpatient clinic at Al Hussin Hospital, Faculty of Medicine, Al-Azhar University. All patients presented with suspected intrauterine abnormality on 2D ultrasonography or on hysterosalpingography. The study was conducted between December, 2017 and June 2018. **The study was approved by the Ethics Board of Al-Azhar University.**

Inclusion criteria: Any woman with suspected intrauterine abnormality on 2D ultrasonography or on hysterosalpingography with complaints of abnormal uterine bleeding in reproductive- aged., peri& postmenopausal bleeding, history of recurrent abortion, infertility, lower abdominal pain, abnormal vaginal discharge or for a routine gynecological examination.

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Exclusion criteria: History suggestive of sexually transmitted diseases. Any cause of bleeding including (bleeding disorders or any coagulation defects, liver cell failure, Drugs as anticoagulant therapy). No vaginal, vulval or cervical causes of bleeding. Any contraindications for hysteroscopy (severe bleeding, Pregnancy, severe vaginitis or cervicitis, endometrial infection and history of pelvic inflammatory diseases Recent uterine perforation.).

Method:

All patients were subjected to the following: Taking their verbal consent about all the steps of both hysteroscopy and transvaginal ultrasonograph. History: Detailed history taking from each patient regarding age, parity, with special reference to present, past, menstrual history and obstetric history. General, abdominal, and pelvic examination (Including; bimanual assessment of the uterine size, position, mobility and adnexal evaluation, any cervical or vaginal abnormalities). Testing for urinary HCG (all patients should have negative results).

Hysteroscopy:

The Hysteroscopic Examination was performed using a rigid hysteroscope (continuous flow; 30-degree forward-oblique view) assembled in a 4-mmdiameter diagnostic sheath with an atraumatic tip (Karl Storz Endoscopy, Tuttlingen Germany). A high-intensity cold light source and fiberoptic cable were used to illuminate the uterine cavity.

Normal saline (0.9%) was used as the distention medium, keeping the pressure between 100 and 120 mm Hg using a pressure adjustable cuff system, with the aim to use the lowest pressure required to distend the uterine cavity adequately.

Eligible and consenting patients underwent OH in the early follicular phase between the 7th and 11th day of the cycle. The gynecologists involved in the procedure were blinded to TVS results, thus minimizing performance bias.

RESULT

This comparative observational cross-sectional study was conducted on 50 females attending outpatient clinic at Al-Hussin Hospital, Faculty of Medicine, Al-Azhar University. The main clinical features of study group are shown in the following tables and charts.

Demographic study of the patients

1. **Age:** Observation of the age in study group revealed that the mean age was 36.5±9.57 years.
2. **Body mass index (BMI, kg/m^2):** The mean BMI of the patients was 29.47 ± 4.24kg/m^2.
3. **Gravidity:** The gravidity of the patients varied between zero to 10 with a mean gravidity of 2.38 ± 2.52.
4. **Parity:** The parity of the patients varied between zero to 8 births with a mean parity of 1.68 ± 2.11.

Table (1): Pin years, Body mass index (BMI, kg/m^2), Gravidity& Parity of the patients among the study group.

	Number of cases	Minimum	Maximum	Mean	Standard deviation
Age	50	21	66	36.5	9.57
BMI	50	21	37	29.47	4.24
Gravidity	50	0	10	2.38	2.52
Parity	50	0	8	1.68	2.11

Table (2): Compliant among the study group.

	Frequency	Percent
1ry infertility	15	30 %
2ry infertility	6	12 %
Recurrent pregnancy loss	4	8 %
2ry amenorrhea	3	6 %
Menorrhagia	8	16 %
Menometrorrhgia	5	10 %
Metrorrhagia	4	8 %
Polymenorrhea	2	4 %
Postmenopausal bleeding	3	6 %
Total	50	100 %

This table shows that the compliant among the study group: 15 women presented with primary infertility (30%) while 6 women (12%) presented with secondary infertility, 3 women presented with secondary

amenorrhea (6%), 4 women (8%) presented with recurrent pregnancy loss and 22 women (44%) presented with abnormal uterine bleeding, bleeding cases include menorrhagia 8 cases (16%), metrorrhagia 4 cases (8%), menometrorrhagia 5 cases (10%), 2 cases (4%) polymenorrhea and 3 cases (6%) were postmenopausal bleeding.

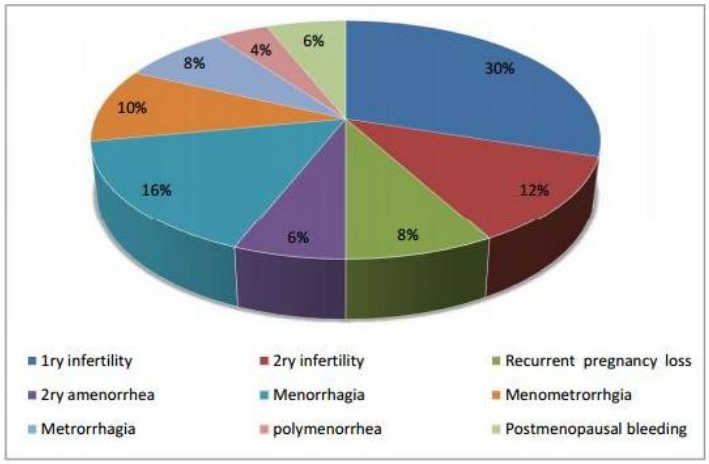


Figure (1): Pie chart presentation of compliant among the study group.

Table (3): The differences between 3D transvaginal Ultrasonography and Hysteroscopy among all the studied cases.

	3D/US		Hysteroscopy	
Abnormalities	**No.Cases**	**Percent**	**No.Cases**	**Percent**
Submucousmyoma	14	28%	14	28%
Endometrial Polyp	8	16%	10	20%
IUA	4	8%	7	14%
Endometrial hyperplsia	4	8%	4	8%
Septate uterus	8	16%	8	16%
Arcuate uterus	3	6%	3	6%
Normal	9	18%	4	8%
Total	50	100%	50	100%

This table shows that the differences between diagnostic capabilities of 3D- TVUS and hysteroscopy in our study were: 10 cases of endometrial polyps diagnosed by hysteroscopy that differ from 3D US, 2 of them were missed by 3D ultrasonography. We diagnosed 7 cases of intrauterine adhesions which were confirmed by hysteroscopy as intrauterine adhesions, 3 of them were missed by 3D ultrasonography.

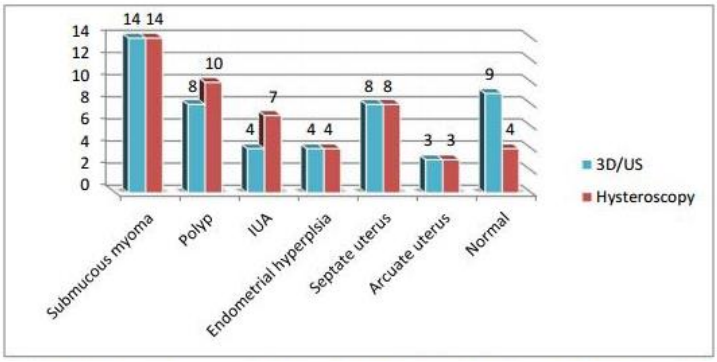


Figure (2): Graph presentation of differences between 3D-TVUS and Hysteroscopy among all the studied cases.

Table (4): Comparison between negative and positive finding of 3D transvaginal ultrasonography.

	Number	Percent
Negative	9	18%
Positive	41	82%

This table shows that the 3D transvaginal ultrasonography detected abnormalities in 41 cases representing 82% of cases, while 9 cases (18%) were free.

Table (5): Comparison between negative and positive finding of hysteroscopy.

	Number	Percent
Negative	4	8%
Positive	46	92%

This table shows that the hysteroscopy detected abnormalities in 46 cases representing 92% of cases, while 4 cases (8%) were free.

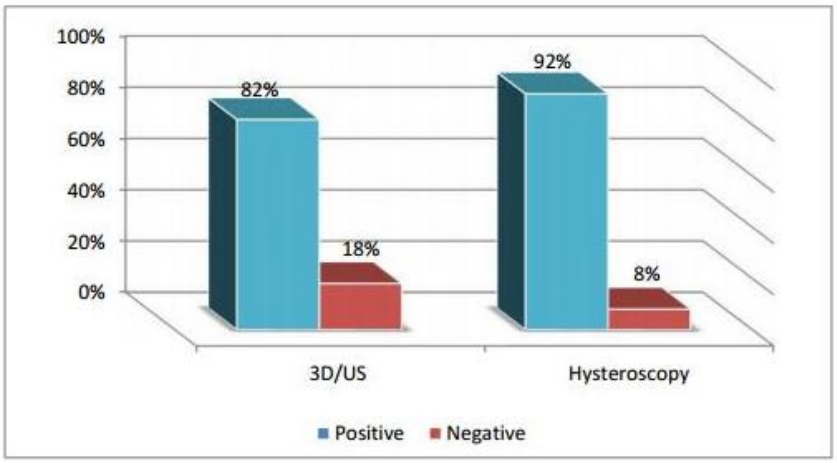
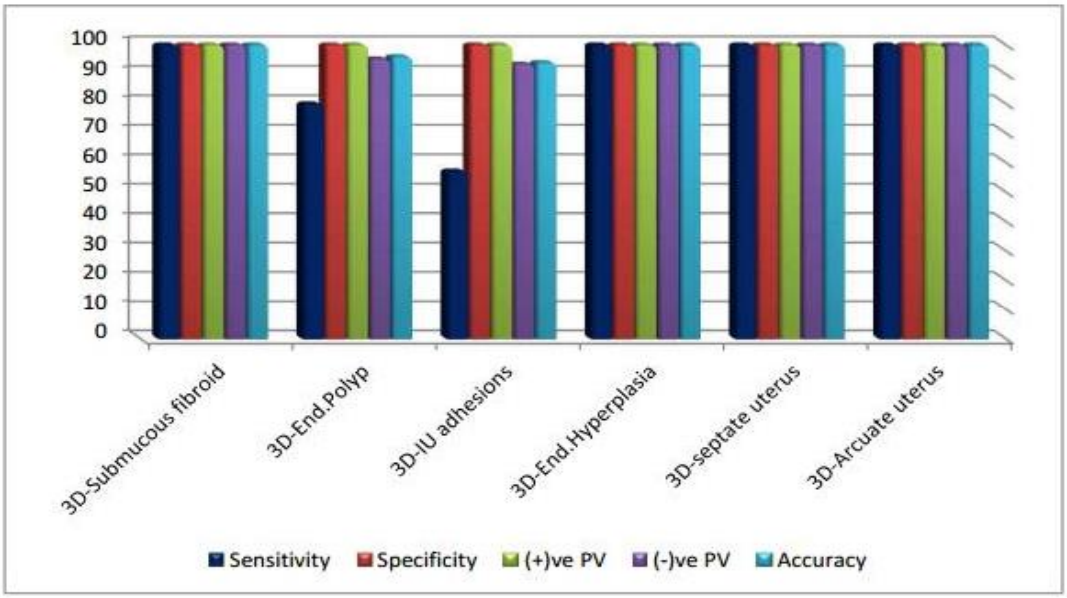


Figure (3): Graph presentation of comparison between negative and positive finding of3D-TVUS and hysteroscopy.

Table (6): 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
3D-Submucous fibroid	100%	100%	100%	100%	100%
3D-End.Polyp	80%	100%	100%	95.24%	96%
3D-IU adhesions	57.14%	100%	100%	93.48%	94%
3D-End.Hyperplasia	100%	100%	100%	100%	100%
3D--Septate uterus	100%	100%	100%	100%	100%
3D Arcuate uterus	100%	100%	100%	100%	100%

This table 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.



Figure(4): Graph presentation of sensitivity, specificity, PPV, NPV, and accuracy of 3D-TVUS for different findings compared to hysteroscopic examination.

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

	Sensitivity	Specificity	PPV	NPV	Accuracy
3D US	89.13%	100%	100%	44.44%	90%

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

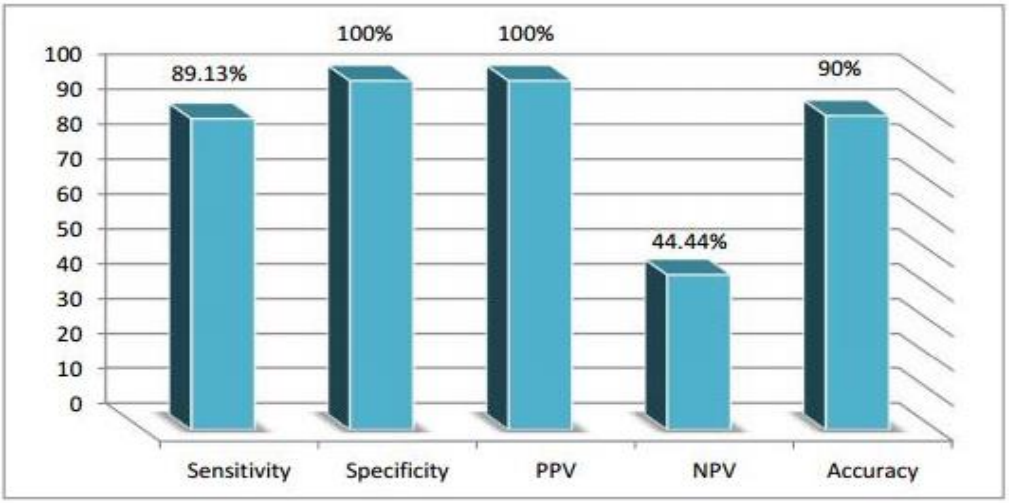


Figure (5): Graph presentation of sensitivity, specificity, predictive values and total accuracy of 3D-TVUS in relation to hysteroscopy.

DISCUSSION

The uterine anomalies can be either congenital (e.g. Müllerian anomalies), or acquired (e.g. Submucousmyomas, endometrial polyps, adhesions) [(6)].TVUS represents a practical approach for the initial evaluation of uterine pathologies [(7)].

One of the most useful scan planes obtained on 3DUS is the coronal view of the uterus, which is usually not obtainable on 2DUS because of anatomic limitations (the vaginal probe has limited mobility within the confines of the vagina). These coronal views show the relationship between the endometrium and myometrium at the uterine fundus, delineate the entire cervical canal, and also depict the cornual angles. We found the coronal plane to be especially helpful in cases of complicated anatomy or multiple findings [(8)].

Hysteroscopy permits direct visualization of cervical canal and uterine cavity. Diagnostic hysteroscopy is both accurate and feasible in diagnosis of intrauterine abnormalities. As diagnostic Hysteroscopy is predominantly perform ed in outpatient clinic, an accurate diagnosis is important to direct treatment at the specific pathology and avoid needless surgery [(9)].

Hysteroscopy is an essential step for infertility workup before ICSI even in patients with normal TV/US[(10)].

This study aimed at assessing the diagnostic accuracy of three dimensional transvaginal ultrasonography in comparison with hysteroscopy for the evaluation of uterine cavity lesions or abnormalities' considering that hysteroscopy is the gold standard. In this prospective study 50 women presented with different compliants 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, 15 women presented with primary infertility (30%) while 6 women (12%) presented with secondary infertility, 3

women presented with secondary amenorrhea (6%), 4 women (8%) presented with recurrent pregnancy loss and 22 women (44%) presented with abnormal uterine bleeding, bleeding cases include menorrhagia 8 cases (16%), metrorrhagia 4 cases (8%), menometrorrhagia 5 cases (10%), 2 cases (4%) polymenorrhea and 3 cases (6%) were postmenopausal bleeding as shown in **(Table 2 & Figure 1)**.

In our 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 shown in **(Table 6 & Figure 4)** were for myomas (submucousmyomas) 100% sensitivity, specificity,

positive predictive value, negative predictive value and total accuracy for 3D-TVUS.

For endometrial polyps the sensitivity, specificity, positive predictive value, negative predictive value and total accuracy for 3D-TVUS were 80%, 100%, 100%, 95.24%, 96% respectively.

For intrauterine adhesions the sensitivity, specificity, positive predictive value, negative predictive value and total accuracy for 3D-TVUS were 57.14%, 100%, 100%, 93.48% & 94% respectively.

For endometrial hyperplasia the sensitivity, specificity, positive predictive value, negative predictive value and total accuracy for 3D-TVUS were 100%.

The sensitivity, specificity, positive predictive value, negative predictive values and total overall accuracy of Three dimentionaltransvaginal ultrasonography in relation to hysteroscopy for total abnormal findings were 89.13%, 100%, 100%, 44.44% and 90% respectively as shown in **(Table 7 &Figure 5)**.

In our study negative predictive value for total abnormal findings of 3D-TVUS was 44.44% due to all patients included in our study were with suspected intrauterine abnormality on 2D US or on HSG. NPV=True(-)ve ÷ [True(-)ve + False(-)ve]= 44.44%, True(-)ve were 4 cases (8%) and False (-)ve were 5 cases(10%).

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 (submucousmyomas) evaluation, 3D-TVUS we found 14 cases only (28%) to have submucousmyomas, finally hysteroscopy diagnosed 14 cases (28%) to have submucousmyomas. 3D-TVUS sensitivity, specificity, PPV, NPV and total accuracy for myomas (submucousmyomas) were 100%.

this agree with the results of ***Balen et al.*** [(11)] found the capability of both 3D-TVUS and hysteroscopy to identify polypoid structures in the uterine cavity (endometrial polyps &submucousmyomas), they were well documented with a sensitivity and specificity of 100%.

For uterine polyps evaluation, 3D-TVUS we found 8 cases only (16%) to have polypi, finally hysteroscopy diagnosed 10 cases (20%) to have polypi. 3D-TVUS sensitivity, specificity, PPV, NPV and accuracy were 80%,100%,100%,95.24%, and 96% respectively.

This differs from the study of ***La Torre et al.*** [(12)] 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 ***La Torre et al.*** [(12)]**.**

For intrauterine adhesions evaluation: by 3D-TVUS diagnosed 4 cases (8%) to have intrauterine adhesions, but by hysteroscopy 7 cases (14%) found to have intrauterine adhesions, 3 cases (6%) 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 57.14%, 100%, 100%, 93.48% 94.00% respectively.

these results disagree with study of ***Knopman and Copperman*** [(13)]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. Also we had the same disagreement with ***Jiménez et al.*** [(14)]**.**

For endometrial hyperplasia evaluation: by 3D-TVUS we found 4 cases (8%) to have endometrial hyperplasia, finally hysteroscopy diagnosed 4 cases (8%) to have endometrial hyperplasia. the sensitivity, specificity, positive predictive value, negative predictive value and total accuracy for 3D US were 100%.

El Tabbakh et al. [(15)]who studied 255 patients with abnormal uterine bleeding by ultrasound, sonohysterography and operative 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 ND 75.7%, 97.3%, 91.4%, 91.45,91.4% for hysteroscopy.

For Müllerian anomalies evaluation, ***Yu et al.*** [(16)] 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).

Kupesic and Kurjak [(17)]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. 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.*** [18] 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 ***Woelfer et al.*** [19].

For total abnormal findings, in our study the overall 3D- TVUS had sensitivity 89.13%, specificity 100%, PPV 100.00%, NPV 44.44% and total accuracy 90%.

Hemila et al. [20]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.

Souse et al. [21] 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 while ***Karample et al.*** [22] reveals sensitivity, specificity, positive predictive value, negative predictive value of 33.3%, 88.6%, 25% and 92.1% respectively.

Giuseppe et al. [23] 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.

CONCLUSION

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 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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