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CLINICAL STUDY

The role of three-dimensional imaging in the investigation of IUD malposition

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Abstract: *Objectives:* The aim of this study was to present a systematic review of the use of three-dimensional ultrasound for the detection and evaluation of intrauterine device malposition in a patient of our department.
Background: Transvaginal sonography failed to detect IUD misplacement in about 9 % of cases. Whereas the three-dimensional ultrasound (3D), a new emerging technology, that could provide precise evaluation of IUD malposition.
Methods: The data were extracted from the literature using computerised Medline system. The use-effectiveness and acceptance of three-dimensional imaging in the detection of IUD malposition was examined as an alternative method to two-dimensional ultrasound.
Results: Three-dimensional ultrasound was more accurate than two-dimensional for the identifying IUD device. Three-dimensional technique enables assessment of IUD length in the longitudinal section synchronically with imaging arms of the device. Examination with 2D ultrasound is limited to transverse views of the shaft. The arms or other smaller parts cannot be investigated completely because of the frontal view of an IUD is rarely presented.
Conclusion: Three-dimensional ultrasound is a new and promising imaging tool which provides much better view of the endometrial cavity. This is especially useful in uterus examination and in the detection of IUDs because structures that are not located in one single plane can be imaged simultaneously. Three-dimensional ultrasound is considered to be more secure and safer diagnostic technique to determine the location of IUDs than hysteroscopic evaluation *(Fig. 2, Ref. 17).* Full Text (Free, PDF) *www.bmj.sk.*
Key words: 3-D imaging, IUD malposition.

Intrauterine devices (IUDs) are one of the world's most popular methods of reversible birth control. Worldwide, a hundred and six million women use medicated or non-medicated IUDs. The IUD is a foreign body that is placed in the uterine cavity to prevent pregnancy. Most types of IUDs have a plastic T-shaped frame that is wrapped with copper and/or has copper bands. The presence of an IUD in the uterus prompts an inflammatory response by the endometrium and increases the spermicidal effect. Furthermore, IUD can also change the lining of the uterus preventing implantation. An IUD is usually used for 3–5 years because it increases the rates of PID (Chlamydia infection, actinomycosis) with longer duration of use.

Transvaginal ultrasonography is a common procedure for verifying the correct position of an IUD following insertion. Sonography is the best method to locate a lost or misplaced IUD and it is recommended when there is a suspicion of migration of the IUD, especially when a woman presents with unexplained chronic pelvic pain (1).

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However, examination of the two arms of the IUD can be very difficult because the frontal view of the IUD may be impossible to be visualized by the two-dimensional ultrasound. Therefore, ultrasonography may fail to detect IUD misplacement in about 9 % of cases (2).

Moreover, three-dimensional ultrasound (3D) is a new emerging technology that provides precise evaluation of the endometrial cavity. Multiplanar and volume rendering display methods, combined with the ability to rotate volume data into standard orientations with a supplementation of specific software, are essential components of 3D ultrasound success in identifying incorrect position of IUD parts or displacement of the entire device (3).

Method

Data source-study selection

Using the PubMed database we searched for any type of articles regarding the role of three dimensional ultrasound in the detection of an intrauterine device published between the years 1996 and 2007. The keywords we used were "intrauterine device", "three dimensional ultrasound". In order to achieve complete coverage of the literature we searched the references of the initially retrieved articles. The reviewers independently extracted the data from the articles that were qualified for inclusion in our

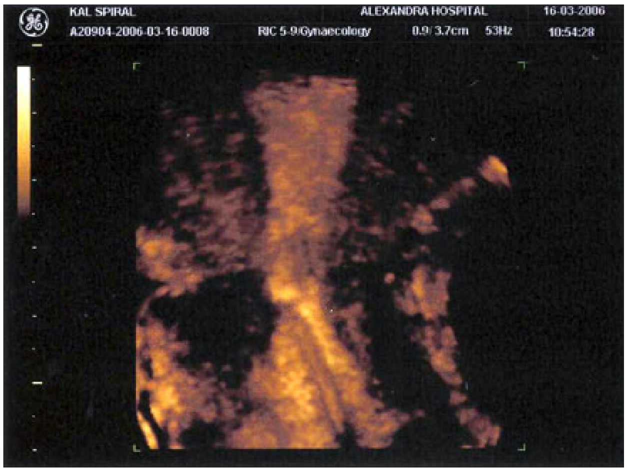

Fig. 1. Three-dimensional imaging of an endometrial cavity with no IUD in it (transparent uterus with high-pass filter).

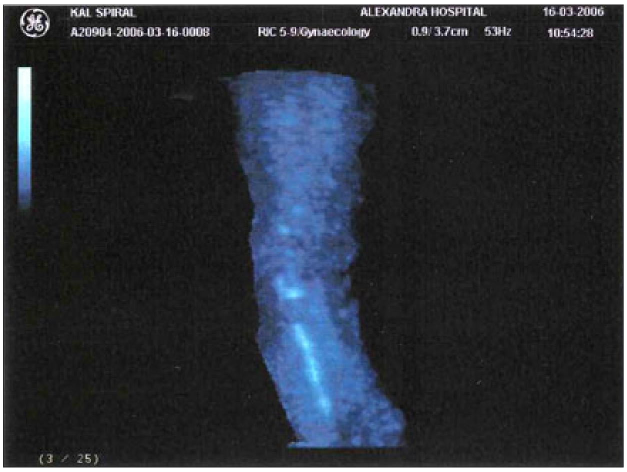

Fig. 2. Three-dimensional ultrasound demonstrates in frontal reformated section a displaced IUD.

review. Eleven articles were initially retrieved from our search in PubMed. Only articles that were written in English language (eight out of eleven) were included in our review. However, two articles in Chinese and one in German were also identified.

The role of ultrasound in control of IUD placement

Insertion is usually carried out during menses, so as not to disturb a possible pregnancy. Transvaginal ultrasound is well known for its ability to diagnose pathological changes in the uterus and adnexa. Three-dimensional technique is a new diagnostic modality which allows a better diagnostic view of the adnexa and is more reliable in detecting abnormalities of the endometrial cavity such as endometrial polyps, submucous myomas and duplication anomalies (septate uterus, bicornate uterus) that are contraindications for the insertion of an IUD (4, 5).

Once the area of interest has been identified, the volume box is superimposed, the volume mode is switched on and the 3D ultrasound is generated by the automatic rotation of the mechanical transducer through 360°. The acquisition time ranges between 2–10 seconds, depending on the size of the volume box. Three perpendicular planes are displayed simultaneously (sagittal, frontal, coronal) thus enabling better understanding of the endometrial cavity.

Evaluation of the stored volumes depends on the number of slices, rotation angle and rendering modes used. Since the number and orientation of reformatted planes are not limited, meticulous evaluation of numerous sections through the cavity becomes possible. From the stored image, a plastic image of the cavity and of its content, as well as surface rendering can be obtained. The surface rendering allows exploration of the outer wall of the cavity (Fig. 1).

Results

Intrauterine device localization by three-dimensional sonography

The expulsion of the device can be complete or incomplete. Incomplete expulsions have been connected with intrauterine pregnancies. It has been shown that in 80 % of unwanted pregnancy with an IUD, the device had been placed too low (6, 7). The same authors found that in all patients with IUDs, malposition was found in 10–16.3 %. The migration and expulsion of the device usually occurs in the first few months after insertion, so ultrasonographic control of the device's position is advisable immediately and 4–12 weeks after insertion (8). Three-dimensional ultrasound provides useful information on the location of the IUD following insertion (9). Normally, the correct measurement is defined as the distance between top of the IUD and inner endometrium as well as IUD and myometrium (fundus) in the longitudinal plane (2D) plus the frontal plane (3D). The possibility to visualize the complete IUD could be evaluated in the frontal plane and in the transparent mode after volume rendering (10).

Depending on IUD type and provided it is placed correctly in the uterine cavity, the device can be visualized sonographically in the longitudinal section as a hyperechogenic stripe (Cooper-T) or as five echogenic points (Loop). In the transverse section, the Cooper-T presents a hyperechogenic point in the middle of the corpus, while in the fundal area the arms of the device can be seen as a hyperechogenic horizontal line. The multiload device presents with three echogenic points lying beside one another. Zohav et al presented in 2007 the first case of three-dimensional transvaginal ultrasonography imaging of malpositioned levonorgestrel-releasing intrauterine system, where the application of 3-D ultrasound with the adjunctive volume contrast imaging in the coronal plane and inversion rendering modes could clearly display the correct spatial position of the LNG-IUS in relation to the uterine cavity much better than two-dimensional ultrasound (11). Furthermore, Valsky et al after studying thirty cases concluded from the shadow images that volume contrast imaging in the C plane is a useful modality in cases of difficult visualization of the IUD and provides an adjunctive approach (10). Zhang et al showed that satisfactory three-dimensional images were obtained in 29/30 cases in which the type and location of IUDs were distinctly shown; satisfying imaging was not obtained in one menopausal case because of thinning of the endometrium. It was found that 17 IUDs (10 of single metal cirque type, 3 of gamma type, 2 of uterine cavity type, and 2 of T type) remained intact and 13 became fractured. Twenty-four IUDs were incarcerated, four were rotated (3 of gamma type and 1 of uterine cavity type), and 2 T type IUDs were normal (12).

Three-dimensional ultrasound is more accurate in the identification of the IUD device (Fig. 2). One of the main advantages is its potential for both surface and volume rendering. Bonilla-Musoles et al found a statistically significant difference between identification of the IUD with 2D versus 3D sonography. In a comparative study, they showed that for the identification and location of IUDs in 66 asymptomatic women, three-dimensional transvaginal sonography (3D-TVS) offered advantages over two-dimensional transvaginal sonography (2D-TVS). Hysteroscopy was performed in cases in which there was a discrepancy between the information obtained by both methods (n=14). In eight cases (12.2 %) the IUD was misidentified with 2D-TVS. In six cases (9.1 %) it was not possible to identify the device model with 2D-TVS. In two cases (3.0 %) 2D-TVS failed to identify the position of the device. In contrast, all IUDs were identified and located accurately with 3D-TVS (13). The distance between the fundal part of the uterus and the end of the device is important for the assessment of the proper placement of the IUD. The distance should not be less than 2 cm. This distance can be more precisely measured by 3D imaging. With the use of 3D ultrasound the three perpendicular planes are visualized simultaneously and it is much easier to locate the correct position of the device. Also, 3D technique enables assessment of IUD length in the longitudinal section synchronically with the imaging of the arms of the device.

The three-dimensional ultrasound allows volume examination on the monitor simultaneously in the planes. These planes are located in a separate window and each of them can be rotated at 90• to each other in all three axes. After acquiring the volume, the presence of the patient is no longer needed, so the examination lasts no more than three minutes (9). In the three-plane mode (frontal, sagittal, longitudinal) the device can be fully visualized only after the volumes are rotated. In a large number of patients (36 %) simultaneous visualization of all parts of the IUD is not possible with the three plane view, but all parts of the IUD can be demonstrated simultaneously by volume rendering (15).

Examination with 2D ultrasound is limited to transverse views of the shaft. The arms or other smaller parts cannot be investigated completely because the frontal view of an IUD can be rarely presented.

Another advantage of the 3D imaging has to do with the detection and clear estimation of the uterine anatomy (uterine position and size, presence of submucosal leiomyoma or congenital uterine anomalies), which is crucial before insertion of an IUD.

In the 1st Department of Obstetrics and Gynecology, in Alexandra Hospital of University of Athens, all the cases of lost IUDs have been detected by the application of 3D-sonography. It is considered to be a secure and safe diagnostic technique to determine the location of IUDs, better than the hysteroscopic evaluation (Fig. 2).

Discussion

Three-dimensional ultrasound is a new and promising imaging tool which provides much better view of the endometrial cavity and its main advantage is the ability to study a volume by stepping through it and rotating the volume in any direction. Three-dimensional technique allows also surface and volume rendering, which can produce images similar to a photograph. In volume rendering, internal structures can be visualized by allowing the surface to become transparent. This is especially useful in uterus examination and in the detection of intrauterine foreign bodies, because structures that are not located in one single plane can be imaged simultaneously (14–17). Three-dimensional ultrasound for investigation of IUDs provides access to the location, orientation of the shaft and also the position and orientation of the branches of the device. It may also help in the identification of unknown types of IUDs. These advantages of 3D-ultrasound may improve the follow-up sonographic examination of patients after the insertion of an IUD, permitting the identification of cases with IUD. malposition and migration.

Unfortunately, 3D-ultrasound is expensive and is not available in all hospitals and family planning centers, but it is believed that in the near future 3D equipments will be less expensive, allowing their widespread application benefiting the gynecologic patients.

References

1. Sulak PJ: Intrauterine device practice guidelines: patient types. Contraception 1998; 58 (Suppl 3): 55S—58S.

2. Bonilla-Musoles F, Pardo G, Simon C. How accurate is ultrasonography in monitoring IUD placement? J Clin Ultrasound 1990; 18 (5): 395—399.

3. Bonilla-Musoles F, Raga F, Osborne NG. Three-dimensional ultrasound evaluation of ovarian masses. Gynecol Oncol 1995; 59 (1): 129—135.

4. Kupesic S, Kurjak A. Septate uterus: detection and prediction of obstetrical complications by different forms of ultrasonography. J Ultrasound Med 1998; 17 (10): 631—636.

5. Kurjak A et al. Three-dimensional ultrasound and power doppler improve the diagnosis of ovarian lesions. Gynecol Oncol 2000; 76 (1): 28—32.

6. Bernaschek G, Endler M, Beck A. Control of IUD-position (author's transl). Geburtshilfe Frauenheilkd 1981; 41 (8): 566—569.

7. Meyenburg M. Ultra sonography for the localization of intra-uterine contraceptive devices (i.u.d.'s) (author's transl). Geburtshilfe Frauenheilkd 1978; 38 (11): 950—957.

8. Stanwood NL, Garrett JM, Konrad TR. Obstetrician-gynecologists and the intrauterine device: a survey of attitudes and practice. Obstet Gynecol 2002; 99 (2): 275—280.

9. Lee A et al. Intrauterine device localization by three-dimensional transvaginal sonography. Ultrasound Obstet Gynecol 1997; 10 (4): 289—292.

10. Hösli I, Holzgreve W, Tercanli S. Use of 3-dimensional ultrasound for assessment of intrauterine device position. Ultraschall Med 2001; 22 (2): 75—80.

11. Zohav E, Anteby EY, Orvieto R. Use of three-dimensional ultrasound in evaluating the intrauterine position of a levonorgestrel-releasing intrauterine system. Reprod Biomed Online 2007; 14 (4): 495—497.

12. Valsky DV, Cohen SM, Hochner-Celnikier D, Lev-Sagie A, Yagel S. The shadow of the intrauterine device. J Ultrasound Med 2006; 25 (5): 613—616.

13. Zhang S, Ying W, Xu J, Yang M, Xu K, Luo Q. The use of three-dimensional ultrasound imaging in detecting the type and location of intrauterine contraceptive device. Zhonghua Yi Xue Za Zhi 2002; 82 (7): 459—461.

14. Bonilla-Musoles F, Raga F, Osborne NG, Blanes J. Control of intrauterine device insertion with three-dimensional ultrasound: is it the future? J Clin Ultrasound 1996; 24 (5): 263—267.

15. Balen FG et al. 3-dimensional reconstruction of ultrasound images of the uterine cavity. Brit J Radiol 1993; 66 (787): 588—591.

16. Feichtinger W. Transvaginal three-dimensional imaging. Ultrasound Obstet Gynecol 1993; 3 (6): 375—378.

17. Steiner H et al. Does 3D sonography present new perspectives for gynecology and obstetrics?. Geburtshilfe Frauenheilkd 1993; 53 (11): 779—782.

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