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**LAPAROSCOPY IN GYNAECOLOGY; COMPLICATIONS
& AVOIDANCE**

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ABSTRACT

The purpose of this paper is to carry out a systematic review of the literature regarding the complications of laparoscopic surgery in gynaecology; their incidence, causes and ways of prevention. The minimally invasive surgery has established wide acceptance by the patients because of its well recognized advantages. However, the associated complications of the surgical procedures are not perceived at the same level. The possibility of occurrence of complications with the new techniques and the new technologies are well recognized. The role of the surgeon in laparoscopic surgery is explored regarding the safety of the procedure.

Key words: Gynaecology- Laparoscopy- Surgery- Complications- Prevention.

INTRODUCTION

"No complications"; is the simple sentence which relax the patient, the relatives and the whole team working at the end of any surgery. In operative laparoscopic surgery, it does require a lot of work at many levels to reach the acceptable rates of complications. Nevertheless, the complication rate for laparotomy could be higher than the complication rate for laparoscopic surgery ⁽¹⁾.

Laparoscopic surgery is regarded as a revolution technology and major trend for the last few decades because of its many advantages. Although the procedure is generally safe, it involves, like any other surgery, a risk of complications or failure. The distinctive characteristics of the laparoscopic surgery such as closed field, under tension pneumoperitoneum, use of electro-coagulation, laser, etc; have their impact on the

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procedure performed with possible negative sequel. The progress of the operative procedures was associated with invention of new technology and introduction of new techniques. The growing impact of laparoscopic surgery must not make us underestimate the existence of complications, particularly those which are severe and have medico-legal implications ⁽²⁾. Of course, the instruments and the associated technologies have their own inherited characteristics, which have been reflected actively and passively on the patients. Describing the means to prevent complications in laparoscopic surgery is difficult as it implies; being familiar with the technique and its environment, having already evaluated the technique and thus acknowledge it as being effective, having sufficient homogeneous experience, having described the surgical methodology and knowing the alternative techniques and their results ⁽³⁾.

EPIDEMIOLOGY

The overall complication rate ranges from 3.6 /1000 to 5.4 /1000 procedures ⁽⁴⁾ and the mortality rate was 3.33/ 100000 to 5.4 / 100000 laparoscopies ^(5, 6). Shapron et al. ⁽⁵⁾ reported on the outcome of 29966 cases in seven centres for laparoscopic gynaecological surgery during 9 years period (1987-1995). The complication rate for minor laparoscopic procedures was 0.84 /1000, for a major laparoscopic procedure was 4.30 /1000 and for advanced procedures it was significantly high (17.45 /1000). The complication rate was significantly correlated with the complexity of the laparoscopic procedure. One in three complications (34.1%) occurred while setting up for laparoscopy and one in four (28.6%) were not diagnosed during the operation. Findings reported by Paivi and Tapiu ⁽⁴⁾ studying 70607 laparoscopic procedures in the period 1990-1994 indicated that the complication rate for major procedures was 1.4 /1000, for diagnostic laparoscopies was 0.6 /1000, and for sterilization procedures was 0.8/1000. The complication rate for major complications in operative laparoscopies were found to be increased in the follow up study of 32205 laparoscopic procedures in the period 1995-1996 by Paivi et al. ⁽⁷⁾ it was 12.6/1000. This might be attributed to the increased proportion of laparoscopic hysterectomies. The complication rate of 2.7 /1000 for diagnostic laparoscopic procedures, 4.5 /1000 for sterilization and 17.9 /1000 for operative laparoscopies was noted by Jansen and co-workers ⁽⁸⁾ in a nationwide, prospective, multi centres, observational studies.

Conversion to laparotomy during laparoscopic procedures ranges from 1.3 to 5.9/ 1000, mainly for managing hemorrhage and/or visceral injury ^(5, 6). Adhesiolysis as one of the advanced laparoscopic procedures was found to be associated with the highest complication and conversion to laparotomy (8.37/1000).

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ETIOLOGICAL FACTORS

The Veress needle, pneumoperitoneum, trocars and electrocautery are the main factors causing complications during laparoscopic instrumentation and the associated technology like light source cable, electrical and laser required for doing the job in the abdominal cavity have their own risks ⁽⁹⁾. The limited vision of the field may lead to some accidents as instruments can be left without visual control in the cavity and can create undesired actions ⁽³⁾. Some cases of delayed complications are caused by secondary necrosis of the bowel, ureter or bladder and cannot be diagnosed intra-operatively. Lavage with large volumes of fluid at room temperature can be associated with hypothermia ⁽¹⁰⁾. Older age, malignancy, previous radiation therapy, and previous abdominal surgery were identified as significant risk factors for complications and/or conversion in laparoscopic procedures ⁽¹¹⁾. Obese women had increased likelihood of conversion to laparotomy and greater blood loss after laparoscopic assisted vaginal hysterectomy (LAVH) for benign lesions ⁽¹²⁾, and laparoscopic management of endometrial carcinoma ⁽¹³⁾. Post operative periadnexial adhesions formation was detected after laparoscopic ovarian drilling for the treatment of polycystic ovary (PCO) ⁽¹⁴⁾ and adhesion reformation after laparoscopic salpingo-ovariolysis may reach up to 40.2 % ⁽¹⁵⁾. Port site metastasis is relatively a newly recognized complication of oncological surgery and is a concern ⁽¹⁶⁾. The possible etiologies thought to be contaminated instruments or dissemination of tumor cells by the positive pressure pneumoperitoneum ⁽¹⁷⁾ in addition to a large number of malignant cells ⁽¹⁸⁾. The Veress needle, pneumoperitonization, trocars, and electrocautery are the main factors causing complications during laparoscopic surgery.

VERRUS NEEDLE INJURIES

The most dangerous time for direct trauma is when the Veress needle and the first trocar and cannula are being introduced blindly. Test for proper instillation of the Veress needle will safeguard further complications, if the needle is misplaced. Further instillation of carbon dioxide (CO₂) under pressure through the Veress needle can create serious complications. Large vessel entry, though it is rare, during Veress needle insertion, if not recognized immediately, and if followed by immediate insufflations, may lead to gas

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embolism and even death ⁽¹⁹⁾. The anatomy of the major blood vessels running in the retro-peritoneum below the umbilicus must be understood, because many deaths are related to injuries to these vessels. Hurd and colleagues ⁽²⁰⁾ have looked at the position of the umbilicus relative to the aortic bifurcation and the left common iliac vein using abdominal CT. They noted differences in this relationship with weight. The location of the umbilicus, but not the aortic bifurcation, was more caudal in heavier women and negatively correlated with body mass index. Factors increasing the risk of perforation or laceration include bowel adhesions, lateral displacement of the needle during its insertion, too steep insertion angle, uncontrolled sudden entry, premature Trendelenburg position and stomach distention during difficult endotracheal intubation as well as previous history of laparotomy ⁽²¹⁾.

PNEUMOPERITONIZATION

The existence of numerous techniques for the creation of pneumoperitoneum laparoscopy indicates that none have been proven to be totally efficacious or complications free ⁽²²⁾. Preperitoneal insufflation may cause surgical emphysema by escape of the gas to mediastinum or pneumopericardium. Gas embolism must be detected by pericardial auscultation, capnometry, or right side echocardiography and treated quickly ⁽²³⁾. As CO₂ pneumoperitoneum affects cardiopulmonary function, hepatic function and general anaesthesia during laparoscopic procedures; gasless laparoscopy or the use of other gases like nitrous oxide or helium have been suggested ⁽²⁴⁾.

The CO₂ gas plays a major role in post operative pain as it changes into carbonic acid when it comes in contact with the liquid in the peritoneal cavity resulting in severe local acidosis with pH below 7 or when infiltrates between the right diaphragmatic copula and the hepatic fundus causing traction on the phrenohepatic ligaments by the liver resulting in projected right scapular pain ⁽²⁵⁾. Also CO₂ pneumoperitoneum was found to increase the port-site metastasis, and tumor dissemination when compared to laparotomy ⁽²⁶⁾. CO₂ seems to limit postoperative inflammatory response and to preserve parameters reflecting the immune status.

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TROCAR INJURIES

Trocar injuries can result from excessive force and sudden entry of the trocar. Also its lateral displacement during insertion, too steep an angle for placement or dull trocar. Distorted anatomy, inadequate umbilical incision and scar tissue; especially in women with previous laparotomy⁽²⁷⁾, can also cause major injuries. Avoidance of port-site complications includes many alternatives regarding the site of peritoneal access, the type of the trocar, and the technique of the access into the peritoneal cavity. Open laparoscopy, where the primary trocar placement is done with direct vision, does decrease the risk of major vascular injuries when compared with the closed technique⁽²⁸⁾. Inspection of the umbilical area with a micro-laparoscope and insertion of the umbilical trocar under direct vision were recommended for insertion of the principle trocar⁽²⁹⁾.

Different types of trocars were introduced to decrease the incidence of complications during peritoneal entry. A disposable trocar with sharp tip and spring-loaded safety shield alleged to allow a controlled entry and decrease the risk of injury to intra-abdominal structures. A comparative study between the sharp cutting trocars and the cone-shaped ones, in animal model, revealed that the sharp trocar tip had more relative risk of vessel injury and more bleeding⁽³⁰⁾. With the bladeless technology, there was an improvement in the outcome following laparoscopy, as bladeless trocar, blunt tipped device, pushes through the layers of the abdominal wall instead of cutting, so patients experienced less pain, faster healing, and decreased incidence of hernia formation⁽¹⁶⁾. Woolcott found that bowel or vessel injury rate were 1/1000 regardless the method (open technique, Veress needle insufflations or direct trocars insertion⁽³¹⁾). So the opinions about the best approach regarding gaining peritoneal access are variable.

Incisional hernia occurs mostly at sites where trocars 10 mm in diameter or larger were used with the incidence of 0.21/1000⁽³²⁾. The possible preventive measures, although not proven, include Z-path trocar insertion, avoiding trocar insertion directly through the umbilicus and careful withdrawal of the umbilical trocar⁽³¹⁾. Some gynaecologists

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advocate removing the umbilical trocar under laparoscopic observation to avoid entrapment of the bowel, or removing the trocar with the valve open to avoid the negative pressure that could draw omentum or small bowel into the defect ⁽²⁷⁾.

ELECTROSURGICAL INJURIES

These are caused by monopolar or bipolar electrosurgical techniques, laser light surgery and the harmonic scalpel. Ignorance of the electro-surgical effects by the surgeon or the anaesthetist can lead to disruption of the patient's monitoring and poor surgical practice. Accidental and unsuspected thermal injuries can have significant adverse medical impacts like organ damage, vessel hemorrhage, bowel perforation and peritonitis and if not detected expeditiously, any of these conditions can result in significant morbidity or even death ⁽³³⁾. Despite the fact that electro-physics and its application to surgery, in particular endoscopic surgery, is very important, there is little attention paid to the applied principles of the physics involved when surgeons receive their formal training in the technical aspects of surgery.

MAJOR COMPLICATIONS

Vascular complication:

Most of the major vascular injuries occur at the setting up phase of laparoscopy (79.2%). The trocar was blamed in three fourths of cases and the Veress needle in one fourth, while only 20.8% occurred during the laparoscopic surgical procedure in a retrospective study ⁽³⁴⁾. Proper technique when inserting the Veress needle and the laparoscopic canula can prevent most of the accidents. Distorted anatomy or steep Trendlenburg position may increase the risk of vessel injury. Dissection around the great vessels of the pelvis requires the same methods and precautions as with laparotomy. The superficial abdominal wall vessels are located by transillumination in most women of normal weight

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regardless of skin colour and the course of the inferior epigastric vessels can be seen through the parietal peritoneum laparoscopically ⁽²⁸⁾ .

Bowel injuries:

The overall incidence of bowel injuries has been found to be 0.4-1.6 /1000 laparoscopies ^(4, 5). The risk is higher in operative laparoscopy; 2.4 /1000 than in diagnostic laparoscopy; 0.5/1000 ⁽⁵⁾. In the study of Chapron et al ⁽³⁵⁾; one third of the gastrointestinal complications occurred during the instillation phase for laparoscopy. Only one third of these complications were diagnosed during the operations. The range of time before diagnosing the rest of injuries reached up to 23 days. In another study, 40% of intestinal injuries were unrecognized until 2 to

14 days after the procedure.

Colon injury is a major complication, particularly if the bowel is unprepared or the injury is not recognized. Even small perforations, such as those from the Veress needle, require attention as high bacterial concentration of minor leaks can cause infection and abscess formation ⁽²⁷⁾. Adhesions between the small bowel and the anterior abdominal wall are associated with a risk of trocar injury, especially in the patients who have had an exploratory laparotomy. A high index of suspicion and vigilant physical examination were the keys to early recognition of bowel injury. Factors that contribute to an increased risk of large bowel injuries include failure to establish an adequate pneumo-peritoneum, the use of dull trocars which require excessive force and uncontrolled sudden entry of sharp instruments ⁽²⁷⁾, or extensive adhesions involving the bowel by neoplasm, endometriosis or infection ⁽¹⁾.

Adynamic ileus is unusual after laparoscopic surgery but any abdominal distention, worsening pain, or vomiting must be taken seriously as unsuspected bowel injuries manifest themselves by abdominal distention, pain and free air ⁽³⁶⁾. Consultation of the general surgeon is appropriate whenever significant bowel trauma occurs or suspected.

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Urinary tract injuries:

Unlike vascular or bowel injuries, which most often occur during the setup of the laparoscopy, urologic injuries are mostly related to the gynaecologic procedures being performed. The incidence of bladder injury during laparoscopic procedures ranged from 0.02 to 8.3% ⁽³⁷⁾, while the incidence of ureteric injuries ranged from 1 to 2% ⁽³⁸⁾. Laparoscopically assisted vaginal hysterectomy, laparoscopic adenectomy and electro-coagulation were the leading procedures in which injuries occurred ⁽³⁹⁾.

Knowledge of the ureters path through the pelvis and the vulnerable points are the key to prevent injuries. The intrapelvic segment of the ureter is near to the broad ligaments, ovaries and uterosacral ligaments and the injuries occur in those areas. The ureter is at risk during laparoscopic surgery when the cardinal ligament is dissected and divided below the uterine vessels ⁽³⁹⁾. Ureteral injury can occur in the course of sharp dissection of an ovary adherent to the pelvic side wall, uterosacral ligament transection, ligation, transection or coagulation of the uterine artery, removal of endometriotic implant or fibrosis from the ureter ⁽⁴⁰⁾. Laparoscopic placement of intramural sutures at the bladder neck has been reported to lead to entrapment of the intramural portion of the ureter. During laparoscopic hysterectomy, ureteral injuries usually occur at the terminal part of the ureter mostly on the right side. The main risk factor for ureteral injury is bleeding from the uterine vessels and repeated coagulation ⁽⁴¹⁾. Coagulation or laser ablation of endometriotic implants or adhesiolysis in the anterior cul-de-sac can predispose a patient to bladder injury ⁽⁴²⁾.

PREVENTION

preoperative preparation:

Thorough preoperative evaluation, consultation and proper patient selection help lessen the possibility of injury and subsequent legal action (litigation). All women undergoing laparoscopy should be counseled as unintended laparotomy is a known risk and has additional morbidity over laparoscopy alone. The individual surgeon must decide between patient's oriented benefits and the risk of severe complications ⁽⁴³⁾.

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The hospital structures must be capable of adapting to efficient practice of laparoscopic surgery.

The optic and suction-irrigation system, instruments and electric generator should be properly selected. Proper instillation of the instruments regarding sterilization, function, arrangement and easy access should speed up the reaction time in case of complications. Preparation of the bowel as well as the bladder drainage should be done before any gynaecological laparoscopic operation.

Intraoperative measures:

The newer devices and modifications in techniques may reduce the incidence of the complications associated with the blind entry e.g. visceral, vascular injury as well as incision related complications (dehiscence and hernia) ⁽¹⁶⁾. Uterine transfundal route of inducing pneumoperitoneum was advised to avoid complications associated with transumbilical insertion of Veress needle ⁽⁴⁴⁾. The pneumoperitoneum should be pressure limited, and not volume limited, reaching up to 25mmHg when the primary cannula is inserted ⁽⁴⁵⁾. Alternative sites for entry into the abdomen as open laparoscopy in patients with prior abdominal surgery or the use of micro-laparoscopy in the left upper quadrant were advised

⁽⁴⁶⁾.

Adhesion formation and reformation can be prevented by preoperative and postoperative administration of gonadotrophin-releasing hormone agonist ⁽⁴⁷⁾ and by the use of the new barrier materials e.g. interceed and spray gel ⁽⁴⁸⁾.

The use of vasopressin to achieve homeostasis in laparoscopic management of ectopic pregnancy reduces the operation time and the need of electro-coagulation ⁽⁴⁹⁾.

When unipolar current is used, the grounding pad should be applied properly. Mixed trocars (half plastic and half metal) should not be used as they will result in undesired capacitation and contribute to burns ⁽³³⁾. The instruments should not be in the cavity

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without visual control. The energy supply should not be activated unless all active parts of the electrodes are visible on the screen. The use of warmed irrigation fluid decreases the drop in core temperature associated with laparoscopy ⁽¹⁰⁾.

During laparoscopic hysterectomy, the round ligament should be coagulated in its middle part far from the uterine horn; infundibulopelvic ligament should be coagulated only after the fenestration of the broad ligament is performed. Proper preparation of the uterine pedicle should be performed, that means the vessels should be visualized after dissection of all the surrounding tissues before application of the bipolar coagulation to the ascending portion of the uterine artery at 90°. The opening of the prevesical space should be done in a combined action; peritoneal traction upward by the first assistant while the second assistant is pushing on the uterus upwards. When coagulation of the uterine vessels is applied on the right side, the first assistant should use the bipolar to approach the pedicle at right angle with the ascending portion of uterine vessels thus reducing the risk of ureteral injury ⁽⁴¹⁾ .

The uterine manipulator has an important role during laparoscopic hysterectomy by presenting the ureter to the surgical field, stretching the vaginal fornices while maintaining a safe distance from the ureter. It can reduce the operating time up to 30% ⁽⁴¹⁾. The ureter should be identified and dissected in the context of major laparoscopic pelvic surgery e.g. severe adhesiolysis; severe endometriosis resection and pelvic lymphadenectomy.

The use of ureteral catheter in patients who have severe endometriosis and adhesions is quite variable. If there is any doubt about ureteral function, indigo carmine should be injected intravenously to show up any leak, or cystoscopy can be carried out to confirm that there is bilateral ureteral ejaculation ⁽⁵⁰⁾. Stenting of the ureter, repair by laparotomy, or laparoscopic repair of the injury all can be done according to the nature of the injury and the surgeon's experience ⁽⁵¹⁾. Consultation of an urologist is recommended wherever ureteral injury occurs or suspected. Blunt dissection of the intestine should be avoided. When the Culde-Sac is dissected, identification of the vagina and rectum is facilitated

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by placing probe or an assistant's finger in the vagina and/or rectum. Dissection should begin lateral to the uterosacral ligaments where the anatomy is less distorted and proceed towards the obliterated cul-de-sac ⁽⁵²⁾. Under water examination "Michelin Test" (100 ml normal saline is placed in the pelvis then the rectum is insufflated using a 60 ml syringe with a large tip. If there are no bubbles this confirms that the rectum is intact) this test is recommended after the severe endometriosis and adhesions resection ⁽⁵⁰⁾.

Port site metastasis can be prevented by the use of nonporous bag, postoperative trocar site excision or irradiation. Also by conversion to laparotomy intra or postoperatively when it is indicated ⁽¹⁷⁾ and by avoidance of over manipulation of the diseased organ during laparoscopic surgery to decrease the tumor spillage, intraperitoneal dissemination, and wound contamination. Trocar port hernia is avoided by facial and peritoneal closure not only when using trocar of 10 mm or larger as previously suggested but also when extensive manipulation is performed through a 5mm trocar port, causing extension of the incision ⁽⁵³⁾ .

Postoperative measures:

The immediate post operative pain can be reduced by the infiltration of bupivacain. Also Shoulder pain can be significantly reduced, following operative and diagnostic laparoscopy for 72 hours by the presence of patent passive gas drain for the first four hours post operatively ⁽⁵⁴⁾. The systematic postoperative assessment of C- reactive protein in patients at high risk for bowel injury may help to identify this complication earlier in the postoperative period ⁽⁵⁵⁾.

ROLE OF THE SURGEON

The operative skill of the surgeon is the variable which affects the rate of complications when the surrounding factors e.g. instruments and patient selection, etc. are fixed. In a large study series the complication rate in laparoscopic surgery made by the inexperienced surgeon was found to be 6 times greater than that by the experienced one ⁽⁵⁶⁾ . Although most laparoscopic improvements have been technical and instrument driven, a basic understanding of anatomy, physiology and diagnostics remains essential

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to high quality patient care and risk reduction. A successful operation depends on the gynaecologist's familiarity with normal and abnormal anatomy, a thorough evaluation of abnormal findings, meticulous dissection, familiarity with instruments limitations and energy sources, training under the supervision of a qualified surgeon, and a properly trained operation room staff and assistants. According to Wattiez ⁽³⁾, training is the most obvious means of preventing complications in endoscopic techniques. He also stressed on the absence of proper training at present and requests it as a part of house surgeons training. The meaning of training for Wattiez is not a question of holding a discourse on how to make an endoscopic surgeon, but to affirm that it is possible to put in the minds and hands of competent surgeons the necessary means required to follow their learning curves, which are essential to acquire the essence of endoscopy without endangering the patients.

Increased experience by the surgeons has three consequences: a statistically significant drop in the number of bowel injury ($p=0.0003$), a drop in the rate of complications requiring laparotomy ($p=0.01$) and a change in the way complications are treated, with a significant increase in the proportion of incidents treated by laparoscopy ($p=0.0001$) ⁽⁵⁾. This again reflects the experience of the laparoscopic surgeons in the advanced laparoscopic procedures. In the series of Visco et al ⁽⁵⁷⁾, the rate of conversion to laparotomy during LAVH was significantly decreased with increasing physician experience but not the complication rate. Means of training are variable according to Wattiez ⁽³⁾ and include workshops, pelvic trainer, laboratory animals, simulators, videocassettes, computer assisted teaching and preceptorship.

CONCLUSION

The established results by the pioneers in this field, no doubt; changed a lot of minds and consequently changed the surgical approach in many instances. Due to the rapid progress of the laparoscopic surgical techniques and technologies, laparoscopy has become the reference management for several gynaecological surgeries e.g. ectopic pregnancy and benign ovarian tumors. However, in practice, in spite of the advanced

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technology used nowadays, we did not reach the maximum safety for the patients. Still a lot of work is required to decrease the hazards of electro-coagulators, laser, pneumoperitoneum, trocars and other instruments. Modification of techniques is required continuously to adapt for the variable pathological findings. However, modification of historically proven techniques are controversial regarding the expenses generated, equipment necessary to perform the procedure, training necessary, and potential for complication. With the introduction of new laparoscopic procedures, e.g. laparoscopic management of gynaecological cancer, there is emergence of complications related to these procedures. The implications of such complications are not yet well defined. Definition of the size of the rising problem, the effects on the patient, the exact causes, and the methods to avoid as well as to manage all are required.

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