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COMPARISON BETWEEN DIFFERENT ENTRY TECHNIQUES IN PERFORMING PNEUMOPERITONEUM IN LAPAROSCOPIC SURGERY

General Surgery

Dr.Ahmed Abdulsaheb AL-khaqany M.B.Ch.B.D.S General surgeon F. I. C. M. S. Department of surgery l Collage of medicine/ university of kufa

Dr . Mohammed Najm Mohammed Tameemi* M. B. Ch. B.D.S General surgeon F. I. C. M. S. Department of surgery l Collage of medicine/ university of kufa *Corresponding Author

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 November 2009 in Al-Sader Teaching Hospital and Private Hospital in Najaf , 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% .

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.

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)1(lthcare system and society.patients, hea

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 .)2, 3(of the surgery

If there is delay in diagnosis of visceral injuries or delay in .)4(reporting , the morbidity will increase and may lead to mortality 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 .)5(0.3%

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 This indicates that in spite of the improvement in the intends to use.technology and experience, primary access complications were decreased but not completely eliminated. The included techniques (Veress needle pneumopertonium, 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 .)6(trocarless, reusable visual access cannula

Laparoscopic entry techniques

Veress needle and pneumoperitoneum:

1947Veress needle was first popularized by Roal Palmer of France . 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 pneumopertonium 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 .)7(clavicular line-costal border in the mid 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 .)8(pancreatic mass - surgery or palpable gastro splenic A 5-millimeter telescope can be introduced at the same site of Veress needle visualize the peri-umblical 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 .)9,10(gynecologists to achieve pneumoperitoneum in obese patients 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 .)11,12(inflammatory disease (PID) or severe endometriosis For optimal and safe pneumoperi toneum initially the patient 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 .)13(degrees toward the hollow of the sacrum in thin patient

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) and 230 kg/m-), overweight (BMI 25 2normal weight (BMI <25 kg/m) women respectively. In all cases, the umbilicus 2obese (BMI >30 kg/mwas 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 .)28(degrees in very obese women

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,
.)10(Syringe test -4

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 .)15(mm Hg or less, and the gas is flowing freely

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)16(entry of the primary trocar and minimize the risk of vascular injury

The high pressure entry technique is recommended by Royal college of Obstetricians and gynecologists-London (RCOG) and Canadian .)14, 17(Society of Obstetricians and Gynecologists (SOGC)

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 .(18)their extra cost

Hasson (open) entry technique was first described by Harrith Hasson in 1971.When first reported his technique Hasson claimed that his technique avoids Veress needle pneumoperitoneum and its This .

associated complications (gas embolism and vascular injury) 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 .)19(issue

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 proc edure 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 .)24(, 0.01% and 0% respectively rates were 0.04%

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 .)24(the surgeon preference and experience with the individual technique

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 .)25(en deaths caused by laparoscopic entry injuryout of sev

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 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 .)26(el of shielded trocars voluntary eliminate safety claims from the lab

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 .)29(their expensive cost

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 .)22(iscence and herniation infection, and fascial deh

PATIENTS AND METHODS

Prospective and retrospective(2008) data was collected for (360) patients underwent laparoscopic surgery from January 2009 to November 2009 in Al-Sader Teaching Hospital, infertility centre and Private Hospitals in Najaf city, 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.

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), 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% . done by different entry techniques as 2Peritoneal insufflations by Cofollow;

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.

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%)

Laparoscopic	no. of patients

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

	no. of patients
Vascular injury	1
Visceral injury	0
Preperitoneal insufflations	0
Gas embolism	0
Bradycardia	0
laparoscopic complications	**no. of patients**
Vascular injury	1
Visceral injury	0
Preperitoneal insufflations	0
Gas embolism	0

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

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

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

	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)

Vascular injury	1
Visceral injury	0
Preperitoneal insufflations	0
Gas embolism	0
Bradycardia	0
Total	1(5%)

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

	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)

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

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% .)27(laparoscopic entry related injuries The overall incidence of laparoscopic entry injuries in the Dutch study was 0.33%. There were 29 cases of gastro-intestinal damage. . In our study we)5(3%). 27 cases of abdominal vessels injuries (0.1%)(0.1report 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 , while in our results the incidence of entry)21(to laparoscopic 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 . While in our study of 360 cases)24(entry) and 0.04% (Veress/trocar)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.

70607 laparoscopic after)5(GVP, Brown JC Chamberlain 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, , while in our study [5]ries and 0.01% vascular injuries0.03%urological injuthere 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 , but in our)6(percent of these were related to the primary port entrystudy 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%, % complications While in our study, 10 .)20(0.1% and 0.2% respectively(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 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 , no complications While in our study. (21)laparoscopic entry primary(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.

REFERENCES

1. Garry R.Complications of laparoscopic entry. Gynecol. Endosc 1997; 6:319-29.
2. Jansen FW, Kolman W, Bakkum EA, Trimpos T, TrimposJB. Complications of laparoscopy: an inquiry about closed versus open entry technique. Am J Obstet Gynecol 2004; 190:634-8.
3. Yuzpe AA.pneumoperitoneum needle and trocar injuries in laparoscopy: a survey on possible contributing factors and prevention. J. Reprod Med 1990; 35:485-90.
4. Garry R.Towards evidence based laparoscopic entry techniques: clinical problems and dilemma.Gynecol endosc 1999; 8:315-26.
5. Chamberlain GVP, Brown JC. The report of the working party of the confidential inquiry into gynaecolical laparoscopy. London: Royal College of Obstetrician and Gyaecologists.
6. Hakki-Siren, Kurki T. A nationwide analysis of laparoscopic complications. ObstetGynecol.1997;89:108-12
7. Palmer R. Safety in Laparoscopy. J. Reprod Med 1974; 13:1-5.
8. Tulikangas RK, NIclas A, FalconeT, Price L.-Anatomy of the left upper quadrant for cannula insertion.J Am assoc Gynecol Laparosc 2000; 7:21-4.
9. Sandrs RR,Filshie GM,.Transfundal induction of the pneumoperitonium prior to laparoscopy.J Obstst Gynaeco BrCmwlth 1944;107:316-7
10. Wolfe WM, Pasic R. Trasuterine insertion of Veress needle in laparoscopy. Obset Gynecol1990; 75:456-7.
11. Neely MR, Mc William R, Makhlouf HA. Laparoscopy: routine pneumopertonium via the posterior fornix. Obstet Gynecol 1975; 45:459-60.
12. Van Lith DA, Van Chic KJ, Beckhumzin W. Cul- de-sac insufflations: an easy alternative roué for safely inducing pneumoperitonium.Int J Gynaecol Obstet 1980; 17:375-8.
13. Hurd W W, Bude RO, De Lancy JOL. The relationship of the umbilicus to the aortic bifurcation: complications for laparoscopic technique. Obstet Gynecol 1992; 80:48-51.
14. Vilos GA, ArtinT, Temamian A, Laberge PY. SOGC clinical practice guideline. J SOGC 2007; 193:433-45.
15. Tooh B, Sen R, Abbott J. An evaluation of four tests used to ascertain Veress needle placement at closed laparoscopy. J Minim Invasive Gynecol 2005; 12:153-8.
16. Richardson RF, SuttonCJG.Complications of first entry: a prospective laparoscopic audit. Gynaecol Endosc 1999, 8:327-34.
17. Sutton CJG,Philip K. Preventing Gynaecological injury. Royal College of Obstetricians and Gynaecologist. Guideline No.48 2007:1-10
18. Audebert AJ,Gomel V. Role of microlaparoscopy in diagnosis of peritoneal and visceral adhesions and in prevention of bowl injury associated with blind trocar insertion. Fertil Steril 2000; 73:631-5.
19. Hasson HM. A modified instrument and method for laparoscopy. Am J Obstst Gynecol 1971; 110:886-7.
20. Hasson HM. Open laparoscopy as a method of access in laparoscopic surgery. Gynaecol Endosc 1999; 8:353-62.
21. Larobina M, Nottle P. Complete evidence regarding major visceral injuries during laparoscopic access. Surg Laprosc Endosc Tech 2005; 5(3):119-23.
22. Catarci M,Carlini M,Santioro E.Major and minor injuries during creation of pneumopertoneum, A multicentre study of 12919 cases. Surg Endosc 2001; 15:566-9.
23. soper NJ,swanstrom LL,Eubanks WS (eds):Mastery of endoscopic & laparoscopic surgry,2nd ed. Lippincott, Williams &Wilkins, Philadelphia 2005.
24. Molly D, Kalloo PD, Cooper M. Laparoscopy entry: a literature review and analysis of techniques and complications of primary port entry. Aust NZJ Obstet Gynaecol 2002; 14:365-74.
25. Savill LE, Wood MS. Laparoscopy and major retroperitoneal vascular injuries. Surg Endosc 1995; 9:1096-1110.
26. Wellis T Shielded trocars and needles used for abdominal access during laparoscopy. Rockville MD. Department of Health and Human Services 1996.
27. Jones KD, Fan A, Sutton CJG. Safe entry during laparoscopy. Gynaecol Endosc 2002; 11:327-34.
28. Hurd WW, Bude RO, DeLancey JO, Pearl ML. The relationship of the umbilicus to the aortic bifurcation: complications for laparoscopic technique. Obstet Gynecol 1992; 80:48-51.
29. Mohamed AS. Laparoscopic entry: Techniques complications and recommendations for prevention of laparoscopic injury. Laparoscopy Hospital, India 110018