2D-3D Ultrasound in the Diagnosis of Uterine Malformations

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INTRODUCTION

Uterine malformations form a non-homogenous group of pathologies with a variable impact on reproduction, often not strictly related to the apparent seriousness of pathology. It concerns about 1-5% of women.

Among the many tecniques, invasive and not, useful to diagnosis, many authors believe that laparoscopy associated with hysteroscopy allows diagnosis in all cases. Many references confirm this opinion: hysteroscopy and laparoscopy are used in the classification of uterine anomalies.[1,2]

Magnetic resonance imaging, safe and little invasive, gives a diagnostic accuracy close to 100%. From 1997 to nowadays magnetic resonance has demonstrated its role in the imaging of female pelvis. Pellerito et al using magnetic resonance correctly diagnosed 24 of 24 anomalies (100% accuracy), compared to 11 of 12 anomalies (92%) using endovaginal sonography. Magnetic resonance imaging demonstrated 100% sensitivity and specificity compared to 67% sensitivity and 100% specificity of transvaginal sonography for unicornuate or bicornuate uteri (anomalies requiring surgery). For non-surgical uterine anomalies, both techniques had 100% sensitivity and specificity.

Pellerito *et al* also noted that magnetic resonance imaging had the further advantage of detecting other incidental abnormalities, including a dermoid and submucosal leiomyoma, not found on transvaginal ultrasound (indeterminate and nonvisualized).[3-5]

A review by Troiano *et al*[16] confirms that the need for diagnostical surgical intervention has largely been eclipsed with the advent of magnetic resonance imaging, which has become the imaging modality of choice for characterization of congenital mullerian anomalies.[17]

Ultrasound imaging, in its various techniques available, gives 92% or more of diagnostic accuracy, with some advantages, like lower costs, availability of equipments, non invasivity, repeatability, use at an early stage of pregnancy.

The traditional 2D ultrasound gives a good visualization of the uterine outline and a good endometrial image as well. The main difficulty is obtaining especially in "non-ideal" patients, all the correct sections, which is absolutely necessary to identify malformations, especially the coronal section. These limits of the bidimensional scanning were noted from 1987 in a study by Nicolini *et al*.[7] The authors founds that transabdominal 2D sonography failed to visualize the uterine cavity adequately in as many as 35% of patients although it adequately imaged the uterine fundus in 90% of patients.

For reasons not been elucidated, patients with uterine malformations often have preterm birth. Transvaginal ultrasound examination is an accurate test for the prediction of preterm birth. A study by Airoldi *et al*,[15] examined specifically preterm birth in this population, evaluating 64 pregnancies : there were 28 with a bicornuate uterus, 13 with a septate uterus, 11 with a uterine didelphys, and 12 with a unicornuate uterus. They were followed prospectively. In women with uterine anomalies, if transvaginal scan shows a short cervical length , exists a 13-fold risk for preterm birth. Unicornuate uterus had the highest rate of cervical shortening and preterm delivery (level of Evidence: II-2) (Figs 1 to 3).

Sonohysterography provides further information on the endometrial cavity. In a study by Sergeant *et al*,[8] 14 patients with a history of repeated spontaneous abortion or infertility, after the hysterosalpingography were examined by hysterosonography. The uterine septum were diagnosed by hysterosonography in all 14 patients (100%). A recent study that evaluates the role of saline infusion sonohysterography in the investigation of uterine abnormalities and malformations in

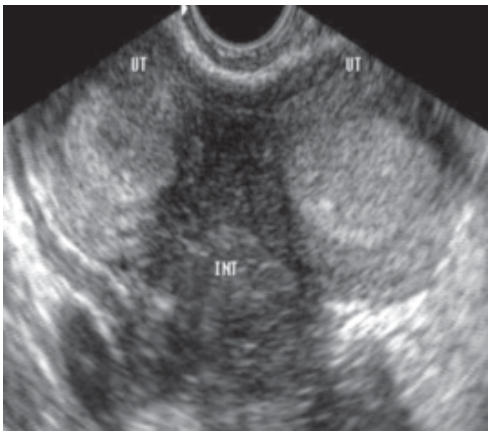

Fig. 1: Uterus didelphys, 2D scan

1009 patients,[11] demonstrates 20% of uterine anomalies in patients referred for infertility. The technique, used in an outpatient setting, appeared safe, well tolerated, and should be considered routinely in infertile patients.

2D transvaginal contrast sonography and 3D transvaginal ultrasound in the diagnosis of congenital uterine anomalies has provided sensitivity rates of up to 100% about uterine anomalies.[14]

Color Doppler adds important information on the vascularization of the malformed uterus, especially on the septum. The role of vascularization in the reproductive future of women with uterine malformation was suggested by some studies.[12,21]

Only 12 studies are reported in PubMed related to keywords "uterine malformations and 3D ultrasound" and similar, and there aren't metanalises of controlled trials that evaluate 2D ultrasound versus 3D in the diagnosis of the uterine malformations.

From 1995, some studies have found that three dimensional sonography is highly sensitive (up to 100%) and specific (up to 100%) in helping to diagnose major müllerian anomalies (Jurkovic). Studies also have found 2D transvaginal sonography to be a highly effective means of diagnosis, with 75-100% sensitivity and up to 95% specificity. Positive predictive value was higher with 3D scanning compared to 2D scanning (100% vs 50%, respectively). Three dimensional ultrasound agreed with hysterosalpingography in all major uterine anomalies. The ability to visualize both the uterine cavity and the myometrium on a 3D scan facilitates the diagnosis of uterine anomalies and enables easy differential diagnosis between subseptate and unicornuate uterus.[5]

In a study by Raga *et al*, 3D US detected 12 of 12 congenital uterine anomalies.The anomalies were correctly classified (according to AFS class) in 11 of 12 patients. A leiomyoma caused the misdiagnosis of a bicornuate uterus as septate uterus.[6]

In a study by Lev-Toaff *et al*,[9] 20 women were studied by three-dimensional sonohysterography, 13 also by two-dimensional sonohysterography, and 12 had X-ray hysterosalpingography. 3D sonohysterography gives additional information in the vast majority of women, compared with standard accepted techniques. The coronal plane was most useful for displaying the uterine cavity.

Many authors report that 3D ultrasound offers the three dimensional image of the uterus, with striking images of the conformation of the cavity and outline of the uterus, The most important aspect is the perfect visualization of the coronal scanning from the bottom to the cervix, which generally gives more information and which is, on the contrary, very difficult to visualize in 2D ultrasound. The outline of the uterus is perfectly visible as it would be with laparoscopy. In the future, according to a study by Alborzi *et al*,[10] the 3D ultrasound might replace

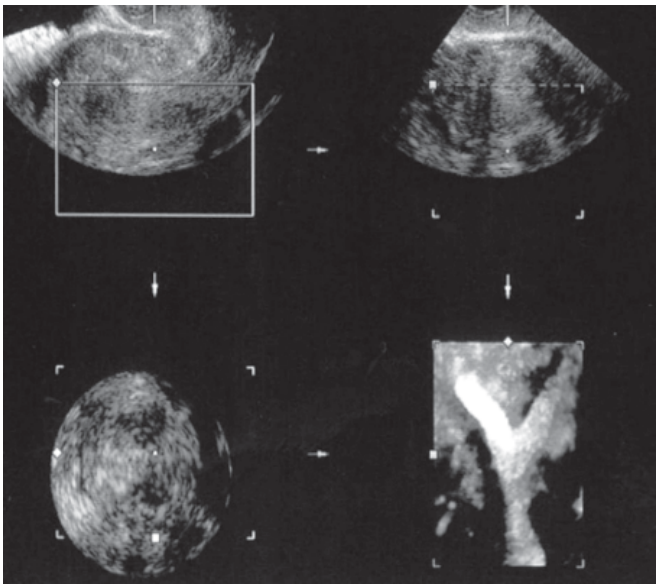

Fig. 2: Bicornuate uterus, 2D versus 3D imaging

laparoscopy in the diagnosis of the uterine malformations, especially in case of septate uterus.[20]

A study by Kupesic and Kuriak *et al*,[13] reports that three-dimensional ultrasound can be a screening method for detection of uterine abnormalities in a population of infertile patients. In 23,2% of 3850 infertile patients, 3D US detected major uterine anomalies. The prevalence of septate uterus, the most common uterine abnormality, was 17.9%.

3D ultrasound proves to be very useful for the differentiation between subseptate uterus and bicornuate and is absolutely necessary for the diagnosis of a malformation of less importance but difficult identification: arcuate uterus, which is not always visible with 2D ultrasound. 3D ultrasound shows with great precision the border between endometrium and myometrium and the slight convexity of the uterine bottom.

Fig. 3: Arcuate uterus, 3D imaging

The 3D ultrasound is a reproducible method for the diagnosis of congenital uterine anomalies. Salim et al in a study performed to examine the reproducibility of the diagnosis of uterine malformations by 3D ultrasound[22] demonstrate in 83 examined volumes only a single case of anomaly described as arcuate uterus by one ecographer and as subseptate by another.

A limit of 3D ultrasound may be the long time necessary to acquire and elaborate scan. An interesting study by Benacerraf *et al*[18] determines whether 3-dimensional ultrasound is a rapid, efficient way to do a gynecologic scan. The authors scanned 35 cases with 2D and 3D sonography. The accuracy was similar. The average time needed for the standard 2D scan was 2,6 minutes. The time needed for 3D scan was 1,07 minutes (volume acquisition) and 1,19 minutes (offline elaboration): 2,26 minutes for the entire 3D examination. This study shows that 2D and 3D ultrasound need about the same time to scan uterus.

In early pregnancy, the three-dimensional ultrasound does not generally provide further information on the malformation and classic 2D scan is probably sufficient.

In our experience, the 3D ultrasound represents a second step in the diagnostic process on those patients where a 2D makes us suspect a uterine malformation. It is useful not so much to confirm the existence of a pathology, but mainly to allow us a more precise definition of the uterus morphology and to express a reproductive prognosis as much realistic as possible.[19]

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