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Pneumoperitoneum Creation for Laparoscopic Entry: Veress Needle Insertion Technique Versus Direct Trocar Insertion Technique: A Prospective Comparative Study

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Abstract

Background: In laparoscopic surgery, establishment of pneumoperitoneum is the important step for the continuation of surgery. There are several techniques for the creation of pneumoperitoneum - Veress needle, hasson's cannula, direct trocar insertion and optical trocars. *Aim:* This is a prospective study for comparing the differences between the veress needle (VNI) and the direct trocar (DTI) insertion techniques, regarding the time, safety and complications. *Methods:* In the department of general surgery, Govt. medical college, Omandurar govt. estate, Chennai, India, 306 cases of laparoscopic surgeries were operated from Nov 2016 to Dec 2017. Patient's clinical data was recorded in a specially prepared proforma.

The technique of pneumoperitoneum creation was alternately changed for every successive patient. Patients were followed up for immediate post-operative complications. The two groups were compared using appropriate statistical tests. *Results:* Pneumoperitoneum was successfully created in all 306 cases. The mean access time was significantly lesser in the DTI (136.41 sec vs. 211.86 sec in VNI). Two cases of bowel injury that occurred in the DTI technique wasn't statistically significant. Minor complications such as omental injury and extraperitoneal insufflation were significantly higher in the VNI. Multiple attempts were also needed for pneumoperitoneum creation in the VNI. *Conclusion:* DTI is a safe, rapid and efficient alternative to VNI and other techniques of laparoscopic entry. And with expertise, it also has lower incidence rates of both major and minor laparoscopic entry complications.

Keywords: Laparoscopy; Pneumoperitoneum; Veress Needle Insertion Technique; Direct Trocar Insertion Technique.

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Introduction

Laparoscopy is the examination of the abdominal cavity and its contents, without making large incisions [1]. The important step in laparoscopy is the establishment of pneumoperitoneum [2], so that it provides a working space intra abdominally.

This can be created by the insertion of a cannula, distention of the abdominal cavity with gas or air, and visualization of the intra abdominal contents by an illuminated telescope. About 50% of injuries during laparoscopy occur before commencement of the main operation [3]. There are various techniques for pneumoperitoneum creation - veress needle, hasson's cannula, direct trocar insertion and optical trocars, along with their modifications [4].

Aims & Objectives

This is a prospective study which was under taken to study the differences between the veress needle insertion (VNI) technique and the direct trocar insertion (DTI) technique, comparing with their time, safety and complications.

Materials & Methods

A prospective study in 306 cases of laparoscopic surgeries operated in the department of general surgery, Govt. medical college, Omandurar govt.

estate, Chennai, India from Nov 2016 to Oct 2017 (Figure 1). Patient's data were all recorded in a specially prepared proforma.

The patients were investigated for fitness for surgery and for the presence of any comorbid conditions. If detected, they were treated appropriately before taking up the cases for surgery. BMI of patients were calculated and patients with BMI above 30 were excuded from the study.

The technique of pneumoperitoneum creation was alternately changed for every successive patient. Patients were followed up for immediate post-operative complications. The two groups were compared using appropriate statistical tests.

Out of 306 patients, 153 patients had pneumoperitoneum created by veress needle insertion technique and the remaining 153 by direct trocar insertion technique. The first patient was started with the traditional veress needle technique. Then, the 2 techniques were alternately changed from the second patient, irrespective of the type of procedure intended.

All the patients received one dose of antibiotic prophylaxis I.V cefotaxime 1 gm at induction and the same antibiotic was continued for 3 days post-operatively.

Observations were noted regarding duration and ease of pneumoperitoneum creation in both the groups. Other parameters such as access time (ie) skin-to-laparoscopic entry time, number of attempts for pneumoperitoneum creation and complications such as port site bleeding, extra/ pre-peritoneal insufflations, port site gas leak, omental/ bowel injury, major vessel injury, port site infection and conversion to laparotomy pertaining only to the complication during pneumoperitoneum creation (leaving out conversion due to intra operative procedural complications or difficulty in proceeding with laparoscopy) were monitored and compared. Early mobilization was encouraged. Observations were tabulated and appropriate statistical tests were used to calculate the level of significance. The above study was conducted after getting clearance from the institution's ethical committee.

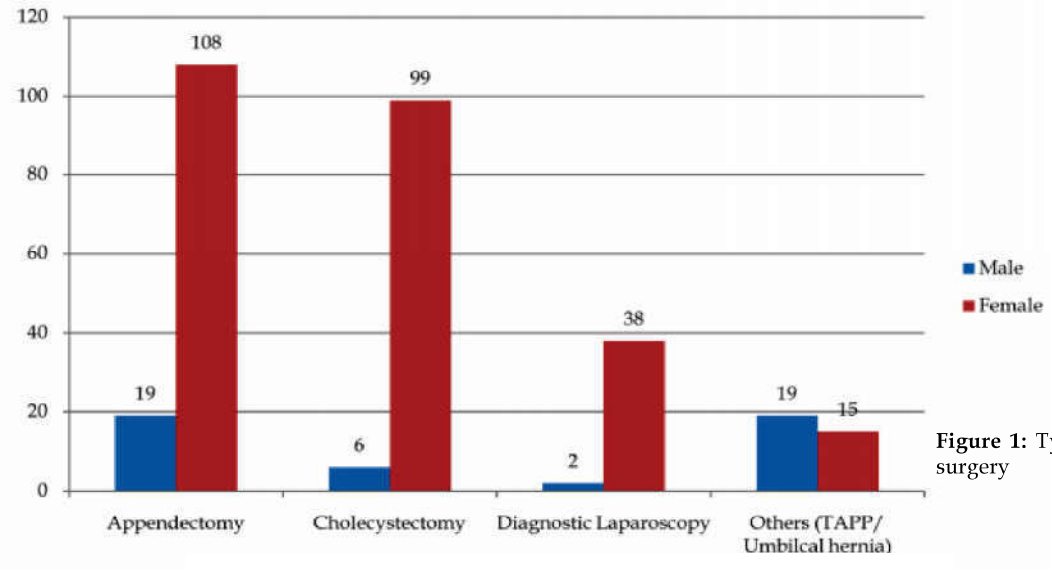

Figure 1: Type of laparoscopic surgery

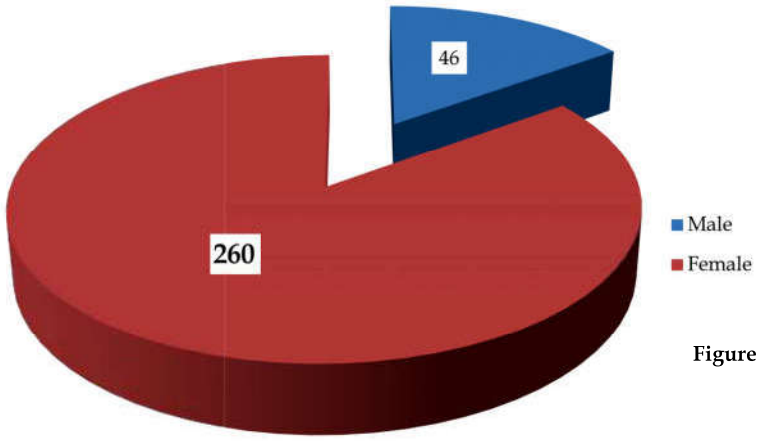

Figure 2: Sex distribution

Results

About 306 patients underwent laparoscopic surgery during the period. Among them, 46 were males and the remaining 206 were females (Figure 2). The youngest was a 13 years Old female, who underwent laparoscopic appendectomy and the oldest was an 80 years old female, who underwent laparoscopic cholecystectomy.

An equal number of 153 patients were divided into two groups (Table 1) via random alternation of the technique (ie) VNI & DTI. The mean access time for pneumoperitoneum (ie) skin-to-laparoscopy time for the VNI group is 211.86 seconds. The access time for DTI is 136.41 seconds. The access time was more in the VNI group, which was statistically significant.

Successful pneumoperitoneum was created in all the 306 cases. While 2 or more attempts was needed in around 26 patients in the VNI group, only 9 patients needed more than a single attempt in the DTI group. This was statistically significant.

Omental injuries occurred more in the VNI group (13 patients), compared with that of DTI group (4 patients). This also proved to be statistically significant. Most of the omental injuries were minor. They were managed conservatively in all the cases, except in 4 patients in VNI which needed conversion to open procedure.

Two cases of bowel injury occurred in the DTI group, which needed to conversion of laparotomy immediately to assess the nature of the injury and further management. No bowel injury was reported in the VNI group. But this was not statistically significant.

Conversion to laparoscopy was also not statistically significant. Twelve cases of extra-peritoneal insufflation occurred in the VNI group, whereas it was only 5 in the DTI group. Port site bleeding and port site gas leak happened more in the DTI group, but neither of them were statistically significant. Port site infection incidence was almost the same in both the groups. No major vessel injury was noted in either of the groups.

Table 1: Distribution of patients in vni and dti

	Laparoscopic Appendectomy		Laparoscopic Cholecystectomy		Diagnostic Laparoscopy		Others (TAPP, Umbilical hernia)	
	Males	Females	Males	Females	Males	Females	Males	Females
VNI	13	21	4	74	2	20	12	7
DTI	6	87	2	25	0	18	7	8

Table 2: Mean access time/ skin-to-laparoscopic insertion time

Direct trocar insertion time n = 153	Veress needle insertion time n=153
136.41 sec	211.86 sec

[p value - less than 0.0001/ statistically significant/ paired t test]

Table 3: Complications

S. No.	Complication during pneumoperitoneum creation	VNI No (%)	DTI No (%)	Comparison by FISHER TEST - p value/significance
1	Successful pneumoperitoneum creation	153 (100)	153 (100)	-
2	Port site bleeding	8 (5.23)	13 (8.50)	0.3662/ not significant
3	Extraperitoneal insufflation	12 (7.84)	5 (3.27)	0.1322/ not significant
4	Port site gas leak	7 (4.58)	12 (7.84)	0.3437/ not significant
5	Omental injury	13 (8.50)	4 (2.61)	**0.0429/ significant**
6	Bowel injury	Nil	2 (1.31)	0.4984/ not significant
7	Conversion to laparotomy	4 (2.61)	2 (1.31)	0.6844/ not significant
8	Major vessel injury	Nil	Nil	-
9	Multiple attempts (2 or more)	26 (17)	9 (5.89)	**0.0035/ significant**
10	Port site infection	7 (4.58)	6 (3.92)	1.0000/ not significant

found to be statistically significant (p-value = 0.0429).

Discussion

As this is an era of modern surgery, minimal access laparoscopic surgery has become more popular both among the patients and the doctors. The key reasons being its advantages like minimal access approach, early return to daily activities due to shorter hospital stay and minimal post operative morbidity & good cosmesis. The key to safe laparoscopic surgery is in its first and foremost important step (ie) an expedite and reliable access to the abdomen. There are several techniques in use for the laparoscopic entry. They are either by blind insertion of veress needle to create pneumoperitoneum followed by another blind insertion of the trocar, direct insertion of the trocar without prior pneumoperitoneum, open insertion of the trocar using a specialized hasson's cannula or using opical trocar systems. The traditional technique is the usage of veress needle in creation of the pneumoperitoneum, due to the long held perception that once the abdomen is distended with gas via a veress needle, the abdominal wall moves away from the viscera, thereby making the introduction of the thicker trocar into the abdomen safe and reducing the incidence of visceral and vascular injuries. But literature shows that regardless of the technique used, their incidence is 1:1000 in experienced hands.

Usage of veress needle had its own share of complications like embolism, preperitoneal insufflations, failed pneumoperitoneum, bowel or vascular injury, apart from the increased duration for creation of pneumoperitoneum. To avoid the complications of veress needle, direct trocar insertion technique into the peritoneal cavity without prior pneumoperitoneum was developed.

Veress needle was introduced in 1938 by Janos Veress of Hungary and has been widely used by the general surgeons and gynecologists [5]. It is a spring-loaded needle containing an inner stylet which automatically converts the sharp cutting edge to a rounded end with the incorporation of a side hole for pneumoperitoneum. Open access was first described by Hasson in 1971 [6]. It required a 3-4 cm incision and a special cone-shaped trocar to minimize gas leakage. It minimized vascular injuries but did not reduce bowel injury. Also open access had complications of gas leak and port instability. DTI without prior pneumoperitoneum was first described by Dingfelder JR. in 1978 [7]. It has many benefits as: a shorter operation time, immediate recognition of vascular and visceral injuries, decreased incidence of entry failure and less insufflation-related complications such as gas embolism.

Among the 306 patients included in this study, 46 were males and 260 were females. This huge variation in the sex distribution is because of the fact that the college in which the study was conducted has a specialized OG institute in its campus.

The major advantage of the DTI is its faster access of the peritoneum, thereby reducing the duration of surgery [8]. Theoretically, DTI involves only one blind insertion of the trocar. Whereas, in the VNI, it requires 2 blind insertions - first with the veress needle and then with the created pneumoperitoneum, second blind insertion of the trocar, with one intervening blind insufflations with veress needle. Insertion of the trocar without prior pneumoperitoneum is easier when compared with the lifing of the abdomen with prior pneumoperitoneum using a veress needle, which would be very difficult.

The mean access time was significantly lesser in the DTI group, which was also statistically significant (Table 2: 136.41 seconds in DTI vs. 211.86 seconds in VNI; p-value = <0.0001). Prieto et al had reported a similar skin-to-laparoscopic insertion time that was significantly different between the two techniques (D.T.I. = 1.5 ± 0.5 versus V.N.I. = 3.0 ± 0.4 minutes < 0.001) [9].

DTI without previous pneumoperitonium is found to be a safe and effective method for laparoscopic access and is associated with fewer complications (Table 3). But in our study, we had 2 cases of bowel injury with DTI, whereas no bowel injury was reported in VNI. Both these cases were done in the initial period of our study, which shows that with experience, this complication had decreased and avoided. Even with those 2 cases of bowel injury with DTI, this was not found to be statistically significant (p-value = 0.4984).

Minor complications such as extra-/ pre- peritoneal insufflations and omental injury (8.50% in VNI to 2.61% in DTI) were significantly more frequent in the VNI technique. This is because of insufficient depth achieved with the veress needle, resulting in preperitoneal insufflation and that will lead to difficulty in subsequent placement of trocar, thereby needing multiple attempts for trocar insertion. Increased percentage of omental injury seen in DTI is

Due to the injuries caused, conversion to laparotomy was also seen in increased number of cases in VNI technique (17%) compared to that of DTI (5.89%), which is found to be statistically significant (p-value = 0.0035).

Other complications such as port site bleeding and gas leak were seen in increased percentage in DTI, but these were not statistically significant in our study. No major vessel injury occurred in either of the

group. There was no difference seen in the incidence of port site infection in both the groups.

Zakherah *et al.* concluded in their study that the open technique is a safer and faster alternative to the closed entry technique (ie) VNI technique for the creation of pneumoperitoneum [10]. Direct entry approach has further advantages such as lesser cost and instrumentation and rapid creation of pneumoperitoneum.

In his study he reported no major injuries but minor complications were more with open technique such as port site gas leak and bleeding, which is comparable to our study.

Ahmad G et al (2012) in their similar study reported that a reduction in the incidence of complications such as multiple attempts of laparoscopic entry, risk of extraperitoneal insufflation and omental injury were demonstrated with the use of DTI technique in comparison to VNI technique [11].

Conclusion

Safe pneumoperitoneum access depends on adherence to well-recognized principles of trocar insertion, knowledge of abdominal anatomy, and recognition of hazards imposed by previous surgery [12]. Trocar use for laparoscopic entry requires considerable training, practice, skill, expertise, manual dexterity, adequate muscular strength, knowledge of the associated risks, and careful patient selection.

Each method has its own advantages and disadvantages. All have similar morbidity and mortality, when they are performed by experienced surgeons with appropriate indications. The individual surgeon should use the technique that best suits his or her operating style in light of the particular circumstance of each patient. Preference should be given to that method with which the surgeon has the experience and is most comfortable [13].

DTI technique of laparoscopic entry and pneumoperitoneum creation is a safe, rapid and efficient alternative to VNI technique and other techniques of laparoscopic entry [14]. It has the shortest entry time than that of other laparoscopic entry techniques, which could be easily learned by surgeons previously trained in laparoscopy. It also has lower incidence rates of both major and minor laparoscopic entry complications, except for the rare 2 cases of bowel injuries in our study, which was also not statistically significant.

Conflict of Interest

The authors acknowledge that there is no conflict of interest with regards to this article.

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