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REVIEW ARTICLE

ENTRY COMPLICATIONS IN MINIMAL ACCESS SURGERY

Dr. Muzzafar Zaman, *Dr. Kunal Chowdhary and Dr. Aliya Shah

S.C.F-3 H.U.D.A Complex Opp. Palika Bazar Rohtak

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ABSTRACT

A minimally invasive procedure has many advantages for the patients, health care system and society. Over the past 50 years, many techniques, technologies and guidelines have been introduced to eliminate the risks associated with laparoscopic entry. The laparoscopic entry techniques and technologies reviewed include the classic pneumoperitoneum (Veress/trocar), the open technique (Hasson), the direct trocar insertion, the use of disposable shielded trocars, radially expanding trocars and visual entry systems. It is an evidence based fact that minimal access surgery is superior to conventional open surgery. No single technique or instrument has been proved to eliminate laparoscopic entry associated injury. Proper evaluation, supported by surgical skills and good knowledge of the technology and instrumentation is the keystone to safe access and prevention of complications during laparoscopic surgery. We are reviewing the complications associated with laparoscopic surgery.

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INTRODUCTION

Laparoscopy is the modern art of examining the abdominal cavity and its contents which requires insertion of a cannula through abdominal wall, creation of pneumoperitoneum and visualization of abdominal cavity to perform any surgical procedure. Access into the abdomen is associated with injuries to the G.I.T or major blood vessels and at least 50 percent of these major complications occur prior to commencement of the intended surgery. This complication rate has remained the same during the last 25 years. The majority of injuries are due to the insertion of the primary umbilical trocar. Increased morbidity and mortality result when surgeons or patients do not recognize injuries early and do not address them quickly. (Fuller *et al.*, 2005) To minimize entry related injuries, several techniques, instruments and approaches have been introduced during the last century. These include the veress classic or closed entry, the open (hasson) technique, direct trocar insertion without prior pneumoperitoneum, use of shielded trocars (disposable), optical verres needle, optical trocars and a trocarless reusable visual access cannula. Each of these methods of entry enjoys a certain degree of popularity according to the surgeons training,

experience and bias and according to regional and interdisciplinary variability. (Palmer, 1974; Hasson, 1971; Dingfelder, 1978; Byron *et al.*, 1989; Lanvin *et al.*, 1996; Riek *et al.*, 1994; McGurgan and O'Donovan, 1999)

Common entry complications during laparoscopic surgery

Complications associated with laparoscopic surgery are rare, occurring in less than 1% of patients. Up to a half of all major intraoperative complications associated with laparoscopy, including the most devastating which is major vascular injury, occur at the time of surgical entry. Half of all bowel injuries occur during entry, with the small intestine at highest risk. Recommended methods for avoiding trocar injuries while gaining laparoscopic access during the insertion of the Veress needle and port trocars will be reviewed.

The most common entry complications in laparoscopy are listed as follows:

1. Vascular injuries

During access into abdominal cavity the most dangerous complication of entry are to great vessels like aorta, vena cava and common iliac vessels. Vascular injury is a major cause of death from laparoscopy, with a reported mortality of 15%.

*Corresponding author: Kunal Chowdhary,
S.C.F-3 H.U.D.A Complex Opp. Palika Bazar Rohtak

The cause of these injuries is the close proximity of the anterior abdominal wall to the retroperitoneal vascular structures. The most common minor vascular injury is to the inferior epigastric vessels and superior epigastric vessels occurring in up to 2.5% of lap. hernia repairs. (Kaali, 1993)

2. Bowel injuries

Bowel injury is a rare but serious complication of laparoscopic surgery. The incidence of laparoscopy-induced gastrointestinal injury was 0.13 per cent and of bowel perforation 0.22 per cent. The small intestine was most frequently injured (55.8 per cent), followed by the large intestine (38.6 per cent). In at least 66.8 per cent of bowel injuries the diagnosis was made during the laparoscopy or within 24 h thereafter. A trocar or Veress needle caused the most bowel injuries (41.8 per cent), followed by a coagulator or laser (25.6 per cent). In 68.9 per cent of instances of bowel injury, adhesions or a previous laparotomy were noted. Management was mainly by laparotomy (78.6 per cent). The mortality rate associated with laparoscopy-induced bowel injury was 3.6 per cent. At 0.13 per cent, the incidence of laparoscopy-induced bowel injury is small and such injury is usually discovered during the operation. Nevertheless, laparoscopy-induced bowel injury is associated with a high mortality rate of 3.6 per cent. (Mettler *et al.*, 1999)

3. Urological injuries

In the studied articles, the incidence of bladder injury during laparoscopic procedures ranged from 0.02 to 8.3 percent of cases. Most frequently, these injuries occurred during laparoscopic-assisted vaginal hysterectomy. Sharp electro-surgical dissection was the leading instrument causing injury. The bladder dome was the most commonly injured structure. Less than half of the bladder injuries were corrected laparoscopically. Ureteral injuries accounted for 4.3% to 7% of total laparoscopic complications. Ureteral injuries were identified with incidence rates ranging from 0.025% to 2%. (Turner, 1996; Turner, 1999; Ternamian, 1997)

Recommended steps for safe entry in laparoscopy

Entry systems fulfill several important functions, including safe placement of optical and operative instruments, administration of distending gas, maintenance of operative envelope and preservation of port-competence. To avoid entry error, port-dynamics at tissue-instrument interface must be exposed to understand accident causation. Only then can a more error tolerant and comparatively less dangerous laparoscopic entry systems be developed to offer instrument and method redundancy. Conventional first generation laparoscopic access instruments generally consist of two parts, a removable central trocar and an encasing outer sheath or cannula. Once placed inside a body cavity, the central trocar is removed to accommodate a laparoscope or various operating instruments. Trocars have a blunt proximal end to accommodate the surgeon's dominant palm and transmit generated Penetration Force (PF) to the instrument-tissue interface. The distal end is traditionally designed to have a pointed sharp conical, beveled pyramidal or cutting bladed tip. Cutting pyramidal or bladed trocars are the most commonly used access devices as their

extremely sharp pointed tips render trajectory propulsion require less PF. (Ternamian, 1999) Although extreme sharpness of disposable trocars help slices across different myofascial tissue layers with relative ease, risk of inadvertent bowel or vessel injury because of overshoot, uncontrolled excessive force and blind insertion cannot be denied. In some series, risk of bowel injury with disposable entry trocars is three times that previously reported for reusable trocars, and 87% of deaths from vascular injuries involved use of sheathed disposable trocars (Krishnakumar and Tambe, 2009).

Recommendations and summary statement

1. Left upper quadrant (LUQ, Palmer's) laparoscopic entry should be considered in patients with suspected or known periumbilical adhesions or history or presence of umbilical hernia, or after three failed insufflation attempts at the umbilicus. Other sites of insertion, such as transuterine Veress CO₂ insufflation, may be considered if the umbilical and LUQ insertions have failed or have been considered and are not an option. (Härkki-Siren *et al.*, 1999)
2. The various Veress needle safety tests or checks provide very little useful information on the placement of the Veress needle. It is therefore not necessary to perform various safety checks on inserting the Veress needle; however, wagging of the Veress needle from side to side must be avoided, as this can enlarge a 1.6 mm puncture injury to an injury of up to 1 cm in viscera or blood vessels. (Härkki-Siren *et al.*, 1999)
3. The Veress intraperitoneal (VIP-pressure \leq 10 mm Hg) is a reliable indicator of correct intraperitoneal placement of the Veress needle; therefore, it is appropriate to attach the CO₂ source to the Veress needle on entry. (Härkki-Siren *et al.*, 1999)
4. Elevation of the anterior abdominal wall at the time of Veress or primary trocar insertion is not routinely recommended, as it does not avoid visceral or vessel injury. (Härkki-Siren *et al.*, 1999)
5. The angle of the Veress needle insertion should vary according to the BMI of the patient, from 45 degrees in non-obese women to 90 degrees in obese women. (Härkki-Siren *et al.*, 1999)
6. The volume of CO₂ inserted with the Veress needle should depend on the intra-abdominal pressure. Adequate pneumoperitoneum should be determined by a pressure of 20 to 30 mm Hg and not by predetermined CO₂ volume. (Härkki-Siren *et al.*, 1999)
7. In the Veress needle method of entry, the abdominal pressure may be increased immediately prior to insertion of the first trocar. The high intraperitoneal (HIP-pressure) laparoscopic entry technique does not adversely affect cardiopulmonary function in healthy women. (Härkki-Siren *et al.*, 1999)
8. The open entry technique may be utilized as an alternative to the Veress needle technique, although the majority of gynecologists' prefer the Veress entry. There is no evidence that the open entry technique is superior to or inferior to the other entry techniques currently available. (Härkki-Siren *et al.*, 1999)

9. Direct insertion of the trocar without prior pneumoperitoneum may be considered as a safe alternative to Veress needle technique. (Härkki-Siren *et al.*, 1999)
 10. Direct insertion of the trocar is associated with less insufflations-related complications such as gas embolism, and it is a faster technique than the Veress needle technique. (Härkki-Siren *et al.*, 1999)
 11. Shielded trocars may be used in an effort to decrease entry injuries. There is no evidence that they result in fewer visceral and vascular injuries during laparoscopic access.¹⁶
 12. Radially expanding trocars are not recommended as being superior to the traditional trocars. They do have blunt tips that may provide some protection from injuries, but the force required for entry is significantly greater than with disposable trocars. (Härkki-Siren *et al.*, 1999)
 13. The visual entry cannula system may represent an advantage over traditional trocars, as it allows a clear optical entry, but this advantage has not been fully explored. The visual entry cannula trocars have the advantage of minimizing the size of the entry wound and reducing the force necessary for insertion. Visual entry trocars are non-superior to other trocars since they do not avoid visceral and vascular injury. (Härkki-Siren *et al.*, 1999)
 14. After introduction of the telescope, the bowel should be inspected for obvious injury and abdomen visualized for presence of adherent bowel around the umbilicus. (Härkki-Siren *et al.*, 1999)
- Conclusion**
- All surgical procedures open or laparoscopic have their risks and associated complications. Complications can occur even the best of hands and it is vital that these are recognized promptly and immediately addressed. The importance of proper training and the value of experience is clear. It must be our goal to inculcate in ourselves the necessary skills and encourage the development of specially designed fellowships for those performing the most advanced procedures. When complications do occur, excellent training and experience will allow these to be managed by laparoscopy.

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