Role of 3D Ultrasound in Assessment of Correlation between Position of Intrauterine Contraceptive Device and Post-Insertion Uterine Bleeding

NAWARA M. HASHEESH, M.D.; MOHAMED A. ABDEL KADER, M.D. and FADIA ANTAR, M.Sc.*
The Department of Obstetrics and Gynecology, Cairo University and Menof Hospital*.

Abstract

Objective: The objective of this study is to assess the role of 3D-US in correlating the position of IUD and bleeding complaints related to IUD use. Also to detect the cut-off values for normal position of the IUD beyond which bleeding complaints will significantly increase.

Patients and Methods: 2D and 3D-US were done to assess IUD position in the uterine cavity of two groups of patients, a group having bleeding complaints after using IUD and another group of asymptomatic users. The IUD-Endometrial (IUD-E), IUD-Myometrial (IUD-M), IUD-Fundal (IUD-F) and lateral displacement were measured by 2D and 3D-US and compared and the most sensitive and specific distance to indicate the limit above which the removal of the IUD will be recommended as bleeding complaints will significantly increase was assessed.

Results: The distance measurement between IUD and endometrium or myometrium or the fundus with 2D and 3D-US did not differ significantly. However, a significant difference was found in IUD-F, IUD-M and IUD-E distances and the amount of lateral displacement between normal IUD users and those with complaints. IUD-E distance and the amount of lateral displacement are the more sensitive and specific indicators for detecting the relation between IUD position in the uterus and bleeding complaints related to IUD use. The Cut-off distance for IUD malposition is: IUD-E $\geq$ 11mm and lateral displacement $\geq$ 2.4mm.

Conclusion: The study strongly correlates the occurrence of IUD induced abnormal uterine bleeding to IUD malposition which 3D has more advantage over 2D-US in detecting missed cases which could reach up to 10%. Therefore, 3D-US has a role in cases of unexplained bleeding after IUD use if 2D-US failed to explain why especially cases of lateral displacement, incarceration and incomplete opening of both horizontal arms as the 3D-US allows better visualization of the uterine cavity and the spatial position of all IUD parts inside the uterus.


Correspondence to: Dr. Nawara M. Hasheesh, The Department of Obstetrics & Gynecology, Cairo University.

Introduction

THE first intrauterine contraceptive device was introduced by Richer in 1909 [1], since then, it is increasingly adopted as a reliable method of contraception by over 100 million women in the world as it is one of the most efficient and reversible methods of birth control with the additional advantage of low cost and long duration of use [2,3].

However, in the first year after insertion, between 5 and 15% of women will have their IUD removed because of irregular uterine bleeding which have been attributed to the effect of contact between the device and the endometrium and even the pressure on the uterine muscle. The disharmonious relationship between the IUD and the uterus is the cause of most of the bleeding complaints, so bleeding is related to improper position rather than the contraceptive method itself which should be excluded before abandoning the IUD for any other method of birth control [4].

The use of ultrasound waves as a diagnostic medical tool began in the United States in the early 1950's. Since the early 1970's, ultrasound has been used to document the presence of the IUD inside the uterus. In the mid 1980's and 1990's, the development of high frequency transvaginal scanning improved the accuracy of gynaecological ultrasound in identifying the IUD position in the uterus but 2D-US can not visualize structures that are not located in one single plane simultaneously thus some problems with IUD misplacement can be missed, actually 2D-US may fail in the detection of 9% of IUD malposition which paved the way for application of 3D-TVS in displaying the spatial position of the IUD in relation to the uterine cavity. 3D-TVS allows complete simultaneous imaging.
of all parts of the IUD; the shaft and the arms in the coronal plane which was impossible to visualize before. This brings an entirely different diagnostic perspective for the evaluation of the IUD position in the uterus [5].

We directed our study on two groups of patients; a group of asymptomatic IUD users and another group having bleeding complaints after using IUD to investigate the relation between the IUD position in the uterus and irregular uterine bleeding using 2D and 3D-TVS.

Our study aimed at assessing the role of 3D-US in correlating the position of IUD and bleeding complaints related to IUD use. We wanted to examine the ability of 3D-US to explain the reason of abnormal uterine bleeding in some of the IUD-users which 2D-US failed to find its cause by displaying the undetected cases of malposition so that replacing the IUD will solve the problem without abandoning this safe method of contraception. Our second aim is to detect the cut-off values for normal position of the IUD beyond which the IUD should be removed as bleeding complaints will significantly increase. We aim at decreasing unnecessary removal of mildly displaced IUD.

**Patients and Methods**

30 patients attending Kasr El-Ainy Hospital outpatient clinic or Menof Hospital outpatient clinic with IUD causing menorrhagia and 30 asymptomatic IUD users were included in the study. In the period from June 2009 to June 2010 all the participating women gave an informed consent.

Patients having another cause of bleeding such as:

- Associated uterine, cervical or adenexal pathology.
- Associated pelvic infection.
- Generalized bleeding disorders.
- Medications causing coagulation defects.
- Medical disorders causing bleeding e.g. hypertension.
- Hormonal disorder as thyroid dysfunction.

were excluded from the study.

Age, parity, duration of use of the IUD and previous contraceptive method and any associated complications were recorded.

All patients have undergone vaginal ultrasonography at Kasr-El Ainy Hospital in the postmenstrual period, where hysterometry, assessment of uterine position and IUD position were assessed. 3D images were obtained by superimposing a volume box over a 2D-image generated within an Accuvix-XQ machine. The crystal in the 3D-TVS transducer then sweeps mechanically over the 2D-IUD image. This scanning procedure takes few seconds.

The spatial position of the IUD in relation to the uterine cavity was displayed in the multiplaner mode. The 3D-view software allowed volume examination in three simultaneous perpendicular planes; plane A representing the sagittal view of the uterus, plane B showed a transverse view and plane C representing a frontal view, each of these planes was rotated 90° to each other in all three axes. After volume sampling was performed, the presence of the patient was no longer necessary.

The simultaneous visualization of the arms and shaft of the T-type IUD was accomplished in the coronal view. In cases of difficult visualization, the shadow image was attempted by the volume contrast imaging in the C plane (VCI-C).

The IUD fundal distance, the IUD myometrial and the IUD endometrial distance and the amount of lateral displacement of IUD were assessed by both 2D and 3D-US. These distances were compared in both groups, the complaining and the asymptomatic groups of IUD users to correlate the relation between the IUD position and the patient's complaint and to estimate the amount of displacement allowed for the IUD without causing symptomatic complaints.

Which measurement of the IUD fundal distance, the IUD myometrial or the IUD endometrial distance is more sensitive and specific to indicate the limit above which the removal of the IUD would be recommended was assessed.

**Statistical analysis:**

Data were statistically described in terms of mean±standard deviation (±SD), frequencies (number of cases) and percentages when appropriate. Comparison of quantitative variables between the study groups was done using student *t*-test for independent samples. For comparing categorical data, Chi square (\(\chi^2\)) test was performed. Exact test was used instead when the expected frequency is less than 5. McNemar test was used to test the difference between 2D and 3D examination of the study cases. A probability value (*p*-value) less than 0.05 was considered statistically significant. All statistical calculations were done using computer programs; Microsoft Excell 2003 (Microsoft Corporation, NY, USA) and SPSS (statistical package for the social science SPSS, Chicago, IL, USA) version 15 for Microsoft Windows.
Results

There were no significant differences in age, parity, duration of IUD use, hysterometry, endometrial thickness and uterine position between asymptomatic IUD users and those with complaints.

Table (1)

<table>
<thead>
<tr>
<th></th>
<th>Complaining group</th>
<th>Asymptomatic group</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>27.8±6.4</td>
<td>29.2±5.6</td>
<td>0.37</td>
</tr>
<tr>
<td>Parity</td>
<td>2.9±1.5</td>
<td>2.8±1.4</td>
<td>0.66</td>
</tr>
<tr>
<td>Duration of IUD use (months)</td>
<td>9.2±6.2</td>
<td>11.1±7.9</td>
<td>0.315</td>
</tr>
<tr>
<td>Hysterometry:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length</td>
<td>79.2±9.4</td>
<td>78.3±8.7</td>
<td>0.701</td>
</tr>
<tr>
<td>Breadth</td>
<td>48.8±9.7</td>
<td>44.7±6.9</td>
<td>0.062</td>
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<tr>
<td>Width</td>
<td>41.1±3.4</td>
<td>39±4.4</td>
<td>0.410</td>
</tr>
<tr>
<td>Endometrial thickness</td>
<td>5.8±3.9</td>
<td>4.5±2.9</td>
<td>0.175</td>
</tr>
<tr>
<td>Uterine (RVF) position</td>
<td>5 (16.7%)</td>
<td>6 (20%)</td>
<td>0.73</td>
</tr>
</tbody>
</table>

p-value <0.05 is significant.

The distance measurement between IUD and endometrium or myometrium or the fundus with 2D and 3D-US did not differ significantly. However, a significant difference was found in IUD-F, IUD-M and IUD-E distances and the amount of lateral displacement (X-value) between normal IUD users and those with complaints.

Table (2)

<table>
<thead>
<tr>
<th></th>
<th>Complaining group</th>
<th>Asymptomatic group</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IUD-F</td>
<td>30±9.2</td>
<td>30.2±9.2</td>
<td>0.000</td>
</tr>
<tr>
<td>IUD-M</td>
<td>17.9±9.3</td>
<td>18.5±9.6</td>
<td>0.000</td>
</tr>
<tr>
<td>IUD-E</td>
<td>13.2±5.5</td>
<td>14.2±5.7</td>
<td>0.000</td>
</tr>
<tr>
<td>X-value</td>
<td>2.8±1.5</td>
<td>3.5±1.3</td>
<td>0.000</td>
</tr>
</tbody>
</table>

X-value: Is the distance denoting the lateral displacement of the IUD.

Calculated by subtracting half the uterine width from the bigger distance from the vertical arm of the IUD to the lateral uterine margin.

IUD-E distance and X-value are more sensitive indicators for detecting the relation between IUD position in the uterus and bleeding related to IUD use.

Table (3)

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
<th></th>
<th>Specificity</th>
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<tr>
<td></td>
<td>2D</td>
<td>3D</td>
<td>2D</td>
<td>3D</td>
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<tr>
<td>IUD-F</td>
<td>53.3%</td>
<td>56.6%</td>
<td>96.6%</td>
<td>96.6%</td>
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<tr>
<td>IUD-M</td>
<td>60%</td>
<td>63.3%</td>
<td>93.3%</td>
<td>96.6%</td>
</tr>
<tr>
<td>IUD-E</td>
<td>80%</td>
<td>90%</td>
<td>96.6%</td>
<td>96.6%</td>
</tr>
<tr>
<td>X-value</td>
<td>86.6%</td>
<td>96.6%</td>
<td>96.6%</td>
<td>96.6%</td>
</tr>
</tbody>
</table>

2D-TVS detected only 17 cases of IUD malposition, while 3D-TVS detected 20 cases in the complaining group. Meanwhile 2D-TVS detected 2 cases of IUD malposition, while 3D-TVS detected only 1 case in the asymptomatic group.

Table (4)

<table>
<thead>
<tr>
<th></th>
<th>Complaining group</th>
<th>Asymptomatic group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2D</td>
<td>3D</td>
</tr>
<tr>
<td>Correct position</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td>Malposition</td>
<td>17</td>
<td>20</td>
</tr>
</tbody>
</table>

In the complaining group, there was a difference between 2D and 3D-US in 3 cases. 2 cases were described as normal in position by 2D-US but 3D-US revealed lateral displacement of the IUD while the third case was shown to be embedded in the myometrium in the frontal view by 3D-US.

In the asymptomatic group, one case was defined as descended by 2D-US but the 3D US revealed it in normal position in the uterine cavity.

The Cut-off distance for IUD malposition is:

- IUD-E ≥11mm.
- X-value ≥2.4mm.

The use of two standard deviation above the normal is the best indicator for IUD malposition above which bleeding complaints are likely to increase because we wanted to decrease the false positive to a minimum.

Discussion

In this study, all IUD’s were examined by ultrasound with a minimum duration of use at least 3 months. This was done according to recommendation of Faundes et al. [6] who held a study to observe the position dynamics of the T-shaped intra-uterine contraceptive device in the uterine cavity and concluded that the IUD accommodates its position in the cavity during the first 3 months after insertion.
2D and 3D Images of Displaced IUD'S

3D Image showing IUD incarceration

2D Image not showing IUD incarceration.

3D Image showing IUD lat. displacement.

2D Image of displaced IUD.

3D Picture showing VCI in C-plane.

2D Image of displaced IUD.

IUCD Appears descended in 2D image but appears in normal position in 3D image.
All the patients were examined in our study postmenstrual according to recommendation of Faundes et al., [7] who suggested that the IUD position in the uterine cavity is influenced by the growth and thinning of the endometrium and this information should be considered when evaluating the IUD position by sonography.

Our study strongly correlates the occurrence of IUD induced abnormal uterine bleeding to its position within the uterine cavity in contrary to Faundes study [8] who concluded that the IUD position was unable to discriminate between women who did or did not have complaints of bleeding because they considered IUD-F value of 25mm as an indicator of normal limit, considering this indicator as gold standard gave them a proportion of false positives of greater than 40% which means that they removed the IUD unnecessarily too frequently.

The technique and the equipment used in their study gave them a lot of false negatives also because only 2D-US was used which did not permit measuring the relationship between the horizontal cross arms of the T and the shaft and the lateral uterine wall because one can not see the horizontal arms of the T in the sagittal view of the uterus but in our study measurements were taken by both 2D and 3D-US and the horizontal arms and the amount of lateral displacement and incarceration of the IUD in the myometrium could be displayed in the coronal view by 3D-US which revealed cases of malposition screened as normal by 2D-US.

Also volume contrast imaging in plane-C was useful in locating IUD’s of similar echogenicity to the surrounding tissues whose identification was difficult which agrees with Valsky study [2] and Zohav study [9] who reported that the technique could have the added benefit of recognizing the type of IUD used by better visualizing the small parts of the IUD.

Zhang and his colleagues [10] have undergone a study on malpositioned IUD’s only as examined by 2D and 3D-US but it lacked the correlation with the patient’s complaint.

Fernando Musoles and his colleagues [11] have directed a study to compare the accuracy of 2D and 3D-US in detecting IUD position in the uterine cavity but they only studied asymptomatic patients which decreased its clinical benefit because the IUD’s diagnosed as malpositioned were not causing any complaints and the definitions of the normal position of IUD in the uterine cavity were quite variable.

Most of these definitions did not take into account the variability in the uterine wall and endometrial thickness. Actually the IUD-M distance chosen by some examiners as gold standard for assessing IUD position because the endometrium is readily identified is lately criticized by Faundes study [7] because of the strong correlation they illustrated between the IUD-M distance and the endometrial thickness. Also the IUD-F distance includes myometrial thickness which is highly variable among females.

Our study revealed IUD-E distance is one of the most reliable indicators for assessing IUD position and its relation to the patient’s complaint because it is not dependent on the thickness of the uterine wall or the endometrium which are quite variable.

Previous studies done by Kroon [4] to develop guidelines for the insertion and follow-up of IUD considered that whenever the IUD-E distance was >5mm, removal of the IUD was advised which caused unnecessary removal of mildly displaced
IUD's but our study assessed 2 groups of patients those having bleeding complaints and asymptomatic users and found the IUD-E distance above which the patient’s complaints markedly increase is ≥ 11 mm and amount of lateral displacement > 2.4 mm.

In our study, measurements were taken by both 2D and 3D-US and they did not differ significantly which agrees with Hosli study [12] who concluded that distance measurement could be obtained equally by 2D and 3D-US but the 3D offers the advantage of better visualization of the whole IUD simultaneously and its spatial position in the uterine cavity accurately. In fact, our study found that 2D-US fails to detect malposition in 10% of symptomatic patients which agrees with previous studies by Kalmantis [5]. Therefore we reached the conclusion that 3D-US should be reserved only for cases of IUD induced irregular uterine bleeding which 2D-US failed to explain because 3D proved of better value in assessing the correlation between IUD position and bleeding complaints. We use 3D-US aiming at exploiting all the techniques available to exclude IUD malposition before condemning IUD as non-suitable method of contraception for the patient and abandoning it for another method.

References