Diagnostic Accuracy Of 3D Transvaginal Ultrasound With Saline Infusion Sono-Hysterography In Detecting Uterine Cavity Abnormalities Prior To First IVF Trial

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Citation

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Abstract

Objective: to evaluate the accuracy 3D transvaginal ultrasound with SIS in the assessment of the endometrial cavity in women undergoing first IVF.

Study design: This is prospective observational cross-sectional study. Women prepared for first trial of IVF were evaluated by 3D transvaginal ultrasound with saline infusion sonohysterography followed by office hysteroscopy.

RESULTS: 581 patients were eligible for the study. Three-dimensional transvaginal sonography and saline infusion sonography in comparison with office hysteroscopy demonstrated 100% sensitivity, 100% specificity in detection of uterine anomalies. However, it demonstrated 79.4% sensitivity, 99.6% specificity in detection of endometrial polyp. Furthermore, its sensitivity and specificity was 75%, 100% in detection of intrauterine adhesions.

Conclusion: Three-dimensional saline infusion sonography can be considered not only a safe and reliable tool for evaluation of uterine abnormality but also as an alternative tool to office hysteroscopy in infertile patient prior to 1st trial of IVF.

INTRODUCTION

Successful implantation in assisted reproduction technology (ART) patients depends on either embryo quality or uterine factor (1). The uterine factor includes many causes, which are considered to have negative impact on the implantation such as mullerian anomalies, fibroid, endometrial polyp, adenomyosis and intrauterine adhesions (2). Therefore, evaluation of the uterine factor is a vital step prior to ART (3), by using different methods such as two-dimensional (2D) ultrasound, three-dimensional (3D) ultrasound, saline infusion sonohysterography (SIS) (4) and hysteroscopy.

The 2D transvaginal ultrasound is widely used in screening of the uterus but it has poor diagnostic accuracy for small polyp and intrauterine adhesions (4). On the other hand, hysteroscopy is the gold standard modality in the evaluation of the uterine cavity (3), irrespective to its invasive nature and limited ability to evaluate the myometrium. However, hysteroscopy is not recommended before 1st trial of ART according to results of INSIHGT study (5).

The (3D) ultrasound is considered more beneficial than (2D) ultrasound due to its ability to evaluate the coronal plane in addition to assessment of the junctional zone (6). However, its diagnostic accuracy is considered low if compared with three-dimensional (3D) SIS for the diagnosis of pathologies like polyps, adhesions, and submucous fibroids (7,8).

SIS is an efficient diagnostic modality, which is considered to be minimally invasive, cost-effective (9) and free of complications except for the theoretical risk of intracavitary infection, which is rarely expected, if complete aseptic precautions are ensured (10). It is not only beneficial in visualizing intracavitary structures, but also increases the diagnostic accuracy of transvaginal ultrasound. The research question of the current study was whether 3D transvaginal ultrasound with SIS is accurate in the evaluation of the endometrial cavity in women undergoing first IVF trial as compared with office hysteroscopy.

MATERIALS AND METHODS

Study type

A prospective observational cross-sectional study was conducted at the Feto-Maternal Unit and the Unit of Endoscopic Surgery of Ibn-Sina IVF center, Sohag, Egypt, during the January 2017 to June 2020 study period.

Ethics

All patients provided written informed consent. The study was approved by the ethical committee of Ibn-Sina IVF center.

Patients

Inclusion criteria: infertile women aged (20-40) years and subjected to 1st IVF trial with no history of previous hysteroscopy and absence of active STDs, PID or active vaginal bleeding.

Exclusion criteria: patients with history of failed trial of IVF & those with obvious uterine lesion by conventional 2D ultrasound such as (myoma or adenomyosis) or at high risk for undergoing hysteroscopy (e.g., congestive heart failure).

Study design

All the patients who fulfilled the inclusion criteria were evaluated by 3D transvaginal ultrasound with saline infusion sonohysterography followed by office hysteroscopy.

Ultrasonographic assessment

Patients were primarily evaluated by two- and three-dimensional transvaginal ultrasound and Saline infusion sonography (SIS) by a single operator (AH) using (Philips Clearview 360, probe 4-7 MHz), at the follicular phase of the menstrual cycle (Days 3–15), 1–3 months prior to starting the IVF/ICSI treatment. Initially, the uterus was evaluated by 2D ultrasound in a strict mid-sagittal view, adjusting the capture window to obtain the optimal 3D volume between one and three static volumes of the uterus, with a quality ranging from medium to maximum. Volume was obtained using a sweep angle of 90□ from one side of the uterus to the other. In case we suspect mullerian anomalies, a transverse plane was obtained so that both uterine horns could be visualized. Saline infusion sonography was then performed, Cusco's speculum was inserted to visualize the cervix, followed by cleaning of the cervix by povidone iodine 10%.

Gentle insertion of intrauterine insemination (IUI) catheter then removal of speculum and insertion of transvaginal transducer. Instillation of saline was done slowly using light pressure by assistant using 50 ml syringe connected to intrauterine insemination catheter. The volumes were manipulated using the Z technique in the multiplanar view described by Abuhamad et al., 2006 (11), until a satisfactory surface rendered image of the fundus and uterine cavity as well as the cervical canal was obtained.

Hysteroscopy assessment

On the same day the ultrasound examination was performed, office hysteroscopy was also performed by a single operator (MA), The operator was blinded to the ultrasound results. All hysteroscopies were scheduled in the follicular phase of the menstrual cycle (Days 3–15), 1–3 months prior to starting the IVF/ICSI treatment, in an outpatient setting, using the vaginoscopic, non-touch technique without anesthesia or dilatation. A 5-mm outer-diameter continuous flow Bettocchi hysteroscope (Karl Storz, Germany, type) with 30□ direction of view was used and normal saline solution was installed for distension of the uterine cavity at a pressure of (60-80) mmHg.

The hysteroscope was gently introduced through cervical canal, internal os, and then into the uterine cavity. Upon entering the uterine cavity, a systematic assessment was implemented, including the uterine cornu, tubal ostia, uterine fundus, and anterior, posterior and lateral uterine walls. Hysteroscopy findings were documented on a case record form. Appearance of cervical canal and endometrium and presence, size, and location of structural anomalies were recorded. In case of positive findings for uterine cavity lesion, modalities of surgical management were discussed with the patient, with the intervention being performed in a follow-up operative setting.

Outcome measures

The primary outcome was to determine the diagnostic accuracy of three-dimensional transvaginal ultrasound with saline infusion sonography compared with hysteroscopy in detecting uterine cavity abnormalities in infertile women prior to 1st IVF trial. The secondary outcome was to evaluate the prevalence of uterine cavity abnormality in infertile women.

Statistical analysis

Sensitivity, specificity, positive and negative predictive value of 3D-TVS were calculated and compared with hysteroscopic diagnosis, the gold standard for evaluation of the uterine cavity. Ninety-five percent confidence intervals were calculated by MedCalc software (MedCalc Software bvba, Ostend, Belgium).

RESULTS

581 women completed the study and five patients were excluded from the study because the uterus was axial with difficult evaluation by ultrasound. Age of included patients ranged from (22-40) years and the duration of infertility ranged from (2 – 20) years. Primary and secondary infertility were found in 74.1% and 25.9% of subjects, respectively. Causes of infertility and other baseline characteristics are shown in Table 1.

Three-dimensional transvaginal ultrasound and hysteroscopy were successfully performed in all 581 women. Ultrasonographic and hysteroscopic findings are shown in Tables 1 & 2 respectively. Hysteroscopy and 3D-TVS findings revealed normal uterine cavity in 456 women and 462 women, respectively. Hysteroscopy showed 130 cases with positive findings, including endometrial polyp in 34 patients, submucous myoma in eight patients, intrauterine adhesions in four patients and uterine anomaly in 84 cases. Three-dimensional transvaginal sonography and saline infusion sonography missed the diagnosis of six patients, five of them were suffering from endometrial polyp and one from intrauterine adhesions while two cases were wrongly diagnosed as polyps by three-dimensional transvaginal sonography and saline infusion sonography Table (IV).

As a clinical tool for detection of uterine anomalies and submucous myoma, three-dimensional transvaginal sonography and saline infusion sonography in comparison with hysteroscopy demonstrated 100% sensitivity, 100% specificity, 100% positive predictive value (PPV), and 100% negative predictive value (NPV) (Table IV). However, detection of endometrial polyp by three-dimensional transvaginal sonography and saline infusion sonography in comparison with hysteroscopy demonstrated 79.4% sensitivity, 99.6% specificity, 93.1% positive predictive value (PPV), and 98.7% negative predictive value (NPV) (Table IV).

Furthermore, detection of intrauterine adhesions by three-dimensional transvaginal sonography and saline infusion sonography in comparison with hysteroscopy demonstrated 75% sensitivity, 100% specificity, 75% positive predictive value (PPV), and 99.8% negative predictive value (NPV) (Table IV).

Table 1

Baseline characteristics of included patients

Clinical data	value	
Age (range)	(22-40) years	
Type of infertility	Primary	74.1%
	Secondary	25.9 %
Duration of infertility	(2 – 20) years	
Causes of infertility	Male	18%
	Female	30%
	Combined	25%
	Unexplained	27%

Table 2

3D ultrasound findings.

Finding	Number	Percentage
Normal	462	78.8%
Abnormal	124	21.2%
Mullerian anomalies	84	14.3%
Arcuate uterus	38	6.5%
Septate	24	4.1%
Unicornuate	8	1.36%
Bicornuate	1	0.17%
Didelphes	3	0.51%
Submucous myoma	8	1.36%
Endometrial polyp	29	4.9%
Intrauterine adhesion	3	0.51%

Table 3

Hysteroscopic findings.

Finding	Number	percentage
Normal	456	77.8%
Abnormal	130	20.2%
Mullerian anomalies	84	14.3%
Endometrial polyp	34	5.8%
Submucous myoma	8	1.36%
Intrauterine adhesions	4	0.68%

Table 4

Comparison of 3D ultrasound with office hysteroscopy.

	3D TVS	Office hysteroscopy	P value*
Normal	462	456	0.67
Abnormal	124	130	

*Using chi-square test.

Table 5

Sensitivity, specificity, positive and negative predictive values of 3D/SIS of variable uterine cavity lesions and anomalies

3D/SIS	Sensitivity Percentage	Specificity Percentage	Positive predictive value Percentage	Negative predictive value Percentage
Uterine anomalies	84/84 100%	502/502 100%	84/84 100%	84/84 100%
Polyps	27/34 79.4%	552/554 99.6%	27/29 93.1%	552/559 98.7%
Submucous myoma	8/8 100%	578/578 100%	8/8 100%	578/578 100%
Intrauterine adhesion	3/4 75%	582/582 100%	3/4 75%	582/583 99.8%
All lesions	122/130 93.8%	456/458 99.6%	122/124 98.4%	456/462 98.7%

Figure 1

Mullerian anomalies diagnosed by 3D ultrasound: (A normal uterus, B unicornuate uterus, C arcuate uterus, D septate uterus, E subseptate uterus, F bicornuate uterus).

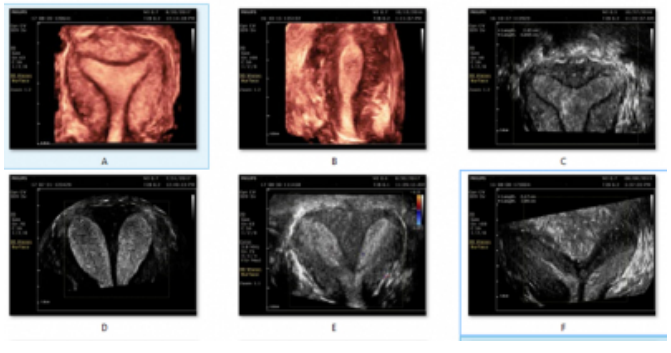

Figure 2

Acquired uterine abnormalities: (G intrauterine adhesions, H submucous myoma, I endometrial polyp)

DISCUSSION

The current study has shown that three-dimensional transvaginal sonography and saline infusion sonography is as accurate as office hysteroscopy in the diagnosis of uterine anomalies and submucous myoma, however, it is less invasive and can diagnose both myometrial and adnexal abnormalities at the same time (Table IV).

Uterine cavity is very essential for successful embryo implantation and presence of any benign intrauterine lesion, such as endometrial polyps, uterine septum, and submucous myoma may contribute to infertility with limited chance of successful ART. Therefore, accurate and reliable tools for uterine cavity assessment are very important specially before any ART Trial. The current study showed that 3D-TVS has an overall sensitivity of 93.8%, specificity of 99.6%, positive predictive value of 98.4%, and negative predictive value of 98.7% for diagnosis of all lesions including uterine anomalies, polyps, submucous myoma and intrauterine adhesions.

The diagnostic accuracy of 3D-TVS in detection of uterine cavity lesion in women with abnormal uterine bleeding was evaluated by Van den Bosc (12). They found endometrial polyp in 26%, submucous myoma in 7%, endometrial hyperplasia in 6%, and cancer in 1% of subjects. They also reported 93% diagnostic accuracy, 96% sensitivity, and 91% specificity. In the current study, 3D-TVS detected all eight cases of submucous myoma and 84 cases of uterine anomalies.

For detection of endometrial polyp, our study showed 79.4% sensitivity, 99.6% specificity, 93.1% positive predictive value, and 98.7% negative predictive value. In comparison to study by Fang (13) which reported sensitivity of 65.6% and specificity of 89% for 3D-TVS in detection of endometrial polyps using combined parameters of endometrial echogenicity, endometrial thickness, and endometrial volume.

In our study, 3D-TVS failed to detect seven endometrial polyps. In cases of submucous myoma, hysteroscopic diagnosis showed 100% sensitivity, 100% specificity, and 100% diagnostic accuracy. The prevalence of uterine cavity lesion in the current study was 7.84%, the most common pathology was endometrial polyp (5.8%), then submucous myoma (1.36%) and intrauterine adhesions (0.68%).

Surgical treatment of submucous myoma and septate uterus is reported to improves ART outcomes (14). Data regarding the role of polypectomy in infertile couples suggest that excision of endometrial polyp improves fertility, but no consensus available regarding the size of polyp that musts to be excised to improve ART outcomes (14). Some studies suggest that polyps less than two cm has no influence on results of fertility management (15). In contrast, another study suggested that fertility outcomes were not dependent on the size of polyp (16). In another study it was shown that level of some molecular markers for endometrial receptivity such as HOXA10 and HOXA11 was significantly impaired by endometrial polyps (17). Furthermore, uterine cavity lesion is a significant and treatable factor that can lead to improvement in ART outcome (14).

Identification of accurate and reliable detection and diagnostic tools for assessment of the uterine cavity is a necessary first step in the improvement of ART success rates. Our study demonstrated that three-dimensional transvaginal sonography/SIS had high sensitivity (93.8%) and specificity (99.6%), especially for detecting uterine anomalies and submucous myoma. Furthermore, uterine abnormalities both congenital or acquired have a negative effect of the success of IVF which necessitate the evaluation of the uterine factor prior to IVF cycles.

Hysteroscopy by far is the gold standard modality in evaluation of the uterine cavity (3) but it is invasive method and missing evaluation of the myometrium. Furthermore, in this study, the prevalence of one or more intrauterine abnormalities in patient attending for IVF screened by 3D US, was found to be around 21% which is the same prevalence reported by Karayalcin et al (18) who found similar prevalence around 22%. However, higher prevalence around 38% was reported by other studies such as Hinckley and milki (19), this difference is mostly due to dissimilarity in study population as they included patient with previous IVF failure.

In the current study the sensitivity and specificity of 3D/SIS as comparison with operative hysteroscopy were 100% for both submucous fibroid and mullerian anomalies and around 99% for other abnormalities. Furthermore, positive and negative predictive value were 100% for both submucous fibroid and mullerian anomalies, however positive and negative predictive value for adhesions were 75% and 99 % respectively and for the endometrial polyps were 93.1 and 98.7 respectively (Table IV). these results agreed with the previous study by Ali et al (20).

In our study the three-dimensional saline infusion sonography diagnostic accuracy was high for diagnosis of different uterine abnormalities as comparison with office hysteroscopy with the advantage of being less invasive and can diagnose both myometrial and adnexal abnormalities at the same time.

CONCLUSION

Three dimensional saline infusion sonography can be considered not only a safe and reliable tool for evaluation of uterine abnormality but also as an alternative tool to office hysteroscopy in infertile patient prior to 1st trial of IVF.

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