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REVIEW ARTICLE

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Laparoscopic entry techniques: a protocol for daily gynaecological practice in The Netherlands

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Abstract This Dutch model protocol aims to formulate recommendations on insertion of laparoscopic instruments in order to reduce entry-related complications. It was written on behalf of the Dutch Society of Gynaecological Endoscopy and Minimal Invasive Surgery and serves as guidance to safe entry in laparoscopy for the Dutch gynaecologist in daily practice. It was translated and made suitable for publication in English. Despite the variety of methods described for creating pneumoperitoneum, no one single method can claim to be fundamentally superior to another. The practising laparoscopist should be familiar with at least more than one entry technique.

Keywords Laparoscopy · Entry techniques

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Introduction

The creation of the pneumoperitoneum remains the first step of a laparoscopic procedure. The complication rate of laparoscopy is 5.7/1,000 procedures [1]. It has been calculated that one half of all laparoscopic complications are entry related [1–3]. Entry-related complications are either due to introduction of the Veress needle or to primary or secondary trocars. In a Dutch survey, 0.3/1,000 injuries were caused by the Veress needle, 1.9/1,000 by the primary trocar, and 0.8/1,000 by a secondary trocar [1]. Entry-related complications can be divided into two categories: vascular injuries and visceral injuries. Vascular injuries comprise injuries to the superficial vessels of the abdominal wall (such as epigastric vessels) and to the large blood vessels deeper in the abdomen. Visceral injuries comprise injuries of the bowel, stomach, and omentum and in the pelvis, the uterus and the bladder. These can occur both in cases of normal abdominal anatomy and in anatomical variations caused by pathology such as adhesions or enlarged structures. Risk factors for entry-related complications can be identified, which include adhesions due to previous abdominal surgery, especially median laparotomy; peritoneal infections; and large intraabdominal tumours. Clinical research has not confirmed the often-mentioned risk factor of high body mass index (BMI).

Review of the available information

No publications on the subject were found in the Cochrane Library, nor were controlled trials found in the Cochrane Register. A PubMed search was performed with relevant MeSH terms (1996–2002), and cross references were sought in Medline journals and journals that are not part of the Medline database. The subject was further discussed at meetings of the Dutch Society of Gynaecological Endoscopy and Minimal Invasive Surgery on three different occasions. This review was updated with Jansen et al.'s 2004 publication [4].

Description of standard entry technique

Preoperative

It is advisable to have laparotomy instruments at hand in case of serious entry-related injuries. The first step is to visualise the intraabdominal space. Recognising the patient's physical appearance and abdominal wall morphology and palpating the bifurcation of the aorta and promontory and iliac crests may help in visualising the intraabdominal space. The bifurcation of the aorta is positioned between the 4th and 5th lumbar vertebrae. The umbilical region is situated opposite the 3rd and 4th lumbar vertebrae. The angle between the large blood vessels and the horizontal plane may vary according to the patient's position. Insertion of the Veress needle in a patient in Trendelenburg position is not recommended, or the angle of insertion should be adjusted because the bifurcation of the aorta may be more cranial than when the patient is in a horizontal position. Furthermore, the position of the umbilicus in relation to the large blood vessels correlates with the patient's abdominal mass and body weight. With respect to the bladder, catheterisation of the bladder has been proposed to decrease bladder lesions. In contrast, others have proposed filling the bladder to visualise its cranial borders and thereby prevent bladder injuries.

Introduction of the Veress needle

The closed laparoscopic entry technique with the use of a Veress needle for insufflation followed by the blind insertion of a sharp trocar remains the most common approach used by gynaecologists [4]. The Veress needle consists of a blunt-tipped, spring-loaded inner stylet and a sharp outer needle that penetrates the tissue layers of the abdominal wall. Before introduction of the Veress needle, the needle is checked by retracting the stylet by its spring and then passing gas through the needle to confirm its patency. After a small abdominal incision in the (sub) umbilical region, the Veress needle is introduced in the abdomen by lifting the abdominal wall, preferably by hand. The Veress needle is introduced in a right angle to the horizontal plane of the patient on the operating table. The hand that guides the Veress needle rests on the abdomen to ensure controlled entry of the needle into it. During introduction of the needle, two "clicks" can be heard or felt, one when penetrating the fascia of the rectal abdominal muscle and another when penetrating the parietal peritoneum. After having passed the fascia, further introduction of the needle can progress at a 45º angle to the operating table. Once the peritoneal cavity is entered, tissue resistance dissipates, and the stylet springs back into position, thus presenting a blunt-tipped surface to the structures inside the peritoneal cavity. After insertion into the abdominal space, the needle's position can be tested by an aspiration test; aspiration with an empty syringe attached to the needle can confirm the presence of the needle in the abdominal space and not inside a blood vessel or the bowel [5]. Other tests rely on the principle of negative intraperitoneal pressure, such as hanging a drop of saline on the tip of the Veress needle; it is then sucked into the abdomen through the open Veress needle upon rapid elevation of the abdominal wall.

Insufflation

Carbon dioxide is introduced via the port at the top of the Veress needle; however, the needle's narrow diameter limits the rate of gas insufflation. Insufflation is continued until the preadjusted insufflation pressure of 12–24 mmHg is reached. During insufflation, a free flow of gas, observation of the insufflation pressure gauge, percussion for loss of liver dullness, and steady, symmetrical distension of the abdominal wall can all confirm correct placement of the Veress needle. Absence of these signs should alert the physician to incorrect placement. Use of an initial insufflation pressure of 20–24 mmHg is called hyperdistension. If, in the case of hyperdistension, the external pressure is adjusted to the abdominal wall, then the distance between the abdominal wall and the back of the abdominal space is greater than in the case of lower pressures. With a sharp trocar entry method it is safer to start with a high pressure (20–25 mmHg) as the gas bubble size and thereby the abdominal space are increased [6] (Table 1). In the case of hyperdistension, the insufflation pressure gauge must be lowered to 12–16 mmHg after insertion of the primary trocar. High intraabdominal pressure is possibly associated with high ventilation pressure, with subsequent hypercapnia as a result.

Placement of primary trocar

After satisfactory insufflation, the next step requires blind insertion of a large-diameter trocar for the laparoscope itself, usually in the same entry port as the Veress needle. With the insertion of the primary trocar, one should again keep in mind the position of the patient and of the large blood vessels, in the same way as with insertion of the

Table 1 Laparoscopic entry techniques (+ recommended, ± can be considered, – not advisable)

	Standard risk	Low/high BMI	Previous lower abdominal median laparotomy
Blind			
Direct trocar	±	–	–
Veress 12 mmHg	±	–	–
Veress 20–24 mmHg	+	+	–
Needlescope	–	–	+
Optical	–	+	±
Open			
Hasson	–	+	±

Veress needle. In the case of low distension pressure, the trocar is introduced in the exact same way as the Veress needle. In the case of hyperdistension (24 mmHg), the abdominal wall need not be lifted, and the trocar is introduced in a right angle to the abdominal wall.

An alternative method for introducing the trocar is direct trocar insertion (Table 1). This procedure involves an infraumbilical skin incision, grasping and elevation of the abdominal wall, and insertion of the trocar directed toward the uterine fundus. This technique theoretically has the advantage of only one "blind" insertion (instead of two, with a trocar following insertion of a Veress needle). On the other hand, damage in the case of vessel or bowel lesion is more pronounced. Clinical research is contradictory [7]. After insertion of the primary trocar, the laparoscope is introduced and the abdominal cavity inspected 360°. After inspection, the patient is placed in Trendelenburg position.

Placement of secondary trocars

Insertion of the secondary (and third, etc.) trocar should be done under direct laparoscopic control. The insertion place is chosen with the aid of transillumination through the abdominal wall, thereby identifying the superficial epigastric vessels. The inferior epigastric vessels can be visualised directly from inside the abdominal cavity. They run vertically in the anterior abdominal wall 5.5 cm lateral to the midline [8]. Lesions to the epigastric vessels caused by secondary trocars are the most frequent of all vascular lesions related to insertion (0.2–6/1,000) [9, 10].

Removal of trocars

It is advisable to remove the primary and secondary trocars under direct visualisation—for the primary trocar, with the laparoscope inside the trocar. A bowel perforation or a bowel herniation can thereby be seen.

Patients with a higher risk of entry-related complications

History of abdominal surgery

A multivariate analysis of laparoscopic complications done in The Netherlands in 1996 showed that only a previous laparotomy was a significant risk factor for having an entry-related complication [1]. In 27% of patients with a previous laparotomy through a Pfannenstiel incision, adhesions between viscera and abdominal wall are seen [11]. In general, this occurs more often after gynaecological surgery than after obstetric surgery [11]. After a median infraumbilical laparotomy, these adhesions are seen in 55% of patients and in 67% of patients in whom the laparotomy was extended beyond the umbilicus towards the upper abdomen [11]. On theoretical grounds, the use of the needle laparoscope is preferable in these cases [5] (Table 1). Under visualisation of the abdominal cavity, the insertion of the laparoscope can then best be chosen at a site where no adhesions are visible.

Patients with high or low BMI

As a result of the greater or smaller distance from skin to peritoneal cavity in obese or cachectic patients, there might be an increased rate of failure and increased complication rate in these patients. Nonetheless, successful techniques have been described (Table 1). Hyperdistension during insufflation can reduce the risk of complications. Weight itself presents no contraindication to laparoscopy, with perhaps only the technique causing relative technical problems to the surgeon.

Description of entry techniques in patients at higher risk for entry-related complications

On theoretical grounds, the selection of a high-risk group of patients for an alternative entry instead of a closed-entry technique can still be recommended. At this time it seems that either entry technique has its risks for complication. It is advisable to be familiar with more than one entry technique.

Open-entry laparoscopy

The open-entry technique has a low complication rate with respect to vascular lesions [12]. In the open technique, a small infraumbilical laparotomy is performed. The skin, rectus sheath, and peritoneum are then incised under direct vision. Incision of the fascia can be facilitated by placing two stay sutures through the fascia, then elevating the fascia and incising it between the two sutures. The peritoneum can now be opened with a blunt clamp or cut open using forceps and scissors. Thereafter a blunt-tipped (Hasson's) trocar and cannula are inserted and a pneumoperitoneum created [13]. The cannula is kept in place with the use of the fascia sutures. After the procedure, the sutures are used to close the created fascia defect. An alternative to the Hasson's trocar is the balloon trocar.

The incidence of visceral complications does not differ significantly between the open-entry technique compared with the closed-entry technique [12, 14]. When it is performed in selected patients, the number of complications is not necessarily reduced. The number of entry-related complications in the open technique has even been shown to be significantly higher than in the closed-entry technique [4]. Even when a patient at risk is selected for an open procedure, the number of complications with the closed-entry technique is not necessarily reduced [4]. One has to consider that the open procedure has a learning-curve risk. An inquiry among members of the American Association of Gynecological Laparoscopists showed a complication rate for visceral lesions of 12/1,000 open procedures versus 1.5/1,000 closed procedures [14].

In the open-entry technique, the size of visceral lesions is probably even bigger than those caused by a closed-entry technique. The larger wound of the abdominal wall opening that is caused by the open-entry technique has been associated with leakage of carbon dioxide [12]. It might also be related to incisional hernia after the procedure [12]. While gynaecologists most commonly use the closed-entry technique, the open-entry technique is embraced, especially by general surgeons. It has been calculated that only a randomised study that would include at least 800,000 patients would give an evidence-based answer to the question of which entry technique—blind or open—is preferable [15]. In The Netherlands, gynaecologists rarely use the open-entry technique.

Needle laparoscopy

In cases of suspected adhesions between the viscera and the abdominal wall, such as after previous laparotomy, needle laparoscopy can be useful. A 2–3-mm needle laparoscope is therefore introduced under vision. This can be done at an alternative site such as Palmer's point (located in the left upper quadrant 2–3 cm below the midpoint of the left costal margins). Although from this point both a gas-distended stomach and an enlarged spleen might present potential hazards, adhesions between the viscera and the abdominal wall are rarely seen in this region. After insertion of the needle laparoscope, the Veress needle or the primary trocar can then be introduced at the umbilicus while viewed through the camera of the needle laparoscope [16, 17]. An alternative to this technique is the use of a 5-mm trocar with telescope.

Under-vision-entry techniques

Alternatives for the open-entry technique are those techniques in which the passage of the subsequent anatomical layers can be viewed with the laparoscope during introduction of the trocar. Disposable cannulas with transparent tips and cutting blades have been developed for this by different manufacturers (EndoTIP by Storz, Optiview by Johnson & Johnson, Visiport by Tyco). Discrimination of tissues during insertion through the abdominal wall is difficult, particularly the differentiation between peritoneum and bowel wall. Visceral lesions (due to adhesions between the viscera and the abdominal wall) are not entirely prevented.

Conclusion

Despite the variety of methods described for creating pneumoperitoneum, no one single method can claim to be fundamentally superior to another. The practising laparoscopist should be familiar with more than one entry technique, preferably two more. In the absence of randomised controlled trials, the safest technique remains that which is most familiar to the individual surgeon. In gynaecological laparoscopy, the closed-entry technique remains the technique most commonly used and the one with the lowest complication rate. For all patients, it might be recommended to create hyperdistension up to 20–24 mmHg to prevent lesions of structures in the posterior abdominal cavity. The optical trocar can be introduced under visual guidance of a needle scope. The use of open techniques may be considered as well if sufficient experience is available. The selection of patients for an open- or alternative-entry procedure can still be recommended.

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