**Original Research Article** 

## Received : 28/02/2025 Received in revised form : 19/04/2025 Accepted : 03/05/2025

Keywords: Pneumoperitoneum, Laparoscopic Cholecystectomy, Cholelithiasis, Direct Optical Trocar, Veress Needle, Minimally Invasive Surgery.

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DOI: 10.47009/jamp.2025.7.3.17

Source of Support: Nil, Conflict of Interest: None declared

*Int J Acad Med Pharm* 2025; 7 (3); 84-89



# COMPARATIVE EVALUATION OF VERESS NEEDLE AND DIRECT OPTICAL TROCAR INSERTION FOR CREATION OF PNEUMOPERITONEUM IN LAPAROSCOPIC CHOLECYSTECTOMY

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#### ABSTRACT

Laparoscopic cholecystectomy is the preferred method and the gold standard treatment for treating cholelithiasis globally. The initial entry into the abdominal cavity, known as the access technique, is crucial, as most complications occur during this phase. Surgeons performing minimally invasive procedures must develop proficiency in access techniques to ensure patient safety. Laparoscopic access can be categorized as either closed or open. This study aims to compare the Veress Needle method with Direct Optical Trocar Insertion for creating pneumoperitoneum in laparoscopic cholecystectomy. A total of 60 patients undergoing elective laparoscopic cholecystectomy will be randomly assigned into two groups (30 each) using computer-generated randomization. The study will span one and a half years following ethical approval. The findings indicate that while both techniques have associated risks, the optical trocar method is considered safer and more efficient. However, no single approach has been universally recognized as the ideal technique for pneumoperitoneum creation. Further research is required to establish a standardized laparoscopic entry method. Surgeons should be adept at both techniques and choose based on individual patient characteristics.

## **INTRODUCTION**

The first human laparoscopy was performed by Jacobeus of Sweden in 1910 and the first laparoscopic cholecystectomy was done by Erich Muhe of Germany in 1985.<sup>[1]</sup> Since then, laparoscopic techniques have continuously evolved. Over the past few decades, laparoscopy has become the preferred approach for numerous surgical procedures.<sup>[2]</sup> Laparoscopic cholecystectomy is now recognized as the gold standard for treating symptomatic gallstone uncomplicated disease worldwide.<sup>[3]</sup> This technique is associated with fewer complications and offers cosmetic advantages.<sup>[4]</sup> It is safe to perform, has early recovery and early resumption of work, rapid turnover of the patient and less morbidity of patient.

Laparoscopy involves examining the abdominal cavity and its organs without requiring large incisions. The procedure entails inserting a cannula through the abdominal wall, creating а pneumoperitoneum by inflating the cavity with gas, and using an illuminated telescope for visualization and surgery.<sup>[5]</sup> Since the 1980s, laparoscopic cholecystectomy has largely replaced traditional open cholecystectomy.<sup>[6]</sup> Compared to open surgery, laparoscopy results in lower morbidity and mortality, reduced postoperative pain, and a quicker return to daily activities.<sup>[7]</sup> Other benefits include early ambulation, shorter hospital stays, and its feasibility as a daycare procedure.

Over the years, several techniques have been developed for accessing the abdominal cavity, including the closed (Veress needle), open (Hasson), direct trocar insertion, disposable-shielded trocars, expanding trocars, and visiports.<sup>[8]</sup> Among these, the closed (Veress needle) and open (Hasson cannula) methods are the most commonly used worldwide.<sup>[9]</sup> The closed method involves blindly inserting the Veress needle into the abdominal cavity, whereas the open technique requires making an incision, dissecting the subcutaneous tissue, and inserting the Hasson cannula under direct vision.<sup>[10]</sup>

In minimally invasive surgery, the initial entry into the abdomen with a telescope and instruments is known as the access technique. Many complications in laparoscopy occur during this step, making proper training in access techniques essential for surgeons. The two primary approaches for laparoscopic entry are closed and open access. The Veress needle is widely used in the closed technique, although it is a blind method. Recently, optical trocars have been introduced, allowing for visually guided abdominal entry.

Creating a safe pneumoperitoneum is a crucial initial step in laparoscopic cholecystectomy. As with any procedure, complications may arise, such as bleeding, subcutaneous emphysema, vascular injuries, and bowel injuries. There are four main techniques for establishing pneumoperitoneum: the Veress needle method, direct trocar insertion, optical trocar insertion, and the open (Hasson) technique. The selection of a technique depends on the surgeon's preference, the patient's body type, and any previous abdominal surgeries that may have caused adhesions.

The Veress needle, invented by Janos Veress in 1930 for treating tuberculosis patients, was later adapted for laparoscopy by Raoul Palmer in 1947.<sup>[11]</sup> It consists of an outer cannula with a beveled needle and a spring-loaded inner stylet with a dull tip. This stylet retracts as the needle passes through the abdominal wall and re-extends upon entering the peritoneal cavity, reducing the risk of visceral injury. The needle is typically 7 to 15 cm long with a 2 mm diameter.

In this technique, a small incision is made near the umbilicus, and the patient is positioned in the Trendelenburg position. The abdominal wall is lifted to create negative pressure before inserting the needle at an angle toward the pelvis to minimize the risk of injury. A distinct "give" is felt upon entry into the peritoneal cavity. Verification of correct placement is done using saline injection (ensuring no resistance). air escape, and the drop test. After confirmation, lowflow CO2 insufflation begins until intra-abdominal pressure reaches 13-15 mm Hg. The Veress needle is then replaced with a sharp trocar, and a scope is introduced for further verification before additional trocars are placed. In cases where midline adhesions are anticipated, an alternative entry site is Palmer's point, located 3 cm below the left subcostal margin at the midclavicular line, which is particularly useful for obese and very thin patients.

Optical trocars have a transparent tip and a hollow shaft, allowing direct visualization of tissue layers during insertion. A zero-degree telescope is placed within the trocar, and the surgeon advances the trocar with a rotating motion, ensuring safe and controlled entry into the peritoneal cavity.

Establishing and maintaining pneumoperitoneum is essential for laparoscopic procedures, as it provides sufficient working space. The ideal insufflating gas should be cost-effective, non-toxic, colorless, highly soluble in blood, and non-explosive. Options include carbon dioxide, nitrous oxide, helium, and argon, but carbon dioxide is the most commonly used due to its affordability, low toxicity, easy absorption, minimal risk of gas embolism, and non-explosive properties.<sup>[12]</sup>

This analysis compares the advantages and risks of two laparoscopic entry techniques: the blind Veress needle method and the visually guided optical trocar approach.

### **MATERIALS AND METHODS**

This prospective observational and comparative study will be conducted in the Department of General Surgery at Pt. B. D. Sharma Post Graduate Institute of Medical Sciences, Rohtak. The Aim of our study is to compare the Veress Needle Vs Direct Optical Trocar Insertion for creation of Pneumoperitoneum in laparoscopic cholecystectomy with objectives as follows- To study and compare the merits of closed (blind) technique of creating pneumoperitoneum and clear view (under vision) technique of optical trocar in creating pneumoperitoneum in Laparoscopic surgery, To assess, evaluate and compare the incidence of complications in blind and clear view access techniques in laparoscopic surgery. 60 patients with symptomatic gallstone who are undergoing elective laparoscopic cholecystectomy will be studied. Patient will be randomly divided into two groups of 30 each i.e. Group A and B via computer generated randomization. The study period is One and a half years from the date of approval after ethical approval with a sample size of 60. In our study, Inclusion criteria are as follows- All patients undergoing elective laparoscopic cholecystectomy and exclusion criteria as follows- patients with age <15 years and >75 years will be excluded, patients who had undergone previous midline laparotomy for any infective pathology in abdomen, patients with BMI  $\geq$  35, patients with any contraindication to surgery.

Pneumoperitoneum will be created by following techniques in two groups:

**Direct Trocar Insertion:** In this method of entry, a 10 to 12mm transverse incision will be given supraumbilical or infraumbilically. After placing the patient in Trendelenburg position, the abdominal wall will be elevated by operating surgeons and assistants and the trocar will be inserted into the abdominal cavity turned 30 degrees towards the pelvis.

**Veress Needle group:** With the patient in the Trendelenburg position, a small 3 mm incision will be given, the abdominal wall will be elevated with

two skin clamps, the VN will be introduced at a  $45^{\circ}$  angle toward the pelvis; two "pops" from the fascia and peritoneum will be heard before entering the abdominal cavity. The needle will be aspirated and verified with the saline drop test before initiating insufflations.

#### RESULTS

This study was conducted in the department of general surgery at Pt. B. D. Sharma PGIMS, Rohtak, Haryana on 60 patients divided into 2 groups of 30

patients each. 1st in Group patients, pneumoperitoneum was created using Veress needle and in Group 2nd patients, pneumoperitoneum was created using direct optical trocar. Both methods of creation of pneumoperitoneum were then compared for their merits and demerits and their intraoperative and postoperative complications. Patients were followed up later in OPD and other important investigations were done if required. This study was prospective in nature and done over a period of one and half years from May 2023 to October 2024. The following observation and results were recorded from the study.

Table 1: Distribution of cases according to age of the patient. (N = 60)				
Age of the patient	Number of cases			
15 – 30 years	13 (21.66%)			
31 – 40 years	17 (28.33%)			
41-50 years	11 (18.33%)			
51 – 60 years	11 (18.33%)			
60 –75 years	8 (13.33%)			
Mean age of the patient in years (SD)	42.45 (4.56)			
Range	18 - 74			

The mean age of patients in the study was 42.45 year. Age range was from 18 to 74 years. Maximum number of patients were in the age range of 31-40 years.

Table 2: Distribution of cases according to gender of the patient. (N = 60)					
Gender of the patient Number of cases					
Male	18 (30%)				
Female	42 (70%)				

The number of male in the study was 18 as compared to 42 females in the study. Males accounted for 30% of cases whereas females were 70%.

Table 3: Distribution of cases according method of creation of pneumoperitoneum (N = 60)						
Post-operative antibiotic	Post-operative antibiotic Number of cases					
Group 1: Veress Needle	30 (50%)					
Group 2: Optical Trocar	30 (50%)					

Of the 60 patients, randomly 30 patients were distributed equally in both the group. Group 1: Veress Needle Group 2: Optical Trocar

Table 4: Failure of technique ( $N = 60$ )								
Failure	of	Category				Total		
technique								
		Veress Needle		<b>Optical Trocar</b>				
		Ν	%	Ν	%	Ν	%	
Failure	of	4	13.33	0	0.0	4	6.66	
Technique								
Nil		26	86.66	30	100.0	56	93.33	
Total		30	100.0	30	100.0	60	100.0	

13.33% of the Veress needle group and none of the optical Trocar group have failure of technique.

Table 5: Time required to induce pneumoperitoneum in minutes. (N = 60)						
	Ν	Time required to induce pneumoperitoneum in p-value				
		minutes				
		Mean	SD			
Veress needle	30	3.1		< 0.001		
Optical Trocar	30	2.1				

Average time required to induce pneumoperitoneum among Veress needle was  $3.1\pm0.7$  in minutes and that of Optical trocar was  $2.1\pm0.4$  minutes. The observed difference was statistically significant(p<0.05). Time required to induce pneumoperitoneum among was Veress needle significantly greater than Optical trocar.

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Table 6: Port site hematoma and bruise. (N = 60)							
Port site	Category				Total		
hematoma							
	Veress needle		Optical port				
	Ν	%	Ν	%	Ν	%	
Hematoma &	0	0.00	1	3.33	1	1.66	
bruise							
Port site	1	3.33	2	6.66	3	5.0	
hematoma							
Nil	29	96.66	27	90.00	56	93.33	
Total	30	100.0	30	100.0	60	100.0	

3.33% of the Veress needle group developed port site hematoma while 6.66% of the optical trocar group developed port site hematoma.

Fable 7: Preperitoneal Insufflation (N = 60)							
	Category				Total		
	Veress needle Optical trocar						
	Ν	%	Ν	%	Ν	%	
Preperitoneal	2	6.66	0	0.00	2	3.33	
Insufflation							
Nil	28	93.33	30	100	58	96.66	
Total	30	100.0	30	100.0	60	100.0	

93.3% of the Veress needle group and 100% of the optical trocar group have no Preperitoneal Insufflation.

Table 8: Visceral injury. (N = 60)							
Visceral injury	Veress needle		Optical trocar		Total		
	Ν	%	Ν	%	Ν	%	
Omental injury	1	3.33	0	0.0	1	1.66	
Omental tear	1	3.33	0	0.0	1	1.66	
Bowel injury	0	0.0	0	0.0	0	0.0	
Nil	28	93.33	30	100.0	57	95.0	
Total	30	100.0	30	100.0	60	100.0	

93.3% of the Veress needle group and 100% of the optical trocar have no visceral injuries.

Table 9: Vascular Injury (N = 60)								
Vascular injury	Vascular injury Veress needle Optical trocar Total							
	Ν	%	Ν	%	Ν	%		
Aortic injury	0	0.0	0	0.0	0	0.0		
IVC injury	0	0.0	0	0.0	0	0.0		
Nil	30	100.0	30	100.0	60	100.0		
Total	30	100.0	30	100.0	60	100.0		

None of the groups had any vascular injury.

Table 10: Gas embolism in the two groups. $(N = 60)$							
Gas embolism Veress needle Optical trocar Total							
	Ν	%	Ν	%	Ν	%	
Nil	30	100.0	30	100.0	60	100.0	
Total	30	100.0	30	100.0	60	100.0	

None of the group developed gas embolism.

Table 11: Duration of Surgery (N = 60)							
	Ν	Duration of Su	rgery in minutes	p-value			
		Mean	SD				
Veress needle	30	59.6	20.2	.264			
Optical trocar	30	56.7	17.2				

Average Duration of surgery among Veress needles was  $59.6 \pm 20.2$  minutes and that of Optical trocar was  $56.7 \pm 17.2$  minutes. The observed difference was not statistically significant (p>0.05). Duration of surgery among Veress needles was significantly greater than Optical trocar.

## **DISCUSSION**

Laparoscopy, a minimally invasive surgical technique, has significantly transformed both diagnostic and therapeutic procedures in modern medicine. By utilizing small incisions and a camera-

equipped laparoscope, surgeons can access the abdominal cavity with minimal trauma compared to traditional open surgery. This technique is associated with advantages such as faster recovery, shorter hospital stays, and reduced post-operative pain. It is commonly used for various procedures, including cholecystectomies, appendectomies, and complex gastrointestinal surgeries, thereby improving patient outcomes. Its widespread adoption highlights its effectiveness and safety, making it an integral part of contemporary surgical practice due to its precision and patient-centered benefits.<sup>[13]</sup>

Laparoscopic cholecystectomy is widely regarded as the gold standard for treating symptomatic gallbladder disease, having replaced open cholecystectomy as the preferred approach. This procedure offers several advantages over the open method, such as reduced post-operative pain, earlier oral intake, lower risk of post-operative ileus and surgical site infections, shorter hospital stays, and quicker return to daily activities with better cosmetic results.

This study was conducted at PGIMS Rohtak, involving 60 patients who were divided into two groups: Group A and Group B, each consisting of 30 patients. It was a prospective study conducted over 1.5 years, from May 2023 to October 2024, aiming to compare the Veress needle and direct optical trocar methods for creating pneumoperitoneum in laparoscopic cholecystectomy.

Since the first laparoscopy performed by Jacobeus of Sweden in 1925, various techniques and evidencebased guidelines have been introduced to minimize the risks associated with laparoscopic entry. Studies indicate that nearly 50% of major complications in laparoscopic surgeries occur before the actual procedure begins, with delayed diagnosis of visceral injuries increasing morbidity and mortality rates.<sup>[14]</sup>

Despite the method used, accessing the abdomen and initiating pneumoperitoneum remains a critical step associated with risks such as visceral injuries and preperitoneal insufflation. Over the past three decades, advancements in laparoscopic surgery have made it a well-established practice, though debates continue regarding the optimal technique for creating pneumoperitoneum.<sup>[15]</sup>

Several methods exist for peritoneal access, including the Veress needle, open technique (Hasson Method), direct trocar insertion, disposable shielded trocars, radially expanding trocars, and visual entry systems like the optical trocar. This study reviewed and compared 12 similar studies on different access techniques in laparoscopic cholecystectomy.

As laparoscopic surgery continues to expand with technological advancements, all surgeons must achieve proficiency in the induction of pneumoperitoneum, regardless of the chosen method.<sup>[16]</sup> Various studies have examined different entry techniques, each with its own benefits and limitations.

For instance, a study by Pravin Shinde et al. suggested that a modified optical port entry site could

be a better alternative in developing countries, enhancing both patient satisfaction and surgeon comfort.<sup>[17]</sup>

Another study by Dr. Abdullah Shoeb Mansuri et al. concluded that direct trocar entry is as safe as prior insufflation with the Veress needle, reducing blind procedures and complications associated with Veress needle use.<sup>[18]</sup>

Similarly, research by Shanker Dharmaraj Basa and Hemanth Gudur highlighted that direct trocar entry reduces the number of blind insertions, accelerates pneumoperitoneum creation, minimizes gas use, and shortens operating time. A comparative analysis of complications between Veress needle and direct trocar entry methods revealed differences in risks. Direct trocar entry showed fewer complications such as mesenteric injuries and preperitoneal insufflation, making it a more reliable and time-efficient approach.<sup>[19]</sup>

Further studies, such as those by Rajesh Godara et al. and Ashirwad Datey et al., support the notion that both Veress needle and direct trocar insertion techniques are effective and safe. The findings indicate no significant difference in failure rates between the two methods.<sup>[20,21]</sup>

Additionally, research on bladeless optical trocar insertion by Murat Coşkun and comparative studies on Veress needle versus Visiport technique by Sheela Prince et al. reinforce that both methods have their own sets of complications. However, the optical trocar technique is considered a faster and safer alternative.<sup>[22,23]</sup>

In studies focused on advanced laparoscopic procedures, such as those conducted by Mohab G. Elbarbary et al., the use of an optical trocar at Palmer's point was shown to provide a controlled, safe, and efficient first-port access method.<sup>[24]</sup>

In the study of Timothy Lapham et al 5 years study from 2001 to 2006 using visiport 1623 out of 1626 cases were successful in inducing pneumoperitoneum with visiport. There were three (0.2%) retroperitoneal vascular injury.

In the study of N. Dunne et al, there were visceral injury with veress needle (0.1%) but there was no vascular injury with veress needle technique.<sup>[16]</sup>

Struge et al in a four year period of study had only (0.3%) complications with visiport in creating pneumoperitoneum.

Berch et al four years study in optical trocar, there was no trocar related bowel or vascular injuries with visiport.

Our study suggests that optical trocar is a safer and a faster method as compared to Veress needle in terms of less injuries and rapid creation of pneumoperitoneum.

## **CONCLUSION**

Laparoscopic cholecystectomy has established itself as the preferred treatment and gold standard treatment for cholelithiasis as it is safe to perform and has reduced complications, improved cosmetic outcomes, early recovery, early resumption of work and rapid turnover of the patient.

While both Veress needle and optical trocar techniques have their own advantages and risks, the optical trocar is considered a safer and faster method for creating pneumoperitoneum. However, there is no definitive evidence favoring one technique over the other as the absolute gold standard.

Both techniques carry the potential risk of perforating injuries during the initial trocar insertion, but optical trocar entry, being a visual technique, allows for early injury recognition and immediate management. Safe surgical practices, proper patient evaluation, and surgeon proficiency in both techniques are essential for minimizing complications. Future research and advancements in laparoscopic entry methods will further refine best practices, ensuring safer and more efficient minimally invasive surgeries.

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