LAPAROSCOPY OF THE UPPER URINARY TRACT
A Survey of Current Techniques

Evangelos N. LIATSIKOS, MD PhD
Assistant Professor of Urology, University of Patras, Greece

With the collaboration of:

Panagiotis KALLIDONIS, MD
Resident in Urology, University of Patras, Greece
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Correspondence address of the author:
Evangelos N. Liatsikos, MD PhD
Associate Professor of Urology, University of Patras
Dept. of Urology, University Hospital
Rio Patras 26500, Greece
E-mail: Liatsikos@yahoo.com

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1st edition 2011
2015 Endo Press GmbH
P.O. Box, 78503 Tuttlingen, Germany
Phone: +49 (0) 74 61/1 45 90
Fax: +49 (0) 74 61/708-529
E-mail: endopress@t-online.de

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Editions in languages other than English and German are in preparation. For up-to-date information, please contact Endo Press GmbH at the address shown above.

Design and Composing:
Endo Press GmbH, Germany

Printing and Binding:
Straub Druck + Medien AG
Max-Planck-Straße 17, 78713 Schramberg, Germany

ISBN 978-3-89756-334-6
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Laparoscopic Transperitoneal Radical Nephrectomy

Introduction

During recent years, the laparoscopic approach has been established as first-line modality in the treatment of patients undergoing radical nephrectomy. The significant advantages of laparoscopic surgery over the classical open approach have been extensively investigated and documented for two decades. Nevertheless, laparoscopic surgery is a briskly evolving field, which is characterized by the rapid adaptation of technical innovations. Laparoscopic oncological renal surgery includes approaches for radical and partial nephrectomy, with oncological outcome similar to open surgery, but with limited morbidity. The following review, which is based on recent literature, describes the current technique of laparoscopic radical nephrectomy and includes technical considerations discussing the pros and cons of the transperitoneal versus the retroperitoneal approach.

Indications

Laparoscopic radical nephrectomy (LRN) is considered as the gold standard in the treatment of malignant renal tumors with stage T1 and T2 without any lymph node or distant metastasis. The oncological outcomes of LRN in terms of cancer-free survival are similar to those found with open radical nephrectomy (ORN) regarding tumors of the above stages. Nevertheless, recent developments in the field of nephron-sparing surgery have prompted the European Association of Urology to propose its selective performance only for patients with clinical stage T1a and T1b renal disease. In addition, the use of the nephron-sparing approach for the excision of renal tumors is considered to be absolutely indicated for patients with solitary kidneys. Even though significant experience has been accumulated with LRN, the maximum tumor size for LRN still remains unclear. In general, based on the principles of oncologic surgery, the performance of LRN is proposed for renal tumors up to stage T3N0M0. In patients with higher-stage disease (T4, renal vein involvement), tumors with a diameter of up to 14 cm (without positive surgical margins) have been reported to be successfully managed by LRN.

Surgical Technique

Surgical Setup: Initially, the patient is placed in the supine position for induction of anesthesia and intubation. Next, the patient is positioned in modified lateral decubitus position with the operative table flexed in the middle and the umbilicus positioned above the table break. Care should be given to appropriate padding and draping of the patient.

Trocar Placement: The arrangement of ports varies between the transperitoneal and retroperitoneal approach. For the transperitoneal approach, a Veress needle is inserted at the lateral margin of the rectus muscle sheath at the level of the umbilicus, and pneumoperitoneum is established. An 11-mm trocar is placed either umbilically or paraumbilically, depending on the body habitus of the patient. A 30°-laparoscope, coupled to a video camera, is used to inspect the peritoneal cavity. A 13-mm trocar is inserted at the level of the anterior iliac spine on the anterior axillary line, and a 6-mm trocar is placed at the level of the mid-clavicular line below the costal margin. An auxiliary trocar is inserted under the xiphoid for liver retraction during right-side nephrectomies (Figs. 1a, b). It is highly advisable that all trocars be inserted under direct vision. Special care should be paid in patients with a previous history of abdominal surgery. In this case, insertion of a Veress needle at sites of previous surgery should be avoided, and rather an open Hasson cannulation technique be employed for placing the camera port.
Reflection of the colon: The transperitoneal approach requires that the colon be mobilized prior to entering the retroperitoneal space. The white line of Toldt is incised from the level of the iliac vessels as far as above the spleen, in the case of a left-side nephrectomy (Figs. 2a, b). The splenocolic ligament is incised (Figs. 3a, b), allowing the spleen to be mobilized medially along with the colon and pancreas.

1. Port-site placement for transperitoneal laparoscopic radical nephrectomy. ① Abdominal midline; ② Lateral margin of rectus muscle; ③ Mid-clavicular line; ④ Anterior axillary line; ⑤ Mid-axillary line; ⑥ Posterior axillary line.

2.

3.
For right nephrectomy, a peritoneal incision is carried cranially above the hepatic flexure including the right triangular and right anterior coronary vessels. Meticulous care is paid to prevent any iatrogenic injury to the diaphragm regardless of the side of dissection. Next, Gerota’s fascia and psoas muscle are localized. The colorenal attachments are also divided.

**Dissection of the Ureter:** The ureter is identified medially to the psoas muscle, and mobilization is continued towards the renal hilum (Fig. 4a), taking care to identify the gonadal vein which should be swept medially. The ureter is then clipped (Fig. 4b).

**Mobilization of the lower pole:** Oncologic surgery requires the en-bloc excision of the kidney along with Gerota’s fascia and the perirenal fat. Once the ureter has been mobilized up to the level of the ureteropelvic junction, the lower kidney pole is dissected from its inferior and posterior attachments (Fig. 5). Placement of an auxiliary (fourth) trocar for additional instrumentation should be considered if the existing set-up is found insufficient to provide adequate retraction. Especially in cases of right-sided nephrectomy, the use of a fourth trocar has been shown to facilitate liver retraction.

**Ligation of Renal Vasculature:** The lower kidney pole is elevated and the renal vessels are carefully exposed (Fig. 6). There are two options for pedicle ligation. Both artery and vein can be ligated and transected en-block with the use of an 60-mm Endo-GIA stapler (Covidien PLC, Ireland) (Figs. 7a, b). The other option is to ligate first the artery and then the vein. This can be done either with Hem-o-lok clips (Teleflex Inc, PA, USA) or with the Endo-GIA stapler.
Fig. 8 shows the renal vein following its ligation by use of Hem-o-lok clips. In left-side nephrectomy, positioning the stapler proximal or distal to the adrenal vein results in excision or sparing of the ipsilateral adrenal gland, respectively.

Dissection of the Upper Pole and Ureteral Ligation: Once division and ligation of the renal and adrenal vasculature has been completed, the ureter is also dissected. The posterior attachments of the kidney are also divided until the kidney is fully mobilized (Figs. 9a, b).

Specimen Extraction: An endoscopic bag is used for specimen extraction. A trocar incision is extended to allow the specimen to be extracted. Alternative options are as follows: morcellation of the kidney in a special endoscopic bag or a Pfannenstiel incision, and specimen retrieval.
Technical Considerations: Transperitoneal Versus Retroperitoneal Approach

The retroperitoneal approach for laparoscopic nephrectomy has been proposed as an alternative option for the transperitoneal technique. The latter was found to be associated with a reduced operative time, whereas the retroperitoneal approach was preferentially used in patients with a previous history of abdominal surgery.14-17 The retroperitoneal approach has been shown to be related to low mean blood loss (100 – 225 ml) and mean operative time of 2.4–3.6 hours. Complication rates of up to 17% and conversion rates of up to 7% were reported during resection of tumors of up to 9 cm in diameter.16, 17 A prospective randomized comparison of transperitoneal versus retroperitoneal approach for LRN observed no difference in morbidity and technical difficulty for the surgeon.18 In the latter study, 40 patients with stage T1 and T2 diseases were included. Nevertheless, a major drawback of the retroperitoneal approach is the reduced maneuvering space afforded to entrap the dissected specimen in an extraction bag, which frequently necessitated division or morcellation of the specimen in order to avoid extension of the port incision. Therefore, several investigators have advocated making an additional incision for specimen extraction.19

Outcome

Recently, long-term results of LRN have been reported in the literature.20-24 The study was focused on the prospective comparison of LRN versus ORN in patient populations exhibiting similar TNM staging characteristics. Investigators from Cleveland Clinic (Cincinnati, U.S.A.) prospectively compared 88 patients who underwent LRN (45 patients) with those of ORN (43 patients). Tumors classified as T1 or T2 and 15 cm in diameter or smaller were included. Mean tumor diameter was of 5.8 vs 6.2 cm for LRN and ORN, respectively. LRN was advantageous in comparison to ORN in terms of intraoperative blood loss (183 vs 461 ml) and hospital stay (1.4 vs 3.9 days). Mean follow-up period was 60 vs 72 months. Cancer-specific survival was found to be 90 vs 92% and overall survival was 81 vs 79% for LRN and ORN, respectively. Local recurrence rate was minimal and was detected in a patient with pT4 disease. Patients who developed metastatic disease, showed a mean survival of 25 months for LRN, and 17 months for ORN. No significant differences in long-term outcome were observed between the two techniques, but the short-term postoperative results were in favour of LRN.20

Hemal et al. performed LRN and ORN in 41 and 71 patients for T2 tumors and investigated the collected data in a retrospective comparative non-randomized study. LRN was performed using either the transperitoneal or retroperitoneal approach. LRN had lower blood loss, transfusion rate, morphine-equivalent anesthesia, length of hospitalization and convalescence time in comparison to ORN. Complication rate was 12% for LRN, and 15% for ORN. Mean follow-up was 51 vs 57 months for LRN and ORN, respectively. No statistical difference was observed in the actuarial 5-year recurrence-free survival rate, which was 92% for LRN, and 90% for ORN. Cancer-specific and survival rates were 95 and 88% for LRN as well as 94% and 89% for ORN, respectively. Mean tumor size excised was approximately 10 cm for both techniques. Nevertheless, the authors considered laparoscopic treatment of such tumors to be challenging and emphasized that the surgical intervention should be performed by experienced laparoscopic surgeons.21

In the most recent literature only one randomized controlled trial comparing LRN with ORN could be found. A total number of 45 patients with benign and malignant disease were included in the study. Maximum tumor size was 8 cm. Operative time was similar for both techniques, LRN required 105 min and ORN 93 min. Length of hospitalization was 4 days for LRN and 5 days for ORN. The latter results were unexpected since in the literature LRN required less hospitalization. Postoperative pain was significantly higher in patients who underwent ORN. Nevertheless, pain scores were similar 3 months postoperatively. Convalescence for patients in the LRN group was favourable since these patients required 42 days vs 62 days found in the ORN group.22, 23
Long-term follow-up of (up to 5 years) oncological outcomes of LRN in comparison to ORN has been studied by several authors.23 Only recently, data collected from LRN patients with a follow-up of more than 7 years have been reported. Luo et al.14 reported on the oncological outcomes of LRN vs ORN by investigating a total number of 336 patients. Cancer-specific survival was 92.5% for LRN, and 91.4% for ORN at 7 years. Cancer stage and tumor grade were factors influencing the oncological result while the approach used for tumor management was not observed to have an impact on the outcome. In another report Berger et al. presented the oncological results of LRN after a mean follow-up period of 11.2 years.22 Overall cancer-specific and recurrence-free survival rates at 10 years were 65%, 92% and 86%, respectively. Overall cancer-specific and recurrence-free survival rates at 12 years were 35%, 78% and 77%, respectively. The oncological outcome of LRN was excellent and similar to that found with ORN.

References

Single-Port Radical Nephrectomy

Introduction

Laparoscopic radical nephrectomy (LRN) is considered the first-line treatment option for T1/T2 stage renal cell carcinoma (RCC) and has been proven to provide limited acute systemic reaction in comparison to open radical prostatectomy. However, LRN requires the use of several laparoscopic ports, which has been found to be associated with rare, but considerable complications. Bleeding, hernia and iatrogenic visceral injury are considered to be related to laparoscopic trocar insertion. In addition, multiple 1–2 cm incisions, required for trocar placement, and ensuing scar formation has been shown to compromise the cosmetic outcome. Recently, the insertion of all essential instruments through a single trans-umbilical incision and the placement of a specially designed multi-lumen port have been proposed for safe use in urologic surgery. The latter approach minimizes the number of ports required for instrument insertion and bears the benefit of better cosmesis and improved postoperative course. To date, almost all major urological procedures have been successfully performed using the aforementioned approach.

Indications

The indications and contraindications of the procedure are similar to LRN. However, the body mass index of the patient could probably be accounted an additional relative contraindication for single-port radical nephrectomy (SP-RN). Obese patients may represent a challenge since the instruments are inserted through the umbilicus and the available working length may not be sufficient.

Surgical Technique

Surgical Setup: The patient is positioned in a modified lateral decubitus position (classical flank position, identical to LRN) for trocar placement.

Instruments: Only one incision is required for port placement. Instruments of various diameters can be introduced and maneuvered through the single-site port, the X-Cone® or Endocone® (KARL STORZ Tuttlingen, Germany) which has five integrated access ports for instruments with diameters of 5 mm and 12 mm.

A HOPKINS® 30°-laparoscope (diameter 5.5 mm), coupled to a high-definition video camera, is adequate for proper performance of SP-RN. The length of the HOPKINS® laparoscope is 50 cm, which is enough to perform single-port renal surgery even in obese patients. The diameter of the scope allows the use of the camera through one of the 6-mm channels. Accordingly, two channels are available for insertion of instruments with a diameter of more than 5 mm, such as clip appliers and/or the vascular endoGIA linear stapler.

In order to yield the most in terms of efficiency, single-port procedures need to be performed using specialized laparoscopic instrumentation. Pre-curved instruments are essential for single-port nephrectomy since the triangulation of conventional laparoscopic instruments is not feasible in single-port surgery, because during insertion all instruments are aligned on-axis with each other through the single-site port (Fig. 1a). During deployment, the curved instrument shaft allows for triangulation while crossing of instruments can be avoided. The latter phenomenon is common with other types of instruments (flexible deflectable) used in single-port surgery. Various types of curved-shaft instruments or the combined use with standard laparoscopic (straight shaft) instruments (e.g. scissors, ultrasound scissors, bipolar forceps) are well-suited for efficient practice of single-port nephrectomy (Fig. 1b). All instruments are deployed and maneuvered through the 6 mm or 13 mm channels of the X-Cone® or Endocone®. In case of right nephrectomy, an additional 3-mm instrument (without the need for placing an auxiliary trocar) or a 5-mm instrument through an auxiliary trocar can be used for liver retraction. The instrument is inserted in the anterior axillary line below the 12th rib or below the xiphoid process depending on the preference of the surgeon.
Chapter II: Single-Port Radical Nephrectomy

Port Placement: The operative table is adjusted to dorsal supine position and a mini-laparotomy is performed for placement of the X-Cone® single-site port. The X-Cone® device consists of symmetric metal half shells of outward curved funnel-shaped design that are fitted together and sealed with a plastic cap accommodating the inlets for the instruments. Once the incision has been made, the two half shells are introduced and adapted to form the X-Cone® single-site port (Fig. 2a). Next, the plastic cap is attached and the insufflations tube is connected to the compatible inlet (Fig. 2b). Another multi-access single-site port is the Endocone® which has a funnel-shaped design and offers multiple instrument ports at its base. The single-site port is inserted using the open Hasson technique (Figs. 3a, b).
Exposure of the Kidney and Bowel Reflection: Left nephrectomy is initiated by placing an incision in the white line of Toldt from the level of the iliac vessels to above the spleen. This is performed in a similar fashion as in standard laparoscopic radical nephrectomy. Once dissection of the splenocolic ligament has been completed, the spleen and colon are mobilized (Figs. 4a, b). Meticulous care should be paid during dissection to prevent inadvertent injury to the spleen or diaphragm. The incision follows the line of Toldt using curved-shaft instruments or a combination of both standard and curved-shaft instruments.

In case of right nephrectomy, the peritoneal incision is carried cephalad above the hepatic flexure, followed by dissection along the line of Toldt. Next the colon is retracted and all lateral ligaments are released. As soon as Gerota’s fascia and the psoas muscle are identified, the colorenal attachments can be divided. If the need for liver retraction arises, it is advisable that a 3-mm grasping forceps be inserted directly through the skin.

Ureteral Mobilisation: The ureter is identified within the retroperitoneal fat medially to the psoas muscle. A curved-shaft instrument provides retraction and another curved-shaft or conventional laparoscopic instrument is used for dissection (Fig. 5d). A good level of ambidexterity is essential during all steps of the procedure due to lack of triangulation and often unavoidable crossing of instruments as they are passed through the X-Cone® single-site port.
Proximal mobilization of the ureter allows the gonadal vein to be identified (Fig. 6a). The vessel should be swept medially. In the presence of small vessels, they should be ligated to facilitate ureter mobilisation. Once localized immediately posterior to the gonadal vein, the ureter is elevated. Early dissection of the ureter provides an essential point for traction in single-port surgery. The ureter is mobilized up to level of the ureteropelvic junction, elevated and ligated without transecting it. Next, a straight needle is inserted through the abdominal wall, passing a suture around the ureter and extracting it through the abdominal wall where a knot is tied (Fig. 6b). Through the latter maneuver, elevation and retraction of the kidney is provided facilitating the next steps of the procedure. If deemed necessary, additional retracting sutures around the ureter can be placed (Fig. 7a).

**Hilar Dissection and Control of Renal Pedicle:** The renal vessels are skeletonized with the use of bipolar forceps or Kelly forceps and curved grasper (Fig. 7b). Lumbar vessels should be clipped and divided. Retraction of these vessels has been shown to be useful for exposure of the major vessels. The lower pole is lifted laterally and the hilum is placed under gentle tension in order to skeletonize the vessels.
The renal vein is the first vessel to be identified. Nevertheless, the renal artery is usually skeletonized and ligated first (Fig. 8a). Ligation of the renal artery is accomplished with two Hem-o-lok clips, one is applied to the aortal side and the other to the kidney side. The renal vein is dissected using vascular EndoGIA staplers or Hem-o-lok clips in a similar fashion as in LRN (Fig. 8b). Fig. 9 shows both renal vessels after ligation and transection.

**Final Renal Mobilisation:** In radical nephrectomy, the kidney is removed along with Gerota's fascia (including the perirenal fat). Following control of renal vessels, the lower pole is dissected with monopolar scissors, taking care that all inferior and posterior attachments are released (Figs. 10a, b). Provided the adrenal gland is planned to be excised along with the specimen, the adrenal vein needs to be ligated.
first, followed by mobilization of the upper pole, which is performed using the same technique as with the lower pole, and the kidney is released.

**Specimen Removal:** An endoscopic bag is used for specimen extraction (Fig. 11a). The site of surgery should be finally inspected once the specimen has been removed (Fig. 11b). For specimen retrieval, the rectus fascia incision must be extended in a cranial and caudal direction to permit safe extraction of the intact organ through the umbilicus. At the end of the procedure, a 16-F Robinson drainage catheter can be placed through the umbilicus. Fascia and skin are carefully sutured to prevent the risk of umbilical herniation.
Technical Considerations

Continued advances in laparoscopic surgery have made it possible that some of the major urologic operations are nowadays performed through small incisions. In an attempt to reduce to the minimum the number of incisions, the use of a single-site abdominal access port for traditional laparoscopic surgery is currently under extensive evaluation (single-port surgery).\(^1\) Single-port surgery for nephrectomy, pyeloplasty and even donor nephrectomy have recently been reported.\(^4,5-10\) Even though laparoscopic procedures have several advantages over their open surgical counterparts, the advantages and effectiveness of single-site surgery versus conventional laparoscopic techniques are still to be proven.\(^10\) Limited port-related morbidity and better cosmetic outcome have been proposed as benefits of single-port surgery without adequate documentation.\(^4\)

The introduction of specialized instrumentation, such as curved-shaft and deflectable laparoscopic instruments and technical modifications (intracorporeal traction sutures) eliminated the need for multiple triangulated ports for laparoscopic surgery, and made single-port procedures feasible.\(^7,11,12\) The lack of triangulation and reduced range of motion during on-axis deployment of standard laparoscopic instruments was one of the major problems conflicting with single-port procedures. Our previous experience with SP-RNs revealed, that the combined use of flexible and conventional instrumentation is an effective strategy to minimize the intrinsic limitations related to poor intraoperative ergonomics. Nevertheless, the performance of single-port surgery requires the surgeon to have ambidexterity because not rarely crossing of instruments is needed at the entry site of the multi-port device, so that the external right-hand instrument becomes the left internal instrument and vice versa.\(^11,12\) In addition, manual force transferred via the flexible instrument tip gets lost along its way through this part of the shaft, and obviously, the instrument’s maneuverability and dissection/retraction properties are considerably impaired.\(^11,12\) Crossing of instruments, lack of triangulation, “crowding” of instruments outside the port and in the operative field account for the steep learning curve inherent in the technique of single-port surgery.

The deployment of curved-shaft instruments designed with a double-curved shaft has been found useful to provide adequate triangulation and helps to minimize instrument crossing frequently encountered with flexible and conventional laparoscopic instruments. Curved-shaft instruments are typically designed with a shaft of greater length which improves maneuverability and reduces instrument clashing outside the port. We currently prefer the use of curved-shaft instruments because they offer the benefit of adequate triangulation and transmission of force during dissection, while preventing awkward crossing of instruments. Evaluating the use of curved-shaft instruments in comparison to deflectable and conventional laparoscopic instruments, Stolzenburg et al.\(^13\) reported that the surgical performance yielded by the use of curved-shaft instruments is clearly superior and offers greater efficiency. It should be noted, that single-port surgery usually requires that dissection is performed using only one instrument while traction is provided by the other. Multi-access trocars, such as X-Cone\(^\circledR\) and Endocone\(^\circledR\) allow various channels to be used for maneuvering different instruments. Occasionally, the rigid design of these instruments has been found cumbersome in that it limits the motion range. Several tips may be used to facilitate single-port procedures. The placement of traction sutures approximating the ureter to the abdominal wall has proven to be helpful for dissection. A 21-G cannula inserted through the abdominal wall may be used as “suction tube” for evacuation of smoke produced during dissection, which eliminates the need for inserting an additional suction instrument (Fig. 12).
Outcome

Data reflecting the experience with single-port surgery currently encompasses several hundred cases.\textsuperscript{5, 13, 14} We have recently described the technique and reported a series of 10 SP-RN cases. All tumors treated with SP-RN were stage T1, with size ranging between 4 and 8 cm. The mean operative duration was 141 minutes (range 120 to 180 minutes) and the median blood loss was 103 ml (range 50 – 150 ml). The incision size ranged between 3 cm and 6 cm. Complete excision of the specimen was confirmed by histology. Organ-confined renal cell carcinoma was observed in all cases. No intra-operative complications occurred and the specimens were all removed intact through umbilical incisions of less than 5 cm. Postoperative pain was minimal.\textsuperscript{15} One case of SP-RN was reported by Ponsky et al.\textsuperscript{16} The investigators used three standard ports inserted through a Gelport\textsuperscript{th}(Applied Medical Resources, Rancho Santa Margarita, CA, USA). A paramedian 7-cm incision was made for placement of the Gelport. Conventional laparoscopic instruments were used. The specimen was extracted intact with an operative time of 96 min. Estimated blood loss was 10 ml and no complications were reported. The patient was discharged home on the second postoperative day. The first comparative study between conventional laparoscopic nephrectomy and single-port surgery was conducted by Raman and colleagues.\textsuperscript{9} The authors compared 11 cases of SP-RN with 22 conventional laparoscopic nephrectomies. The two groups were matched for age, surgical indications and tumor size. The investigators found similar outcomes in both groups in terms of operative time (122 vs 125 min), percentage of hemoglobin drop, analgesic use, length of hospital stay and complication rate. Proposed advantages of single-port surgery over laparoscopic nephrectomy, such as improved cosmesis, were not documented. The oncological outcome of SP-RN still remains to be proven as, to date, there is only short-term evidence available in the literature.\textsuperscript{5, 13, 14}

Conclusion

Single-Port Radical Nephrectomy is a feasible and efficient technique which offers multiple benefits as compared to conventional laparoscopy. The combination of X-Cone\textsuperscript{th}/EndoCone\textsuperscript{th} and curved-shaft instruments considerably facilitates the performance of the procedure.

References

Laparoscopic Partial Nephrectomy

Introduction

The decision-making as to whether the open or laparoscopic approach should be employed for partial nephrectomy is based on the preference of the surgeon. Nevertheless, laparoscopic partial nephrectomy (LPN) is a challenging procedure requiring advanced laparoscopic experience and skills. Therefore, only surgeons with adequate laparoscopic expertise should perform the procedure due to the risk of prolonged warm ischemia and severe deterioration in renal function.

Indications

Open partial nephrectomy is recommended by the European Urological Association Guidelines (2008) for the management of T1a and T1b renal cell tumors. Absolute indications include cases of anatomic or functional solitary kidney and bilateral renal cell carcinoma (RCC). Relative indications for partial nephrectomy are conditions such as decreased function of the contralateral kidney, systemic disease that could influence renal function in the future, hereditary types of RCC associated with the risk of tumor development in the contralateral kidney, diabetes, renovascular disease and hypertension. Solid evidence for the establishment of laparoscopic partial nephrectomy as an alternative to the open approach are not yet available, which is why the procedure should be considered for selected patients only.

Contraindications for LPN are any systemic diseases precluding a laparoscopic approach, such as severe cardiac or respiratory disorders and uncorrected coagulopathy. Relative contraindications for the laparoscopic approach are cases of previous ipsilateral open surgery, morbid obesity or complex mid-pole intrarenal/hilar tumor in patients with absolute indication for nephron-sparing surgery.

Technical Considerations

Key to the successful performance of LPN is adequate renal hemostasis for tumor excision and pelvicaliceal reconstruction in a time-sensitive manner. The latter is considered to be efficient in reducing the risk of any ischemia-related damage of the kidney. Appropriate oncological excision requires a clear surgical margin. Independently of the efficiency of oncologic excision of the tumor, intense postoperative surveillance is recommended for all tumors.

Hemostasis: Hemostasis and bloodless operative field can be achieved by various methods. Percutaneous radiofrequency (RF) coagulation has been used in 10 patients for hemostasis in LPN. The lesion was encompassed with a safety margin of 1 cm by use of the RF probe, creating a spherical coagulation area. Tumor excision involved the use of cold scissors or ultrasound shears. Mean estimated blood loss (EBL) was observed to be limited (~125ml). Nevertheless, the RF coagulation was found to account for collateral damage to the renal vasculature and collecting system, delayed urinary fistula, difficulty to delineate the margins of the tumor from the normal parenchyma as well as coagulation artefacts at the excision margin. A monopolar RF device which provided simultaneous dissection, hemostasis and coagulation was evaluated in a series of LPN without clamping of the renal vessels. Mean tumor size of the treated cases was 3.9 cm. Mean EBL was 352 ml (20–1000ml). Another method of hemostasis is based on the application of a thrombin gel slurry to the cut surface after tumor excision. A sponge stick is used for compressing the gel over the renal surface for 1–2 min. The renal vessels remain clamped throughout the above procedure. Average warm ischaemia time was limited to 13 min and average EBL was 200 ml. The hemostatic sealant FloSeal (Baxter Healthcare, USA) has also been evaluated in LPN. A comparative assessment of patients who underwent LPN revealed that the use of FloSeal was associated with significantly decreased overall complications (37% vs. 16%) in comparison to the control group not treated with FloSeal. Moreover, haemorrhagic complications were less frequent (3% vs. 12%) in the FloSeal group. A recent report including 102 cases of LPN confirmed the safety and feasibility of FloSeal for hemostasis. After the initial suturing of the pelvicaliceal system, the application of FloSeal followed.
**Hilar Control and Warm Ischaemia:** Several variations of hilar control have been proposed. Clamping the artery alone or both renal vessels as well as intermittent instead of permanent hilar occlusion has been attempted. Nevertheless, the advantages of each clamping method remain inadequately documented and the main issue remains the time of renal warm ischaemia that should never exceed a limit of 30 min.

Moreover, warm ischaemia time of more than 60 min has been found to be not associated with permanent renal function damage. Desai et al., in a large series of patients, demonstrated that keeping warm ischaemia time within the 30 min limit does not induce deterioration in the function of the remaining kidney. In 179 consecutive LPNs the observed reduction of function of the operated kidney, demonstrated by renal scintigraphy (29%), was proportionate to the amount of excised parenchyma (average 29%). Consequently, it is advisable to keep below the critical warm ischaemia time of 30 min. Renal function and glomerular filtration were not associated with warm ischaemia time. Nevertheless, advancing age and a previous history of renal disease increase the risk of renal insufficiency in cases of warm ischaemia time exceeding 30 min.9

A technique for early unclamping of the renal vessels to reduce warm ischemia time during LPN has also been described. Unclamping of renal vessels takes place immediately after initial parenchymal suturing, followed by bolstered renorrhaphy. With the early unclamping technique, ischemia time can be reduced by > 50%, and the risk of renal failure is supposed to be potentially decreased. Other investigators confirmed these results.10,11

**Renal Hypothermia:** The induction of renal hypothermia has been proposed as a method to reduce the consequences of renal ischemia. Gill et al. proposed an intracorporeal surface hypothermia during LPN with entrapment of the kidney in an endoscopic bag. The endoscopic bag was filled with 600–750 ml of iceslush delivered into the bag over 4–7 min. Core renal temperatures of 5–19°C were observed.12 Another method was proposed by Janetschek et al. who used continuous perfusion of lactated Ringer solution at a temperature of 4°C through an angiocatheter in the clamped renal artery. Measurements of parenchymal temperature showed 25°C. Nevertheless, further improvement of the technique is necessary as the optimal renal protective temperature is considered to be lower than 15°C.13 The perfusion of cold saline through an ureteral sheath was shown to be ineffective to induce proper kidney cooling. Renal temperatures of 24°C for the renal cortex and 21°C for the renal medulla have been reported via this technique.14,15 Renal hypothermia probably represents an efficient method for reducing ischemia-related renal damage. Nevertheless, further technical refinements should be proposed and clinically evaluated for the wide acceptation of these techniques.

**Pelvicaliceal Repair:** Pelvicaliceal suture repair is necessary for tumors invading deeply into the parenchyma and involving the collecting system. The lesion of the collecting system could be repaired by suturing in an attempt to restore patency of the system. Although, urinary leakage is an uncommon incident in patients under going pelvicaliceal repair, the pelvicaliceal repair is related to longer hospitalization and warm ischemia time.16

**Ureteral Stent Placement:** The use of ureteral stents does not improve urinary leakage rate. Nevertheless, the use of these stents in LPN is indicated for two main reasons. Firstly, precise localization of the pelvicaliceal entry site is facilitated. It is worth mentioning that pelvicaliceal entry can be obtained at more than one location, which may be difficult to locate without retrograde injection. Secondly, retrograde injection allows the pelvicaliceal repair system to be tested for patency at the end of suturing.2

**Transperitoneal versus Retroperitoneal LPN:** Both transperitoneal and retroperitoneal approaches proved to be feasible and safe in case of LPN. In general, the transperitoneal approach is characterized by a familiar operative field appropriate for surgeons in the beginning of their learning curve and a wide working space suited for the treatment of larger tumors. Still, there remains an inherent risk of iatrogenic injury to intraabdominal organs during their manipulation. The retroperitoneal approach, although constrained owing to a considerably smaller working space, is particularly indicated for skinny patients with a history of prior abdominal surgery. Due to the
The retroperitoneal nature of the approach, the existence of intrabdominal adhesions is not considered a contraindication. A retrospective comparative study evaluated the transperitoneal access for anterior or lateral lesions, and the retroperitoneal approach for posterior or posterolateral lesions. A Satinsky clamp was used for en-bloc hilar control of the renal vessels during transperitoneal LPN while the retroperitoneal approach was performed with individual control of renal artery and vein using bulldog clamps. The transperitoneal LPN was found to be correlated with significantly larger tumors, more pelvicaliceal repairs, longer warm ischaemia time, longer operative time and longer hospital stay in comparison to retroperitoneal LPN. Blood loss, perioperative complications, postoperative serum creatinine, analgesic requirements, and histologic outcomes were not observed to have significant differences.\textsuperscript{17}

**Surgical Technique**

In case of LPN, patient positioning, trocar placement and transperitoneal access to the retroperitoneal space are similar to laparoscopic radical nephrectomy. The ureter is identified and exposed as far as the renal hilum (Figs. 1a, b).

Exposure of the hilum vessels and ligation: Individual skeletonization of the renal vessels is not required in preparation for control of the renal artery and vein. Nevertheless, any thick surrounding tissue should be dissected in order to avoid incomplete clamp occlusion (Figs. 2a, b). A Satinsky clamp is inserted for renal vessel occlusion through an auxiliary trocar used for this purpose. Alternatively, bulldog clamps may be inserted for vessel occlusion. Next, Gerota’s fascia is incised allowing the tumor to be visualized. The plane of excision should be defined prior to renal vessel clamping. The Satinsky clamp should be deployed only after the vessels have been adequately skeletonized, and excision is considered to be imminent (Figs. 3a, b). The warm ischemia time is initiated by occluding the renal vessels. If renal clamping is supposed to be insufficient, additional bulldog clamps may be used.
Excision of the Tumor and Renal Reconstruction: Meticulous care is given during tumor excision by use of scissors, prudently avoiding any tumor-positive surgical margin (Figs. 4a, b). Dissection should be performed rapidly, always bearing in mind that warm ischemia time should not exceed the limit of 30 minutes (Figs. 5a, b).

Reconstruction of the renal stump involves the use of a 3-0 vicryl suture (5/8 needle) which has been loaded with a resorbable clip (LAPRA TY II®) on its terminal end. Slipping of the suture through the clip is prevented by tying a knot which is applied to the terminal end of the suture. If the collecting system has been opened during tumor excision, reconstruction with continuous sutures is performed to close the lesion.
The renal parenchyma is reconstructed and secured with a continuous suture (Figs. 6, 7a, b). Additional Hem-o-lok clips are applied to the suture to enhance closure of the renal parenchyma (Fig. 8a). A bolster of hemostatic gauze is placed underneath the suture in order to provide hemostasis (Figs. 8b, 9a). While suturing the interstitial layer of the parenchyma, deep bites should be avoided to prevent the potential risk of major vascular encroachment to the kidney. Satinsky clamps are removed, once suturing of the renal parenchyma is complete. The use of fibrin glue applied to the suture line for additional hemostasis is recommended (Fig. 9b). Gerota’s fascia is finally closed and the specimen, entrapped in an endoscopic bag, is retrieved.

**Outcome**

A comparison has been drawn between LPN and its counterpart, open partial nephrectomy, in an attempt to demonstrate the advantages of the laparoscopic approach over open surgery. The initial experience with LPN did not reveal the full scope of benefits offered by the procedure but rather presented a survey of accumulated experience along with several controversial issues that remain to be further elucidated. The initial comparison of the techniques has revealed that LPN is associated with decreased blood loss and shorter hospital stay. Mean operative time has been reported to be shorter in the case of laparoscopic partial nephrectomy, whereas warm ischemia time was increased and fraught with a higher risk of postoperative complications. The oncological outcome of the procedure
was shown to be similar to open partial nephrectomy (OPN). In a series including tumors larger than 4 cm, the 5-year overall, cancer-specific and recurrence-free survival rates have been reported to be 90%, 99% and 97%, respectively. The same investigators reported the 7-year oncological outcome of LPN to be similar to OPN.\textsuperscript{19,20} Complication rates for LPN and OPN were higher for the latter approach at the beginning of the laparoscopic learning curve while accumulation of experience and expertise was shown to decrease the rate of complications. Currently, the outcome of LPN regarding ischaemia time, complications, and renal function has improved significantly despite the increasing tumor size and complexity of the procedure. Experienced laparoscopists have recently published a review on 5-yr and 7-yr oncological outcomes that are similar to those of OPN, and they have demonstrated that LPN has a considerably lower rate of patient morbidity as compared to the open approach.\textsuperscript{21}

**Conclusions**

Laparoscopic radical and partial nephrectomy techniques are nowadays considered alternative options to the standard open approach in the armamentarium of oncological urological surgery. The long-term oncological efficacy has been documented. Undoubtedly, several issues of technical refinement remain to be assessed in greater detail. It can therefore be expected, that in the future further clinical evaluation will propose solutions for the above considerations.
References


Laparoscopic Transperitoneal Adrenalectomy

Introduction
The first attempt of laparoscopic resection of the adrenal gland can be traced back to 1991. Snow et al. successfully performed the first transabdominal laparoscopic adrenalectomy in a patient with hematoma of the right adrenal gland. In 1992 and in 1995, the lateral transabdominal and the posterior retroperitoneal laparoscopic approach were introduced by Garner et al., and Marcan et al. accordingly. Since then, laparoscopic adrenalectomy (LA) has become the generally accepted standard of surgical approach for the majority of adrenal tumors. The advantages of LA over conventional open surgery have been well documented. Improved cosmesis and less postoperative pain due to minimal muscular trauma, significant reduction of postoperative hospitalization and earlier return of patients to their normal daily activities are only few of them. The aforementioned advantages have led to the widespread use of LA in the management of adrenal gland resection.

Indications
Laparoscopic adrenalectomy is considered the gold standard adrenalectomy approach in cases of relatively small benign adrenal tumors. Functioning lesions, such as aldosteronoma, Cushing’s syndrome (ACTH-independent or -dependent with uncontrolled ACTH secretion), and pheochromocytoma, and non-functioning tumors, such as ganglioneuroma, non-functioning adenoma, myelolipoma and cyst are strict indications of the procedure. Nevertheless, the role of LA in the treatment of malignant adrenal tumors is still controversial. Several reports on LA for malignant adrenal tumors have revealed that the procedure is associated with a risk of tumor spillage, peritoneal or port-site dissemination resulting in local recurrence. Despite the fact that tumor spillage is not universally accepted, no benefit in matters of oncological outcome has been demonstrated in case of LA versus the open approach. Consequently, open adrenalectomy should be currently preferred in cases of pre-operatively diagnosed adrenocortical cancers.

Adrenal tumor size could constitute a relative contraindication for two reasons. Firstly, bigger adrenal lesions are associated with a higher risk of misdiagnosed malignancy. Prager et al. reviewing a series of 150 consecutive laparoscopic adrenalectomies, reported that none of the smaller (< 4 cm) tumors (N = 102) was malignant. Henry et al. found that 21.2% of tumors larger than 6 cm were malignant versus 1.9% of lesions smaller than 6 cm. Thus, a cutoff point of < 5 – 6 cm adrenal tumors has been empirically proposed by many urologists for laparoscopic resection. Increased operative time, perioperative blood loss, and conversion to open surgery rate have been reported in the case of large (> 5 cm) adrenal lesions in comparison to smaller lesions. Nevertheless, operative time, blood loss, hospital stay, and complication rate are consistently lower for laparoscopic adrenalectomy in comparison to the conventional open adrenalectomy for large tumors. Moreover, the growing laparoscopic skill and clinical experience are considered to account for successful laparoscopic management of tumors up to 12 cm in diameter. Accordingly, the size of benign tumors that are treated via the laparoscopic approach should be determined according to the clinical experience of the performing surgeon.
Surgical Technique

Patient Setup and Trocar Placement: The patient is placed in the same position as with laparoscopic radical nephrectomy. An 11-mm trocar is placed by using a Veress needle – or an open Hasson technique – on the lateral margin of the rectus muscle at a site cranially to the umbilical level. Pneumoperitoneum is then established. A 30°-laparoscope is inserted through the camera trocar. One working trocar is placed on mid-axillary line near the costal margin (13-mm trocar), while the other one (6-mm trocar) is located at the costal margin towards the xiphoid near the pararectal line.

Right Laparoscopic Adrenalectomy: For right LA after trocar placement (Fig. 1), the right lobe of the liver is elevated using a fan retractor which is inserted via the medial port. The triangular ligament is incised down to the level of the diaphragm (Fig. 2a). With the right lobe of the liver retracted, the Gerota’s fascia and the adrenal gland should be at least partially visible (Fig. 2b). Adrenal dissection begins medially between the gland, the inferior vena cava and cephalad to the liver (Figs. 3a, b).
The adrenal vein is identified, gently dissected and clipped before being divided (Fig. 4a). Two clips are left on body's side and one on the specimen's. Dissection is continued medially, superiority and inferiorly using clips or coagulation to maintain a relatively bloodless field whenever an interfering vessel is encountered (Figs. 4b, 5a, b, 6a). Extracapsular dissection of the adrenal gland is essential in order to avoid bleeding. Separation from the kidney is accomplished at the end of the procedure just before specimen extraction (Fig. 6b).
**Left Laparoscopic Adrenalectomy:** Trocar placement for left sided procedure is presented in Fig. 7. Dissection begins by mobilizing the splenic flexure of the colon (Fig. 8a). The lateral attachment to the spleen and the tail of pancreas are divided using the electrocautery (Fig. 8b). Dissection of the left adrenal gland should proceed similar to that of the right one taking care on the differences of blood supply between them, as the left adrenal vein typically drains into the ipsilateral renal vein (Fig. 9).
The attachments of the gland with surrounding organs are carefully divided, and any vascular supply is ligated by using either coagulation or clipping (Figs. 10a, b, 11a, b, 12a, b). Once dissection of the has been accomplished, the specimen is being retrieved using an endoscopic extraction bag. Given proper irrigation of the adrenal bed, a drainage tube rarely needs to be placed.
Outcome

Due to the numerous advantages that LA offers over the standard open surgery approach, it is considered as the golden standard for the management of adrenal masses. Better cosmesis, significantly reduced blood loss, shorter hospital stay and more rapid recovery are the most well-documented benefits. Mean duration of the approach has been recently reported to be approximately 130 min. Intraoperative complications were vascular injuries (in bilateral adrenalectomy) or postoperative blood pressure disturbances should be expected. Complications associated with the underlying disease such as adrenal insufficiency, port-site infection or hematomas and deep vein thrombosis, although rare. Finally, complications associated with additional general complications related to laparoscopy, such as organ manipulation have been reported in addition to general complications related to laparoscopy, such as post-site infection or hematomas and deep vein thrombosis, although rare. Finally, the outcomes after laparoscopic adrenalectomy: thirty years’ experience of one medical centre. Endokrynol Pol. 2010 Jan-Feb; 61(1):94–101.

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16. lubikowski J, umiński m, andrysiak-mamos e, pyńka s, fuchs h, wójcicki m, szajko m, moleda p, post m, zochowska e, kiedrowicz b, safranow k, syrenicz a. From open to laparoscopic adrenalectomy: thirty years’ experience of one medical centre. Endokrynol Pol. 2010 Jan-Feb; 61(1):94–101.
Laparoscopic Pyeloplasty

Introduction

Open pyeloplasty (OP) remains the gold standard treatment option in the management of congenital or acquired ureteropelvic junction obstruction (UPJO). Success rates of the open approach are reported to range over 90%. However, the required loin incision is associated with increased pain, prolonged hospital stay and protracted return to normal activity. In an attempt to overcome the aforementioned drawbacks, minimally invasive treatment options were introduced. Percutaneous antegrade and ureteroscopic retrograde techniques were developed to encounter UPJO. Nevertheless, success rates of the latter techniques are lower than the one reported for the open approach and are considerably dependent on the cause and type of UPJO. Even though an intrinsic obstruction is usually managed favorably, the results for extrinsic causes are considered unsatisfactory. Laparoscopic pyeloplasty (LP) represents an alternative treatment option that integrates the benefits of the endoscopic approaches including decreased postoperative pain and low morbidity, while demonstrating success rates comparable to those of the conventional open approach. Moreover, the technique can be performed in all age groups, in the presence of secondary stones, crossing vessels and secondary UPJO.

Indications

Surgical treatment of UPJO is indicated for symptoms related to progressive impairment of ipsilateral renal function, development of stones or infection, and rarely, for the development of causal hypertension.
Dismembered LP is indicated in cases where prior less invasive endopyelotomy approaches have failed to alleviate the obstruction (Fig. 1) and in cases of anatomical variations including crossing vessels and high insertion of the ureter on the renal pelvis. Conversely, it is not well-suited to UPJO associated with lengthy or multiple proximal ureteral strictures or to patients in whom the UPJ obstruction is associated with a small, relatively inaccessible intrarenal pelvis.\(^5\)

**Surgical Technique**

**Patient Positioning and Trocar Placement:** The patient is placed in a 45° lateral decubitus position and is properly restrained using pillows and tape, as described for laparoscopic radical nephrectomy. For the transperitoneal approach usually 3 trocars are necessary (Fig. 2). Using the open Hasson technique, the peritoneum is incised at umbilical level and pneumoperitoneum is established. Then, an 11-mm trocar is inserted, that will host the laparoscopic camera. The remaining trocars are inserted under direct vision. A 6-mm trocar is inserted under the costal margin on the mid-clavicular line. Another trocar is placed on the mid-axillary line at the level of the umbilicus. A 6-mm trocar may be inserted between the 12th rib and the anterior iliac spine in cases where an additional instrument is deemed necessary.

**Exposure of the Kidney:** The colon, spleen or liver are mobilized away from the kidney as previously described for laparoscopic radical nephrectomy.

**Dissection of the Ureteropelvic Junction:** The operation begins with identification and dissection of the ureter. The posterior parietal layer of the peritoneum is incised along the root of the underlying ureter and the preperitoneal fat as well as other tissue layers are dissected until the proximal ureter is exposed (Fig. 3a). Ureteral dissection continues cephalad until the UPJ is reached (Fig. 3b).
It is of critical importance that the ureter be not excessively skeletonized to prevent the potential risk of ureteral ischemia. In the presence of a crossing vessel, it should be dissected carefully from the underlying pelvis to prevent unnecessary bleeding.

*Excision of the Ureteropelvic Junction:* Once UPJ dissection is considered sufficient (Fig. 4a), the operation continues with incision of the pelvis and excision of the malfunctioning UPJ (Figs. 4b, 5a, b). The ureter is sharply dissected just underneath the UPJ (Fig. 6a) and a Double-J stent is inserted (Fig. 6b).
An 18-Gauge percutaneous access needle is inserted directly through the skin of the abdominal wall in such a way that its end can be approximated to the ureteral opening. A hydrophilic guidewire is advanced through the trocar of the needle directly in the distal ureteral segment into the bladder (Fig. 7). The trocar is then removed and the double-pigtail stent is passed over the guidewire within the bladder. Next, the wire is removed and the superior tip of the stent introduced into the renal pelvis. Ureteral spatulation for 1.5 – 2 cm is usually necessary in order to ensure a wide anastomosis (Figs. 8a, b). The posterior surface of the UPJ junction is not transected until the stent is inserted avoiding cumbersome maneuvers for stent positioning. Once the stent is in place, the UPJ is completely transected (Fig. 9).
Creation of the New Anastomosis: Absorbable sutures 4/0 are used for this purpose. The first stitch should be placed in an outside-inside manner at the inferior angle of the spatulated ureter and vice versa at the inferior angle of the pelvic stump ascertaining that the final knot is not included in the lumen of the pelvicaliceal system (Figs. 10a, b). The posterior aspect of the anastomosis is completed first and followed by the anterior one (Fig. 11a). We prefer inserting the stent prior to creating the anastomosis as the stent facilitates the suturing in that it provides some degree of rigidity to the spatulated ureter. Next, the anterior aspect of the anastomosis is closed (Figs. 11b, 12a, b). We prefer the use of LAPRA-TY clips (Ethicon Endo-surgery, CA, USA) at the distal end of the suture at the level of the pelvis. Once the anastomosis has been completed (Fig. 13), a suction drain is placed near the anastomosis and the trocars can be being removed.

Outcome

Laparoscopic pyeloplasty poses several advantages over alternative treatment options in the management of UPJ obstruction. In contrast to other minimally invasive endourological approaches it demonstrates success rates equal to open surgery. The higher success of LP compared to retrograde and antegrade endopyelotomy or balloon dilation is based on the direct laparoscopic visualization of the pathologic areas directing the appropriate repair. Moreover, certain techniques of laparoscopic repair are suited to almost all cases ranging between crossing vessels, secondary stones and secondary UPJ obstruction. However, the definite outcome of endourological procedures is often disease-dependent. From the author’s point of view, a success rate as low as 39% for endopyelotomy in the presence of a lower pole vessel indicates that not all patients are suitable for endourological management.

On the other hand, morbidity of LP is significantly lower than in the conventional surgical approach given that flank incision is avoided. In a comparative retrospective study Zhang et al. compared the outcomes and other perioperative parameters
of 56 patients treated by LP with 40 patients subjected to open pyeloplasty. The laparoscopic group was found to have significantly lower operative times, estimated blood loss, analgesic requirements and postoperative hospital stay. Finally, the authors reported that the incidence of postoperative complications and success rates were equivalent in both groups.7

References


Needlescopic-Assisted Single-Port Pyeloplasty

Introduction

Laparoscopic surgery has been established as standard of care in urological clinical practice. Laparoscopic pyeloplasty is currently being established as the standard of care for ureteropelvic junction (UPJ) obstruction. The minimally invasive nature of laparoscopic surgery is reflected by clinical outcomes as well as by experimental studies. Nevertheless, the constant evolution of surgical equipment is rapidly adopted in the surgical field and enables the further refinement of surgical techniques. Recently, in the field of laparoscopic surgery, there is an increasingly widespread tendency to employ minimally invasive techniques, such as laparoscopic single-site surgery and needlescopic / mini-laparoscopic surgery. The latter approach involves that a laparoscopic procedure is performed by using instruments of smaller diameter. The diameter of conventional laparoscopic instruments is 5 – 12 mm, while needlescopic instruments measure between 3 mm and 5 mm. Small-caliber instruments are inserted at the same sites as in the conventional laparoscopic approach, with or without the use of appropriate small-diameter ports.

Indications

The indications for needlescopic pyeloplasty are similar to those of laparoscopic pyeloplasty.

Surgical Technique

Patient Positioning and Trocar Placement: Patient positioning is identical to laparoscopic pyeloplasty. The camera trocar is inserted at the umbilicus and Hasson technique is used. The video camera is coupled to a HOPKINS® 30°-laparoscope, 5 mm in diameter only, which can be inserted through a standard laparoscopic 6-mm trocar. The remaining instruments are 3 mm in diameter and are positioned at the same sites as in the standard laparoscopic approach (Fig. 1a). These ports can be placed by preliminary insertion of a 3-mm trocar or directly by stabbing the instrument through the abdominal wall (Fig. 1b). Nevertheless, large-caliber instruments, such as ultrasonic scissors, vascular staplers or clip applicators cannot be inserted through the umbilical 6-mm port. Therefore, an additional 13-mm standard trocar can be inserted at the umbilicus or a multi-lumen port may also be appropriate for single-port surgery at the same site. We prefer the use of a multi-lumen port at the umbilicus as it provides ports for both the camera and a large-caliber instrument (Fig. 2). Suction, bipolar coagulation and clip applicators may be inserted through the multi-lumen port, which has proven to considerably facilitate the performance of the procedure. Occasionally, the rapid insertion of large-caliber instruments is required urgently for safety reasons during an upper urinary tract procedure, eliminating the need for additional operative time required to insert an auxiliary trocar.
Mobilization of the Colon: The steps of the procedure are similar to those involved in laparoscopic pyeloplasty. In left-sided pyeloplasty, as shown in the figures, mobilization of the colon is performed by sharp and blunt dissection which is extended from the splenic flexure to the level of the iliac vessels (Figs. 3a, b). Next, Gerota's fascia is identified and incised (Figs. 4a, b). Even though the 3-mm suction cannula performs efficiently in the majority of the cases, severe bleeding can necessitate the use of a larger 5-mm suction instrument through the single port. Moreover, a 21-Gauge cannula, inserted through the abdominal wall, may also be used as an alternative means of aspiration to evacuate smoke produced during dissection, which obviates the need for an auxiliary suction instrument (Fig. 5).
Localization of the Ureter / Dissection of the UPJ: Dissection of the posterior parietal fat is performed in an attempt to identify the ureter. Once the ureter has been localized, careful dissection is carried towards the renal hilum. The ureter should be dissected without removing its surrounding fatty tissue and blood supply. The straight needle is inserted through the abdominal wall, is passed around the ureter and brought back through the abdominal wall (Figs. 6a, b). The suture is tied on the abdominal wall. In this way, continuous traction to the ureter is applied. When dissection of the ureter and the pelvis is complete, the pelvis and the proximal ureter should be free of any attachments.
Transection of UPJ and Renal Pelvis Excision: The UPJ is transected. Any redundant tissue of the renal pelvis is excised while the stenosed segment of the ureter is dissected. It is important to avoid excising too much redundant pelvic tissue as the anastomosis may be too close to the calyces. The stenosed portion of the ureter should be completely dissected (Fig. 7). A needle for percutaneous access is inserted through the abdominal wall and a guide wire is passed through the needle in the ureter (Figs. 8a, b). The needle is removed and a double-J is inserted in the ureter by over-the-wire technique (Figs. 9a, b). The ureter is then spatulated for approximately 2 cm (Figs. 10a, b).

Ureteropelvic Anastomosis: this step of the procedure is performed using the same method as in the conventional laparoscopic approach (Figs. 11a, b).
It is important to note that the sophisticated task of suturing is more demanding than in the conventional approach because the small-sized needle holder and forceps require a higher level of precision during needle handling, suturing and knotting (Figs. 12a, b). Nevertheless, the use of small sutures such as 5-0 is possible with the 3-mm needle holders and allows the delicate reconstructive surgery to be performed with great accuracy, e.g., the anastomosis of the ureter to the pelvis during the pyeloplasty.

Outcome
To our knowledge, needlescopic pyeloplasty has not been reported in adults. Accordingly, there are no reports available in the literature addressing the clinical outcomes. In the author's experience with 10 cases of needlescopic single-port-assisted pyeloplasties, the perioperative and short-term outcome was similar to that of conventional laparoscopic pyeloplasty. No complications were encountered. The needlescopic instruments require more precision to perform the surgical tasks but the triangulation of instruments provides almost identical surgical conditions for the surgical team as in the conventional laparoscopic setting. Retraction tasks were more demanding than in conventional laparoscopy but the surgeon experienced no difficulties to adapt to the new conditions. The 5-mm HOPKINS® laparoscope provides excellent visualization of the surgical field. In summary, the advantage of needlescopic surgery in terms of the cosmetic outcome is reflected by the smaller skin incision which does not require any suturing (Fig. 13). Further evaluation is needed to establish needlescopic pyeloplasty as an alternative to the conventional laparoscopic technique.
Recommended Instrument Sets and Videoendoscopic Equipment for

- Laparoscopic Transperitoneal Radical Nephrectomy
- Single-Port Radical Nephrectomy
- Laparoscopic Partial Nephrectomy
- Laparoscopic Transperitoneal Adrenalectomy
- Laparoscopic Pyeloplasty
- Needlescopic-Assisted Single-Port Pyeloplasty
Laparoscopic Transperitoneal Radical Nephrectomy

Recommended Set according to LIATSIKOS
## Laparoscopic Transperitoneal Radical Nephrectomy

**Recommended Set** according to LIATSIKOS

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>26003 BA</td>
<td>1x <strong>HOPKINS®</strong> Forward-Oblique Telescope 30°, enlarged view, diameter 10 mm, length 31 cm, autoclavable, fiber optic light transmission incorporated, color code: red</td>
</tr>
<tr>
<td>30103 MP</td>
<td>1x <strong>Trocar</strong>, with pyramidal tip, with insufflation stopcock, size 11 cm, working length 10.5 cm, color code: green, including: Cannula, without valve</td>
</tr>
<tr>
<td>30107 MP</td>
<td>1x <strong>Trocar</strong>, with pyramidal tip, with insufflation stopcock, size 13 mm, working length 11.5 cm, color code: black, for use with linear staplers from the company Covidien (formerly Tyco), including: Cannula, Trocar only, Multifunctional Valve</td>
</tr>
<tr>
<td>30160 MP</td>
<td>2x <strong>Trocar</strong>, with pyramidal tip, with insufflation stopcock, size 6 mm, working length 10.5 cm, color code: black, including: Cannula, Trocar only, Multifunctional Valve</td>
</tr>
<tr>
<td>33351 D</td>
<td>1x <strong>CLICKLINE</strong> Grasping Forceps, rotating, dismantling, insulated, with connector pin for unipolar coagulation, with Luer-Lock irrigation connector for cleaning, double action jaws, size 5 mm, length 36 cm, including: Plastic Handle, without ratchet, with larger contact area, Metal Outer Sheath, insulated Forceps Insert</td>
</tr>
<tr>
<td>33351 KJ</td>
<td>1x <strong>CLICKLINE REDDICK-OLSEN Dissecting and Grasping Forceps</strong>, rotating, dismantling, insulated, with connector pin for unipolar coagulation, with Luer-Lock irrigation connector for cleaning, double action jaws, size 5 mm, length 36 cm, including: Plastic Handle, without ratchet, with larger contact area, Metal Outer Sheath, insulated Forceps Insert</td>
</tr>
<tr>
<td>34351 MS</td>
<td>1x <strong>CLICKLINE METZENBAUM Scissors</strong>, rotating, dismantling, with connector pin for unipolar coagulation, with Luer-Lock irrigation connector for cleaning, double action jaws, curved, length of jaws 15 mm, size 5 mm, length 36 cm, including: Plastic Handle, without ratchet, with larger contact area at the finger ring, Metal Outer Sheath, Scissors Insert</td>
</tr>
<tr>
<td>38651 ON</td>
<td>1x <strong>RoBi® Grasping Forceps</strong>, CLERMONT-FERRAND model, rotating, dismantling, with connector pin for bipolar coagulation, with especially fine atraumatic serration, fenestrated jaws, double action jaws, size 5 mm, length 36 cm, color code: light blue, including: RoBi® Plastic Handle, without ratchet, RoBi® Metal Outer Sheath, RoBi® Forceps Insert</td>
</tr>
<tr>
<td>26173 BN</td>
<td>1x <strong>Suction and Irrigation Tube</strong>, with lateral holes, with two-way stopcock for single-hand control, size 5 mm, length 36 cm</td>
</tr>
<tr>
<td>37113 A</td>
<td>1x <strong>Pistol Grip Handle</strong>, with clamping valve, for suction and irrigation, autoclavable to be used with: 37360 LH 1x <strong>Suction and Irrigation Tube</strong>, with lateral holes, size 5 mm, length 36 cm, for use with suction and irrigation handles or 37560 LH 1x <strong>Suction and Irrigation Tube</strong>, with lateral holes, size 10 mm, length 36 cm, for use with suction and irrigation handles</td>
</tr>
</tbody>
</table>

It is recommended to check the suitability of the product for the intended procedure prior to use.
Single-Port Radical Nephrectomy

Recommended Set according to LIATSIKOS
Single-Port Radical Nephrectomy

Recommended Set according to LIATSIKOS

1. 26048 BA 1x HOPKINS® Forward-Oblique Telescope 30°, enlarged view, diameter 5.5 mm, length 50 cm, autoclavable, fiber optic light transmission incorporated, color code: red

2. 23161 OND 1x CLICKLINE Dissecting and Grasping Forceps, non-rotating, dismantling, with connector pin for unipolar coagulation, single action jaws, sheath bending according to LEROY, fenestrated, with especially fine atraumatic serration, for the left hand, size 5 mm, length 36 cm, including: Metal Handle, insulated, without ratchet, with 4 locking positions Outer Sheath, with working insert

3. 23261 MSC 1x CLICKLINE METZENBARUM Scissors, curved, length of jaws 15 mm, double action jaws, with connector pin for unipolar coagulation, sheath bending according to LEROY, size 5 mm, length 36 cm, including: Metal-Handle, insulated, without ratchet, with 4 locking positions Outer Sheath, with working insert

4. 23020 PA 1x X-CONE Single Portal Surgery Access System, autoclavable, size 25 mm, including: Port, size 25 mm, consisting of two half-cones 23020 P1 and 23020 P2 Seal, with 4 x 3 and/or 5 mm and 1 x 5 – 13 mm ports Reducer, 13/5 mm and 11/5 mm Luer-Lock Connector, with insufflation and desufflation stopcock Wire Tray

5. 23010 PA 1x CUSCHIERI ENDOCONE® Single Portal Surgery Access System, autoclavable, size 34 mm including: Port, size 34 mm Seal Plate, with 1 x 10 mm, 1 x 10 – 15 mm and 6 x 3 – 5 mm ports Reducer, 13/5 mm and 11/5 mm Luer-Lock Connector, with insufflation and desufflation stopcock

6. 33351 D 1x CLICKLINE Grasping Forceps, rotating, dismantling, insulated, with connector pin for unipolar coagulation, with Luer-Lock irrigation connector for cleaning, double action jaws, atraumatic, spoon-shaped, multiple teeth, size 5 mm, length 36 cm, including: Plastic Handle, without ratchet, with larger contact area Metal Outer Sheath, insulated Forceps Insert

7. 33351 KJ 1x CLICKLINE REDDICK-OLSEN Dissecting and Grasping Forceps, rotating, dismantling, insulated, with connector pin for unipolar coagulation, with Luer-Lock irrigation connector for cleaning, double action jaws, size 5 mm, length 36 cm, including: Plastic Handle, without ratchet, with larger contact area Metal Outer Sheath, insulated Forceps Insert

8. 34351 MS 1x CLICKLINE METZENBAUM Scissors, rotating, dismantling, with connector pin for unipolar coagulation, with Luer-Lock irrigation connector for cleaning, double action jaws, curved, length of jaws 15 mm, size 5 mm, length 36 cm, including: Plastic Handle, without ratchet, with larger contact area at the finger ring Metal Outer Sheath Scissors Insert

9. 38651 ON 1x RoBi® Grasping Forceps, CLERMONT-FERRAND model, rotating, dismantling, with connector pin for bipolar coagulation, with especially fine atraumatic serration, fenestrated jaws, double action jaws, size 5 mm, length 36 cm, color code: light blue, including: RoBi® Plastic Handle, without ratchet RoBi® Metal Outer Sheath RoBi® Forceps Insert

10. 26173 BN 1x Suction and Irrigation Tube, with lateral holes, with two-way stopcock for single-hand control, size 5 mm, length 36 cm

11. 23460 LHG 1x Suction and Irrigation Tube, with lateral holes, curved, sheath bending according to DAPRI, size 5 mm, length 40 cm

12. 37113 A 1x Pistol Grip Handle, with clamping valve, for suction and irrigation, autoclavable
Laparoscopic Partial Nephrectomy

Recommended Set according to LIATSIKOS
Laparoscopic Partial Nephrectomy
Recommended Set according to LIATSIKOS

1. 26003 BA 1x HOPKINS® Forward-Oblique Telescope 30°, enlarged view, diameter 10 mm, length 31 cm, autoclavable, fiber optic light transmission incorporated, color code: red

2. 30160 MP 2x Trocar, with pyramidal tip, with insufflation stopcock, size 6 mm, working length 10.5 cm, color code: black, including:
   - Cannula, without valve
   - Trocar only

3. 30103 MP 2x Trocar, with pyramidal tip, with insufflation stopcock, size 11 cm, working length 10.5 cm, color code: green, including:
   - Cannula, without valve
   - Trocar only

4. 33351 D 1x CLICKLINE Grasping Forceps, rotating, dismantling, insulated, with connector pin for unipolar coagulation, with Luer-Lock irrigation connector for cleaning, double action jaws, atraumatic, spoon-shaped, multiple teeth, size 5 mm, length 36 cm, including:
   - Plastic Handle, without ratchet, with larger contact area
   - Metal Outer Sheath, insulated
   - Forceps Insert

5. 33351 KJ 1x CLICKLINE REDDICK-OLSEN Dissecting and Grasping Forceps, rotating, dismantling, insulated, with connector pin for unipolar coagulation, with Luer-Lock irrigation connector for cleaning, double action jaws, size 5 mm, length 36 cm, including:
   - Plastic Handle, without ratchet, with larger contact area
   - Metal Outer Sheath, insulated
   - Forceps Insert

6. 33351 MS 1x CLICKLINE MANHES Dissecting and Grasping Forceps, “duckbill jaws”, rotating, dismantling, insulated, with connector pin for unipolar coagulation, with Luer-Lock irrigation connector for cleaning, single action jaws, blunt, specially designed for extended clinching of tissue to effect mechanical hemostasis, size 5 mm, length 36 cm, including:
   - Plastic Handle, without ratchet, with larger contact area
   - Metal Outer Sheath, insulated
   - Forceps Insert

7. 38651 ON 1x RoBi® Grasping Forceps, CLERMONT-FERRAND model, rotating, dismantling, with connector pin for bipolar coagulation, with especially fine atraumatic serration, fenestrated jaws, double action jaws, size 5 mm, length 36 cm, color code: light blue, including:
   - RoBi® Plastic Handle, without ratchet
   - RoBi® Metal Outer Sheath
   - RoBi® Forceps Insert

8. 30173 LPL 1x KDH Macro Needle Holder, dismantling, with Luer-Lock irrigation connector for cleaning, single action jaws, jaws curved to left, with tungsten carbide inserts, with ergonomic handle, pistol grip, disengagable ratchet, ratchet position left, size 5 mm, length 33 cm, for use with suture material size 0/0 – 7/0, including:
   - Handle
   - Metal Outer Sheath
   - Working Insert

9. 37113 A 1x Pistol Grip Handle, with clamping valve, for suction and irrigation, autoclavable to be used with:
   - 37360 LH 1x Suction and Irrigation Tube, with lateral holes, size 5 mm, length 36 cm, for use with suction and irrigation handles
   - 37560 LH 1x Suction and Irrigation Tube, with lateral holes, size 10 mm, length 36 cm, for use with suction and irrigation handles

10. 26173 BN 1x Suction and Irrigation Tube, with lateral holes, with two-way stopcock for single-hand control, size 5 mm, length 36 cm

11. 49310 SC 1x SATINSKY Laparoscopic Clamp, short version, length of jaws 8 cm, depth of jaws 2 cm, straight sheath, with axial ring handle, ratchet with safety locking device, size 10 mm, length 30 cm (not illustrated)
Laparoscopic Transperitoneal Adrenalectomy

Recommended Set according to LIATSIKOS
### Laparoscopic Transperitoneal Adrenalectomy

**Recommended Set** according to LIATSIKOS

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>26003 BA</td>
<td><strong>HOPKINS® Forward-Oblique Telescope 30°</strong>, enlarged view, diameter 10 mm, length 31 cm, autoclavable, fiber optic light transmission incorporated, color code: red</td>
<td></td>
</tr>
<tr>
<td>30160 MP</td>
<td><strong>Trocar</strong>, with pyramidal tip, with insufflation stopcock, size 6 mm, working length 10.5 cm, color code: black, including: <strong>Cannula</strong>, without valve</td>
<td></td>
</tr>
<tr>
<td>30103 MP</td>
<td><strong>Trocar</strong>, with pyramidal tip, with insufflation stopcock, size 11 cm, working length 10.5 cm, color code: green, including: <strong>Cannula</strong>, without valve</td>
<td></td>
</tr>
<tr>
<td>33351 D</td>
<td><strong>CLICKLINE Grasping Forceps</strong>, rotating, dismantling, insulated, with connector pin for unipolar coagulation, double action jaws, atraumatic, spoon-shaped, multiple teeth, size 5 mm, length 36 cm, including: <strong>Plastic Handle</strong>, without ratchet, with larger contact area <strong>Metal Outer Sheath</strong>, insulated</td>
<td></td>
</tr>
<tr>
<td>33515 KJ</td>
<td><strong>CLICKLINE REDDICK-OLSEN Dissecting and Grasping Forceps</strong>, rotating, dismantling, insulated, with connector pin for unipolar coagulation, double action jaws, size 5 mm, length 36 cm, including: <strong>Plastic Handle</strong>, without ratchet, with larger contact area <strong>Metal Outer Sheath</strong>, insulated</td>
<td></td>
</tr>
<tr>
<td>38651 ON</td>
<td><strong>RoBi® Grasping Forceps</strong>, CLERMONT-FERRAND model, rotating, dismantling, with connector pin for bipolar coagulation, fenestrated jaws, double action jaws, size 5 mm, length 36 cm, color code: light blue, including: <strong>RoBi® Plastic Handle</strong>, without ratchet <strong>RoBi® Metal Outer Sheath</strong> <strong>RoBi® Forceps Insert</strong></td>
<td></td>
</tr>
<tr>
<td>37113 A</td>
<td><strong>Pistol Grip Handle</strong>, with clamping valve, for suction and irrigation, autoclavable to be used with: 37360 LH</td>
<td><strong>Suction and Irrigation Tube</strong>, with lateral holes, size 5 mm, length 36 cm, for use with suction and irrigation handles or 37560 LH</td>
</tr>
</tbody>
</table>
Laparoscopic Pyeloplasty

Recommended Set according to LIATSIKOS
Laparoscopic Pyeloplasty
Recommended Set according to LIATSIKOS

1. 26003 BA 1x HOPKINS® Forward-Oblique Telescope 30°, enlarged view, diameter 10 mm, length 31 cm, autoclavable, fiber optic light transmission incorporated, color code: red

2. 30160 MP 3x Trocar, with pyramidal tip, with insufflation stopcock, size 6 mm, working length 10.5 cm, color code: black, including:
   - Cannula, without valve
   - Trocar only
   - Multifunctional Valve

3. 30103 MP 1x Trocar, with pyramidal tip, with insufflation stopcock, size 11 cm, working length 10.5 cm, color code: green, including:
   - Cannula, without valve
   - Trocar only
   - Multifunctional Valve

4. 33351 D 1x CLICKLINE Grasping Forceps, rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, spoon-shaped, multiple teeth, size 5 mm, length 36 cm, including:
   - Plastic Handle, without ratchet
   - Metal Outer Sheath, insulated
   - Forceps Insert

5. 33351 KJ 1x CLICKLINE REDDICK-OLSEN Dissecting and Grasping Forceps, rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, size 5 mm, length 36 cm, including:
   - Plastic Handle, without ratchet
   - Metal Outer Sheath, insulated
   - Forceps Insert

6. 34351 MS 1x CLICKLINE METZENBAUM Scissors, rotating, dismantling, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, curved, length of jaws 15 mm, size 5 mm, length 36 cm, including:
   - Plastic Handle, without ratchet
   - Metal Outer Sheath
   - Scissors Insert

7. 38651 ON 1x RoBi® Grasping Forceps, CLERMONT-FERRAND model, rotating, dismantling, with connector pin for bipolar coagulation, with especially fine atraumatic serration, fenestrated jaws, double action jaws, size 5 mm, length 36 cm, color code: light blue, including:
   - RoBi® Plastic Handle, without ratchet
   - RoBi® Metal Outer Sheath
   - RoBi® Forceps Insert

8. 30173 LPL 1x KOH Macro Needle Holder, dismantling, with LUER-Lock irrigation connector for cleaning, single action jaws, jaws curved to left, with tungsten carbide inserts, with ergonomic handle, pistol grip, disengageable ratchet, ratchet position left, size 5 mm, length 33 cm, for use with suture material size 0/0 – 7/0, including:
   - Handle
   - Metal Outer Sheath
   - Working Insert

9. 37113 A 1x Pistol Grip Handle, with clamping valve, for suction and irrigation, autoclavable to be used with:
   - 37360 LH 1x Suction and Irrigation Tube, with lateral holes, size 5 mm, length 36 cm, for use with suction and irrigation handles or
   - 37560 LH 1x Suction and Irrigation Tube, with lateral holes, size 10 mm, length 36 cm, for use with suction and irrigation handles

10. 26173 BN 1x Suction and Irrigation Tube, with lateral holes, with two-way stopcock for single-hand control, size 5 mm, length 36 cm
Needlescopic-Assisted Single-Port Pyeloplasty

**Recommended Set** according to LIATSIKOS
Needlescopic-Assisted Single-Port Pyeloplasty

Recommended Set according to LIATSIKOS

1. 26048 BA 1x HOPKINS® Forward-Oblique Telescope 30°, enlarged view, diameter 5.5 mm, length 50 cm, autoclavable, fiber optic light transmission incorporated, color code: red

2. 23010 PA 1x CUSCHIERI ENDOCONE® Single Portal Surgery Access System, autoclavable, size 34 mm, including:
   - Port, size 34 mm
   - Seal Plate, with 1 x 10 mm, 1 x 10 – 15 mm and 6 x 3 – 5 mm ports
   - Reducer, 13/5 mm and 11/5 mm
   - LUER-Lock Connector, with insufflation and desufflation stopcock

3. 23020 PA 1x X-CONE Single Portal Surgery Access System, autoclavable, size 25 mm, including:
   - Port, size 25 mm, consisting of two half-cones
   - Seal, with 4 x 3 and/or 5 mm and 1 x 5 – 13 mm ports
   - Reducer, 13/5 mm and 11/5 mm
   - LUER-Lock Connector, with insufflation and desufflation stopcock

4. 30114 GKK 1x Trocar, with pyramidal tip, with LUER-Lock connector for insufflation, size 3.5 mm, working length 15 cm, color code: green-red, for use with instruments size 3 mm, including:
   - Cannula
   - Trocar only
   - Silicone Leaflet Valve

5. 30341 ONG 1x CLICKLINE Grasping Forceps, rotating, dismantling, without connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, single action jaws, with especially fine atraumatic serration, fenestrated, size 3 mm, length 36 cm, including:
   - Metal Handle, with disengageable ratchet
   - Outer Sheath, with forceps insert

6. 30351 MLG 1x CLICKLINE KELLY Dissecting and Grasping Forceps, rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, long, size 3 mm, length 36 cm, including:
   - Plastic Handle, without ratchet, with larger contact area
   - Outer Sheath, with forceps insert

7. 30351 MWG 1x CLICKLINE Scissors, rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, serrated, curved, conical, size 3 mm, length 36 cm, including:
   - Plastic Handle, without ratchet, with larger contact area
   - Outer Sheath, with forceps insert

8. 33351 D 1x CLICKLINE Grasping Forceps, rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, atraumatic, spoon-shaped, multiple teeth, size 5 mm, length 36 cm, including:
   - Plastic Handle, without ratchet, with larger contact area
   - Metal Outer Sheath, insulated
   - Forceps Insert

9. 33351 KJ 1x CLICKLINE REDICK-OLSEN Dissecting and Grasping Forceps, rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, size 5 mm, length 36 cm, including:
   - Plastic Handle, without ratchet, with larger contact area
   - Metal Outer Sheath, insulated
   - Forceps Insert

10. 34351 MS 1x CLICKLINE METZENBAUM Scissors, rotating, dismantling, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, curved, length of jaws 15 mm, size 5 mm, length 36 cm, including:
    - Plastic Handle, without ratchet, with larger contact area at the finger ring
    - Metal Outer Sheath
    - Scissors Insert

11. 38951 ON 1x ROBi® Grasping Forceps, CLERMONT-FERRAND model, with connector pin for bipolar coagulation, with especially fine atraumatic serration, fenestrated, double action jaws, size 3.5 mm, length 36 cm, color code: light blue, including:
    - ROBi® Plastic Handle
    - ROBi® Forceps Insert with Outer Sheath

12. 38651 ON 1x ROBi® Grasping Forceps, CLERMONT-FERRAND model, rotating, dismantling, with connector pin for bipolar coagulation, with especially fine atraumatic serration, fenestrated jaws, double action jaws, size 5 mm, length 36 cm, color code: light blue, including:
    - ROBi® Plastic Handle, without ratchet
    - ROBi® Metal Outer Sheath
    - ROBi® Forceps Insert

13. 26167 FNL 1x KOH Ultramicro Needle Holder, with tungsten carbide inserts, straight handle with ratchet, jaws slightly curved to left, size 3 mm, length 36 cm, for use with suture material 7/0, 8/0 (Ethicon) and needle size BV 175-6

14. 30173 LPL 1x KOH Macro Needle Holder, dismantling, with LUER-Lock irrigation connector for cleaning, single action jaws, jaws curved to left, with tungsten carbide inserts, with ergonomic handle, pistol grip, disengageable ratchet, ratchet position left, size 5 mm, length 33 cm, for use with suture material size 0/0 – 7/0, including:
    - Handle
    - Metal Outer Sheath
    - Working Insert

15. 37113 A 1x Pistol Grip Handle, with clamping valve, for suction and irrigation, autoclavable to be used with:
    - 37360 LH 1x Suction and Irrigation Tube, with lateral holes, size 5 mm, length 36 cm, for use with suction and irrigation handles or
    - 37560 LH 1x Suction and Irrigation Tube, with lateral holes, size 10 mm, length 36 cm, for use with suction and irrigation handles

16. 26167 H 1x Two-Way Stopcock, for use with Suction and Irrigation Tubes 26167 LH/LHS/LHL

17. 26167 LHL 1x Suction and Irrigation Tube, size 3 mm, length 36 cm, for use with Two-Way Stopcock 26167 H or modular handles for irrigation and suction
**IMAGE1 S Camera System**

**Economical and future-proof**
- Modular concept for flexible, rigid and 3D endoscopy as well as new technologies
- Forward and backward compatibility with video endoscopes and FULL HD camera heads

**Innovative Design**
- Dashboard: Complete overview with intuitive menu guidance
- Live menu: User-friendly and customizable
- Intelligent icons: Graphic representation changes when settings of connected devices or the entire system are adjusted

**Sustainable investment**
- Automatic light source control
- Side-by-side view: Parallel display of standard image and the Visualization mode
- Multiple source control: IMAGE1 S allows the simultaneous display, processing and documentation of image information from two connected image sources, e.g., for hybrid operations

**Dashboard**

**Live menu**

**Intelligent icons**

**Side-by-side view: Parallel display of standard image and Visualization mode**
Instruments and Videoendoscopic Equipment

**IMAGE1 S Camera System**

**Brilliant Imaging**
- Clear and razor-sharp endoscopic images in **FULL HD**
- Natural color rendition

**Reflection is minimized**
- Multiple IMAGE1 S technologies for homogeneous illumination, contrast enhancement and color shifting

* SPECTRA A: Not for sale in the U.S.
** SPECTRA B: Not for sale in the U.S.
**IMAGE1 S Camera System**

TC 200EN

**IMAGE1 S CONNECT**, connect module, for use with up to 3 link modules, resolution 1920 x 1080 pixels, with integrated KARL STORZ-SCB and digital Image Processing Module, power supply 100–120 VAC/200–240 VAC, 50/60 Hz including:

- **Mains Cord**, length 300 cm
- **DVI-D Connecting Cable**, length 300 cm
- **SCB Connecting Cable**, length 100 cm
- **USB Flash Drive**, 32 GB, USB silicone keyboard, with touchpad, US

*Available in the following languages*: DE, ES, FR, IT, PT, RU

**Specifications**:

<table>
<thead>
<tr>
<th>Feature</th>
<th>TC 200EN*</th>
</tr>
</thead>
</table>
| HD video outputs                | - 2x DVI-D
                     | - 1x 3G-SDI |
| Format signal outputs           | 1920 x 1080p, 50/60 Hz |
| LINK video inputs               | 3x |
| USB interface                   | 4x USB, (2x front, 2x rear) |
| SCB interface                   | 2x 6-pin mini-DIN |
| Power supply                    | 100–120 VAC/200–240 VAC |
| Power frequency                 | 50/60 Hz |
| Protection class                | I, CF-Defib |
| Dimensions w x h x d            | 305 x 54 x 320 mm |
| Weight                          | 2.1 kg |

For use with IMAGE1 S

**IMAGE1 S CONNECT Module TC 200EN**

TC 300

**IMAGE1 S H3-LINK**, link module, for use with IMAGE1 FULL HD three-chip camera heads, power supply 100–120 VAC/200–240 VAC, 50/60 Hz, for use with **IMAGE1 S CONNECT TC 200EN** including:

- **Mains Cord**, length 300 cm
- **Link Cable**, length 20 cm

**Specifications**:

<table>
<thead>
<tr>
<th>Feature</th>
<th>TC 300 (H3-Link)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supported camera heads/video endoscopes</td>
<td>TH 100, TH 101, TH 102, TH 103, TH 104, TH 106 (fully compatible with IMAGE1 S) 22,220055-3, 22,220056-3, 22,220053-3, 22,220060-3, 22,220061-3, 22,220054-3, 22,220055-3 (compatible without IMAGE1 S technologies CLARA, CHROMA, SPECTRA*)</td>
</tr>
<tr>
<td>LINK video outputs</td>
<td>1x</td>
</tr>
<tr>
<td>Power supply</td>
<td>100–120 VAC/200–240 VAC</td>
</tr>
<tr>
<td>Power frequency</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Protection class</td>
<td>I, CF-Defib</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>305 x 54 x 320 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>1.86 kg</td>
</tr>
</tbody>
</table>

* **SPECTRA A**: Not for sale in the U.S. **SPECTRA B**: Not for sale in the U.S.
**IMAGE1 S Camera Heads**

For use with IMAGE1 S Camera System

**IMAGE1 S CONNECT Module TC 200EN, IMAGE1 S H3-LINK Module TC 300**

and with all IMAGE1 HUB™ HD Camera Control Units

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**TH 100**

**IMAGE1 S H3-Z Three-Chip FULL HD Camera Head**, 50/60 Hz, IMAGE1 S compatible, progressive scan, soakable, gas- and plasma-sterilizable, with integrated Parfocal Zoom Lens, focal length \( f = 15–31 \) mm (2x), 2 freely programmable camera head buttons, for use with IMAGE1 S and IMAGE1 HUB™ HD/HD

<table>
<thead>
<tr>
<th>Specifications:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IMAGE1 FULL HD Camera Heads</strong></td>
<td><strong>IMAGE1 S H3-Z</strong></td>
</tr>
<tr>
<td>Product no.</td>
<td>TH 100</td>
</tr>
<tr>
<td>Image sensor</td>
<td>3x ( \frac{1}{3}'' ) CCD chip</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>39 x 49 x 114 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>270 g</td>
</tr>
<tr>
<td>Optical interface</td>
<td>integrated Parfocal Zoom Lens, ( f = 15–31 ) mm (2x)</td>
</tr>
<tr>
<td>Min. sensitivity</td>
<td>F 1.4/1.17 Lux</td>
</tr>
<tr>
<td>Grip mechanism</td>
<td>standard eyepiece adaptor</td>
</tr>
<tr>
<td>Cable</td>
<td>non-detachable</td>
</tr>
<tr>
<td>Cable length</td>
<td>300 cm</td>
</tr>
</tbody>
</table>

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**TH 104**

**IMAGE1 S H3-ZA Three-Chip FULL HD Camera Head**, 50/60 Hz, IMAGE1 S compatible, **autoclavable**, progressive scan, soakable, gas- and plasma-sterilizable, with integrated Parfocal Zoom Lens, focal length \( f = 15–31 \) mm (2x), 2 freely programmable camera head buttons, for use with IMAGE1 S and IMAGE1 HUB™ HD/HD

<table>
<thead>
<tr>
<th>Specifications:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IMAGE1 FULL HD Camera Heads</strong></td>
<td><strong>IMAGE1 S H3-ZA</strong></td>
</tr>
<tr>
<td>Product no.</td>
<td>TH 104</td>
</tr>
<tr>
<td>Image sensor</td>
<td>3x ( \frac{1}{3}'' ) CCD chip</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>39 x 49 x 100 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>299 g</td>
</tr>
<tr>
<td>Optical interface</td>
<td>integrated Parfocal Zoom Lens, ( f = 15–31 ) mm (2x)</td>
</tr>
<tr>
<td>Min. sensitivity</td>
<td>F 1.4/1.17 Lux</td>
</tr>
<tr>
<td>Grip mechanism</td>
<td>standard eyepiece adaptor</td>
</tr>
<tr>
<td>Cable</td>
<td>non-detachable</td>
</tr>
<tr>
<td>Cable length</td>
<td>300 cm</td>
</tr>
</tbody>
</table>
Monitors

9619 NB

19" HD Monitor, color systems PAL/NTSC, max. screen resolution 1280 x 1024, image format 4:3, power supply 100–240 VAC, 50/60 Hz, wall-mounted with VESA 100 adaption, including:
- External 24 VDC Power Supply
- Mains Cord

9826 NB

26" FULL HD Monitor, wall-mounted with VESA 100 adaption, color systems PAL/NTSC, max. screen resolution 1920 x 1080, image format 16:9, power supply 100–240 VAC, 50/60 Hz including:
- External 24 VDC Power Supply
- Mains Cord
## Monitors

<table>
<thead>
<tr>
<th>KARL STORZ HD and FULL HD Monitors</th>
<th>19&quot;</th>
<th>26&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall-mounted with VESA 100 adaption</td>
<td>9619 NB</td>
<td>9826 NB</td>
</tr>
</tbody>
</table>

### Inputs:

- **DVI-D**: ●
- **Fibre Optic**: –
- **3G-SDI**: –●
- **RGBS (VGA)**: ●●
- **S-Video**: ●●
- **Composite/FBAS**: ●●

### Outputs:

- **DVI-D**: ●●
- **S-Video**: ● –
- **Composite/FBAS**: ●● –
- **RGBS (VGA)**: ● –
- **3G-SDI**: – ●

### Signal Format Display:

- 4:3: ●
- 5:4: ●
- 16:9: ●
- Picture-in-Picture: ●●
- PAL/NTSC compatible: ●●

### Specifications:

<table>
<thead>
<tr>
<th>KARL STORZ HD and FULL HD Monitors</th>
<th>19&quot;</th>
<th>26&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desktop with pedestal</td>
<td>optional</td>
<td>optional</td>
</tr>
<tr>
<td>Product no.</td>
<td>9619 NB</td>
<td>9826 NB</td>
</tr>
<tr>
<td>Brightness</td>
<td>200 cd/m² (typ)</td>
<td>500 cd/m² (typ)</td>
</tr>
<tr>
<td>Max. viewing angle</td>
<td>178° vertical</td>
<td>178° vertical</td>
</tr>
<tr>
<td>Pixel distance</td>
<td>0.29 mm</td>
<td>0.3 mm</td>
</tr>
<tr>
<td>Reaction time</td>
<td>5 ms</td>
<td>8 ms</td>
</tr>
<tr>
<td>Contrast ratio</td>
<td>700:1</td>
<td>1400:1</td>
</tr>
<tr>
<td>Mount</td>
<td>100 mm VESA</td>
<td>100 mm VESA</td>
</tr>
<tr>
<td>Weight</td>
<td>7.6 kg</td>
<td>7.7 kg</td>
</tr>
<tr>
<td>Rated power</td>
<td>28 W</td>
<td>72 W</td>
</tr>
<tr>
<td>Operating conditions</td>
<td>0–40°C</td>
<td>5–35°C</td>
</tr>
<tr>
<td>Storage</td>
<td>-20–60°C</td>
<td>-20–60°C</td>
</tr>
<tr>
<td>Rel. humidity</td>
<td>max. 85%</td>
<td>max. 85%</td>
</tr>
<tr>
<td>Dimensions w x h x d</td>
<td>469.5 x 416 x 75.5 mm</td>
<td>643 x 396 x 87 mm</td>
</tr>
<tr>
<td>Power supply</td>
<td>100–240 VAC</td>
<td>100–240 VAC</td>
</tr>
<tr>
<td>Certified to</td>
<td>EN 60601-1, protection class IPX0</td>
<td>EN 60601-1, UL 60601-1, MDD93/42/EEC, protection class IPX2</td>
</tr>
</tbody>
</table>

### Optional accessories:

9826 SF **Pedestal**, for monitor 9826 NB  
9626 SF **Pedestal**, for monitor 9619 NB
with the compliments of
KARL STORZ — ENDOSKOPE