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The sonographic sliding sign for assessing intra-abdominal adhesions in expectant mothers

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Abstract

Background: Intra-abdominal adhesions are a common complication in pregnant patients with a history of cesarean sections. These adhesions can lead to increased risks during repeat cesarean sections, including bleeding, infection, hysterectomy, and injury to the bladder and bowel. Accurate assessment of these adhesions is crucial for managing and mitigating these risks.

Objective The purpose of this research is to track pregnant patients who have had at least one cesarean section in the past and assess their current pregnancy using ultrasound.

Methods: The study involved assessing ultrasound findings for diagnosing intra-abdominal adhesions in pregnant women with a history of cesarean sections. The findings were then compared with intra-abdominal adhesions observed during surgery.

Results: out of the 52 women, only half (50.0%) had no adhesions, 12/52 (23.1%) had mild adhesions, and 8/52 (15.4%) had moderate adhesions. The remaining 6/52 (11.5%) had severe adhesions, resulting in a frozen pelvis. According to outcome definition 1, the rate of substantial adhesions was 26.9%, whereas the rate of any adhesions (outcome definition 2) was 50.0%.

Conclusion: Ultrasound can be a valuable tool in diagnosing intra-abdominal adhesions in pregnant women with a history of cesarean sections, helping to predict the risk of complications during repeat cesarean sections.

Keywords: Ultrasound, cesarean section, pregnancy, adhesions

INTRODUCTION

Over the last ten years, the average rate of cesarean sections performed has climbed by fifty percent to thirty-five percent[1]. To facilitate a multidisciplinary surgical discussion before surgery and advise patients of the possible high risk of complications associated with recurrent abdominal surgery, physicians must identify patients at a high risk of acquiring adhesions. The risk of problems in a patient with possible abdominal adhesions is related not only to the dangers of the abdominal surgery itself but also to the timing of the procedure and, in the event of an emergency cesarean section, to the perinatal period[2].

While no standard, trustworthy technique exists for detecting intra-abdominal adhesions before surgery; several writers have proposed abdominal scar characteristics as a possible predictor of adhesion existence, severity, and level of intensity[3].

Adhesions are the most frequent side effect following pelvic and abdominal surgery; they arise following over 85% of abdominal procedures and can lead to small intestinal blockage, persistent pelvic pain, and infertility[4]. Adhesions raise the danger of bleeding during surgery, which in turn increases the chance of harm to the intestines and urinary tract[4].

Due to its significant effects on older pregnant women, this poses a serious health care issue and raises rates of morbidity and death as well as medical expenses[5].

Surgeons must identify individuals at a high risk of adhesion development. Using this information, a multidisciplinary team of surgeons may organize the procedure, and the patient may be made aware of the possible high risk of complications[6].

Materials and methods

Fifty-two women who were scheduled for elective cesarean sections for various reasons were enrolled in the case series test validation study. All the women had diagnostic ultrasound scanning to elicit the sliding sign, which denotes the freedom of the rectum and lower sigmoid from the uterus and adnexal tissues.

Using prospective observational methods, this study included women who had planned repeat cesarean sections performed in private facilities. The "glide sign" is an ultrasound observation of the uterus gliding on the abdominal wall when deep breathing. The absence of a sliding sign, a symptom of a high risk of dense abdominal and uterine adhesions, was compared to the surgical outcomes. The sliding signal's ability to forecast adhesions was the primary finding. Secondary outcomes included the time from incision to birth and the time to surgery.

Before giving birth via cesarean section, all of the women had Trans abdominal ultrasounds using equipment with a transabdominal probe that operated at 5 to 9 MHz. Patients were not asked to empty their bladders before the ultrasound test; in those who had both an empty and a full bladder, the intra-abdominal adhesion evaluation was performed without any technical problems. The transverse skin scar was placed over the probe to be perpendicular to it. The probe is moved slightly back and forth during the

examination and perpendicular to the scar.

The patient was instructed to inhale deeply until the transverse fascia and parietal peritoneum were seen to slip caudally behind the uterus. When the uterus is seen to slide against the abdominal wall, this has been identified as a sliding sign. The sliding indication is missing when the uterus is not moving beneath the transverse fascia. If there was moderate uterine movement or evidence of uterine sliding, women were deemed to have a low chance of developing intra-abdominal adhesions (presence of sliding sign). The absence of the slip sign indicates a significant probability of intra-abdominal adhesions.

The adhesion assessment took a few minutes. Thus, the standard ultrasound examination did not considerably extend, and there were no patient pain reports. Following CS, the agreement between pre- and intra-operative assessment of the existence of adhesions was assessed by comparing the surgical report and initial ultrasound diagnostic.

To predict the presence of intra-abdominal adhesions, data were analyzed to assess the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), positive (LR+), and negative (LR−) likelihood ratios of the sliding.

RESULT

Sonographic diagnosis of intra-abdominal adhesions:

Using ultrasound imaging has proven to be effective for diagnosing intra-abdominal adhesions. By analyzing the movement of specific points on the uterine serosa and muscle fascia during patient breathing, sonographers can identify the presence and extent of adhesions (see Figures 1 and 2).

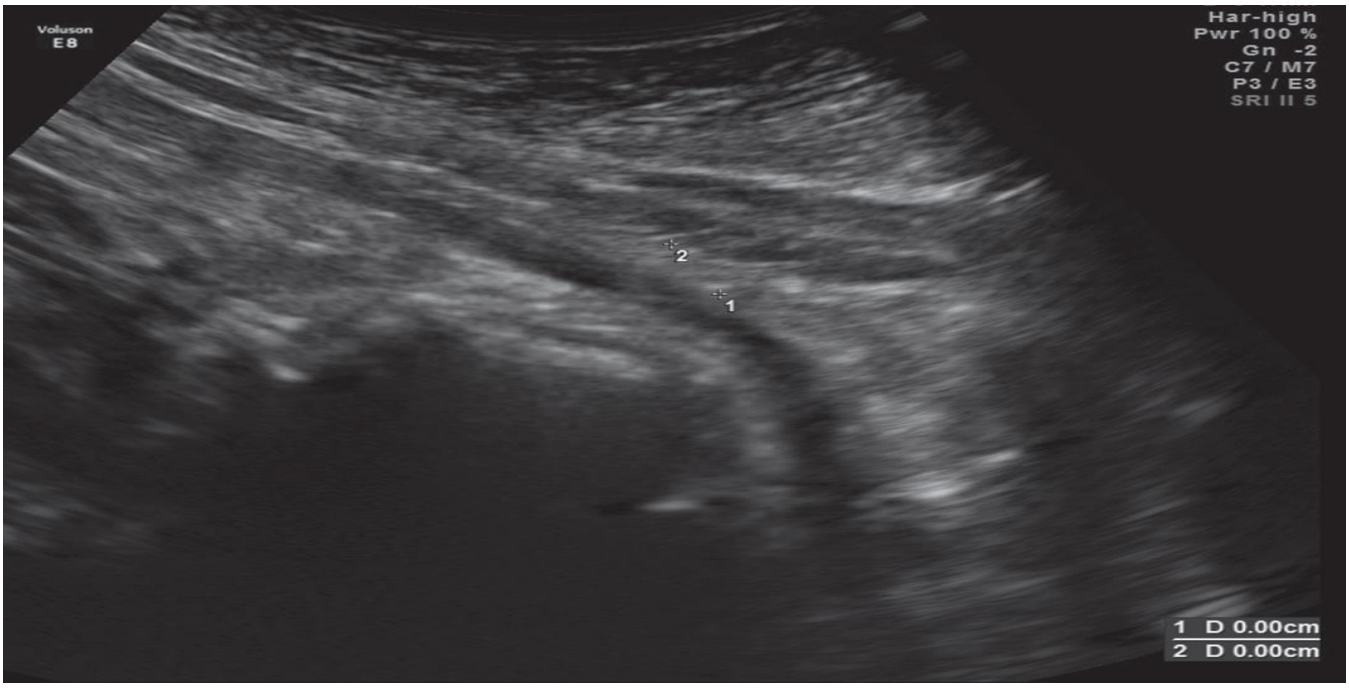

Figure 1 shows a Change during the patient's breathing. Point 1 on the uterine serosa has slid downwards, while point 2 on the muscle fascia remains in its initial position.

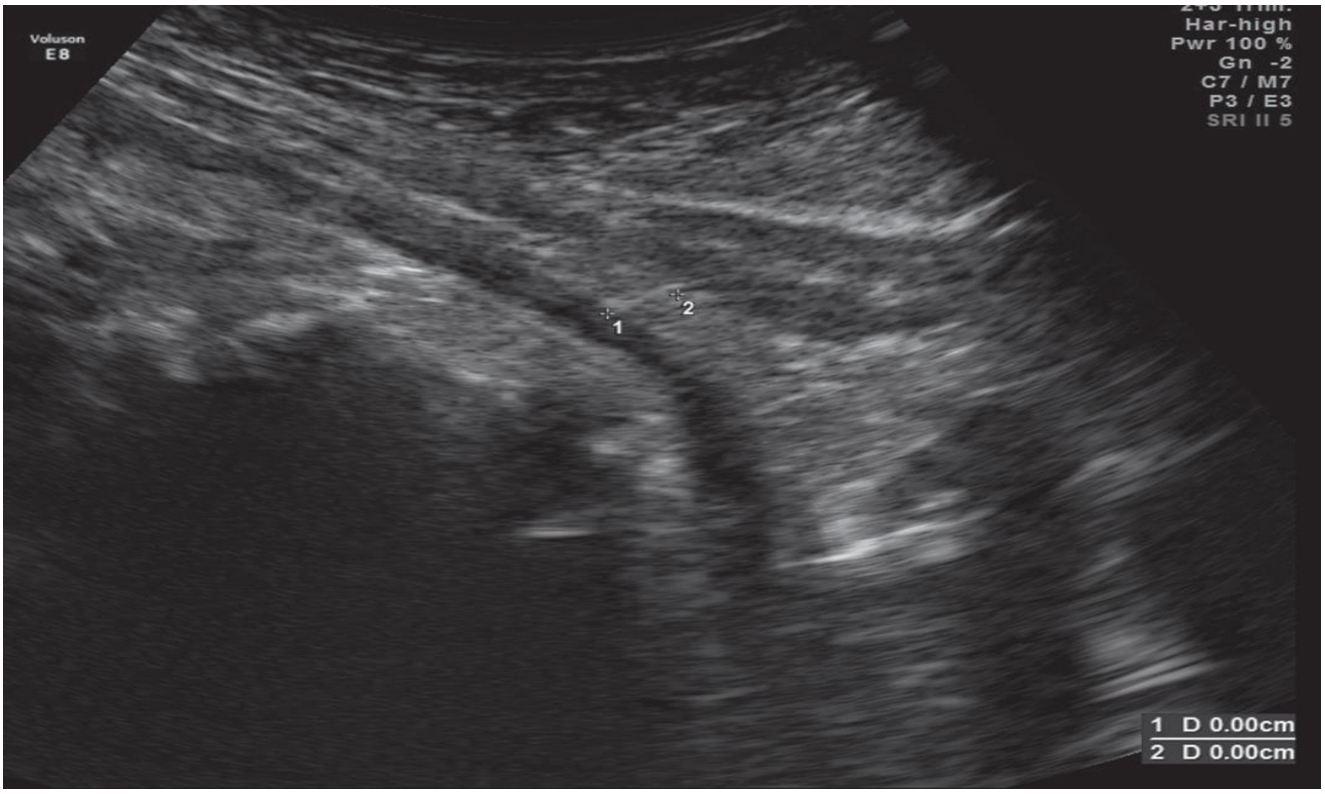

Figure 2 shows Third-trimester trans-abdominal ultrasound images of a patient with a history of Caesarean section, showing a sliding sign. (a) The Starting point is before the patient is asked to breathe; point 1 is on the uterine serosa, and point 2 is on the muscle fascia

The mean age is 28.5 years (±SD 4.9 years), ranging between 20 and 40 years. The rate of advanced maternal age was 7/52 (13.5%). Gravidity ranges from 1 to 6, and parity from 0 to 5. The grand multi-parity rate was 11/52 (21.2%). Previous caesareans number ranged from 0 to 5. The rate of mothers with two previous scars or more was 29/52 (55.8%). Only two cases (3.8%) had no previous scars.

All cases were within the term (37 to 42 weeks). The ultrasound sliding sign was positive (suggestive of adhesions) in 17/52 cases (32.7%). The operational findings indicated that only half (50.0%) of the women were free of adhesions, 12/52 (23.1%) had only mild adhesions, 8/52 (15.4%) had moderate adhesions, while the remaining 6/52 (11.5%) have frozen pelvis (severe adhesions). The rate of significant adhesions (outcome definition 1) was 26.9%, while the rate of any adhesion (outcome definition 2) was 50.0%.

Definition of the outcome:

Definition 1: Only moderate to severe adhesions are included in the outcome. See (table 1-3)

Definition 2: Any level of adhesions shown in the table is included in the result.

Test Positive is the absence of a sliding indication on ultrasonography when the suprapubic area is gently probed.

Table 1: Outcome Analysis (Definition 1): Associations (Monovariate Analysis)

Factor		Adhesions		*P*
		Significant adhesions	No or mild adhesions	
Advanced maternal age	AMA	3	4	0.370
		42.9%	57.1%	
	OMA	11	34	
		24.4%	75.6%	
Parity	Grand multi	4	7	0.460
		36.4%	63.6%	
	Less parity	10	31	
		24.4%	75.6%	
Previous scars	The previous two scars, plus	11	18	0.044
		37.9%	62.1%	
	One or no previous scars	3	20	
		13.0%	87.0%	

The rate of significant pelvic adhesions (definition 1) was significantly higher among women with previous two or more scars (37.9% versus 13.0%; $P = 0.044$). There is no statistically significant difference regarding advanced maternal age and parity.

Table 2: Multivariate Analysis

	B	Wald	*P*
Age	0.022	0.046	0.831
Advanced maternal age(1)	0.736	0.362	0.547
GRAVIDITY	-0.286	0.222	0.637
Multipara(1)	-0.510	0.186	0.666
Previous two scars plus(1)	0.936	0.558	0.455
Constant	0.779	0.029	0.865

Multivariate analysis did not show any significant independent predictor for the outcome among the investigated factors for the outcome with definition 1.

Table 3: Agreement and Test Validity in Detecting the Outcome According to Definition 1

	Adhesions By USS	OT findings		Kappa (*P*)	Test validity parameters	
		Significant adhesions	No or mild adhesions			
All	Likely	14	3	0.863 *	Sensitivity	100.0%

		82.4%	17.6%	*P*<0.001†	Specificity	92.1%
	Unlikely	0	35		PV +	82.4%
		0.0%	100.0%		PV -	100.0%
AMA	Likely	3	0		Sensitivity	100.0%
		100.0%	0.0%	1.000 **	Specificity	100.0%
	Unlikely	0	4	*P* = 0.008†	PV +	100.0%
		0.0%	100.0%		PV -	100.0%
OMA	Likely	11	3		Sensitivity	100.0%
		78.6%	21.4%	0.835 *	Specificity	91.2%
	Unlikely	0	31	*P* <0.001†	PV +	78.6%
		0.0%	100.0%		PV -	100.0%
Grand multi	Likely	4	0		Sensitivity	100.0%
		100.0%	0.0%	1.000 **	Specificity	100.0%
	Unlikely	0	7	*P* = 0.001†	PV +	100.0%
		0.0%	100.0%		PV -	100.0%
Less parity	Likely	10	3		Sensitivity	100.0%
		76.9%	23.1%	0.820 *	Specificity	90.3%
	Unlikely	0	28	*P* <0.001†	PV +	76.9%
		0.0%	100.0%		PV -	100.0%
The previous two scars, plus	Likely	11	2		Sensitivity	100.0%
		84.6%	15.4%	0.859 *	Specificity	88.9%
	Unlikely	0	16	*P* <0.001†	PV +	84.6%
		0.0%	100.0%		PV -	100.0%
One or no previous scars	Likely	3	1		Sensitivity	100.0%
		75.0%	25.0%	0.832 *	Specificity	95.0%
	Unlikely	0	19	*P* <0.001†	PV +	75.0%
		0.0%	100.0%		PV -	100.0%

* Near perfect agreement. ** Perfect agreement.

† Significant at a 95% confidence level (the agreement by chance is unlikely).

The agreement was very high and significant in all categories (perfect or near). Among gran multipara and women of advanced maternal age, an ideal agreement (Cohen kappa =1.0) with a 100% rate of all validity parameters was realized. The test was 100% sensitive, and the negative predictive value was 100% in all categories.

Table 4: **Outcome analysis (definition 2): Associations (Monovariate analysis)**

Factor		Adhesions		*P*
		Any adhesions	Free of adhesions	
Advanced maternal age	AMA	3	4	1.000
		42.9%	57.1%	
	OMA	23	22	
		51.1%	48.9%	
Parity	Grand multi	6	5	0.734
		54.5%	45.5%	
	Less parity	20	21	
		48.8%	51.2%	
Previous scars	The previous two scars, plus	17	12	0.163
		58.6%	41.4%	
	One or no previous scars	9	14	
		39.1%	60.9%	

According to outcome definition 2, there was no statistically significant difference regarding advanced maternal age, grand multiparity, or previous two scars plus.

Multivariate analysis

Multivariate analysis did not show any significant independent predictor for the outcome among the investigated factors for the outcome with definition 2.

Table 5: Outcome Analysis (Definition 2): Associations (Monovariate Analysis)

	B	**Wald**	***P***
Age	-0.055	.598	0.440
GRAVIDITY	0.160	.186	0.666
Previous two scars plus(1)	0.996	1.111	0.292
Constant	0.620	.106	0.745

Table 6: Agreement and Test Validity in Detecting the Outcome According to Definition 2

	Adhesions By USS	**OT findings**		**Kappa (*P*)**	**Test validity parameters**	
		Any adhesions	**Free of adhesions**			
All	Likely	16	1	0.577* *P* <0.001 ‡	Sensitivity	61.5%
		94.1%	5.9%		Specificity	96.2%
	Unlikely	10	25		PV +	94.1%

		28.6%	71.4%		PV -	71.4%
AMA	Likely	3	0	1.000† *P* = 0.008 ‡	Sensitivity	100.0%
		100.0%	0.0%		Specificity	100.0%
	Unlikely	0	4		PV +	100.0%
		0.0%	100.0%		PV -	100.0%
OMA	Likely	13	1	0.515* *P* <0.001 ‡	Sensitivity	56.5%
		92.9%	7.1%		Specificity	95.5%
	Unlikely	10	21		PV +	92.9%
		32.3%	67.7%		PV -	67.7%
Grand multi	Likely	4	0	0.645** *P* = 0.022 ‡	Sensitivity	66.7%
		100.0%	0.0%		Specificity	100.0%
	Unlikely	2	5		PV +	100.0%
		28.6%	71.4%		PV -	71.4%
Less parity	Likely	12	1	0.557* *P* <0.001 ‡	Sensitivity	60.0%
		92.3%	7.7%		Specificity	95.2%
	Unlikely	8	20		PV +	92.3%
		28.6%	71.4%		PV -	71.4%
The previous two scars, plus	Likely	12	1	0.593* *P* = 0.001 ‡	Sensitivity	70.6%
		92.3%	7.7%		Specificity	91.7%
	Unlikely	5	11		PV +	92.3%
		31.3%	68.8%		PV -	68.8%
One or no previous scars	Likely	4	0	0.493* *P* = 0.006 ‡	Sensitivity	44.4%
		100.0%	0.0%		Specificity	100.0%
	Unlikely	5	14		PV +	100.0%
		26.3%	73.7%		PV -	73.7%
Moderate agreement. ** Substantial agreement † Perfect agreement. ‡Significant at a 95% confidence level (the agreement by chance is unlikely).						

A perfect agreement (Cohen kappa =1.0) with a 100% rate of all validity parameters was realized among gran multipara and women of advanced maternal age. Substantial agreement was seen within the category of grand multipara. Other categories showed only a moderate agreement. The test was 100% specific, and the positive predictive value was 100% in advanced maternal age, grand multipara, and mothers with one or no previous scars.

DISCUSSION

The rate of cesarean sections is currently rising sharply, contributing to an increase in complications such as placenta accreta and intraperitoneal adhesions. These complications can sometimes lead to severe challenges during the procedure, which can have a detrimental effect on both the mother and the newborn [7]. An increased risk of problems during a repeat cesarean section, including bleeding, infection, hysterectomy, and bladder and bowel injuries, is associated with adhesions inside the abdomen [8].

When breathing deeply, the uterus slides under the abdominal myofascial's inner layer, an ultrasound sign we evaluated. If uterine prolapse is absent, women are thought to be at high risk for severe adhesions, and if uterine prolapse is marked or moderate, they are considered to be at low risk. The gliding sign is a better indicator for detecting intra-abdominal adhesions in women who have undergone a repeat cesarean delivery. A comparison was made between intra-abdominal adhesions seen during surgery and ultrasound findings.

The mean age of participants in our study was 28.5 years (±SD 4.9 years), ranging from 20 to 40 years. The percentage of older mothers was 13.5%, or 7 out of 52.

According to [9], the mean age was 34.6 ± 1.15 years (4). Our research shows no statistically significant relationship between the rate of major pelvic adhesions and lower parity or older maternal age.

The study conducted by [10]revealed a statistically significant relationship between the occurrence of adhesions during the operation and the mothers' age groups (years). Specifically, women aged 30 or older had a higher incidence of adhesions than younger women. This can be explained by the fact that more cesarean sections are performed and higher parity with increasing age. Regarding parity, women with a parity of at least three are more susceptible to adhesions than women with a parity of less than five.

According to our research, women who previously had two or more scars had a significantly greater rate of severe pelvic adhesions (37.9% vs. 13.0%). Among the mothers, 29/52 (55.8%) had two or more scars in the past. Only 2.8% of cases had no previous scarring.

According to [11], 44.5% of patients developed dense or membranous intra-abdominal adhesions. Adhesions were found to have a statistically significant relationship with parity (6) and the number of previous cesarean sections.

According to our analysis, the ultrasound sliding sign was positive in 17 out of 52 cases (32.7%), indicating adhesions.

According to[12], ultrasonography revealed the presence of a sliding index in (61%) of patients. Only half of the women (50.0%) in our study had no adhesions, 12/52 (23.1%) had only mild adhesions, 8/52 (15.4%) had moderate adhesions, and the remaining 6/52 (11.5%) had moderate adhesions—pelvic immobilization (severe adhesions). Our investigation supports these operational results. According to[13], 33.8% of adhesions were classified as moderate or severe. According to our research, the sliding score had a specificity of 100% and a sensitivity of 92.1% in predicting the presence of intra-abdominal

adhesions in women who underwent repeat cesarean sections. Cohen's kappa statistic indicated an intra observer correlation of 0.863. NPV is 100% and PPV is 82.4%. In all groups, there was very high test validity and agreement in determining the rate of intrinsic adhesions [14]. The sensitivity and specificity of the sliding sign were found to be decreased in identifying intra-abdominal adhesions in women undergoing recurrence.

Fifty-four percent and 53 percent of the cases were cesarean sections. Cohen's kappa value indicated an inter-observer correlation of 0.77 and an inter-observer correlation of 0.52. According to[15], the sensitivity was 100% (95% CI 92-1), the specificity was 86.84% (95% CI 77.1-93.5), the PPV was 81.5%, and the NPV was 100%.

CONCLUSION

Our findings suggest that in individuals with a history of cesarean delivery, a straightforward ultra-sonographic marker may be able to distinguish between patients at high and low risk of intra-abdominal adhesions.

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Conflict of interest none

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