COMPARATIVE STUDY OF HYSTEROSCOPY AND 3D ULTRASOUND FOR DIAGNOSING UTERINE CAVITY ABNORMALITIES

Mihaela Grigore¹, Anda Pristavu¹, F. Iordache¹, D. Gafitanu¹, Corina Ursulescu²

“Grigore T. Popa” University of Medicine and Pharmacy Iasi
Faculty of Medicine
1. Department of Mother and Child Medicine
2. Department of Surgery (II)
*Corresponding author. E-mail: mihaela.grigore@edr.ro

COMPARATIVE STUDY OF HYSTEROSCOPY AND 3D ULTRASOUND FOR DIAGNOSING UTERINE CAVITY ABNORMALITIES (Abstract) Objective: Hysteroscopy is the most accurate method for diagnosing intrauterine pathologies related to abnormal bleeding and infertility. The accuracy of three-dimensional (3D) ultrasonography and hysteroscopy were compared in identifying uterine cavity abnormalities. Material and methods: A total of 139 cases of abnormal uterine bleeding or infertility first had two-dimensional and 3D ultrasound performed before hysteroscopy. Findings on 3D ultrasound and hysteroscopy were compared, and sensitivity, specificity, positive predictive value, negative predictive value, and likelihood ratio were calculated. Results: Mean patients’ age was 36.5 (+/- SD 9.04). Three-dimensional ultrasound had a sensitivity of 88%, specificity of 94%, a positive predictive value of 96%, negative predictive value of 84%, likely ratio of 5.5, and accuracy of 90% in diagnosing uterine cavity abnormalities. Three-dimensional ultrasound had a high sensitivity and specificity for polyps (97% and 97%, respectively), congenital uterine malformations (100% and 99%, respectively) and submucous myoma (87% and 100%, respectively), but a low sensitivity and high specificity for uterine synechia (41% and 99%, respectively). Conclusions: For diagnosing uterine cavity anomalies, 3D ultrasound is a useful tool and could replace diagnostic hysteroscopy for certain conditions, such as congenital uterine anomalies. Keyword: HYSTEROSCOPY, THREE-DIMENSIONAL ULTRASOUND, UTERINE CAVITY ABNORMALITIES.

Abnormal uterine bleeding and infertility are two of the most common complaints in gynecologic practice. To properly diagnose and manage both conditions, assessing the uterine cavity for possible abnormalities is essential. Transvaginal ultrasonography is the standard method for screening for possible endometrial or uterine cavity abnormalities. When indicated, saline/gel infusion sonography, hysterosalpingography, or hysteroscopy may also be used to evaluate the uterine cavity lining. Hysteroscopy is widely accepted to be the most accurate method for investigating the uterine cavity (1, 2).

Three-dimensional (3D) ultrasound is a new technology that allows us to examine pelvic structure and their volumes with great accuracy. The main advantage 3D ultrasound confers is the ability to obtain a view of the coronal plane of the uterus (3), which, in turn, may be used to locate the
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position of intrauterine pathology. Therefore, 3D volume ultrasound is superior to two-dimensional (2D) sonography in identifying uterine cavity abnormalities.

Our study aimed to compare 3D ultrasound with hysteroscopy in assessing the uterine cavity and to find a place for this technology in gynecologic practice.

**MATERIAL METHODS**

Our study included 139 women attending our university hospital for hysteroscopy. The main indications for hysteroscopy were abnormal uterine bleeding and infertility. Before hysteroscopy was scheduled, transvaginal 2D and 3D ultrasound examinations were performed for each patient. For both examinations, we used 3D endovaginal ultrasound probes (RIC6-12D, 4-8Mhz, Voluson E8 and RIC 5-9H Voluson 730 Pro, GE Healthcare). The ultrasound examination began with a conventional 2D ultrasound. First, the uterus was localized and its position was noted, then the uterus was measured in three planes (longitudinal, coronal, transverse). Endometrial thickness was measured in the longitudinal plane, including the two layers at its maximum thickness. Then, the adnexal region was scanned to identify the ovaries, fallopian tubes, or adnexal pathology. The 3D volume was obtained longitudinally along the length of the uterus. The coronal plane of the uterus was obtained using the Abuhamad technique (4). For patients with infertility, the ultrasound examinations were scheduled in the follicular phase of their menstrual cycles (Days 3-10). Informed consent was obtained from all patients.

A 5-mm outer-diameter continuous flow Bettocchi hysteroscopy was used with a 30° direction of view (Karl Storz Endoscopy). Normal saline solution was used for distension of the uterine cavity at a pressure of 20-50 mm Hg. The hysteroscopy procedures were performed under local and/or general anesthesia. Systematic inspection of the uterine cavity was done, and internal os and cervical canal were visualized. The hysteroscopically detected intrauterine abnormalities were defined as endometrial polyps, submucous myomas, endometrial hyperplasia, intrauterine adhesions, or uterine congenital anomalies, such as arcuate or septate uterus. Treatment consisted of removal of polyps, myomas, adhesions, or septa using scissors, grasping forceps, or a resectoscope (Karl Storz Endoscopy). After the intervention, a detailed record was completed with information about patient tolerance, diagnostic findings, and treatment.

**Statistical methods**

Data was statistically represented in terms of range and mean standard deviation (+/- SD) and percentages. Accuracy was represented using the terms of specificity, sensitivity, positive predictive value, negative predictive value, likely ratio, and overall accuracy. The statistical data were calculated using the Microsoft Excel (Microsoft Corporation, NY, USA). Diagnostic accuracy of hysteroscopy and 3D ultrasound for different intrauterine pathologies were compared using tables.

**RESULTS**

A total of 139 patients with abnormal uterine bleeding, primary infertility, or secondary infertility were included in the study (Table 1). The patients’ mean age was 36.5 +/- 9.04 years old. Abnormal uterine bleeding included cases of menorrhagia, metrorrhagia, hypomenorrhea, and postmenopausal bleeding (Table 2). A
comparison of the uterine anomalies detected using 3D ultrasound and hysteroscopy are shown in Table 3.

In diagnosing uterine cavity abnormalities, 3D ultrasound has a sensitivity of 88%, specificity of 94%, a positive predictive value of 96%, negative predictive value of 84%, likely ratio of 5.5 and accuracy of 90%. When we analyzed different uterine cavity pathologies, we observed a high sensitivity and specificity of 3D ultrasound for polyps (97% and 97%, respectively), myoma (87% and 100%, respectively), and uterine congenital abnormalities (100% and 99%, respectively), but a low sensitivity for uterine synechia (41%) (tab. IV).

**TABLE I**

**Patients’ Indications for Hysteroscopy**

<table>
<thead>
<tr>
<th>Indications for hysteroscopy</th>
<th>Number of cases</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Infertility</td>
<td>51</td>
<td>36.71%</td>
</tr>
<tr>
<td>Secondary infertility</td>
<td>42</td>
<td>30.21%</td>
</tr>
<tr>
<td>Abnormal uterine bleeding</td>
<td>46</td>
<td>33%</td>
</tr>
<tr>
<td>Total</td>
<td>139</td>
<td>100%</td>
</tr>
</tbody>
</table>

**TABLE II**

**Type of abnormal uterine bleeding**

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Number of cases</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metrorrhagia</td>
<td>8</td>
<td>17.3%</td>
</tr>
<tr>
<td>Menorrhagia</td>
<td>20</td>
<td>43.47%</td>
</tr>
<tr>
<td>Menorrhagia and Metrorrhagia</td>
<td>9</td>
<td>19.57%</td>
</tr>
<tr>
<td>Postmenopausal bleeding</td>
<td>9</td>
<td>19.57%</td>
</tr>
<tr>
<td>Total</td>
<td>46</td>
<td>100%</td>
</tr>
</tbody>
</table>

**TABLE III**

**Anomalies Detected using 3D Ultrasound and Hysteroscopy**

<table>
<thead>
<tr>
<th>Type of Anomaly</th>
<th>3D Ultrasound</th>
<th>Hysteroscopy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endometrial polyp</td>
<td>45</td>
<td>44</td>
</tr>
<tr>
<td>Endometrial hyperplasia</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Submucous myoma</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Uterine congenital anomalies</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Osseous metaplasia</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Uterine synechia</td>
<td>8</td>
<td>17</td>
</tr>
<tr>
<td>Uterine neoplasm</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Uterus normal</td>
<td>61</td>
<td>54</td>
</tr>
</tbody>
</table>
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### TABLE IV

<table>
<thead>
<tr>
<th>Uterine anomaly</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NNV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyp</td>
<td>97%</td>
<td>95%</td>
<td>95%</td>
<td>98%</td>
</tr>
<tr>
<td>Myoma</td>
<td>85%</td>
<td>99%</td>
<td>100%</td>
<td>99%</td>
</tr>
<tr>
<td>Congenital anomaly</td>
<td>100%</td>
<td>99%</td>
<td>85%</td>
<td>100%</td>
</tr>
<tr>
<td>Synechia</td>
<td>44%</td>
<td>100%</td>
<td>87%</td>
<td>92%</td>
</tr>
</tbody>
</table>

### DISCUSSION

Abnormal uterine bleeding and infertility are two of the most common complaints in gynecology. Their management depends on diagnostic accuracy, and the first step is evaluating the uterine cavity. The basic work-up consists of transvaginal sonography possibly followed by hysterosonography, hysterosalpingography, or hysteroscopy to directly assess the uterine cavity.

Hysteroscopy is generally considered to be the gold standard in diagnosing intrauterine pathologies, including endometrial polyps, submucous myomas, intrauterine adhesions, and uterine septa (5). Compared to histopathology or hysterectomy findings, hysteroscopy is very accurate for diagnosing intrauterine abnormalities (6). One advantage of hysteroscopy is the possibility of performing a directed biopsy or a small surgical intervention during the same session (5). Also, in more recent years, hysteroscopy has been increasingly performed in an outpatient setting, which is highly acceptable and popular with patients. Office hysteroscopy has increasingly been recommended as a routine procedure in infertility evaluation (7, 8, 9, 10). After repeated implantation failure during in vitro fertilization cycles, the uterine cavity should be reevaluated using hysteroscopy; this practice has been demonstrated to improve pregnancy rates (6, 11, 12). However, hysteroscopy is an invasive procedure, and complications, such as uterine perforation and ascending genito-urinary infections, although very rare, can still occur (13, 14).

Because transvaginal ultrasound is a common and noninvasive procedure, its role in diagnosing uterine cavity anomalies should not be neglected. Although hysteroscopy is the gold standard, 2D transvaginal ultrasound has a sensitivity of 78.15% and specificity of 44.4% in detecting cavity abnormalities (15). However, 2D sonography cannot confidently diagnose submucosal fibroids in a uterus with multiple fibroids, distinguish between a hyperplastic endometrium and a large polyp, nor differentiate between an arcuate and a septate uterus (16, 17). These limitations can be overcome by 3D ultrasound, which has become more important in recent years in gynecology and obstetrics.

First introduced in the 1980s, 3D ultrasound has taken some time to be adopted. In 1993, a transvaginal application was developed, which allowed the acquisition of 3D surface images of the uterus and ovaries (18). The main advantage of 3D ultrasound is the ease in obtaining the coronal view with the entire endometrial cavity, the relationship of the endometrium to myometrium, and the uterine serosa. Compared to using 2D slices, the ability to ob-
tain and navigate through the 3D coronal views of the uterus allows the clinician to visualize the cavity more precisely and accurately. Three-dimensional ultrasound with surface- and transparent-mode reconstructions of the uterus has reported advantages over conventional 2D scanning. In experienced hands, a sensitivity of 93% and a specificity of 100% have been achieved (19).

In our study, compared to hysteroscopy in diagnosing uterine cavity abnormalities, 3D ultrasound has a sensitivity of 88%, specificity of 94%, a positive predictive value of 96%, negative predictive value of 84%, likely ratio of 5.5, and accuracy of 90%. Using transvaginal 2D sonography or hysterosalpingography, Sylvestre et al. studied 209 subfertile patients who were thought to have an intrauterine lesion (20). Using saline infusion sonography with 2D and then 3D sonography, 92 patients were subsequently identified as having a variety of intrauterine lesions, suggesting a sensitivity and specificity of 97% and 11%, respectively, for 2D sonography, 87% and 45%, respectively, for 3D sonography, and 98% and 100%, respectively, for 2D saline infusion sonography.

In our study, when analyzing different uterine cavity pathologies, 3D ultrasound had a high sensitivity and specificity for identifying polyps (97% and 97%, respectively), myoma (87% and 100%, respectively), and congenital uterine abnormalities (100% and 99%, respectively) (fig. 1, 2). In cases with synechia, 3D ultrasound had a low sensitivity (41%). The low sensitivity for synechia could be explained by the timing of the ultrasound. The ultrasound was performed during the follicular phase of the menstrual cycle when the endometrium was thin. Performing transvagi-

**Fig. 1.** Endometrial polyp.

a. 2D longitudinal image of the uterus.
b. 3D coronal image of the uterus.
c. Hysteroscopic image of the polyp.
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La Torre et al. compared 3D sonography with conventional 2D imaging with and without saline contrast in their study of 23 patients in whom subsequent hysteroscopy revealed the presence of 16 endometrial polyps (21). Standard 2D sonography demonstrated a relatively poor specificity of only 69.5%, suggesting the presence of polyps in 23 patients. In contrast, 3D sonography diagnosed 18 polyps, with a specificity of 88.8%, and 3D hystero-sonosalpingography diagnosed 16 polyps, per hysteroscopic and histologic findings, with a specificity of 100%. Another prospective study of 70 patients that compared 3D ultrasound with hysteroscopy in premenopausal bleeding found that 3D ultrasound had a sensitivity of 63.2%, specificity of 80.8%, positive predictive value of 54.6%, negative predictive value of 85.7%, and accuracy of 76.1% (22).

In our study, 3D ultrasound proved to be very accurate for diagnosing uterine congenital anomalies, in agreement with the literature. Ghi et al. consider 3D ultrasound to be extremely accurate for the diagnosis and classification of congenital uterine anomalies and suggest that it may become the only mandatory step in the assessing the uterine cavity in patients with a history of recurrent miscarriage (23). The advantage of 3D ultrasound over hysteroscopy is that it can show the external contour of the uterus and can differentiate septate uterus from bicornuate uterus. In addition, 3D ultrasound is superior to 2D views in identifying the exact location of endometrial polyps and the degree of protrusion of a submucous fibroid into the cavity, as well as the amount of myometrium remaining outside of the submucous fibroid. In recent years, hysteroscopic resection of submucous fibroids has become an accepted method for treating premenopausal women with a history of abnormal uterine bleeding. The success and safety of this operation depends largely on the accurate preoperative assessment of the position of the submucous fibroid in relation to the uterine cavity (24). Before planning surgery for uterine myoma, 3D ultrasound could be an essential tool because it can provide precise information regarding the size of the myoma and the depth of myometrial exten-

Fig. 2. Intramural and submucous myoma.
   a. 2D longitudinal image of the uterus.
   b. 3D coronal image of the uterus.
   c. Hysteroscopic image of the myoma.
sion. Moreover, 3D is useful also during post-surgical management.

**CONCLUSIONS**

Hysteroscopy remains the gold standard for diagnosing uterine cavity anomalies. However, 3D ultrasound has high sensitivity and specificity for uterine cavity anomalies and should be used a primary screening tool. Although 3D ultrasound has a low specificity for uterine synechia, it has a high specificity for uterine congenital anomalies. Further, 3D ultrasound is useful before planning an intervention on the uterine cavity, especially in cases of congenital anomalies and uterine fibroma.

**REFERENCES**

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NEWS

CLOPIDOGREL AND THE ENDOTHELIAL FUNCTION – BEFORE AND AFTER

The conclusion of a recent article published in the Journal of American Heart Association is that the administration of Clopidogrel in healthy people with high platelet aggregation improved the microcirculatory endothelial function and it apperas to have additional vascular benefits. The researchers evaluated the platelet activity of the healthy persons, a group of 287/241 Old Order Amish, before and after the administration of Clopidogrel for 7 days, quantifying it by laser Doppler flowmetry (LDF) mediated by thermal hyperemia and postocclusive reactive hyperemia. The results showed that Clopidogrel influenced only LDF mediated by thermal hyperemia, having a bigger impact on women than men; also, the evaluation before Clopidogrel showed that women have a higher platelet aggregation (Salimi S., Lewis J.P. et al. Clopidogrel Improves Skin Microcirculatory Endothelial Function in Persons With Heightened Platelet Aggregation. J Am Heart Assoc. 2016; 5:e003751).

Măriuca Balan