

ULTRASONOGRAPHIC SLIDING SIGN IN PREDICTION OF INTRA-ABDOMINAL ADHESIONS IN PREGNANT WOMEN UNDERGOING CESAREAN SECTION FOLLOWING PELVI-ABDOMINAL SURGERY

By

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ABSTRACT

Background: Intra-abdominal adhesions are frequently encountered during repeated cesarean section delivery, and are aggravated in prevalence and severity in multiple repeated cesarean section deliveries. Adhesiolysis may result in lengthy fetal extraction, injury to adjacent viscera and blood loss.

Objective: To evaluate preoperative U/S in detecting pelvic adhesions and their related complications in pregnant women in third –trimester with history of previous pelvi-abdominal surgery.

Patients and Methods: This was a prospective observational study included 158 pregnant women with previous cesarean section, conducted at the Department of Obstetrics and Gynecology, Al-Hussien Hospitals, between April 2020 and October 2020. Each patient was subjected to abdominal ultrasound to detect sliding sign between the uterine wall and anterior abdominal wall.

Results: Of the recruited patients, 98.2% had positive sliding sign, while 10.2 % had negative sliding sign. On cesarean section procedure in 82.9% of patients, while 8.9% of them had marked adhesions, and 3.8% of patients complicated with visceral injury. Only 2.5% of patients complicated with hemoglobin (HB) drop > 3g/dl, and 5% complicated with hemoglobin drop between 2-3 g/dl. Positive sliding sign correctly identified 138 out of 144 patients who had no or mild adhesions on cesarean section procedure while negative sliding sign correctly identified 10 out of 14 patients who had marked adhesions on cesarean section procedure.

Conclusion: Negative uterine sliding sign predicted severe intra-abdominal adhesions encountered during repeat cesarean delivery. Furthermore, a longer time to delivery and a higher chance of both intra-operative bleeding and visceral injury were more common in the patients with negative sliding sign.

Keywords: Sliding sign, Intraabdominal adhesions, Cesarean section, Pelviabdominal Surgery.

INTRODUCTION

Post-CS adhesions are a major complication in subsequent surgeries, causing an increased risk for bladder and bowel injury (0.1–0.3%), hemorrhage (0.1–1.4%), infection (0.4–1.6%) and

even hysterectomy (0.1–1.4%). In addition to the risk associated with the abdominal surgical procedure itself, adhesiolysis may result in injury to adjacent viscera, blood loss and in case of emergency CS to the perinatal adverse

outcome associated with delayed delivery of the neonate (*Greenberg et al., 2011*).

Surgeons lack a reliable method for the preoperative prediction of intra-abdominal adhesions in repeat Cesarean delivery. Several strategies have been suggested, including skin scar visual characteristics and surgical history. However, these methods suffer from lack of reproducibility, and there is often no relevant history before the first repeat cesarean delivery. Hence, whether a specific woman before a repeat cesarean delivery is at risk for severe intra-abdominal adhesions remains unknown. This represents a considerable healthcare issue, as it has a significant impact both on the patient, increasing morbidity and mortality, and on healthcare cost (*Bates and Shomento, 2011*).

Women suspected to have severe intra-abdominal adhesions may benefit from appropriate preparation of blood products, better assignment of surgeons, request for preoperative surgical assistance of other medical specialties, and possibly performance of a midline skin incision to enter the peritoneal cavity. It is, therefore, important for surgeons to detect patients at high risk of having adhesions (*Reid et al., 2013*).

This information can permit preoperative planning by a multidisciplinary team of surgeons and allow the patient to be informed of the potentially high risk of complications. Various means have been proposed to predict adhesions prior to surgery, including analysis of patient characteristics and appearance of the scar, as well as the intraoperative peritoneal adhesion index (*Sepilian et al., 2010*).

The sonographic sliding sign has been shown to have high predictive value for the detection of pelvic adhesions in women with endometriosis and chronic pelvic inflammation as well as infraumbilical adhesions before laparoscopic surgery (*Saeed et al., 2017*).

This study was conducted to evaluate preoperative U/S in detecting pelvic adhesions and their related complications in pregnant women in third –trimester with history of previous pelviabdominal surgery.

PATIENTS AND METHODS

This was a prospective observational study conducted at the Department of Obstetrics and Gynecology, Al-Hussien Hospitals between April 2020 and October 2020.

The study included 158 full-term pregnant women with history of previous pelviabdominal surgery admitted for elective cesarean section from outpatient clinic of Al-Hussien Hospital, and to participate in the study to investigate the value of the sonographic evaluation in predicting the intra-abdominal adhesions.

The study included full term women with history of previous pelviabdominal surgery who were scheduled to undergo elective cesarean section.

Pregnant females with body mass index more than 40 on admission, patient with abnormal placental invasion and patients with unplanned repeated cesarean delivery were excluded from the study.

Ethical consent:

An approval of the study was obtained from Al- Azhar University academic and ethical committee. Every patient signed an

informed written consent for acceptance of the operation.

The patients were subjected to the following: Careful history taking including age, parity, gestational age, complete physical examination and assessment of previous scars, preoperative and postoperative complete blood picture, coagulation profile, liver functions and kidney functions were taken from the patient for laboratory, trans-abdominal ultrasonography (TAS) using 2D (voluson p8) US during the preoperative examination, Using the real-time TAS pelvic sliding sign (the relative motion between the maternal abdominal wall and uterine wall), as described by *Drukker et al. (2018)*.

The patient was asked to breathe deeply, accentuating her respiratory movements and the sonographer record a video clip, in a mid-sagittal plane lateral to umbilicus focus on the infra-umbilical space, to determine whether the abdominal wall glided freely in relation to adjacent structures to be considered as sliding, the structures have to glide easily, one against the other (positive sliding sign), no motion of the structure in question considered as a negative sliding sign.

During surgery, within 48 hours from TAS examination, a detailed description of adhesions and any inadvertent damage

was provided through direct observation by the surgeons.

Adhesions were graded according to severity using a standardized scoring system: (0) no adhesions, (1) minimal or filmy adhesions, (2) moderate or thick adhesions, and (3) absence of free space between the uterus and anterior abdominal wall.

The duration of the cesarean section, expressed in minutes, hemoglobin drop greater than 3 g/dl (calculated between preoperative and postoperative hemoglobin levels), bladder and bowel injury, recorded.

Statistical analysis:

All statistical calculations were done using computer program SPSS (Statistical Package for the Social Sciences; SPSS Inc., Chicago, IL, USA) release 15 for Microsoft Windows (2006). Data were statistically described in terms of mean \pm standard deviation (\pm SD), or frequencies (number of cases) and percentages when appropriate. For comparing categorical data, Chi square (χ^2) test was performed. Exact test was used instead when the expected frequency is less than 5. P values less than 0.05 was considered statistically significant.

RESULTS

The mean age of patients was 30.6 years (± 4.04), while the mean BMI was 30.9 kg/m² (± 2.5) (Table 1).

Table (1): Demographic features of the studied patients

	Mean	Standard Deviation
Age (y)	30.6	4.04
BMI (kg/m ²)	30.9	2.5

Of the recruited patients 77% had done previous CS before, 14% had done appendectomy before, 6% had done open myomectomy before and 3 % of them had previous exploratory laparotomy (Table 2).

Table (2): Number of Previous abdominopelvic surgery among the studied patients

	Number	Percentage
Cesarean Section	121	77%
Open Myomectomy	10	6%
Appendectomy	22	14%
Exploratory laparotomy	5	3%
Total	158	100%

Of patients with positive sliding sign 89.4% had no adhesions on CS procedure, and 2.9 % of them had marked adhesions. On the other hand, 62.5% of patients with negative sliding sign had marked adhesions on CS procedure and 25% of them had no adhesions (Table 3).

Table (3): Association between sliding sign and adhesions

Adhesion \ Sliding Sign	MARKED Adhesions	MILD Adhesions	NO Adhesions	Total
Positive	4 (2.9%)	11 (7.7%)	127 (89.4%)	142
Negative	10 (62.5%)	2 (12.5%)	4 (25%)	16
Total	14 (8.8%)	13 (8.1%)	131 (82.8%)	158

Positive sliding sign correctly identified 138 out of 144 patients who had no or mild adhesions on CS procedure, while negative sliding sign correctly identified 10 out of 14 patients who had marked adhesions on CS procedure (Table 4).

Table (4): Correlation between ultrasonographic sliding sign and the operative findings

Adhesions Sliding sign	No or mild adhesions	Marked adhesions	Total
Positive	138	4	142
Negative	6	10	16
Total	144	14	158

Patients with negative sliding sign were more liable to intra operative bleeding (had a significant Hb drop during CS) as 25% (4 out of 16) complicated

with Hb drop more than 3 g/dl and 12.5% (2 out of 16) with Hb drop 2-3 g/dl (**Table 5**).

Table (5): Association between sliding sign and Hb drop

Hb drop (g/dl) Sliding sign	< 1 g/dl	1-2 g/dl	2-3 g/dl	> 3g/dl	Total
Positive	25 (17.6%)	111 (78.2%)	6 (4.2%)	0 (0%)	142
Negative	1 (6.25%)	9 (56.3%)	2 (12.5%)	4 (25%)	16
Total	26	120	8	4	158

Patients with negative sign were more prone to visceral injury compared to patients with positive sign. The percent of patients complicated with visceral injury

and had positive sliding sign was 1.4% (2 out of 142), while it was 25% (4 out of 16) for patients who had negative sliding sign (**Table 6**).

Table (6): Association between sliding sign and visceral injury

Visceral injury Sliding sign	Yes	No	Total	P-value*
Positive	2 (1.4%)	140 (98.6%)	142 (100%)	<0.001
Negative	4 (25%)	12 (75%)	16 (100%)	
Total	6	152	158	

DISCUSSION

Post-CS adhesions are a major complication in subsequent surgeries, causing an increased risk for bladder and bowel injury (0.1–0.3%), hemorrhage (0.1–1.4%), infection (0.4–1.6%) and even hysterectomy (0.1–1.4%). In addition to the risk associated with the abdominal surgical procedure itself, adhesiolysis may result in injury to adjacent viscera, blood loss and in case of

emergency CS, to the perinatal adverse outcome associated with delayed delivery of the neonate (*Greenberg et al., 2011*).

Formation of adhesions is common after cesarean delivery, and the extent and density increase with increasing numbers of repeat cesarean deliveries: the reported prevalence of adhesions is 12 to 46 percent of women at their second cesarean and 26 to 75 percent of women at their third cesarean (*Hesselman et al., 2018*).

Several approaches have been proposed for the preoperative prediction of intra-abdominal adhesions in repeat cesarean delivery (e.g., abdominal scar visual characteristics and surgical history). However, these methods suffer from lack of reproducibility and there is often no relevant history before the first repeat cesarean delivery (*Greenberg et al., 2011*).

Diagnosis of adhesions is often based on initial clinical suspicion in a relevant context, which may then be confirmed by direct examination of the abdomen or pelvis via laparoscopy or laparotomy, or with indirect methods, such as imaging that may include ultrasound (demonstrating reduced visceral sliding) or magnetic resonance of the abdomen and computed tomography (CT) of the abdomen. Prediction of intraabdominal adhesions before CS may be by scar characteristics with parameters of color, appearance, contour, and distortion, number of previous abdominal operations, neutrophil fraction is higher in patients with intra-abdominal adhesions, smoking rate is higher in patients with intra-abdominal adhesions, preoperative symptom assessment as recurrent vaginal infection and pelvic pain, preoperative ultrasonographic sliding sign (*Tulandi and Lyell, 2013*).

The sliding sign is the relative motion between the abdominal and uterine wall as assessed by ultra-sonography, it may help to identify severe intra-abdominal adhesions before repeating cesarean delivery. Using trans abdominal ultra-sonography, while the patient breathed deeply, the ultra-sonographer recorded a video clip in a sagittal plane lateral to the

umbilicus. To determine whether the structure glided freely in relation to adjacent structures. To be considered as sliding, the structures have to glide easily, one against the other (positive sliding sign); no motion of the structure in question signaled a negative sliding sign (*Diamond et al., 2010*).

Adhesions are the most common cause of intestinal obstruction in Western countries. The incidence of small bowel obstruction resulting from postoperative adhesions increases with each subsequent procedure performed in the management of bowel obstruction (*Schnüriger et al., 2011* and *Ouaiissi et al., 2012*).

Adhesions can interfere with ovum capture and transport or from tubal adhesions that hinder sperm transport or embryo implantation, responsible for approximately 10 % of cases of female infertility (*DeCherney and Kumar, 2018*).

Adhesions are found in up to 95 percent of patients who have subsequent surgery, can impose technical difficulties and increase risk for complications that may include; Difficult abdominal access related to loss of tissue planes or distorted anatomy, inability to perform laparoscopic surgery, inadvertent injury to the small bowel, bladder, or ureters, increased duration of surgery and prolonged anaesthesia and increased blood loss (*ten Broek et al., 2012, 2013*).

Nearly 1% of all general surgical admissions and 3% of all laparotomies relate directly to adhesions, which increases the burden of care (economic, manpower, logistics). Complications related to or resulting from postoperative adhesions increase the surgical workload and hospital utilization and tax other

healthcare resources, resulting in a significant economic burden; the overall estimated annual costs of managing adhesion-related complications exceed \$2 billion in the United State (*Sikirica et al., 2011*).

The current study was an observational one conducted in the Obstetrics and Gynecology Department at El Hussein hospital and aimed to evaluate the efficacy of sliding sign in predicting intra-abdominal adhesion prior to repeated cesarean delivery. The study included 158 pregnant women candidate for repeated cesarean section.

Our results demonstrated that 98.2% of the recruited patients had positive sliding sign, while 10.2 % had negative sliding sign. 82.9% of patients had no adhesions on CS procedure, while 8.9% of them had marked adhesions. 3.8% of patients complicated with visceral injury. Only 2.5% of patients complicated with HB drop > 3g/dl and 5% complicated with HB drop between 2-3 g/dl. Positive sliding sign correctly identified 138 out of 144 patients who had no or mild adhesions on CS procedure while negative sliding sign correctly identified 10 out of 14 patients who had marked adhesions on CS procedure. Accordingly, the sensitivity, specificity, PPV and NPV of sliding sign in predicting marked intra-operative adhesions were 71.4%, 95.8%, 62.5% and 97.1% respectively. The median of delivery time (time from skin incision till delivery of baby) was significantly longer in patients with negative sliding sign compared to those with positive sliding sign (18 minutes versus 8 minutes).

Also, patients with negative sliding sign were more liable to intra operative

bleeding as 12.5% of them complicated with Hb drop from 2 to 3 g/dl and 25% more than 3 g/dl, while 4.2% of patients with positive sliding sign complicated with Hb drop from 2 to 3 g/dl and 0% more than 3 g/dl.

Visceral injury is more common in patients with negative sliding sign as 25% of patients with negative sliding sign complicated with visceral injury, while 1.4% of patients with positive sliding sign complicated with visceral injury.

Similarly, in a study done by *Drukker et al. (2018)*, pregnant women with previous cesarean section were recruited, positive sliding sign correctly identified 329 out of 340 patients who had no or mild adhesions on CS procedure while negative sliding sign correctly identified 16 out of 30 patients who had marked adhesions on CS. A negative sliding sign had a sensitivity of 56% (95%ci 35–76), specificity of 95% (95% CI 93–97), a positive likelihood ratio of 12.1 (95% CI 6.7–21.8), and a negative likelihood ratio of 0.46 (95% CI 0.30–0.72) for the detection of severe adhesions. They also reported that women with a negative sliding sign had significantly elevated risk of bleeding (hemoglobin drop greater than 3 g/dl) compared with those with a positive sliding sign. Furthermore, the study showed that the skin incision-to-delivery interval was significantly longer by 6.7 minutes (95% CI 3.3–10.0, $p < 0.001$), in women with a negative sliding sign compared with those with positive sliding sign.

A prospective cohort study done by *Greenberg et al. (2011)* on 145 women undergoing first repeat cesarean where severity and location of adhesions were

reported by surgeons immediately postoperatively. The study compared adhesion density scores with delivery data. The study showed that 63.5% had adhesions and 36.5% did not. Mean incision to delivery time in women with adhesion scores >3 was 19.8 minutes, compared to 15.6 minutes with scores ≤ 3 ($P = .04$). More women with adhesion scores >3 remained undelivered at 30 minutes after incision compared to scores ≤ 3 (17.9% vs 5.1%; odds ratio, 7.6; 95% confidence interval, 1.6–34.5), after controlling for potential confounders.

A retrospective study done by *Morris et al. (2016)* showed the incidence of bladder injury during cesarean delivery was 0.22% overall, 0.11% for primary cesareans, and 0.49% for repeat cesareans. Of 39 bladder injuries, 21 (54%) occurred during urgent cesarean sections. 27 (69%) had adhesions. 35 cases were identified intra operatively. The results of the two above studies agree with the results of our study as the current study demonstrated that a negative uterine sliding sign predicts severe intra-abdominal adhesions encountered during repeat cesarean delivery. Furthermore, a longer time to delivery and a higher chance of both intra-operative bleeding and visceral injury were more common in the patients with negative sliding sign.

The problems faced us that the accuracy of ultrasonography highly correlates with the abdominal wall thickness. We included only women whose BMI was below 40; hence, the accuracy of the sliding sign in women with a BMI greater than 40 remains to be determined. Moreover, adhesion grading

was based on surgical notes that may lack consistency between surgeons.

CONCLUSION

In conclusion, a negative sliding sign predicted severe intra-abdominal adhesions encountered during repeat cesarean delivery, and raised the possibility of longer time to deliver the fetus. Moreover, they might have higher chance of bleeding and visceral injury

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تنبؤ الموجات الصوتية بالإلتصاقات داخل البطن في السيدات الحوامل اللآتى سوف يخضعن للولادة القيصرية بعد عمليات البطن والحوض

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خلفية البحث: إلتصاقات داخل البطن بشكل متكرر أثناء الولادة القيصرية المتكررة وتفاقم إنتشارها وشدتها في الولادات القيصرية المتكررة المتعددة قد يؤدي إلى إستخراج طويل للجنين وإصابة الأحشاء المجاورة وفقدان الدم.

الهدف من البحث: دور الموجات فوق الصوتية قبل الجراحة في الكشف عن إلتصاقات الحوض والمضاعفات المرتبطة بها في النساء الحوامل في المرحلة الثالثة من الحمل مع تاريخ من جراحة الحوض والبطن السابقة.

المريضات وطرق البحث: هذه دراسة إستطلاعية شملت ١٥٨ امرأة حامل خضعن لعملية قيصرية سابقة، أجريت في قسم النساء والولادة بمستشفيات الحسين بين أبريل ٢٠٢٠ وأكتوبر ٢٠٢٠. وقد تم إخضاع كل مريضة إلى الموجات فوق الصوتية على البطن للكشف عن علامة إنزلاق بين جدار الرحم وجدار البطن الأمامي.

نتائج البحث: كان لدى ٩٨.٢٪ من المريضات علامة إنزلاق إيجابية، بينما ١٠.٢٪ كانت لديهن علامة انزلاق سلبية. ٨٢.٩٪ من المريضات لم يكن لديهن إلتصاقات في العملية القيصرية، في حين أن ٨.٩٪ منهن كان لديهن إلتصاقات ملحوظة. وعانى ٣.٨٪ من المريضات من

إصابات في البطن. وعانى ٢.٥ ٪ فقط من المريضات من انخفاض الهيموجلوبين > ٣ جم / ديسيلتر و ٥ ٪ مع انخفاض الهيموجلوبين بين ٢-٣ جم / ديسيلتر. وحددت علامة الانزلاق الإيجابية بشكل صحيح ١٣٨ مريضه من أصل ١٤٤ مريضه لم يكن لديهن التصاقات أو التصاقات خفيفة في إجراء العملية القيصرية بينما حددت علامة الانزلاق السلبية بشكل صحيح في ١٠ من أصل ١٤ مريضه لديهن إلتصاقات في إجراء العملية القيصرية.

الاستنتاج: علامة إنزلاق الرحم السلبية تتنبأ بالتصاقات شديدة داخل البطن تصادفها أثناء الولادة القيصرية المتكررة. علاوة على ذلك ، كان الوقت الأطول للولادة وفرصة أكبر للنزيف أثناء الجراحة والإصابة الحشوية أكثر شيوعاً في المريضات اللاتي تعانين من علامات الانزلاق السلبية.

الكلمات الدالة: علامة منزلقه، إلتصاقات داخل البطن، عملية قيصرية، جراحة منطقة الحوض.