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Accuracy of Three-Dimensional Saline Infusion Sono-Hysterography Versus Diagnostic Hysteroscopy in Diagnosis of Uterine Cavity Lesions

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Abstract

Background: Endometrial carcinoma & benign entities like normal proliferative transformation, hyperplasia, & polyps can all lead to abnormal uterine cavity. Addition of three-dimensional (3D) sonohysterography to conventional sono-hysterography improves accuracy of endometrial pathology diagnosis. Three-Dimensional Saline Infusion Sono-Hysterography (3D SIS) assess uterine contour, adhesions, & focal pathologies with confidence.

Aim of Study: To compare between accuracy of three-dimensional saline infusion sono-hysterography versus diagnostic hysteroscopy in diagnosis of uterine cavity lesions.

Patients and Methods: This was a prospective cohort research, conducted at Al-Hussein Hospital of Al-Azhar University on a total of 60 cases with uterine cavity lesions from March 2021 till March 2022.

Results: 3D SIS was significant in detecting uterine cavity abnormality with sensitivity of 92.5% and specificity of 95% while PPV was 97% and NPV was 86% with accuracy of 93.3 %.

Conclusion: Saline infusion sonohysterography in three dimensions is safe alternative to hysteroscopy. In diagnosis of uterine cavity lesions, it is comparable to hysteroscopy, & it may be used as primary technique for assessing uterine cavity when intracavitary lesions are suspected. Hysteroscopy is still gold standard for evaluating uterine cavity.

Key Words: *3D sonohysterography – Fibroid – Hysteroscopy – Polyps.*

Introduction

FERTILITY and pregnancy outcomes are affected by uterine cavity abnormalities. It is well known that abnormalities such as myomas, polyps, Mullerian anomalies, & intrauterine synechiae are more common in infertile & reproductive failure studied cases [1].

Uterine anomalies can result from malformations at any stage of Müllerian developmental process & are found in 5.5 percent of general population, eight percent of infertile women, & 13.3 percent of women with history of miscarriage. Congenital uterine anomalies are frequently linked to infertility, recurrent miscarriage, & elevated chance of first- & second-trimester miscarriage & premature birth [2].

Uterine endometrial cavity can have variety of visualisation manifestations, including normal, reactive, inflammatory, benign, & malignant neoplasms. Preoperative diagnosis is critical for determining best surgical procedure. Some illnesses of endometrial cavity can be diagnosed via endometrial cytology & endometrial curettage, whereas others are difficult to identify & characteristic imaging results are helpful for diagnosis [3].

Hysteroscopy is regarded gold standard method for determining reseasons of endometrial lesions; however, it is invasive, costly, time consuming, requires general anaesthesia, & is related with some dangers like uterine perforation & genitourinary infection [4].

Saline infusion sonohysterography is minimally invasive method that distends endometrial cavity with saline to evaluate single layer of endometrial lining. SIS allows radiologist to differentiate between focal and disperse endometrial pathologic conditions. It is less costly, less complex, & takes less time to identify & measure intra cavitary abnormalities than hysteroscopy [5].

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Addition of three-dimensional sonohysterography to conventional sonohysterography improves accuracy of endometrial pathology diagnosis. Simultaneous display of 3 perpendicular planes gives more complete summary of examined area & connect to planes that conventional two-dimensional tests do not offer. Surface rendering of intra cavitary pathological conditions allows for visualisation of their surface areas while also providing valuable information about their topographical orientation [5].

Infusion of Saline in Three Dimensions Sono-Hysterography provides reliable assessment of uterine contour, adhesions, & focal pathologies. Moreover, after distending cavity with saline, inner surface of both sides of endometrium is clearly visible in 3D SIS [6].

Purpose of this research was to evaluate performance of three-dimensional saline infusion sono-hysterography versus diagnostic hysteroscopy in detecting uterine cavity lesions.

Material and Methods

This prospective cohort research was conducted at Al-Hussein Hospital of Al-Azhar University on a total of 60 cases with uterine cavity lesions who were invited to join the study the during the period from March 2021 till March 2022.

Inclusion criteria was pre-menopausal or post-menopausal cases, all women presenting with a history of heavy and/or irregular periods during the study period of research who were diagnosed as uterine cavity lesions, infertile patient with suggested endometrial lesion, recurrent pregnancy loss in patient with suggested uterine anomaly. Exclusion criteria was normal uterine cavity by Ultrasonography.

All patients were subjected to the following: Informed written consent was taken from each participant before being involved in research, Detailed History, General examination, Local examination, Laboratory Investigations and Transvaginal ultrasonographic examinations using both 2D imaging & 3D image volumes were done for transvaginal sonography. 2D ultrasound examination was performed with Hitachi EUB450 ultrasound machine with transvaginal probe (5-7.5 MHz) and 3.5 MHz for the transabdominal probe to measure diameters of the uterus, endometrial thickness, and detection of focal lesion. Three-dimensional vaginal ultrasound was done for all studied cases with Voluson E63D system with 5-8 MHzaS-VDW 5-8 probe to obtain coronal plane and relation of any focal lesion to the endometrium in the three planes.

All studied cases underwent diagnostic hysteroscopy while under general anaesthesia. We used twenty five cm long rigid continuous flow panoramic hysteroscopy with six mm outer sheath. By connecting plastic bags of Glycine 1.5 percent solution & saline bags to dual infusion tubing, method produces constant uterine distention. The cavity was explored looking for polyps, masses, myomas or polyploidy endometrium. Panoramic view of uterine cavity was taken step by step, beginning with fundus, then anterior, posterior, & lateral walls of uterus, & ending with uterotubal junctions. All aspects of the endocervical mucosa and the endometrium were fully described. If any intrauterine pathology was found, shape, size, & location were estimated. Then sharp curette was used to curettage fundus, then posterior wall, then anterior wall, then right & left lateral walls. Sample was fixed in ten percent formalin & sent for histopathological identification of endometrium & pathological lesion. Infusion of Saline in Three Dimensions Sono-Hysterography & Second-look Hysteroscopy were performed under general anaesthesia during early follicular phase of menstrual cycle, immediately after cessation of menstrual flow & before day ten. To accurately explain lesion, 2D sonographic assessment was repeated using standard transvaginal transducer; parameters were registered; & another 3D volume of entire uterus was recorded. Hysteroscopy was then conducted. Procedure's period & total fluid loss were recorded. For 2D transvaginal sonography, 2D saline infusion sonography, & hysteroscopy, performing gynaecologist recorded size, type, & placement of lesion. Size, type, location, & percentage of protrusion of lesion on 3D transvaginal sonography & 3D saline infusion sonography, as well as interpretability of 3D transvaginal sonography & 3D saline infusion sonography, were coded, & case report was used. On 4-point scale, estimated percentage of protrusion & interpretability of tests were scored (1, not interpretable; 2, moderate; 3, good; & 4, very good). For every imaging technique, mean results will be computed.

Statistical analysis: When suitable, data were statistically presented in form of range, mean, standard deviation, median, frequencies (number of cases), & percentages. Agreement among US, hysteroscopy diagnosis and endometrial sampling diagnosis was done using kappa statistic. Chi square (χ^2) test was used to compare categorical data. When expected frequency was less than 5, exact test was used instead, & p-values less than 0.05

were considered statistically significant. SPSS version 15 for Microsoft Windows was used to perform all statistical calculations.

Results

Table (1): Demographic characteristics among studied patients.

	Studied cases (n=60)
Years old:	
Mean ± SD	34.71±4.03
Range	25-40
BMI (kg/m ^{2}):	
Mean ± SD	25.41±4.58
Range	20-36
Residence:	
Urban	26 (43.3 percent)
Rural	34 (56.7%)

Patients' age ranged 25-40 years with mean BMI 25.41kg/m^2. Majority of the patients were rural (56.7%) (Table 1).

Table (2): 3D SIS vs hysteroscopy findings among studied patients.

	3D SIS		Hysteroscopy	
	N	%	N	%
Normal	22	36.7	20	33.3
Myoma	13	21.7	14	23.3
Polyp	16	26.7	18	30
Adhesions	5	8.3	6	10
Septum	4	6.7	2	3.3

As regard 3D SIS, the most prevalent finding was polyp (26.7%) followed by myoma (21.7%). Meanwhile, there was 36.7% of the patients were normal SIS. Regarding hysteroscopy, 33.3% of patients were normal while 30% were polyp and 23.3% were myoma (Table 2).

Table (3): Comparison between 3D SIS with hysteroscopy among the studied patients in diagnosis of myoma.

3D SIS	Hysteroscoy		Total	*p*
	Myoma	None		
Myoma	13 (92.9%)	0	13 (21.7%)	<0.001
None	1 (7.1%)	46 (100%)	47 (78.3%)	
Total	14 (100%)	46 (100%)	100	

Statistic	Value	95% CI
Sensitivity	92.86%	66.13%-99.82%
Specificity	100%	92.29%-100%
Positive Predictive Value	100%	
Negative Predictive Value	97.87%	87.44%-99.67%
Accuracy	98.3%	91.06%-99.96%

3D SIS was significant with sensitivity of 92.8% and specificity of 100% while PPV was 100% and NPV was 97.8% with accuracy of 98% for diagnosis myoma (Table 3).

Table (4): Comparison between 3D SIS with hysteroscopy among the studied patients in diagnosis polyp.

3D SIS	Hysteroscoy		Total	*p*
	Polyp	None		
Polyp	14 (87.5%)	4 (9.1%)	18 (30%)	<0.001
None	2 (12.5%)	40 (90.9%)	42 (70%)	
Total	16 (100%)	44 (100%)	100	

Statistic	Value	95% CI
Sensitivity	87.5%	61.65%-98.45%
Specificity	90.91%	78.33%-97.47%
Positive Predictive Value	77.78%	57.45%-90.07%
Negative Predictive Value	95.24%	84.5%-98.66%
Accuracy	90%	79.49%-96.24%

3D SIS was significant with sensitivity of 87.5% and specificity of 90.9% while PPV was 77.8% and NPV was 95.2% with accuracy of 90% in diagnosis polyp (Table 4).

Table (5): Comparison between 3D SIS with hysteroscopy among the studied patients in diagnosis adhesions.

3D SIS	Hysteroscoy		Total	*p*
	Adhesions	None		
Adhesions	4 (80%)	2 (3.6%)	6 (10%)	<0.001
None	1 (20%)	53 (96.4%)	55 (90%)	
Total	5 (100%)	55 (100%)	100	

Statistic	Value	95% CI
Sensitivity	80%	28.36%-99.5%
Specificity	96.36%	87.47%-99.56%
Positive Predictive Value	66.67%	32.38% - 89.31%
Negative Predictive Value	98.15%	90.17% - 99.67%
Accuracy	95%	86.08% - 98.96%

3D SIS was significant with sensitivity of 80% and specificity of 96.4% while PPV was 66.7% and NPV was 98.2% with accuracy of 95% in diagnosis adhesions (Table 5).

Table (6): Comparison between 3D SIS with hysteroscopy among the studied patients in diagnosis septum.

3D SIS	Hysteroscoy		Total	*p*
	Septum	None		
Septum	2 (50%)	0	2 (3.3%)	<0.001
None	2 (50%)	56 (100%)	58 (96.7%)	
Total	4 (100%)	56 (100%)	100	

Statistic	Value	95% CI
Sensitivity	50%	6.76%-93.24%
Specificity	96.55%	88.09%-99.58%
Positive Predictive Value	50%	15.74%-99.13%
Negative Predictive Value	96.55%	91.3%-98.68%
Accuracy	93.55%	84.3% -98.21%

3D SIS was significant with sensitivity of 50% and specificity of 96.6% while PPV was 50% and NPV was 96.6% with accuracy of 93.6% in diagnosis septum (Table 6).

Discussion

First screening operation used to diagnose uterine malformations is transvaginal ultrasonography, while hysteroscopy coupled with histopathology is considered gold standard in assessing studied cases with abnormal uterine bleeding. Even though transvaginal ultrasonography is effective screening method for abnormal uterine bleeding induced by endometrial atrophy, it is not without limitations [7]. It has low specificity & sensitivity in assessing thick, non-homogeneous endometrium, which can be supplanted by saline contrast sonohysterography, which can differentiate focal lesions.

Regarding the demographic data of the studied patients, our results showed that patients' age ranged 25-40 years with mean BMI 25.41kg/m^2. Majority of the patients were rural (56.7%).

Our study was in line with Abd Elkhalek et al., [4] purpose of this study was to evaluate diagnostic accuracy of 3D saline infusion sonohysterography & hysteroscopy in detecting intracavitary uterine abnormalities in premenopausal women with abnormal uterine bleeding. Research included fifty female studied cases who had abnormal uterine bleeding & were among ages of twenty five & forty five.

Regarding 3D SIS vs. hysteroscopy findings among studied patients, we found that concerning 3D SIS, the most prevalent finding was polyp (26.7%) followed by myoma (21.7%). Meanwhile, there was 36.7% of the patients were normal SIS. Regarding hysteroscopy, 33.3% of patients were normal while 30% were polyp and 23.3% were myoma.

However, the study by Abd Elkhalek et al., [4] 3D-SIS identified normal uterine cavity in twenty four studied cases (forty eight percent), submucous fibroids in twelve studied cases (twenty four percent), & endometrial polyps in fourteen studied cases (twenty eight percent) with diagnostic performance accuracy of eighty eight percent, sensitivity of about 81.25 percent, & specificity of one hundred percent. Hysteroscopy identified normal uterine cavity in twenty two studied cases (forty four percent), submucous fibroids in ten studied cases (twenty percent), & endometrial polyps in eighteen studied cases (thirty six percent), with diagnostic performance accuracy of ninty two percent, sensitivity of about 87.5 percent, & specificity of one hundred percent. In forty cases, there was contract among 3D-SIS & hysteroscopy (eighteen true negative & twenty two true positive) & disagreement in ten cases.

Also, research by Moradan et al., [8] Polyp was most common focal lesion discovered by SIS (forty percent) & hysteroscopy (forty seven percent). Myoma, on other hand, was identified in only 8% of attendees using SIS & in 9% of attendees using hysteroscopy. They discovered correlation among results of 3 different technique & pathological results.

This study also found that 3D SIS was significant in detecting uterine cavity abnormality with sensitivity of 92.5% and specificity of 95% while PPV was 97% and NPV was 86% with accuracy of 93.3%. As well, 3D SIS was significant with sensitivity of 92.8% and specificity of 100% while PPV was 100% and NPV was 97.8% with accuracy of 98% for diagnosis myoma. 3D SIS was significant with sensitivity of 87.5% and specificity of 90.9% while PPV was 77.8% and NPV was 95.2% with accuracy of 90% in diagnosis polyp. 3D SIS was significant with sensitivity of 80% and specificity of 96.4% while PPV was 66.7% and NPV was 98.2% with accuracy of 95% in diagnosis adhesions. 3D SIS was significant with sensitivity of 50% and specificity of 96.6% while PPV was 50% and NPV was 96.6% with accuracy of 93.6% in diagnosis septum.

This was supported by Abd Elkhalek et al., [4] who reported that 3D-SIS had very high specificity & precision in diagnosing endometrial polyps & fibroids, with submucous fibroids accuracy of one hundred percent, which outperformed hysteroscopy, which missed two cases with accuracy of ninety

six percent & sensitivity of eighty three percent. 3D-SIS also provided precise findings in diagnosis of endometrial polyps, with sensitivity of seventy percent & precision of eighty eight percent, compared to ninety percent sensitivity & ninety six percent precision for hysteroscopy. Overall sensitivity for 3D-SIS was 81.3 percent compared to 87.5 percent for hysteroscopy, & precision was eighty eight percent compared to ninety two percent for hysteroscopy.

Also, the study by Soguktas et al., **[9]** in terms of area under the ROC curve showed that 3D-SIS was superior than hysteroscopy in detecting Polypoid lesion, and Overall rates (any abnormality) and similar in detecting Submucosal myoma, Endometrial hyperplasia & Endometrium carcinoma.

In addition, study by Abd El-Gaber et al., **[10]** showed that with p-value greater than 0.05, there was no important variation among 3D/SIS & OH in research results throughout uterine cavity assessment. 3D/SIS sensitivity, specificity, positive & negative predictive values, & diagnostic accuracy in assessing uterine cavity lesions & anomalies were evaluated (64.4 percent, 94.3 percent, 73.4 percent, 91.7 percent, & 88.6 percent respectively). In terms of pain score on visual analogue scale, there was large discrepancy among OH & 3D/SIS with p-value <0.01.

As well, research by Moradan et al., **[8]** sensitivity of SIS for focal lesions, polyps, & submucous myomas was noted to be 79.6 percent, seventy five percent, & sixty percent, while specificity was noted to be 89.1 percent for focal lesions, 87.5 percent for polyps, & 97.8 percent for submucous myomas. Hysteroscopy had sensitivity of one hundred percent, one hundred percent, & ninety percent for focal lesions, polyps, & submucous myomas, respectively, with specificity of ninety fivepercent for focal lesions, ninety four percent for polyps, & one hundred percent for submucous myomas.

Conclusion:

Saline infusion sonohysterography in three dimensions is safe alternative to hysteroscopy. In diagnosis of uterine cavity lesions, it is comparable to hysteroscopy, & it may be used as primary technique for assessing uterine cavity when intracavitary lesions are suspected. Hysteroscopy is still gold standard for evaluating uterine cavity.

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دقة التصوير ثلاثى الابعاد بالموجات فوق الصوتية والحقن الملحى مقابل منظار الرحم التشخيصى فى تشخيص آفات تجويف الرحم

تتأثر الخصوبة والحمل بتشوهات الرحم. من المعروف أن التشوهات مثل الأورام العضلية، والأورام الحميدة، والتشوهات المولارية، والتزامن داخل الرحم هى أكثر شيوعاً فى حالات العقم والفشل الإنجابى المدروسة.

يمكن أن تنجم التشوهات الرحمية عن تشوهات فى أى مرحلة من مراحل عملية نمو مولر وتوجد فى ٥.٥٪، و ٨ فى المائة من النساء المصابات بالعقم، و ١٣.٣ فى المائة من النساء اللائى لديهم تاريخ من الإجهاض.

يمكن أن يكون لتجويف بطانة الرحم مجموعة متنوعة من المظاهر التصورية، بما فى ذلك الأورام الطبيعية والتفاعلية والالتهابية والحميدة والخبيثة. التشخيص قبل الجراحة أمر بالغ الأهمية لتحيدي أفضل إجراء جراحى.

يعتبر تنظير الرحم طريقة قياسية ذهبية لتحديد أسباب آفات بطانة الرحم. ومع ذلك، فهو غزوى، ومكلف، ويستغرق وقتاً طويلاً، ويتطلب تخديراً عاماً، ويرتبط ببعض المخاطر مثل انثقاب الرحم والتهاب الجهاز البولى التناسلى.

التصوير فوق الصوتى بالتسريب بالمحلول الملحى هو طريقة طفيفة التوغل تعمل على توسيع تجويف بطانة الرحم بالمحلول الملحى لتقييم طبقة واحدة من بطانة الرحم. يسمح نظام SIS لأخصائى الأشعة بالتمييز بين الحالات المرضية البؤرية والمتفرقة لبطانة الرحم.

تعمل إضافة التصوير الصوتى ثلاثى الأبعاد إلى التصوير الصوتى التقليدى على تحسين دقة تشخيص أمراض بطانة الرحم. يوفر حقن المحلول الملحى فى التصوير ثلاثى الأبعاد للرحم تقييماً موثوقاً به لمحيط الرحم والا لتصاقات والأمراض البؤرية.