

Complications of Veress Needle Insertion for Creation of Pneumoperitoneum

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Abstract

Objective: To determine the frequency of major and minor complications associated with Veress needle insertion method for creation of pneumoperitoneum for laparoscopic cholecystectomy procedure.

Methods: This is a descriptive study aimed to assess the complications caused by Veress needle insertion and to determine the safety profile of this procedure. In this study patients undergoing laparoscopic cholecystectomy in Sindh Government Qatar Hospital were selected from January 2014 to December 2015. Exclusion criteria were established and those patients having age more than 80 years, procedure converted to open surgery or having previous history of upper abdominal surgeries were excluded. Complications occurring during creation of pneumoperitoneum by Veress needle were assessed. Complications were grouped as major and minor complications. Major complications included injury to abdominal viscera and vascular injuries, including injury to aorta, inferior vena cava, iliac and mesenteric arteries. Minor injuries included injury to omentum and mesentery.

Results: Total of 377 cases of laparoscopic surgeries were included in the study. In these laparoscopic surgeries 3 (0.79%) injuries were recorded. All injuries recorded were categorised as minor complications and included two omental injuries and one mesenteric injury. No major complications were recorded including visceral or vascular injuries.

Conclusion: It was concluded in this study that Veress needle method for creation of pneumoperitoneum has good safety profile, being less prone to major and minor complications, along with being a time-saving procedure.

Keywords: Laparoscopic cholecystectomy, needle, safety, complications, pneumoperitoneum.

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Introduction

Several methods for creation of pneumoperitoneum during a laparoscopic procedure have been developed over the years. It is a quick procedure and provides rapid access to the peritoneal cavity in general surgical procedures as compared to other open methods of creation of pneumoperitoneum. This method also has implications in retroperitoneal approach as in certain urological procedures^{1,2}.

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Surgical access into the abdomen for creation of pneumoperitoneum through a smaller incision, as compared to open procedures, during laparoscopic surgeries has posed a particular challenge. Laparoscopy is being used for both diagnostic and therapeutic purposes in the field of surgery, urology and gynaecology. The minimally invasive approach has now become the treatment of choice for treating most benign pathologies of abdomen¹. Furthermore, there is evidence to suggest that there is an overall reduction in the rate of complications following laparoscopic surgeries compared with open procedures². Despite this fact, major and minor injuries to bowel, bladder, abdominal viscera and vascular structures do occur^{3,4}.

Complications of laparoscopy observed in closed and open-entry technique have been observed⁵. However, there is still no consensus with regard to the best method of gaining access to the peritoneal cavity for creation of pneumoperitoneum. The closed technique, with the insertion of a Veress needle, is the most frequently used method⁶.

Evidence suggests that most primary and secondary port injuries have been recognised at the time of laparoscopic surgeries. As a result, there has been an excessive level of concern and increased vigilance among general surgeons regarding injuries related to port site formation, especially the port for the creation of pneumoperitoneum. These injuries can pose a serious threat with regard to morbidity and mortality. Thus, failure to identify such injuries intra-operatively leads to grave outcomes and complications⁷.

It has been previously established in studies that vascular injuries are more common with the Veress needle technique of pneumoperitoneum creation in laparoscopic surgeries compared to other techniques. Majority of these included vascular injuries and visceral injuries were reported minimally. All these injuries were caused when Veress needle method was implicated via midline puncture in laparoscopic operations. Previous history of abdominal surgeries has shown to be a major factor contributing to risk of injury and thus, it has been concluded that patients who have undergone previous abdominal surgeries are more prone to visceral injury caused by the Veress needle due to peritoneal adhesions⁷. Bowel injury during laparoscopic procedures is reportedly rare but results in devastating complications⁸.

In literature, the majority of vascular complications are due to lesions of great vessels (vena cava, aorta, iliac vessels, mesenteric vessels) and they are mostly described during general surgery procedures (appendectomy, cholecystectomy, hernia repair)⁹, and urology procedures with retroperitoneal access¹⁰.

Local data regarding complications of Veress needle insertion for creation of pneumoperitoneum is scarce. Hence, we decided to conduct this study to determine the frequency of major and minor complications associated with Veress needle insertion method for creation of pneumoperitoneum for laparoscopic cholecystectomy procedures.

Methods

A descriptive study was conducted at Sindh Government Qatar Hospital, Orangi Town, Karachi, from January 2014 to December 2015. All patients undergoing elective laparoscopic cholecystectomies within this two year period were included in this study. A protocol for the systematic review of the cases and complications occurring due to Veress needle insertion was established. All patients were included in the study after informed consent and underwent laparoscopic cholecystectomy.

Sample size was calculated with online Rao soft sample size calculator. The margin of error was established to be 5%. The confidence level was set to 95% and the response distribution was set to 50%. The sample size was calculated to be 377. Non-probability consecutive sampling technique was used, thus nullifying the selection bias.

In exclusion criteria, patients above the age of 80, pregnant female patients and those having past history of upper abdominal surgeries were excluded from the study. However, the patients who underwent creation of pneumoperitoneum but the procedure was abandoned due to any reason were included in this study as assessment of complication was still applicable in these patients.

The parameters assessed for the study included total number of injuries observed immediately after insertion of Veress needle for creation of pneumoperitoneum during laparoscopic cholecystectomy, injuries to abdominal structures (great vessels, iliac and mesenteric vessels, digestive tract, and self-limited minor injuries without clinical complications including omentum and mesentery) due to Veress needle insertion and the outcome (con-

version to open cholecystectomy, laparoscopic repair).

The complications encountered were divided into two large groups: major and minor injuries. The first group i.e. major injuries comprised injuries to vessels including aorta, inferior vena cava, iliac vessels and mesenteric vessels and abdominal viscera, while the second group i.e. minor injuries comprised injuries to other structures such as the greater omentum and mesentery.

Results

A total of 377 patients that underwent laparoscopic cholecystectomy in the specified duration of two years in Sindh Government Qatar Hospital from January 2014 to December 2015 were included in the study.

Routine pre-operative investigations of all the patients was done including liver function tests (LFTs). Confounding factors including age, pregnant females and previous abdominal surgical history were removed through exclusion criteria. Nature of the reported injuries was recorded.

Complications were classified into major and minor injuries. Major injuries included injuries to solid abdominal viscera and vascular injuries i.e. injury to aorta, mesenteric vessels, ilial vessels or inferior vena cava. Minor injuries included injuries to omentum and small bowel or large bowel mesentery, along with those injuries not affecting the hospital stay (subcutaneous emphysema and extra peritoneal insufflations).

Results of this study show that among these patients, 17 (4.5%) were male and 360 (95.4%) were females. Average age of the patients was 38 ± 11 years. SPSS version 23.0 software was used for the calculation of average age and standard deviation. Out of these patients, 3 (0.79%) female cases were converted to open cholecystectomy due to difficult procedure. However, 0% male cases were converted to open cholecystectomy. Among these patients, 10 (2.65%) were dealt as diagnostic

laparoscopy of which 1 (0.26%) patient was male while 9 (2.38%) were female.

Total numbers of injuries due to Veress needle were reported to be 3 (0.79%). Minor injuries included 2 (0.53%) omental injuries and 1 (0.26%) abdominal wall emphysema. No other complications as per criteria of minor injury group were recorded. No major injuries including visceral and vascular injuries were recorded in our study, thus the recorded cases of major injury group are 0%. There was no recorded mortality in our study.

The total number of complications as a result of Veress needle insertion in our patients turned out to be 0.79% (Table 1).

Table 1. Major and minor injuries due to Veress needle insertion for creation of pneumoperitoneum during laparoscopic procedures.

Injuries	Number of injuries
Major Injuries	0%
Minor Injuries	
Omentum	0.53%
Mesentery	0.26%
Total	0.79%

Discussion

Laparoscopy is currently widely used in the practice of surgery, for both diagnostic and therapeutic purposes in fields of general surgery, urology and gynaecology. This minimally invasive approach has become the method of choice in modern era for treating most benign abdominal and pelvic pathologies that require surgical intervention. However, it is obvious that laparoscopic procedures are not free of complications.

There are various advantages of a laparoscopic surgery versus an open procedure. These include reduced severity of pain due to smaller incisions, less chances of haemorrhage and reduced post-operative recovery time⁵.

The first laparoscopic procedure was done in 1987. Since then, this approach for surgical inter-

vention has progressively gained acceptance among surgeons¹¹. The first step in this minimally invasive procedure is the creation of pneumoperitoneum for clear visualisation of abdominal contents and formation of space for free movement of instruments within the abdominal cavity.

For creation of pneumoperitoneum several techniques have been proposed over time. Three of these techniques are widely accepted and practiced. One of these methods is an open technique while the other two are closed techniques and are blind procedures. The open method is called Hasson technique while the other two closed methods are Veress needle insertion and direct trocar insertion. There is another alternative to this technique which includes entering the abdomen using an optical trocar under direct vision but this method is less frequently used. The method of choice is dependent upon the operating surgeon. However, studies suggest that the most widely used technique for this step is Veress needle insertion¹².

In 1938, a Hungarian doctor János Veress created Veress needle to induce pneumothorax for the treatment of tuberculosis¹³. These days the needle is used in laparoscopic procedures for gaining access to the peritoneal cavity in order to create pneumoperitoneum¹⁴.

Since Veress needle's invention, its usage has been gaining popularity and nowadays, it has spread worldwide. The creation of pneumoperitoneum is the moment of maximum risk of complications in laparoscopic surgery, mainly due to abdominal viscera and great abdominal vessels lesions. Commercially, Veress needles are available in a wide array of varieties with the length of the needle ranging from 12 to 15 cm and with an external diameter of 2 mm. A bezel-shaped tip enables the needle to pierce the tissues of the abdominal wall when the needle is pushed through the abdominal incision.

Veress needle can perforate soft tissues of the abdominal wall with its bevelled tip. When it reaches the peritoneal cavity, an inner cylinder with

a blunt end is advanced outward. This system is quite effective and safe, making the Veress needle puncture a time-saving and secure technique for entering the peritoneal cavity^{15,16}.

The entrance can be achieved with a supraumbilical approach or at the Palmer's point. It was concluded by our extensive bibliographic search that the majority of studies which compare different peritoneal access methods use the supraumbilical point to insert Veress needle in order to proceed with the surgery¹⁷. We used the same incision for the entry of Veress needle in accordance with the accepted published studies.

Traditional texts recommend an insertion angle of 45° from the horizontal in patients with a body mass index smaller than 30 kg/m² to avoid a vascular or visceral injury. Chandler JG et al.¹⁸ reported not having a problem with a vertical orientation of the Veress needle, provided that the umbilicus is significantly elevated manually and the needle is only inserted a distance of approximately 2 to 3 cm within the cavity or until a negative pressure is encountered¹⁶. In our study, we followed vertical insertion method of Veress needle along with manual elevation of the umbilicus.

The length of the Veress needle that should be inserted in the abdominal cavity is not specified in any scientific report or its related complications. The use of a click sound associated with the springing forward of the blunt stylet, along with the feeling of giving away, is the indication to determine when to stop advancing the needle into the cavity. Complications observed in our patients were minimal.

During and after insufflation, the needle tip direction is not always known. Severe iatrogenic injuries may occur as there are frequent errors in puncturing and insufflations. Due to the retroperitoneal anatomical position of the great vessels, it is quite difficult to diagnose such a complication once it has occurred. Such cases have previously been reported¹⁸. Thus, it is quite essential for the surgeon to be very vigilant during laparoscopic procedures to diagnose such complications.

There are various methods described in the literature to ascertain the position of the needle tip, whether it is inside the peritoneal cavity after puncturing the abdominal wall. Once the needle enters the peritoneal cavity, atmospheric air is promptly sucked into the cavity with the sound of a hiss (hiss test). This is one method of testing the position of Veress needle. Other methods are aspiration of air into a partially filled syringe and free instillation of saline through the needle, sucking in of a drop of saline placed onto the hub of the Veress needle due to negative intraperitoneal pressure (drop test), etc. All these tests are designed to confirm the needle tip position once it is inside the peritoneal cavity¹⁹.

A 5 cc syringe (with the plunger removed), filled with approximately 3 ml saline in it, is fitted with the reusable Veress needle. With the air channel kept locked, the needle is inserted as described previously through the skin incision. As the needle reaches the muscle layer, the lock is released open. After that the needle is pushed further down. As soon as the needle punctures the peritoneum the saline filled within the syringe starts flowing through the needle and into the peritoneal cavity. The flow of saline is a confirmatory indication of the intra peritoneal position of the needle tip. Through this technique one can create pneumoperitoneum with the most superficial position of the needle tip inside the abdomen. We used drop test¹⁹ for confirmation of needle tip position within the peritoneum in our study.

As reported by Neudecker J et al. in 2002, the morbidity reported for creation of pneumoperitoneum by any of the techniques described above is estimated to be less than 1% but the actual incidence of major or minor injuries, either visceral or vascular, for the individual techniques is unknown⁶.

It is essential to know the possible complications arising from risk factors for, and prevalence of bowel and major vascular injuries in order to prevent, establish an early diagnosis of, and treat these injuries properly, thus reducing morbidity and mortality rates.

According to a study by Guloglu R et al. in 2004, most of the vascular complications are due to lesions of great vessels (vena cava, aorta) and the majority are associated with general surgical procedures (appendectomy, cholecystectomy) and urological procedures with retroperitoneal access¹⁹.

Patients with a history of previous abdominal surgeries are more liable to visceral injuries during the Veress needle insertion. This is due to the fact that these patients develop intra peritoneal adhesions which classically grow where the incision of the parietal peritoneum was previously given. In such patients, this step of creating pneumoperitoneum via access to the peritoneal cavity is an extremely dangerous one. In our study, we excluded the patients with a previous history of upper abdominal surgeries.

According to a study by Wherry DC et al.²⁰ number of vascular injuries in laparoscopy is 0.11%. Comparatively, in our study no vascular injuries (0%) were reported. This difference might be due to the fact that there is a large difference between the sample size of this study (9130) compared to ours (377).

In another study, reported prevalence of vascular injury is very low (0.05%), the mortality rate arising from these lesions reportedly ranges between 8% and 17%²¹. The sample size of this study (280) is nearly equal to our study. The difference in reported vascular complications might be due to the fact that we have more experienced surgeons and technicians doing laparoscopic cholecystectomy.

According to one study, in patients who underwent creation of pneumoperitoneum via Open Hasson technique, there were 3 (2.9%) major complications including 1 (1%) colon perforation and 2 (1.9%) iliac artery injuries and 6 (5.8%) minor complications including 1 (1%) subcutaneous emphysema and 5 (4.8%) abdominal wall vessel injury¹⁵.

According to Moberg AC et al.²² visceral injury was reported to be 0.07% in closed and 0.05% in Open method. Comparatively, in our study visceral injuries were reported to be 0%. Moreover, accord-

ing to a study by Kumar S et al.²³ visceral injury was reported to be 0%. Omental injuries were reported to be 0.3%, whereas in our study 0.53% were reported. Abdominal wall emphysema was reported to be 0.32% in this study while we reported it to be 0.26%. This study has a gender distribution of 80% female and 20% males while in our study 95.4% females and 4.6% males were included.

Different authors have reported the rate of trocar-related injury (vascular, mesenteric, small bowel and omental injury) as high as 1%²⁴, but in our study it was reported to be 0.79%.

In view of these facts and figure, our study reveals the safety profile of Veress needle technique with a total complication rate of 0.88% with no major catastrophic complications. Out of the 377 patients included in the study, only 3 developed minor complications while 374 punctures were performed without any adverse effects. As compared to the other techniques, being time consuming in accessing the peritoneal cavity and creating pneumoperitoneum for an already lengthened laparoscopic procedure compared to an open one, Veress needle method with its lower incidence of complications provides a better alternative for this purpose.

It is thus established that there are two important factors to take care of while the insertion of a Veress needle, as done in our cohort of patients. First, the insertion should not be excessive to avoid the risk of visceral or vascular injury. Second, it should be adequate enough to avoid extra-peritoneal insufflation within the plane of abdominal wall because this will lead to failure of the pneumoperitoneum with an associated operative difficulty due to inappropriate distension of the anterior abdominal wall as a result of opposing pressure.

There is an ongoing debate whether Veress needle or Open Hasson technique is the safer option for creation of pneumoperitoneum. Internationally, studies are still being conducted to evaluate safety profile of either technique²⁵. Uranues S et al. published an article in 2016, conducted in Austria, in which he studied 2750 patients and compared

open and Veress needle technique²⁶. There is no previous study conducted in Pakistan to evaluate complications of only Veress needle during creation of pneumoperitoneum. A few local studies have been done which compare open and closed method for creation of pneumoperitoneum. Two of those studies have a very small sample size^{27,28}. One of the studies was conducted in Norwich University Hospital, United Kingdom²⁸. In one of the studies, Veress needle is compared with direct trocar insertion and the other is compared with Hasson's method²⁷. All of these studies are more than 5 years old. Our study provides a relatively larger sample size compared to other local studies and offers local evidence for significant Veress needle safety profile. However, further multicenter studies need to be done with a larger sample size with eventual comparison of local data with international data.

Veress needle is a safer technique and is less prone to major and minor injuries for creation of pneumoperitoneum during a laparoscopic procedure. The procedure is less time consuming as compared to other open techniques for accessing peritoneal cavity for creating pneumoperitoneum, thus providing a safe and better alternative for this purpose.

Conclusion

This study provides evidence that the use of Veress needle method is a safe method for creation of pneumoperitoneum. As Veress needle method is less time consuming, the overall surgery time can be reduced with less anaesthesia time and overall better outcomes for the patient. Complications, including vascular as well as visceral injuries due to Veress needle insertion method, were found infrequent.

Conflict of Interest

Authors have no conflict of interests and no grant/funding from any organisation for this study.

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