

Comparison between different entry techniques in performing pneumoperitoneum in laparoscopic surgery

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ABSTRACT:

Background

The main challenge facing the laparoscopic surgery is the primary abdominal access, as it is usually a blind procedure associated with vascular and visceral injuries. It has been proved from studies that 50% of laparoscopic major complications occur prior to the commencement of the surgery. The surgeon must have adequate training and experience in laparoscopic surgery before intending to perform any procedure independently. He should be familiar with the equipment, instrument and energy source he intends to use.

Aim of the study

Aim of this dissertation is to study the incidence of complications according to different techniques used for inducing pneumoperitoneum in laparoscopic surgery.

Patients and methods

Prospective and retrospective data was collected for (360) patients underwent laparoscopic surgery from January 2009 to April 2010 in Al-Sader teaching hospital , private hospital in Najaf and Alhussien teaching hospital in Nassyriah , all these patients were operated by different surgeons using different entry techniques

Result

Three hundred and sixty patients underwent laparoscopic surgery; 300 of them were female and 60 were male. The operations included in our study were cholecystectomy (254), hydatid cyst of the liver (15), perforated peptic ulcer (2), appendectomy (3), diagnostic laparoscopy for infertility and abdominal pathology (56), undescended testes (8), ovarian cyst (20), achalasia and Nissen fundoplication (1). The early complications recorded in our study are abdominal wall vascular injuries ,visceral injuries ,bradycardia , preperitoneal insufflations .The incidence of laproscopic entry related injuries in gynecological operations was 6.9% .But the incidence of laproscopic entry related injuries in major pelvic operations was 7.8% .

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Conclusion

No single technique or instrument has been proved to eliminate laparoscopic entry associated injury. Proper evaluation of the patient, supported by good surgical skills and reasonably good knowledge of the technology of the instruments remain to be the cornerstone for safe access and success in minimal access surgery.

Keywords;

Trocar, laparoscopy, complication and pneumoperitoneum.

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INTRODUCTION:

The word laparoscopy originated from the Greek word (Lapro-abdomen, scopion-to examine). Laparoscopy is the art of examining the abdominal cavity and its contents. This is achieved by sufficiently distending the abdominal cavity (pneumoperitoneum) and visualizing the abdominal contents using illuminated telescope. Over the past 50 years rapid advancement in technology in terms of electronics, optical equipments and other ancillary instruments, combined with improved surgical proficiency and expertise, laparoscopic surgery rapidly advanced from a gynecological procedure for tubal sterilization to one used in performing most of the surgical procedures in all surgical and gynecological discipline for a variety of indications. Initially laparoscopic surgery was termed a minimally invasive surgery, but this term was changed to minimal access surgery as laparoscopic surgery is an invasive procedure associated with similar risks of major complications as compared with the conventional open surgery. The major difference between

laparoscopic surgery and conventional open surgery is the minimal access to the abdominal cavity, as the abdominal incision (and its associated complications) is replaced by very small incisions only sufficient to introduce trocar of 5-10mm in diameter. This minimal traumatic insult to the patient, if achieved safely and efficiently the patient postoperative recovery will be shorter with less pain and return to full activity and work in shorter time. This has many advantages to patients, healthcare system and society.⁽¹⁾ The main challenge facing the laparoscopic surgery is the primary abdominal access, as it is usually a blind procedure associated with vascular and visceral injuries. It has been proved from studies that 50% of laparoscopic major complications occur prior to the commencement of the surgery^(2, 3). If there is delay in diagnosis of visceral injuries or delay in reporting, the morbidity will increase and may lead to mortality⁽⁴⁾. Over the past 30 years primary access complications rate has not decreased significantly in spite of the improvement in technology and surgical skills. The Royal College of

Obstetricians and gynecologists – London, conducted a survey in 1978 evaluating the laparoscopic surgery complications, the rate of laparoscopic entry related complications was 0.3%⁽⁵⁾. In a recent literature review, the risk of primary access complications in advanced laparoscopic tertiary centre was 0.1%. The surgeon must have adequate training and experience in laparoscopic surgery before intending to perform any procedure independently. He should be familiar with the equipment, instrument and energy source he intends to use. This indicates that in spite of the improvement in the technology and experience, primary access complications were decreased but not completely eliminated. The included techniques (Veress needle pneumoperitoneum, trocar/cannula system). Open (Hasson) technique. Direct trocar insertion without prior pneumoperitoneum. The use of shielded disposable trocars. Optical Veress needle and optical trocar. Radically expanding trocar and the trocarless, reusable visual access cannula⁽⁶⁾.

Laparoscopic entry techniques

Veress needle and pneumoperitoneum:

Veress needle was first popularized by Roal Palmer of France 1947 . The creation of pneumoperitoneum remains an essential step of successful laparoscopic surgery. Being a blind procedure it is associated with injury to the vascular and visceral contents of the peritoneal cavity .It is the most popular technique used by most of the laparoscopic surgeons worldwide to achieve pneumoperitoneum. There are many sites for insertion for Veress needle to achieve pneumoperitoneum. In

the usual circumstances in a patient with an average BMI(body mass index) and no history of previous or suspected intra-peritoneal adhesions, the Veress needle is inserted through an incision at the base of the umbilicus. In obese patient with BMI >30 or patient with history of previous midline incision, or failed pneumoperitoneum after three attempts alternative site for Veress needle insertion may be thought. The second common site for insertion of Veress needle is the Palmer's point which lies 3 cm below the left costal border in the mid-clavicular line⁽⁷⁾. This technique is recommended for obese or very thin patient, patient with history of previous midline surgery or suspected intraperitoneal adhesions, or failure to achieve pneumoperitoneum after three attempts. It is essential to decompress the stomach using nasogastric tube suction. This technique should be avoided in patient known to have hepato-splenomegally, history of previous gastric or splenic surgery or palpable gastro-pancreatic mass⁽⁸⁾. A 5-millimeter telescope can be introduced at the same site of Veress needle visualize the peri-umbilical adhesions ,then a 10 mm trocar can be introduced under direct vision , followed by additional trocar/cannula system inserted under direct vision as required . Other sites that have been used for pneumoperitoneum include trans-uterine and trans-cul-de-sac. These techniques had been used in the past by gynecologists to achieve pneumoperitoneum in obese patients^(9,10). These two sites are not recommended as they carry the risk of sepsis and the risk of perforation of the rectum in the presence of pelvic inflammatory disease (PID) or severe endometriosis^(11,12). For optimal and safe pneumoperitoneum initially the patient

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should be lying flat. The abdomen should be palpated for palpable masses. The sacral promontory should be palpated as the aortic bifurcation is very close to the sacral promontory, this is especially important in very thin patient with android pelvis. The angle of insertion of the Veress needle in relation to the skin varies according to the patient BMI. A study to localize the position of the umbilicus in relation to the bifurcation of the aorta using computerized axial tomography (CT), the location of the umbilicus varied from 0.4cm in average person, 2.4 cm in overweight and 2.9 cm in obese patients . Based on these results the Veress needle should be introduced perpendicular to the skin of the umbilicus in obese patient and at 45 degrees toward the hollow of the sacrum in thin patient⁽¹³⁾. Hurd et al. reported on CT scans of 38 unanaesthetised women of reproductive age that the position of the umbilicus was found, on average, 0.4 cm, 2.4 cm and 2.9 cm caudal to the aortic bifurcation in normal weight (BMI <25 kg/m²), overweight (BMI 25-30 kg/m²) and obese (BMI >30 kg/m²) women respectively. In all cases, the umbilicus was cephalad to where the left common iliac vein crossed the midline at the sacral promontory. Therefore, the angle of Veress needle insertion should vary accordingly from 45 degrees in non-obese women to 90 degrees in very obese women⁽²⁸⁾. Several tests have been recommended to ascertain correct placement of Veress needle in the peritoneal cavity. These include

- 1- Double click sound of the Veress needle test,
- 2- Aspiration test,
- 3- Hanging drop of saline test,
- 4- Syringe test⁽¹⁰⁾.

A recent retrospective study evaluating these four tests reported that non of four tests proved confirmatory for the intraperitoneal placement of the Veress needle and concluded that the most valuable test is to observe actual insufflation pressure (intra-peritoneal) to be 8 mm Hg or less, and the gas is flowing freely⁽¹⁵⁾. It has been shown that achieving high intra-peritoneal pressure entry (HIP entry) ranging from 20 -25 mm hg will increase the gas bubble and produce greater splinting of the anterior abdominal wall and increase the distance between the umbilicus and bifurcation of the aorta from 0.6cm (at pressure of 12 mm Hg) to 5.9 cm. this will allow easy entry of the primary trocar and minimize the risk of vascular injury⁽¹⁶⁾. The high pressure entry technique is recommended by Royal college of Obstetricians and gynecologists-London (RCOG) and Canadian Society of Obstetricians and Gynecologists (SOGC)^(14, 17). New modifications to the Veress needle have been introduced to minimize Veress needle associated injury. These include pressure sensor equipped Veress needle, optical Veress needle. However none of these new modifications has been proved to be superior to the classic Veress needle and eliminated Veress needle related injury. Controlled randomized trials are recommended to ascertain their safety and justify their extra cost⁽¹⁸⁾. Hasson (open) entry technique was first described by Harith Hasson in 1971. When first reported his technique Hasson claimed that his technique avoids Veress needle pneumoperitoneum and its associated complications (gas embolism and vascular injury) . This technique involves incising the fascial layer and holding its edges by two lateral stay sutures, these will be used

to stabilize the cannula. This will seal the abdominal wall incision to the coned- shape sleeve. The telescope is introduced and insufflations commenced after visualizing omentum and bowel. Long standing controversy remains about the optimal primary access technique. Some authorities believe that Hasson open technique is superior to the classic closed entry technique defending their views in that it is faster, eliminate the risk of gas embolism ,and significantly reduces the vascular and bowel injuries related to primary access. However there is conflicting evidence between different studies and there is no unified opinion regarding this issue⁽¹⁹⁾.

Direct trocar entry technique:

This technique was introduced by Dingerfield in 1978. In his first publication he suggested the advantages of his technique which eliminates Veress needle complications, these include failed pneumoperitoneum, preperitoneal insufflation and gas embolism. It is fast as it is a one step pneumoperitoneum. However being a blind procedure it does not eliminate the risk of bowel and vascular injuries^(22,23). Several studies were published stressing on safety of this method and recommending its use for primary access. Most of these studies were retrospective, only few studies were prospective. A retrospective review of 51 publications comparing the entry related complications with the closed (Veress /trocar technique, open and direct trocar technique). Entry related bowel injury rate were 0.04% (Veress/trocar), 0.11% (open), and 0.05% (direct). The corresponding vascular injury rates were 0.04%, 0.01% and 0% respectively⁽²⁴⁾. From the above

studies there is no clear evidence as to the optimal form of laparoscopy entry in low risk patient and it depend on the surgeon preference and experience with the individual technique⁽²⁴⁾.

Disposable shielded trocar (Veress trocar):

Disposable shielded “ safety” trocar when first introduced to the market in 1984, the manufacturer claimed that this trocar system works in a way that the sharp tip is and only becomes active and gets exposed when it encounter resistance through the abdominal wall. As it enters the abdominal cavity the sharp edge retract and the shield springs forward and cover the sharp tip of the trocar and the manufacturer wrote in the commercial label “safety” trocars. These trocars were intended to avoid contact of the end of the trocar with the intra-abdominal content. However it must be pointed out that even when this trocar was introduced correctly according to the recommended specification, there will be a moment when this trocar enters the peritoneal cavity and before its retraction, it will be in contact with abdominal content. This brief moment is sufficient to produce injury especially with its very sharp end. Disposable trocars require half the force required to introduce the classic reusable trocars. A retrospective study of 103852 laparoscopy entry used the disposable shielded trocars and classic trocars showed the ,shielded trocars were responsible for 30% of serious injuries caused by laparoscopic entry, and two deaths out of seven deaths caused by laparoscopic entry injury⁽²⁵⁾. Many studies were done and all disputed the complete safety of these trocars. As it is very popular in the united states , most of these studies were published in the United States, this led the FDA(Federal

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Drug Association) to directly write to the manufacturers of shielded laparoscopic trocars requested that in the absence of clinical data showing reduced incidence of injuries, manufacturers and distributors voluntarily eliminate safety claims from the label of shielded trocars (26).

Visual entry systems (visiport):

These include the disposable optic trocars and the endo TIP visual cannula. These new technology aims to optimize the laparoscopic entry by facilitating entry under direct vision. Controlled randomized trials are required to assess their safety and proof their superiority to the traditional Veress needle and trocar /cannula system in order to justify their expensive cost (29).

Complications of laparoscopic access

The complications resulting from insertion of veress needle & direct trocar are injuries to major abdominal wall vessels, most commonly injured vessels are superficial epigastric & circumflex iliac vessels & deep superior & inferior epigastrics.as well as injuries to the bowel & other abdominal organs which are associated with significant morbidity and mortality. Other more minor complications resulting from Veress needle and trocar insertion include abdominal wall hematoma, wound infection, and fascial dehiscence and herniation (22).

PATIENTS AND METHODS

Prospective and retrospective(2008) data was collected for (360) patients underwent laparoscopic surgery from January 2009 to April 2010 in Al-Sader teaching hospital, infertility centre and private hospitals in Najaf city and

AlHussien teaching hospital in Nassyriah all these patients were operated by different surgeons using different entry techniques. The operations included in our study were cholecystectomy, hydatid cyst of the liver, perforated peptic ulcer, appendectomy, diagnostic laparoscopy for infertility and abdominal pathology, undescended testes, ovarian cyst and Nissen fundoplication. The complications resulting from entry techniques were identified intraoperatively or inquired from operating surgeons postoperatively. The techniques included in this study were: 1-Verres trocar 2-verres needle 3-blunt trocar 4-sharp trocar 5-Hasson technique 6-palmer technique 7-visiport .The complications searched in this study were: 1-vascular injury 2-visceral injury 3-preperitoneal insufflations 4-gas embolism 5-.bradycardia. The distension pressure was between 10 – 12 mmHg in all our laparoscopic surgery.

RESULTS

Three hundred and sixty patients underwent laparoscopic surgery; 300 of them were female and 60 were male. The operations included in our study were cholecystectomy (254), diagnostic laparoscopy for infertility and abdominal pathology (56), ovarian cyst (20), hydatid cyst of the liver (15), undescended testes (8), appendectomy (3), perforated peptic ulcer (2), achalasia (1) and Nissen fundoplication (1). The early complications recorded in our study are abdominal wall vascular injuries ,visceral injuries ,bradycardia , preperitoneal insufflations .The incidence of laproscopic entry related injuries in gynecological operations was 6.9% .But the incidence of laproscopic entry related injuries in major pelvic operations was

7.8% . Peritoneal insufflations by CO₂ done by different entry techniques as follow;

1-veress trocar: used in (222) patients.

2-veress needle: used in (31) patients.

3-blunt trocar: used in (30) patients.

4-sharp trocar: used in (27) patients.

5-visiport: used in (20) patients.

6-palmer technique: (20) patients; used when the patients have umbilical scar .

7-Hasson technique: used in (10) patients.

DISCUSSION:

In our study the entry related complications in gynecological operations are 6.9% (5 patients out of 72). The result of a prospective observational study of all gynecological laparoscopic procedures in United Kingdom performed by all grade of staff in a teaching hospital over a period of twelve months showed an incidence of 0.3% laparoscopic entry related injuries⁽²⁷⁾. The overall incidence of laparoscopic entry injuries in the Dutch study was 0.33%. There were 29 cases of gastro-intestinal damage. (0.13%). 27 cases of abdominal vessels injuries (0.1%)⁽⁵⁾. In our study we report no such complications whatever the technique used. A prospective study of 1265 cases underwent major pelvic surgery performed in advanced surgery centre in Australia; the overall incidence of complications was 0.6%. Fifty percent of complications were related to laparoscopic entry⁽²¹⁾, while in our results the incidence of entry related complication was 7.8% (10patients out of 78).In the united states a review of 51 publications including 21547 open technique,16739 direct entry technique and 134917 Veress/ trocar reported entry related bowel injury were 0.11% (open), 0.05% (direct entry) and 0.04% (Veress/trocar)⁽²⁴⁾. While in our study of

360 cases underwent laparoscopic surgery, the incidence of complications were (11.1% , 10% , 12.9% , 5.4%, 5%, 10% & 5%) to corresponding entry techniques (sharp trocar, blunt trocar, Veress needle, Veress trocar, palmer technique , Hasson technique & visiport) respectively. Chamberlain GVP, Brown JC⁽⁵⁾ after 70607 laparoscopic procedures performed, 256 complications were reported to the national patient insurance association. The overall rate of major complications was 0.14%. This includes 0.06% intestinal injury, 0.03%urological injuries and 0.01% vascular injuries^[5], while in our study there were no such major complications. By Hakki-Siren, Kurki T. a multicentre prospective study from 72 hospitals, the overall incidence of cases of intestinal injuries of major complications was 0.57%. Seventy percent of these were related to the primary port entry⁽⁶⁾, but in our study we reported no such complications.Hasson reviewed 19 publications in which closed entry technique was used by surgeons and gynecologists. The total number of laparoscopic operations performed was 660110. These were compared with 17 publications where the open technique was used. The total number of operations performed was 579510. The incidences of complications in the open laparoscopy group were as follows: umbilical infection 0.4%, bowel injury 0.1%, and vascular injury 0.0%. The corresponding complications rates for closed laparoscopy were 0.2%, 0.1% and 0.2% respectively⁽²⁰⁾. While in our study, 10% complications (vascular injury) occurred in open (Hasson technique).A meta-analysis of 760890 closed laparoscopy and 22465 open laparoscopy reported the incidence of vascular injury rate in closed

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laparoscopy was 0.44% compared with 0% in open laparoscopy. The incidence of bowel injury 0.7% compared with 0.5% respectively. The authors concluded that the open (Hasson) technique eliminate the risk of vascular injury and gas embolism and reduces the risk of bowel injury and recommend the open technique to be adopted for primary laparoscopic entry⁽²¹⁾. While in our study, no complications (bowel injury) occurred in open (Hasson technique). From the results above, it is evident that our incidence of complications more than in other studies and this can be attributed to the inclusion of vascular injury in the abdominal wall

in our study, and this by mean has no relation to a technique of entry because for all different modality of entry the blade will incise the wound, otherwise incidence of complications is less or similar to studies abroad.

CONCLUSION:

No single technique or instrument has been proved to eliminate laparoscopic entry associated injury. Proper evaluation of the patient, supported by good surgical skills and reasonably good knowledge of the technology of the instruments remain to be the cornerstone for safe access and success in minimal access surgery.

Table (1): Incidence of laparoscopic complications according to Veress trocar (total no.222)

laparoscopic complications	no. of patients
Vascular injury	5
Visceral injury	0
Preperitoneal insufflations	5
Gas embolism	0
Bradycardia	2
Total	12 (5.40%)

Table (2): Incidence of laparoscopic complications according to Veress needle (total no.31)

Laparoscopic Complications	no. of patients
Vascular injury	0
Visceral injury	1(omentum)
Preperitoneal insufflations	3
Gas embolism	0
Bradycardia	0
Total	4 (12.9%)

Table (3): Incidence of laparoscopic complication according to visiport (total no.20)

laparoscopic complications	no. of patients
Vascular injury	1
Visceral injury	0
Preperitoneal insufflations	0
Gas embolism	0
Bradycardia	0
Total	1(5%)

Table (4): Incidence of laparoscopic complications according to Hasson technique (total no.10)

laparoscopic complications	no. of patients
Vascular injury	1
Visceral injury	0
Preperitoneal insufflations	0
Gas embolism	0
Bradycardia	0
Total	1(10%)

Table (5): Incidence of laparoscopic complications according to Palmer technique (total no.20)

laparoscopic complications	no. of patients
Vascular injury	1
Visceral injury	0
Preperitoneal insufflations	0
Gas embolism	0
Bradycardia	0
Total	1(5%)

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**Table (6): Incidence of laparoscopic complications
according to sharp trocar (total no.27)**

laparoscopic complications	no. of patients
Vascular injury	2
Visceral injury	1(omentum)
Preperitoneal insufflations	0
Gas embolism	0
Bradycardia	0
Total	3(11.1%)

**Table (7): Incidence of laparoscopic complications
according to blunt trocar (total no.30)**

laparoscopic complications	no. of patients
Vascular injury	2
Visceral injury	0
Preperitoneal insufflations	0
Gas embolism	0
Bradycardia	1
Total	3 (10%)

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مقارنة بين الطرق المختلفة لنفخ التجويف البطني في عمليات الجراحة المنظارية

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المقدمة

الدخول الاولي الى تجويف البطن هو التحدي الرئيسي الذي يواجه الجراحة المنظارية بأعتبارها طريقة دخول عمياء قد يصاحبه أضرار في الاوعية الدموية الاحشاء الداخلية للبطن. على الجراح ان يكون ذو خبرة جيدة وتدريب كاف في الجراحة المنظارية قبل ان يقدم على اجراء مثل هذه العملية بصورة مستقلة وأن يكون ملماً بجميع الادوات والاجهزة المراد استخدامها.

الهدف من الدراسة

الهدف من هذا البحث هو دراسة معدل حدوث المضاعفات الناتجة من تقنيات الدخول المختلفة والمستخدمه لنفخ التجويف البريتوني اثناء الجراحة المنظارية.

الطريقة

تم جمع معلومات مستقبلية وأسترجاعية(٢٠٠٨) عن (٣٦٠) مريض اجريت لهم عمليات منظارية للفترة من كانون الثاني ٢٠٠٩ ولغاية نيسان ٢٠١٠ في مستشفى الصدر التعليمي ومركز العقم والمستشفيات الاهلية في مدينة النجف الاشراف ومستشفى الحسين(ع) التعليمي في الناصرية. تم اجراء هذه العمليات من قبل العديد من العديد من الجراحين باستخدامهم لطرق مختلفة لدخول التجويف البريتوني.

النتائج

العدد الاجمالي للمرضى ٣٦٠، النساء ٣٠٠، الذكور ٦٠
العمليات المتضمنة في هذه الدراسة هي :- استئصال المرارة(٢٥٤)، اكياس مائية في الكبد(١٥)، قرحة المعدة المنفجرة(٢)، استئصال الزائدة الدودية(٣)، ناظور تشخيصي لأمراض البطن والعقم(٥٦)، الخصية الهاجرة(٨)، اكياس المبيض(٢٠)، تنننية القاع المريئي(١)، تعذر الارتخاء المريئي(١).
المضاعفات التي سجلت في هذه الدراسة هي اضرار الاوعية الدموية في جدار البطن الامامي، واضرار الاحشاء، تباطؤ القلب. كان معدل حدوث الاضرار اثناء العمليات النسائية(٦,٩)، بينما كان معدل حدوث الاضرار في عمليات الحوض(٧,٨).

الاستنتاج

ليست هنالك تقنية بعينها اثبتت بانها القادرة على تجنب المضاعفات المرافقة لدخول المنظار البطني، لكن التدريب الجيد والمهارات الجراحية العالية والمعرفة الكافية بالاجهزة المستخدمة هي حجر الزاوية لانجاز الدخول الآمن.

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