

Sonographic Sliding Sign as a Predictor of Intra- Abdominal Adhesions in Pregnant Woman with Previous Pelvi-Abdominal Surgery

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ABSTRACT

Background: Intra-abdominal adhesions are frequently linked to higher likelihood of complications such as hemorrhage and visceral injury during cesarean section in a woman with previous pelvi-abdominal surgery. This is why prediction of intraoperative adhesions is important.

Objective: To check the sonographic sliding sign of the uterus as a predictor of intra-abdominal adhesions prediction in females who are undergoing CS and who had a history of pelvic and abdominal surgery, involving a previous CS.

Methods: A prospective observational study carried out on 69 females with history of previous pelvi-abdominal surgery including CS and planned to have CS to predict intra-abdominal adhesions. During deep breathing, transabdominal ultrasound (TAS) is utilized to demonstrate the sonographic sliding sign of the uterus beneath the inner fascia of abdominal muscles. Females were believed to be at a high hazard for severe adhesions when sliding was absent but at a low hazard when sliding was obvious. Intraoperative assessment of adhesions was done in correlation to the sonographic finding.

Results: 5 out of 8 cases with -ve sliding sign were confirmed intraoperatively to have marked adhesions and 59 out of 61 cases with +ve sliding sign had no or mild adhesions. The sensitivity, specificity, ppv, npv of the sliding sign were 71.4%, 95.2%, 62.5%, and 96.7% respectively.

Conclusion: The uterine sliding sign has a good specificity, negative predictive value, and moderate sensitivity for predicting intraoperative adhesions. This technique might help surgeons to undertake anticipated complex operations.

Keywords: Sliding sign, Intra-abdominal adhesions, Abdominal ultrasound.

INTRODUCTION

In the last three decades, Cesarean section (CS) rates have increased to levels well above the recommended between ten and fifteen⁽¹⁾. The frequency of repeat Caesarean sections is increasing worldwide. Approximately ninety percent of women with a history of Cesarean deliveries have an intended repeat Cesarean delivery in their subsequent gestation. Those who have undergone pelvic-abdominal surgery or who had many CS may develop intra-abdominal adhesions. Prolonged damage to nearby viscera, and blood loss are all possible complications of adhesiolysis⁽²⁾. Injuries to the bladder and colon (0.1–0.3%), blood loss (0.1–1.4%), infection (0.4–1.6%), and even hysterectomy (0.1–1.4%) are all significantly increased in subsequent procedures due to post-CS adhesions. Damage to neighboring viscera, hemorrhage, and, in the event of emergency CS, the perinatal poor consequence coupled as a result of the delayed birth of the newborn are all possible complications of adhesiolysis⁽³⁾.

When a woman is suspected of having extensive intra-abdominal adhesions, it is advisable to perform surgery by making a midline skin incision to gain access to the peritoneal cavity. Additionally, preparations for blood products should be made, surgeons should be assigned, and preoperative surgical assistance from other medical specialties should be requested to ensure a successful operation. It is crucial for surgeons to possess the ability to identify patients at risk of developing adhesions. This valuable information can then be utilized by multidisciplinary surgical teams to adequately prepare for the procedure, while also

allowing the patient to be informed about the potential for heightened complications, if necessary⁽⁴⁾.

Hypothesis: To analyze the connections among the uterine sliding sign and other operational and neonatal outcomes, as well as to determine the predictive usefulness of the uterine sliding sign for the presence of intra-abdominal adhesions in women who had a history of pelvi-abdominal surgery or who had undergone a prior CS.

PATIENTS AND METHODS

This was a prospective observational study conducted at Obstetrics and Gynecology Department, Menoufia Faculty of Medicine Hospitals and Shebin Elkom Teaching Hospital during time interval from January 2022 till January 2023. The study included 69 pregnant women recruited from Outpatient Clinic of Obstetrics and Gynecology Department and were candidates for elective cesarean section.

Inclusion Criteria: History of previous pelvi-abdominal surgery including previous CS, gestational age at or beyond 37 weeks, planned to undergo elective CS and BMI < 30 on admission).

Exclusion Criteria: Overweight women, abnormal placental invasion, emergency Cesarean delivery.

The following maternal features and obstetrical history were obtained through interviews and medical record reviews: Demographic data (patient age, parity,

BMI, number of prior CS, history of previous pelvic surgery). TAS was performed by Siemens acuson nx3 2020 edition device (Siemens medical solutions USA, Inc.) with a 1.4-5.0MHz trans-abdominal probe during the preoperative examination, utilizing the real-time TAS pelvic sliding sign (maternal abdominal wall and uterine wall movements in relation to one another).

Each participant was positioned supine and asked to full their bladder prior to sonographic examination. Over the midsection, among the umbilicus and the pubic symphysis, the transducer was placed vertically. If a midline scar was present, the transducer was positioned slightly laterally to avoid the scar, and in cases with previous CS, it was positioned perpendicular to the vertical skin incision. The participant was then instructed to breathe deeply and expel. It was considered a positive sliding sign if the anterior uterine wall was observed to glide across the abdominal wall.

During Cesarean section, A detailed description of adhesions (its site and its nature whether filmy or dense) and Direct observation by the surgeons revealed any unintentional damage. Adhesion severity was dichotomized as absent or present and categorized as "mild" or "severe" according to adhesion scores below and above the median sixteen points, range 0-64 points)⁽⁵⁾.

In addition, thickness of the anterior abdominal wall over the previous scar was measured starting from skin till the lowermost point on the abdominal muscles. The duration of the intervention (from surgical incision to childbirth), expressed in minutes, hemoglobin drop (hemoglobin levels determined among pre- and post-operative), visceral injury, were recorded. All the sonographic data were correlated with type and grade of adhesions demonstrated intraoperative.

Sample Size was 69 Participants that was calculated by Statistics and Sample Size Pro-Program version 6 ⁽⁶⁾. Sonographic Sliding Sign is a predictor of Intra-Abdominal Adhesions in Pregnant women with Prior Pelvi-Abdominal Surgery with sensitivity of 68%, specificity of 96.5% and prevalence of 24% ⁽⁷⁾ with drop out 10%. The Power of the study is 80% and confidence level is 95% ⁽⁷⁾.

Ethical Approval:

The study was approved by the Ethics Board of Menoufia University [Committee N: (11/2021 OBG 17)]. The patients were given all the information they need about the trial. An informed written consent was taken from each participant in the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical analysis

The collected data were introduced and statistically analyzed by utilizing the Statistical Package for Social Sciences (SPSS) version 26.0 for windows. Qualitative data were defined as numbers and percentages.

Chi-Square test and Fisher's exact test were used for comparison between categorical variables as appropriate. Quantitative data were tested for normality by Kolmogorov-Smirnov test. Normal distribution of variables was described as mean and standard deviation (SD). Independent sample t- test and analysis of variance (ANOVA) were used for comparison between groups. P value ≤ 0.05 was considered to be statistically significant.

RESULTS

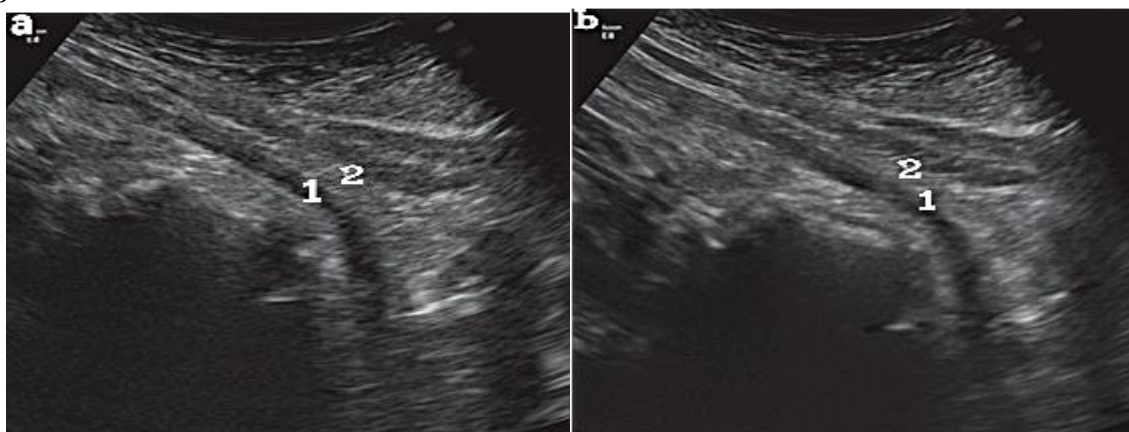


Figure (1): Third trimester TAS images in patient with previous pelvi abdominal surgery, showing sliding sign. (a) Starting point before patient was asked to breathe, point 1 is on uterine serosa and point 2 is on muscle fascia. (b) Change during patient's breathing, point 1 on uterine serosa has slid downwards while point 2 on muscle fascia remains in its initial position.

Adhesions	Consistency of adhesions	<3 cm	3-6 cm	>6 cm
Between uterus and bladder	Filmy	1	2	4
	Dense	4	8	16
Between uterus and abdominal fascia	Filmy	1	2	4
	Dense	4	8	16
Between uterus and omentum	Filmy	1	2	4
	Dense	4	8	16
Between omentum and abdominal fascia	Filmy		2	
	Dense		8	
Adhesions to other pelvic structures that interfere with the delivery	Filmy		4	
	Dense		8	

Figure (2): Adhesion classification system according to Tulandi and Lyell (5)

We examined 69 females in their 3rd trimester with a previous history of pelvi-abdominal surgery including previous CS.

The average length of gestation for these patients was 38.5 weeks ± 0.47, and the average age of the affected individuals was 26.36 ± 4.1 years. The mean BMI was 27.29 ± 1.13 kg/m². 91.3% of the recruited participants had previously had CS, 5.8% had previously undergone appendectomy and 2.9% had previously undergone open myomectomy. Positive sliding signs were seen in 88.4% of the individuals who were recruited, whereas negative sliding signs were present in 11.6%. During the CS operation, 10.1% of the participants had significant adhesions, whereas 89.9% of the cases only had moderate or no adhesions at all. Visceral damage was a complication that occurred in 4.3% of cases. Only 2.9% of individuals experienced complications with their hemoglobin level dropping > 3g/dl (Table 1).

Table (1): Demographic features and clinical history of the studied patients

Variable	Mean ± SD	Range	Median (IQR)	
Age (y)	26.36±4.1	20 - 35	26(23 – 30)	
BMI (kg/m ²)	27.29±1.13	25.4 – 29.6	27(26.4 – 28.2)	
Gestational Age (weeks)	38.5±0.47	37.43-39.57	38.43 (38.28 – 38.71)	
Variable	Number Total= 69		Percent %	
Medical history	Free	67	97.1	
	Hypo-thyroidism	2	2.9	
Surgical history	CS	Total	63	91.3
		once	31	44.9
		twice	23	33.3
		three times	9	13.1
	Open myomectomy	2	2.9	
	Append-ectomy	4	5.8	

Fifty-nine out of sixty-one individuals with either no or minor adhesions on the CS procedure were accurately diagnosed by the +ve sliding sign, while five out of eight patients with pronounced adhesions were correctly identified by the -ve sliding sign (Table 2).

Table (2): Association between sliding sign and the operative findings

Sliding sign	Adhesion				Test of sig. (χ ²)	P value
	Marked n=7		No or mild adhesion n=62			
	No.	%	No.	%		
Positive n=61	2	3.3	59	96.7	27.210	<0.001**
Negative n=8	5	62.5	3	37.5		

Sliding sign had 71.4% sensitivity, 95.2% specificity, 62.5% PPV and a 96.7% NPV for predicting marked intra-operative adhesions (Table 3).

Table (3): The diagnostic performance of sliding sign in the prediction of marked intra-abdominal adhesions.

Sensitivity	Specificity	Predictive value of +ve result (PPV)	Predictive value of -ve result (NPV)	accuracy
71.4	95.2	62.5	96.7	92.8%

Our study showed that patients with negative sliding had median anterior abdominal wall thickness of 21.7 mm and those with positive sliding have a median of 28 mm with significant difference knowing that the BMI of recruited patients was below 30 (Table 4).

Table (4): Comparison between anterior abdominal wall thickness with negative and positive sliding sign

Sliding sign	anterior abdominal wall thickness(mm)			Test of sig.	P – value
	Mean ± SD	Range	Median (IQR)		
Positive	27.5±2.2	19 - 32	28 (26.5 – 29)	t=3.680	0.006 *
Negative	23.23±3.	20.2 - 29	21.7 (20.8 – 25.9)		

There was an association with a cutoff point above which sliding tends to be positive and this point was 25.7 mm (Table 5).

Table (5): Receiver operating characteristic (ROC) curve analysis of the optimal cutoff of anterior abdominal wall thickness with negative and positive sliding sign

Cutoff point	AUC	Sensitivity %	Specificity %	P-value	95%CI Lower Upper
≥25.7	0.846	91.8	75	0.002	0.669 - 1

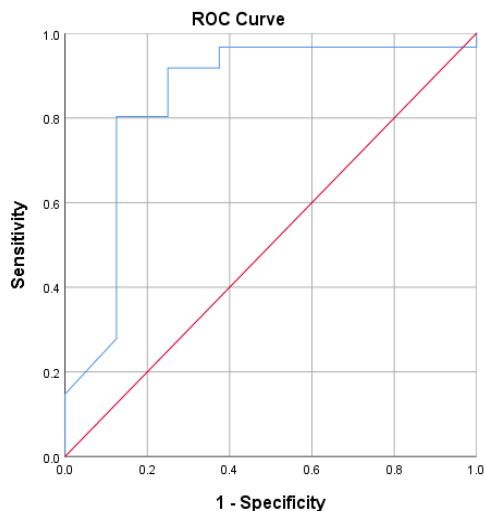


Figure (3): Receiver operating characteristic (ROC) curve analysis of the optimal cutoff of anterior abdominal wall thickness with negative and positive sliding sign

DISCUSSION

Caesarean sections (CS) are becoming more common over the globe, with rates of roughly 33% in the United States, 26.5% in the United Kingdom, 32.3% in Australia, and 51.8% in Egypt (8,9).

The production of post-CS adhesions is one of the important side effects of CS. These adhesions may raise the risk of damage to the gastrointestinal system and bladder, as well as the danger of bleeding, infection, and potentially even hysterectomy. The surgical removal of adhesions is referred to as adhesiolysis. This procedure entails the potential risk of damaging nearby organs, bleeding, and infection (3). There is a significant risk of developing adhesions as a result of caesarean section,

with reported rates ranging from 12% to 46% in women experiencing their second CS and from 26% to 75% in women receiving their third CS (2,10). After having a cesarean section, the likelihood of adhesion development is high.

The purpose of this research was to determine whether or not the sliding sign is an accurate tool for predicting the existence of intra-abdominal adhesions in women who had a history of both cesarean section (CS) and pelvic-abdominal surgery. In addition, we investigated whether or not there is a connection between the thickness of the anterior abdominal wall and the sliding sign, which is a topic that has not been thoroughly researched before. Participants in the research were all expecting mothers who were planned to have cesarean sections.

Previous research has employed the sliding sign as a predictor of intra-abdominal adhesions, either on its own or in conjunction with stria gravidarum and CS scar (11-16). Previous research has used transvaginal ultrasound, magnetic resonance imaging (MRI), and computed tomography (CT) of the abdomen to predict adhesions in female patients with probable endometriosis or other pelvic diseases (4,17).

The patients in our research had a mean age of 26.36 years, a mean body mass index of 27.29 kg/m², and a mean gestational age of 38.5 weeks on average. Among those who took part in the study, 91.3% had previously been treated with CS, 5.8% had undergone an appendectomy, and 2.9% had undergone an open myomectomy. During the CS surgery, 3.3% of patients developed severe adhesions, whereas 88.5% of those who had a good sliding sign did not have any adhesions at all. On the other hand, one quarter of those who had a negative sliding sign did not have any adhesions, while the remaining 62.5% had obvious adhesions. When evaluating the participants using the sliding sign, 59 out of 61 had either no or mild adhesions, but when utilizing the negative sliding sign, five out of eight persons with severe adhesions were discovered. According to these results, the sliding sign is an accurate predictor of adhesions that occur during CS, and there is only a small probability that this is a coincidence. These findings are in line with those obtained by **Drukker et al.** (11), who discovered that a positive sliding sign accurately identified pregnant women who previously had CS and stated that during the CS procedure, a positive sliding sign was able to successfully identify zero or minimum adhesions in 329 out of 340 persons, but a negative sliding sign was only able to accurately detect considerable adhesions in 16 out of 30 individuals. These findings have been confirmed by the current study.

According to the findings of **Drukker et al.** (11), this study showed that the sliding sign had a sensitivity of 71.4%, a specificity of 95.2%, a PPV of 62.5%, and a NPV of 96.7% when it came to predicting marked intra-operative adhesions. Also, they reported that when it came to the identification of severe adhesions, they

found that the test had a sensitivity of 56%, a specificity of 95%, a positive likelihood ratio of 12.1, and a negative likelihood ratio of 0.46.

Yet another study, conducted by **Baron *et al.*** ⁽⁷⁾, the researchers found that among 59 people who had elective CS with a history of one or more previous CS, 16 out of 19 instances, that were defined as high risk for adhesions based on negative sliding of the uterus, were verified after surgery. These cases were identified as high risk because the adhesions prevented the uterus from moving freely. According to our results, the sliding sign had a sensitivity of 76.2% and a specificity of 92.1% when it came to predicting the presence of adhesions in women who had undergone CS more than once. In addition, a low risk for adhesions was correctly assigned to 35 out of the 40 instances that were evaluated.

In our research, the length of labor following the skin incision was found to be 7.8 ± 3.67 minutes on average, with a range of 5 to 21 minutes. We found that the duration of this condition was substantially longer in persons who had a negative sliding sign compared to those who had a positive sliding sign (the median was 16.5 minutes vs 6 minutes, and the p-value for this comparison was more than 0.001). The findings of **Drukker *et al.*** ⁽¹¹⁾, who observed a considerably longer delivery time among those who had a negative sliding sign, are supported by our data, which are congruent with their findings.

Greenberg *et al.* ⁽³⁾ performed a research on 145 women who were receiving repeat CS and found that women with adhesion scores > 3 had a mean time from incision to delivery of 19.8 minutes, while those with scores ≤ 3 had a mean time of 15.6 minutes ($p = 0.04$). When other possible confounding factors were taken into account, the percentage of women who had adhesion scores of 3 or above who had not given birth 30 minutes after incision was significantly greater than the percentage of women who had scores of less than 3 (17.9% vs. 5.1%; odds ratio, 7.6; 95% confidence interval, 1.6–34.5). These data provide indirect support for the conclusions of our investigation.

Patients who had a positive sliding sign had a significantly lower risk of bleeding during the operation (4.9% with a Hb drop of 2-3 g/dl and 0% with a drop greater than 3 g/dl), whereas patients who had a negative sliding sign had a significantly higher likelihood of bleeding during CS (25% with a drop above 3 g/dl and 12.5% with a drop of 2-3 g/dl). Those who had a negative sliding sign are more likely to develop bleeding (a reduction in hemoglobin of more than 3 g/dl) compared to those who had a positive sign, according to the results of **Drukker *et al.*** ⁽¹¹⁾, which are comparable to our own findings.

In our research, patients who had a negative sliding sign had an anterior abdominal wall thickness that was a median of 21.7 millimeters, whereas patients who had a positive sliding sign had a thickness that was a median of 28 millimeters. It is important to note that all of the

patients who were recruited had a BMI of less than 30. We found that there was a correlation between sliding and a cutoff point of 25.7 mm, beyond this point, sliding had a tendency to be positive. The link between the thickness of the abdominal wall and the sliding sign, which has not been thoroughly researched in the past, may now be understood more clearly thanks to these discoveries.

Limitations of the study

Doing this study over a large scale of women to confirm these results and perhaps include patients with BMI more than 30 trying to find a relation between anterior abdominal wall thickness and sliding sign and adhesions.

CONCLUSION

The present research showed that a negative uterine sliding sign can predict the presence of extensive intra-abdominal adhesions during Cesarean delivery. Furthermore, patients with a -ve sliding sign were more likely to have a prolonged duration of labor and a greater likelihood of intra-operative hemorrhage and visceral injury.

- **Availability of data:** All data from the current study are accessible upon request from the corresponding author.
- **Consent for publication:** I attest that all authors agreed to submit the work.
- **Availability of data and material:** Available
- **Competing interests:** None
- **Funding:** No fund
- **Conflicts of interest:** No conflicts of interest.

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