

The Direct Trocar Technique: An Alternative Approach to Abdominal Entry for Laparoscopy

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ABSTRACT

Objective: The direct trocar technique is an alternative to Veress needle insertion and open laparoscopy for accessing the abdominal cavity for operative laparoscopy. We review our approach to abdominal entry in 1385 laparoscopies performed between September 1993 and June 2000 by our group at Stanford University Hospital, a tertiary Medical Center.

Methods: We performed a retrospective chart review of 1385 patients who underwent operative laparoscopy during the study years. The mode of abdominal entry, patient demographics, and complications were reviewed.

Results: The transumbilical direct trocar entry method was used in 1223 patients. In 133 patients, the Veress needle insertion technique was used. Open laparoscopy was used in 22 patients. Three (0.21%) major complications occurred: 1 enterotomy, 1 omental herniation, and 1 bowel herniation. One complication was related to primary access (0.072%) in a patient who had an open laparoscopy. She sustained an enterotomy during placement of the primary trocar. The bowel was repaired laparoscopically. No trocar-related injuries occurred among the 1223 patients in whom the direct trocar entry technique was used. One patient had an omental herniation and required a repeat laparoscopy on postoperative day 2. The second patient had a repeat laparoscopy

on the 12th postoperative day to repair a bowel herniation. None of our patients required a laparotomy. No vascular injuries occurred.

Conclusion: Based on our experience, the direct trocar technique is a safe approach to abdominal entry for laparoscopic surgery.

Key Words: Abdominal entry, Laparoscopy, Direct trocar technique.

INTRODUCTION

Over the last decade, a rapid increase has occurred in both the applications of operative laparoscopy and the number of surgeons using this technique. Although the complications of operative laparoscopy are low, they can be severe and life threatening. A search of the Manufacturer and User Facility Device Experience Database (MAUDE) from the Medical Device section of the Food and Drug Administration's Web site¹ lists 25 serious iatrogenic injuries involving Veress needle entry between March 1992 and May 2000. Seventeen (68%) vascular injuries and 4 (16%) bowel perforations occurred, all requiring exploratory laparotomy. One death, as a result of an aortic laceration, was reported. A search of "trocar" and "pneumoperitoneum" yielded 17 serious iatrogenic injuries reported between January 1993 and May 2000. Thirteen (76%) vascular injuries and 4 (24%) bowel perforations occurred that were repaired by laparotomy. One patient died as a result of a vascular injury. A previous review of the same Web site by Bhojru et al² analyzed the data on all reported trocar injuries through 1996. They identified 629 trocar injuries. Injuries included 408 to major vascular structures, 182 to other viscera (mostly bowel), and 30 abdominal wall hematomas. Twenty-seven vascular injuries (7%) occurred during trocar insertion or reinsertion without pneumoperitoneum or with the use of excessive force.

Most laparoscopic injuries occur at the time of Veress needle and trocar insertion. Preventing the complications associated with initial abdominal entry is a prime concern for laparoscopic surgeons. In a prospective obser-

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vational study of 25,764 cases, Jansen et al³ found that 57% of complications occurred during primary trocar insertion, and 43% were related to surgical skill. Bateman et al⁴ reviewed 2324 laparoscopies performed by the same surgical team and reported that more complications occurred during trocar placement than during the operative procedure being performed. **Table 1** shows the incidence of major complications associate with various techniques of abdominal entry as reported in a review of selected studies.³⁻⁷ These data suggest that no significant difference exists in complication rates based on the technique used for abdominal entry. Open laparoscopy as described by Hasson⁸ has been shown to minimize vascular injuries but does not reduce bowel injuries. This may reflect a selection bias because the Hasson technique may be more likely to be used in high-risk patients.

METHODS

A retrospective review of the charts of 1385 patients who underwent operative laparoscopy from September 1993 through June 2000 was performed. The team of surgeons performing these techniques were highly experienced, advanced laparoscopic surgeons operating with residents and fellows in endoscopic surgery. Veress needles were either reusable or disposable types (Autosuture or Ethicon). Transumbilical direct trocar, Veress needle, open laparoscopy, and micro-laparoscopy were used. Entry-related complications were analyzed. Complications were classified as major or minor, immediate (right after trocar entry) or late (during first 6 weeks postoperation).

Direct Trocar Entry Technique

After the institution of general anesthesia, the patient is placed in the dorsal supine position with her legs in Allen stirrups. She is then prepped and draped in the usual sterile fashion. A transurethral Foley catheter is placed for intraoperative bladder drainage. The stomach is decompressed with a nasogastric tube. The operating table is lowered at or below the level of the surgeon's waist. After palpating the bifurcation of the aorta and sacral promontory, the umbilical skin is elevated with a skin hook and a 1-cm intraumbilical incision is made sharply with a scalpel. The anterior abdominal wall is then elevated by pulling on 2 towel clips placed 3 cm on either side of the umbilicus. While elevating the anterior abdominal wall away from the underlying viscera, the surgeon holds a 10-mm trocar with his index finger positioned 3 cm away from the trocar tip to guard against sudden uncontrolled

Technique	Complication Rate per 1000
Direct trocar	0.6-1.1
Veress needle	0.3-2.7
Open laparoscopy	0.6-12.0
First trocar	1.9-2.7
Accessory trocar	0.8-6.0

entry into the abdomen. The trocar is inserted at a 90-degree angle and advanced in a controlled fashion into the peritoneal cavity with a twisting semicircular motion.⁹ The laparoscope is then introduced, proper intraperitoneal placement ascertained, and a pneumoperitoneum created with high-flow insufflation. The underlying structures are then carefully inspected for injury.

In patients suspected of having significant anterior abdominal wall adhesions, Veress needle, open laparoscopy, and direct micro-laparoscopy were performed. We have previously reported our experience with direct small diameter laparoscopy as a safe alternative to open laparoscopy in patients at risk for blind initial abdominal entry.¹⁰ High-risk patients included those with a history of prior laparotomy with a vertical midline incision extending above the umbilicus, those with a history of severe adhesions based on prior operative reports, bowel resection, peritonitis, Crohn's disease, oncologic procedures with omentectomy, or abdominoplasty. In these patients, transumbilical, subxiphoid, or left subcostal regions were selected as points of entry. Intraperitoneal placement was ascertained with the aspiration test, "hanging drop test," and by observing initial gas flow pressure rates.⁹

RESULTS

Our team performed 1385 laparoscopic procedures between September 1993 and June 2000. Four patients with incomplete medical records were excluded. In 3 patients, the micro-laparoscope was used to evaluate the extent of the patient's adhesions after introducing the Veress needle to achieve pneumoperitoneum. Our approach to abdominal entry and data on the patients' mean age, height, weight, and BMI are presented in **Table 2**. Complications were categorized as major or minor, immediate (right after trocar entry) or late (during

Table 2.
Patient Characteristics

Method of Abdominal Entry	Number	Mean Age (range)	Mean Height cm (range)	Mean Weight Kg (range)	Mean BMI (range)
Direct trocar entry	1223	37.7(13-77)	164.9(147-188)	66.0(42-132)	24.3(16.3 – 42.5)
Veress needle	133	41.3(17-69)	168.8(150-183)	68.3(42-132)	24.8(16.3–49.1)
Open laparoscopy	22	45.8(31-69)	169.0(159-183)	72.6(50-120)	25.6(18.9–44.1)
Micro-laparoscopy	3	34(30-38)	156.0(148-165)	61.8(45-74)	28.9(27.1–30.4)
Total	1381	38.4(13-77)	165.4(147-188)	66.3(42-134)	24.42(16.3–49.1)

Table 3.
Complications Associated with Different Methods of Abdominal Entry

Method of Abdominal Entry	No.	Mean BMI	Mean No. of Previous Laparotomies or Laparoscopies	No. of Complications				Complication Rate Per 1000	
				Major		Minor		Major	Minor
				Immediate	Late	Immediate	Late		
Direct entry	1223(88.49%)	24.3	1.50	0	2	0	25	1.64	20.46
Veress needle	133(9.63%)	24.8	3.47	0	0	0	1	0	7.41
Open laparoscopy	22(1.59%)	25.6	3.95	1	0	0	2	47.6	95.2
Direct small diameter Micro-laparoscopy	3(0.22%)	28.9	2	0	0	0	0	0	0

first 6 weeks postoperation) (**Table 3**). Late minor complications included abdominal wall ecchymosis, wound infection or discharge, granulation tissue formation, delayed healing, and minor oozing. Minor complications are summarized in **Table 4**. The sites used for placement of the Veress needle are shown in **Table 5**.

Three (0.21%) major complications occurred: 1 enterotomy and 2 herniations (1 bowel and 1 omental). During open laparoscopy, an enterotomy occurred, which was repaired endoscopically. One patient had an omental herniation through the 5-mm left lower quadrant trocar site and required a repeat laparoscopy on postoperative day 2. Another patient had a bowel herniation. She presented on postoperative day 12 with left lower quadrant pain and bulging near her left lower quadrant incision. She had a repeat laparoscopy to release the mesentery of

the small bowel that was attached to her left lower quadrant incision. No vascular injuries occurred in our series.

Veress needle, open laparoscopy and direct small diameter laparoscopy were used in patients judged to be at higher risk for visceral injury during trocar insertion. As expected these patients had a higher average number of prior laparotomies as shown in **Table 6a**. Data on patients with previous abdominal surgeries are shown in **Tables 6a and 6b**.

DISCUSSION

Direct trocar insertion was first reported in the literature by Dingfelder in 1978.¹¹ In a randomized study, the complications of Veress needle insertion were compared with that of direct insertion of conventional reusable and dis-

Table 4.
Late Minor Complications

Late Minor Complications	Direct Trocar	Veress Needle	Open Laparoscopy	Microlaparoscopy	Total
Abdominal wall ecchymosis	11(0.9%)	0	0	0	11(0.8%)
Wound infection or discharge	6(0.5%)	0	2 (9.09%)	0	8(0.58%)
Granulation tissue formation	5(0.41%)	1(0.75%)	0	0	6(0.43%)
Delayed healing	1(0.08%)	0	0	0	1(0.07%)
Minor oozing or bleeding (LLQ)	2(0.16%)	0	0	0	2(0.15%)
Total	25(2.04%)	1(0.75%)	2(9.09%)	0	28(2.03%)

Table 5.
Site of Veress Needle Placement

Trocar Placement Site	Number(Percent)
Umbilical	91(68.4%)
Left upper quadrant (subcostal margin)	33(27.1%)
Umbilical (Left middle quadrant)	5(3.8%)
Supraumbilical	1(0.75%)
Undocumented	3(2.25%)

posable shielded trocars for obtaining pneumoperitoneum in 200 patients.¹² Fewer complications were associated with direct trocar insertion, but no difference occurred in the frequency of multiple attempts or the ease of insertion. Byron et al¹³ compared Veress needle and direct trocar entry in 252 women. They found a statistically significant increase in minor complications and longer insertion time in the Veress needle group.

The direct trocar technique, as presented above, was performed according to the same routine to standardize our methodology and minimize variations that could increase the risk of injury. The decision to use alternative entry techniques was based on the surgeon's assessment of the patient's likelihood of having adhesions to the anterior abdominal wall. The risk of adhesions has been shown to be directly related to a patient's past medical and surgical history. In a study by Brill et al,¹⁴ 360 women who prior laparotomy were evaluated for adhesions

between the anterior abdominal wall and underlying omentum and bowel at operative laparoscopy. The authors found adhesions between the old abdominal scar and overlying omentum or bowel in 130 (36%) patients. Specifically, patients with a midline incision extending above the umbilicus were more likely to have bowel adhesions when compared with those with either Pfannenstiel or lower midline incisions.

In our series of 1385 cases, 1 minor bowel injury and no vascular injuries with either Veress needle or direct trocar entry techniques occurred. This is in line with the known low levels of complications as reported in other studies. Our study did not have the power to establish whether 1 method of abdominal entry is superior to another. Proving a statistically significant difference in entry techniques given the low incidence of entry-related complications would require a prospective, randomized study of a large number of patients operated on by a team of surgeons with comparable levels of experience and skill. To show a 33% reduction in incidence with 80% power and 95% confidence limits, more than 800,000 cases would have to be studied.¹⁵

Entry-related complications were analyzed by a group of gynecologists and general surgeons with special interest in laparoscopy that convened in Middlesbrough, England in March 1999 to form an evidence-based consensus opinion about laparoscopic entry techniques.¹⁶ They reported an incidence of bowel and vascular injuries as 0.4 per 1000 and 0.2 per 1000, respectively, based on a multicenter study of more than 350,000 closed laparoscopies. They recommended closed laparoscopy with the Veress needle as the preferred technique for initial

Table 6a.
Previous Laparotomies

No. of Previous Laparotomies	Method of Abdominal Entry			
	Direct entry	Veress needle	Open laparoscopy	Microlaparoscopy
0	721	11	3	1
1-3	481	95	14	2
4-5	19	21	3	-
6-7	2	6	1	-
8-10	-	-	1	-
Total	1223	133	22	3
Mean	0.61	2.32	2.68	1.00

Table 6b.
Previous Laparoscopies

No. of Previous Laparoscopies	Method of Abdominal Entry			
	Direct entry	Veress needle	Open laparoscopy	Microlaparoscopy
	643	64	11	1
1-3	527	59	8	2
4-5	39	9	3	-
6-7	9	1	-	-
8-12	5	-	-	-
Total	1223	133	22	3
Mean	0.88	1.11	1.27	1.00

abdominal entry. However, this consensus did not include contributions from the American Association of Gynecologic Laparoscopists or the Society of Laparoscopic Surgeons.

Various methods are available for the safe creation of pneumoperitoneum at laparoscopy. One of the advantages of the direct trocar entry technique is the reduced number of blind insertions required to gain abdominal access. However, entry-related complications can occur despite adequate surgical experience and up-to-date equipment; surgeons should therefore use the tech-

niques that they are familiar with and feel most comfortable using.

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