

DOI: <http://dx.doi.org/10.18203/2320-1770.ijrcog20182875>

## Original Research Article

# Role of ultrasound in reducing complication during primary trocar insertion in laparoscopic surgery: prospective observational study

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**Received:** 23 April 2018

**Accepted:** 23 May 2018

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### ABSTRACT

**Background:** Patients presenting to Gynecology OPD at LLRM Medical College, Meerut, UP, India for benign laparoscopic surgery from June 2016 to May 2017 were included in the study. A total of 130 women completed the study of which 30 had history of previous abdominal surgery and 100 had no history of previous abdominal surgery. The ability of the visceral slide test to detect periumbilical adhesions was compared with laparoscopic detection of adhesions.

**Methods:** Patients fulfilling inclusion and exclusion criteria and preanaesthetic clearance were subjected to office based Visceral Slide test using high frequency ultrasound probe (7.5 MHz) in the sagittal plane at the level of umbilicus. Distance between the skin and posterior rectus sheath was measured. Diagnostic accuracy of visceral slide test and mean time taken to perform the test was noted.

**Results:** On laparoscopy 4 women had periumbilical adhesions while 24 women in the total sample had adhesions elsewhere in the abdominal cavity. The visceral slide test had a sensitivity of 75%, specificity of 98%, positive predictive value of 75% and negative predictive value of 99%. The diagnostic accuracy of the test is 97%. The median time to perform the examination was 1.69 minutes.

**Conclusions:** The visceral slide technique was convenient and rapid to perform, and reliably identified adhesions in the periumbilical area.

**Keywords:** Periumbilical adhesion, Primary trocar insertion, Visceral slide test

### INTRODUCTION

Adhesions form as a natural part of the body's healing process after surgery or infection, in a similar way that a scar forms. Adhesion formation post-surgery occurs when two injured surfaces are close to one another, local inflammatory response, increased vascularity and fibrin deposits onto the damaged tissues.<sup>1</sup> The fibrin then connects the two adjacent structures where damage of the tissues occurred, thereby connecting structures that should have normally been separate. Primary trocar entry is the most challenging step of a laparoscopic procedure with more than half of all laparoscopic complications

occur during abdominal entry.<sup>2</sup> Injury to bowel or blood vessels can occur during primary insertion of the Veress needle or trocar.<sup>3</sup>

Existing entry methods, such as entering the left upper quadrant or performing a mini laparotomy, do not directly address the issue of adequately identifying those adhesions and require additional tissue dissection.<sup>4,5</sup>

Ultrasound is readily available to gynecologists and is commonly used in many diagnostic and curative procedures. Seigel et al were the first to use ultrasound imaging of visceral slide in detecting abdominal wall

adhesions.<sup>6</sup> Visceral slide is the presence of intra-abdominal viscera sliding in relation to the abdominal wall. The absence of this finding is associated with adhesions of viscera to the abdominal wall.

Using ultrasound (7.5 MHz Probe) for measurement of anterior abdominal wall thickness and visceral slide test in the umbilical area: defined as an area with a 5 cm radius, centered on the umbilicus, useful information regarding underlying adhesions can be obtained.<sup>7</sup>

The aim of this feasibility study is to assess visceral slide test as a method in detecting periumbilical adhesions in patients undergoing laproscopic gynaecological surgeries.

## **METHODS**

After approval from medical ethics committee, a prospective study was performed in 130 patients between June 2016 to May 2017. Patients presenting to Gynaecology OPD for benign laparoscopic surgery were considered for the study. Informed and written consent was taken. After full inclusion and exclusion criteria, patients underwent preanaesthetic clearance for proposed elective surgery. Pre operative investigations were done as per the requirement. Portable USG machine (Sono Site) with linear probe high frequency (7.5 MHz) was used to perform following two tests -Office based visceral slide test and Measurement of distance between skin and posterior rectus sheath.

### ***Inclusion criteria***

Inclusion criteria were patients between 18-55 years of age having body mass index (BMI) between 18-25, waist circumference less than 35 inches, patient requiring laparoscopic gynecological surgery like: Laparoscopic myomectomy, laparoscopic cystectomy, diagnostic laparoscopy and hysteroscopy for primary and secondary infertility, chronic pelvic pain, laparoscopic ligation, laparoscopy assisted vaginal hysterectomy.

### ***Exclusion criteria***

Exclusion criteria were any abdominal wall pathology (hernia, cellulitis, soft tissue infection), severe cardiovascular, respiratory, abdominal disease, laparotomy within 12 weeks, uterine size >20 weeks, malignancy, chronic diseases like tuberculosis, hypertension and diabetes mellitus.

All laparoscopic surgeries were done by consultants having more than 5 years experience and abdominal ultrasound (USG) were performed by a person having at least 6 months of experience in USG.

All patients received routine medical and chemical bowel preparation. Then one consultant did USG evaluation and recorded the data. After completion of USG evaluation,

other consultant came into operation theater and performed trocar insertion.

After pre anaesthetic evaluation and consent for study, participants were shown a video regarding the examination technique for better understanding of patients and standardization of examination technique. Visceral slide test and distance between the skin and posterior rectus sheath was measured. Acoustic coupling was achieved by methylcellulose gel between the transducer and the skin. USG was performed with patients in supine position (sagittal plane) in the umbilical zone.

A stable echogenic focus corresponding to omentum or intestine was identified and the distance this focus travelled was recorded as the participant took maximal inspiratory and expiratory breaths.

Visceral slide was defined as the normal, longitudinal movement of the viscera caused by respiratory excursion of the diaphragm. In a non restricted abdomen, on maximal respiration, the viscera moves 2 to 5 cm in the longitudinal direction and >1 cm in the transverse direction. Restriction in this movement as a consequence of abdominal wall adhesions was defined as movement of the viscera <1 cm during visceral slide or no movement at all.<sup>6</sup>

Measurement between the skin and posterior rectus sheath was made at 3 points at the level of umbilicus.

- Distance between skin and posterior rectus sheath 2 cm right of umbilicus.
- Distance between skin and posterior rectus sheath 2 cm left of umbilicus.
- Distance between skin and posterior rectus sheath in midline (linea alba).

After laparoscopic entry into the abdominal cavity, assessment of adhesions around the umbilicus was done. Adhesions were defined as cohesive, apron-like, thick tissue including intra-abdominal organs such as small bowel /omentum that would prevent safe laparoscopic entry at the umbilicus.<sup>8</sup> Presence of any adhesion in the abdomen and pelvis was noted. Adverse events during laparoscopic entry and perioperative complications were also recorded.

### ***Statistical analysis***

Descriptive statistics was used to explain the data using Microsoft excel 7 and MedCalc software. Results were reported as mean, standard deviation, range of values, number, percentage and p value assessment with 95% C.I. Calculation of sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy was done.

**RESULTS**

A total of 130 patients completed the study, 100 patients had no history of previous surgery while 30 patients had history of previous surgery. The mean age of total sample was 29.25±4.5 years (range 18 to 47 years) and BMI 22.09±0.8 (range 19- 24.2). Distribution of patients according to previous incision type was: 6.7% laparoscopy, 56.7% Pfannensteil, 33.3% midline infraumbilical, 3.3% right paramedian. 23% patients had history of previous two surgeries and 77% had one previous surgery.

**Table 1: Demographic details.**

Variable	Data
No. of patients	130
Age (years)	29.25±4.5 (18-47)
BMI ( kg/m <sup>2</sup> )	22.09±0.8 (19-24.2)
Parity	2 (0-8)
<b>Geographic distribution</b>	
Rural	95 (73%)
Urban	35 (27%)
<b>Socio economic class</b>	
Upper Middle	3 (2.3%)
Lower Middle	12 (9.2%)
Upper Lower	34 (26%)
Lower	81 (62%)
<b>Indication of surgery</b>	
MTP LL	42 (32%)
LL	30 (31%)
DLH	43 (33%)
LAVH	4 (3%)
<b>Ovarian cystectomy</b>	1 (1%)
<b>Entry location</b>	
Umbilical	125 (96%)
Lee Haunge's point	3 (2.5%)
Jain Point	2 (1.5%)
Time taken to perform visceral slide test (mins)	1.69±0.6 (1-3.5)
<b>Measurement of distance(cm) between the skin and posterior rectus sheath at</b>	
Point A	2.43±0.44
Point B	2.42±0.41
Point C	2.27±0.38
Entry Complications	None

The outcome was that in the patients with no previous surgery (n=100), only 3 patients had adhesions elsewhere in the abdominal cavity seen on laparoscopy. In patients with previous abdominal surgery (n=30), 3 of the 4 patients having periumbilical adhesion was detected preoperatively by viscera slide test,

21 patients had adhesions elsewhere in the abdominal cavity seen laparoscopically.

**Table 2: Details of incision type and adhesions in patients with previous abdominal surgery (n=30).**

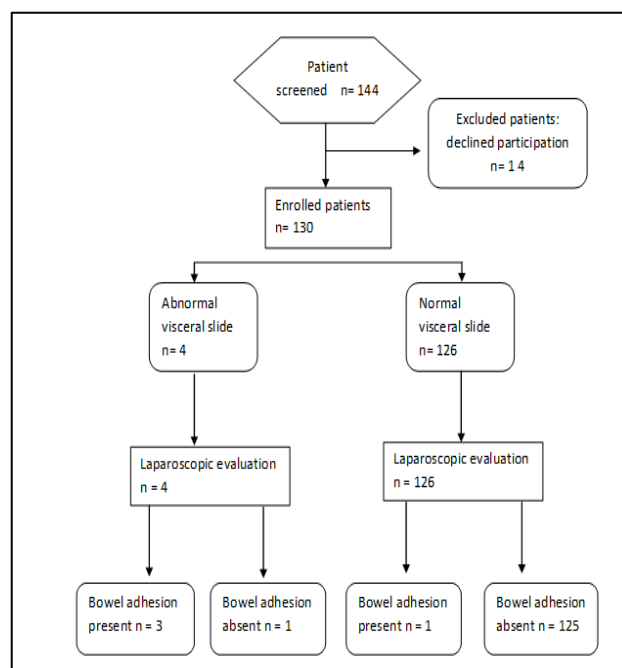
Incision type	No. of incisions one two	Periumbilical adhesion	Other abdominal adhesion
Laparoscopic	1	1	2
Pfannensteil	14	3	10
Midline infraumbilical	7	3	3
Paramedian infraumbilical	1	0	0

**Table 3: Statistical measure of performance of visceral slide test on total sample (n=130).**

Office visceral slide test	Laparoscopic diagnosis of adhesions	
	Present	Absent
+ve	3	1
-ve	1	125

Sensitivity = 75%; Specificity = 98%; Positive Predictive Value = 75%; Negative Predictive Value = 99%; Diagnostic Accuracy of test = 97%

In the total study sample (n=130), incidence of umbilical adhesions was 3% (4/130), incidence of other abdominal adhesions = 18.46% (24/130) while the total incidence of any adhesion was 21.46% (28/130).



**Figure 1: Patient flowchart.**

Sensitivity of visceral slide test 75%, specificity is 98%, positive predictive value is 75%, negative predictive value is 99% and diagnostic accuracy of the test is 97% (95% CI). In the total sample, the mean measurement of

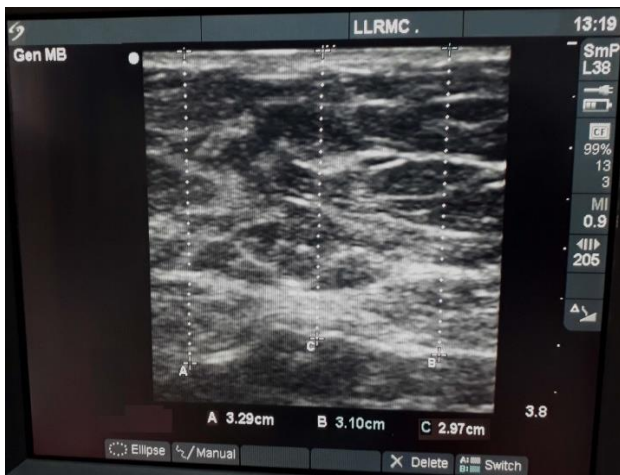
distance at point A is  $2.43 \pm 0.44$ cm, at point B is  $2.42 \pm 0.41$ cm and at point C is  $2.27 \pm 0.38$  cm.

Mean time taken to perform the visceral slide test in patients without surgery was  $1.6 \pm 0.6$  minutes, in patients with surgery it was  $2 \pm 0.5$  minutes.

The mean time taken for the total sample was  $1.69 \pm 0.6$  minutes.

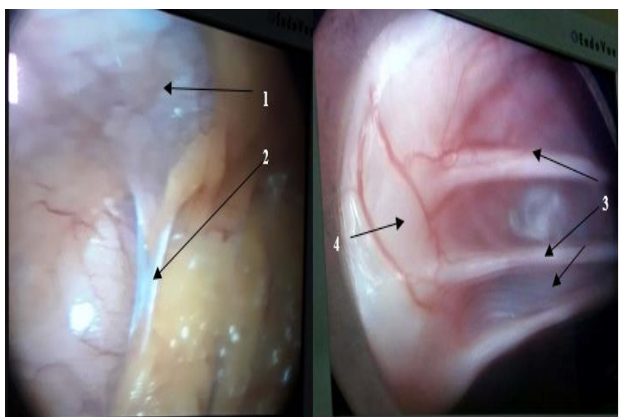
To avoid injury to underlying viscera as detected by visceral slide test, ultrasonic assessment of adhesion free area was done at alternate points like the Le Haunge's point and Jain point.<sup>9,10</sup>

No entry complications were documented in any of the patients.

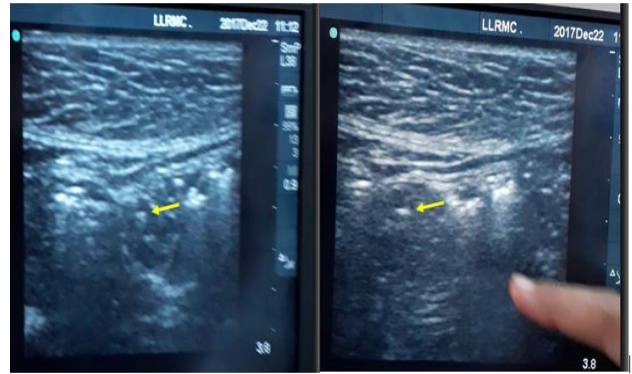


A-Distance between skin and posterior rectus sheath 2cm right of umbilicus; B-Distance between skin and posterior rectus sheath 2cm left of umbilicus; C- Distance between skin and posterior rectus sheath in midline (linea alba).

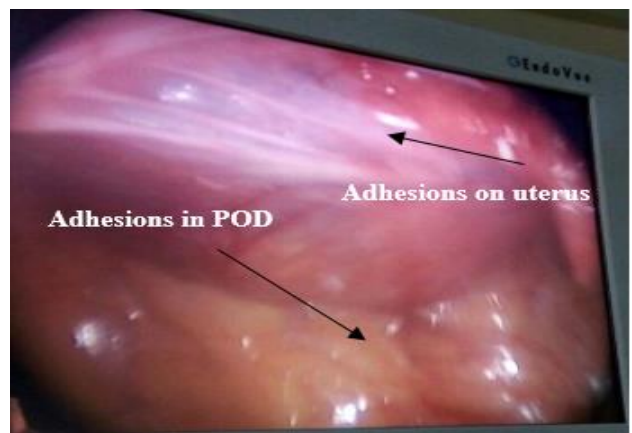
**Figure 2: Measurement between the skin and posterior rectus sheath at three points at the level of umbilicus.**



**Figure 3 (A and B): Photographs of periumbilical adhesions. 1: Anterior abdominal wall; 2: Adhesion band; 3: Adhesion bands; 4: Anterior abdominal wall.**



**Figure 4: Visceral slide test. (A) Location of echogenic focus on inspiration; (B) Location of echogenic focus on expiration.**



**Figure 5: Flimsy adhesions elsewhere in the abdominal cavity.**

## DISCUSSION

Postoperative adhesions are a sequelae of impaired fibrinolysis of the fibrin and cellular exudate after peritoneal injury. Adequate blood supply is essential for normal fibrinolysis. Therefore factors that increase ischemia and potentiate adhesion formation include thermal injury, infection, presence of a foreign body, and radiation-induced endarteritis.

Access into the abdomen is the one challenge of laparoscopy that is particular to the insertion of surgical instruments through small incisions. Access is associated with injuries to the gastrointestinal tract and major blood vessels<sup>11</sup> and at least 50% of these major complications occur prior to commencement of the intended surgery. This complication rate has remained the same during the past 30 years. The overall complications/injuries that occur following laparoscopic surgeries involve, gastrointestinal (0.6 per 1,000), genitourinary (0.3 per 1000), vascular (0.1 per 1,000), and omentum (0.4 per 1,000).<sup>5,12</sup>

Adhesions at the umbilical area are found in approximately 10% of all laparoscopies.<sup>13</sup> Kali et al in a

series of 4532 laparoscopies reported an incidence of only 0.2 per 1000.<sup>14</sup> In women with no previous abdominal surgery, umbilical adhesions are found in 0% to 0.68% of laparoscopies. Rates of umbilical adhesions range from 0% to 15% in women with prior laparoscopic surgery, from 20% to 28% in those who have had previous laparotomy with transverse suprapubic incision, and from 50% to 60% in those who have had previous laparotomy with vertical incision.<sup>13,15</sup> In a study by Brill et al, patients with midline incisions performed for gynecologic indications had significantly more adhesions (109/259, 42%) than those with all types of incisions performed for obstetric indications (12/55, 22%).<sup>16</sup>

In our study, ultrasound visceral sliding evaluation was correct in detecting the presence of bowel adhesion in 3 patients and its absence in 126 patients. There was no bowel adhesion at the site of primary trocar entry in the 100 patients with no previous surgery; however, 3 had omental adhesions elsewhere in the abdominal cavity. Possible cause of such adhesions could be previous history of pelvic inflammatory disease.

In the study group of patients with history of previous abdominal surgery, visceral slide test was successful in identifying 3 of the four patients with periumbilical adhesion. All 3 patients had vertical midline infraumbilical incision with history of excessive blood loss in previous surgery. In the one patient in whom diagnosis of adhesion was missed, was a patient with pfannenstiel incision in which technique of performing the test, that is increased pressure on the abdominal probe was the cause of erroneous interpretation of the test.

Alternate sites of primary trocar insertion was made in five patients- three at Le haunge's point and two at Jain point. None of the patients had immediate entry point complication. Wound site was healthy in all patients in follow up. In present study, sensitivity of visceral slide test was 75%, specificity 98%, positive predictive value 75%, negative predictive value 99% and a diagnostic accuracy of 97%.

In a recent study by Nezhat et al, at laparoscopy, 6 of 70 women (8.6%) had periumbilical adhesions diagnosed; 18 of 70 women (25.7%) had any adhesions located in the abdomen or pelvis.<sup>17</sup> The office visceral slide test had a sensitivity of 83.3%, specificity of 100%, positive predictive value of 100%, negative predictive value of 98.5% and diagnostic accuracy of 98.6%.

Similarly, Minaker et al, using the visceral slide technique assessed 145 patients for the presence of adhesions immediately before surgery.<sup>18</sup> Surgeon who performed ultrasound demonstrated a sensitivity of 69.6%, specificity of 98.7%, and positive predictive value of 99.5% for detection of areas free from critical adhesions. The median time to perform the examination was 2 minutes.

Measurement of distance between the skin and posterior rectus sheath helped in the accurate assessment of the thickness of anterior abdominal wall to be traversed by the primary trocar, thereby minimizing the injury due to overshooting. A finger set at the same distance from the tip of primary trocar as the thickness of the anterior abdominal wall, served as a safety mark for safe trocar insertion.

### **Limitations**

The small number of participants with previous history of surgery and low prevalence of periumbilical adhesions in the sample undermined our results. The study population included low risk patients who did not have many previous abdominal surgeries.

The study included potential information bias because the investigators' had knowledge of the participants' medical and surgical history. It is possible that this knowledge may have introduced a detection bias that could have altered interpretation of the visceral slide.

It is also possible that bias could be introduced when one both performs and validates a diagnostic test. To minimize the risk of bias, visceral slide assessment was completed and documented before intraoperative validation by the surgical team.

In spite of the added value provided by the visceral slide technique, surgical principles still apply. It is not a replacement for sound surgical technique. Excessive trocar force or improper technique may still result in injuries of the abdominal wall, mesentery, retroperitoneal vascular structures, and viscera.

### **Advantage of our study**

Our experience demonstrated that a high level of accuracy was achievable with strict adherence to the technical protocol. We believe that gynecologists in other centers would be able to achieve the same degree of success with this technique.

The technique is easy to understand and learn. The test is cost-effective, quick to perform, office based, non painful with good patient acceptability.

It gives confidence during primary trocar insertion which is traditionally done blindly.

### **CONCLUSION**

To conclude, the visceral slide test is an effective test in predicting periumbilical adhesions in the preoperative period thereby minimizing injury to the underlying adherent viscera. The test being non invasive, easy and quick to learn and perform, and has good patient acceptability.

This test has more appeal when done in high risk group like women with previous operative history and history of pelvic inflammatory disease.

Our study is the first of its type done on Indian subjects and therefore contributes to the existing knowledge of the test when applied to the South East Asian population. Results were comparable with previous studies.

However, the lesser number of patients having previous surgery and lesser diversity in terms of number of previous surgeries and types of previous surgeries caused limitation to our study. Thus further studies may be done at centers having more diversity in surgical history of patients undergoing laparoscopy for benign gynecological indications.

### ACKNOWLEDGMENTS

We would like to thank Dr Nezhath, Dr Tenaly for providing us with useful information regarding methodology of test.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the Institutional Ethics Committee*

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**Cite this article as:** Dhama V, Dhama V, Chaudhary R, Singh S, Aafrin S. Role of ultrasound in reducing complication during primary trocar insertion in laparoscopic surgery: prospective observational study. *Int J Reprod Contracept Obstet Gynecol* 2018;7:2747-52.