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Laparoscopy in Urology: An Overview

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1. Introduction

The idea of inspection of the abdominal and other cavities in humans is not and invention recent years but dates back to the early 20th century. However, technical limitations prevented the widespread use of the technique. Along with technical progress laparoscopy became a tool of increasing popularity, but its use was mainly limited to diagnostic inspection of the abdomen for gynaecological and gastroenterological indications. The breakthrough of laparoscopic surgery was the development of laparoscopic cholecystectomy, which within few years was established as the golden standard approach.

In these early days, laparoscopy was still far away from being standard of care in the field of urology. In 1989, the first cases of laparoscopic pelvic lymphadenectomy in prostate cancer patients have been performed and published be Schuessler et al (Schuessler et al., 1991). In the early 1990s, some centres advocated laparoscopic pelvic lymphadenectomy prior to radical prostatectomy or radiotherapy for prostate cancer, since treatment with curative intent was indicated only in cases with histologically negative nodes. Meanwhile along with the development of laparoscopic and robot-assisted prostatectomy, pelvic lymph node dissection if indicated is usually performed together with radical prostatectomy in the same session.

In 1990, the first laparoscopic varicocele repair has been performed, followed by the first laparoscopic nephrectomy performed and published by Clayman and co-workers in 1991 (Clayman et al., 1991). In the pioneer times of laparoscopy, varicocele repair was one of the most frequently used indications to establish this novel technique. However, this indication has been widely abandoned due to more restrictive indications with regard to surgery in varicoceles in general (Diegidio et al., 2011). Moreover, a clear advantage of laparoscopy compared with the small incision of open surgery could not be demonstrated.

Subsequently the laparoscopic approach became increasingly accepted by the urological community. Nephrectomy for primary benign and furthermore also for malignant diseases, via either transperitoneal or retroperitoneal approach, performed with or without morcellation, became more and more accepted. Hand-assisted laparoscopy was developed to facilitate surgery especially during the learning curve in these pioneer days. Indications for the laparoscopic approach were expanded towards cryptorchidism, adrenalectomy, nephroureterectomy, retroperitoneal lymph node dissection for testis cancer, renal cyst decortication, nephropexy, or lymphocele fenestration.

Adrenalectomy for adrenal tumours has been developed in the early days of laparoscopy and has been established and maintained as golden standard approach in adrenal surgery

including phaeochromocytomas except for cancer. The advantage is evident: The adrenal is a small organ but its location requires usually big incisions in open surgery, whereas laparoscopy provides excellent visualization of the adrenal region and in many cases there is no need to extend incisions for specimen retrieval.

Retroperitoneal lymph node dissection in patients with testis cancer has been developed as an alternative to the open approach which requires a median laparotomy from the xyphoid down to the symphysis and frequently leads to retrograde ejaculation in this young patient group. However, retroperitoneal lymph node dissection in general is performed rarely nowadays since the majority of non-metastatic patients undergo risk-adjusted observation, whereas metastatic patients are primarily treated with chemotherapy.

One of the larger steps in advancing laparoscopy was the development of nephrectomy. Meanwhile, the guidelines of the "European Association of Urology" (Ljungberg et al., 2010) suggest the laparoscopic approach as gold standard if tumour nephrectomy for renal cell carcinoma is indicated, whereas the open approach is used only in patients with large tumours, tumour thrombus, enlarged nodes or multiple abdominal operations. In absence of randomized trials, oncological outcomes appear to be identical with the open approach, thus there is no evidence that laparoscopy by itself impacts on prognosis. However, with regard to morbidity and invasiveness, clear advantages in favour of laparoscopy have been reported. Basically, laparoscopic nephrectomy can be performed via trans- or retroperitoneal approach. Comparative studies did not demonstrate differences with regard to perioperative morbidity or oncological outcomes.

Laparoscopic nephroureterectomy for urothelial carcinoma of the upper urinary tract is another indication for laparoscopy in urological malignancies. The main difference is that the entire ureter together with a bladder cuff needs to be resected, which is not required for renal cell carcinoma. The main difficulty in this regard is the handling of the distal ureter, since opening the urinary tract has to be strictly avoided in this type of cancer. Most laparoscopic surgeons therefore perform the nephrectomy laparoscopically, whereas the distal ureter and bladder cuff are removed via a lower abdominal incision required for specimen removal (Zigeuner & Pummer 2008).

Moreover, there is a more frequent indication to perform a lymph node dissection in urothelial cancer compared with renal cell carcinoma which may be difficult in advanced cancers. Consequently, laparoscopy in upper tract urothelial cancer is not yet considered the golden standard approach, although retrospective comparative studies did not demonstrate a detrimental effect of laparoscopy with respect to oncological outcomes. According to current guidelines, laparoscopic nephroureterectomy is reserved for locally confined cancers, whereas the advanced cases should be managed by open surgery.

The development of laparoscopic live donor nephrectomy contributed to an increasing acceptance of live donor nephrectomy on the background of continuously scarcely available kidneys obtained from cadaver donors.

The above mentioned indications have in common that they require mainly ablative techniques. Along with increasing surgical skills and experience, urologists throughout the world developed techniques for more and more complex indications requiring reconstruction of parts of the urinary tract. The most challenging and crucial part of laparoscopic reconstructive procedures is undoubtedly intracorporeal suturing and knotting. Reconstructive surgery includes procedures like ureterocystoneostomy, uretero-ureterostomy, bladder autoaugmentation, pyeloplasty, nephropexy, or bladder neck

suspension, each of which has been performed in mostly smaller series. More frequent indications compared to the ones mentioned before include small renal masses, prostate cancer, and bladder cancer. Along with establishing laparoscopic radical prostatectomy and partial nephrectomy, each of these procedures performed either via a transperitoneal or retroperitoneoscopic approach, suturing techniques gained importance as these indications became more and more widely accepted. Indications were expanded towards radical cystectomy and extended pelvic lymph node dissection for muscle-invasive bladder cancer, even with urinary diversions constructed completely intracorporeally.

During the past decade indications for organ sparing surgery (partial nephrectomy) for renal cell carcinoma have undergone significant modifications. Since Robson standardised radical nephrectomy for renal tumours in 1969 this approach remained standard for about 25 years even for small tumours. After slowly increasing acceptance of partial nephrectomy for small (<4cm) renal tumours in the presence of a normal contralateral kidney, the past years brought new insights into possible harmful effects of radical nephrectomy. There is an increasing body of evidence that loss of renal function after nephrectomy increases long term cardiovascular morbidity and mortality, especially if the glomerular filtration rate decreases below 45. Thus, current recommendations suggest to preserve the kidney whenever technically feasible. While there is an expanding indication for partial nephrectomy, the open approach is still considered golden standard for this operation (Ljungberg et al., 2010). However, along with the advances of laparoscopy, laparoscopic partial nephrectomy becomes increasingly accepted. The laparoscopic approach is mainly indicated in smaller, exophytic tumours, whereas the more complex cases are operated by open surgery.

Laparoscopic radical prostatectomy was another progress in the field of laparoscopy. Initially established as a transperitoneal procedure, the extraperitoneal approach was developed subsequently. Although no clear advantage of laparoscopic prostatectomy compared with the open retropubic approach could be demonstrated yet (Ficarra et al., 2009), the procedure has gained popularity and is offered as a standard approach in many centres.

A revolution in laparoscopy was the development of robot-assisted surgery. The technical difficulties due to the inherent limitations of degrees of freedom of rigid laparoscopic instruments contributed to the development of this technique. The major difference of the robot in comparison with conventional laparoscopy is a tremendous improvement in performing complex maneuvers due to articulating instruments. Robot-assisted radical prostatectomy was the first operation to establish this technique. The most challenging step in radical prostatectomy by conventional laparoscopy is the vesicourethral anastomosis, since intracorporeal suturing in the narrow space of the pelvis is technically difficult. Especially this step was facilitated by the robot which enables a wide range of angular movements of the instruments intracorporeally. Although the robotic approach has never been (and presumably will never be) evaluated in prospective controlled trials in comparison with either open surgery or conventional laparoscopy (Ficarra et al., 2009), it is increasingly utilized throughout the world for complex reconstructive procedures.

Consequently, indications for robotic surgery were expanded to other operations requiring any form of intracorporeal reconstructive surgery, like urinary diversion after cystectomy, partial nephrectomy or pyeloplasty.

Most recently, attempts have been initiated to further decrease invasiveness of laparoscopy by development of single incision laparoscopic surgery (SILS), also known as laparo-

endoscopic single-site surgery (LESS) which uses angulated instruments inserted through one multi-channel trocar (Canes et al., 2008), as well as natural orifice transluminal endoscopic surgery (NOTES) which is preformed via pre-existing orifices like mouth, rectum, or vagina. Whereas SILS is continuously gaining popularity, experience with NOTES in humans is still very limited. Due to the increasing use of robotic surgery, a combined use of these novel techniques (combining robotic assisted surgery with either SILS or NOTES) is increasingly utilised (Rane & Autorino, 2011)

2. Preoperative considerations

2.1 Indications-contraindications

As in any medical treatment or surgical procedure, the key to success is a correct indication. Without any doubt, the first step to indicate any procedure is a precise assessment of patients' history including any previous surgery as well as comorbid conditions. All standardized investigations which are routinely required to be performed prior to any procedure under general anaesthesia apply for laparoscopic surgery exactly the same way. In patients with significant comorbidities, close communication with the anaestesiologists is essential, especially in patients suffering from severe chronic obstructive pulmonary disease, since high intraabdominal pressures resulting from the pneumoperitoneum may result in impaired or even insufficient respiration.

There are a couple of absolute contraindications to laparoscopic surgery. Mainly, infectious conditions in the operative field, like peritonitis or abscess formation represent contraindications, since pressure elevation in a bacterially contaminated environment may result in bacterial dissemination und ultimately septicaemia. Massive haemorrhage in the peritoneal cavity and/or retroperitoneum, either due to trauma or postoperatively, represents another contraindiciation due to impaired visualisation and lack of effective bleeding control mechanisms. Uncorrected haemorrhagic diathesis represents a contraindication as in open surgery as well. However, in case of emergency, when time to correct a coagulopathy is lacking, an open surgical approach will permit haemostasis more effectively (Eichel et al., 2007).

Relative contraindications to the laparoscopic approach include previous abdominal or retroperitoneal surgery, morbid obesity, suspected fibrosis in the operative field due to previous inflammatory or traumatic conditions, excessive ascites, pregnancy, aortic aneurisms, or size of the organ to be operated (e.g., large renal tumours or polycystic kidneys).

Whenever extensive intraperitoneal adhesions have to be expected, entering the peritoneal cavity must be undertaken with maximal care. In this case, open minilaparotomy access with direct vision might preferable over the Verress needle technique. Alternatively, a retroperitoneoscopic approach can be chosen if the patient had undergone previous transperitoneal surgery. The same applies the other way round, if the patient had had open surgical procedures in the retroperitoneum, a transperitoneal laparoscopic approach may be the saver alternative (Eichel et al., 2007).

In morbidly obese patients, technical difficulties may occur from insufficient length of instruments, which may prevent access to the operative field, necessity for higher intraabdominal pressures to ensure adequate visualisation, as well as difficulties in anatomic orientation due to excessive adipose tissue. However, in experienced hands,. obese patients have been shown to benefit even more from the minimally invasive approach with

regard to postoperative morbidity compared with normal weight patients (Klingler et al., 2003).

The size of the affected organ, which applies mainly to the kidney from a urological point of view, may be a limitation for the laparoscopic approach. Very large renal tumours, especially if they are located on the upper pole, may restrict the available space required for mobilisation of the specimen in a way that complete specimen mobilisation is made impossible, thus enforcing conversion to open surgery. The same limitation applies for large polycystic kidneys. Pathologically enlarged adjacent organs, like liver or spleen may also limit surgical space and a higher risk of injury to these organs must be taken into consideration in these patients when indicating a laparoscopic approach.

In patients with excessive, yet non-malignant ascites, bowels normally float on the fluid and are consequently at risk for injury when entering the peritoneal cavity. In such cases, comparable to what was noted with regard to previous abdominal surgery, either an open access under direct vision or a retroperitoneal approach should be undertaken. If a transperitoneal procedure is chosen, care must be taken to ensure a watertight closure of the abdominal wall to prevent fistula formation (Eichel et al., 2007).

In case of pregnancy, all efforts must focus on protection of the gravid uterus. As a result of pre-existing compression of the vena cava by the gravid uterus, additional elevation of the intrabdominal pressure may result in hypotension. Moreover, hypercarbia might be detrimental to the fetus and should be avoided. Thus, a pneumoperitoneum of no more than 10mmHg is usually recommended for laparoscopy during pregnancy. Beyond the 20th week of pregnancy the laparoscopic approach is no more feasible in most cases due to working space limitations corresponding with the size of the uterus (Eichel et al., 2007).

In patients with large aortic or iliac aneurysms, a preoperative consultation of a vascular surgeon is mandatory. Care must be taken to avoid vascular injury by trocar placement. Again, entering the peritoneal cavity under direct vision or performing a retroperitoneoscopic procedure should be preferred.

Preoperative imaging is mainly determined by the underlying condition to be operated. Thus, standardized imaging procedures have to be properly performed regardless which surgical approach is chosen. However, in several cases the size or location of a tumour impacts on the decision of the surgical approach, especially in renal masses. The decision whether to perform a radical or partial nephrectomy, via an open, transperitoneal-laparoscopic or retroperitoneoscopic approach is dependent on the findings on preoperative imaging.

2.2 Patient preparation

As for any intervention, a precise informed consent must be obtained prior to surgery. A minimally invasive procedure offers clear advantages for the patients' postoperative course. However, minimal invasiveness does not equal minimal risk of complications. Patients must be informed about the typical risks of the procedure. This includes the possibility of conversion to open surgery, either due to fibrosis, adhesions, bleeding with impaired visualisation or lesions to adjacent organs. The possibilities of bowel injury with the ultimate consequence of bowel resection and even colostomy, the risk of splenectomy or pancreatic lesions for left-sided renal surgery, liver injury for right-sided renal surgery, injury to any of the larger blood vessels, urinary leakage in any procedure opening the urinary tract (like radical prostatectomy, partial nephrectomy, bladder augmentation, pyeloplasty, urinary diversion, ureteral reimplantation), loss of the kidney if partial nephrectomy was indicated

or nerve injuries in pelvic or retroperitoneal lymph node dissection need to be discussed. In addition, possible complications associated exclusively with the laparoscopic approach, like hypercarbia, gas embolism, subcutaneous gas emphysema have to be mentioned as well (Eichel et al., 2007).

Prior to surgery, bowel preparation is required if a transperitoneal approach is chosen, since overdistended bowels may limit working space considerably and expose the patient to a higher risk of bowel injury.

Although laparoscopic procedures in general have been reported to be associated with lower blood loss than the corresponding open surgical procedures, significant bleeding cannot entirely be ruled out. Thus, packed red blood cells should be made available prior to the laparoscopic approach as in open surgery, if indicated by the character of the procedure (Eichel et al., 2007).

3. Intraoperative considerations

3.1 Patient positioning

The patients' position is dependent on the intended surgical procedure. For procedures in the retroperitoneum (like any renal or adrenal as well as retroperitoneal lymph node dissection) which are performed via a transperitoneal approach, it is advisable to place the patient in a modified lateral position with a dorsal decline of approximately 30 degrees. This position permits a more supine position for getting access to the abdominal cavity, as it is required for establishing the pneumoperitoneum by Verress needle or open access, whatever is preferred. At the end of surgery, the table can be moved again towards a supine position to facilitate specimen retrieval and wound closure. To perform the intracorporeal steps of the laparoscopic procedure, the table is moved to place the patient in a strictly lateral position. Thus, bowels will move away from the operative field by gravitation and additional trocars are often not necessary. We also omit kidney rests and have abandoned flexing the table in order to increase the distance between ribs and iliac crest as it is indispensable for performing a flank incision in open surgery. In almost all patients the pneumoperitoneum by itself will provide ample space on the patients abdomen to enable adequate trocar placements. Since flexing the patients' spine may cause additional morbidity postoperatively especially in patients affected by spinal disorders, this positioning appears to be advantageous.

If a retroperitoneoscopic approach is preferred, the patient is in a strictly lateral position from the beginning of the operation. In this case, it is necessary to elevate the patients flank by a kidney rest and to flex the table exactly as in a flank incision in open surgery in order to achieve a sufficient distance between the ribs and the iliac crest. From this much more dorsally located position the pneumoretroperitoneum alone will not provide sufficient space for trocar placement.

The decision, whether a transperitoneal or retroperitoneal approach is chosen for renal surgery usually relies on personal experience of the surgeon and a history of abdominal surgery. Currently there is no evidence that the approach by itself impacts on outcomes of the procedure ((Eichel et al., 2007; Desai et al., 2005).

Procedures performed in the pelvis, like radical prostatectomy or cystectomy, require an elevated position of the pelvis (Trendelenburg) to permit the bowels to move away from the operative region, just as described before for renal surgery. The elevation of the pelvis has to be more pronounced if a transperitoneal approach is chosen. For extraperitoneal radical prostatectomy a less pronounced Trendelenburg position is adequate.

3.2 Beginning of the procedure
3.2.1 Transperitoneal approach

Before the laparoscopic procedure can get started, a pneumoperitoneum has to be established. The most commonly used gas for insufflation in laparoscopy is CO_2. The advantage of CO_2 is its excellent solubility in blood which is essential to prevent gas embolism due to high gas pressure in presence of venous leaks. The major disadvantage of CO_2 is the risk of hypercarbia in patients suffering from severe pulmonal disorders. In these patients, helium may be used as insufflant, which, however, is much less soluble in blood than CO_2 and consequently associated with a higher risk of gas embolism. Oxygen, which is well soluble in blood as well is not an adequate insufflant since it leads to intracorporeal combustions and even explosions if fulguration is used (Eichel et al., 2007).

To establish the pneumoperitoneum, two techniques can be used: either a closed approach using a Verress needle, or an open approach.

If the Verress technique is used, the needle is usually inserted at the cranial circumference of the umbilicus with the patient in a supine position. Care must be taken to avoid injury to bowels and major blood vessels during insertion of the needle. In normal weight patients, the needle is usually inserted in direction towards the pelvis to avoid bowel injury, whereas in obese patients insertion is usually done in a more perpendicular fashion. The intended intraabdominal gas pressure is usually set at no more than 15mm Hg. It has been shown that higher pressures are able to to increase the intraabdominal volume only marginally (Mc Dougall et al., 1994).

The Verress technique can also be used if the patient is in a lateral position. In this case, the needle is usually inserted either in the lower abdomen or in a subcostal position. In a lateral position, it is essential to place the needle not in the midline but more laterally, otherwise the insertion is associated with a high risk of bowel injury.

Serveral methods to confirm a correct needle position have been described: using a syringe filled with some saline, an aspiration test can be performed to check whether blood or bowel contents are aspirated. If no aspiration can be seen, saline is injected into the needle. If the needle position is correct in the peritoneum, no resistance will be felt during saline injection. If there is any doubt regarding the correct position, a drop of saline can be placed on the Verress needle. By elevating the abdominal wall, the drop will pass spontaneously into the abdominal cavity, provided that the needle is placed correctly. If the needle is in a correct position, it is possible to advance the needle without resistance. If the tip of the needle is still in a preperitoneal position, gas insufflation will immediately show high pressure and low Flow, pointing to an increased resistance of insufflation.

The possible complications of the Verress technique can be safely avoided by using an open technique. In this case, a slightly larger incision is required to perform a mini-laparotomy. The size of the incision is of minor importance, since it can be used for specimen retrieval at the end of the procedure. A possible disadvantage of the open access is gas leakage, which, however, can be safely avoided by placing a suture incorporating skin and fascia before inserting the trocar. Then, the unloaded trocar is inserted, the suture is tied and the insufflation gets started. While the open access technique has its clear advantages over blind access in patients with previous abdominal surgery, we use the open access technique in all laparoscopic operations at our institution and did not note a single failure or bowel injury so far. The tightening of the incision by suturing can be replaced by using a balloon trocar, which covers the incision from inside the abdominal wall and prevents gas leakage.

Hand-assisted laparoscopy had some popularity in the pioneer days of laparoscopy. Nowadays the hand-assisted technique has been widely abandoned. One still valid indication for hand-assisted laparoscopy is live donor nephrectomy for transplantation. If a hand port is used, a proper incision is made, and after opening the abdominal cavity the port is inserted and the pneumoperitoneum can be established via the hand port.

3.2.2 Extraperitoneal approach

In contrast to intraperitoneal approaches, where ample space is present without additional manipulation, the working space needs to be created artificially for any extraperitoneal approach. For these indications, a small incision is made just enough to permit insertion of the surgeon's index finger. To get access to the kidney, the patient is in a strictly lateral position. The incision is usually made below the tip of the 12th rib in the mid axillary line. After entering the retroperitoneal space, the psoas muscle and the lower pole of the kidney are identified by palpation of the retroperitoneal space Then, in most cases a balloon dilatation of the extraperitoneal space is performed. This dilatation can be performed under direct visual control by using transparent balloons, thus minimising the risk of blind and blunt injury of vital structures. By dilatation the required working space is created between the psoas muscle and the posterior layer of the Gerota's fascia, thus placing the kidney together with its adipose capsule anteriorly. Since the incision is located at the level of the lower pole of the kidney, the balloon is directed cranially to enable a complete mobilisation of the posterior Gerota's fascia and to provide direct access to the renal artery. If additional space is required depending on the procedure, additional dilatation can be made in a caudal direction like for nephroureterectomy or more cranially for partial nephrectomy of upper pole tumours or adrenalectomy, respectively. Only after creation of an adequate working space, placement of the working trocars is possible and safe.

For extraperitoneal radical prostatectomy, similar principles apply with the main difference that the patient is in a supine position with a 30 degrees head-down decline of the table. The first incision is usually made just below the umbilicus, and the balloon is directed caudally towards the pelvis to create a working space preperitoneally.

Basically, the Verress technique can be applied also for extraperitoneal procedures. However, the established tests the prove the correct position of the needle as described for the transperitoneal approach cannot be used outside the peritoneal cavity. Moreover, insufflation alone creates only a small working space, which is usually inadequate for trocar placement. Thus, additional dissection of the retroperitoneum is required. Consequently, most surgeons use the open access technique for retroperitoneal procedures.

3.2.3 Trocar placement

Once pneumoperitoneum or –retroperitoneum have been established, the trocars have to be placed. If a Verress technique had been used for insufflation, the primary trocar for insertion of the laparoscope is place first. If an open access technique had been used, the primary trocar is already in place and the laparoscope can be inserted. Prior to insertion of the laparoscope, the light cord has to be connected and the camera has to be white balanced as in any endoscopic procedure. It is advisable to warm the laparoscope to body temperature to prvent fogging of the lens intracorporeally. After inserting the laparoscope, the operative field is inspected with special focus on intraperitoneal adhesions close to the intended port sites, as well as any other anatomical abnormalities. Additional trocars can be placed under

direct vision. Number and size of the required working trocars depend on the procedure and on the diameter of the instruments which have to be passed through the trocar during surgery. Nowadays trocars are routinely equipped with valves enabling the use of 5mm instruments through a 10mm trocar without loss of gas pressure. Basically, two types of trocars regarding the way of entering the abdomen are available: On the one hand, bladed trocars cutting through the abdominal wall and usually equipped with a safety shield that covers the blade after entering the abdomen, on the other hand non-cutting trocars which simply spread the muscle and fascial fibres of the abdominal wall without causing any cutting damage. Consequently, the latter trocars have been shown to cause less bleeding and postoperative hernias (Eichel et al., 2007). Moreover, suturing of the abdominal wall is not required after removal of blunt trocars, whereas closure of the port is mandatory after use of cutting trocars of 10mm or more.

With respect to placement of the trocars care must be taken to avoid injury to underlying sutures and to provide sufficient distance between the trocars. Ideally, the trocar placement corresponds with the operative field which should be located within the borders of the ports sites.

For intraperitoneal procedures, the trocars are placed in a triangular or quadrangular fashion depending on the number of trocars used. If the trocars are located to closely to each other, intracorporeal interference of the instruments is likely. On the other hand, very large distances between the ports may require very wide movements of the surgeons's arms with the result of increased physical efforts for the surgeon and possible problems due to insufficient length of instruments as well as intracorporeal acute angles aggravating adequate preparation. In most cases, a distance of approximately 10-12cm between the trocars appears adequate.

Transilluminating the abdominal wall from inside to chose the correct port site is helpful to avoid injury to larger vessels within the abdominal wall. Skin incisions are made just large enough to permit insertion of the respective trocar, which is then inserted under direct vision. If possible, the trocars should be directed towards the operative field, otherwise moving the instruments may be more difficult. In our experience, any left-sided retroperitoneal procedure can be performed by using just one camera port and 2 working channels. Separate trocars for retraction of bowels or spleen can be omitted in the majority of cases. For right-sided retroperitoneal surgery, one additional 5mm trocar is inserted below the xyphoid to enable retraction of the right lobe of the liver.

For retroperitoneal access to kidney or adrenal gland, trocars are frequently placed in a line parallel to the lower edge of the 12th rib (sites are located at the lateral edge of the erector spinae muscle, below the tip of the 12th rib and anteriorly in the anterior axillary line). Since limited space is available in this region, the patient is positioned in a standard flank position just as in open surgery with elevation of the kidney rest and flexion of the table. The trocars need to be placed close to the 12th rib to enable access to the upper pole of the kidney. If necessary, a fourth trocar can be placed more caudally above the iliac crest for retraction of the kidney.

Extraperitoneal access to the pelvis is mostly used for radical prostatectomy and requires four working channels, which are usually placed in an inverted "U"-shape fashion.

Usually at least one 12mm working channel is required for most procedures to permit passage of endoclip applicators, right angle dissectors, insertion of the specimen retrieval bag, drainage placement or interchanging the insertion site of the laparoscope for

visualization from a different perspective. Whether additional working channels consist of 5mm or 12mm trocars depends on the difficulty of the operation and the surgeon's experience.

Recently, single port devices have been developed which enable insertion of three or four instruments through one multichannel port. Since in this case no distance between the working channels is available, the problem of intracorporeal clashing needs to be overcome by use of curved or flexible instruments which provide adequate angulation inside the body. This method is mainly used for procedures which require some extension of the incision for specimen retrieval, like nephrectomy. The advantage of the single port access is that the incision required for the single port device is sufficient for specimen retrieval in most cases without extension, and additional incisions for working trocars can be spared.

3.3 Performing the procedure

In order to perform and finish a laparoscopic procedure successfully, two major prerequisites must be fulfilled. The first one is to duplicate the principles of open surgery. The second one is excellent visualisation of the operative field. The principles of open surgery depend on the respective procedure to be carried out. It is essential not to agree to any compromise regarding oncological safety. If there is any doubt regarding the feasibility of the laparoscopic approach with respect to oncological outcomes, it is advisable to choose an open approach. It is not acceptable to enforce short term perioperative benefits by all means on the expense of long-term harmful outcomes.

The key to excellent visualisation is high standard camera equipment. Most lenses have a diameter of 10mm and zero or 30 degrees angles. The 30 degree lens has the advantage of varying the perspective in a larger operative field. For preparation of the renal hilar vessels we see an advantage for the 30 degree lens to achieve a better visualisation of the renal artery which is usually located just behind or even slightly cranially to the renal vein. Moreover, dissection of the upper pole and dorsal surface of the kidney via transperitoneal approach is facilitated by the angled lens. In contrast, procedures with a limited space like extraperitoneal prostatectomy are mostly performed using a zero degree lens, since the angled vision is not helpful under these circumstances.

Recent advances include the development of deflectable laparoscopes. Their use, however, is still limited. Three-dimensional systems are mainly used in robotic-assisted procedures (Eichel et al., 2007).

As in open surgery, instruments used for laparoscopy consist of cutting devices like scissors and harmonic scalpels, graspers for retraction, dissectors for blunt preparation, electrosurgical devices using either mono- or bipolar current, clip applicators, vascular staplers, argon beam coagulators and various tissue sealants for haemostasis and needle drivers for suturing. All laparoscopic instruments have in common that they are rotating, thus enabling some variability intracorporeally. None of the instruments used in laparoscopy is distinctly different from those in open surgery. In order to fulfil the prerequisite of duplication open surgery, laparoscopic instruments are simply elongated version of the instruments used in open surgery. With the exception of some clip applicators, stapling devices, and right angle dissectors most of the instruments are available in 5mm diameters.

Whether cutting is performed by scissors together with current or by a (disposable and consequently more costly) harmonic scalpel remains a question of taste. In both cases, some fogging of the operative field will occur leading to impaired visualisation. In this situation

the assistant has to open a valve of one of the trocars to deflate the fog until perfect visualisation is re-established.

As in open surgery, irrigation and suction is sometimes required. Both is performed via one instrument, usually 5mm in diameter, containing an irrigation and a suction unit. If suction is over-used, the pneumoperitoneum will collapse and continuing the procedure will be possible only after re-establishing the proper pressure.

Whereas some titanium clips can be applied via 5mm instruments, the use of polymer clips which provide more security regarding vascular closure is possible only with 10mm instruments. In our own experience, vascular staplers are usually not required when performing a nephrectomy. The renal vein collapses after proper clipping of the artery and can be safely closed with large polymer clips. In contrast to vascular staplers which are disposable instruments the applicators for polymer clips are reusable. As in open surgery, use of electrocautery in close contact to bowels and major vessels has to be strictly avoided to prevent injury to these structures.

In open surgery, retraction of adjacent structures is essential for optimal visualisation of the operative field. The retractors in open surgery are usually large instruments, which cannot be used for laparoscopy. For laparoscopic purposes, as described before, a very important part of visualisation is patient positioning which by itself will replace most of the retractors that would be needed for the same respective operation by an open approach. Several retractors are available. Some of these are inserted in a folded fashion via the trocar and unfolded inside the abdomen like a fan. However, the larger the instrument, the more it may become an obstacle rather than a support for surgery. In our experience, for right sided renal or adrenal surgery we place a 5mm trocar just below the xyphoid an insert a lockable grasper which retracts the right lobe of the liver and is fixed on the peritoneum of the diaphragm just laterally to the liver. Care must be taken to place the trocar as cranially as possible to avoid clashing with working instruments. On the left side, only two trocars are sufficient, no additional retraction is required, if the spleen is mobilised completely from laterally.

The use of tissue sealants is of importance especially when performing a partial nephrectomy. A variety of tissue sealants, fibrin based or non-fibrin based are available. No head-to-head prospective trials comparing the various sealants directly have been conducted. At our institution we use an autologous fibrin glue obtained from patients' own blood at the beginning of surgery (Schips et al., 2006).

Most laparoscopic procedures in urology (with the exception of pyeloplasty, nephropexy, bladder neck suspension, varicocelectomy, ureteral re-implantation) have an ablative character and require retrieval of a surgical specimen. For this purpose, a variety of specimen retrieval bags has been developed. The common principle is that the folded bag is inserted into the patient via a 10mm or 15mm trocar (depending on the size of the specimen and the required bag), then the bag is opened to permit specimen entrapment, followed by closure of the bag enabling intact specimen retrieval. In malignant diseases it is essential to retrieve the specimen within an intact bag to prevent port site metastases (Zigeuner & Pummer 2008). If gas insufflation is applied via the same trocar containing the retrieval bag, it is advisable to insert the insufflation at a different trocar to avoid distension of the organ bag by gas insufflation into the bag instead of the abdomen. If a large specimen is present like in case of nephrectomy, the incision needs to be enlarged until the bag can be removed. For most nephrectomies, skin incisions can be limited to 4-5cm due to elasticity of the tissue, whereas on the level of the fascia consisting of tense and non-elastic connective tissue

slightly longer incisions are required dependent on the size of the specimen. For smaller specimens like in partial nephrectomy, prostatectomy or adrenalectomy mostly no or very limited enlargements of the incisions are required.

In the early days of laparoscopy, specimens were routinely morcellated intracorporeally to avoid larger incisions for retrieval. However, in oncological diseases, tissue morcellation may contribute to cancer cell dissemination especially when the bag is damaged by the morcellator. Definitely, even in case of an intact bag, histopathological assessment of the specimen is severely compromised if not impossible. Thus, morcellation has been widely abandoned for oncological diseases.

After retrieval or entrapping of the specimen, the laparoscope is re-inserted to inspect the operative field for bleeding and to perform adequate haemostasis. Lowering the pressure is advisable since smaller venous haemorrhages might be masked by gas pressure. This is especially essential with respect to the venous plexus after radical prostatectomy. A drain is placed if indicated. In most cases of nephrectomy and adrenalectomy drains can be safely omitted. In contrast, any procedure associated with opening the urinary tract and thus amenable for urinary leakage requires drainage. This includes partial nephrectomy, pyeloplasty, nephroureterectomy, radical prostatectomy, cystectomy, ureteral reimplantation, or ureterolithotomy. In case of retroperitoneal lymph node dissection the urinary tract is not opened. However, a typical complication is chylous leakage, which can be easily diagnosed if a drain is in place and is treated dietetically immediately after diagnosis.

Finally the trocars have to be removed. This is done under direct vision to control for bleeding. If cutting trocars have been used, any 10mm or larger port requires closure, whereas 5mm ports do not. If blunt trocars have been used, no suture is required.

Before removing the last trocar, the pneumoperitoneum is deflated. Then, the trocar is removed, the specimen retrieval bag, if still in place is removed after extension of the incision if necessary. Closure of the retrieval incision is performed just as in open surgery.

3.3.1 Intraoperative complications and management:

One complication which is directly associated with laparoscopy and does not occur in open surgery is the risk of hypercarbia resulting from CO_2 insufflation. Since CO_2 is well soluble in blood, it is quickly resorbable from the abdomen an has a low risk of gas embolism. The other side of the medal is that this high solubility in blood may cause hypercarbia. Especially in patients suffering from severe chronic obstructive pulmonary disease (COPD) the high CO_2 levels cannot always be fully compensated by ventilation. Hypercarbia results in increased stimulation of the sympathetic nervous system with the consequence of increased cardiac strain. The risk of hypercarbia is directly related to intraabdominal pressure. The optimal intraabdominal pressure with respect to volume has been described at 15mmHg whereas higher pressures showed only very moderate gain in volume (Mc Dougall et al., 1994). Lowering the pressure to 12mmHg has been shown to reduce cardiac side effects (Eichel et al., 2007).

Other complications exclusively associate with laparoscopy are related to Verress needle insertion. Preperitoneal placement of the needle prevents successful trocar placement. The most important indicator to recognise improper needle positioning is a steep rise in CO_2 pressure associated with a low flow. If the pressure is raised to increase insufflation, an artificial preperitoneal cavity may be created suggesting a correct intraperitoneal needle position. After insertion of the camera, no bowels but only adipose tissue will be visible, and

correct trocar placement will be difficult to obtain. In that case, deflating of this artificial cavity and proceeding with an open access technique is advisable (Eichel et al. 2007).

Vascular injury by placement of the Verress needle is indicated by aspiration of blood into the syringe. Removing the needle without additional manipulations will results in no major bleeding in most cases. However, after establishing the pneumoperitoneum identification and inspection of the punctured vessel is mandatory (Eichel et al., 2007).

Despite excellent solubility of CO_2 in blood, gas embolism cannot be entirely ruled out, especially by incidental unrecognised puncture of a vessel followed by insufflation. This can be prevented by proper check of correct needle placement as described previously. In this case, insufflation must be stopped immediately, followed by hyperventilation with oxygen.

Another possible source of complications is bowel injury, which may be caused by placement of the Verress needle especially in case of intraabdominal adhesions, which may be anticipated by a history of previous abdominal surgery. Puncture of bowels is identified by aspiration of gas and/or bowel contents. If unrecognised, insufflation will lead to asymmetric distension of the abdomen. If bowel puncture is suspected, the needle is removed and either re-inserted at a different site, or the abdomen is entered by open access. After the pneumoperitoneum has been established, identification and inspection of the punctured organ is essential. If no other injury to the bowel except puncture has occurred, usually no further measures are required.

Even after correct needle placement and establishing an adequate pneumoperitoneum, injuries a described before can occur by blind placement of the first trocar. The risk of injury is highest for the underlying bowels. In contrast to needle puncture, trocar induced bowel injury is a much more severe trauma requiring early recognition and repair. Diagnosis is difficult, if the trocar extends through both walls of the bowel. Therefore, after placement of the second trocar it is mandatory to insert the laparoscope through this port to inspect the first blindly placed trocar and ensure proper trocar placement as well as integrity of bowels.

Injury to major vessels, especially aorta or iliac arteries may rarely occur and represents an emergency situation. After blind trocar placement, the diagnosis is made by removing the obturator followed by immediate severe haemorrhage out of the trocar. First, the obturator is reinserted to stop bleeding. Subsequently, immediate laparotomy with vascular repair is required (Eichel et al., 2007).

Most of the complications associated with Verress needle and blind trocar placement can be safely avoided by an open access technique, which is the routinely used approach at our institution. In our own experience, not a single complication was ever noted by open access. However, bowel injury in presence of intraabdominal adhesions may occur even with an open approach. The only disadvantage of the open approach is the need for placing sutures in the fascia to ensure a tight pneumoperitoneum. Suturing on skin level only will allow gas leakage to the subcutis with the consequence of subcutaneous emphysema and hypercarbia. Proper tightening of the abdominal wall may be difficult to obtain especially in obese patients.

After positioning the working trocars under direct vision, bleeding from the port site may occur despite transillumination of the abdominal wall prior to trocar placement. These haemorrhages are usually do not represent an emergency situation, however, proper haemostasis must be ensured. This can be achieved by identification of the bleeding site by using the trocar for compression and followed by electrocoagulation, either from inside the abdomen or from skin level. If the origin of bleeding cannot be identified, placing of haemostatic stitches around the trocar using a perpendicular stitching device which incorporates all layers of the abdominal wall is helpful in most cases.

Any other complications occurring during laparoscopy are typically of surgical origin occurring during the procedure and comparable to those observed in open surgery. The difference lies in the management of the complication resulting from a different approach compared with open surgery. To prevent any injury during laparoscopy, it is essential to ensure adequate visualisation of all instruments during the whole procedure. Any manipulation or even movement of an instrument outside the field of vision may cause damage to adjacent structures. Therefore the camera assistant must be alert to follow all intracorporeal movements of laparoscopic instruments.

The most frequently reported intraoperative complications in laparoscopy are vascular and bowel injuries, followed by injuries to other adjacent structures like liver, spleen, or urinary tract. Bowel injuries may result either from electrosurgical or mechanical tissue damage. Electromechanical damage can occur from direct contact of surgical instruments with bowels and simultaneous activation of coagulation current, or from indirect effects due to insulation failures or contact to other current conducting instruments. Early identification of electrothermic bowel injury is essential for adequate repair. Diagnosis of superficial injuries is made by identification of whitish areas in the serosa. In severe cases the bowel lumen is opened and the mucosa is visible. Dependent on the extent of injury, small serosal lesions may be managed by laparoscopic suturing in skilled hands. If there is any doubt regarding the safety, conversion to an open procedure is advisable. For larger defects, resection of the affected segment followed by anastomosis is required.

To prevent thermal bowel injury, again visualisation of the instruments during any mode of action as well as control of current activation only by the primary surgeon is essential. Moreover, coagulation should only be activated in safe distance to the bowels, which requires adequate visualisation of any endangered structures during the procedure. The camera assistant needs to be instructed to maintain an optimal distance which permits visualisation of the tissue to be fulgurated as well as the structures to be spared from coagulation. Use of bipolar current reduces the risk of electrothermal injury, since indirect effects are minimized, but direct bowel coagulation will result in injury as well.

Mechanical bowel injury can occur by any sharp or blunt instrument. In contrast to thermal lesions, mechanical injuries are usually diagnosed immediately and need to be repaired properly.

Vascular injuries during laparoscopy most frequently occur in renal surgery by injuring renal vein or vena cava. To facilitate venous repair laparoscopically, the gas pressure can be elevated until sufficient visualisation of the defect is possible (Eichel et al., 2007). Subsequent haemostasis is dependent on the location and size of the defect. The available tools include clipping, sealing with any of the commercially available tissue sealants, as well as application of a laparoscopic Satinsky clamp and suturing.

For any arterial bleeding, gas pressure elevation is not helpful since an adequate back-pressure will never be achieved. Arterial injuries that affect non vital vessels can be clipped, if visualised correctly. Injuries to the renal artery might be clipped end ultimately result in a nephrectomy of the affected kidney, even if a partial nephrectomy was intended originally. Injuries of aorta, iliac vessels or superior mesenteric artery will require immediate conversion and consultation of a vascular surgeon.

However, if there is doubt regarding bleeding control by laparoscopy, fast conversion to an open approach is advisable early before the patients becomes haemodynamically unstable. The safest way to perform a fast conversion is elevating two trocars towards the abdominal wall in a fashion that these trocars form a line, followed by incision directed towards the

trocars which are in proximate contact with the abdominal wall. Thus, no additional structures are endangered by fast laparotomy except vessels within the abdominal wall which usually can be controlled without troubles.

Ureteral injuries may occur during retroperitoneal or pelvic lymph node dissection, or during partial nephrectomy. If the ureteral injury is incomplete and the continuity of the ureter is intact, transurethral insertion of a ureteral stent combined with continuous indwelling catheter drainage will solve the problem. In case of complete transection of the ureter, end-to end anastomosis or re-implantation, dependent on the site of injury, will be required. Whether this is done laparoscopically or after conversion to an open procedure is mainly a question of surgical skills.

Bladder injury may be repaired by laparoscopic suturing followed by catheter drainage. If suspected, intravesical injection of indigocarmine via the indwelling catheter will help to confirm and identify the lesion.

Splenic injury may occur in left sided renal or adrenal surgery. Smaller lesions can be managed laparoscopically by application of a tissue sealant or by argon beam coagulation, if available. However, in cases of uncontrolled haemorrhage of injury of the splenic hilum, splenectomy performed either laparoscopically or via open approach may be required. For prevention, direct contact of any instruments to the splenic surface should be avoided and the spleen should be safely mobilized away from the operative field. This is facilitated by meticulous dissection of the phrenicosplenic ligaments. If this dissection is extended cranially into the diaphragm, spleen and pancreas can be safely and bluntly dissected from the anterior surface of Gerota's fascia without direct contact to the splenic capsule, and with the patient in a lateral position the spleen will move medially by gravitation without additional retraction, which by itself could cause splenic or pancreatic injury.

4. Postoperative considerations

4.1 Postoperative patient care

One of the major advantages of laparoscopy is minimising postoperative pain, the condition which many patients are more scared of than surgery itself. Due to the minimally invasive character of the procedure, elaborate measures like patients controlled analgesia or peridural catheters are not required in laparoscopy. After day 1 most patients will have adequate pain control by oral analgesics alone. Oral nutrition is usually started the next day. Antibiotics are usually administered as a single shot prophylaxis immediately prior to surgery and do not need to be continued. Prophylaxis against deep venous thrombosis consisting of low molecular heparin and compression stockings is routinely applied like in open surgery.

Indwelling Foley catheters can be removed on day 1 or 2 (with the exceptions of radical prostatectomy and neobladders) dependent on the patients' mobility. Routine laboratory parameters are obtained the same evening and the next morning.

4.2 Postoperative complications

Some postoperative complications originate from surgical injuries that have not been recognised during the procedure.

If thermal injury of the bowels has not been recognised during surgery, symptoms will occur after a delay of several days, with the highest risk on days 3 and 4. Diagnosis of free air intraabdominally is not helpful after laparoscopy in this early phase since it may

represent residual gas left after the procedure. Clinical signs and symptoms pointing to ileus and an abdominal CT will aid in diagnosis.

If mechanical bowel injuries are left undiagnosed for any reason, symptoms will develop without the delay that is typical for with thermal injuries. With regard to repair, the same principles apply as described before.

In case of intraoperatively undiagnosed bladder lesions, the patient may develop urinary ascites postoperatively with elevation of serum creatinine due to reabsorption and abdominal symptoms. The diagnosis is made by cystography. As it is standard in traumatology, the management of urinary leakage depends on the location: intraperitoneal lesions require surgery, extraperitoneal lesions may be managed conservatively by indwelling catheter drainage.

If a ureteral lesion had been missed during surgery and is diagnosed postoperatively, signs and symptoms of urinary leakage occur after some days. The diagnosis is confirmed by retrograde ureterography. In the lesion is incomplete, stenting of the ureter is attempted together with catheter drainage. The catheter is removed, after a cystogram shows no extravasation, whereas the ureteral stent is left in place for 6 weeks. In contrast, complete ureteral lesions require again surgical repair together with stenting.

Postoperative pain is usually limited after laparoscopy. A typical pain pattern after laparoscopy is shoulder discomfort. If deflation of the pneumoperitoneum had been incomplete, patients will feel some pain in their shoulder girdle. This is the result of distension of the diaphragm. This sensation is transmitted by the phrenical nerve which originates from the segment C4. Consequently, the sensation radiates to other regions innervated from the same segment.

Any pain exceeding normal values requires evaluation regarding intraoperatively missed injuries as described above or postoperative haemorrhage. Along with clinical evaluation and laboratory parameters focusing on bleeding, inflammation and renal function, an abdominal CT scan will help to clarify the situation. Postoperative chest pain requires exclusion of myocardial infarction and pulmonary embolism just as after open surgery. Specifically for laparoscopy, the frequent shoulder girdle discomfort may mimic pulmonary embolism. Localised pain may result from incisional hernia. If bowel incarceration is suspected, immediate diagnosis by CT is initiated, and after confirmation, surgical repair is required.

Incisional hernias may occur in the later postoperative course as well. Repair can be performed via either a laparoscopic or open approach, dependent on site and symptoms. In case of emergency of an incarcerated hernia, the open approach is preferred. Hernias are more frequently seen after use of cutting trocars of 10mm or more and in the scars of organ retrieval incisions, whereas hernia formation is unlikely in port sites when blunt trocars are used.

After lymphadenectomy, lymphocele formation may occur, especially after extended pelvic lymph node dissection as it is advocated for cystectomy as well as for radical prostatectomy in high risk cases. Due to compression of adjacent structures, edema of lower extremities, thrombosis, hydronephrosis and in case of infection fever may occur. Large lymphoceles can be easily diagnosed by ultrasound and confirmed by CT. First step is decompression by percutaneous drainage, which can be applied either by ultrasonic or CT guidance. Differential diagnosis includes urinoma, which can easily be confirmed or ruled out by measuring creatinine concentration of the drained fluid. Whereas lymph shows serum-

equivalent creatinine levels, urine will always show multiple of serum levels. Thus, even the fluid contains a mixture of lymph and urine, even small amounts of urine can be diagnosed reliably.

A special type of lymphocele is chylous fistula, which may occur after left-sided surgery in the upper retroperitoneum, especially after any renal procedure, adrenal surgery, or retroperitoneal lymph node dissection for testis cancer. If a drain had been placed during the procedure, the milky chylous fluid will be visible in the drain as soon as the patient will re-start fat-containing diet. If no drain has been placed, patients return after discharge with increasing abdominal distension and discomfort, since the fatty chylomicrons are not reabsorbed by the peritoneum. For symptomatic relief, a CT-guided drainage may be inserted. The treatment of chylous fistula consists of fat-free diet and usually does not require surgical interventions. In the rare event that chylous fistula does not resolve by dietary measures, surgery is facilitated by preoperative fatty diet which helps to identify the fistula intraoperatively, thus permitting clipping or ligation (Eichel et al., 2007).

5. References

Canes, D.; Desai, M.M.; Aron, M.; Haber, G.P.; Goel, R.K.; Stein, R.J.; Kaouk, J.H.;& Gill, I.S.(2008). Transumbilical single-port surgery: evolution and current status. *European Urology* Vol 54, No. 5 (November 2008), pp. 1020-1029.

Clayman, R.V.; Kavoussi, L.R.; Soper, N.J.; Dierks, S.M.; Meretyk, S.; Darcy, M.D.; Roemer, F.D.; Pingleton, E.D.; Thomson, P.G.; & Long, S.R. (1991). Laparoscopic nephrectomy: initial case report. *Journal of Urology* Vol. 146, No. 2 (August 1991), pp. 278-82.

Desai, M.M.; Strzempkowski, B.; Matin, S.F.; Steinberg, A.P.; Ng, C.; Meraney, A.M.; Kaouk, J.H.; & Gill, I.S. (2005). Prospective randomized comparison of transperitoneal versus retroperitoneal laparoscopic radical nephrectomy. *Journal of Urology* Vol 173, No. 1 (January 2005), pp. 38-41

Diegidio, P.; Jhaveri, J.K.; Ghannam, S.; Pinkhasov, R.; Shabsigh, R.; & Fisch, H.(2011). Review of current varicocelectomy techniques and their outcomes. *British Journal of Urology International.* 2011 (Epub), doi: 10.1111/j.1464-410X.2010.09959.x.

Eichel, L.; McDougall, E. & Clayman, R.V. (2007). Basics of Laparoscopic Urologic Surgery, In: *Campbell-Walsh Urology 9th edition*, (pp. 171-220), Saunders-Elsevier, ISBN 13 978-0-7216-0798-6, Philadelphia, PA, USA

Ficarra, V.; Novara, G.; Artibani, W.; Cestari, A.; Galfano, A.; Graefen, M.; Guazzoni, G.;, Guillonneau, B.; Menon, M.; Montorsi, F.; Pate,l V.; Rassweiler, J.& Van Poppel, H. (2009). Retropubic, laparoscopic, and robot-assisted radical prostatectomy: a systematic review and cumulative analysis of comparative studies. *European Urology* Vol. 55, no.5 (May 2009), pp.1037-1063.

Klingler, H.C.; Remzi, M.; Janetschek, G.; & Marberger, M.(2003). Benefits of laparoscopic renal surgery are more pronounced in patients with a high body mass index. *European Urology* Vol. 43 No. 5 (May 2003) pp. 522-527

Ljungberg, B.; Cowan, N.C.; Hanbury, D.C.; Hora, M.; Kuczyk, M.A.; Merseburger, A.S.; Patard, J.J.; Mulders, P.F.; Sinescu, I.C.; & European Association of Urology Guideline Group (2010). EAU guidelines on renal cell carcinoma: the 2010 update. *European Urology* Vol. 58 No. 3 (September 2010), pp. 398-406.

McDougall, E.M.; Figenshau, R.S.; Clayman, R.V.; Monk, T.G.; & Smith, D.S. (1994). Laparoscopic pneumoperitoneum: impact of body habitus. *Journal of Laparoendoscopic Surgery*, Vol. 4 No. 6 (December 1994), pp. 385-391

Rane, A. & Autorino, R. (2011). Robotic natural orifice translumenal endoscopic surgery and laparoendoscopic single-site surgery: current status. *Current Opinions in Urology* Vol. 21, No.1 (January 2011) pp. 71-77.

Schips, L.; Dalpiaz, O.; Cestari, A; Lipsky, K.; Gidaro, S.; Zigeuner, R.; & Petritsch P (2006). Autologous fibrin glue using the Vivostat system for hemostasis in laparoscopic partial nephrectomy. *European Urology*, Vol. 50 No. 4 (October 2006) pp. 801-805

Schuessler, W.W.; Vancaillie, T.G.; Reich, H. & Griffith, D.P. (1991). Transperitoneal endosurgical lymphadenectomy in patients with localized prostate cancer. *Journal of Urology*, Vol. 145, No.5 (May 1991), pp. 988-91

Zigeuner, R. & Pummer, K. (2008). Urothelial carcinoma of the upper urinary tract: surgical approach and prognostic factors. *European Urology* 2008 Vol. 53 No. 4 (April 2008), pp.720-731.
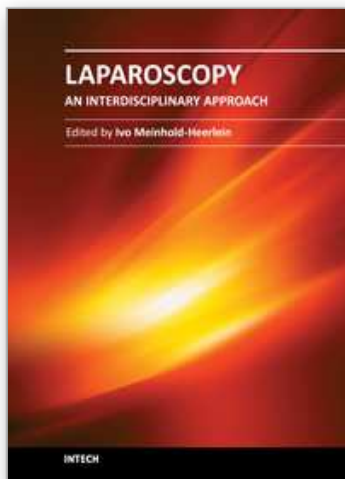
Laparoscopy - An Interdisciplinary Approach

Edited by Dr. Ivo Meinhold-Heerlein

Over the last decades an enormous amount of technical advances was achieved in the field of laparoscopy. Many surgeons with surgical, urological, or gynaecological background have contributed to the improvement of this surgical approach which today has an important and fixed place in the daily routine. It is therefore comprehensible to compose a book entitled laparoscopy serving as a reference book for all three disciplines. Experts of each field have written informative chapters which give practical information about certain procedures, indication of surgery, complications and postoperative outcome. Wherever necessary, the appropriate chapter is illustrated by drawings or photographs. This book is advisable for both beginner and advanced surgeon and should find its place in the libraries of all specialties â€" surgery, urology, and gynecology.

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