



## MANAGEMENT OF LAPAROSCOPIC COMPLICATIONS

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### ABSTRACT

Management of Laparoscopic Complications Laparoscopy has become a standart procedure in some diseases by shorter duration of hospital stays, better cosmetical results, less blood loss and similar long term oncological results with open surgery. By increasing number of laparoscopic procedures in urological practice, mortality and morbidity has started to be reported. In this review, prevention, diagnosis and management of complications were discussed.

The prevention of laparoscopic complications begins with patient selection and preoperative preparations. Age, possible effects of anaesthesia on patient, body mass index, operative history have important roles in patient selection. Pneumoperitoneum tension, dysrhythmia, venous stasis/trombosis, cerebral ischemia and edema are physiological complications of laparoscopic surgery. For preventing these physiological complications, higher intraabdominal pressures (> 20 mmHg) should be avoided and compressing devices and pillow should be used during procedures. For preventing orthopedical and neuromuscular complications patient positioning is essential.

Most of the complications related to laparoscopy occur during the first access. Misplacement of Veress needle, vascular and organ injuries are complications occurring during the first access. With different access techniques (open vs blind) , complications will be decreased in selected patients. Bowels, liver, spleen, pancreas, diaphragma, urether and bladder are the organs those are at risk of injury during laparoscopic procedures. In case of organ injuries, laparoscopic repairment and converting to open procedure are alternatives.

Laparoscopic approaches in urology have become popular with years. Laparoscopic urologists must know possible complications and management of these complications.

**Key Words:** Laparoscopy, Complications, Management

At first, prolonged operative times, technical complexity and not being sure about the usage of laparoscopy in oncological surgeries limited laparoscopic approach in Urology. By shortening in duration of hospital stays, getting better cosmetical results, less blood loss and having similar long term oncological results with open surgery, laparoscopy has become a standart procedure in some diseases (1-3). By increasing number of laparoscopic procedures in urological practice, mortality and morbidity has started to be reported.

Laparoscopic urologists must know complications and management of these.

Some laparoscopic complications are similar to open surgery while some of them are laparoscopic surgery specific. Laparoscopic complications can take place from patient selection, patient positioning, the first trochar's placement to creating promoperitoneum, dissection and closing the incision. In this review, prevention, diagnosis and management of complications are going to be discussed.

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For prevention and management of laparoscopic complications, the physiological effects of laparoscopy on a patient should be well known. While the increased intraabdominal pressure during laparoscopy is in normal ranges (<15-20 mmHg); there is a hyperdynamic effect. When the intraabdominal pressure becomes higher (>40 mmHg), venous return decreases, cardiac output and blood pressure fall down, collapse occurs (4). Carbondioxide (CO<sub>2</sub>) is get absorbed rapidly by tissues and it is not a flammable gas. When pCO<sub>2</sub>>60 mmHg, cardiac rate and contractility decreases. Fatal arrhythmias take place and there is respiratory acidosis (4). Urine output decreases according to the pressure to renal parenchyma, decreased renal blood flow and hormonal factors (5). Patient positioning has different effects on patients during surgeries. Cardiac flow decreases at reverse Trendelenburg and over flexion at flank position. At Trendelenburg position cardiac flow increases, while there is no change in cardiac flow at lateral position. Surgeon should always be aware of the risks of nerve damage and rhabdomyolysis.

There are cardiac and pulmonary physiological complications in laparoscopic surgery (6). For preventing pneumoperitoneum tension, surgeon should avoid leaning on the patient's abdominal wall and intraabdominal pressure should be below 20 mmHg. Also, using insufflator that limiting pressure and coordination with anaesthesia team and having an experienced surgery team may help preventing the increases of the tension of pneumoperitoneum. When there is a hemodynamic defect according to pneumoperitoneum tension, intraabdominal pressure should be decreased immediately. Dysrhythmia is seen between 17-50 %. Dysrhythmia often depends on vagal stimulation by hypercapnia and peritoneal irritation. Bradyarrhythmia and sinus arrest are possible results. Dysrhythmia could be a sign of gas embolism and pneumothorax. Atropin is recommended for prevention. Venous stasis / thrombosis is seen between 0-1 %. Increased intraabdominal pressure could cause decreased venous return in lower extremities, venous stasis in lower extremities, deep venous thrombosis and pulmonary embolism. Using pillows and devices making compression by pressure are recommended. Usage of low molecular weight heparin is yet controversial. The most important reason of cerebral ischemia and edema is cerebrovascular stasis. 15 mmHg intraabdominal pressure by insufflation has increased intracranial pressure as 5 mmHg in porks. While performing laparoscopic surgery patients with cerebrovascular disease and ventriculoperitoneal shunt, there should be additional attention.

The prevention of laparoscopic complications begins with patient selection and preoperative preparations. Age, possible effects of anaesthesia on patient, body mass index, operative history have important roles in patient selection. Patients with severe cardiopulmonary disease would not tolerate

pneumoperitoneum. The need of helium insufflation and open surgery should always be kept in mind. The difficulty degree of the surgery is directly correlated with the surgeon's experience. Technical equipment and facilities should be well analysed preoperatively. The patients' expectations should be learned and possible complications should be also explained to patients preoperatively. Informed consent should always be taken because of medicolegal reasons. The imaging modalities have vital roles in planning, entrance, dissection and avoiding complications. Computerized tomography with three dimensional reconstruction provides valuable informations for renal vascular structures, collecting system and parenchyma during partial nephrectomy and donor nephrectomy. The usage of imaging modalities during surgery has positive effects on correct placement of ports.

Surgeon and anaesthesia team should always be correlated during laparoscopic surgery for preventing physiological effects as mentioned above. The monitorization of the patient by electrocardiography, pulse oximetry, capnography and blood pressure is well recommended. Bladder should be emptied and a nasogastric tube should be placed in the beginning of the operation. Nitrous oxide is known to cause bowel distension when operation time becomes longer but this is controversial. There is more fluid loss to third spaces in laparoscopic surgery than open surgery. Over fluid replacement during surgery would cause fluid loading that's why the communication between surgeon and anaesthesia team should always continue..

Obesity increases laparoscopic complications because of related comorbidities, delays in wound healing, susceptibility in infections, difficulties in the continuous insufflation and trocar placement. In recent data, it is reported that, obesity had no additional risks for laparoscopic surgery in experienced hands. The patients over 181 kg should not be operated by unexperienced surgeons.

In initial studies, previous surgery was a contraindication because of adhesions, deteriorated tissue planes, the risk of adhesion of bowels to anterior abdominal wall and the difficulties in finding the previous trocar entrances. In recent studies, there are no changes in rates of turning to open surgery, complications and blood loss in patients with previous surgery but an increase in surgery and hospital stay durations in patients with previous surgery(7). In light of these data, Veress needles should be placed far away from previous scars and using Hasson technique in patients with previous surgery.

Both retroperitoneal and transperitoneal procedures have advantages and disadvantages. Limited operation area, the missing anatomical markers and retroperitoneal fat tissue are the disadvantages of retroperitoneal procedure while the chance

of working away from peritoneum, providing safer access in obese or patients with previous surgery, the possibility of rapid control of renal hilum, less ileus and bowel complications are advantages of this procedure (8).

For preventing orthopedical and neuromuscular complications as sensorial and motor deficits, neuralgia, back pain and rhabdomyolysis, an additional attention should be given to patient position. These complications occur more in retroperitoneal procedures than pelvic laparoscopic procedures. The incidence of these complications is 3.1% in the literature (9). Careful positioning, safe stabilisation of the patient to the operation table, supports to pressure points, chest, armpit and neck would prevent these complications. Rhabdomyolysis is a serious complication of laparoscopy with an incidence of 0.4%. The risk factors for rhabdomyolysis are male gender, higher amount of muscle tissue, obesity, elongated operation times, over flank or lithotomy positions (9). Intravenous hydration (with or without alkalization) is recommended as treatment.

Nearly half of the complications related to laparoscopy occur during first access (10). The incidence of injuries related to access is 5-30/10.000/dir (11). While blind access methods are performed by Veress needle or directly trochar access; open Access methods are Hasson technique and Access by optical trochars. Both methods have different complication rates. Vascular or organ injuries occur 0.1% by Veress needle (12-14). Placing Veress needle away from previous scars, using tests during access decrease the risk of injuries. The first access sense and keeping insufflation pressure below 5 mmHg are the best access methods with Veress needle. A high first insufflation pressure, immediate increases in pressure and asymmetry are premonitory for wrong access. When a bowel injury by Veress needle is noticed, the needle should be removed, area should be well evaluated and according to the limits of injury conservative or open procedures should be chosen.

Avoiding using excessive forces during trochar placement decreases the risk of injuries. Making a skin incision wide enough and lifting the skin by clamps are the other factors decreasing the injuries during the first trochar access.

Hasson technique has disadvantages as gas leakage and time loss. This technique also has disadvantages (15,16). The bowel injury in open technique is 0,06 % (17).

The injury during the placement of second trochar using direct vision by translumination is a rare condition. This access should be performed laterally to rectus muscle for avoiding injuries of epigastric artery.

Misplacement of Veress needle causes insufflation into extraperitoneal areas. The most misplacement area of needle

is preperitoneal space. In case of preperitoneal placement, the gas could pass through diaphragma and develop pneumomediastinum, pneumopericardium or pneumothorax (18). Placement of Veress needle into subcutaneous area causes subcutaneous emphysema. Subcutaneous emphysema is often clinically insignificant. Subclinical thoracic gas collection is detected in 5.5% of all urological laparoscopic procedures (19,20). In symptomatic cases pneumoperitoneum should be diminished, ectopic gas should be emptied. Pneumothorax, complications of anaesthesia and positive pressure ventilation, emphysematous bullae could occur by anatomical or congenital ways with passing through diaphragma without subcutaneous emphysema.

In patients with successful pneumoperitoneum, an increased intraabdominal pressure to 20 mmHg could be well tolerated. The complications due to increased CO<sub>2</sub> pressure could be treated by ventilation. In some cases hypercapnia could take place. When hypercapnia is detected, intraabdominal pressure should be immediately decreased. If no compensation is seen, use of helium or turning into open surgery should always be kept in mind.

Gas embolism is a rare but fatal complication. It often occurs during induction of pneumoperitoneum. It mostly develops by placing needle or trochar directly into vessels or abdominal organs while it could also occur due to increased intraabdominal pressure (21,22). The incidence of gas embolism is 0,0014 % (13). The survival of the patient after gas embolism is due to rapid diagnosis and treatment. Tachycardia, arrhythmia, hypotension, increased central venous pressure, mill wheel murmur, findings of failure of right part of heart should be interpreted as warnings of gas embolism. Embolism in pulmonary system when an immediate decrease in end tidal CO<sub>2</sub> pressure is detected. In a gas embolism suspicion, pneumoperitoneum should be diminished, 100% oxygen should be given to the patient. The patient is put into upside down in a lateral decubitus position. There should be preparations for cardiopulmonary resuscitation and gas aspiration by central venous catheter should be tried.

Vascular injury is the most frequent and difficult complication in urological laparoscopic procedures with an incidence of 2.8%. Most complications could be conservatively treated while major injuries could be fatal. The most common injury is epigastric artery injury during second trochar Access into lower abdomen (24). This injury is more common in bladed trochars (25). An aspiration should always be performed during access with Veress needle. If blood is aspirated, the needle should be removed then access should be tried again. While blood is aspirated, needle would never be turned over. If an extensive bleeding is detected, the needle should be left in place for finding the injury site during open procedure.

Vascular injuries due to trochar are often on abdominal wall. Blood leakage from trochar and hematoma formation should be cautionary for vascular injuries. Performing a hemostatic approach near the peritoneum or a smooth withdrawal of trochar could take minor vascular injuries under control. If a major bleeding is detected, a traction with a foley catheter could be performed. With excessive forces to very thin patients, major vascular injuries would occur. In case of a suspicion, an immediate turning into an open approach should be kept in mind. Trochar should be left in place while turning into open surgery. Rarely, serious bleeding would not be diagnosed during operation. Hypotension, tachycardia, decrease in blood count and hemotocrit levels, presence of hematoma in leaves of rectus muscle, pain in trochar sites, ecchymosis and a palpable mass located paramedianly in postoperative period are cautions for major bleeding. In a hemodynamic instability situation, exploration is needed. Endovascular gastrointestinal anastomosis (Endo GIA) devices are routinely used for vascular sealing in laparoscopy. Complications due to Endo GIA occurs 1,7 % of patients (26). These complications can be prevented by being careful about the absence of clip in stapler line, fat and unwanted vessels. By a severe bleeding by Endo GIA, intraabdominal pressure should be increased to 20-25 mmHg. Then, a foley catheter over a guide should be placed into bleeding area and get inflated. Minor venous bleedings could be taken under control by electrocoater and clips, moderate bleedings need sutures. In case of a persistent bleeding, hand device should be left in place and open surgery should be performed afterwards.

Bowel injuries are seen in rates of 0,25-2,5 % in laparoscopic surgeries (23). Bowel injuries are often due to access of needle or trochars and electrocoaterization (23). Hand device's isolation should be controlled, blind energy performance should be avoided, the device's end side should always be seen during using device and the coaterized area should be kept away from adjacent tissues for preventing thermal damage. The injuries detected during operation should be repaired immediately. These injuries are more than they seem to be that's why large bowel resections should be performed. Unfortunately, most thermal injuries could not be detected during operation. Prolonged ileus, nausea, vomiting, mild distension, pain in trochar site, mild fever occur in 2-7 days after operation. In a suspicion of bowel injury, if the patient has no response to conservative treatment; radiological evaluation and exploration are needed.

Liver and spleen injuries generally could be taken under control by hemostatic agents and argon coagulators. In case of persistent injury laparoscopic repairment and open surgery are other alternatives.

Pancreas injuries usually occur during left radical nephrectomy and left adrenalectomy. In case of detection during operation should be repaired immediately or followed by amylase and

lipase levels after putting a drainage catheter. In case of need, the tail of pancreas should be excised by Endo GIA. If the injury is noticed after operation, a drainage catheter should be put, and in persistence clinical situations exploration should be performed.

Bladder and urethra injuries usually occur during gynecological procedures. Inserting a foley catheter into bladder before operation is essential. Hematuria, pneumoturia are usually suspects for an injury. In case of a suspicion, bladder should be filled by methylen blue. In injuries by Veress needle, conservative methods are usually enough while injuries of trochar, repairment or open surgery should be performed. Urethral injuries usually become prominent after 1-5 days. Urinoma, localised pain are cautions for urethral injury. In case of urine extravasation, peritoneal irritation findings take place. In urethral injuries detected during operation, a double J (DJ) stent should be placed. In urethral injuries detected after operation, a percutaneous nephrostomy or DJ stent should be placed and laparoscopic or open repairment should be performed if needed.

Incidence of pleural and diaphragmatic injuries are 0.6 % (27). These injuries usually occur during mobilization of liver and spleen at laparoscopic surgeries of upper polar renal tumours and adrenal gland. Additionally, mobilization of the trochar above the 12th rib would cause pleural and lung injuries. Tension pneumothorax or pneumomediastinum should always remind a diaphragm injury. Waving movement of diaphragm in surgery site which is known as "floppy diaphragm sign" should be a caution for injury. Communication with anaesthesia team should be continuous for decrease in oxygen saturation, increase in airway pressure, decrease in respiratory sounds, retention of CO<sub>2</sub> and hemodynamic instability. In patients those are hemodynamically stable, laparoscopic diaphragm repairment, air aspiration just before the last suture and putting a 6F central catheter under careful inspection of the injury site at low pressures (10 mmHg) after completing the initial laparoscopic procedure are enough while in hemodynamically unstable patients, pressure should be decreased then tube thoracostomy should be placed.

Laparoscopic partial nephrectomy (LPN) is a struggling surgery including both resection and repairment. Complication rates range between 19,7 % and 33 % (28-31). The incidence of intraoperative bleeding is 3,5-8%; postoperative bleeding is 1,8-2%; late bleeding is 4% (28,29,31). Bleeding during LPN could occur due to insufficient hilar control and inadequate bleeding control (28). The well definition of renal vascular structures, the usage of laparoscopic bulldog and satinsky clamps are essential in hilar control. LPN without hilar clamp would prevent inspection of the renal mass and surgical margins that's why it

is not recommended (32). Urine extravasation in open partial nephrectomy ranges between 1,4% and 17,4% while it ranges between 1,4 % and 10% (28-31,33,34). There are studies supporting retrograde stain enjection by ipsilateral urethral catheter while there are also studies mentioning no decrease in urine extravasation by catheterization (35,36). Excision should be performed by cold knife instead of monopolar coteterization for preventing surgical margin positivity and coagulation necrosis (36,37). Urinary fistula after LPN usually could be treated by conservative methods as elongated catheter drainage. Percutaneous nephrostomy, urethral stents and surgical modalities are rarely needed.

Herniation after laparoscopic surgery is less than 0.1% (38). The herniation risk increases by larger trocar sizes that's why trochars larger than 10 mm should be closed. Peritoneal repairment should be performed because there should be herniation into preperitoneal space. By using balloon, there would be large defects. The whole mesenteric defects should be closed for preventing mesenteric herniation.

For reducing pain and morbidity after laparoscopy, some details should be kept in mind. Before removing trochars, the pressure should be reduced and hemostasis control should be performed. The inside of the abdomen should be inspected carefully and clots should be removed. Trochars should be removed under direct vision. Before the removal of the last trocar, the whole CO<sub>2</sub> inside should be emptied.

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