Direct Primary Trocar Insertion without Prior Pneumoperitoneum is a Safe, Feasible and Quick Laparoscopic Entry Technique

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ABSTRACT:

BACKGROUND :

In laparoscopic surgery, the primary (first) trocar entry is of a great importance because of it's association with serious complications such as visceral and vascular injuries. There are several techniques for laparoscopic entry, the commonly used ones are Veress Needle (closed) and Hasson's (open) techniqes. Recently, the Direct Primary Trocar Insertion (DPTI) without prior pneumoperitoneum was reported as safe alternative laparoscopic entry technique .

OBJECTIVE:

This study assesses the safety ,feasibility ,complications and time of DPTI without a prior pneumoperitoneum in laparoscopic surgery.

PATIENTS METHODS:

This is a prospective study included ٢١٩ patients ,١٩٦ females (٨٩,٥ %) and ٢٣ males (١٠,٥ %), prepared for different laparoscopic procedures using only DPTI .Open laparoscopic entry (Hasson's technique) was reserved for patients with associated small umbilical hernias or previous mid-line lapararotomy.Veress Needle (VN) and other methods of laparoscopic entry were not used.This study was performed in AL-Karama Teaching Hospital/ College of Medicine / Wasit University,IRAQ from April ٢٠١١ till July ٢٠١٣ .Recorded data were : age,sex, indications for laparoscopic surgery,time of DPTI , laparoscopic entry related complications, conversion to laparotomy , length of hospital stay and the mortality.

RESULTS AND DISCUSSION:

DPTI technique was feasible in ٢٠٨ patients (٩٥٪) while open laparoscopy was reserved for the remaining ١١(٥ %) patients . Conversion to laparotomy was done for ١٢ patients (٥,٤٧ %) . This study has no major complications nor deaths .

Immediate minor complications occurred in ٧ patients (٣,٢٪).Late minor complications occurred in ٦ patients(٢,٧ %).Time of DPTI was ١,٨٠ ± ٠,٦٤ SD minutes, P-value= ٠,٠١ . The follow-up period ranged from ٢- ٢٧ months .

CONCLUSION:

DPTI entry is a safe alternative to the Veress Needle and other techniques of laparoscopic entry and creation of pneumoperitoneum. It has shorter laparoscopic entry time than the other laparoscopic entry techniques.

***KEY WORDS*:** Laparoscopy,Direct trocar insertion ,Pneumoperitoneum.

INTRODUCTION:

Insertion of the primary trocar and creation of successful pneumoperitoneum are the first crucial steps for laparoscopic surgery because more than ٥٠ % of laparoscopic surgery complications occur at the time of Veress Needle (VN) or primary trocar entry , independent of the complexity of surgery [١،٢] . Bateman et al reviewed ٢٣٢٤ laparoscopic procedures performed by the same surgical team , he reported that more complications occurred during VN and primary trocar placement than during the operative procedures being performed[٣] .Therefore, optimizing the entry technique is essential. Methods ,today used for laparoscopic entry, are : the standard technique of insufflation by insertion of VN , open laparoscopy (Hasson's technique) , optical trocar, threaded or radially expanding devices and direct primary trocar insertion DPTI without prior Pneumoperitoneum[٤] .The existence of numerous techniques for laparoscopic entry and creation of

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pneumoperitoneum indicates that no one has been totally proven efficacious or complication free[٥] .

Laparoscopic entry and creation of pneumoperitoneum with the VN may be associated with a recognized incidence of complications such as preperitoneal insufflation which makes the procedure more difficult and time-consuming [٦]. A meta-analysis study ,performed by Xuezhi Jiang and his collegues, suggests that the commonly used VN entry technique carries a significantly increased risk of minor complications.In addition, the likelihood of multiple insertion attemps and failed entry are significantly higher in the VN group [٧]. Although generally safe, this technique may be associated with life-threatening complications such as, abdominal vascular and visceral injuries. This is especially true in patients with suspected intra-abdominal adhesions and obesity [٨].

Open laparoscopy ,as described by Hasson , has been shown to minimize vascular injuries but does not reduce bowel injuries [٩].This may reflect a selection bias because the Hasson's technique may be ,more likely, used in high-risk patients [٩].The DPTI entry without prior pneumoperitoneum was reported to be associated with minimal complications and preferred by some laparoscopic surgeons (١٠).

The method of DPTI without prior pneumoperitoneum for laparoscopic entry was first described by Dingfelder .JR. in ١٩٧٨ [١١]. The reported benefits of this method are : a shorter operation time, immediate recognition of visceral and vascular injuries, and near exclusion of entry failure [١]. Jansen et al found that ٥٧ % of complications occurred during primary trocar insertion and ٤٣٪ of them were related to surgical skill [٥]. Failure to achieve and maintain pneumoperitoneum may predispose to these complications.

Veress Needle and DPTI are blind techniques, their use can result in severe visceral and vascular injuries.To prevent visceral and vascular injuries caused by the technique used for the creation of neumoperitoneum, laparoscopic surgeons and gynecologists look for safe and effective laparoscopic access techniques. DPTI without prior pneumoperitoneum was reported to be a safe alternative to Veress needle technique [١٠].

It is confirmed in the literature that DPTI is not contraindicated in niether thin nor obese patients in non-emergency situations [١٢]. In these patients, Palmer's point for the DPTI can be the chosen as a site of the primary trocar entry.Despite being a blind technique,DPTI reduces the number of "blind steps" from ٣ with V N (insertion, insufflation, and trocar introduction) to just one .The most important advantage of DPTI entry is the avoidance of complications related to the use of the VN such as; failed pneumoperitoneum, preperitoneal insufflation, intestinal insufflation, or the more serious $CO_{٢}$ embolism [١٣]. It is not $CO_{٢}$ pneumoperitoneum or the trocars but skills and experience of the performer that determine whether a successful laparoscopic access can be achieved [١٤]. A controllable easy-to-follow technique and the experience of the performer are far more reliable than any instruments.

The majority of the laparoscopic surgery injuries are due to the insertion of the primary umbilical trocar [١٥] . DPTI entry method is faster than any other methods of entry (١٦) , however, it is the least performed laparoscopic technique in clinical practice today [١٧] . DPTI is associated with less insufflation-related complications such as gas embolism [١٨].

This study reports the experience of a single laparoscopic surgeon using DPTI without prior pneumoperitoneum for laparoscopic entry over a ٢,٥-year period.

PATIENT AND METHODS:

This is a prospective clinical study included ٢١٩ patients ,١٩٦ females (٨٩,٥ %) and ٢٣ males (١٠,٥ %) prepared for different laparoscopic procedures using DPTI . Open laparoscopy (Hasson's technique) was reserved for patients having associated small umbilical hernias and patients in whom closed laparoscopic entry is highly risky .Veress Needle and other methods of laparoscopic entry such as optical trocars, were not used in this study .It was performed in AL-Karama Teaching Hospital/ College of Medicine / Wasit University, IRAQ from April ٢٠١١ till July ٢٠١٣. Routine investigations ; CXR , Abdominal Ultrasonography ,E.C.G ,Hb gm/dl ,blood group,fasting blood sugar, blood urea and Hepatitis B and Hepatitis C screening were done . Every patient included in this study was informed about his / her inclusion and a signed consent was kept in his/her hospital file .Antithrombotic measures such as subcutaneous low molecular weight Heparin and elastic stockings were taken. All ٢١٩ operations were planned to be laparoscopically performed by one specified laparoscopic surgeon using DPTI without prior pnuemoperitoneum. Recorded data were : age,sex, indications for laparoscopic surgery, time of DPTI , conversion to laparotomy , laparoscopic entry-related complications, length of hospital stay and mortality .

Direct Primary Trocar Insertion .

After induction of general anesthesia, the patient is placed in the dorsal supine position . She / he is then prepared and draped in the usual sterile fashion.One centimeter infraumbilical incision is made sharply with a scalpel. In obese patients,the incision is done ٣-٤ centimeter supraumbilically while in patients with previous upper mid-line laparotomy,left subcostal ,Palmer's point, is the site of DPTI entry .The anterior abdominal wall is then elevated by pulling up with left hand of the operating surgeon and his assisstant .While elevating the anterior abdominal wall away from the underlying viscera, the surgeon holds a ١٠-mm trocar with his right index finger positioned ٣ cm away from the trocar tip to guard against sudden uncontrolled entry into the abdomen. The trocar is inserted at a ٩٠-degree angle and advanced in a controlled fashion into the peritoneal cavity with a twisting semicircular motion. In contrast to Veress needle insertion, where surgeon can feel the penetration through the fascia and peritoneum separately,with DPTI, a distinct and single "pop" signifies that the trocar has pierced the fascia and peritoneum .The laparoscope is then introduced, proper intraperitoneal placement is ascertained, and a pneumoperitoneum is created with high-flow insufflation. Intraperitoneal placement is,also ascertained by observing initial gas flow rate and the intraabdominal pressure. The underlying structures are then carefully inspected for any injury . The patient's position the is then changed to Reverse –Trendeliburg's position .Other trocars are inserted under direct vision .

Laparoscopic entry complications are classified as following: I-major complications that are veseral injuries and major abdominal vascular injuries and CO_2 embolisim and II- minor injuries that are : A-immidiate complications that are ; subcutaneous emphysema,preperitoneal insufflations ,abdominal wall vascular injuries.and B-late minor complications that are ; infection ,port hernia port granuloma (١٣). ***Statical Analysis***

Statistical analysis was performed using (SPSS ١٨) software.The stastistical results were tabulated . $p < ٠,٠٥$ was considered statistically significant.

RESULTS:

This study included ٢١٩ patients , their ages ranged from ١٦ -٧٤ years with a mean ٣٨,٧١ ± ١١,٨٩ SD years ,١٩٦ females (٨٩,٥ %) and ٢٣ males (١٠,٥ %) who underwent different laparoscopic procedures, predominantly laparoscopic cholecystectomy,using DPTI technique for ٢٠٨ patients (٩٥٪) , while open laparoscopy (Hasson's technique) was used in the remaining ١١ patients (٥٪) because: ٧ patients had chromic calculous cholecystitis with small-sized umbilical hernias and ٤ patients had lower vertical laparotomies extending to the umbilicus (Tables ١and ٢) .

The pathologic distribution of the laparoscopic procedures was: ٢٠٤ patients (٩٣,٢٪) had chronic calculous cholecystitis,٧ patients (٣,٢ %) had chronic calculous cholecystitis with umbilical hernias, ٦ patients (٢,٧ %) had acute appendicitis and ٢ female patients (٠,٩ %) had migrating intrauterine device (IUD) .

DPTI insertion was feasible in ٢٠٨ patients (٩٥٪) while open laparoscopy (Hasson's technique) was reserved for the remaining١١ patients (٥ %) .Conversion to laparotomy was done for ١٢ patients (٥,٤٧ %) with chronic calculous cholecystitis because of dense adhesions at Calot's triangle and adhesions between the bowel and the abdominal wall Table .١.

Immediate minor complications occured in ٧ patients (٣,٢ % of the total study group) ; ٥ patients (٢,٤ %) of ٢٠٨ patients (DPTI group) and ٢ patients (١٨,٢٪) of II patients (Hasson'technique group) as following: three patients (from DPTI group) had extraperitoneal insufflation , one patient (from DPTI group) had small liver injury caused by the epigastric trocar needed no any intervention .Three patients (one patient from DPTI group and two patients from Hasson's technique group) had bleeding at the secondary trocar sites that stoped spontanously .Table.٣.

Late minor complications occured in ٦ patients (٢,٧٪ of the total study group) ,٤ patients (١,٩ %) of ٢٠٨ (DPTI group) and ٢ patients (١٨,٢ %) of ١١ patients (Hasson's technique group) as following : ٢ patients (DPTI group) had ecchymosis ,three patients had wound infections (two patients from DPTI group and one patient in Hasson's technique group) ,one patient (Hasson's technique group) had epigastric port site granuloma . There were no major abdominal vascular or visceral complications in this study .Table .٣.

In this study ,time of DPTI was ١,٨٠ ± ٠,٦٤ SD minutes ,P-value = ٠,٠١ (in males was ٢,٠٨ ± ٠,٨٥ SD m while females was ١,٧٦ ± ٠,٦٦ SD m) as shown in Table.٢ .In shis study Veress Needle was not used to compare with. Table .٤.compares this study DPTI time with DPTI time and VN time of other studies .The hospital stay ranged from ١-٤ days, ١,٣٨ ± ٠,٦١SD.P-value = ٠,٢٦ (the low complication rate ,the shorter hospital stay) .The follow-up period ranged from ٢- ٢٧ months .

Table ١: Pathologies / Techniques Of Laparoscopic Entry And Conversion To Laparotomy .

Pathology	Patients n = ٢١٩	Direct Primary Trocar Insertion (DPTI)			Hasson's Technique	Conversion to Laparotomy
		Infraumbilical	Supraumbilical	Palmer's Point		
Chronic calculous cholecystitis only	٢٠٤ (٩٣,٢٪)	١٩٠	٦	٤	٤	١١
Chronic calculous cholecystitis with umbilical Hernia	٧ (٣,٢ %)	٠	٠	٠	٧	١
Acute Appendicitis	٦ (٢,٧ %)	٦	٠	٠	٠	٠
Migrating IUD*	٢ (٠,٩ %)	٢	٠	٠	٠	٠
Total	٢١٩ (١٠٠٪)	١٩٨ (٩٠,٥٪)	٦ (٢,٧ %)	٤ (١,٨ %)	١١ (٥٪)	١٢ (٥,٤٧ %)

IUD*= Intrauterine device .

Table ٢: Statistical Analysis Of Patient's Gender Vs Age , DPTI Time And Hospital Stay.

Gender		Number of the patients & age statistics / year	DPIT* Time statistics / minute	DPIT Hospital stay statistics / day
Male	n = ٢٣	٢٣	١٩	١٩
	Mean ± SD	٤٦,٧٥ ± ١١,٩٢	٢,٠٨ ± ٠,٨٥	١,٤٢ ± ٠,٥٠
	Range	٢٩ - ٦٥	٢ -٣	١ - ٢
	% of Total N	١٠,٥ %	٩,١٣ %	٩,١٣ %
Female	n =١٩٦	١٩٦	١٨٩	١٨٩
	Mean ± SD	٣٧,٧٢ ± ١١,٥٤	١,٧٦ ± ٠,٦١	١,٣٧± ٠,٦٢
	Range	١٦ - ٧٤	١ - ٤	١ - ٤
	% of Total N	٨٩,٥٪	٩٠,٨٧٪	٩٠,٨٧٪
Total	N = ٢١٩	٢١٩	٢٠٨	٢٠٨
	Mean ± SD	٣٨,٧١ ± ١١,٨٩	١,٨٠ ± ٠,٦٤	١,٣٨ ± ٠,٦١
	Range	١٦ -٧٤	١,٥ - ٥	١ - ٤
	% of Total N	١٠٠,٠٪	٩٥ %	٩٥ %

n = number of the patients of each gender group.
N = total mumber of the patients of the study.

Table ٣: Laporoscopic entry related complications of this study .

٢١

The Complications n*= ٢١٩	Method of Laparoscopic Entry	
	DPTI n=٢٠٨	Hasson's Technique n=١١
Immidiate Minor Complications	٣	٠
Extraperitoneal insufflations.	١	٠
Small liver injury by epigastric trocar.	١	٢
Bleeding from the secondary port sites.	٠	٠
Bleeding from the primary port site.		
Total ٧ (٣,٢٪)	٥ (٢,٤ %)	٢ ٠,٣٥٨
P-value	٠,٠٠٣	
Late Minor Complications		
Ecchymosis of the abdominal wall	٢	٠
Wound infection	٢	١
Granuloma of the port site	٠	١
Total ٦ (٢,٧ %)	٤(١,٩ %)	٢
P-value	٠,٠٠٨	٠,٣٥٨
Major complications		٠ ٠
Total of immediate & late Minor & Major Complications ١٣ (٥,٩ %)		٩ (٤,٣ %) ٤ (٣٦,٤ %)
P- value		٠,٠٠٤ ٠,٣٥٨
n*=٢١٩		٩ (٤,١ %) ٤ (١,٧ %)

n* = number of patients of the study ,

Table ٤: Time of The laparoscopic entry technique: comparison between this study and other studies .

Time of Laparoscopic Entery /minute	F.Argesta .et al [١٢]	Byron JW et al. [١٦]	Mahmood S. Zakherah [١٩]	Prieto et al [٢٠]	This Study
DPTI	٠,٥٥± ٠,١٣	٢,٢	٢,٢± ٠,٧ SD	١,٥±٠,٥	١,٨٠±٠,٦٤SD
VN	Not used	٥,٩	٨,٢ ± ١,٤SD	٣,٠±٠,٤	Not used

Table ٥: DPTI & veress needle entery complications: comparison between this study and other studies .

Methods Of Laparoscopic Entery And Their Complications		Mahmood S. Zakherah [١٩]	Mary T. Jacobson et al [٩]	Günenç MZ et al [١٠]	This Study
DPTI	Immediate minor complications %	٠,٤	٠		٢,٤
	Late minor complications %	?	٢,٤		١,٩
	Immediate major complications%	٠	٠	?	٠
	Late major complications %	?	٠,١٦		٠
	Total complications %	?	٢,١٦	٣,٣	٤,٣
	P-value	< ٠،٠٠٠١	?	< ٠,٠٥٠	٠,٠٠٤
Veress Needle	Immediate minor complications %	١٤	٠		Veress Needle was not used in this study
	Late minor complications %	?	٠,٧		
	Immediate major complications %	٠	٠	?	
	Late major complications %	٠	٤,٧		

	Total complications %	≥ ١٤	٥,٤	١٥,٧	

DISCUSSION:

The primary trocar entry and establishment of pneumoperitoneum are the first and most crucial steps in laparoscopic surgery.The DPTI technique was first reported by Dingfelder in ١٩٧٨ [١١] and later described by Copeland et al in ١٩٨٣ [١] According to Copeland et al ,the keys to a successful DPTI are : adequate abdominal wall relaxation, proper skin incision, and the use of a sharp trocar [٢١]. Other authors advise elevation of the rectus sheath [١٢]. The introduction of shielded trocars has encouraged some surgeons to adopt DPTI [٢١،٢٢] but no experimental or clinical study has shown the superiority of the shielded trocar over the non-shielded trocar [١].

The rationale for DPTI without prior pneumoperitoneum is based on the fact that many complications reported during laparoscopic procedures are directly related to the use of the VN [٢٢،٢٣] . DPTI has been reported as a safe alternative to VN [٢٠،٢٤]. DPTI has been reported to be associated with fewer insufflation-related complications, such as gas embolism and to be a faster technique than the VN technique [٢٥] .

The objective of this study was to assess the safety, feasibility and quickness of the DPTI technique. Theodoropoulou et al [١] reported that DPTI feasibility rate was ٩٩,٥ % ,while in this study, the feasibility rate of DPTI was ٩٥٪ which is comparable with Theodoropoulou et al study.

In a randomized prospective study of ٨٤ patients, Prieto-Diaz-Chavez et al [٢٠] reported complication rates of ٢,٣٪ and ٢٣,٨٪ after DPTI and VN insertion, respectively. In another study of ١٥٦٧ patients, Mehmel Ali Verdel et al [٢٤] reported complications of ٠,٩٪ and ١٤,٤٪ after DPTI and VN insertion, respectively. Argesta et al [٢٦] found that, in a population of ٥٩٨ thin and very obese patients, DPTI is safe, having a slightly higher feasibility rate compared with the VN technique and is associated with fewer minor complications ,but reported no differences in the incidence of major complications.DPTI of this study has no major complications but it's minor complications rate was ٤,٣ % ,which slightly higher than DPTI minor complication rate but ,significantly lower than that of VN in the studies [٢٠،٢٤،٢٦] .

In this study, DPTI time was ١,٨٠ ± ٠,٦٤ SD minute . Mahmood S. Zakherah [١٨] reported DPTI time ٢,٢± ٠,٧ SD minute and VN time ٨,٢ ± ١,٤ SD minutes . Byron et al. [١٦] reported DPTI time ٢,٢ minute and VN time ٥,٩ minute .Thus, this study DPTI time is comparable with DPTI time of either studies [١٦،١٩] but ,is significantly shorter than their VN time .

Argesta .T.et al[١٢] study shows that DPTI was feasible in ١٠٠٪ of cases, and no conversion to open laparoscopy was necessary. Duration of DPTI was ٥٥±١٣ seconds, while for open laparoscopy, it was ١٨٠±٣٦ seconds. Although the open trocar technique with a Hasson's cannula is considered a safe alternative, it is not complication free and its time consuming entry technique having made many laparoscopic surgeons use it very selectively [١٤،٢٦].

Reviewing of the studies [١٤،٢٢،٢٦] reveals that none of the available methods of laparoscopic entry for creation of pneumoperitoneum are free of complications. Each has its individual advantages and disadvantages and similar morbidity when performed by experienced operators with appropriate indications [٢٧] .

CONCLUSION:

In conclusion,DPTI entry is a safe alternative to the Veress Needle and other techniques of laparoscopic entry and creation of pneumoperitoneum. It has shorter laparoscopic entry time than the other laparoscopic entry techniques .

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