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Comparative study between two dimensional Transvaginal Ultrasound (2D TVUS) and hysteroscopy in assessment of Cesarean Section (CS) scar defects: A diagnostic test accuracy study

Mohamed A. Daoud[1], Manal A. Mohamed[2]*, Alaa Eldin H. Elfeky[1], Aliaa Maaty[1],Alaa M. Atef[1]
[1]Department of Obstetrics and Gynecology, Faculty of Medicine, Ain Shams University, Cairo, Egypt
[2]Department of Obstetrics and Gynecology, Osim Central Hospital, Giza, Egypt

SUMMARY

AUTHORS' CONTRIBUTION: (A) Study Design · **(B)** Data Collection . **(C)** Statistical Analysis · **(D)** Data Interpretation · **(E)** Manuscript Preparation · **(F)** Literature Search · **(G)** No Fund Collection

Background: One of the most frequently used surgical techniques in obstetric practise is the caesarean section. Studying the effects of this surgery on potential future fertility has become more crucial. To prevent its dehiscence or rupture during pregnancy or childbirth, CS scar integrity assessment requires special examinations.

Objective: Comparing the effectiveness of ultrasonography and hysteroscopy in identifying the location of the Cesarean section scar in females who are not pregnant as well as determining and commenting on the thickness, continuity, and ballooning of the scar.

Methods: During this study, 41 women with any indication of hysteroscopy were enrolled. Those who accepted the invitation were booked for an ultrasound examination for assessment of cesarean scar defect after hysteroscopic procedure.

Results: TVUS detected 13 (31.7%) out of 41 women having CSD, on the other hand, 16 women (39%) were diagnosed using hysteroscopy. There is a statistically significant correlation between the use of TVUS and hysteroscopy in determination of occurrence of scar defect after previous Cesarean sections. TVUS had sensitivity 68.8%, specificity 92%, positive predictive value 84.6% and negative predictive value 82.1% and accuracy 82.9%.

Conclusion: Although diagnostic hysteroscopy is still more accurate than ultrasound for assessing caesarean scar thickness and spotting scar defects.

Keywords: Transvaginal ultrasound; Hysteroscopy; Cesarean section scar

Address for correspondence:

Dr. Manal Abd El Atty Mohamed,
Department of Obstetrics and Gynecology, Osim Central Hospital, Giza, Egypt, E-mail: manalqadri4@gmail.com

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INTRODUCTION

Cesarean sections are being performed much more frequently than before. Egypt stands up with a rate of 52 percent, trailing only the Dominican Republic (56.4%) and Brazil as the countries with the highest CS delivery rates globally (55.6 percent). Compared to other Arab countries in the region, Egypt has significantly higher rates of CS [1].

Complications including scar pregnancy with potentially fatal haemorrhage, placenta previa, placenta accreta, increta, or percreta, dehiscence, or uterine rupture are more likely to occur after a caesarean section [2].

The Caesarean Scar Defect (isthmocele) (CSD) is a well-known issue following a caesarean delivery. It has become more common as the number of caesarean deliveries has climbed [3].

A caesarean scar defect is the development of a pouch at the location of an old caesarean incision at the anterior lower uterine section, uterine isthmus, or in the upper portion of the cervical canal (isthmocele) [4].

Many gynaecological and obstetric conditions, such as uterine rupture, pregnancies with caesarean scars, and bleeding disorders have been connected to isthmocele [5].

There are numerous imaging methods, including 2D Transvaginal Ultrasound (TVUS), to find the CSD, however there is no agreement on which is the best. Furthermore, there are no established diagnostic standards. Moreover, numerous techniques, such as hysterography, sonohysterography, hysteroscopy, and magnetic resonance imaging, have been proposed [6].

2D TVUS is a fundamental and widely used imaging technology. It is unknown whether large abnormalities carry a higher risk of complications than minor abnormalities, or whether irregularities in Cesarean scars detected during transvaginal ultrasound examination of non-pregnant women carry a higher risk of these complications than scars that seem to be in tact [7].

It has been studied how ultrasound can help non-pregnant ladies see and identify CS scar abnormalities. It was discovered that the 2D transvaginal ultrasonography was a reliable way to gauge scar thickness. Moreover, coloured

Doppler was discovered to be helpful in determining the scar's vascularity [8].

Diagnostic hysteroscopy, which was long regarded as the "gold standard" for the diagnosis of intrauterine abnormalities, has been shown to be a sensitive tool for the direct viewing of uterine scar and intrauterine adhesions [9].

METHODS

From August 2022 to February 2023, the Obstetrics and Gynecology Department, School of Medicine, Ain Shams University Maternity Hospitals, conducted this prospective diagnostic test accuracy controlled clinical experiment.

41 women who had any indication of hysteroscopy were included in the trial. After the hysteroscopic operation, those who accepted the offer were scheduled for an ultrasound test to assess any defects in the caesarean scar.

Inclusion criteria

Women between the ages of 18 and 55 who were delivered by one or more straightforward elective lower segment caesarean sections, did not have any co-existing medical conditions, had any indications of hysteroscopy, such as abnormal uterine bleeding, postcoital bleeding despite a normal cervical smear, a history suggestive of fibroids, polyps, or enometrial pathology, persistent intermenstrual or irregular bleeding, infrequent or heavy bleeding in obese, PCOS

Exclusion criteria

Women with uterine contraindications, such as pelvic infection, pregnancy, cervical cancer, heavy menstrual bleeding, advanced cardiac or pulmonary disorders, women without prior sections, women who have had uterine surgery in the past, women who have an Intrauterine Device (IUD), and women who are breastfeeding are not candidates for hysteroscopy.

Ethical considerations

Patient information and informed consent

The patient gave her consent before being enrolled in the study after having the nature, scope, and potential outcomes of the clinical trial explained to her in a manner she could understand.

Confidentiality

When the patient's name appeared on any other document, the investigators retained it in a secure location and only noted the patient's initials in the case report. To facilitate record identification, the investigators kept a personal patient identification list (patient initials with the associated patient names).

Protocol approval

Prior to the start of the study and any compliance with regional laws, the protocol and all related paperwork were authorised for ethical and research purposes by the OB/GYN department council at Ain Shams University.

Concerning safety and efficacy

There is no proof that TVUS has any negative impacts. Hysteroscopy side effects include anaesthesia problems or uterine perforations are rare.

Study procedures

Women were included in the study when the study's inclusion and exclusion criteria were approved.

Following hysteroscopy, the women who accepted the study's invitation were due for an ultrasound to assess the caesarean scar defect.

A complete history was taken prior to the evaluation in accordance with a recognised study methodology (parity, medication, contraceptives, day of menstrual cycle, earlier deliveries and gynaecological operations).

To rule out pelvic infection and cervical pathology, a gynaecological exam was performed, and the results will be recorded on a paper form.

The Ultrasound Special Care Unit for the Fetus and Endoscopy Unit of Maternity Hospital, Ain Shams University, utilised the same skilled personnel for all ultrasound tests and hysteroscopies.

2D transvaginal ultrasound examination

The woman was placed in the lithotomy position for the transvaginal exam, and her bladder was empty.

The uterus was inspected for problems in the scar from the caesarean surgery.

Despite the fact that representative ultrasound images of longitudinal and transverse uterine sections were also kept by the researcher, the ultrasound images were only seen during the ultrasound examination.

Any noticeable flaw or divot in the scar, no matter how slight, was labelled as a flaw.

The ultrasound examiner divided ultrasound images of scars into complete scars and scars with defects.

Following the ultrasound examination, measurements were made and archived ultrasound images were inspected.

The internal cervical os was found to be located at the point where the uterus constricts between the corpus and the cervix near the lower edge of the bladder.

A longitudinal cut through the uterus was used to quantify the length and height of a scar defect, the thickness of the residual myometrium covering the defect, and the thickness of the myometrium adjacent to and fundal to the defect to assess its size (width of the defect).

A Samsung Medison 04 ultrasound equipment with a 2.8-10-MHz transvaginal transducer was used for all ultrasound exams.

Hysteroscopic examination

One skilled surgeon who was unaware of the ultrasound results performed diagnostic hysteroscopies on all of the patients.

To illuminate the uterine cavity, a fiberoptic cable and a cold light source with high intensity were used.

The uterine cavity was dilated with normal saline at a 100 mmHg maximum pressure.

The uterine cavity and CS scar underwent rigorous evaluation in great detail.

The hysteroscopic evaluation was based on the scar's kind (thin or thick), location, and extent as well as its thickness, continuity, and vasculature. It also considered whether the scar was healthy (pinkish) or unhealthy (fibrosed), had a defect.

STATISTICAL ANALYSIS

The recorded data were evaluated using statistical software for social sciences, version 20.0. (SPSS Inc., Chicago, Illinois, USA). Data in quantitative form were expressed using the mean and standard deviation (SD). The qualitative data were expressed using frequency and percentage.

RESULTS

The study was conducted on a wide age group ranging from 21 to 54 years, (mean age of 36.56 ± 7.88 years), Gravidity ranged 1 to 8 with Median (IQR) 3 (2-4), while ranged parity 1 to 5 and Median (IQR) 3 (2-3), also ranged of abortion 0 to 6 with Median (IQR) 0 (0-1), as for the ranged of living GPAL was 1 to 5 with Median (IQR) 3 (2-3) and range of gynecological surgical history of CS 1 to 4 with Median (IQR) 2 (1-3) (**Tab. 1.**). **Tab. 2.** shows that the 13 women (31.7%) were CSD, while 28 women (68.3%) were no CSD among TVUS. **Tab. 3.** shows that the 16 women (39.0%) were CSD, while 25 women (61.0%) were no CSD among Hysteroscopies

As regard the cesarean scar defect of previous sections, there is a statistically significant correlation between the use of TVUS and hysteroscopy in determination occur or not occur of scar of previous Cesarean sections with (kappa agreement "κ =0.629" & p-value "p<0.001") (**Tab. 4.**). **Tab. 5.** shows statistically significant diagnostic performance of TVUS for detection of cesarean scar defect, it was sensitivity 68.8%, specificity 92%, positive predictive value 84.6% and negative predictive value 82.1% and accuracy 82.9%, with p-value (p<0.001).

As regard the site of scar of previous sections, there is a statistically significant correlation between the use of TVUS and hysteroscopy in determination site of scar of previous cesarean sections with (kappa agreement "κ=0.629" & p-value "p<0.001") (**Tab. 6.**). As regard the CSD continuity, there is a statistically significant correlation between the use of TVUS and hysteroscopy in determination CSD continuity with (kappa agreement "κ=0.593" & p-value "p<0.05") (**Tab. 7.**).

DISCUSSION

Contrary to our findings, El-Ewiny, et al. asserted that ultrasound is more accurate than hysteroscopy for assessing scar thickness and detecting scar flaws. They evaluated the scar's thickness, vascularity, continuity, and ballooning as well as the efficacy of hysteroscopy and ultrasonography in identifying the location of the Cesarean section scar in females who were not pregnant [8].

The findings of our investigation concur with those made by Osser, et al. They came to the conclusion that patients who had previously undergone caesarean sections had a considerable decrease in myometrial thickness in the isthmus uteri [10].

Tab. 1. Baseline characteristics distribution among study group.

Baseline characteristics	Total (n=41)
Age (years)	
Range	21-54
Mean ± SD	36.56 ± 7.88
Gravidity	
Range	1-8
Median (IQR)	3 (2-4)
Parity	
Range	1-5
Median (IQR)	3 (2-3)
Abortion	
Range	0-6
Median (IQR)	0 (0-1)
Living (GPAL)	
Range	1-5
Median (IQR)	3 (2-3)
Gynecological surgical history of CS	
Range	1-4
Median (IQR)	2 (1-3)

Tab. 2. TVUS distribution among study group.

TVUS	Total (n=41)
Presence of CSD	
No	28 (68.3%)
Yes	13 (31.7%)
Outcome of CSD	**N=13**
CSD number	
1	13 (100.0%)
CSD shape	
Oval	8 (61.5%)
Round	2 (15.4%)
Triangular	4 (30.8%)
CSD size (Height mm)	
Range	1.5-32
Mean ± SD	8.07 ± 6.45
CSD size (Width mm)	
Range	2.0-12
Mean ± SD	4.87 ± 3.36
CSD location	
Above IO	13 (100.0%)
CSD thickness (cm)	
Range	0.4-5.5
Mean ± SD	1.90 ± 1.80
Ratio between myometrium over CSD and normal myometrium	
Range	5.7-55.56
Mean ± SD	33.99 ± 14.67
CSD continuity	
Yes	13 (100.0%)
CSD ballooning	
No	13 (100.0%)

Tab. 3. Hysteroscopy distribution among study group.

Hysteroscopy	Total (n=41)
Presence of CSD	
Yes	12 (29.3%)
Small Irrelevant	4 (9.8%)
Not seen	1 (2.4%)
No	24 (58.5%)
Outcome of CSD	**N=16**
CSD number	
1	16 (100.0%)
CSD location	
Above IO	5 (31.3%)
Just Above IO	11 (68.8%)
Scar vasculature	
No	15 (93.8%)
Yes	1 (6.3%)
Healthy or fibrosed scar	
Fibrosed	2 (12.5%)
Healthy	14 (87.5%)
CSD thickness	
Not detected	16 (100.0%)
CSD continuity	
Fibroid is present	1 (6.3%)
Gapped	1 (6.3%)
Yes	14 (87.5%)
CSD ballooning	
No	16 (100.0%)

43% of the patients Armstrong, et al. identified as having scar problems [11].

Others discovered scar problems in 42% of their patients Valenzano, et al., 19% of them Ofili-Yebovi, et al., and 69% of them Osser, et al. [10,12,13].

In the context of the site of the scar, our study found a statistically significant connection between the use of 2D TVUS and hysteroscopy (kappa agreement "κ=0.629" & p-value "p<0.001") in locating the scar from prior caesarean sections.

Tab. 4. Agreement between TVUS and hysteroscopy as regard cesarean scar defect.

TVUS	Hysteroscopy					
	Yes		No		Total	
	No.	%	No.	%	No.	%
Yes	11	68.8%	2	8.0%	13	31.7%
No	5	31.3%	23	92.0%	28	68.3%
Total	16	100.0%	25	100.0%	41	100.0%

Tab. 5. Validity of TVUS and Hysteroscopy for detection of cesarean scar defect.

Variables		Hysteroscopy	
		Yes	No
TVUS	Yes	11	2
	No	5	23
Sensitivity		68.8%	
Specificity		92.0%	
PPV		84.6%	
NPV		82.1%	
Accuracy		82.9%	
p-value		<0.001**	

Tab. 6. Agreement between TVUS and hysteroscopy as regard site scar.

TVUS	Hysteroscopy					
	Above IO		Not found		Total	
	No.	%	No.	%	No.	%
Above IO	11	68.8%	2	8.0%	13	31.7%
Not found	5	31.3%	23	92.0%	28	68.3%
Total	16	100.0%	25	100.0%	41	100.0%

Tab. 7. Comparison between TVUS and hysteroscopy as regard CSD continuity.

CSD continuity	TVUS		Hysteroscopy	
	No.	%	No.	%
Yes	13	100.0%	14	87.5%
Fibroid is present	0	0.0%	1	6.3%
Gapped	0	0.0%	1	6.3%
Total	13	100.0%	25	100.0%

Similar to this, El-Ewiny, et al. demonstrated a statistically significant association between hysteroscopy and ultrasonography in determining the location of the CS scar [8].

Also, our study found that hysteroscopy cannot comment on scar thickness. However, 2D TVUS can measure it in all patients of the study which makes the 2D TVUS more superior than the hysteroscopy regarding detection of scar thickness.

According to Elwiny, et al. (2019), who concurred with our findings, the only way to quantify the scar thickness was by hysteroscopy [8].

Both 2D TVUS and hysteroscopy have not documented any cases of the scar ballooning in our investigation.

However, according to research by El-Ewiny, et al., there is no statistically significant difference between hysteroscopy and ultrasound for determining the ballooning of past Cesarean scars. Six cases of scar ballooning were documented by ultrasonography alone, whereas twelve cases were documented by hysteroscopy alone. Using hysteroscopy and ultrasonography, scar ballooning was only found in 2 cases [8].

In our study, we showed that only one case out of 16 has increased scar vascularity during hysteroscopic examination but we failed to compare results with cases examined by 2DTVUS because Doppler was not included in our study.

On the other hand, El-Ewiny, et al. asserted that there is a statistically significant correlation between the application of ultrasound and hysteroscopy in assessing the vascularity of scars from prior caesarean sections. Ultrasound analysis of 50 cases revealed that 26 had increased scar vascularity. Despite the fact that only 24 out of 50 hysteroscopies showed increased vascularity [8].

Regarding the continuity of the scar; our study revealed that all cases diagnosed by 2D TVUS as CSD have CSD continuity, but by hysteroscopy there were 14 cases with continuous CSD, 1 case with gapped CSD and one case with present fibroid which make us unable to comment on continuity of the CSD. The use of 2DTVUS and hysteroscopy in determining CSD continuity therefore exhibits a statistically significant connection (kappa agreement "κ=0.593" & p-value "p<0.05").

According to El-Ewiny, et al., it is clear from all previous studies on this issue that postoperative scar thickness and ultrasound-measured scar thickness (regardless of the timing and location of sonography) are significantly correlated [8].

CONCLUSION

Although diagnostic hysteroscopy is still more reliable, two-dimensional transvaginal ultrasound is an accurate method for determining the thickness of caesarean scars and identifying scar defects. 82.9% accuracy, 68.8%

sensitivity, 92% specificity, 84.6% positive predictive value, and 82.1% negative predictive value were all achieved using 2D TVUS. The use of 2D TVUS and hysteroscopy in determining the incidence of scar defect following prior caesarean sections is statistically correlated.

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ETHICAL ENDORSEMENT

The Institutional Ethics Committee gave their approval to the project.

CONFLICT OF INTEREST

No conflict of interest has been reported.

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