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Prediction of Intraperitoneal Adhesions in Repeated Cesarean Section Using Sliding Sign, Striae Gravidarum, and Cesarean Scar

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Abstract

Background: Intraabdominal adhesions are associated with an increase in complications during cesarean section because of recurrent cesarean sections. This is why the possibility of predicting adhesions is important. In this study, the diagnostic value of depressed scar, severe striae gravidarum, and negative sliding sign, and their combinations were evaluated for predicting intraabdominal adhesions of cesarean candidates.

Methods: This prospective descriptive study was performed during 2019-2020 on 123 pregnant women referred to Ayatollah Taleghani university hospital with a gestational age of ≥36 weeks 0 days who were candidates for cesarean section because of a previous cesarean section. In each patient, the presence of a depressed scar, a severe striae gravidarum, the absence of a sliding sign, and the presence and severity of adhesions during the operation were examined. Sensitivity and specificity, and positive and negative predictive values of each of the 3 indicators and their combinations were calculated.

Results: The frequency distribution of severe adhesion in these individuals was 16.27%. The highest sensitivity was related to depressed scar and negative sliding sign (65%). The highest specificity was related to the negative sliding sign and its combinations (97%-99%). The highest positive predictive value was related to negative sign sliding and its combinations (81%-92%). The negative predictive values of depressed scar, negative sliding sign, and severe striae gravidarum, and even their combinations were almost the same and approximately between 89% and 93%.

Conclusion: To predict the presence of adhesions in a cesarean candidate because of a previous cesarean section, you should first examine the striae gravidarum and scar. In the absence of a depressed scar and severe striae gravidarum, there is a 90% chance of no adhesions. According to this study, if both signs are present, it is recommended to check the sliding sign to obtain a more accurate estimate.

Keywords: Cesarean Section, Intraperitoneal Adhesions, Prediction, Sliding Sign, Striae Gravidarum, Cesarean Scar

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Introduction

The rate of cesarean section has increased dramatically in recent decades. Based on data obtained from 150 coun-

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↑What is "already known" in this topic:
The presence of adhesions due to previous cesarean section(s) can be associated with complications in the current cesarean section. As a result, the prediction of a severe adhesion has always been taken into account. Past research has relied on a range of single approaches, including ultrasonography to check for sliding symptoms, scars from previous surgeries, and striae gravidarum.

→What this article adds:
Examination of different methods of predicting adhesion and their combinations showed that it is better to check the sliding sign if there is a depressed scar or severe striae or even both of them. However, if a person does not have a depressed scar or severe striae gravidarum, checking the sliding sign will have little effect on the predictive power.

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tries, the rates of cesarean deliveries in different regions range from 7.3% to 40.5% (amean: 18.6%) (1). In Iran, this rate is estimated to be about 48% (2). One of the main causes of cesarean section is a previous cesarean section (3). Adhesion formation is one of the most common complications of abdominal and pelvic surgeries (4), and its prevalence is 7% after the first cesarean section and about 68% after the third cesarean section (5). Adhesions can make future surgeries more difficult by increasing the risk of damage to the urinary and gastrointestinal tracts, surgery duration, amount of bleeding during the procedure, infection, adverse perinatal outcomes (such as low umbilical artery pH and 5-minute Apgar score, as well as lengthening the time from the start of surgery to delivery), requiring the assistance of other colleagues, and hysterectomy (6, 7). For these reasons, surgeons always want to know about the possibility and extent of adhesions before cesarean section so that they can be prepared. Although to date, there has been no reliable method for predicting intraabdominal adhesions in women with a history of cesarean section, various methods have been used for this purpose.

One of these methods is to examine the characteristics of the scar (7). The relationship between abdominal scar resulting from previous surgery and intraabdominal adhesion has been of interest to researchers since both are tissue repair processes (8).

Another method is to check the sliding sign with ultrasound, which is a noninvasive method that does not cause discomfort for the patient. In this method, the relative motion between the abdominal wall and the uterus is examined. If there is no uterine sliding, the patient is deemed high risk, and if there is uterine sliding, she is considered low risk (7).

Another method is to examine the striae gravidarum (stretch marks). Stretch marks are linear, visible scars that form where the skin is damaged by stretching (5). Because the tissue repair pathway appears to be similar in both intraabdominal adhesions and striae gravidarum, it is thought that there may be a relationship between striae severity and adhesion severity (9).

We aimed to evaluate the diagnostic value of the negative sliding sign, severe striae gravidarum, scar depression, and their combinations in predicting severe intraabdominal adhesion.

Methods

The proposal of this study was approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences (code: IR.SBMU.MSP.REC. 1398.768).

This prospective diagnostic study was performed during 2019 and 2020 on 123 pregnant women with a gestational age of ≥36 weeks 0 days who were candidates for a cesarean section because of a previous cesarean section and referred to Ayatollah Taleghani university hospital in Tehran. The sampling method was convenience sampling. We excluded women who had multiple pregnancies, wound infection, or endometritis after previous cesarean sections, connective tissue disease, a history of systemic steroid use or endometriosis, pelvic inflammatory disease, or any previous abdominal surgery other than cesarean section.

We initially informed eligible individuals that they would not be subjected to any further action other than an examination of abdominal scars and stretch marks, a free ultrasound, and the completion of an information form and that they would not be precluded from receiving routine treatment if they did not want to participate in the study.Written informed consent was obtained if they agreed to participate in the study.

Then, the evaluator (who was the same person in all surgeries) completed a form, including the following information: the patient's name; case number; maternal age by year; fetal age by week; and number of pregnancies, including the current pregnancy, number of deliveries before the current delivery, number of previous cesarean sections, and the interval between the current and previous cesarean sections by month, type of skin incision (midline or Pfannenstiel), body mass index (kg/m^2), type of scar (depressed or elevated, flat, or raised), and condition of stria gravidarum (absence, mild, severe).

The Davey scoring system was used to measure the severity of striae. In this system, the abdomen is divided into 4 quarters (by 2 lines perpendicular to each other that pass through the navel), each quarter receives a score. It receives a score of 0 if it has no striae, a score of 1 if it has 1 to 3 striae, and a score of 2 if it has 4 striae. Finally, the score of the 4 quarters are added together. A score of 0 is considered as the absence of striae, a score of 1 or 2 as mild striae, and 3 to 8 as severe striae (50. In this study, striae with any color were considered in the analysis.

Prior to cesarean section, all women underwent abdominal ultrasound using a GE Voluson E6 with a 5–9-MHz transabdominal probe. Women were not requested to empty their bladder before ultrasound examination. The ultrasonographer placed the probe prependicular to the scar. During the ultrasound examination, the patient was asked to take a deep breath. Then, the ultrasonographer assessed the sliding of the uterus under the inner part of abdominal muscles fascia. A sliding sign was detected when sliding of the uterus against the abdominal wall was observed. If the uterus had no movement or it was less than 1 centimeter, the sliding sign was absent and the patient was considered to be high risk for intraperitoneal adhesion (10).

Immediately after the operation, the evaluator, who was blind to the ultrasound result, recorded her observations about fetal sex, absence or presence of adhesions, if present, the severity of adhesions: filmy and thin, or a dense/frozen pelvis, and recorded them in the information form.

Data were analyzed using SPSS software Version 24. The descriptive statistics (means, SDs, etc) of the variables was calculated. Sensitivity (number of true positives/total number of sick individuals in population), specificity (number of true negatives/ total number of well individuals in population), positive and negative predictive values (number of true positives/ number of positive calls and number of true negatives/number of negative calls), and the likelihood ratio for positive and negative tests (sensitivity/1- specificity and 1- sensitivi-

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ty/specificity) of the negative sliding sign, severe striae gravidarum, depressed scar, and its combinations were calculated.

Results

A total of 123 parturients were included in this study. Of these, 20 (16.26%) had severe adhesions or frozen pelvis. None of this led to a hysterectomy or rupture of the bladder. Table 1 shows the demographic characteristics and results of the examination of the scar, stria gravidarum, sliding sign, and intraabdominal adhesions of the cesarean section candidates.

Table 2 also shows the sensitivity, specificity, positive predictive value, and negative predictive values of a depressed scar, severe striae gravidarum, negative side sliding, and their 2 combinations (depressed scar and severe striae gravidarum, depressed scar and negative side sliding, severe striae gravidarum and shows negative side sliding), and their triple combination (depressed scar, negative side sliding, and severe striae gravidarum). As demonstrated in Table 2, the highest positive likelihood ratios are related to the combination of a negative sliding sign and a depressed scar (55), a negative sliding sign and severe stria gravidarum (40), and the combination of all 3 (35). Also, the lowest negative likelihood ratios were related to a negative sliding sign (0.36), a depressed scar (0.42), and the combination of the 2 (0.45), respectively. This ratio was 0.62 for severe striae gravidarum.

Table 1. Demographic characteristics and results of scar, striae, gravidarum, sliding sign, and intra-abdominal adhesions in 123 cesarean section candidates because of a previous cesarean section

Patients' characterisitcs	All (N=123)
Age (year) *	31.44 ± 5.09
Gravidity (number) *	2.85 ± 1.03
Parity (number) *	1.60 ± 0.82
BMI (kg / m^2) *	30.80 ± 4.31
Previous C/S *	1.50 ± 0.73
The interval between current and previous cesarean section (month)*	43.40 ± 23.35
Incision (number, %)	Midline: (5, 4.07%) Pfannenstiel: (118, 95.93%)
Scar type (number, %)	Depressed: (31, 25.20%) Flat: (76, 61.79%) Elevated: (16, 13%)
Sliding sign (number, %)	Negative: (16, 13%) Positive: (107, 87%)
Fetus sex (number, %) **	Boy: (59, 47.2%) Girl: (66, 52.8%)
Adhesion (number, %)	No: (34, 27.64%) Mild (filmy and thin): (69, 56.10%) Sever (dense / frozen pelvis): (20, 16.26%)

* Mean and standard deviation
BMI: Body Mass Index
C/S: Cesarean section
**: Two cases of twin pregnancy

Discussion

We studied 123 women undergoing cesarean section because of a previous cesarean section to predict intra-abdominal adhesion and found that the highest sensitivity was related to a depressed scar and a negative sliding sign (65%), and the highest specificity was related to a negative sliding sign and its combinations (97%-99%). However, these 2 criteria are characteristics of the test, and what is more important for the physician and the patient is the positive predictive value and the negative predictive value. The reason is that "sensitivity and specificity indicate the concordance of a test with respect to a chosen referent, while the positive and negative predictive value indicate the likelihood that a test can successfully identify whether people do or do not have a target condition, based on their test results." (11).

The results show that the highest positive predictive value was related to the negative sliding sign and its combinations (81%-92%). Since the positive predictive values of the depressed scar and severe striae gravidarum and their combination were 42, 45, and 54%, respectively, if an expert ultrasonographer and ultrasound device are available and there is enough time, it is preferable to check the sliding sign in case of observing a depressed scar or severe striae or both and to check the presence of an intra-abdominal adhesion and be ready to deal with severe adhesions. Results also show that the positive predictive value of the combination of a negative sliding sign and a depressed scar (92%), a negative sliding sign and a severe striae gravidarum (89%), and the combination of all 3 (88%) is higher than the negative sliding sign alone (81%) and it is preferable to use them.

In contrast, the negative predictive value of a depressed scar, a negative sliding sign, and severe striae gravidarum, and even their combinations, was almost the same (89%-

Table 2. Sensitivity, specificity, positive and negative predictive value, negative sign sliding, severe striae gravidarum, scar depression, and their combinations in prediction of severe intraperitoneal adhesion

Predictors of adhisions	Sensitivity	Specificity	Positive predictive value	Negative predictive value	Likelihood ratio for positive test	Likelihood ratio for negative test
Depressed scar	0.65	0.83	0.42	0.92	3.82	0.42
Negative sliding sign	0.65	0.97	0.81	0.93	21.67	0.36
Severe striae gravidarum	0.45	0.89	0.45	0.89	4.09	0.62
Depressed scar & Negative sliding sign	0.55	0.99	0.92	0.92	55.00	0.45
Depressed scar & Severe striae gravidarum	0.35	0.94	0.54	0.88	5.83	0.69
Severe striae gravidarum & Negative sliding sign	0.40	0.99	0.89	0.89	40.00	0.61
Depressed scar & Severe striae gravidarum & Negative sliding sign	0.35	0.99	0.88	0.89	35.00	0.66

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93%). Therefore, if a person does not have a depressed scar or severe striae gravidarum, there is a 90% probability that she does not have severe intra-abdominal adhesions, and assessing a sliding sign will have little effect on our predictive ability.

Also, the results of the positive likelihood showed that the presence of a depressed scar, severe striae gravidarum, and their combination has a likelihood ratio of <10, and with the addition of a negative sliding sign, this ratio increases significantly and it is recommended that in the presence of a depressed scar and/or severe striae gravidrum ultrasound be used to increase the accuracy of prediction of adhesion. The results also showed that the negative likelihood ratio of any of the tests is not small enough and in the absence of a depressed scar and/or severe striae gravidarum, ultrasound will not have much effect on increasing the accuracy of prediction of adhesion.

As in the present study, other studies have shown the role of a sliding sign in predicting abdominal and pelvic adhesions. Ayachi study on 107 laparoscopy or laparotomy candidates with a history of abdominopelvic surgery showed that examination of a sliding sign with real time dynamic transvaginal ultrasound before surgery was an effective method for predicting preoperative adhesions with positive and negative predictive values of 89.29% and 97.47%, respectively (6).

Nirumanesh studied the sliding sign in 207 candidates for cesarean section due to previous cesarean sections and showed that a negative sliding sign had a sensitivity of 68%, specificity of 96.5%, and positive and negative predictive values of 81% and 91%, respectively (12), which is consistent with our results.

Baron and colleagues studied 59 candidates for cesarean section because of a previous cesarean section and found that the sensitivity, specificity, and positive and negative predictive values of the negative sliding test with abdominal ultrasound in the third trimester of pregnancy in predicting intra-abdominal adhesions was 76.2, 92.1, 84.2, and 87.5%, respectively (7).

Fibroblasts play an active role in creating peritoneal adhesions and striae. Incomplete degradation of fibrin induces collagen production by fibroblasts and ineffective collagen degradation creates adhesion to the peritoneum. Collagen also plays a key role in striae (13). Therefore, assuming the existence of a common etiopathology between peritoneal adhesions and striae, studies on the prediction of intra-abdominal adhesions have been performed by examining striae, with contradictory results.

At a prospective descriptive study on 210 pregnant women who had a cesarean section with a history of at least 1 cesarean section, Naser showed that the adhesion score decreased with an increased striae score ($p<0.0001$), and the 2 had a significant inverse relationship. They showed that the sensitivity, specificity, and positive and negative predictive values of abdominal striae for the diagnosis of intra-abdominal adhesions were 81.2%, 54.02%, 71.43%, and 67.14%, respectively. They noted that the reason for decreased adhesion in women with severe striae gravidarum was the dysfunction of fibroblast cells, which are involved in both striae formation and adhesion formation. These fibroblasts produce less collagen in the adhesive tissue during formation of extracellular matrix, and thus adhesion formation is reduced (5).

In contrast with Naser study, Elprince showed that in 408 pregnant women undergoing cesarean section because of a previous cesarean section, striae severity based on Davey and Vancouver scores could significantly predict intraperitoneal adhesion severity (14). However, one study on 378 candidates for cesarean section because of a previous cesarean section did not show a significant relationship between the severity of stria gravidarum and intraperitoneal adhesion (15).

Regarding the relationship between depressed scar and intra-abdominal adhesion, a meta-analysis on 5 studies and 902 women showed that the presence of previous depressed cesarean scar could be positively associated with intra-abdominal adhesions (odds ratio, 2.79; 95% CI, 1.74-4.46) (16).

The results of Yaghmaei study on 109 term candidates of cesarean section because of a previous cesarean section also showed that the 2 groups of women with and without dense and vascular or frozen pelvis adhesions were significantly different regarding the existence of a depressed scar (17).

However, Dugan study on 295 candidates for cesarean section because of a previous cesarean section did not confirm this and, on the contrary, showed that an elevated scar was associated with an increased likelihood of intra-abdominal adhesions (18).

One of the limitations of this study was that despite all the ultrasounds being performed by a qualified specialist and no need for interobserver agreement, the intraobserver agreement was not performed before the study began. Because of inconsistent results and also inverse correlation between striae severity and presence of intraperitoneal adhesion, further studies should be performed in this field. Also, this study was performed on women who were candidates for cesarean section with a gestational age of ≥36 weeks 0 days. Since they might need emergency cesarean section for various reasons, we suggest performing similar studies on women with younger gestational age to be more prepared for possible intra-abdominal adhesions.

If adhesions can be predicted before a repeat cesarean section, these surgeries can be referred to more experienced physicians or better-equipped centers and expert colleagues can be informed to be on call in case of an emergency. It is suggested that future studies with the same factors and other predictors of intraperitoneal adhesion be performed.

Conclusion

Our study showed that the possibility of adhesions in cesarean candidates with a previous cesarean section could be easily predicted by considering 2 points in the examination and performing an ultrasound, if necessary, thus, appropriate measures can be taken to reduce unwanted complications.

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Conflict of Interests

The authors declare that they have no competing interests.

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