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Guideline No. 412: Laparoscopic Entry for Gynaecological Surgery

(En français : Entrée laparoscopique en chirurgie gynécologique Entrée laparo en chirurgie gynécologique)

The English document is the original version. In the event of any discrepancy between the English and French content, the English version prevails.

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Keywords: laparoscopic surgery; pneumoperitoneum; Veress needle; Hasson technique; direct trocar insertion; visual entry system

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UPDATED PRACTICES

1. When inserting the Veress needle, consider shifting or elevating the umbilicus caudally to minimize retroperitoneal vascular injury.

Weeks Gestation Notation: The authors follow the World Health Organization's notation on gestational age: the first day of the last menstrual period is day 0 (of week 0); therefore, days 0 to 6 correspond to completed week 0, days 7 to 13 correspond to completed week 1, etc.

2. Use an initial Veress intraperitoneal pressure of <10 mm Hg as the most reliable indicator of correct intraperitoneal placement of the Veress needle.
3. Use transient high intraperitoneal pressure of 20–30 mm Hg just before inserting a trocar.
4. Use the non-disposable threaded cannula for visual entry.

KEY MESSAGES

1. Laparoscopic access into the abdomen is a challenge and deserves careful attention.
2. No single method of laparoscopic entry has been proven safer or superior to another. Use the technique with which you are most comfortable and experienced.
3. Consider left upper quadrant insertion of the Veress needle, because this site is associated with fewer attempts and fewer conversions to alternative sites.

ABSTRACT

Objective: To evaluate the benefits and risks of laparoscopic surgery and provide clinical direction on entry techniques, technologies, and their associated complications in gynaecological surgery.

Target population: All patients, including pregnant women and women with obesity, undergoing laparoscopic surgery for various gynaecological indications.

Options: The laparoscopic entry techniques and technologies reviewed in formulating this guideline included the closed (Veress needle–pneumoperitoneum–trocar) technique, direct trocar insertion, open (Hasson) technique, visual entry systems, and disposable shielded and radially expanding trocars.

Outcomes: Implementation of this guideline should optimize decision-making in the selection of entry technique for laparoscopic surgery.

Evidence: We searched English-language articles from September 2005 to December 2019 in PubMed/MEDLINE, Embase, Science Direct, Scopus, and Cochrane Library using the following MeSH search terms alone or in combination: laparoscopic entry, laparoscopy access, pneumoperitoneum, Veress needle, open (Hasson), direct trocar, visual entry, shielded trocars, radially expanded trocars, and laparoscopic complications.

Validation methods: The authors rated the quality of evidence and strength of recommendations using the Canadian Task Force on Preventive Health Care approach (Appendix A).

Intended audience: Surgeons performing laparoscopic gynaecological surgery.

SUMMARY STATEMENTS

1. Laparoscopic entry using the Veress needle–pneumoperitoneum–trocar (or "closed") technique is practised by the majority of gynaecologists worldwide (I).
2. During closed entry, caudal umbilical displacement below the sacrum and great vessels facilitates intraperitoneal placement of the Veress needle and maximizes the success of entry and avoidance of injury (I).
3. The Veress needle can be inserted intraperitoneally at umbilical or left upper quadrant sites. Left upper quadrant placement is associated with fewer attempts and fewer conversions to alternative sites (I).
4. Initial Veress intraperitoneal pressure of <10 mm Hg is the most reliable indicator of correct Veress needle placement (I).
5. Shielded trocars do not result in fewer visceral or vascular injuries during laparoscopic access (II-2).
6. The blunt tip of the radially expanding trocars may provide protection from injuries, but the force required for entry is significantly greater than for disposable trocars (I).
7. Single-use, push-through, optical trocars are not superior to blind methods of inserting trocars and do not avoid visceral or vascular injury (II-2).
8. Reusable visual entry cannulas have no sharp or pointed trocar, minimize port wound size, and reduce insertional force; as a consequence, they may be safer than trocars (II-2).
9. Direct trocar insertion is associated with fewer insufflation complications and failed entries. However, there is insufficient evidence to conclude that direct insertion is associated with fewer major complications (I).
10. Open entry is neither superior nor inferior to other entry techniques. Open entry has a lower incidence of vascular injuries but a potentially higher incidence of bowel injury (I).
11. Laparoscopy can be performed in pregnancy (II-2).

RECOMMENDATIONS

1. Alternative insertion sites for the Veress needle (e.g., left upper quadrant [Palmer's point], transvaginal, or transuterine) should be considered (1) when an umbilical entry is considered complicated, based on patient history and characteristics (e.g., suspected or known periumbilical adhesions, history or presence of umbilical hernia, low or high body mass index) or (2) after 3 failed attempts at umbilical Veress needle insertion (I-A).
2. Elevation of the abdominal wall during insertion of a Veress needle or primary trocar is not routinely recommended because it does not avoid visceral or vessel injury (II-2E).
3. Because the position of the umbilicus in relation to the aortic bifurcation varies according to the patient's body mass index, the angle of insertion of the Veress needle at the umbilicus should be adjusted accordingly—from 45° in women of normal body mass to 90° in women with obesity (I-A).
4. Previously recommended Veress needle safety checks or tests, such as the saline drop test and aspiration for fluid, have not been found to confirm position and therefore are no longer recommended as best practice (I-A).
5. Wiggling the Veress needle from side to side should be avoided; this can increase the risk of complications (II-1E).
6. It is appropriate to to leave the source of gas attached to the Veress needle so that the surgeon can use the pressure gauge to measure the intraperitoneal pressure (<10 mm Hg) as the most reliable indicator of correct placement of the Veress needle (I-A).
7. The volume of CO_2 insufflated with the Veress needle before trocar insertion should depend on intra-abdominal pressure. Adequate pneumoperitoneum insufflation should be determined by a pressure of 20–30 mm Hg rather than by CO_2 volume (II-1 A).
8. During entry using Veress needle insufflation, intraperitoneal pressure may be increased immediately before insertion of the trocars. Transiently high intraperitoneal pressure does not adversely affect cardiopulmonary function in healthy patients (II-1 A).
9. The threaded, reusable, visual cannula may be considered a safer instrument for peritoneal entry than conventional trocars (II-2 B).
10. Direct trocar insertion may be used in accordance with the surgeon's training, experience, and preference (I B).
11. Open (Hasson) entry may be used in accordance with the surgeon's training, experience, and preference (II-2 C).

12. Because there is no clear consensus on the optimal method of peritoneal entry, surgeons should use the technique with which they are most comfortable and experienced (II-2 C).
13. In women requiring intra-abdominal surgery in pregnancy, Veress needle insufflation at the umbilical site can be employed until 14 weeks gestation (if there are no contraindications), and open (Hasson) entry or left upper quadrant insufflation are preferable after 14 weeks gestation (II-2 B). After 24 weeks gestation, an open (Hasson) entry is recommended (II-2 B).

INTRODUCTION

Laparoscopy involves insertion of a cannula through the abdominal wall, distension of the peritoneal cavity with gas, and visualization and examination of the abdomen's contents with an illuminated telescope. Laparoscopic entry and access into the abdomen may be challenging and have been associated with injuries to abdominal viscera and blood vessels. The overall injury rate at the time of entry is estimated to be 1 per 1000 cases, and this rate has remained the same over the last 40 years. The majority of these injuries are due to the insertion of the primary umbilical trocar. If surgeons fail to recognize the injury or intervene in a timely fashion, morbidity, mortality, and medicolegal issues can result.[1-5]

There are three main techniques for laparoscopic entry: classic or closed (Veress needle—pneumoperitoneum—trocar) entry, open (Hasson) entry, and direct trocar insertion (DTI) without prior pneumoperitoneum.[1] Table 1 lists variations of laparoscopic entry, including optical Veress needle, optical trocars, radially expanding trocars, shielded disposable trocars, and trocarless, reusable visual cannula.[1,4] Surgeon training, experience, and preference, as well as regional and interdisciplinary variability, influence the choice of entry method. Gynaecologists worldwide commonly use closed entry, whereas general surgeons prefer the open (Hasson) method. Because the frequency of entry complications with any method is low and variable (e.g., 0.04%—0.2% for bowel injury), no randomized controlled trials (RCTs) have been sufficiently powered to conclude that one method is safer than or superior to another.

SUMMARY STATEMENT 1

This guideline examines the available evidence on laparoscopic entry techniques and provides recommendations based on the Canadian Task Force on Preventive Health Care levels of evidence (Appendix A).[6]

CLOSED (CLASSIC) LAPAROSCOPY

Closed entry involves cutting the skin at the umbilicus with a scalpel, inserting the Veress needle into the peritoneal cavity (Figure), insufflating the cavity with carbon dioxide (CO_2), and inserting a primary trocar into the abdomen. Because inserting both the Veress needle and the primary trocar are non-visual, the two key steps of a successful closed (classic) laparoscopy are (1) correct intraperitoneal placement of the Veress needle and (2) avoidance of injury with the Veress needle and/or primary trocar.

ABBREVIATIONS

DTI	Direct trocar insertion
LUQ	Left upper quadrant
VIP	Veress intraperitoneal pressure

Umbilical Insertion

Conventionally, the most common site to insert the Veress needle is the umbilical area. Alternative insertion sites may be sought (1) in patients with a history or presence of umbilical or ventral hernia, midline surgical incisions, known or suspected periumbilical adhesions, high or low body mass index (BMI), or a palpable mass, or (2) after 3 attempts to establish pneumoperitoneum have failed. The most common alternative site is the left upper quadrant (LUQ; Palmer's point).[1]

RECOMMENDATION 1

Elevation of the Anterior Abdominal Wall

Some surgeons elevate the lower anterior abdominal wall by hand or using towel clips when they insert a Veress needle or primary trocar. One study reported that only towel clips placed within 2 cm of the umbilicus provided significant elevation of the peritoneum (mean 6.8 cm above viscera) and maintained that elevation during the force of the primary trocar insertion.[7] One RCT found that lifting the lower abdominal wall to place the Veress needle increased the risk of failed entry, provided no difference in extraperitoneal insufflation, and did not reduce vascular or visceral complications.[8]

RECOMMENDATION 2

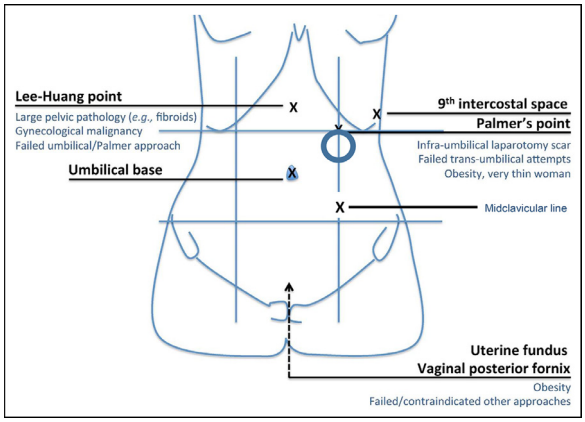
Angle of Insertion of the Veress Needle at the Umbilicus

Based on computed tomography scans of 38 women of reproductive age examined while under anaesthetic, the umbilicus was located, on average, 0.4 cm, 2.4 cm, and 2.9 cm caudal to the aortic bifurcation in women with a normal body mass (BMI <25), those who were overweight (BMI 25—30), and those with obesity (BMI >30), respectively. In all cases, the umbilicus was cephalad to where the left common iliac vein crossed the midline at the sacral promontory.[9] Based on these findings, it is recommended that the angle of insertion of the Veress needle at the umbilicus vary from 45° in women of normal body mass to 90° in women with obesity.

Table 1. Laparoscopic entry and access techniques and technologies

Technique		Non-visual entry	Visual entry
Closed	Insufflated with Veress needle	Classic entry (Veress needle pneumoperitoneum–trocar)	• Optical trocar • Visual cannula
Open	• Non-insufflated • Hasson blunt trocar	Direct trocar insertion (sharp trocar entry)	

Figure. Anatomy of the anterior abdominal wall and Veress needle insertion sites.



Adapted from Taskforce for Abdominal Entry (https://www.ejog.org/article/S0301-2115(16)30138-5/fulltext).

RECOMMENDATION 3

Caudal Umbilical Displacement (Vilos Technique)

In the Vilos technique, the assistant grasps the skin and abdominal wall below the umbilicus with both hands and pulls caudally and upwards to maximize displacement of the umbilicus. After a 1-cm vertical infraumbilical incision is made with a No. 12 (hooked) scalpel cutting upwards, the Veress needle is inserted at a 90° angle at the base of the umbilicus. One study showed that the median umbilical caudal displacement was 6 cm (range 2–9 cm) and correlated with patient's height ($r = -0.3$, $P = 0.001$), body mass ($r = 0.17$, $P = 0.08$), BMI ($r = 0.29$, $P = 0.001$), and parity ($r = 0.15$, $P = 0.10$).[10]

SUMMARY STATEMENT 2

Left Upper Quadrant (Palmer's Point) Insertion

Adhesions at the umbilical area are found in approximately 10% of all laparoscopies. In women who have undergone no previous abdominal surgery, umbilical adhesions are found in 0% to 0.7% of laparoscopies. Rates of umbilical adhesions range from 0% to 15% in women who have had prior laparoscopic surgery, from 20% to 28% in those who have had previous laparotomy with horizontal suprapubic (Pfannenstiel) incisions, and from 50% to 60% in those who have had previous laparotomy with longitudinal incisions.[11-13] Patients with midline incisions for gynaecological indications have significantly more adhesions (109 of 259; 42%) than those with all types of incisions for obstetrical indications (12 of 55; 22%).[11]

In patients who have had a previous laparotomy, Palmer advocated insertion of the Veress needle 3 cm below the left subcostal border in the midclavicular line (Palmer's point; Figure). In very slender women with prominent sacral promontory and android pelvis, the great vessels lie only 1 to 2 cm underneath the umbilicus; in women with obesity, the umbilicus is shifted caudally to the aortic bifurcation.[9] Insufflation at Palmer's point requires emptying the stomach by nasogastric (or orogastric) suction and introducing the Veress needle perpendicular to the abdominal wall. This approach is contraindicated in patients with previous splenic or gastric surgery, significant hepatosplenomegaly, portal hypertension, or gastro-pancreatic masses.[1]

Alternatively, an area of approximately 5 cm in diameter centred in the LUQ (Figure), caudally to Palmer's point, can be used to insert a Veress needle and trocar after palpation to exclude underlying masses. When using this area, emptying the stomach may not always be necessary. In a randomized comparison of Veress needle insertion at an umbilicus that had been shifted caudally ($n = 146$) versus at the LUQ area ($n = 137$), conversion from umbilicus to LUQ sites occurred in 10 (6.9%) cases and from LUQ to umbilicus sites in 1 (0.75%) case ($\chi^2 = 0.025$). Veress intraperitoneal placement was satisfactory with both LUQ and umbilical sites, but the LUQ site was associated with fewer attempts and fewer conversions to alternative sites.[14] Using this technique, there have been no reported failed entries or complications in over 5000 laparoscopies.

SUMMARY STATEMENT 3

Other Sites of Veress Needle Insertion

Ninth and 10th Intercostal Space

Agarwala and Liu[15] have used Veress needle insertion in the ninth or 10th intercostal space at the anterior axillary line along the superior surface of the lower rib; this site is intended to avoid injury to the underlying neurovascular bundle. After pneumoperitoneum is established at 20−30 mm Hg pressure, 5-mm laparoscopes can be introduced at LUQ site for inspection of the abdomen and additional trocars can be inserted under direct vision in appropriate sites to perform the surgery.[15]

Lee−Huang Point

Lee and Huang[16] reported on Veress needle insertion at the midpoint between the umbilicus and xyphoid process, perpendicular to the abdominal wall, followed by introduction of a 5-mm trocar for inspection of the abdomen and insertion of additional trocars under direct visualization in appropriate sites to perform the surgery.

Transvaginal

Others have reported on inserting a long Veress needle through the cervix and uterine wall or the posterior vaginal fornix, with the latter approach being particularly helpful in women with obesity.[17]

Veress Needle Safety Tests or Checks

Tests and techniques for determining intraperitoneal placement of the Veress needle include the double-click sound/acoustic test of the Veress needle as it traverses the fascia and the peritoneum, the aspiration test, the hanging-drop of saline test, the "hiss" sound test, and the syringe test.[1] The combined aspiration−syringe test is referred to as Palmer's test. In 2005, a prospective study reported that the double-click, aspiration, and hanging-drop tests provided very little useful information on the placement of the Veress needle[5,18] and did not prevent visceral or vascular injury.[18] Furthermore, wiggling the Veress needle from side to side, which some surgeons believe can confirm intraperitoneal placement, can enlarge a Veress needle puncture to a tear injury of up to >1 cm in viscera or blood vessels.

RECOMMENDATIONS 4 AND 5

Prospective studies have concluded that an initial Veress intraperitoneal pressure (VIP) of 10 mm Hg or below is the most reliable indicator of correct intraperitoneal Veress needle placement, regardless of the women's body habitus, parity, and age,[18,19] and a VIP ≥10 mm Hg is more likely to indicate failure to achieve intraperitoneal placement.[20]

SUMMARY STATEMENT 4 and RECOMMENDATION 6

Number of Attempts to Insert Veress Needle

The Veress needle is successfully placed into the peritoneal cavity on the first attempt in 82% to 87% of cases, on the second attempt in 8% to 11% of cases, on the third attempt in 2% to 4% of cases, and after more than 3 attempts in 0.3% to 3% of cases.[18,19,21] Corresponding complication rates (e.g., extraperitoneal insufflation, omental and bowel injuries, and failed laparoscopy) are 1% to 16% for 1 attempt, 16% to 38% for 2 attempts, 44% to 64% for 3 attempts, and 85% to 100% for more than 3 attempts.[18,21]

Optical Veress Needle

The Veress needle has been modified to a 2.1-mm diameter cannula to allow insertion of a thin (<1.2-mm diameter), zero-degree, semirigid, fibreoptic mini-laparoscope. This system may be inserted in the umbilicus or LUQ, and subsequent ancillary ports are inserted under direct vision.

Adequate Pneumoperitoneum

Adequate pneumoperitoneum has been defined arbitrarily as a volume of 2−4 L of CO_2 or an intraperitoneal pressure of 10−30 mm Hg.[21]

The rationale for high intraperitoneal pressure entry (20−30 mm Hg) is that greater splinting (tension) of the anterior abdominal wall and deeper intra-abdominal CO_2 bubble can be achieved than with a volume-limited pneumoperitoneum of 2−4 L.[3,18-20,22-24] One study determined that 3 L and 4 L of insufflated CO_2 established intraperitoneal pressures of 10 mm Hg and 15 mm Hg, respectively.[23] The study demonstrated that, when a downward force of 3 kg was applied to an umbilical trocar, the intra-abdominal CO_2 bubble was reduced to 0 at 15 mm Hg, and the tip of the trocar touched abdominal contents; when the same force was applied at 25 mm Hg pressure, a CO_2 gas bubble at least 4 cm deep was maintained, and the tip of the trocar never touched abdominal contents.[23] Inserting a reusable trocar requires 4−6 kg of force, and shielded disposable trocars require half this force.[25]

The combined results of 3 case series involving 8997 laparoscopies using entry pressures of 25 to 30 mm Hg included 4 (0.04%) trocar bowel injuries and 1 (0.01%) major vessel injury.[3] In all bowel injuries, the bowel was

adherent at the entry site, and the vascular injury was caused by inadvertent loss of pneumoperitoneum.

The use of transiently high intraperitoneal pressure entry causes minor hemodynamic alterations of no clinical significance. The high pressure causes a decrease in pulmonary compliance (approximately 20%, requiring ventilation pressure from 15 to 30 mm Hg), similar to that caused by the Trendelenburg position, at an intra-abdominal pressure of 15 mm Hg.[24]

RECOMMENDATIONS 7 and 8

Trocar Insertion

Basic Technique

After correct intraperitoneal placement of the Veress needle and establishment of a pneumoperitoneum pressure of 25 to 30 mm Hg, the surgeon can insert a reusable or disposable primary trocar or visual cannula of a chosen diameter and size. The trocar should be inserted at the same site as the Veress needle and following roughly the same direction and angle. The trocar is usually palmed with the dominant hand while the index finger and thumb of the other hand can pinch the trocar 2−3 cm away from the tip, depending on the estimated thickness of the abdominal wall. This manoeuvre of "choking" the trocar tip prevents surgeons from thrusting the trocar beyond the thickness of the abdominal wall and penetrating viscera or major vessels.

After inserting the trocar or cannula, the surgeon introduces the laparoscope under vision, and examines the insertion site and 360° around the abdomen for any potential injury before the patient is tilted into the Trendelenburg position. The presence of any bowel contents or blood should be investigated before proceeding with the surgical procedure. The origin of free blood can be determined by displacing the omentum and bowel cephalad and to the left of midline, then directly visualizing omental and mesenteric vessels and peritoneum overlying the great vessels. Bowel injuries are evaluated by looking for small punctures, tears, bleeding, oozing of serosal areas, or gas bubbles escaping from the bowel.

Alternative Trocar Systems

Reusable Trocars

Reusable trocars with variable tips lose their sharpness following repetitive insertion and therefore require increasingly greater force for penetration through the abdominal wall. Increased entry force frequently results in loss of operator control and over-thrusting of the trocar, which can cause visceral or vascular injury.[4]

Disposable Shielded Trocars

Disposable shielded trocars are made of plastic materials equipped with bladed or bladeless tips covered by a partially retractable shield, which springs forwards to cover the tip after it traverses the abdominal wall. However, there is a brief moment when the sharp trocar tip is exposed and unprotected as it enters the peritoneum.

In 103 852 laparoscopies involving 386 784 trocars, 10 of 36 (28%) serious injuries and 2 of 7 (29%) deaths involved shielded trocars.[26] Based on 629 trocar injuries reported to the U.S. Food and Drug Administration (FDA), there were 408 injuries to major vessels, 182 injuries to other viscera (mainly bowel), and 30 abdominal wall hematomas. It was concluded that safety-shielded and direct-view trocars cannot prevent serious injury during laparoscopic access.[27] Consequently, the FDA requested that, in the absence of clinical data showing reduced incidence of injuries, manufacturers and distributors voluntarily eliminate safety claims from the labelling of shielded trocars and needles.

SUMMARY STATEMENT 5

Radially Expanding Access System

These systems consist of a 1.9-mm Veress-like needle surrounded by an expanding polymeric sleeve. After insufflation, the needle is removed, and the sleeve acts as a tract that can be dilated up to 12 mm by inserting a blunt obturator.[4] Advantages of this system include eliminating sharp trocars, applying radial force, stabilizing the cannula's position, avoiding injury to abdominal wall vessels, and eliminating the need to suture fascial defects.[25]

SUMMARY STATEMENT 6

Visual Entry Systems

Visual peritoneal entry involves the operating room monitors transmitting real-time images of the trocar's travel through the layers of the abdominal wall. Several single-use optical trocars and one reusable visual cannula entry system are available for this purpose.

Single-Use (Disposable) Optical Trocars

These instruments trade blind, sharp trocars for a hollow trocar with a distal transparent pointed tip where a 0°

laparoscope is loaded, to relay real-time images to a monitor as it traverses abdominal wall layers. After the peritoneum is insufflated with CO_2 using a Veress needle, the laparoscope–trocar–cannula unit is advanced perpendicularly towards the peritoneal cavity. Twisting the trocar advances the hydrophobic, winged trocar to dissect successive tissue layers towards the peritoneal cavity. Once in the peritoneal cavity, the optical trocar and laparoscope are withdrawn, leaving the outer cannula in situ, allowing introduction of a regular laparoscope.

Direct optical trocar application, with or without prior pneumoperitoneum, allows rapid peritoneal entry compared with conventional open[28] or closed[29] entry techniques, and its use without insufflation may be preferred in patients with obesity. However, bowel and vascular injuries have been described.

SUMMARY STATEMENT 7

Reusable Visual Threaded Cannula

The Endoscopic Threaded Imaging Port (EndoTIP) is a reusable visual cannula system that allows real-time, interactive, primary peritoneal entry. As with all visual entry systems, knowledge of anatomy, appreciation of navigational cues, and correct recognition of monitor-displayed images (situational awareness) are essential competencies for safe deployment.[30]

Once CO_2 insufflation is complete, the surgeon uses one hand to hold a 0° laparoscope and sheathed cannula perpendicular to the patient's supine abdomen and into the umbilical or any other chosen site (e.g., the LUQ). The fingers of the other hand rotate the threaded cannula clockwise with minimal downward axial pressure. The cannula eliminates the need for any sharp or pointed trocars, converts uncontrolled excessive linear penetration force to radial torque, allows visual access, offers incremental and controlled entry with no chance of overshoot, and preserves myofascial port competence, as the cannula's tract recoils during removal. The reusable visual cannula has also been used successfully without prior CO_2 insufflation with the Veress needle.

A 10-year multicentre prospective study (n = 4724 entries) revealed no vascular injuries and only 1 inadvertent enterotomy, in which the transverse colon was adhered across the umbilical region. The injury was immediately recognized and repaired with no untoward effects. Many of these patients had undergone more than one previous laparoscopy and/or laparotomy; several (2.6%) had LUQ entry with no adverse events.[30] Since this study was published, the same group reviewed >10 000 laparoscopic entries using the reusable visual cannula, with no vascular or visceral adverse events.

SUMMARY STATEMENT 8 and RECOMMENDATION 9

Systematic Approach to Closed Laparoscopic Entry (Vilos Technique)

A systematic approach to closed laparoscopic entry developed by Vilos et al.[10,14,31,32] advocates (1) shifting the umbilicus caudally, (2) a low initial VIP (<10 mm Hg) indicating correct placement of the Veress needle, (3) high intraperitoneal pressure (20–30 mm Hg) before primary trocar insertion, (4) visual entry with the reusable threaded cannula, and (5) liberal use of the LUQ site for insufflation and/or entry. With the use of these five steps, no injuries have been reported in a cohort of over 5000 laparoscopic entries.[31]

Direct Trocar Insertion Laparoscopic Entry

In 1978 Dingfelder published an article on DTI into the abdomen with a sharp trocar.[33] The obvious advantages of this method are the avoidance of complications related to the use of the Veress needle (i.e., failed pneumoperitoneum, preperitoneal insufflation, Veress needle injury to viscera and vessels, and the more serious but rare CO_2 embolism).[34] Laparoscopic entry is initiated with only one blind step (trocar) instead of three (Veress needle, insufflation, trocar). DTI is faster than any other method of entry; however, it is the least performed technique in clinical practice today.[1]

The technique begins with an infra-umbilical skin incision wide enough to accommodate the diameter of a sharp trocar system. The periumbilical abdominal wall must be adequately elevated by hand before the trocar is inserted directly into the abdominal cavity, aiming towards the pelvic hollow. Alternatively, the abdominal wall is elevated with towel clips placed 3 cm to either side of the umbilicus, and the trocar is inserted at a 90° angle to the abdominal wall. On removal of the sharp trocar, the laparoscope is inserted to confirm correct placement before CO_2 insufflation is initiated.

DTI has a reduced incidence of minor complications, mainly owing to fewer episodes of extraperitoneal insufflation (including omental and subcutaneous insufflation) and fewer failed entries.[35]

A task force for abdominal entry created by the International Society for Gynecologic Endoscopy pointed out that

all existing studies lack power to detect differences in major complications between DTI and Veress techniques.[1] To detect a 50% difference in bowel injury rates between DTI and Veress techniques, a study population in excess of 800 000 would be required. Because existing RCTs are underpowered, surgeons should interpret with great caution any published data attempting to demonstrate a difference in rare complications, such as bowel or vascular injury.

A 2019 Cochrane review reported that trial results show a reduction in failed entry into the abdomen with the use of a DTI in comparison with Veress needle entry (moderate-quality evidence).[35] Evidence was insufficient to show whether there were differences between groups in rates of vascular, visceral, or organ injury (very low−quality evidence). There was no mortality in any of the groups in 4 studies and no gas embolism events in 2 studies.[35]

A major issue with DTI is that injuries to bowel and major blood vessels may be more catastrophic, which may lead to higher litigation and underreporting. The catastrophic nature of DTI injuries is invariably related to the size of the hole created by the sharp trocar. One publication reported on 9 litigated cases involving inadvertent bowel and/or vessel injury with DTI.[36] There were 7 cases of bowel injury and 2 cases of major vessel injury resulting from DTI over a 25-year period. There was 1 death and 1 permanent brain injury among the 9 cases. Most of the cases had medicolegal outcomes that were unfavourable towards the surgeon.

SUMMARY STATEMENT 9 and RECOMMENDATION 10

OPEN LAPAROSCOPIC ENTRY OR HASSON TECHNIQUE

Hasson first described the open-entry technique in 1971.[37] The suggested benefits are prevention of gas embolism, preperitoneal insufflation, and visceral and major vascular injury.

The technique involves using a cannula fitted with a cone-shaped sleeve, a blunt obturator, and possibly a second sleeve to which stay sutures can be attached. The entry is essentially a mini-laparotomy. A small incision is made transversely or longitudinally at the umbilicus. This incision is long enough to allow the surgeon to dissect down to the fascia and peritoneum, incise it, and enter the peritoneal cavity under direct visualization. The cannula is inserted into the peritoneal cavity with the blunt obturator in place. Sutures are placed on either side of the cannula in the fascia and attached to the cannula, or sutures are purse-stringed around the cannula to seal the abdominal wall incision to the cone-shaped sleeve. The laparoscope is then introduced and insufflation is started. At the end of the procedure, the fascial defect is closed, and the skin is reapproximated. The open technique is favoured by general surgeons; some believe that the open technique is indicated in patients who have undergone previous abdominal surgery, especially those with previous longitudinal incisions of the abdominal wall.

Hasson reviewed 17 publications on open laparoscopy by general surgeons (9 publications, 7205 laparoscopies) and gynaecologists (8 publications, 13 486 laparoscopies) and compared them with closed laparoscopy performed by general surgeons (7 publications, 90 152 patients) and gynaecologists (12 publications, 579 510 patients).[38] Hasson reported that the rates of complication for open laparoscopy were 0.4% for umbilical infection, 0.1% for bowel injury, and 0% for vascular injury. The corresponding rates for closed laparoscopy were 1%, 0.2%, and 0.2%. In his own 29-year experience with open laparoscopy in 5284 patients, Hasson encountered 1 bowel injury within the first 50 cases.[39]

Garry reviewed 6 reports (n = 357 257) of closed laparoscopy and 6 reports and 1 survey (n = 20 410) of open laparoscopy performed by gynaecologists.[3] With the closed-entry technique, the rates of bowel and major vessel injury were 0.04% and 0.02%, respectively; with open entry, they were 0.5% and 0%, respectively. When the survey report (n = 8000) was excluded, the rate of bowel injury with open entry was 0.06%. Garry concluded that open laparoscopy is an acceptable alternative method that has been shown to almost eliminate the risk of injury in normally situated intra-abdominal structures.[3]

A 2002 meta-analysis of English-language studies (level III evidence) from both the gynaecological and general surgical literature on open laparoscopy reported 23 (0.1%) bowel injuries and 1 (0.005%) vascular injury in the course of 21 000 procedures.[40] Additional case reports of vascular injuries with the open technique have also been published.[1]

Chapron et al.[41] reported on a non-randomized comparison of open versus closed laparoscopic entry performed by university-affiliated hospital teams. Bowel and major vessel injury rates were 0.04% and 0.01% in the closed-entry laparoscopies (n = 8324) and 0.19% and 0% in the

open-entry procedures (n = 1562), respectively. They concluded that open laparoscopy does not reduce the risk of major complications during laparoscopic access.

According to a 2019 Cochrane review, in the direct comparison of Veress needle and open-entry techniques, there was insufficient evidence to determine whether there was a difference in the rates of vascular or visceral injury or failed entry (very low−quality evidence). Two studies reported no deaths in either group. No studies reported gas embolism or solid organ injury.[35]

SUMMARY STATEMENT 10 and RECOMMENDATIONS 11 AND 12

COMPLICATIONS ASSOCIATED WITH LAPAROSCOPIC ENTRY

With the Veress Needle

Extraperitoneal and Preperitoneal Insufflation

Extraperitoneal insufflation is common, and its occurrence may cause difficult or failed entry, often leading the surgeon to abandon the procedure. Further attempts to achieve pneumoperitoneum are usually unsuccessful and are associated with an increased risk of complications. In 1 study, preperitoneal insufflation occurred in 3%, 15%, 44%, and 100% of cases in 1, 2, 3, and more than 3 attempts, respectively.[18]

Veress Needle Injuries

It is difficult to differentiate between puncture injuries caused by the Veress needle or by the tip of a trocar.[3] Small punctures (<2 mm in diameter) can result from the tip of a trocar, and larger tears (>2 mm in diameter) from wiggling the Veress needle from side to side. A 2009 review of 38 case series, including 696 502 laparoscopic procedures, reported that 1575 (0.23%) injuries were attributed to the Veress needle. Of these, 126 (8%) were injuries to blood vessels or hollow viscera (0.018% of all laparoscopies).[42] Another study reported that 31 (13%) of 246 litigated laparoscopic entry injuries were ascribed to the Veress needle.[43]

Bowel Injury. In the aforementioned review,[42] there were 17 (0.0024%) bowel injuries of both the small intestine (n = 9) and large intestine (n = 8; 1 cecum, 2 transverse, 2 sigmoid, 3 not specified). Although the incidence of bowel (n=17) and retroperitoneal vascular (n=42) injuries during blind insertion of the Veress needle is low (1 in every 11 805 needle insertions), such accidents should not be dismissed; they are potentially fatal if undetected. However, the prognosis is good when injuries are detected quickly and treated properly.[42]

Vascular Injury. The review also found 98 vascular injuries, of which 42 were major vascular injuries (0.006% of the total number of laparoscopic procedures).[42] Eight were injuries to major retroperitoneal vessels (8.1% of the vascular injuries); in 34 injuries, which retroperitoneal vessel was injured was not specified. Three injuries affected the aorta (1 patient died) and 5 affected the common iliac arteries (2 right, 2 left, and 1 unspecified). A total of 34 injuries to the great vessels were reported, but the injured vessel was not specified. Fifty-six minor vascular injuries occurred: 1 to the inferior mesenteric artery, 5 to epigastric vessels, and 1 to a vein in the greater omentum.[42]

Gas Embolism. In a review of 489 335 closed laparoscopies, the rate of CO_2 embolism was 0.001%.[44] Several case reports have detailed fatal or near-fatal coronary, cerebral, or other embolism. Asystole followed by resuscitation has also been reported, with sequelae including prolonged hospitalization. CO_2 embolism is associated with a mortality rate of up to 28.5%.[44]

Complications Due to Trocars

The most crucial step in laparoscopic surgery is the insertion of the primary trocar. The trocar is inserted blindly; resulting injuries are frequently serious (diameter 5−10 mm) and can be catastrophic. According to the FDA, such serious trocar injuries are fairly common and tend to be grossly underreported.[2, 27] The two most critical aspects of laparoscopic trocar complications are overshooting and/or misdirecting a sharp trocar, then failing to recognize the injury and act in a timely fashion. All trocar-related vascular and visceral injuries are associated with significant morbidity and mortality. They are often subject to serious medicolegal scrutiny and litigation, representing one-third of all claims.[2,45]

Secondary Trocar Insertion

All secondary trocars and cannulas should be inserted under direct vision and good manual control to avoid misdirection and/or overshoot, which may result in injury to intra-abdominal viscera or vessels.[46]

Vascular Injuries (Abdominal Wall and Intra-Abdominal Vessels)

Vascular injuries may occur during insertion of the Veress needle, any of the trocars, or with the scalpel during open entry. A significant vascular injury appears perioperatively. By contrast, bowel injuries are more likely to go undetected, resulting in delayed intervention with significant

adverse clinical and medicolegal outcomes.[5] Injuries to anterior abdominal wall vessels, including the inferior epigastric vessels and their tributaries, are more common with secondary port placement. Injury of these smaller vessels may result in patient death. A meta-analysis reported that blunt trocars were associated with less risk of abdominal wall vascular injury than bladed trocars.[47]

Trocar Site Hernia

Herniation of omentum or bowel through a port site is uncommon and is related to port size, occurring more frequently laterally than centrally. Not all herniations through the port site are Richter hernia (herniation of only a portion of the circumference of the bowel wall through the fascial defect). Trocar site hernia occurs rarely in 5- and 7-mm ports and more commonly in ports >10 mm, with a 3.1% increased risk with 12-mm ports. Richter hernia may be fatal if it goes unrecognized and may require emergency reoperation for bowel obstruction or strangulation.[47]

Estimated rates of complications associated with the various laparoscopic entry methods and instruments are summarized in Table 2.

LAPAROSCOPY IN SPECIAL POPULATIONS

Laparoscopy in Patients Who Are Overweight or Obese

Given the global increased incidence of obesity (BMI ≥30 kg/m^2), a growing number of patients will require laparoscopic surgery for common conditions as well as for bariatric procedures. Laparoscopic surgery in people who are overweight or obese represents a safety challenge. In Canada, the prevalence of obesity in adults has doubled from 13.8% in 1979 to 26.8% in 2018.[48] In the United States, approximately 35% of the population is obese, and this number is expected to reach 42% by 2030.[49]

In patients with obesity, the anterior abdominal wall anatomy is variable, necessitating special considerations in port entry, port location, instrument design, and initial VIP and CO_2 volume. Body habitus, standard laparoscopic instruments, patient positioning, and comorbidities all present operative challenges.

All peritoneal entry methods (closed, open, DTI, visual) have been used in patients who are obese.

Closed Entry (Veress Needle Insertion)

In patients weighing >200 pounds (90 kg), the umbilicus is located 2.9 cm caudal to the aortic bifurcation.[9] Lifting the anterior abdominal wall in patients with obesity can be difficult, but the umbilicus can be shifted caudally, as described previously.[10] Therefore, the Veress needle should be inserted at 90° to avoid preperitoneal insufflation.[9] Given the thicker subcutaneous adipose tissue, extra-long Veress needles (>15 cm) may be required if the Veress needle is not inserted infra-umbilically.

Most gynaecologists use the umbilical location in the midsagittal plane for Veress needle insertion. However, in patients with obesity, the LUQ area may be a better alternative; the subcutaneous fat layer of the anterior abdominal wall is thicker caudally to the umbilicus than at the LUQ.[11,50] Transvaginal (transuterine, posterior cu-de-sac) insertion of the Veress needle has also been used in patients who are obese.[17]

Among the most reliable safety tests for correct intraperitoneal Veress needle placement is an initial VIP of <10 mm Hg. In patients with obesity, the weight of the anterior abdominal wall invariably increases the initial VIP reading to closer to 10 mm Hg or sometimes even slightly higher.[18-20]

Open (Hasson) Entry

In patients with obesity, a larger skin incision may be required to expose the anterior rectus fascia, which can be held by long Kocher clamps to offer counter-resistance.

Table 2. Estimated complication rates associated with techniques and instruments during laparoscopic entry

Complication	Closed entry		Direct trocar insertion	Open entry	Optical trocar	Visual threaded cannula
	Veress needle or trocar	Veress needle				
Bowel	0.04%–0.2%	0.0024%[a]	0.11%	0.06%–0.1%	0.8%	0.001%
Major vessel	0.01%–0.2%	0.006%	Cases reported; rate unknown	Cases reported; rate unknown	Cases reported; rate unknown	0.0%
Preperitoneal insufflation		>3.0%	Not applicable	Not applicable		
CO_2 embolism		0.001%				

[a] Approximately 20% of all bowel or major vessel injuries associated with the closed laparoscopic entry technique are attributed to the Veress needle.

Some surgeons believe that the open-entry method is more difficult and time-consuming in patients who are obese. They are concerned that a larger skin incision may lead to CO_2 leakage during the laparoscopic procedure, resulting in inadequate pneumoperitoneum, reduced visibility of the operative field, and increased operative risk.

Direct Trocar Insertion

There are few reputable reports on DTI in patients with obesity.[26] Optical trocars, without prior pneumoperitoneum, have been used in patients with obesity; however, inserting bladed optical trocars without pneumoperitoneum is not recommended, and manufacturers advise their use only after pneumoperitoneum.[51]

Threaded Visual Cannula

Threaded visual cannula has been used for primary umbilical, LUQ, and ancillary port placement after pneumoperitoneum in patients who are obese, with no major complications.[11,30,31]

Trendelenburg Position

The Trendelenburg position may be required to improve visualization in patients who are obese, especially in those with excessive omental fat; this may hamper the ability to provide adequate ventilation, especially when higher pneumoperitoneal pressure is required.

Port-Site Hernia

A systematic review of laparoscopic entry methods and instruments reported a 0.74% incidence of port-site hernia in general, with bariatric procedures having the lowest incidence at 0.57%.[52]

RECOMMENDATION 12

Laparoscopy in Pregnancy

When surgery is required in pregnancy, the surgeon must determine the appropriate modality by taking into account patient factors, including gestational age and the nature and urgency of the surgery, in addition to the experience and comfort level of the surgeon and the availability of appropriate resources, including health care personnel.

If the laparoscopic approach is chosen, there are specific considerations for the entry technique. The size of the gravid uterus and gestational age are key factors in determining the optimal method to access the peritoneal cavity. All entry methods can be considered, and the location can be adjusted to account for the height of the uterine fundus.[53-55] Umbilical Veress needle insufflation can be used until 14 weeks gestation, although some surgeons prefer an open technique for the primary trocar using the supraumbilical subxiphoid midline or LUQ sites. After 14 weeks gestation, however, umbilical Veress needle insufflation should be avoided because of the proximity of the gravid uterus to the umbilicus. Open laparoscopic entry or LUQ entry is therefore recommended.

International guidelines also suggest that an open technique is preferred if laparoscopy is performed after 24 weeks gestation.[55] After establishing the pneumoperitoneum, CO_2 insufflation pressures of 10−15 mm Hg can be safely used, with the lowest pressures needed for adequate visualization.

Although laparoscopy can be performed safely in all trimesters, appreciable risks must be considered if the pregnancy is at an advanced gestational age. These include the risk of intra-amniotic insufflation, intravasation of CO_2 and fetal acidosis, and uterine laceration. The latter can interrupt the uteroplacental unit, resulting in uterine hematomas and/or hemorrhage and preterm labour and delivery. Inadvertent Veress needle insufflation of the gravid uterus has been associated with subsequent prelabour rupture of membranes, preterm birth, and fetal loss.

SUMMARY STATEMENT 11 and RECOMMENDATION 13

CONCLUSION

Laparoscopic entry and access into the abdomen may be challenging and have been associated with injuries to abdominal viscera and blood vessels. No one method of laparoscopic entry has proven safer than or superior to another. Surgeons should perform the technique with which they are most comfortable and experienced. Surgical candidates should be advised of the potential risks associated with laparoscopic surgery, including the risks associated with laparoscopic and laparotomic entry. Regardless of entry method, a systematic approach should be used. Adjustments to surgical technique should be considered in certain populations, including patients who are pregnant or obese.

GUIDELINE TOOLKIT

SOGC members can visit the Guideline Resource Kit webpage on sogc.org to find complementary tools and

resources and to participate in accredited continuing professional development activities.

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APPENDIX A

Table. Key to evidence statements and grading of recommendations, Canadian Task Force on Preventive Health Care[a]

Quality of Evidence Assessment	Classification of Recommendations
I: Evidence obtained from at least one properly randomized controlled trial	A. There is good evidence to recommend the clinical preventive action
II-1: Evidence from well-designed controlled trials without randomization	B. There is fair evidence to recommend the clinical preventive action
II-2: Evidence from well-designed cohort (prospective or retrospective) or case-control studies, preferably from more than one centre or research group	C. The existing evidence is conflicting and does not allow to make a recommendation for or against use of the clinical preventive action; however, other factors may influence decision-making
II-3: Evidence obtained from comparisons between times or places with or without the intervention. Dramatic results in uncontrolled experiments (such as the results of treatment with penicillin in the 1940s) could also be included in the category	D. There is fair evidence to recommend against the clinical preventive action
III: Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees	E. There is good evidence to recommend against the clinical preventive action
	L. There is insufficient evidence (in quantity or quality) to make a recommendation; however, other factors may influence decision-making

[a] Adapted from the Canadian Task Force on the Periodic Health Examination. The periodic health examination. *Can Med Assoc J* 1979;121:1193-125.