Complications of laparoscopic urological surgery.

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Summary.- OBJECTIVES: To describe the complications of laparoscopic surgery in general but also specifically in the field of Urology and then analyze the preventive measures that must be taken in order to minimize these complications.

METHODS: At first we outline the absolute and the relative contraindications of laparoscopic surgery in general. Then we describe the various intra and postoperative complications seen in laparoscopic surgery and finally we discuss the complications reported specifically in Urological laparoscopic procedures.

RESULTS AND CONCLUSIONS: The applications of laparoscopic surgery in Urology grows every day. The main complications are vascular injuries and visceral lesions but the complications rate diminishes as surgeons improve in their learning curve.

Laparoscopy for Urology is here to stay.

Keywords: Laparoscopy. Urologic surgery. Complications.

INTRODUCTION

Laparoscopic surgical procedures have been increasingly used over the last fifteen years, first starting from general surgery and subsequently expanding to other fields, such as urology. Technological advances have offered an ever-
increasing range of indications for the application of these minimally invasive procedures and, as time goes by, a great number of conventional operations will be supplanted by laparoscopic ones. Currently nevertheless, the feasibility of an operation laparoscopically is not necessarily an indication for it to be performed this way.

It should be pointed out that laparoscopic surgery follows a steep learning curve. Technical restrictions, such as the small size of entry sites resulting in a small operative field and the two-dimension vision due to the lack of depth perception, seriously hinder the evolution of skills and dexterity in laparoscopy. Laparoscopic surgery is a monitor-assisted method. Therefore, unlike the rest of endo-urological procedures which are considered single-surgeon operations, laparoscopic procedures usually involve the combined insights and suggestions of two or three urologists who simultaneously follow the operation and in a way participate in it. To say that laparoscopy is usually performed "by a committee" of specialists is quite an understatement. That means that all persons involved need not only be sufficiently trained in this field of surgery but also know how to cooperate and do teamwork. Although each new technique must stand the test of time before it becomes widely accepted, it is essential that complications be minimised so as for the method not to be unfairly discredited. Proper patient selection and strict self-assessment are of paramount importance for someone to become a successful laparoscopist. It is advisable to start with simple and minor procedures before a urologist undertakes extensive surgeries.

This paper starts with the description of preventive measures and proceeds to address, step-by-step, not only the general complications in laparoscopy but also the procedure-specific ones that might occur during the application of this surgical modality.

**PREVENTIVE MEASURES**

It is invariably recommended that patients receive general intubated anaesthesia for laparoscopic surgery. In addition to addressing the usual medical concerns held for patients presenting for urologic surgery, the anaesthesiologist should be able to deal with not only the physiologic consequences of laparoscopic surgery (L.S.) related to the sometimes awkward positioning and intra-peritoneal gas insufflations, but also the cardiovascular and pulmonary complications due to these manoeuvres. Patients non-suitable for general anaesthesia should not be considered candidates for L.S.

<table>
<thead>
<tr>
<th>Table I: Contraindications of Laparoscopic surgery</th>
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<tr>
<td><strong>Absolute contraindications</strong></td>
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<tr>
<td>Shock</td>
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<td>Sepsis</td>
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<td>Active peritonitis</td>
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<td>Abdominal wall infection</td>
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<td>Not corrected bleeding diathesis</td>
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<td>Bowel perforation</td>
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<td>Bowel obstruction-distension</td>
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<td>Extensive bowel adhesions</td>
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It is wise and thus strongly suggested that the following lists of absolute and relative contraindications should be kept in mind in order to minimise the complication rate, especially at an early stage in the laparoscopic experience. Absolute and relative contraindications are shown in Table I.

Continuous monitoring of all available instrumentation is of great importance. Not only the surgeon but also the assistants and nursing staff should be aware of any potential complications (1). The video-monitoring equipment along with the insufflator and surgical instruments should always be kept in optimal condition.

In order to achieve the best visualisation possible, the camera should be precisely focused and white balanced before starting the operation. The laparoscopes (0° and 30°) should be kept warm and defogging liquid should be used whenever necessary. Close cooperation between the surgeon and the cameraman assistant is expected while the surgeons should be able to constantly identify the positions of all intra-abdominally inserted instruments, even those which are outside the optic field of the laparoscope.

GENERAL INTRAOPERATIVE COMPLICATIONS

A variety of intra-operative complications ranging from minor to potentially fatal conditions may arise during the L.S. Not only surgical but also anaesthetic problems may have to be addressed (2). Carbon dioxide embolus, pneumothorax, pneumo-pericardium, pneumomediastinum, pneumoretroperitoneum, subcutaneous emphysema, hypercardia, arrhythmias, gastric regurgitation and pulmonary aspiration are complications of particular concern to the anaesthesiologist. The severity of the aforementioned cases should be carefully assessed and in most cases the procedure should be abandoned, deflation of the pneumoperitoneum should follow and extra shared-care with the anaesthesiologist should be taken in order to avoid quite hazardous situations. Providing detailed information on the above conditions exceeds the scope of the present paper.

1. INSUFFLATION: The first step of every laparoscopic procedure is the effective creation of pneumoperitoneum. This can be achieved either through a mini laparatomy and Hasson cannula placement or more commonly by using a Veress needle. Although the spring-loaded Veress needle insertion is a relatively simple approach, initial misplacement of the needle may lead to technical difficulties or even the necessity of aborting L.S (3).

The idea behind Hasson cannula introduction is to avoid visceral and vascular injuries in risky cases such as those with organomegaly or existing adhesions due to previous abdominal surgery.

The preferred site for needle insertion is the area of midline just below the umbilicus. This is the point where the parietal peritoneum is firmly attached to the anterior abdominal wall. The Veress needle must transverse two tissue layers before entering the peritoneum cavity. These two planes are the anterior rectus fascia and the parietal peritoneum. If the needle fails to penetrate the rectus fascia, the subsequent insufflation will cause subcutaneous emphysema, while pre-peritoneal emphysema will be established if the needle is misplaced between rectus fascia and peritoneum. The first is easily identified by high-pressure recordings on the insufflation apparatus and the subcutaneous crepitus but the latter is more difficult to be diagnosed, as insufflation pressures remain rather low and distension of the pre-peritoneum produce tympany just like the pneumoperitoneum. The only signs that may be indicative of this rather unpleasant situation are the pneumopenis and pneumoscrotum (4).

Both the subcutaneous and pre-peritoneal emphysema may significantly hinder the procedure, because they reduce the intra-abdominal work field and sometimes distort the peritoneal cavity so dramatically that landmark spotting may become impossible. Insufflated CO₂ should be evacuated as much as possible and needle placement should be resumed or preferably a Hasson cannula should be elected in order to create a sufficient pneumoperitoneum.

Should there be any suspicion of adhesions formed among bowel loops or between abdominal wall and bowel loops, an attempt should be made to perform either a mini laparotomy and Hasson cannula or a Veress needle insertion at a site other than the umbilical point, i.e.: the lateral edge of the rectus muscle.

After the correct placement of the Veress needle, the
needle tip should be freely movable and 1-2 cm³ of normal saline should be able to freely pass through the needle into the peritoneal cavity due to the negative intraperitoneal pressure. If gastrointestinal contents or blood can be aspirated and the insufflator shows pressure greater than 15 mmHg then a visceral or vascular injury must be suspected. In this case the needle must be relocated correctly and decisions about continuation or abortion of the procedure should be made.

Another possible complication is insufflation of the omentum. Moreover, this can obscure the view and seriously hamper the procedure laparoscopically to the degree of non accomplishment.

The surgeons, at large, must rely on their experience to identify any of the above described complications and decide whether to proceed laparoscopically or convert the operation to an open one.

After safe placement of the Veress needle or the Hasson cannula in the peritoneal cavity, a pneumoperitoneum can easily be created by CO₂ insufflation. An inevitable consequence of this gas insufflation is that the patient's tissues will absorb CO₂ during L.S. The higher the intra-abdominal pressure and the longer the procedure, the higher the rate of CO₂ absorption. Despite CO₂ increased solubility in blood compared to air, this gaseous accumulation can result in significant deterioration of cardiac status during longer procedures, especially in patients with severe cardiopulmonary dysfunction or obesity.

Pneumothorax, pneumomediastinum and pneumopericardium have all been fully documented as complications of L.S. (5, 6) CO₂ may find access to the thorax through diaphragmatic defects or weak points mainly related to upper abdominal procedures such as adrenalectomy or nephrectomy. Another well described, rare but potentially lethal, complication of insufflation is gas embolus, resulting from direct entrance of CO₂ bubbles into a vessel. Immediate cessation of the procedure, evacuation of the gas and placement of the patient in the left lateral cubitus, head-down position will minimize the right ventricular outflow obstruction. Fortunately, the incidence of this severe complication is estimated at 1 in 65,000 cases (7).

2. TROCAR PLACEMENT: Initial trocar insertion is blindly performed at the site of the Veress needle puncture. The secondary trocars are placed under laparoscopic vision. Therefore the first trocar placement harbors the main danger to injure various abdominal organs and structures.

Surgical experience will minimize this risk. Contemporary trocars have a safety shield advancing over the sharp tip, designed to prevent visceral and vascular injuries.

After completion of the procedure all trocars should be removed under vision. The ports must be closed using fascial sutures and skin sutures or steristrips, especially at 10 mm sites, in order to prevent hernia formation.

3. VASCULAR INJURIES - HEMORRHAGE: Bleeding is a common and sometimes serious complication in L.S. Vascular injuries are either trocar-related or may happen during dissection (8). Large abdominal vessels can cause profuse haemorrhage which is controllable only after performing open laparotomy (9). This is the reason for performing every L.S. in an operating theatre, keeping a laparotomy set in the room during the procedure. Superficial subcutaneous vessels, especially the superior epigastric artery and the inferior epigastric vessels are also subject to injury. This can often be diagnosed from continuous drip from a trocar tip during L.S. Attempts should be made to stop the bleeding, either by electrocauterisation or by placement of abdominal wall sutures. As a rule only one person the surgeon himself activates coagulation, keeping a close eye on the coagulating spot. The use of monopolar diathermy must be kept to a minimum especially close to intestines and the current for coagulation must always be kept as low as possible (less than 50 watts). Additionally use of bipolar diathermy with specially designed forceps as well as new alternative modes such as the harmonic scalpel is encouraged. Even small venous vessels may start bleeding after deflation of the peritoneal cavity. It is advisable therefore to gradually reduce the pressure before leaving the operative field to inspect for any significant bleeding.

In a large study the incidence of major vascular incidence was 3 in 10,000 cases (10).

4. VISCERAL INJURIES: Theoretically every organ or structure may be injured during L.S. The incidence of organ perforation varies from 0.3% to
1.5% (11). They can be caused by either mechanical force exerted by the laparoscopic instruments or electrical burns from the haemostatic electrocautery. These burns may be attributed to surgeon’s lack of experience or may occur away from the operative field and out of the laparoscopic vision. If a visceral damage is identified immediately, the surgeon must decide whether to continue laparoscopically or proceed to open repair of the injury (12, 13).

Nevertheless, the most troublesome complications occur when the above lesions go unnoticed during the procedure and manifest themselves quite dramatically in the postoperative period (2-5 post op. days).

**POSTOPERATIVE COMPLICATIONS**

The fact is that L.S. creates a minimal route of surgical access. It does not minimize, however the procedure itself. Similarly, every previously described complication that occurs after conventional open surgery may also occur after laparoscopy. Some of the problems that are manifest in the postoperative period can be usually prevented if identified intraoperatively.

Patients who have undergone a laparoscopic operation are expected to have a sooner mobilisation and a shorter convalescence period. The most common postoperative finding is a mild peritonism for 24h. after a transperitoneal approach. If this peritonism remains or enhances, its cause should be further investigated.

The most frequent complications are delayed haemorrhage, visceral lesions (gastrointestinal, genitourinary systems), incisional hernias (= 10mm trocar sites), peripheral nerve damage, deep venous thrombosis, lymphoceles, e.t.c (14).

**COMPLICATIONS OF UROLOGIC SURGICAL PROCEDURES**

It is now almost 10 years that L.S was introduced in urology and the first attempts were pelvic lymphadenectomy, varicocelectomy and simple nephrectomy. At the beginning the majority of urologists were reluctant to accept that this was a true surgical alternative, mainly because L.S needs patience and is time consuming. Today a huge variety of urological operations can be performed laparoscopically (15-24) and the number of urologists who seek training in L.S grows every day.

The two main complications of L.S in urology are vascular injuries and visceral lesions. Fahlenkamp et al., reported their experience from 4 centers in Germany after having performed 2407 laparoscopic urological procedures and the complication rate was 4.4%, the re-intervention rate was 0.8% and the mortality rate 0.08% (25). The complication rate depended on the difficulty of the procedure and the vascular injuries were 1.7% and the visceral lesions 1.1%. Another interesting observation is that the complication rate was 13.3% for the first 100 procedures and subsequently averaged 3.6% demonstrating a clear learning curve. Bishoft et al., examined the incidence and the clinical presentation of laparoscopic bowel injury (26). Among 915 procedures bowel perforation occurred in 0.2% of the cases and bowel abrasion in 0.6% proving that bowel injury following L.S is a rare complication which might have a devastating sequence if not recognized intraoperatively.

Higashinari et al., noted a 6.4% conversion rate in laparoscopic adrenalectomies and 14.3% in laparoscopic nephrectomies (27). The major causes of conversion were bleeding (45%) and adhesion (34%). Operative time and conversion rates decreased significantly with the surgeons experience and reached that of open surgery.

In another Japanese study with 370 laparoscopic adrenalectomies, including 311 transperitoneal (TP) and 59 retroperitoneal (RP) approaches, the total intraoperative complication rate was 9%. In the TP approach intraoperative complication rate was 26/311 (8%) and the postoperative complication rate 22/311 (7%). In the RP approach intraoperative complication rate was 7/59 (12%) and postoperative complication rate 2/59 (3%). Conversion rates to open surgery were 13/370% for the TP procedure and 3/59 (5.1%) for the RP procedure. The conclusion of this comparative study was that the RP procedure has a lower morbidity rate (28).

Peters (29), evaluated complications in pediatric urological laparoscopy and among 5400 procedures, complications were reported in 5.38% of cases. The clearest predictor for complication rate was laparoscopic experience in this particular survey.

L.S is being introduced in urological oncological
surgery and is now focused in radical prostatectomy (30, 31). Conversion to open surgery, intraoperative bleeding and mean operating time were again related to the experience of the surgeon proving once again the significant effect of the learning curve in L.S.

**CONCLUSIONS**

Laparoscopic surgery in urology has many applications in various procedures. The main complications that have been reported during the last ten years are vascular injuries and visceral lesions. From all the reports, from various centers, it is clear that the complication rates diminish as the urologists improve in their learning curve.

L.S in now being introduced in more complicated urological oncological procedures and the future will tell it’s true impact upon these operations. In the future many new questions will arise and many more answers will be needed but it is clear now that laparoscopy for urology is here to stay.

**REFERENCES AND RECOMMENDED READING (***of special interest, **of outstanding interest)**


