Uterine cavity assessment prior to in vitro fertilization: comparison of 3D transvaginal ultrasonography accuracy versus office hysteroscopy

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Abstract

Objective: To compare accuracy of 3-D transvaginal sonography (TVS) versus office hysteroscopy (OH) in the evaluation of uterine cavity abnormalities in infertile women undergoing IVF procedures. OH considered as gold standard.
Study Design: A prospective observational study.
Settings: A tertiary care centre.
Materials and Methods: This is a prospective observational study conducted in 667 infertile women who were scheduled for IVF treatment at our department during June 2014 to December 2015. Main outcome measures- The prevalence of abnormal uterine cavity was 11.52% as detected by office hysteroscopy. There was failed hysteroscopy in 7 women due to cervical stenosis. 3D TVS and OH findings were normal in 631 (95.61%) and 584 (88.48%) women and abnormal in 29 (4.39%) and 76(11.52%) women respectively. This difference is statistically significant with p-value < 0.01. False positive and false negative results for 3 D TVS are 16(2.74%) and 63(82.89%). Considering OH as gold standard, 3 D TVS has 17.11% sensitivity, 97.26% specificity, 44.83% positive predictive value and 90.02% negative predictive value.
Conclusion: Uterine cavity abnormalities are considered to have a negative impact on the embryo implantation rates in IVF. OH should be considered as the primary modality to assess uterine cavity in IVF as it can be done without anesthesia and gives accurate diagnosis. Though 3 D TVS is easier, cost effective, non-invasive and have no complications as compared to OH but due to its low sensitivity (17.11%), low PPV (44.83%) and high false negative (82.89%) results, it has a limited role in IVF.

Keywords: 3 D TVS, OH, IVF, Uterine cavity, Implantation rates, Pregnancy

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Introduction

A successful pregnancy outcome for patients undergoing IVF depends on several factors. Among these factors embryo quality, favorable intrauterine environment and a skillful IVF laboratory are prerequisites to achieve a successful pregnancy outcome. Intrauterine abnormalities play an important role in implantation failure in IVF procedures. Abnormal uterine findings have been reported in nearly 34% to 62% of infertile women.[1,2,3] A variety of modalities such as hysterosalpingography (HSG), transvaginal sonography (TVS), diagnostic hysteroscopy, three dimensional transvaginal sonography (3-D TVS) and three dimensional saline sono hysterography (3-D SIS) can be used for the diagnosis of uterine abnormalities. Hysteroscopy has remained the gold standard in infertility investigation[2,4,5] with high diagnostic accuracy and has become popular now days. The availability of hysteroscopes with smaller diameter has made the use of outpatient or office hysteroscopy feasible as a routine examination[6]. It permits direct visualization of the uterine cavity revealing the nature, location, shape, size and vascular pattern of various uterine cavity abnormalities such as polyps, submucosal fibroids, septa and adhesions. The advent of transvaginal 3D ultrasonography has enabled the accurate, noninvasive, outpatient diagnosis of congenital uterine anomalies and can be considered as an alternative to office hysteroscopy with fewer costs and no complications. (7, 8) 3D TVS offer examinations of adnexa and pelvis in addition to uterus.

We carried out this study to compare accuracy of 3-D TVS versus office hysteroscopy in the evaluation of uterine cavity abnormalities in infertile women undergoing IVF procedures.

Materials and Methods

This is a prospective observational study conducted in 667 infertile women who were scheduled for IVF/ICSI treatment in our IVF unit at Institute Of Kidney Diseases and Research Centre and Institute Of Transplantation Sciences, Ahmedabad, India during a period from June 2014 to December 2015. Approval of the study protocol was taken from the ethical committee of the institute. An informed written consent was obtained from all women who were enrolled in this study.

Detailed clinical history was taken with special context to infertility such as duration, possible etiology, any previous investigation or treatment taken. Complete general, systemic and local examination to detect size, mobility of uterus and presence of any uterine, cervical or adnexal pathology was done. Both 3 D TVS and OH were scheduled in post menstrual period in the early-mid follicular phase of same menstrual cycle, on the same day, before starting the IVF/ICSI treatment. All patients received injection atropine 0.6 mg, injection hyoscine 20 mg, tab misoprostol 400 microgram per vaginum and prophylactic antibiotic tablet amoxicillin+ clavulanic 625 mg single dose 1 hour before procedure. Two dimensional followed by 3 dimensional vaginal ultrasonography was done in all patients with GE Voluson E8 3D system. Once the B-mode had been completed, 3 D volumes were recorded. The volumes were generated by automatic rotation of the mechanical transducer in 360 degrees. For this, the probe was kept steady, patient was asked to hold the breath and volume mode was switched on. The acquired volume was in the shape of a truncated cone. Adequacy of uterine cavity and presence or absence of pathology was detected. Thereafter office hysteroscopy was done with rigid continues flow hysteroscope of 2.9 mm in diameter and 30 degree fiber optic lens (KarlStorz Endoscopy , Germany). A fiber optic cable is connected to the light source and to the hysteroscope. Normal saline was used as a distension media with distension pressure of 80-100 mm of Hg. Vaginoscopy done. Once the cavity was entered, a panoramic view of the uterine cavity was taken followed by visualization of anterior, posterior, lateral walls, fundus and bilateral ostia. Size, shape and site of pathology, if any detected, was estimated. At the end of procedure, the hysteroscope was slowly withdrawn through the cervical canal visualizing any pathology and shuttering mechanism of internal OS. Abnormalities detected by OH were corrected by operative hysteroscopy and sent for histopathological examinations any difficulties or complications if encountered were recorded.

Statistical Methods

Analysis was done by SPSS version 20. Data were expressed as mean±standard deviation and percentage where applicable. Comparisons between groups are evaluated by Chi-square test. A probability value (p-value) less than 0.05 was considered statistically significant.

Results

Among 667 women, there was failed hysteroscopy in 7 women due to cervical stenosis. Hysteroscopy was done under anesthesia in these 7 women. 660 women were evaluated with both 3D TVS and OH. The mean age of patients was 32.90±5.40 years. The mean duration of infertility was 9.27±5.26 years. The prevalence of uterine cavity abnormality was 11.52% as detected by OH. We observed no perforation, hemorrhagic, or metabolic complications due to OH.

Main indications of IVF in all women are summarized in Table 1.

Table 1: Indications of ivf

S. No.	Indication of ivf	No. (%)
1.	Unexplained infertility	272(41.21%)
2	Male factor	254(38.38%)
3.	Tubal factor	70(10.60%)
4.	Ovarian factor	45(6.86%)
5.	Endometriosis	19(2.87%)

The number of women with normal and abnormal findings in 3D TVS and OH has been shown in the Table 2.

Table 2: Number of women with normal and abnormal findings reported by 3D TVS and OH

	Hysteroscopy	3D TVS	Chi-square value	P-value
Normal	584	631	21.89	<0.01 *
Abnormal	76	29		

Above Table shows a statistically significant difference between the findings detected by two techniques.

Various clinical abnormal findings reported in women with 3D TVS and office hysteroscopy are endometrial polyp, submucous myoma, uterine septa, adhesions and abnormal uterine shape. Details have been given in Table 3.

Table 3: Clinical abnormal findings detected via 3D TVS and OH

Abnormal findings	3-D TVS	OH
	No. (%)	No. (%)
Polyp	10(34.48%)	16(21.05%)
Myoma	5(17.24%)	3(3.95%)
Septa	6(20.69%)	26(34.21%)
Adhesion	2(6.90%)	10(13.16%)
Arcuate Uterus	1(3.45%)	6(7.89%)
Unicornuate	2(6.90%)	9(11.84%)
Bicornuate	1(3.45%)	1(1.32%)
Myoma , Septa	1(3.45%)	0

Septa, Polyp	1(3.45%)	1(1.32%)
Septa, myoma, polyp	0	1(1.32%)
Tubular	0	2(2.63%)
Myoma, adhesion	0	1(1.32%)

The most common abnormal finding detected via 3 D TVS was endometrial polyp in 11(37.93%) followed by uterine septa in 8 (27.58%) and myoma in 6 (20.68%) women.

Most common abnormal clinical finding reported with office hysteroscopy was uterine septa in 28(36.84%) followed by endometrial polyp in 18(23.68%) and adhesions in 11 (14.47%) women. All abnormal findings detected by OH were corrected by operative hysteroscopy. Endometrial polyps and myoma were sent for histopathological examination which confirmed the OH findings and revealed benign nature of the pathology.

On comparison of 3 D TVS versus OH, it was found that 3 D TVS was in complete agreement with OH in 13(17.11%) abnormalities and 568(97.26%) of normal findings as shown in Table 4.

Table 4: Comparison of 3D-TVS versus Office Hysteroscopy

	Office Hysteroscopy	
3D-TVS	**Abnormal**	**Normal**
Abnormal	13 (17.11%)	16 (2.74%)
Normal	63 (82.89%)	568 (97.26%)
Total	76	584

False positive results for 3 D TVS are 16(2.74%) among the normal cases. It was found to be associated with false negative results in 63(82.89%) of all the abnormal cases As a test for the detection of uterine cavity abnormalities 3D TVS in comparison to OH had 17.11% sensitivity, 97.26% specificity, 44.83% positive predictive value and 90.02% negative predictive value.

Discussion

Despite the numerous advances in the field of IVF and intra-cytoplasmic sperm injection (ICSI), the implantation rate per embryo transferred usually does not exceed 30%.[9] Uterine cavity abnormalities such as endometrial polyps, small submucous myomas, adhesions and septa are considered to have a negative impact on the chances to conceive through IVF[10]. The reported prevalence of minor intrauterine abnormalities detected by hysteroscopy prior to IVF/ICSI differs considerably between studies from 11% to 40%[11,12]. In the present study, the prevalence of intrauterine abnormalities in asymptomatic infertile women, detected by OH prior to IVF cycle was found to be 11.52%. Among various modalities to evaluate uterine cavity, 3D TVS and OH are being used widely in current practice. In present study we have compared the accuracy of 3 D TVS to OH to find a simple and accurate method to detect intrauterine abnormalities provided that significant pathology should not be missed.

With advanced USG technologies, 3D TVS has been commercially available and is a challenging field in current practice. In recent years it has gained a significant popularity in gynecological practice. It helps to improve diagnosis, especially in those complex cases that are difficult to be evaluated by conventional 2D scanning and other diagnostic modalities.[13] This is mainly due to the ability to visualize the coronal section of the uterus and the fundal contour especially important in lateral fusion defects. Detailed evaluation of pelvic organs is possible by collecting a series of sequential ultrasound images and converting them into an ultrasound volume. Information is digitally stored as a database, which may then be analyzed later on. This database is reconstructed in such a way as to allow visualization of an organ from any chosen angle and in any arbitory plane.[14]

Hysteroscopy has been regarded as the gold standard and definitive procedure for exploration and evaluation of uterine cavity. It is a safe and a simple procedure that can be carried out in an office setting. In addition, it has already shown good results with lower health care costs and high patient acceptability in comparison to diagnostic hysteroscopy.[15]

In the present study, by comparing the 3D TVS results against OH, we found that 3D TVS has a sensitivity of 17.11%, specificity 97.26%, positive predictive value of 44.83% and negative predictive value 90.02%. This shows that 3 D assessment of uterine cavity has high false negative rate of (82.89%) which can lead to misdiagnosis before IVF, ultimately increasing the failure rate. This can be avoided by doing routine OH for evaluating uterine cavity. In addition OH tells about the condition of cervix. As in our study, seven women were found to have cervical stenosis which could not be detected by 3D TVS. Embryo transfer is not possible in such women. These women have to undergo serial cervical dilatation and hysteroscopy under anesthesia to facilitate direct uterine cavity evaluation and embryo transfer. There were no complications seen in women due to OH proving the safety of this procedure as shown in previous studies.[11] In literature we could not find any studies comparing 3D TVS and OH for uterine assessment before IVF procedure. Sonohysterography has been proposed as a better diagnostic tool for uterine cavity evaluation. However, it also has low sensitivity and specificity as compared to that of hysteroscopy.[2]

So though 3D TVS is noninvasive, has less complications, more cost effective than OH but due to its high false negative results and to achieve better IVF results, OH should be considered as the mainstay to

assess uterine cavity in IVF procedures. OH has its own limitations as it's an invasive procedure and can lead to complications which can be minimized with its cautious use.

Conclusion

Uterine cavity abnormalities are considered to have a negative impact on the embryo implantation rates in IVF. Among the various available modalities to assess uterine cavity OH should be considered as the primary modality in IVF. Possibility of doing it on outpatient basis without anesthesia and accuracy in diagnosing intrauterine abnormalities makes OH a gold standard procedure. Though 3 D TVS is easier, cost effective, non-invasive and have less complications than OH but due to its low sensitivity (17.11%), low PPV (44.83%) and high false negative (82.89%) results, it can lead to decreased possibility to achieve a successful pregnancy in IVF. Hence we recommend office hysteroscopy as a routine procedure in IVF for uterine cavity evaluation to improve implantation rates.

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