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Post Cesarean Section Scar Niche, Prevalence and Impact on Patient's Life Style

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CASE SERIES

Postcesarean Section Scar Niche: Prevalence and Effect on Patient's Lifestyle

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Abstract

Background: **The dramatic increase in cesarean section (CS) delivery will essentially increase incidence of cesarean scar defect rate, which has a deleterious effect on mother's health as cesarean scar ectopic pregnancy, placenta previa and morbidly adherent placenta, scar dehiscence, postmenstrual spotting, intermenstrual bleeding, dysmenorrheal, dyspareunia, and secondary infertility.**

Aim and objectives: **This study's objectives were to determine the incidence of postcesarean scar niche as determined by transvaginal sonography (TVS) and saline infusion sonohysterography (SHG) and to reveal its effect on patient's lifestyle.**

Patients and methods: **This research was cross-sectional in nature. All patients were thoroughly apprised of the description of the research, and their verbal informed permission was obtained. The research received approval of the ethics committee. Patients who visited the Department of Obstetrics and Gynecology's outpatient clinics at Al-Azhar University Hospitals and Zagazig University Hospitals were the participants of the research. The study was performed from December 2019 to December 2021.**

Results: **The incidence of CS niche detected by TVS was 37.7% (75/199 patients), whereas SHG detected 77.9% (155/199 patients). CS niche parameters such as length, depth, and width were significantly high as measured by SHG compared with TVS and significantly low in residual myometrial tissue as measured by SHG compared with TVS. Postmenstrual spotting, dysmenorrhea, heavy menstrual bleeding, and chronic pelvic pain were significantly high in patients with CS niche.**

Conclusion: **SHG is more accurate in diagnosis and characterization of cesarean scar defect. Postmenstrual spotting, dysmenorrhea, heavy menstrual bleeding, and chronic pelvic pain were significantly high in patients with CS niche.**

Keywords: Cesarean scar defect, Cesarean section, Residual myometrial thickness, Sonohysterography, Transvaginal ultrasound

1. Introduction

In most nations, the proportion of births through cesarean section (CS) has drastically grown. According to the Ministry of Health of Egypt, 2014, the incidence of CS in Egypt increased from 4.6% in 1991 to 7% in 1995 to 28% in 2008 and became 51.8% in 2014, where 59.5% of them were primigravida.[1]

One of the major complications of CS is post-CS scar niche or defect [cesarean scar defect (CSD)]. Some consider CSD as just indentation of myometrium, others consider it as a defect of 1 mm,[2] and others consider it as defect or a discontinuation of the myometrium 2 mm at least of the lower uterine segment at the site of a previous CS scar.[3]

This condition's potential causes include surgery or patient-related factors. Surgery-related variables include the partial closure of uterus (decidual sparing) and insufficient hemostasis, as well as the suture method employed in CS and the low cervical

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incision. Infection may be linked to patient-related variables.[4]

A CSD or niche might be asymptomatic or linked to a variety of obstetrical and gynecological issues.[4]

The dramatic increase in CS delivery will essentially increase the incidence of CSD rate that necessities the research of proper and accurate method for diagnosis of the defect and evaluate its effect on women lifestyle.

The aim of the study was to estimate the incidence of postcesarean scar niche as determined by transvaginal ultrasonography (TVS) and saline infusion sonohysterography (SHG) and to reveal its effect on patient's lifestyle.

2. Patients and methods

This research was cross-sectional in nature. All patients had a thorough description of the research given to them, and their verbal informed permission was obtained. The research received ethics committee approval. Patients who visited the Department of Obstetrics and Gynecology's outpatient clinics at Al-Azhar University Hospitals and Zagazig University Hospitals were the patients of the research. The study was performed from December 2019 to December 2021.

2.1. Sample size

Assuming that total number of women who fulfilled inclusion criteria attended outpatient clinic in 12 months were 5400, the prevalence of post-CS niche was 84%, at design effect of one and confidence level of 95%, so the sample size was 199 women, as calculated by OpenEpi.[5]

2.2. Inclusion criteria

The following were the inclusion criteria: all women enrolled in the study had a history of at least one transverse lower segment CS delivery, with the last one at least 6 months before from inclusion in this study, and age ranged from 20 to 35 years old.

2.3. Exclusion criteria

The following were the exclusion criteria: history of post-CS complication (hemorrhage, pyrexia, and wound infection); pregnancy, congenital, or acquired anatomic uterine anomalies; previous hysterotomy (CS before 28 weeks of pregnancy); history of placenta previa and/or morbidly adherent placenta; previous upper segment incision and/or vertical uterine incision; patients with medical or hematological disorders that may cause vaginal bleeding; and patients with obvious gynecological disorders that can cause intermenstrual bleeding and/or pain such as submucosal fibroids and adenomyosis.

2.4. Operational design

Women included in the study were subjected to the following.

2.4.1. History

Complete history was taken (personal history, medical history, surgical, menstrual history, and obstetric history). If amenorrhic, women were asked to do pregnancy test (serum β-HCG) before the ultrasound to exclude pregnancy. Regarding complaints (if present), patients were asked about history of postmenstrual spotting/bleeding or discharge, heavy menstrual bleeding, dysmenorrhea, chronic pelvic pain, dyspareunia, or secondary infertility.

2.4.2. Clinical examination

General, abdominal, and local gynecological examinations were done for all patients in the study.

Ultrasonic examination was done early after the patient's menstruation, when the endometrial lining is at its thinnest phase and recently menstruated blood has collected in the defect (this may highlight the niche on imaging), or after exclusion of pregnancy in patients with amenorrhea. Each case was subjected to TVS examination followed by saline infusion sonography at the same setting. Ultrasound examinations were performed using Mindray Resona 7 (Shenzhen, China 2017) and Philips HD5 (US) system (Philips, Best, the Netherlands). Ultrasound device was equipped with a 6–10-MHz transvaginal probe. The patients were examined in the lithotomy position after emptying their bladder. This study followed the definition of niche by Bij de Vaate *et al.*[6] as they defined the niche by an anechoic area at the site of the cesarean scar with a depth of at least 1 mm. Measurements of the niche including the length, depth and residual myometrial tissue (RMT) were measured in the sagittal plane. One or two distinct sagittal planes are necessary to measure the niche's narrowest RMT. The transverse plane was only considered when calculating the width of a niche.[7] In the same setting, saline contrast SHG was done after TVS to all patients to evaluate CS scar site and to measure CSD parameters as in TVS if present.

2.5. Outcome measures

The primary outcome measure was to estimate the prevalence of the CSD in patients delivered by at least one CS. Secondary outcomes were to estimate sonographic characteristics of CSD and estimate patient's complaints in symptomatizing patients.

2.6. Statistical analysis

Microsoft Excel software was employed to code, input, and analyze historical data, basic clinical examinations, laboratory investigations, and outcome measurements. The Statistical Package for the Social Sciences ((SPSS) version 20.0 (IBM SPSS Statistics for Windows, Version 20.0; IBM Corp., Armonk, New York, USA)) program was then used to import the data and perform analysis. The following tests were performed to determine if variations were substantial; differences and association of qualitative variable were done by χ^2 test. Quantitative continuous data were represent by mean ± SD, and according to the kind of data, qualitative data were represented as number and percentage. Comparisons of quantitative independent groups were done using a paired t test. P value less than 0.001 was set as very significant findings and less than 0.05 for outcomes that were significant.

3. Results

This study enrolled 204 patients with at least previous one CS, with the last one since at least 6 months before from the time of enrolment in this study. Of these patients, five were excluded owing to variant causes (two endometrial polyp, one intramural fibroid, and one posterior wall adenomyosis), so the net number of cases was 199 patients.

The mean age of patients was 28.0 ± 3.9 years, and the mean BMI was 27.3 ± 2.1 kg/m^2. Most of patients were para two, with only one previous CS (Table 1).

CS scar niche was significantly high in association with increased number of CS and there was no significant effect of parity on the prevalence of CS scar niche (Table 2).

The results showed that TVS detected CSD in 75 (37.7%) patients, whereas SHG revealed a defect in 155 (77.9%) patients. More than half of cases with CSD were missed by TVS, and the difference was highly significant ($P = 0.00$). Moreover, there were weak kappa agreements (0.32) between TVS and SHG (sensitivity 48.4% and perfect specificity 100.0%) (Tables 3 and 4).

Table 1. Demographic and basic clinical characteristic distribution among studied cases.

Demographic characteristics	
Age (years) (mean ± SD)	28.03 ± 3.96
BMI (kg/m^2)	27.39 ± 2.14
	$N = 199$ [n (%)]
Parity	
One	41 (20.6)
Two	102 (51.3)
Three	45 (22.6)
Four or more	11 (5.5)
Number of CS	
I	98 (49.2)
II	79 (39.7)
III or more	22 (11.1)
Miscarriage	
Yes	34 (17.1)
Infertility	
Yes	12 (6.0)

CS, cesarean section.
**P there was statistical highly significance difference.
*P there was statistical significance difference.

Postmenstrual spotting dysmenorrhea, heavy menstrual bleeding, and chronic pelvic pain were significantly high in association with niche cases diagnosed by SHG, and according to niche parameters in these cases, all of them were significant in relation to these symptoms, except depth was insignificant (Tables 5–9 and Figs. 1–4).

4. Discussion

This study enrolled 199 patients. Both TVS and SHG were used to evaluate CS scar site. The patients enrolled in the study were at least 6 months since their last CS. TVS detected CSD in 75 (37.7%) patients, whereas SHG revealed a defect in niche in 155 (77.9%) patients. The difference was highly significant ($P = 0.00$). This result was in accordance with Antila-Långsjö et al.[8] Contrary to these results, Rasheedy et al.[9] could detect CSD in 59.8% of women by TVS and 70.5% by saline contrast sonohysterography, with good agreement strength (Cohen kappa = 0.805). TVS was 84.72% sensitive and 100.00% specific in identifying CSD diagnosed by saline contrast sonohysterography.

Difference in agreement between different studies may be related to the type of ultrasound machine used, experience of the operator, the different categories of patients regarding number of CS or method of closure of CS incision, interval between last CS, and the time of enrollment in the study.

Table 2. Prevalence of niche detected by sonohysterography in relation to demographic characteristics of studied groups.

Demographic characteristics	patients without niche ($N = 44$)	Patients with niche ($N = 155$)	χ^2/t	P
Age (years)				
Mean ± SD	28.81 ± 3.88	27.72 ± 4.95	1.928[a]	0.058
Parity [n (%)]				
One	7 (15.9)	34 (21.9)		
Two	24 (54.5)	78 (50.3)	0.89	0.82
Three	10 (22.7)	35 (22.6)		
Four or more	3 (6.8)	8 (5.2)		
CS [n (%)]				
I	32 (72.75)	66 (42.5)		
II	10 (22.75)	69 (44.5)	12.55	0.001**
III or more	2 (4.5)	20 (13.0)		
Miscarriage [n (%)]				
Positive	9 (20.5)	25 (16.1)	0.45	0.50

CS, cesarean section.
**P there was statistical highly significance difference.
*P there was statistical significance difference.
[a] All data were done by χ^2 except age was done by t test.

Table 3. Agreement between transvaginal sonography and sonohysterography in diagnosis of cesarean section scar niche.

	Niche by SHG [n (%)]		Total [n (%)]	χ^2	P
	No niche	Niche			
Niche by TVS					
No niche	44 (100)	80 (51.6)	124 (62.3)	34.16	0.00**
Niche	0	75 (48.4)	75 (37.7)		
Total	44 (100.0)	155 (100.0)	199 (100.0)		

SHG, sonohysterography; TVS, transvaginal sonography.
More than half the cases (51.6%) diagnosed by SHG were missed by TVS. There was a significant association with 0.32 kappa agreements with weak agreement of TVS (sensitivity 48.4% and perfect specificity 100.0%).
**P there was statistical highly significance difference.
*P there was statistical significance difference.

Table 4. Measurements of cesarean section scar niche parameters by transvaginal sonography and sonohysterography.

Parameters (mm)	TVS ($N = 75$) (mean ± SD)	SHG ($N = 155$) (mean ± SD)	Paired t	P
Length	2.66 ± 0.83	7.91 ± 2.31	14.25	0.00[a]
Depth	1.51 ± 0.54	4.35 ± 1.28	16.47	0.00[a]
RMT	3.87 ± 0.61	2.56 ± 0.84	3.25	0.001[a]
Width	3.32 ± 1.47	9.18 ± 2.93	14.03	0.00[a]

RMT, residual myometrial tissue; SHG, sonohysterography; TVS, transvaginal sonography.
**P there was statistical highly significance difference.
*P there was statistical significance difference.
[a] P value, there was statistical significance difference.

Table 5. Relation between cesarean section scar niche detected by sonohysterography and relevant symptoms.

Patients symptoms	CS scar Niche by SHG [n (%)]		Total ($N = 199$) [n (%)]	χ^2	P
	No niche ($N = 44$)	Niche ($N = 155$)			
Postmenstrual spotting	11 (25.0)	103 (66.5)	114 (57.2)	19.1	0.00**
Dysmenorrhea	12 (27.3)	74 (34.8)	86 (33.2)	5.81	0.01*
Heavy menstrual bleeding	8 (18.2)	55 (35.4)	63 (31.6)	4.75	0.02*
Chronic pelvic pain	4 (9.1)	73 (47.1)	77 (44.7)	20.8	0.00**
Dysparunia	13 (29.5)	30 (19.4)	43 (21.6)	2.10	0.14
Infertility	4 (9.1)	8 (5.1)	12 (6.03)	1.14	0.28

CS, cesarean section; SHG, sonohysterography.
**P there was statistical highly significance difference.
*P there was statistical significance difference.

Table 6. Relation between cesarean section scar niche parameters detected by sonohysterography and postmenstrual spotting.

Postmenstrual spotting	Length (mm) (mean ± SD)	Depth (mm) (mean ± SD)	RMT (mm) (mean ± SD)	Width (mm) (mean ± SD)
No ($N = 52$)	8.23 ± 2.65	5.57 ± 1.98	4.23 ± 1.23	10.05 ± 3.83
Yes ($N = 103$)	11.79 ± 3.59	5.40 ± 2.19	2.11 ± 0.87	12.94 ± 4.02
t	3.053	0.390	2.905	2.487
P	0.001**	0.697	0.002*	0.021*

RMT, residual myometrial tissue.
**P there was statistical highly significance difference.
*P there was statistical significance difference.

Table 7. Relation between cesarean section scar niche parameters detected by sonohysterography and dysmenorrhea.

Dysmenorrhea	Length (mm) (mean ± SD)	Depth (mm) (mean ± SD)	RMT (mm) (mean ± SD)	Width (mm) (mean ± SD)
No ($N = 81$)	8.68 ± 2.86	5.64 ± 1.83	4.52 ± 1.37	9.45 ± 3.94
Yes ($N = 74$)	11.11 ± 3.57	5.19 ± 1.92	2.21 ± 0.74	12.90 ± 3.01
t	2.690	1.296	2.541	3.233
P	0.012*	0.197	0.028*	0.001**

RMT, residual myometrial tissue.
**P there was statistical highly significance difference.
*P there was statistical significance difference.

Table 8. Relation between cesarean section scar niche parameters detected by sonohysterography and heavy menstrual bleeding.

Heavy menstrual bleeding	Length (mm) (mean ± SD)	Depth (mm) (mean ± SD)	RMT (mm) (mean ± SD)	Width (mm) (mean ± SD)
No ($N = 100$)	8.71 ± 2.71	5.47 ± 1.64	4.87 ± 1.55	9.23 ± 3.27
Yes ($N = 55$)	11.25 ± 3.94	5.53 ± 1.79	2.31 ± 0.78	13.96 ± 2.21
t	2.752	0.145	2.741	3.956
P	0.008*	0.885	0.017*	0.00**

RMT, residual myometrial tissue.
**P there was statistical highly significance difference.
*P there was statistical significance difference.

Table 9. Relation between cesarean section scar niche parameters detected by sonohysterography and chronic pelvic pain.

Chronic pelvic pain	Length (mm) (mean ± SD)	Depth (mm) (mean ± SD)	RMT (mm) (mean ± SD)	Width (mm) (mean ± SD)
No ($N = 82$)	8.67 ± 2.81	5.53 ± 2.06	4.09 ± 1.43	9.44 ± 3.09
Yes ($N = 73$)	11.31 ± 3.58	5.37 ± 2.10	2.28 ± 0.84	12.37 ± 3.54
t	2.615	0.405	2.331	3.236
P	0.009*	0.686	0.032*	0.001**

RMT, residual myometrial tissue.
**P there was statistical highly significance difference.
*P there was statistical significance difference.

Most studies found differences in detection of CSD by transvaginal ultrasonography with or without distension media such as saline or gel.

The prevalence of the CSD varied among different studies, as there was no consensus about the definition of the niche. Some consider it as just indentation of myometrium, others consider it as defect of 1 mm,[2,10] and others consider it as a defect or a discontinuation of the myometrium 2 mm at least of the lower uterine segment at the site of a previous CS scar.[3]

In this study, the prevalence of niche differs according the number of previous CS; the more the number of previous CS, the more the chance to have CS niche. Among patients with previous one CS, 66/98 (67.3%) of them had CS scar niche; in patients having two CS, 69/79 (87.3%) of them had CS scar niche; and 20/22 (90.9%) patients who had three previous CS or more had a defect.

Wang et al.[11] reported that the patients with history of multiple CSs were associated with increased

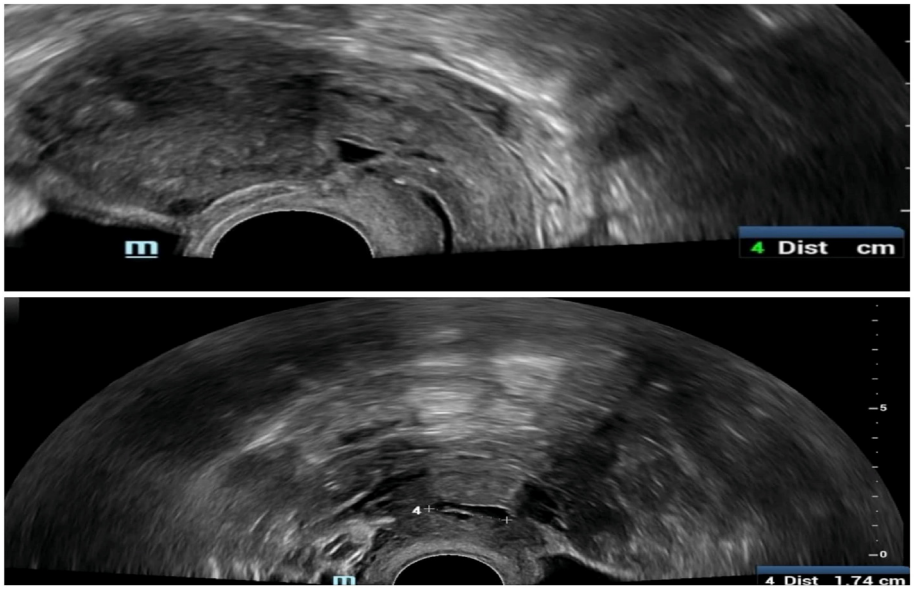

Fig. 1. CSD in midsagittal (upper) and transverse (lower) view by TVS. CSD, cesarean scar defect; TVS, transvaginal sonography.

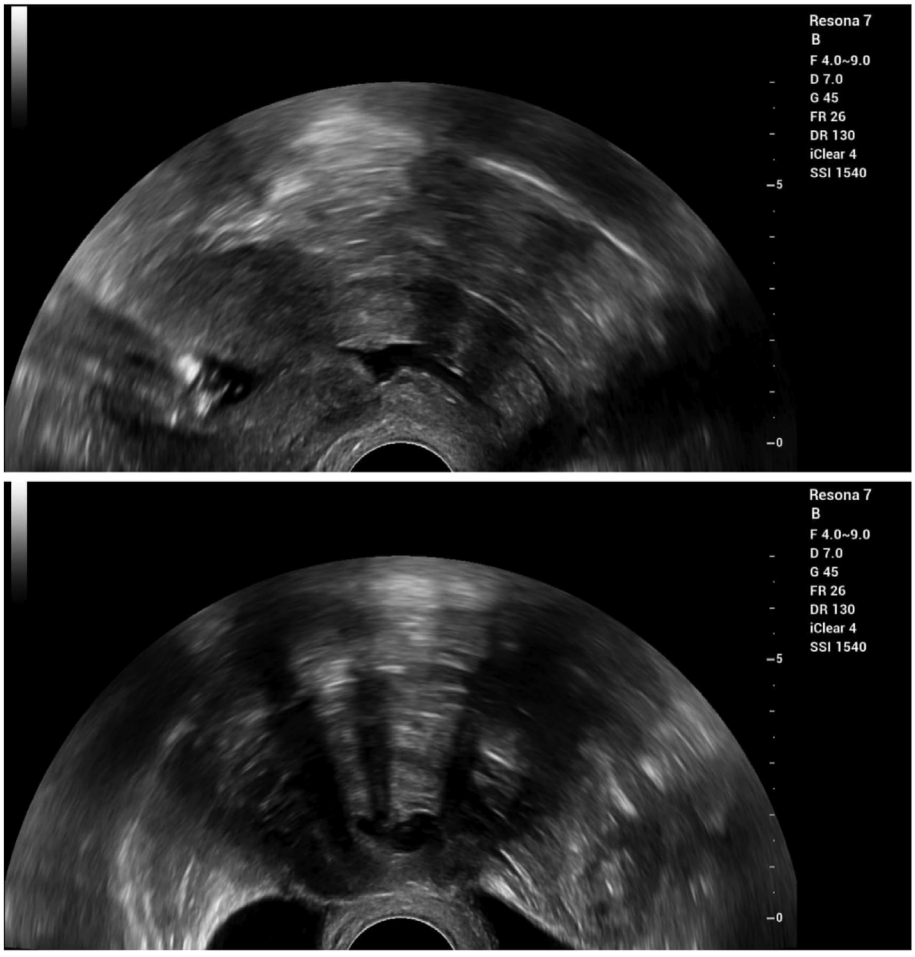

Fig. 2. CSD in midsagittal (upper) and transverse (lower) view of the same case by SHG. CSD, cesarean scar defect; SHG, sonohysterography.

Fig. 3. CSD parameters measurements method in midsagittal view: (a) residual myometrial tissue (RMT), (b) length, and (c) depth. CSD, cesarean scar defect.

Fig. 4. Measurements of CSD width parameter in transverse view. CSD, cesarean scar defect.

width and depth of the CSD. Antila-Långsjö et al.[8] alleged that history of previous CS had a significant influence on isthmocele formation ($P < 0.001$).

One of the aims of this study was to reveal the relation between the CSD and symptoms of patients.

In this study, postmenstrual spotting, heavy menstrual bleeding, dysmenorrhea, and chronic pelvic pain were significantly high in patients having CS niche defect compared with those without the defect ($P = 0.00$, 0.02, 0.01, and 0.00, respectively). The most prominent niche parameters associated with these complaints were length, width, and RMT, with no effect of depth of the niche.

In this study, 63 patients complained of heavy menstrual bleeding, and 55/155 (35.5%) of them had niche. On analysis of niche parameters in all patients with niche by SHG, there was a significant difference between patients who complained of heavy menstrual bleeding and those who did not in length ($P = 0.00$), RMT ($P = 0.03$), and width ($P = 0.00$).

This result was in accordance with Tang *et al.*[12] who found women with CSD had substantially prolonged menstruation compared with women in the control group (6.92 ± 3.99 days vs. 1.08 ± 2.56 days, $P < 0.001$), but no substantial variations in the prevalence of menstrual volume were found ($P > 0.05$). Antila et al.[13] reported that even with

significant isthmocele, there was no variation between the groups with and without isthmocele in terms of the frequency of protracted periods, dysmenorrhea, dyspareunia, usage of painkillers, and absence from work or activities.

In this study, chronic pelvic pain was the second commonest complaint, where 73 (47.1%) of 155 patients had niche and 4/44 (9.1%) did not have niche. On analysis of niche parameters in all patients with niche, there were significant differences between patients who complained of chronic pelvic pain and those who did not in length ($P = 0.00$), RMT ($P = 0.03$), and width ($P = 0.00$). On the contrary, in this study, 86/199 (33.2%) patients complained of dysmenorrhea; 74/155 (34.8%) of them had niche. On analysis of niche parameters in all patients with niche by SHG (155 patients), there were significant difference between patients who complained of dysmenorrhea and those who did not in length ($P = 0.01$), RMT ($P = 0.02$), and width ($P = 0.00$).

Morris[14] in his series of 51 cases of hysterectomy tried to explain the etiology of chronic pelvic pain and dyspareunia related to CSD and indicated that individuals with CSD exhibited pathologic abnormalities in the scar site, including iatrogenic adenomyosis, lymphocyte infiltration, and fibrosis.

4.1. Conclusion

(1) SHG is more accurate in diagnosis and characterization of CSD.
(2) Postmenstrual spotting, dysmenorrhea, heavy menstrual bleeding, and chronic pelvic pain were significantly high in patients with CSD.
(3) CSD parameters such as length, RMT, and width were significantly high in patients with postmenstrual spotting, dysmenorrhea, heavy menstrual bleeding, and chronic pelvic pain, but depth of CSD was insignificant in these patients.
(4) Therefore, this study recommends avoiding liberal use of CS and to customize delivery by CS for indicated cases only to avoid the catastrophic effect of the operation on women's lives.

Consent statement

Verbal informed consent about the procedure and included in the study, the procedure included transvaginal ultrasound and sonohysterography.

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There is no financial issues to be declared.

Conflict of interest

There is no conflict of interest.

References

1. Al Rifai RH. Trend of caesarean deliveries in Egypt and its associated factors: evidence from national surveys, 2005-2014. *BMC Pregnancy and Childbirth*. 2017;17(1):1–14.
2. Fayed MR, Swedan II , Soliman AS, Fawzy WA. Comparative study between TV ultrasound alone and TV ultrasound with gel instillation sonohystrography in assessment of caesarean section scar in non-pregnant women. *Benha J Appl Sci*. 2021;6: 65–68.
3. Madhangi VB, Ramany C. Cesarean scar defect and its association with clinical symptoms, uterine position and the number of cesarean sections. *Int J Reprod Contracept Obstetr Gynecol*. 2020;9:4092.
4. Vervoort AJ, Uittenbogaard LB, Hehenkamp WJ, Brölmann HA, Mol BW, Huirne JA. Why do niches develop in cesarean uterine scars? Hypotheses on the aetiology of niche development. *Hum Reprod*. 2015;30:2695–2702.
5. Tulandi T, Cohen A. Emerging manifestations of cesarean scar defect in reproductive-aged women. *J Minim Invasive Gynecol*. 2016;23:893–902.
6. Bij de Vaate AJM, Brölmann HAM, Van der Voet LF, Van der Slikke JW, Veersema S, Huirne JAF. Ultrasound evaluation of the cesarean scar: relation between a niche and postmenstrual spotting. *Ultrasound Obstet Gynecol*. 2011;37:93–99.
7. Jordans IPM, De Leeuw RA, Stegwee SI, Amso NN, Barri-Soldevila PN, Van Den Bosch T. Sonographic examination of uterine niche in non-pregnant women: a modified Delphi procedure. *Ultrasound Obstet Gynecol*. 2019;53:107–115.
8. Antila-Långsjö RM, Ju Mäenpää, Huhtala HS, Tomás EI, Staff SM. Cesarean scar defect: a prospective study on risk factors. *Am J Obstet Gynecol*. 2018;219:458.e1–458.e8.
9. Rasheedy R, Sammour H, Elkholy A, Fadel E. Agreement between transvaginal ultrasound and saline contrast sonohysterography in evaluation of cesarean scar defect. *J Gynecol Obstetr Human Reprod*. 2019;48:827–831.
10. Vikhareva Osser O, Jokubkiene L, Valentin L. High prevalence of defects in cesarean section scars at transvaginal ultrasound examination. *Ultrasound Obstet Gynecol*. 2009;34: 90–97.
11. Wang CB, Chiu WWC, Lee CY, Sun YL, Lin YH, Tseng CJ. Cesarean scar defect: correlation between cesarean section number, defect size, clinical symptoms and uterine position. *Ultrasound Obstet Gynecol*. 2009;34:85–89.
12. Tang X, Wang J, Du Y, Xie M, Zhang H, Xu H. Caesarean scar defect: risk factors and comparison of evaluation efficacy between transvaginal sonography and magnetic resonance imaging. *Eur J Obstet Gynecol Reprod Biol*. 2019;242:1–6.
13. Antila RM, Ju Mäenpää, Huhtala HS, Tomás EI, Staff SM. Association of cesarean scar defect with abnormal uterine bleeding: the results of a prospective study. *Eur J Obstet Gynecol Reprod Biol*. 2020;244:134–140.
14. Morris H. Surgical pathology of the lower uterine segment caesarean section scar: is the scar a source of clinical symptoms? *Int J Gynecol Pathol*. 1995;14:16–20.