

High-Pressure Trocar Insertion Technique

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ABSTRACT

Background: The majority of laparoscopic complications occur at the time of Veress needle and trocar insertion. Although not very frequent, they increase the morbidity and mortality of both diagnostic and operative laparoscopic procedures. Alternative techniques of trocar insertion have been described but have not completely eliminated the risk of injury.

Technique: After Veress needle insertion and establishment of pneumoperitoneum to 25 to 30 mm Hg, insertion of a short trocar is performed in the deepest part of the umbilicus without elevation of the anterior abdominal wall. The result is a parietal peritoneal puncture directly beneath the umbilicus. The high-pressure setting used during initial insertion of the trocar is lowered as soon as safe abdominal entry is documented.

Experience: The trocar insertion technique described above was performed in 3041 procedures. No vascular injury occurred. There were two bowel perforations. No complications related to the increased intra-abdominal pressure were observed.

Conclusion: The high-pressure abdominal entry technique has the advantage of reducing intra-abdominal trocar-related injuries without requiring additional instrumentation or additional training.

INTRODUCTION

The majority of laparoscopic complications occur in the initial phases of the procedure at the time of Veress needle and trocar insertion. In a series of patients with major vascular injuries during gynecologic laparoscopies, 76.5% of the accidents took place during the initial phase of surgery. In this series, the majority of injuries were secondary to insertion of the umbilical trocar.¹

Abdominal entry injuries are not limited to vascular damage but include perforation of any intra-abdominal organ. A recent series of 26 complications caused by trocars includes 12 vascular injuries, 9 bowel injuries, 3 bladder perforations and 2 incisional hernias.²

A number of patient-related factors are associated with an increased incidence of abdominal entry injuries; these include a history of prior surgeries, intra-abdominal adhesions and patient's physical habitus. Other factors associated with injury are procedure-related and include patient positioning, surgeon's level of experience, surgical equipment (trocars, needles) as well as technique of insertion.

In brief, the standard procedure for abdominal entry involves blind insertion of the Veress needle with the patient positioned flat. Upon documentation of intraperitoneal positioning using the hanging drop, hiss and syringe aspiration test, insufflation is performed using CO₂ up to an intra-abdominal pressure of 15 mm Hg. At this point, the trocar is blindly inserted.³

Alternative techniques of trocar insertion have been described.^{4,5} Although deemed safer, these approaches have not completely eliminated the risk of injury and are more time-consuming and laborious than the standard technique and involve the use of additional grasping instruments on the patient's skin, which may result in undesired scarring. In order to reduce these kinds of complications, we introduced some simple modifications to the standard abdominal entry technique that has been used in our procedures since April 1989.⁶

METHODS

Since April 1989, we performed 3041 procedures using

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Table 1.

High pressure trocar insertion technique.

Insert Veress needle.
Establish pneumoperitoneum to 25–30 mm Hg.
Insert trocar directly without lifting up abdominal wall or twisting.
Immediately reduce pressure to 15–16 mm Hg.

the high-pressure trocar insertion technique as described below.

TECHNIQUE

With the surgeon standing on the patient’s left side and the patient supine, the left thumb (with or without a sponge) is inserted into the umbilicus as deep as possible, after which the thumb and surrounding umbilicus are rolled over the lower left forefinger, stretching and widening the umbilical fossa, which is further enlarged with the blunt back end of the scalpel. A No. 15 blade is used to make a vertical midline incision on the inferior wall of the umbilical fossa, extending to and just beyond its lowest point. In thin patients, this incision frequently traverses the deep fascia, but intraperitoneal injury is avoided by the pulling of the umbilicus onto the surgeon’s forefinger, a maneuver that controls the incision’s depth.

A disposable Veress needle is grasped near its tip, like a dart, between the thumb and forefinger. The lower anterior abdominal wall is stabilized, not elevated, by grasping its full thickness in the operator’s fist and by pulling it downward to bring the umbilicus below the aortic bifurcation. The Veress tip is then inserted at a right angle to the anterior abdominal wall for a distance of 1 cm. Insertion of the Veress needle should be an anatomic exercise, with the surgeon cognizant of the anatomic structures traversed. Individual layers can be felt: deep fascia and peritoneum or, occasionally, peritoneum alone. If the Veress needle is inserted according to these principles, little need exists for testing to ensure proper position of the needle. After complete insertion, the needle is connected to the CO₂ insufflator flowing at 3 to 9 liters/min until a pressure of 25 to 30 mm Hg is obtained, usually after at least 5 liters (**Table 1**).

The umbilical or first puncture trocar, with its surrounding trumpet-valve trocar sleeve, is placed within the umbilicus. It is not necessary to lift the anterior abdominal wall during insertion of the trocar after establishment of pneumoperitoneum at 25 to 30 mm Hg, as the parietal peritoneum and skin move as one unit with a greater distance between the abdominal wall and the aorta. The trocar should be palmed so that only 1 cm of the sharp tip protrudes beyond the operator’s fingers.

Following shallow penetration to seat the trocar at a 90° angle in the fascia-peritoneum anatomical funnel created where skin, deep fascia and peritoneum meet, the trocar is upturned to approximately 60°. This continuous motion is almost straight down at first and then becomes almost horizontal, with the wrist rotating nearly 45°. Pressure by pushing on the trocar is then increased until the fascia gives way. The trocar rarely penetrates more than 1 cm. Twisting of the trocar while under pressure is not done. The result is a parietal peritoneal puncture directly beneath the umbilicus. While holding the sleeve against the abdominal wall, the trocar is removed, and the operator hears a rush of gas out of the abdomen.

The high pressure setting used during initial insertion of the trocar is lowered as soon as safe abdominal entry is documented to diminish the development of vena cava compression and subcutaneous emphysema. The total amount of time in which the intra-abdominal pressure is 25–30 mm Hg is less than 3 minutes.

In cases with known or suspected extensive intra-abdominal adhesions, a special entry technique may be used. The Veress needle is inserted in the left ninth intercostal space, anterior axillary line and again pneumoperitoneum is established to 30 mm Hg. A 5 mm trocar is inserted at the left costal margin, giving a panoramic view of the entire peritoneal cavity. When it is available, a 2 mm scope can be used through a Veress needle.⁷

The lower quadrant trocar sleeves are placed above the pubic hairline and lateral to the rectus abdominalis muscle found by direct inspection of the anterior abdominal wall. A relatively constant intra-abdominal pressure between 10 to 15 mm Hg is maintained during long laparoscopic procedures.

RESULTS

There were no vascular injuries related to umbilical trocar insertion. Two bowel perforations occurred where bowel was directly adherent to undersurface of the umbilicus. Both cases were immediately repaired: one laparoscopically and the other by laparotomy without further complications. The 30 mm Hg intra-abdominal pressure generates a greater distance between the peritoneum and large abdominal vascular structures, allowing a safer umbilical trocar insertion. In addition, the straight-down initial thrust avoids bowel stuck immediately below the umbilicus. As the 30 mm Hg pressure is maintained for less than 3 minutes, the risk of deep venous thrombosis or CO₂ embolism is minimal, and none of the patients in this series experienced these complications. Nevertheless, the whole surgical and anesthesiological team must be aware of the intra-abdominal pressure at all times in order to remember to decrease the pressure after the abdomen is entered.

DISCUSSION

Trocar entry has been a concern of many laparoscopic surgeons for a long time. In 1974, Hasson developed a technique called "open-laparoscopy" to minimize risk of large vessel injury during entry.⁵ It is particularly appropriate for patients with suspected abdominal wall adhesions or for muscular males or children with strong abdominal walls. Although this method has recently been recommended for all laparoscopy by general surgeons in New York State, data concerning increased safety in trained and experienced hands are lacking. Furthermore, open laparoscopy does not necessarily eliminate complications in patients with previous abdominal surgery.⁸ In fact, one of the authors (H.R.), who uses this technique only in cases with known extensive bowel adhesions, has entered bowel in each of six attempts at open laparoscopy.

Using the standard technique of elevation of the skin of the lower anterior abdominal wall with the surgeon's hand often does not elevate the underlying peritoneum away from the viscera. The distance between the posterior peritoneum and the anterior abdominal wall increases as the abdomen is insufflated in proportion to the pressure obtained. With the 15 mm Hg pressure, the surgeon can almost always palpate aortic pulsation. At 30 mm Hg, it is not usually possible, and the anterior abdominal wall is elevated and fixed so that it will not be

squashed or compressed towards the posterior abdominal wall upon downward pressure with a trocar. An additional advantage is that the increased intraperitoneal pressure acts as a counter pressure to the surgeon's thrust, which aids in controlling the depth of trocar penetration.

Others authors advocate direct trocar insertion without pneumoperitoneum. This is a suitable method in selected patients without previous abdominal surgery and easily distensible abdominal wall. Strict attention must be paid to the standard surgical principles of good relaxation, adequate skin incision, sharp instruments and anatomy. The reported incidence of bowel injury has been similar to series using pneumoperitoneum (4 in 4532), although prospective comparative studies have not been performed.⁹

Towel clips have been used to elevate the skin around the umbilicus for Veress needle and trocar insertion. This requires the assistance of a third hand to hold one towel clip while the surgeon is inserting the Veress needle and the trocar and holding the other towel clip.¹⁰ One of the critiques to this approach is the possibility of developing additional scars in some patients with a tendency to keloid due to the towel clips.

We do not use shielded trocars. Manufacturers and distributors have recently (1996) been asked to voluntarily eliminate safety claims from the labeling of the shielded trocars by the Food and Drug Administration (FDA). The letter to the manufacturers says "FDA is unaware of any data, published or unpublished, showing that these shielded trocars provide any additional protection from injury to bowel, blood vessels, or other organs, when compared to conventional trocars. In fact, review of FDA's own MDR database, manufacturer's complaint files and others reports makes it clear that such injuries do occur with shielded trocars and that the incidence of these injuries is not uncommon."¹¹

The high-pressure abdominal entry technique has the advantage of potentially reducing intra-abdominal trocar related injury without requiring additional instrumentation or additional training. Although the potential risks of prolonged exposure to elevated intra-abdominal CO₂ pressure need to be kept into account, the very short exposure time and the absence of complications in this large series point to the safety of the approach. Concerns that insufflation to 25 mm Hg can embarrass

respiration, venous return, and cardiac output are unfounded. We never observed a decrease in blood pressure or difficulties with ventilation.

The simplicity of the approach makes it acceptable for the surgeon in training, as well, reducing the general risk of complications.

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