Comparison between Hysteroscopy and Three Dimensional Hysterosonography in the Diagnosis of Intracavitary Uterine Abnormalities

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Abstract: Introduction & objective: Hysteroscopy offers a precise diagnosis and a better ground for therapy. Although being an invasive procedure, it is considered as the gold standard for evaluation of the uterine cavity .Trying to find another less invasive modality for diagnosis of the uterine cavity abnormalities, several authors have suggested the use of 3D ultrasonography which can, in skilled hands, identify the contour of the uterine cavity. Instillation of ultrasound contrast media (sterile saline) during transvaginal sonography can make this procedure easier and clearer. Therefore in this study we aim to compare 3-dimensional hysterosonography with the gold standard diagnostic hysteroscopy regarding the diagnosis of intrauterine cavitary lesions. **Patients and Methods**: This was a comparative cross sectional study Conducted at Ain Shams University Maternity hospital. 100 patients were recruited from the Hysteroscopy unit at Ain Shams University Maternity hospital from June 2009 to May 2010. A diagnostic office hysteroscopic setting was performed at first, then, in another setting, 3-DHS with saline as a contrast medium was used by instillation of the saline into the uterine cavity via embryo transfer catheter. Then, a comparison was done between 3-DHS in relation to the gold standard in this study which was hysteroscopy. **Results**: there was a good overall agreement between 3-dimensional hysterosonography and hysteroscopy, as a gold standard test, in diagnosing intrauterine cavitary lesions with a sensitivity that reached 97.9%, a positive predictive value (PPV) of 96.9% and an accuracy of 95%. The low specificity and negative predictive value (NPV) of 3-dimensional hysterosonography (25%, 33.3% successively) could be explained by the low number of negative cases in the study (just 4 cases). The comparison between results of the two techniques showed no statistical significant difference. **Conclusion**: The findings suggest almost similar Results of 3-dimensional hysterosonography and hysteroscopy, as a gold standard test, in diagnosing intrauterine cavitary lesions.
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1.Introduction

Hysteroscopy is the visual examination of the cervical canal and the interior of the uterus. Office hysteroscopy is a critical component of a modern gynecologic practice. It is easy to learn and simple to incorporate into a busy gynecologic group practice and the popularity of this office approach to endometrial evaluation is steadily increasing [(1)].

Although still hysteroscopy could be considered an invasive diagnostic procedure yet in all studies it is considered as the gold standard for evaluation of the uterine cavity [(2)].

Ultrasonography by any modality is considered to be a non invasive procedure to investigate uterine lesions if compared to hysteroscopy which is a more invasive one with a higher cost [(3)].

Two-dimensional ultrasound (2DUS) traditionally has relied on acquisition of images from a variety of orientations in which the operator has a good eye - linkage to assist in feature recognition [(4)] .Conventional two-dimensional hysterosono-graphy (2-DHS) has limitations in that the full contour of the uterine cavity has rarely been depicted in a single scanning plane because of limited projection angles of the ultrasound beam. Therefore, the outcome is heavily dependent on the skill of the examiner [(5)].

By instillation of contrast media (sterile saline) into the uterine cavity, the contour of the uterine cavity can be visualized[(5)].

Recently, several authors have reported the use of ultrasound contrast media in the assessment of uterine cavities during trans-vaginal ultrasound, and have emphasized its benefits which include being reproducible and reliable in assessment of tubal patency, better assessment of uterine cavity, enables visualization of ovarian morphology and soft tissue abnormalities, such as fibroids or congenital anomalies of the uterus; feasible, minimal invasiveness and relatively few contraindications; avoidance of exposure to X-rays, allergic reactions and general anesthesia: the possibility of being performed as an outpatient procedure; the fact that it is well tolerated, rapid [(6)].

Objectives:

The aim of the study is to compare 3-dimensional hysterosonography with diagnostic

hysteroscopy regarding the diagnosis of intrauterine cavitary lesions.

2. Patients and Methods:

This study is a comparative cross sectional study that was conducted at Ain Shams University maternity hospital. One hundred (100) patients were recruited from the hysteroscopy unit at Ain Shams University maternity hospital from June 2009 to May 2010. The study included any woman with suspected intrauterine abnormality on 2-D ultrasonography or on hysterosalpingography the study excluded any unfit woman for hysteroscopy or sonohysterography e.g. Pregnant or suspected pregnancy (unless β-HCG rules out pregnancy), women with pelvic infection, excessive uterine bleeding or decompensated cardiorespiratory disease.

The study was approved by the ethical committee of the Faculty of Medicine, Ain Shams University.

All patients were subjected to: Complete history taking, thorough general, abdominal, local examination, all routine investigations according to the protocol of the setting.

Written consent was taken after full explanation of the procedures to the patient.

All patients had 3-dimensional hysterosonography preceded by a setting of diagnostic hysteroscopy. All the examinations were performed during the proliferative phase after complete cessation of menses.

The instrument used in the hysteroscopy procedure was the rigid telescope, 30º Hamou II hysteroscope, model 26157 BT(Karl Storz, Tuttlingen, Germany), with a Hopkins II lens system with a 5-mm outer diameter sheath connected to cold light source: Xenon nova, model 20 13 15 20 manufactured by Storz, Karl Storz-endoscope, telecom DXpal camera, Hamou endomat infusion device, model 26 33 10 20 at an infusion rate of 300 ml/min, pressure 120 mmHg, suction 0.2

Normal saline was used for uterine distension connected to the inflow channel on the sheath with intravenous tubing. A vaginal disinfection with a non irritating watery disinfection solution was performed without placing speculum.

The tip of the hysteroscope was positioned in the vaginal introitus, the labia being slightly separated with fingers. The vagina was distended with saline. The scope was driven to the posterior fornix to readily visualize the portio and slowly backwards to identify the external cervical os. When this is became visible, the scope was carefully moved forward to the internal os and then the uterine cavity with least possible trauma.

The uterine cavity was systematically explored by rotating the fore-oblique scope in order to identify any anomaly in the uterine walls and/or the right and left tubal ostia.

3-dimensional hysterosonography session was carried out starting with trans-vaginal ultrasonography to identify any pelvic pathology. With the patient in the dorsal position, a cusco speculum was inserted into the vagina and positioned such that the entire cervix is visualized and the os was easily accessible. The cervix and the vagina were then thoroughly mobbed with Betadine solution, and then a tenaculum is placed on the anterior lip of the cervix. Application of Fr-8 Pediatric Foley's catheter and 1-2ml of sterile saline was used to inflate the balloon of the catheter, sealing the uterine cavity and preventing vaginal fluid leakage. After removal of the tenaculum, the three-dimensional trans-vaginal probe was gently introduced into the posterior fornix of the vagina.

The probe ***(Medison Accuvix, Probe 3D5-8 EK)*** is an electronic sector transducer with frequency range of 5-8 MHZ. The scan angle is switchable up to 149 degrees and maximum image depth of 12cm. The sterile saline was then injected slowly, under the control of the ultrasound picture. For distension of the uterine cavity 10 to 20 ml of saline was required, infusion of another 10 to 20 ml of saline was done in order to flow along the fallopian tubes. At this stage we could observe the morphology of the uterus, and also detect the tubal flow signal by color Doppler, volume mode was initiated and the scanning plane was based on a coronal (horizontal) section of the uterus with targeted side of the ovary viewed. The region of interest (ROI) was set as wide as possible so that the whole length of the fallopian tube could be detected.

The procedure takes about 15 to 30 minutes and the woman was free to leave as soon as the procedure was completed.

The findings of hysteroscopy were recorded by the same physician and those of 3-dimensional ultrasonography were recorded by a single investigator without the knowledge of each other findings.

3.Results

Tables 1 shows the demographic Charachteristics of patients: the mean age of women participating in the study was 30 ± 5.5 years with mean duration of marriage 7.6 ± 5.3 years, the median of parity was 3 ± 2.

Table (1) Demographic characteristics of women participating in the study

n=100	Mean	±SD	Range
Age	30.0	5.5	22-54
Duration of marriage	7.6	5.3	2-31
Parity	3	2	0-5

Only in 10 % of cases the 3-DHS was objectively described to be difficult while in 52% of cases the office hysteroscopy session was described to be difficult(p<0.05) Table(2).

None of the patients during the session of 3-DHS needed any form of anesthesia while in hysteroscopy 18% of sessions needed local anesthesia (p<0.05). table (2).

Comparing pain perceived subjectively by the patients during both sessions, it was noticed to be much less in 3-DHS than in hysteroscopy (p<0.05).table (2)

As regards post operative complications as pain, vaginal discharge or bleeding, 98% of women underwent 3-DHS had no post procedure complications while in case of hysteroscopy 30% of women had such complications (p<0.05) table(2)

Table (2) Comparison between hysteroscopy and 3-DHS as regards difficulty of introduction of the scope/ catheter,need for anesthesia,pain and post operative complications.

	Hysteroscope No. %		**3-DHS** No. %		X^2	*P*
Introduction of scope/ catheter						
Easy	48	48	90	90	32	0.000
Difficult	52	52	10	10		
Anesthesia						
No	82	82	100	100	17.6	0.000
Local	18	18	0	0		
Pain						
No	0	0	89	89		
Mild	30	30	11	11	167.8	0.000
Moderate	55	55	0	0		
Severe	15	15	0	0		
Post operative complications						
None	70	70	98	98		
+ve (pain, vaginal discharge, bleeding)	30	30	2	2	17.3	0.000
Total	100		100			

Comparing the volume of saline used in both procedures, mean volume for hysteroscopy was 120±11 ml while in 3-DHS it was 30±8.7 ml (p<0.05).table (3)

Table (3) Comparison between the mean volume of saline injected during hysteroscopy and 3-DHS settings.

	Mean	**±SD**	**Range**	**t**	***P***
Injected volume with hysteroscopy	120	11	100-350	64.1	0.000
Injected volume with 3-DHS	30	8.71	20-40		

Abnormalities of the endocervical canal like thickening, hypertrophy or elongation were more evident using hysteroscopy 24% than 3-DHS 11% but the difference was not statistically significant (p>0.05).table(4)

Table (4) Comparison between hysteroscopy and 3-DHS as regards endocervical canal findings among studied cases:

	Hysteroscopy No %		**3-DHS** No. %		**X2**	***P***
Endocervical canal						
Normal	76	76	89	89	4.9	0.2
Abnormal (thickened, hypertrophic, elongated)	24	24	11	11		
Total	100		100			

Assessment of tubal patency(detected by passage of saline through tubes detected by colour doppler in 3-DHS, and good visualization of Ostia with good passage of saline through them in hysteroscopy) revealed no statistically significant difference between the results of both procedures(p>0.05).Table(5)

Table (5) Comparison between hysteroscopy and 3-DHS as regards tubal patency (detected by passage of saline through tubes detected by colour doppler in 3-DHS, and good visualization of Ostia with good passage of saline through them in hysteroscopy).

	Hysteroscopy No %	3-DHS No. %	X2	*P*
Tubal Ostia				
Both blocked	14 14.0	11 11.0		
One patent	2 2.0	2 2.0	0.4	0.8
Both patent	84 84.0	87 87.0		
Total	100	100		

Several types of intrauterine lesions could be detected by both techniques and are listed in table(10).the most common encountered lesions were polyps (41%), congenital uterine anomalies (e.g. septum, bicornuate uterus, uterus didelphys)(23%) and myoma (17%). tables(6,7)

Table (6) Comparison between hysteroscopy and 3-DHS as regards intracavitary uterine lesions encountered among studied cases.

Type of lesion	Hysteroscopy No %	3-DHS No. %
No lesion	4 4	3 3
Polyp	41 41	40 40
Congenital uterine anomalies	23 23	23 23
Myoma	17 17	19 19
Intra uterine adhesions	10 10	9 9
Increased endometrial thickness	1 1	2 2
Haematometra (retained blood)	1 1	1 1
Endometrial condensation (indentation)	1 1	1 1
Endometrial mass (carcinoma)	1 1	1 1
Polyp and congenital uterine anomaly	1 1	1 1
Total	100	100

Studying the agreement between the two techniques as regards the detection of intra uterine lesions (considering hysteroscopy as the gold standard test) reveals that 3-DHS agreed with hysteroscopy in 94 positive cases and 1 negative case(Accuracy of 3D hysterosonography is 95%) ,false +ve results for 3-DHS are 3 cases representing 75% of all –ve cases, false –ve results are 2 cases representing 2% of all +ve cases, sensitivity of 3D hysterosonography in detection of lesions compared to the gold standard test (hysteroscopy) =97.9%, Specificity of 3D hysterosonography is 25.0% , positive predictive value 96.9% and negative predictive value 33.3%.table(7) The table also shows no significant difference between the two studied techniques in diagnosis of lesions. No disagreement of the two techniques in the total diagnosis of cases.

Table (7) Agreement of the two studied techniques in diagnosis of the lesions ,Sensitivity (S), specificity (SP), positive predictive value (PPV), negative predictive value (NPV) and accuracy (A) of 3D hysterosonography in detection of intra-cavitary uterine lesions (compared to hysteroscopy as a goldstandard test) .

	Hysteroscopy	
	Positive No. %	Negative No. %
3D hysterosonography		
Positive	94 97.9	3 75
No lesion (negative)	2 2.1	1 25
Total	96	4

McNemar X2 = 1.0 *P*>0.05 not significant

Table (8) Sensitivity (S), specificity (SP), positive predictive value (PPV), negative predictive value (NPV) and accuracy (A) of 3D hysterosonography in detection of each of intra uterine lesions alone (compared to hysteroscopy as a golden standard test).

	Sensitivity	Specificity	PPV	NPV	Accuracy
Polyp	97.56%	100%	100%	50%	97.67%
Congenital uterine anomalies	100%	100%	100%	100%	100%
Myoma	100%	33.3%	89.5%	100%	90%
Intra uterine adhesions	90%	100%	100%	50%	90.9%
Increased endometrial thickness	100%	50%	50%	100%	66.67%
Endometrial condensation (indentation)	100%	100%	100%	100%	100%
Haematometra (retained blood)	100%	100%	100%	100%	100%
Endometrial mass (carcinoma)	100%	100%	100%	100%	100%

Table (9) Agreement of the two studied techniques in diagnosis of polyps (as it represents 41% of the intracvitary lesions detected among the studied group).

	Hysteroscopy	
	Positive No. %	Negative No. %
3DHS		
Positive	40 97.6	2 66.7
No lesion (negative)	1 2.4	1 33.3
Total	41	3

McNemar X2 = 1 *P*>0.05 not significant

Table (10) Agreement of the two studied techniques in diagnosis of myoma (as it represents 17% of the intracvitary lesions detected among the studied group).

	Hysteroscopy	
	Positive No. %	Negative No. %
3DHS		
Positive	15 89.5	2 66.7
No lesion (negative)	0 0	1 33.3
Total	17	3

McNemar X2 = 1 *P*>0.05 not significant

Table (11) Comparison between distribution of intracavitary uterine lesions as detected by hysteroscopy alone , 3-DHS alone and those as detected collectively by both hysteroscopy and 3-DHS among studied patients:

	Collectively		Hysteroscopy		3 - DHS		
Type of lesion	No	%	No	%	No	%	
No lesion	1	1	4	4	4	4	
Polyp	41	41	41	41	40	40	
Congenital uterine anomalies	23	23	23	23.0	23	23.0	
Myoma	19	19	17	17	19	19	
Intra uterine adhesions	10	10	10	10	9	9	
Increased endometrial thickness	2	2	1	1	2	2	
Haematometra (retained blood)	1	1	1	1	1	1	
Endometrial condensation (indentation)	1	1	1	1	1	1	
Endometrial mass (carcinoma)	1	1	1	1	1	1	
Polyp and congenital uterine anomaly	1	1	1	1	1	1	
Total	100		100		100		

4.Discussion

Diagnostic hysteroscopy has been regarded as the gold standard and definitive procedure for exploration and evaluation of the uterine cavity. It is a safe and a simple procedure that can almost always be carried out successfully in an office setting. In addition, it has already shown good results with lower health care costs and high patient acceptability [(7)].

On the other hand, there is no doubt that three-dimensional ultrasound is a challenging field in technology researches. It has gained a significant popularity in obstetrical practice in recent years, as equipment performance improves and clinical experience accumulates [(8)].

Three dimensional ultrasonography helps to improve the diagnostic procedure in both obstetrics and gynecology, especially in those complex cases that are difficult to be evaluated by conventional 2-D scanning and other diagnostic modalities [(6)].

Abnormalities of the uterine cavity observed by transvaginal ultrasonography are usually further evaluated by 2D hysterosonography (2-DHS) which is a simple technique used to improve visualization of the endometrial cavity via instillation of the uterine cavity with saline [(9)].

Hysterosonography, when combined with 3-dimensional ultrasound, provides additional information over conventional transvaginal ultrasound when evaluating the uterine cavity. The extra information obtained during hysterosonography can be used to direct the clinical intervention. It also can avoid the need for further invasive investigative procedures such as hysteroscopy or laparoscopy [(10)].

In the present study, one hundred (100) patients were recruited from the cancer early detection unit at Ain Shams University Maternity hospital

Infertility was the primary cause of referral in 46 women (46%), while recurrent pregnancy loss was represented in 33 women (33%), and abnormal uterine bleeding in 21 patients (21%).

In the present study, it was found that the volume of saline solution instilled for all patients during hysteroscopic procedures ranged from 100 to 350 ml with the mean ***120*** ml and SD ± ***11*** ml. While during the settings of 3-DHS, the volume of saline injected ranged from 20 to 40 ml with the mean ***30*** ml and SD ± ***8.71*** ml. There was a much lower mean injected volume of saline with 3-DHS compared to hysteroscopy that resulted in subsequent decrease in associated pain and complications in case of 3-DHS. The difference was highly significant statistically (P<0.01).

In a study done by ***Cooper et al. (2011)*** on the effect of the distension medium on pain during outpatient hysteroscopy, they proved that normal saline is a suitable distending medium for outpatient hysteroscopy and that the procedural pain and the views obtained are satisfactory. However, they mentioned that it was the relatively large volume of the saline used for distension (200-430 ml with SD± 21) is the main cause of pain and discomfort in some patients[(11)].

The present study showed that during introduction of the scope of hysteroscopy (a rigid telescope was used with an external sheath of a 5-mm outer diameter), ***52%*** of the cases had difficult insertion, while ***48%*** had easy insertion. With 3-DHS, ***90%*** of the patients had easy insertion of the catheter. The difference was highly significant (P<0.01).

The present study showed that during hysteroscopic settings there were ***30%*** of the patients had mild pain, ***55%*** experienced moderate pain and ***15%*** had severe pain. While during 3-DHS procedures, ***89%*** of the patients had painless settings while only ***11%*** suffered mild pain. The difference was highly significant statistically (P<0.01).

The present study showed that hysteroscopic procedures were done successfully without the need of local anesthesia in ***82%*** of the patients and only ***18%*** of the patients needed local anesthesia for the hysteroscopy. On the other hand, absence of use of local anesthesia in ***100%*** of the patients was recorded during 3- dimensional hysterosonography settings. The difference was highly significant statistically (P<0.01).

Bettocchi et al. (2009) have reported that pain experienced during hysteroscopy continues to represent the most common reason for failure, even if local anesthesia is used. It is the main limiting factor to a large-scale use of office hysteroscopy[(7)].

Cicinelli (2010) also has reported that it is accepted by some physicians that office-based hysteroscopy in experienced hands is a well-tolerated procedure without the need of any form of analgesia or anesthesia (except in selected patients like women with previous caesarean section, history of chronic pelvic pain, anxiety and in menopause). However, it continues, in general, to be considered by most gynecologists and patients to be an invasive and painful technique with low patient tolerance[(12)].

In addition, during the settings, hysteroscopy provided a clear field of vision in ***77%*** of the patients, while the large volume of saline used and the presence of bleeding, blood clots, fibrous bands or tissues made the field of the vision in the other ***23%*** to appear foggy. This was met by a good visual demonstration of the obtained ultrasonographic pictures in ***97%*** of the patients. The difference was highly significant statistically (P<0.01).

This study reported that ***30%*** of the patients had complications after hysteroscopy that varied between pain, vaginal Disharge or bleeding, these

complications were mild to moderate and lasted for a range of few hours to two days as a maximum. In case of 3-DHS, only ***2%*** of the patients had complications. The complications were limited to vaginal discharge and bleeding that took one day to subside spontaneously. The difference was highly significant statistically (P<0.01).

Walker et al. (2007) reported that three dimensional hysterosonography is considered as a minimally invasive procedure. It has very few complications and is well tolerated by the vast majority of women[(3)].

Regarding findings of the endocervical canal in the present study, hysteroscopy revealed that 24% of the patients had abnormal endocervical canal. The abnormality meant that the canal was thickened or hypertrophic or elongated. While 3-DHS detected that only 11% of the patient had abnormal endocervical canal. The difference was statistically significant (P<0.05) (Table "4").

Regarding tubal findings, it was found that 84% of the patients had both tubal ostea patent by hysteroscopy, 14% both blocked and 2% with only one ostium to be patent. On using 3-DHS, there were 11% of the patients that had both tubes blocked and 87% of the patients had both tubes patent with 2% with only one ostium to be patent.

Regarding the diagnosis of uterine lesions, the 3-DHS procedure, compared to the gold standard test (hysteroscopy), detected 40 ***polyps*** from 41 polyps detected by hysteroscopy with ***100%*** specificity, ***97.56%*** sensitivity, ***100%*** PPV, ***50%*** NPV and ***97.67%*** accuracy. There was a good agreement between the two studied techniques in diagnosis of polyps.

It also detected 19 ***myomas*** against 17 myomas detected by hysteroscopy with ***33.3%*** specificity, ***100%*** sensitivity, ***89.5%*** PPV, ***100%*** NPV and ***90%*** accuracy. There was a good agreement between the two studied techniques in diagnosis of myomas .

Three dimensional hysterosonography found 9 of 10 intrauterine ***adhesions*** found by hysteroscopy with ***100%*** specificity, ***90%*** sensitivity, ***100%*** PPV, ***50%*** NPV and ***90.9%*** accuracy.

Regarding other lesions, 3-DHS found two patients with increased endometrial thickness against one patient detected by hysteroscopy. The same results were obtained by both techniques as regards other lesions; they were 23 congenital uterine anomalies (including 11 septate, 9 bicornate, 1 sub-septate and 2 didylphys uteri), one with localised endometrial condensation, one with retained blood in the cavity (haematometra), a patient with endometrial carcinoma, a patient with a polyp associated with a subseptate uterus.

The above results showed that there was a good overall agreement between 3-DHS and hysteroscopy, as a gold standard test, in diagnosing intrauterine cavitary lesions (Table "7") with a ***sensitivity*** that reached ***97.9%***, a positive predictive value (***PPV***) of ***96.9%*** and an ***accuracy*** of ***95%***. The low ***specificity*** and negative predictive value (***NPV***) of 3-DHS (***25%***, ***33.3%*** successively) could be explained by the low number of negative cases in the study (just 4 cases). The comparison between results of the two techniques showed no statistical significant difference.

Hysteroscopy, as a result, was found to miss three cases, 2 submucous-intramural fibroid and a case of homogenous increase in endometrial thickness .While 3-DHS, on the other hand, missed two cases including a small polyp, a case of intrauterine adhesions.

This meant that the results of hysteroscopy in detection of lesions compared to their distribution as detected collectively by both hysteroscopy and 3-DHS (Table 7) had a ***sensitivity*** of ***96.97%*** (for all lesions collectively), ***100%*** for each of polyps, congenital uterine anomalies and intra uterine adhesions and ***89.5%*** for myomas. It had a ***specificity*** of ***100%*** (for all lesions collectively and for each of the lesions individually), a positive predictive value of ***100%*** (for all lesions collectively and for each of the lesions individually), a negative predictive value ***25%*** (for all lesions collectively), ***100%*** for each of polyps, congenital uterine anomalies and intra uterine adhesions and ***66.67%*** for myomas and an ***accuracy*** of hysteroscopy is ***97%*** (for all lesions collectively).

When applying the same for results of 3-DHS compared to those detected collectively by both hysteroscopy and 3-DHS, 3-DHS is found to have a ***sensitivity*** of ***97.97%*** (for all lesions collectively), ***100%*** for each of myomas, congenital uterine anomalies and intra uterine adhesions and ***97.6%*** for polyps. It has a ***specificity*** of ***100%*** (for all lesions collectively and for each of the lesions individually), a positive predictive value of ***100%*** (for all lesions collectively and for each of the lesions individually), a negative predictive value ***33.3%*** (for all lesions collectively), ***100%*** for each of myomas, congenital uterine anomalies and intra uterine adhesions and ***50%*** for polyps and an ***accuracy*** of 3-DHS is ***98%*** (for all lesions collectively).

Regarding hysteroscopy, the two missed cases of submucous-intramural fibroids appeared only as a shallow protrusions into the cavity. It was sure for the physician that there was a pathology but it didn't give a clue about their identity.

But with 3-DHS, it was found that not only the distorted and enlarged uterine cavity could be visualized from many directions on 3D, but the information about the size, position, and the extent of submucous fibroids was also available and accurate. In this study, 3-DHS was successful in detecting the all

(19) submucous-intramural fibroids regarding their exact site, size and extent of emerging into the uterine cavity. Thus helped the physician to settle on the proper way to excise the lesion and to decide which is safer; hysteroscopic removal or open surgery.

This came along with ***Makris*** who published that Diagnostic hysteroscopy only allows a subjective assessment of the size of lesions. Thus, the definitive diagnosis is reached at the time of surgery. He reported that hysteroscopy provides indirect information regarding the depth of myometrial extension in case of myomas. Whereas it can only access the segment of the fibroid protruding into the cavity. He also reported that 3-DHS can also provide information about the part of fibroid hidden within the myometrium [(13)].

Salim et al. (2005) studied (49) women, presented with a history of menorrhagia and diagnosed on two-dimensional ultrasonography to have submucous fibroids, in a prospective double-blind study aiming at comparing 3-DHS and diagnostic hysteroscopy for the diagnosis and classification of submucous uterine fibroids. He identified a total of 61 submucous fibroids in 49 symptomatic women. Diagnostic hysteroscopy confirmed these findings in all cases. There was agreement between the two methods in 11/12 cases of Type 0 fibroids (92%), 34/37 (92%) of Type I fibroids and 9/12 (75%) of Type II fibroids[(9)].

They concluded that there is a good overall agreement between 3-DHS and diagnostic hysteroscopy in classification of submucous fibroids. Agreement is better in cases where a greater proportion of the fibroid is contained within the uterine cavity [(14)].

In the present study, the third case of homogenous increase in endometrial thickness missed by hysteroscopy appeared as a normal cavity. This misdiagnosis was expected and this came in correlation with what was published by ***Bettocchi*** who reported that Problems for endoscopists arise, however, when they have to diagnose forms of hyperplasia because these can be established only by pathologic examination of the endometrium. Hysteroscopy offers the possibility of visualizing focal abnormalities suggestive of endometrial hyperplasia inside the uterine cavity, and of taking a biopsy under visual control, THB (targeted hysteroscopic biopsy). The lack of established hysteroscopic criteria for the diagnosis and classification of endometrial hyperplasia, mainly in premenopausal women, is a drawback to the reliability of this endoscopic procedure if based only on visualization of the uterine cavity [(15)].

In the present study, the two missed cases with 3-DHS (a small polyp and a case of intrauterine adhesions) can be explained by the need of more saline to be injected into the cavity in the first case, as it was done very early in the study with little experience in performing the procedure. The misdiagnosis of the second case was due to severe adhesions that interfered with introduction of the catheter besides the associated discomfort of the patient that prevented further trials.

The results of the present study are verified by a number of studies there is agreement between their results. ***Elsayes et al., Sconfienza et al., La Torre et al., Pasqualotto et al. and Makris et al.*** have published similar results that agree with those of the present study.

For accurate detection of polyps and if they are myometrial or endometrial and for differentiation between polyps and myomas, hysteroscopy depends on visualising the angle between the endometrial surface and the lesion. When this angle is acute, the lesion is most probably in endometrial polyp, while being an obtuse angle, it is almost a fibroid polyp or a myoma. This is still an inconclusive sign for precise differentiation between myomas and polyps [(16)].

Although 3-DHS can visualise this angle, the advantage of 3-DHS lies in its ability to give a clear view of the myometrial-endometrial interface and visualise if it is intact (a sign of an endometrial polyp) or being distorted that is caused by a myoma [(17)].

La Torre et al. (1999) compared three dimensional trans-vaginal sonography (3D-TVS) with conventional imaging, with and without saline contrast, in their study of 23 patients in whom subsequent hysteroscopy revealed the presence of 16 endometrial polyps. Standard two dimensional trans-vaginal sonography (2D-TVS) demonstrated a relatively poor specificity of only 69.5% suggesting the presence of polyps in 23 patients. This was improved to 94.1% when (2D TVS) was used in conjunction with saline infusion as only 17 patients were then thought to have polyps. (3D-TVS) performed almost as well diagnosing the presence of polyps in 18 patients with a specificity of 88.8% and subsequently correctly identified all 16 polyps when used in conjunction with saline infusion. These results agreed with the results of the present study in giving a 100% specificity of 3-DHS in diagnosing the polyps with a higher sample size in the present study (100 patients)[(18)].

Pasqualotto et al. (2000) compared retrospectively similar parameters (submucous fibroid, polyps) on three hundred seventy five (375) patients complaining of abnormal uterine bleeding, main pathology findings were endometrial polyps (172, 45.9%) submucous myomas (105,28%). They found that the Sensitivities of the preoperative diagnostic tools specifically for myomas and polyps were for transvaginal sonography 74% and 39 %, for saline

infusion sonography 96% (100% in the present study) and 96 % (97.6 in the present study) and for hysteroscopy 100% (89.5% in the present study), 99% (100% in the present study)[19].

Makris et al. (2006) had a prospective study in which to compare 3-dimentional hysterosonography (3-DHS) and diagnostic hysteroscopy for the evaluation of intrauterine lesions, (124) women with suspected intrauterine abnormality were scheduled to undergo hysteroscopy and 3-DHS examination. However, 3-DHS could not be performed in 3 of the women because of cervical stenosis (in the present study, the use of embryo transfer catheter for distension of cavity overcame this obstacle and even cases with cervical stenosis could be performed well).

Examination with 3-DHS reached a sensitivity of 91.9% (97.97% in the present study) and specificity of 98.8% (100% in the present study), with a positive predictive value of 97.1% (100% in the present study) and a negative predictive value of 96.5% (33.3% in the present study), respectively. The difference in negative predictive values is due to the high number of negative cases (86 from total of 121) compared to the present study (only one case from total of 100). They concluded that the examination with 3-DHS allows for accurate assessment of intrauterine abnormalities [5].

Regarding congenital uterine anomalies, Assessment of both the external and internal morphology of the uterus is mandatory for a correct diagnosis of their type. This can be achieved by a combined hysteroscopic and laparoscopic evaluation of uterine morphology and contour that, by time, has traditionally been the most widely used method in the differential diagnosis of Mullerian malformations. But the major obstacle of this method is being invasive and time consuming [20].

In present study, 3-DHS proved its accurate and reliable diagnosis and classification of congenital uterine anomalies. It diagnosed all (23) cases of congenital uterine anomalies, detecting (11) septate, (9) bicornate, two didelphys and one subseptate uteri with a patient that had both a polyp and a subseptate uterus.

Also, 3-DHS provided us with a reconstructed view of the internal and external surface of the uterus itself on the coronal plane that gave a clear view of the myometrium and fundal contour enabling us to differentiate between bicornuate and septate uteri by taking full measurements to the septi, to demonstrate their relations to the cavity, presence of myometrium above the septum (in case of bicornuate) or its absence (in case of septate) and its precise thickness.

According to the present study, 3-DHS was found to be a good alternative for combined hysteroscopic and laparoscopic evaluation that was done as a final diagnostic step for classifying uterine anomalies. On this basis, women may be treated with a combined laparoscopic-hysteroscopic approach only when a curative step is clinically indicated and not for diagnostic purposes as previously recommended.

Furthermore, in cases with septate uterus undergoing metroplasty, the width of the septum or the thickness of the free uterine wall above the septum may be measured by volume ultrasound before surgery to make the resectopic procedure safer.

Ghi et al. and Wu et al. have published similar results that agree with those of the present study as regards congenital uterine anomalies.

Ghi et al. (2009) did a prospective study on (284) Nulliparae with three or more consecutive miscarriages in order to assess the accuracy of three-dimensional (3D) ultrasound in the diagnosis of congenital uterine anomalies. All women underwent 3D transvaginal ultrasound study of the uterine cavity. Women with negative ultrasound findings subsequently underwent office hysteroscopy, whereas a combined laparoscopic-hysteroscopic assessment was performed in cases of suspected Mullerian anomaly. They found that a specific Mullerian malformation was sonographically diagnosed in 54 women of the 284 included in the study group. All negative ultrasound findings were confirmed at office hysteroscopy. Among the women with abnormal ultrasound findings, the presence of a Mullerian anomaly was endoscopically confirmed in all. Concordance between ultrasound and endoscopy around the type of anomaly was verified in 52 cases, including all those with septate uterus and two out of three with bicornuate uterus. They concluded that 3-DHS appears to be extremely accurate for the diagnosis and classification of congenital uterine anomalies and may conveniently become the only mandatory step in the assessment of the uterine cavity in patients with a history of recurrent miscarriage [20].

Wu et al. (2007) also reported favorable results suggesting that three dimensional sonography offered 100% specificity for the exclusion of uterine anomalies and was able to differentiate between the different anomalies[21].

In the present study, 3-DHS examination has also been used to visualize accurately intrauterine synechiae and determine their location. Despite of missing one from ten cases, synechiae were shown on both multiplanar and rendering imaging, and were associated with a significant reduction in the endometrial cavity volume.

In fact, there were many studies that were done regarding the efficacy of 3-dimensional hysterosonography as a modern, non-invasive and valuable technique for investigation in the last few years, most of which correspond to our research and verify our results.

In general, examination with 3-DHS is relatively easy and available at any clinic equipped with a 3-D machine. The patient finds the discomfort tolerable, and it can produce high diagnostic accuracy, in particular when assessing the lateral portions of the uterine cavity close to the tubal ostia.

When the setting of 3D-hysterosonography is over and once the volumes are scanned and stored digitally, the images that may be missed easily or visualized incompletely on conventional 2D sonography can be clearly depicted on 3D ultrasound. In 3D ultrasound, three perpendicular planes displayed on the screen can be rotated and adjusted simultaneously into a more suitable anatomic orientation. Optimal display of stored volume data by rotation can also provide more detailed morphology for accurate diagnosis [(21)].

Conclusion

3-DHS has comparable results to the goldstandard hysteroscopy in the diagnosis of intracavitary uterine lesions and it is superior to it as regards the intra and post-operative pain and better visualization of some lesions.

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