Section: Obstetrics and Gynecology

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Comparative Study Between Three-dimensional Transvaginal Ultrasonography and Hysteroscopy in the Diagnosis of Uterine Cavity Abnormalities in Infertile Women

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Abstract

Background: The uterus of 34–62% of infertile women has abnormalities. Clinical hysterosalpingography, saline infusion sonohysterography (saline sonohysterography), transvaginal sonography (TVS) or two-dimensional (2D) TVS, diagnostic hysteroscopy, three-dimensional TVS (3D TVS), and even MRI have all been used to evaluate the uterine cavity. However, diagnostic hysteroscopy has been the standard for examining uterine diseases in cases of infertility for several decades.

Aim and objectives: Compare the diagnostic accuracy of 3D TVS and hysteroscopy in detecting intrauterine cavitary lesions or abnormalities in infertile women.

Patients and methods: This cross-sectional observational study compared 150 women who visited the outpatient clinics at Al-Hussein and EL-Said Galal hospitals affiliated with the Faculty of Medicine at Al-Azhar University.

Results: The average age of the participants was 30.72 ± 5.05 years (range, 20–41) and their BMI ranged between 24.7 and 38.1 with the mean value of 30.75 ± 2.72. (66%) of the study population had primary infertility, and 34% had secondary infertility. The identification of submucous myoma abnormalities did not differ significantly between the groups, and agreement analysis of abnormalities, sensitivity, specificity of ultrasonography for prediction of abnormalities.

Conclusion: Diagnosing uterine focal lesions with 3D TVS is as accurate as hysteroscopy. Most uterine abnormalities can be accurately diagnosed using 3D sonography. However, hysteroscopy provides a direct view of the uterine interior. Thus it can pick up on minor localized intrauterine lesions that would be missed by vaginal ultrasonography.

Keywords: Hysteroscopy, Infertile women, Three-dimensional transvaginal ultrasonography, Uterine cavity abnormalities

1. Introduction

During the study of infertile women, one of the most fundamental and significant tasks is to evaluate and examine the uterine cavity. This is because a normally formed uterine cavity is necessary for the endometrium to perform its physiological role, which is essential for pregnancy. The presence of uterine disease can result in endometrial dysfunction, decreased receptivity, failed implantation, and other unfavorable consequences for the pregnancy, such as repeated pregnancy losses, early labor, and other disorders of a similar kind. Although only ~3–5% of the population is affected by uterine factor infertility per se, ~10–15% of women who seek therapy for infertility are found to have some kind of uterine abnormality. Furthermore, studies have indicated that intrauterine illnesses that are not yet diagnosed might harm the environment of the uterus, which in...
turn decreases the likelihood of sustaining a pregnancy.1,2

Hysterosalpingography (HSG), transvaginal sonography (TVS), or two-dimensional (2D) TVS, diagnostic hysteroscopy, saline infusion sonohysterography (saline sonohysterography), three-dimensional TVS (3D TVS), and even MRI have all been used in clinical practice to evaluate the uterine cavity. Yet, for many decades, diagnostic hysteroscopy has been the pinnacle of infertility examination for uterine disorders.3

Hysteroscopy has several benefits, including the ability to see into the uterus, pinpoint the precise position of the anomaly, determine its form and size, and treat the condition, but it is not without its drawbacks. It is invasive, requires a skilled operator, and is not offered at all hospitals. In addition, there are risks associated with the treatment that should be considered. These include the possibility of uterine perforation, a lacerated cervical cervix, bleeding, and restricted access in the event of cervical stenosis.4

It was considered that there was a need for a more recent or superior imaging technology in a way that hysteroscopy cannot detect. This requirement was satisfied with the introduction of 3D transvaginal ultrasonography. The newly developed imaging method known as 3D TVS can register all three imaging planes at the same time and view the surfaces in a 3D format. As a result, it offers a one-of-a-kind diagnostic instrument for the noninvasive viewing of uterine morphology and the identification of congenital uterine abnormalities.5,6

The primary purpose of this research was to evaluate the diagnostic efficacy of hysteroscopy and 3D TVS for the detection of intrauterine cavitary lesions or anomalies in infertile women.

2. Patients and methods

This study ethically approve by Medical Ethics Committee Faculty of Medicine Al-Azhar University Boys Branch in Cairo.

At the Faculty of Medicine at Al-Azhar University, researchers surveyed 150 female patients at the outpatient clinics of Al-Hussein and El-Said Galal hospitals. All of the patients had 2D ultrasonography or HSG performed because of concerns about an abnormality within the uterus.

2.1. Inclusion criteria

Any infertile woman aged between 20 and 41 years who has abnormal findings on 2D ultrasonography or HSG suggesting an issue within the uterus.

2.2. Exclusion criteria

Bleeding disorders or coagulation deficits, liver cell failure, medicines used for anticoagulant therapy, a history of bleeding, etc., all point to the presence of sexually transmitted infections. Diseases of the pelvic lining include high menstrual flow, pregnancy, severe vaginitis or cervicitis, endometrial infection, and a history of such conditions. Hysteroscopy should not be performed if there has been a recent uterine perforation.

2.3. Methods

The following procedures were carried out on every patient: after obtaining their verbal agreement regarding all of the procedures included in the hysteroscopy as well as the transvaginal ultrasound, a thorough medical history is obtained from each patient, including their ages, the number of children they have had, and any relevant information about their menstrual and obstetrical histories. Examination of the general, abdominal, and pelvic regions (including a bimanual assessment of the uterine size, position, mobility, and adnexal evaluation, as well as evaluation of any cervical or vaginal anomalies), performing a test for the presence of HCG in the patient’s urine (all patients should have negative findings). After telling the patient to empty her bladder, a 2D transvaginal ultrasound was performed in the outpatient clinic to look for any signs of a focal uterine lesion or adnexal masses. This was done after the patient was given instructions to empty her bladder. Both 3D TVS and hysteroscopy were performed on the patients, the former using a rigid hysteroscope (continuous flow; 30° forward-oblique view) assembled in a 4-mm-diameter diagnostic sheath with an atraumatic tip and the latter using a flexible hysteroscope (continuous flow; 30° forward-oblique view).

2.4. Sample size

This study is base on the study carried out by Mohammad and colleagues Epi Info STATCALC was used to calculate the sample size by considering the following assumptions: 95% two-sided confidence level, with a power of 80% and an error of 5% odds ratio calculated = 1.115. The final maximum sample size taken from the Epi-Info output was 150.

2.5. Statistical analysis design

All of the data was manually coded once it was evaluated. These numerical identifiers were entered
into a computer for statistical analysis using SPSS 22, the Statistical Package for the Social Sciences.

### 2.5.1. Descriptive statistics

Both numerical and qualitative information was provided, with the former presented as means and variances and the latter as frequencies and percentages.

### 2.5.2. Analytical statistics

To evaluate differences in group standards based on qualitative data, we employed the $\chi^2$ test, while the Student’s $t$ test was used to compare quantitative data from two independent samples. Receiver operating characteristic curves were utilized to establish sensitivity, specificity, and ideal cut-off points of US for prediction of anomaly, and the Pearson correlation coefficient was employed to study the link between the variables. Sensitivity can be calculated as 100% true positives divided by 100% true positives plus 100% false negatives. True negative rate/(false positive + negative) = specificity.

A 95% confidence level was applied to the coefficient. We used the following probability ($P$) values for statistical significance: $P$ value less than 0.05 determined significance.

### 3. Results

Table 1 showed that the current study included 150 infertile females; their age ranged between 20 and 41 years with the mean value of 30.72 ± 5.05 years and their BMI ranged between 24.7 and 38.1 with the mean value of 30.75 ± 2.72.

Table 2 showed that regarding the clinical data of the studied population; 66% had primary infertility and 34% had secondary infertility. Eight percent had anteflexed uterine position and 24 had previous abortions. Ten percent had small-sized uterus while 8% ad enlarged uterus. The uterine shape was irregular in 30% of cases (Fig. 1).

Table 3 showed that among our studied population hysteroscopy that represents the gold standard in detecting submucous myoma in 28% of cases, which is similar to ultrasonography with insignificant difference between using either method.

Table 4 showed that among our studied population, hysteroscopy, which is the gold standard, detects abnormalities in 86% of cases, which is similar to ultrasonography in 84% with insignificant difference between using either method (Fig. 2).

Table 5 showed that statistically, there is an exceptionally high level of consistency between abnormalities detection using hysteroscopy and ultrasonography.

Table 6 shows that ultrasonography has a sensitivity of 100% and specificity of 100% for predicting abnormalities.

### 4. Discussion

Approximately 34–62% of infertile women have abnormal uterine findings, the most prevalent of which are intrauterine synechiae/adhesions, polyps,
submucous myomas, and uterine deformities. This highlights the need to identify and treat both major and minor uterine anomalies in infertile patients.7

The main results of this study were as follows:

As regard demographic data; the current study included 150 infertile females; their age ranged between 20 and 41 years with the mean value of 30.72 ± 5.05 years and their BMI ranged between 24.7 and 38.1 with the mean value of 30.75 ± 2.72.

The results of Mohammad and colleagues, who reported on a cross-sectional study including 50 women, corroborated our own. Analysis of the age distribution within the sample population indicated a mean value of 36.51 ± 9.57 years. Patients had a mean BMI of 29.47 ± 4.24 kg/m².8

Also, Naredi and colleagues demonstrated that hysteroscopy and 3D TVS were performed on the same day on 154 individuals involved in the trial. The ultrasound and hysteroscopy were performed by two different specialists. Women had a mean age of 27.8 ± 3.7 years with the mean BMI of 24.97 ± 4.48.9

The present study showed that regarding the clinical data of the studied population, 60% were P1 and 66% were PG. Sixty-six percent had primary infertility and 34% had secondary infertility. Eight percent had anteverted uterine position, and 24 had previous abortion. Ten percent had small-sized uterus while 8% had enlarged uterus. The uterine shape was irregular in 30% of cases.

Our findings were corroborated by Fekry and colleagues, who found that the average duration was 4.5 (SD 1.1) years. A total of 74 (53.2%) of the infertility cases were caused by underlying causes, whereas 65 (46.6%) were caused by secondary factors.10

Primary infertility affected 52.4% of participants and secondary infertility affected 47.6% in the Elkashef et al.11 research.

<table>
<thead>
<tr>
<th>Abnormalities detection</th>
<th>By ultrasonography</th>
<th>Hysteroscopy (gold standard)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>24</td>
<td>42</td>
</tr>
<tr>
<td>Yes</td>
<td>126</td>
<td>258</td>
</tr>
</tbody>
</table>

Fig. 2. Abnormalities detection by different methods in the studied population.

Table 3. Submucous myoma detection by different methods in the studied population.

<table>
<thead>
<tr>
<th>Abnormalities detection</th>
<th>By ultrasonography</th>
<th>Hysteroscopy (gold standard)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>108</td>
<td>108</td>
</tr>
<tr>
<td>Yes</td>
<td>42</td>
<td>42</td>
</tr>
</tbody>
</table>

Table 4. Abnormalities detection by different methods in the studied population.

Table 5. Agreement analysis of abnormalities detection using hysteroscopy and ultrasonography.

<table>
<thead>
<tr>
<th>Measure of agreement</th>
<th>Value</th>
<th>Asymp. Std. Error</th>
<th>Approx. T</th>
<th>Approx. Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kappa</td>
<td>0.011</td>
<td>0.011</td>
<td>0.998</td>
<td>0.318</td>
</tr>
</tbody>
</table>

Table 5. Agreement analysis of abnormalities detection using hysteroscopy and ultrasonography.

Table 6. Sensitivity and specificity of ultrasonography for prediction of abnormalities.

<table>
<thead>
<tr>
<th>Area under curve</th>
<th>Std. Error</th>
<th>Sensitivity%</th>
<th>Specificity%</th>
<th>Asymptotic 95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.011</td>
<td>100%</td>
<td>95.5%</td>
<td>Lower bound Upper bound</td>
</tr>
<tr>
<td>0.977</td>
<td>0.011</td>
<td>100%</td>
<td>95.5%</td>
<td>0.955 0.999</td>
</tr>
</tbody>
</table>
Furthermore, Mohammad and colleagues revealed that the gravidities of the patients ranged from 0 to 10, with a mean and SD of 2.38 ± 2.52. Patients' number of children ranged from zero to eight, with a mean and SD of 1.68 ± 2.11. Concerning the conformity of the members of the study group, 15 women presented with main infertility, accounting for 30% of the total, whereas six women presented with secondary infertility, accounting for 12% of the total; three women presented with secondary amenorrhea, accounting for 6%; and four women presented with recurrent pregnancy loss, accounting for 8%.

The current study showed that regarding submucous myoma detection, among our studied population hysteroscopy, which is the gold standard, detects submucous myoma in 28% of cases similar to ultrasonography with insignificant difference between using either method. There is a statistically significant high rate of agreement between submucous myoma detection using hysteroscopy and ultrasonography. Ultrasonography has a sensitivity of 100% and specificity of 100% for predicting submucous myoma.

Our results agree with the study of Mohammad and colleagues as they reported that using hysteroscopy detect submucous myoma in 28% of cases similar to ultrasonography with insignificant difference between using either method. There is a statistically significant high rate of agreement between submucous myoma detection using hysteroscopy and ultrasonography. Ultrasonography has a sensitivity of 100% and specificity of 100% for predicting submucous myoma.

Whereas, Fekry and colleagues revealed that there was substantial agreement (K = 0.648) between 3D TVS and hysteroscopy in the detection of polyps, with five positive cases (3.6% of total) detected by both methods, 129 (92.8%) negative cases, four (2.9% of total) positive cases detected by hysteroscopy alone, and one (0.7%) positive case detected by 3D TVS alone.10

Our results showed that regarding abnormalities detection, among our studied population, hysteroscopy, which is the gold standard, detects abnormalities in 86% of cases, similar to ultrasonography in 84% with insignificant difference between using either method. There is a statistically significant high rate of agreement between abnormalities detection using hysteroscopy and ultrasonography. Ultrasonography has a sensitivity of 100% and specificity of 100% for predicting abnormalities.

Our findings lined up with those of Mohammad and colleagues, who determined that, on the whole, 3D-TVUS was 83.13% sensitive, 100% specific, 100.00% positive predictive value, 44.44% negative predictive value, and 90% accurate for detecting abnormal findings.8

Also, in the study of Abd-Elaziz and colleagues for total abnormal findings, vaginal ultrasonography detected abnormal findings in 28 (93.3%) cases, whereas two (6.7%) cases were free. Hysteroscopy detected abnormal findings in 27 (90%) cases, whereas three (10%) cases were free. Diagnostic accuracy was as follows: sensitivity 92.9%, specificity 50%, positive predictive value 96.3%, negative predictive value 33.3%, and accuracy 90%. Hysteroscopy and ultrasonography had the following levels of diagnostic inter-method agreement: The kappa (κ) value for the female participants was 0.484, indicating a perfect agreement, while the P value was 0.027, indicating statistical significance.12

Loverro and colleagues conducted ultrasound and hysteroscopy examinations on a total of 134 infertile female patients. Fifty out of a total of 58 findings diagnosed by hysteroscopy were also confirmed by US, giving US a sensitivity of 84.5% (49/58) and specificity of 98.7% (74/75), as well as a positive predictive value of 98.0% (49/50). Fifty-eight (44%) out of a total of 134 cases where uterine lesions were found via hysteroscopy were also confirmed by the United States.13

The present study had some limitations. The relatively small sample size. Also, It is a single-center, short-term study.

4.1. Conclusion

Our research led us to conclude that 3D transvaginal ultrasonography is as effective as hysteroscopy as a tool for identifying localized lesions in the uterus. Most uterine abnormalities can be accurately diagnosed using 3D sonography. Whereas vaginal ultrasound cannot detect minor localized intrauterine lesions, hysteroscopy can because it provides a direct view of the uterine chamber.

4.2. Recommendations

We recommend that 3D TVUS, if available, be performed routinely for all cases of uterine cavity anomalies.

Before 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.

Before corrective uterine surgery as myomectomy, 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.

Conflicts of interest

None declared.

References