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MINI-LAPAROSCOPY IN UROLOGY – AN UPDATE

2nd Edition

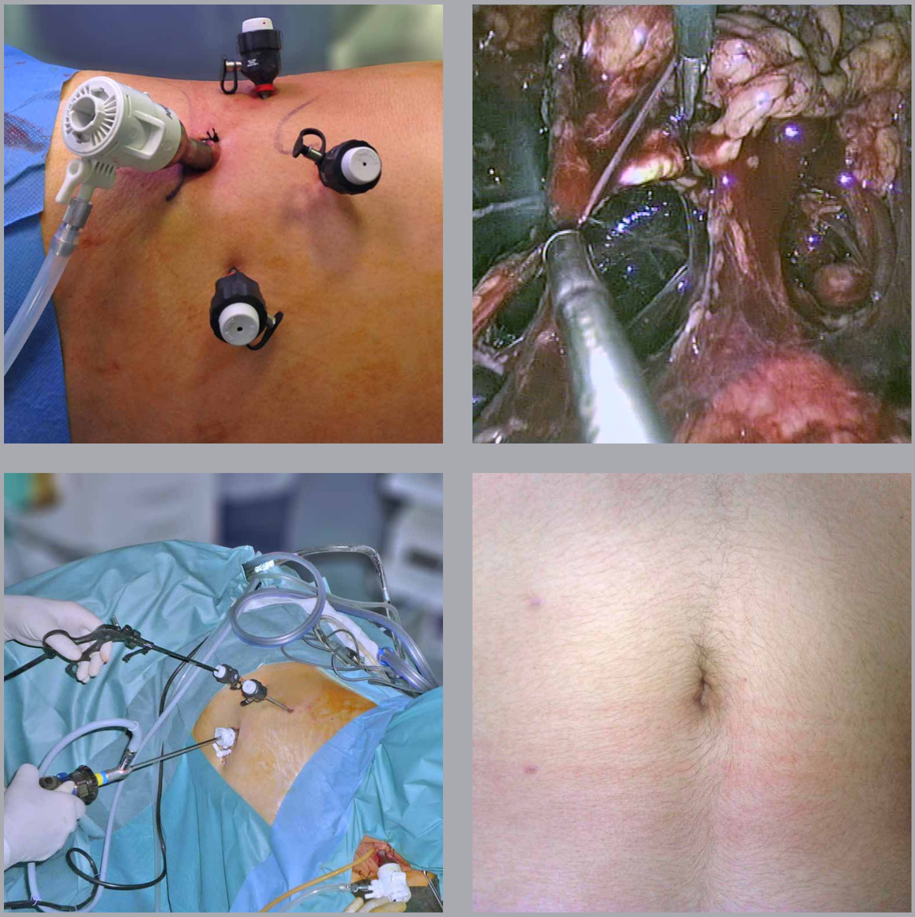

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Table of Contents

1 Introduction . . . 6
1.1. Terminology Issues and Definition . . . 6

2 Current Indications – Review of the Literature . . . 7
2.1. Reconstructive Surgery . . . 7
Ureteral Reimplantation . . . 7
Orchiopexy . . . 7
Varicocelectomy . . . 7
Pyeloplasty . . . 7
2.2. Extirpative Surgery . . . 8
Adrenalectomy . . . 8
Live Donor Nephrectomy . . . 8
2.3. Mini-Laparoscopic Technique . . . 9
Anderson-Hynes Pyeloplasty with a Transperitoneal Approach . . . 9
Adrenalectomy Using a Retroperitoneoscopic Approach . . . 11
Partial Nephrectomy Using a Retroperitoneoscopic Approach . . . 12
Hybrid LESS Nephrectomy with Transperitoneal Approach . . . 14
Other Applications for the Use of 3-mm Instruments . . . 15
2.4. Experience with the Mini-Laparoscopic Technique . . . 16
Pyeloplasty . . . 16
Standard Versus Mini-Laparoscopic Pyeloplasty . . . 16
Adrenalectomy . . . 16
Partial Nephrectomy . . . 17
NOTES-Assisted Nephrectomy . . . 17
Hybrid LESS Nephrectomy . . . 17
2.5. Drawbacks of Mini-Laparoscopy . . . 18
2.6. Digital Image Enhancement and Mini-Laparoscopy . . . 18

3 Discussion . . . 21

4 Summary . . . 22

5 References . . . 23

Mini-Laparoscopic Instrument Set for Diagnostic, Reconstructive and Extirpative Urological Procedures . . . 25

1 Introduction

On account of the inherent benefits, namely decreased blood loss, less postoperative pain, earlier resumption of oral feeding and reduced hospital stay, laparoscopic surgery has become the procedure of primary choice in most urological operations. In recent years, a shift has occurred from traditional multi-incision laparoscopic surgery to 'single-incision' laparoscopic surgery (laparoendoscopic single-site surgery – LESS) and to 'nearly scarless' natural orifice translumenal endoscopic surgery (NOTES), a trend that is based on an increasingly widespread acceptance of minimally invasive approaches.[12,23,25,28,30,37] Meanwhile, the availability of small and efficient instruments along with the development of miniature scopes has sparked up a new interest for mini-laparoscopic and needlescopic procedures, which currently are among the major topics in the field of minimally-invasive approaches. Already in the 1970s, it was the use of small-calibre scopes and miniature instruments in emergency laparoscopy that opened up promising prospects in other specialties, and promoted their initial implementation in a diagnostic setting, particularly in the field of gynecology.[6,36]

Finally, the range of indications has been enlarged until mini-laparoscopy and needlescopy have become viable therapeutic options in selected centres.[7,17,18,21,49] From a theoretical point of view, these innovations reveal evidence of an ongoing change from conventional laparoscopy toward an even greater reduction in the size of access trauma and, a decline in the rate of surgical morbidity. Apart from that, the use of miniaturized scopes and instruments has the potential of improving cosmetic results, and this can be an important contributing issue in the preoperative decision-making for some patients.

The primary objective of this booklet is to offer a retrospective review of the literature evaluating the outcomes of mini-laparoscopic and needlescopic surgeries. In addition, the authors report on specific aspects of their experience related to feasibility, safety and effectiveness of mini-laparoscopy (mL) in urology. The booklet is complemented by the latest clinical applications of mL and gives an overview of the synergistic benefits that accrue from integration of a dedicated HD image enhancement system in the video-endoscopic system used in an operating theatre.

1.1. Terminology Issues and Definition

Unfortunately, there is little or no consensus on the appropriate terminology to be used, nor have any practice parameters been established on the size, number or combination of miniaturised instruments to be included in the definition of mini-laparoscopic surgery.

In the past, 'mini-laparoscopic' instruments were defined as having a size of 3 mm, while those with an outer diameter of less than 3 mm were termed as 'needlescopic' instruments (2-mm scopes are among those most widely used in this category). It was the advent of a new generation of efficient instruments measuring 3.5 mm in size, that prompted the authors to reconsider the specifications included in the definition, because this group of instruments is fully equivalent to that of 3 mm when compared to those measuring 6 mm in size. Accordingly, for the purpose of this brochure, the authors define 'mini-laparoscopic' instruments as having an outer diameter of 3 or 3.5 mm.

In an effort to promote a standardisation of terminology, the authors of this brochure use a modified definition provided by *Soble* and *Gill* in 1998, who defined mini-laparoscopic surgery as follows.[49]

Considering that urologists can choose between two different kinds of surgeries (reconstructive and extirpative), the authors believe that the definition should also reflect this difference.

Mini-laparoscopic procedures should meet the following criteria:

- In a **diagnostic** or **reconstructive** procedure that does not require specimen extraction at its conclusion, 3–3.5 (3.5)-mm instruments are used exclusively.
- In an **extirpative** mini-laparoscopic procedure that does not require specimen extraction, one 10-mm port and one 5-mm port are permissible while all remaining ports should have 3–3.5 mm in size.

Even though it has been suggested that the retroperitoneal space be developed with a custom-made 5-mm trocar with fix-mounted two fingers of a disposable glove,[35] the authors of this brochure hold the opinion that the use of a 10-mm port in a retroperitoneoscopic procedure should be allowable. The primary aim of using 10- and 5-mm ports is to improve laparoscopic vision and to facilitate the alternating use of various instruments, such as suction tubes and metallic / Hem-o-lok® clip appliers. Irrespective of whether there is a consensus on this specific point, it has a lot to commend the use of a 5- or 10-mm laparoscopic port. It is best practice in extirpative urologic procedures that a specimen is extracted through an incision, whereas there is no benefit to the patient from using only mini-laparoscopic instruments throughout the procedure and to make an incision for specimen retrieval at the end. Accordingly, the authors have adopted the use of a 12–15-mm incision, that is made at the beginning of surgery, allowing a 10-mm laparoscope to be used throughout the procedure.[49] In the case of transperitoneal surgery, a 10-mm port, placed at the umbilicus, warrants the best cosmetic results.

2 Current Indications – Review of the Literature

2.1. Reconstructive Surgery

There are only a few papers available in the literature on mini-laparoscopic or needlescopic reconstructive surgery.

Ureteral Reimplantation

In a retrospective analysis, *Tsai et al.* (2008) described a technique for ureteral reimplantation in patients with vesico-ureteral reflux using a 3-mm port.[51] Nine patients were treated with mini-laparoscopic nerve-sparing extravesical ureteral reimplantation without intraoperative complications and with a high success rate. The authors concluded that the adopted approach should be considered an effective and safe technique for the treatment of primary vesico-ureteral reflux, and emphasized that improved cosmetic results (three 3.5-mm incisions) and faster recovery can be achieved in comparison to the outcomes associated with the use of an open surgery technique.

Orchiopexy

In the *'milestone'* paper on needlescopy, *Gill* and *Soble* reported on orchiopexy.[49] They treated five patients with cryptorchidism, with a mean operative time of 60 minutes and a mean blood loss of < 5 ml. All of the procedures were uneventful, and the patients were discharged on the same day of surgery. The authors concluded that needlescopy has the potential to enhance patient satisfaction by minimising incision-related morbidity and improving cosmesis.

Varicocelectomy

In 2011 *Chung et al.* presented a personal approach for varicelectomy with preservation of testicular artery and lymphatic vessels by using an intracorporeal knot tying technique.[11] They treated 87 pts. (153 procedures), all of them were discharged within 24 h after surgery, neither immediate major nor late procedure-related complications were recorded. Only one (1.2%) recurrent varicocele was detected within a mean follow-up of 21 months (range 3–42). Neither hydrocele formation nor testicular atrophy was found during the follow-up period. The authors concluded that mini-laparoscopic varicocelectomy is both a safe and effectiv treatment option that can be used to ligate all spermatic veins and preserve spermatic arteries and lymphatic channels without leading to varicocele persistence or recurrence.

Pyeloplasty

Tan reported about his experience using a 3-mm laparoscopic port and concluded that mini-laparoscopy significantly enhances the ability to perform pyelo-ureteric 'microanastomosis', reduces postoperative pain and results in a 'spectacular' postoperative cosmetic outcome.[50]

In two papers published by *Pini et al*. (2012) and *Nasser et al.* (2014), perioperative and cosmetic outcomes of small-incision access retroperitoneoscopic technique pyeloplasty (SMARTp) were reported and compared with those of standard pyeloplasty.[32,35] Using the aforementioned technique, the authors created a retroperitoneal working space with a 6-mm custom-made balloon-trocar and performed the procedure with 3-mm instruments. They concluded that the outcome in terms of cosmesis (evaluated by use of objective measures) was statistically significant in favour of SMARTp; moreover the patients in the SMARTp group showed a faster drain removal and discharge from hospital than those of the standard treatment group. No statistically significant differences were noted between both groups regarding perioperative variables and postoperative pain.

In 2014, *Simforosh et al.* reported on the safety, efficacy and cosmetic results of mini-laparoscopic pyeloplasty in two pediatric (< 1 y) groups of 20 patients each, and presented a comparative analysis on the perioperative and cosmetic outcomes of standard pyeloplasty (sL) versus mini-laparoscopic pyeloplasty (mL). Operative time (total and anastomosis of ureteropelvic junction), hospital stay, and overall complication rate were significantly lower in mL than in sL. Mean appearance score and consciousness score showed significantly better results in the mL group. On the basis of these results, the authors concluded that mL pyeloplasty in infant patients with ureteropelvic junction obstruction (UPJO) is capable of creating a cosmetically more attractive result while being less invasive than sL pyeloplasty and affording similar functional outcomes.[47]

2.2. Extirpative Surgery

Different types of extirpative procedures have been performed using a mini-laparoscopic or needlescopic approach.

In the article cite above, *Soble* and *Gill* (1998) reported five cases of nephrectomy, four cases of nephro-ureterectomy, five cases of orchiectomy in patients with cryptorchidism, three cases of pelvic lymph node dissection (LND), five cases of marsupialisation (3 cases of lymphocele and 2 cases of renal cyst).[49] Conversion to conventional laparoscopy was required in only two cases, whilst conversion to open surgery was required in one case (pelvic LND) due to small bowel injury. Blood loss was < 100 ml in all cases, and almost all patients were discharged within 24 hours. The authors concluded that needlescopy is feasible and safe, may reduce postoperative pain, length of hospital stay as well as recovery time and offers improved cosmesis, even if mention should be made that the latter points were not included in the investigation and reported in a standardised fashion.

In an interesting review of his personal experience, *Gill* described the needlescopic retrieval of the distal ureter and bladder cuff during laparoscopic radical nephro-ureterectomy.[20] After 20 cases, the mean operative time was one hour, without intraoperative complications, and neither positive surgical margins nor local recurrence were detected after 11 months of follow-up. The author concluded that the technique was safe and produced an excision of the bladder cuff identical to that obtained with open surgery, however the main drawback of the technique was its long learning curve.

Adrenalectomy

Among the mini-laparoscopic or needlescopic extirpative procedures, adrenalectomy is the one most frequently performed.[10,21,26] More than ten years ago, *Gill et al.* (Cleveland, Ohio, USA) reported on their experience with 'needlescopy' to treat adrenal disease.[21] The outcomes of 15 needlescopic adrenalectomies were compared with 21 conventional adrenalectomies. The 'needlescopic' group had a shorter length of surgery, reduced blood loss and shorter hospital stay, whilst no significant complications occurred in either group. The authors concluded that needlescopy improves surgical outcomes and cosmesis.

Liao et al. (2008) published the results of a retrospective study based on 112 patients treated with transperitoneal needlescopic adrenalectomy for presumptively benign adrenal tumours < 5 cm in size.[26] All interventions were completed without any mortality or reoperation. The mean operative time was 151 min, and the mean blood loss was 30 ml. Only one patient required blood transfusion and application of a hand-assisted device. Conversion to standard laparoscopic instruments was necessary in another five patients. The authors concluded that needlescopic adrenalectomy is safe and effective for most adrenal tumours less than 5 cm in size and has acceptable operative times, although patients with previous upper midline or ipsilateral upper quadrant open surgeries may not be suitable candidates for a needlescopic technique.

Live Donor Nephrectomy

Breda et al. (2015) reported on the feasibility of living donor nephrectomy by using 3-mm instruments and a single 5-mm port for the scope.[9] A total of 13 cases underwent operative treatment, no intraoperative complications were recorded and all patients had a good recovery after surgery. In terms of cosmetic outcomes, the donors showed great satisfaction about the minimal size of incision and optimal aesthetic results when questioned at day 7 and 14 of the post-discharge follow-up. Early graft function was satisfactory at 1 and 3 months after kidney transplantation. The authors concluded that the single-port technique should be considered a good alternative option as compared to a standard laparoscopic approach and expressed confidence in the possibility that the higher degree of satisfaction in the donor population of the study may contribute to an increase in the rate of living kidney donation.

Few studies have explored the role of mL in this setting and the article of *Simforoosh et al.* (2015) is among those deserving mention.[48] In this recent study, mini-laparoscopic live donor nephrectomy was compared with a standard approach in a randomized fashion: 100 consecutive kidney donors were randomly enrolled in two equal groups for laparoscopic donor nephrectomy. Demographic, perioperative results were recorded and compared, whilst cosmetic appearance was assessed at 3-month follow-up by using the Patient Scar Assessment Questionnaire (PSAQ). Demographic data of the patients was not significantly different between both groups. Total operative time and mean hospital stay were similar in both groups. Ischemic time and kidney graft function assessed by serum creatinine values were comparable. Mean appearance score (34 vs. 29) and consciousness score (22 vs. 18) in PSAQ showed significantly better results in the mL group. The authors concluded that both types of approaches allowed for similar perioperative and 'functional' results, but the mL group was shown to have a significantly improved cosmetic appearance than that of the standard laparoscopy group.

In two reviews[30,37] (*Pini et al.,* 2012; *Micali et al.,* 2013) investigating the role of mini-laparoscopic surgery in the context of minimally invasive surgery (MIS), the authors concluded that reduced-size laparoscopic instruments, which stem from the current generation of technological innovations, have a similar effectiveness as classic instruments, even though there is still a need for some basic instruments such as clip applicators or haemostatic forceps. The trocar position is the same as in the original setting of standard laparoscopy, which is why the surgeon can draw upon experience and expertise that has already been gained. Accordingly, this allows to reduce the learning curve which is needed to achieve a good command of the skills imperative for mini-laparoscopic surgery. To date, mL offers better cosmetic results and reduced post-operative pain, irrespective of the fact, that clinical controlled randomized studies are still lacking.

The following is an analytical overview of contemporary indications, techniques, and outcomes of urologic mini laparoscopy in multiple European centers. *Porpiglia et al.* (2014) analysed the data of a total population of 192 patients, most of them were non-obese individuals with a low surgical risk profile. Indications for surgery were mostly non-oncologic (132 cases, 68.8%). Most of the procedures were undertaken on the upper urinary tract (133 cases, 69.2%) and with the primary intent of reconstructive surgery (109 cases, 56.7%). Overall operative time was 132 minutes, estimated blood loss was negligible while mean hospital stay was 5 days. Postoperative complications were found to be mainly related to a low Clavien grade (1 and 2). The authors concluded that a broad range of common procedures can be performed both safely and effectively with mini-laparoscopic techniques that are based on the principles of standard laparoscopy while at the same time offering the benefits of smaller surgical scars and reduced trauma.[38]

2.3. Mini-Laparoscopic Technique

Some urological procedures successfully performed with a mini-laparoscopic technique have already been described in detail, such as pyeloplasty, adrenalectomy, prostatectomy, nephrectomy (with a retroperitoneoscopic approach and NOTES-assisted) and other hybrid approaches.[41]

The following is to keep the reader abreast of mini-laparoscopic techniques used in the most common urologic procedures and to present the latest advancements in mini-laparoscopy that have recently been made at the author's institution. Apart from describing the urological indications amenable to a mini-laparoscopic approach, the authors emphasize that safety and effectiveness of the procedure can be maximised by adhering to patient selection criteria excluding morbidly obese patients with a history of previous surgery. This suggestion has also been made by other authors who commonly use needlescopy.[18,21,49]

In a nutshell, mini-laparoscopic techniques exactly reproduce the principles laid down for standard laparoscopy. Considering that the main operative steps are well-known to the reader, the authors decided to address only a few aspects of the procedure that will be enriched by a few 'tricks of the trade' and pieces of advise.

Anderson-Hynes Pyeloplasty with a Transperitoneal Approach

In the presence of left ureteropelvic junction (UPJ) obstruction, the authors adopt a transmesocolic approach as described above.[40] The pneumoperitoneum is established using a Veress needle, and the first port is placed at the umbilicus or 2 cm laterally, according to the patient's body habitus. A 3-mm 30°-miniature scope is used. The other two mini-ports are placed under direct vision along the hemiclavear line on the left and on the right of the miniature scope port. The final configuration of the three ports should be of triangular shape. The procedure first involves dissection of the pelvis and UPJ (Fig. 1) and a standard Anderson-Hynes dismembered pyeloplasty. Following resection of the UPJ (Fig. 2), suspension of the pelvis to the abdominal wall is performed with a right needle (Ethicon Prolene® 3-0 W630) in order to facilitate uretero-pelvic anastomosis.

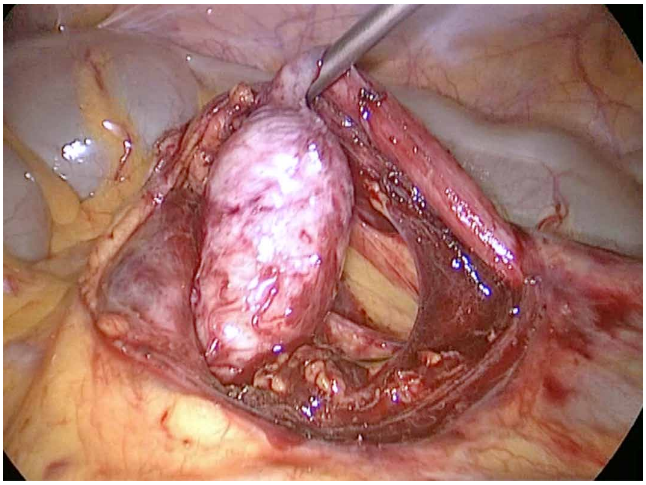

Fig. 1 Left mL pyeloplasty by using a transmesocolic approach. Note the small transmesocolic window created in this thin patient. The pelvis and UPJ were dissected and the surgeon lifts up the UPJ with a suction device.

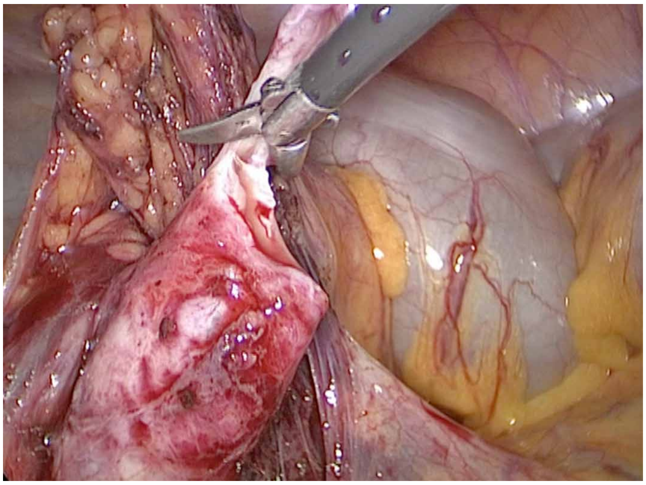

Fig. 2 Left mL pyeloplasty. The UPJ is resected with miniature forceps.

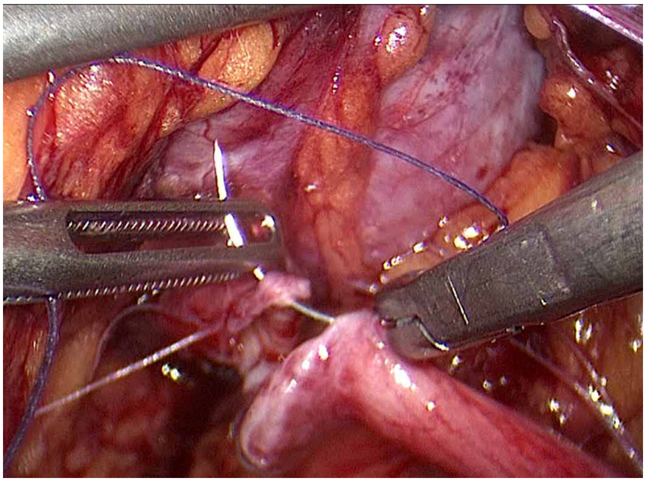

Fig. 3 Left mL pyeloplasty. Uretero-pyelic anastomosis with a 5/0 Vicryl® suture. Note the needle holder and the forceps almost identical to standard 5-mm instruments.

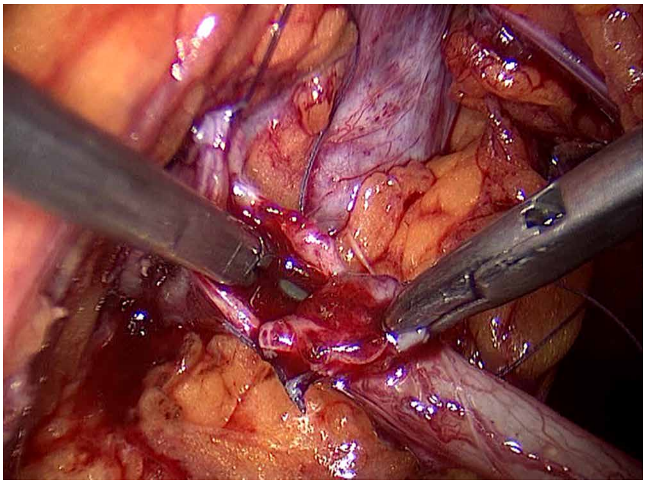

Fig. 4 Left mL pyeloplasty. The posterior portion of ureteropyelic anastomosis was completed. A 0,038" hydrophilic guidewire is inserted in a retrograde fashion into the ureter and gently grasped with a miniature forceps. Then, a double-J stent is placed over the wire in a retrograde fashion.

The suture material used for this purpose is a 4/0 monofilament (or a 5/0 Vicryl®) suture (Fig. 3). The needle is inserted through a mini-port. Once the posterior portion of anastomosis has been completed, a double-J ureteral stent is placed over a guidewire (Fig. 4) inserted in a retrograde fashion using a flexible pneumocystoscopy, as previously described.[16] The guidewire and ureteral stent may even be placed in an anterograde fashion, but in this case, an adjunctive port is needed. Alternatively, this can be accomplished by introducing the guidewire in an anterograde fashion through a peripheral venous catheter inserted through the abdominal wall. Reconstruction of the posterior peritoneum is performed, and an intraperitoneal drain is left in situ, if necessary. Mini-laparoscopic port sites do not require suture closure; a single small adhesive strip (Steri-strip™) is applied to approximate the skin margins.

In the presence of right uretero-pelvic obstruction, four mini-ports are used (Fig. 5). The first port is placed at the umbilicus, two mini-ports are established under direct vision near the right hemiclavear line, and the fourth port is placed just below the xiphoid and is used to retract the liver with a forceps. The UPJ is accessed through an incision made in the posterior peritoneum, if required, allowing upward mobilization of the right colonic flexure. Once the UPJ has been freed, a standard pyeloplasty is performed. Once the UPJ has been freed, a standard pyeloplasty is performed.

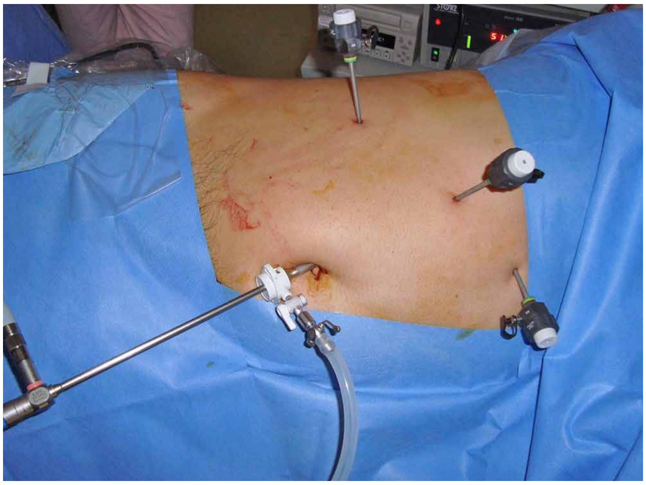

Fig. 5 Right mL pyeloplasty. Four ports are usually established, the first one for the scope at the level of the umbilical scar, the second one for the assistant is below the xyphoid to retract the liver. The other two ports are placed near the right hemiclavear line.

Adrenalectomy Using a Retroperitoneoscopic Approach

This approach is used to treat adrenal masses smaller than 6 cm in size.

Initially, a 12–15-mm transverse incision is made 1–2 cm just above the iliac crest, at the level of the inferior lumbar triangle (also known as ‘Petit triangle’). The retroperitoneal space is expanded with a balloon. Subsequently, three mini-ports are inserted under manual control in a ‘diamond’ shape, as shown in (Fig. 6). Finally, using a Hasson trocar, a 12-mm port is placed at the level of the first incision. Next, adrenalectomy is performed using a standard retroperitoneal technique. At the end of these dissection manoeuvres, the arterial adrenal pedicles and adrenal vein are carefully skeletonized, coagulated selectively and accurately using bipolar forceps until a long segment is freed (Figs. 7a, b). Next, the adrenal vein is transected close to the adrenal gland, leaving the coagulated stump at the renal vein or vena cava as long as possible. Thus, a completely clipless technique is possible. In some instances, however, especially on the right side (Fig. 8) or in cases where the pedicle is wide or if there is doubt about the level of sealing achieved through coagulation, an alternative option is suggested. The pedicles are prepared, the 12-mm laparoscope is then removed, and the 3-mm miniature scope is introduced through the right mini-port. The vein is then secured with Hem-o-lok® (through the 12-mm port) and sectioned. Upon completion of dissection, the specimen is extracted through the 15-mm incision in a retrieval bag under visual control using the miniature scope. In some cases, the wound is enlarged to facilitate specimen extraction, followed by surgical wound closure performed in two layers.

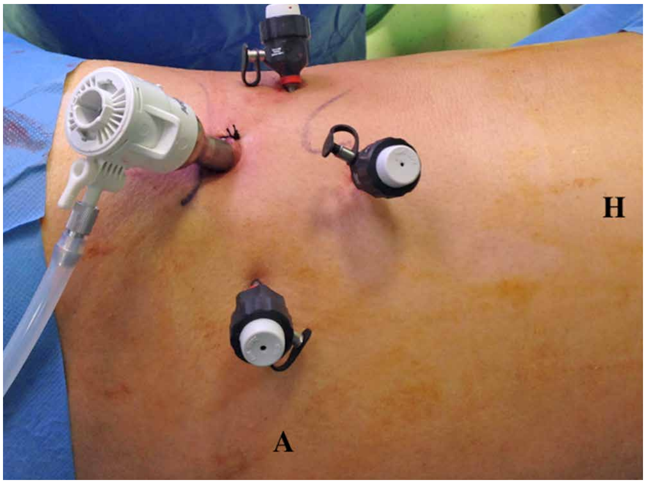

Fig. 6 Right mini-retroperitoneoscopic adrenalectomy. Note that the ports (three mini-ports and one standard 10-mm port at the level of the ‘Petit triangle’) form a ‘diamond’ shape. (**H** = head, **A** = abdomen). The port setup during a left-sided procedure is the same.

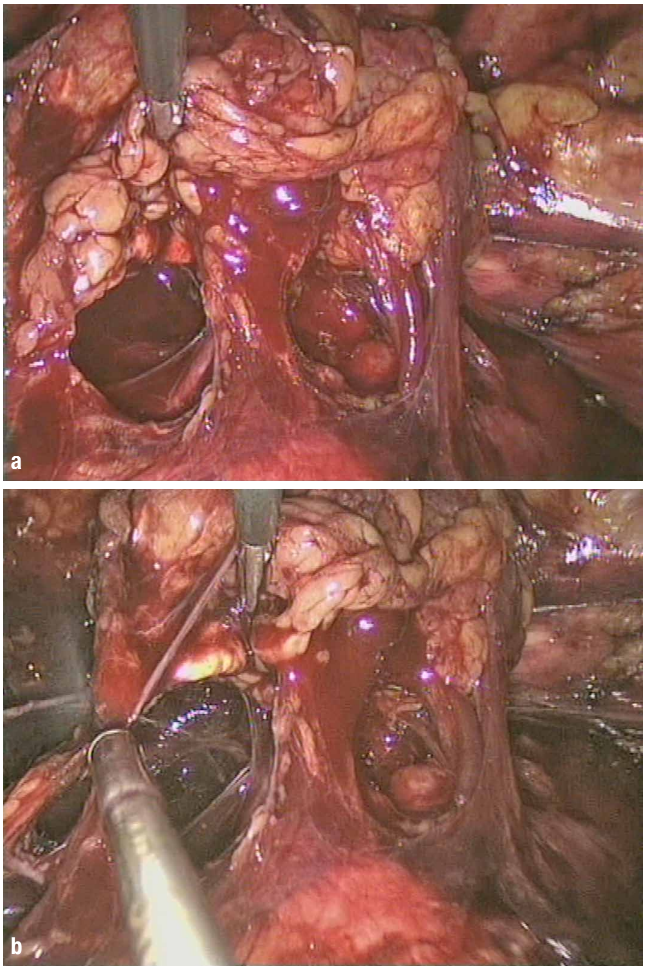

Fig. 7 Left mini-retroperitoneoscopic adrenalectomy. The adrenal gland is completely mobilized and vascular pedicles need to be managed carefully (**a**); Left retroperitoneal adrenalectomy: arterial pedicles are coagulated with bipolar forceps (**b**).

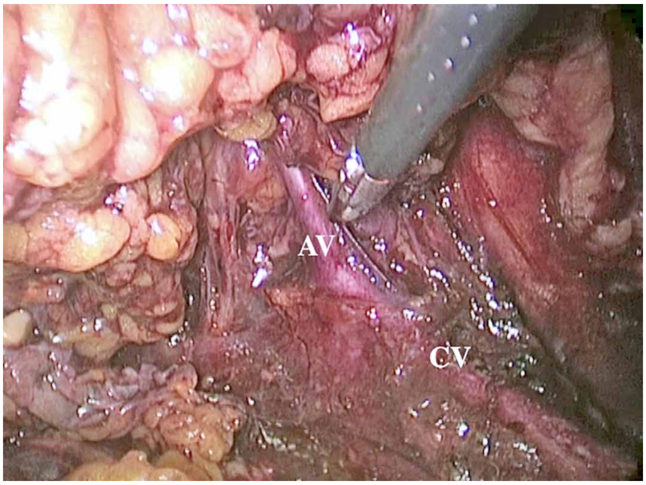

Fig. 8 Right mini-retroperitoneoscopic adrenalectomy. Cava vein (**CV**) and adrenal vein (**AV**) are completely dissected. The 12-mm laparoscope is then removed, and the 3-mm miniature scope is introduced through the right mini-port. The adrenal vein is then secured with Hem-o-lok® (through the 12-mm port) and sectioned. In case of right adrenalectomy, this is the safer procedure.

Partial Nephrectomy Using a Retroperitoneoscopic Approach

This approach has proven to be useful in the treatment of small, exophitic and posterior renal tumours.

Patient position, port configuration and dissection of the retroperitoneal space are the same as in mini-laparoscopic retroperitoneoscopic adrenalectomy (mini-rA).

The psoas muscle is freed completely, leaving the perirenal fat untouched. Identification of the hilar vessels is key to arrest bleeding in case of hemorrhage. Usually, identification of the renal artery via the retroperitoneal approach is a straightforward task (Fig. 9), however, this may be difficult if there is an abundance of fatty tissue in the renal hilar region. For this purpose, kidney and perirenal fat are mobilized upward with a 3 (3.5) mm forceps, as in a standard laparoscopic procedure.

Full or partial mobilization of the kidney is performed as determined by tumor location. When possible, targeted dissection of perirenal fat is performed, while occasionally, intraoperative laparoscopic ultrasonography may also be used to localize the tumour and to examine its consistency. If the need arises, the 10-mm laparoscope is removed, the 3-mm scope is introduced through the right mini-port and the ultrasonic probe is applied through the 10-mm port.

Provided strict adherence to patient selection criteria is ascertained, a 'clampless' technique is routinely applied. In case of need, occlusion of the renal artery is accomplished with a bulldog clamp introduced through the 10-mm port. In such cases, a miniature scope, introduced through a 3-mm port, is routinely used.

Following identification of the tumour, the peritoneum is mobilized upward by the assistant using a forceps that is introduced through the cranial mini-port. The renal parenchyma surrounding the tumour can be demarcated circumferentially with monopolar scissors. Carbon dioxide pressure is increased until reaching a level of 18–20 mmHg. Next, the renal parenchyma is incised (Fig. 10), the peritumoural fat is gently grasped with a forceps and the correct plane between tumour and healthy tissue is accessed. If possible, tumour excision is accomplished along the pseudo-capsule by blunt dissection with the aid of a suction tube and bipolar forceps. Vessels within the resection bed are coagulated with bipolar forceps (Fig. 11). Occasionally, sharp dissection or excision extending into healthy tissue is needed.

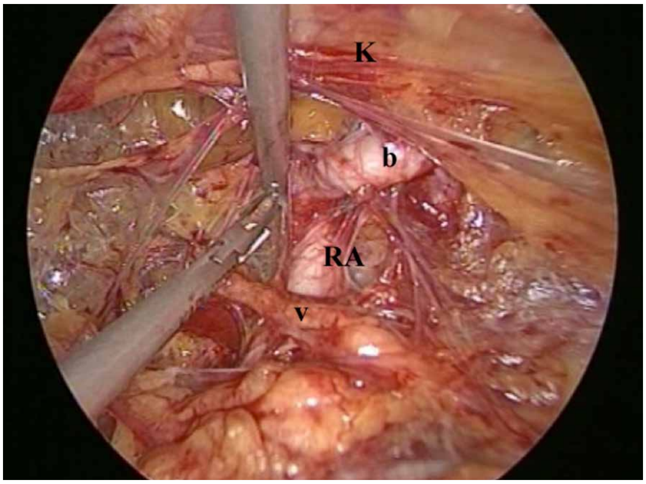

Fig. 9 Right mini-retroperitoneoscopic partial nephrectomy. Dissection of the renal artery is one of the first steps of the procedure. Even we usually do not clamp the artery during this intervention, we prefer dissect it with 3-mm forceps and suction device in case of urgent clamping is required.
RA = renal artery, **b** = branch of RA, **K** = kidney,
v = venous vessel that lay across RA.

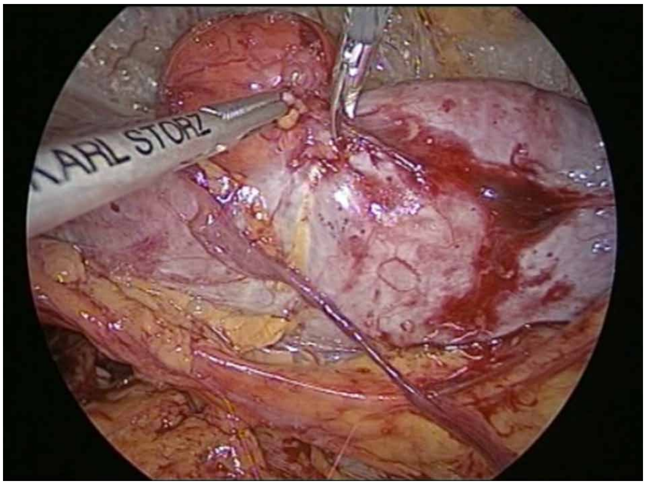

Fig. 10 Right mini-retroperitoneoscopic partial nephrectomy. Renal parenchymal incision. Note that the lesion is small and exophytic, the ideal case for this kind of approach. The lesion is progressively resected, when feasible, along the tumoral pseudocapsule.

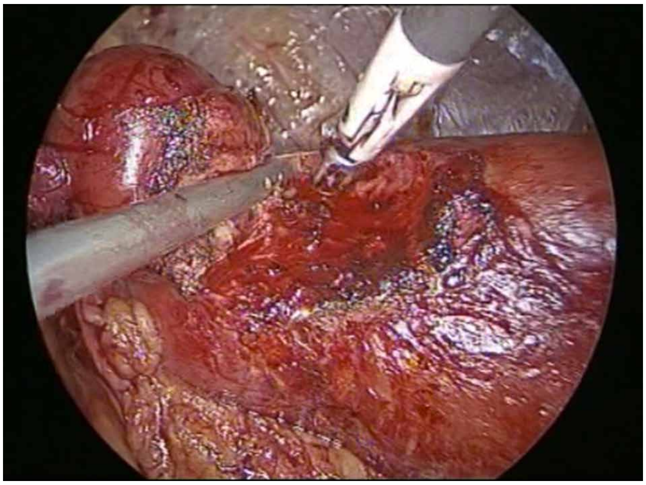

Fig. 11 Right mini-retroperitoneoscopic partial nephrectomy. At the end of the enucleation phase, vessels of the resection bed are coagulated with 3-mm bipolar forceps. The effectiveness and the ergonomics of this instrument are comparable with those used in standard laparoscopy.

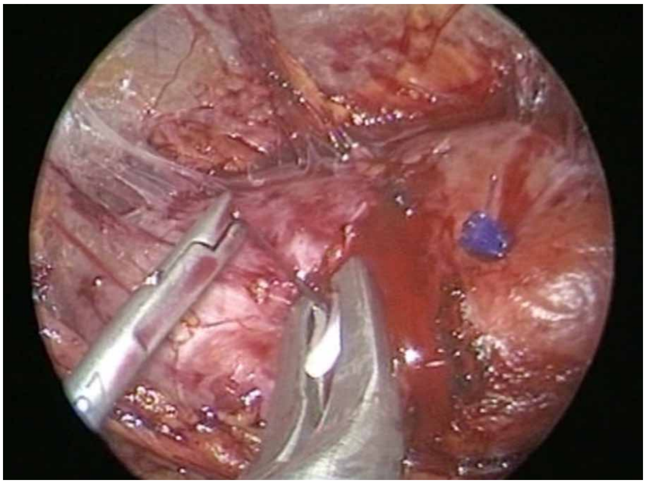

Fig. 12 Right mini-retroperitoneoscopic partial nephrectomy. In this phase, a 10-mm Hem-o-lok® clip applicator is used through the 10-mm port with the surgeon's right hand and a 3-mm needle holder with the left hand. The suture is passed through the depths of the parenchymal defect on one side and exits on its opposite side. Hem-o-lok® clips are applied to secure the suture under moderate tension. All of these surgical maneuvers are performed under visual control with the 3-mm scope placed in the right mini-port.

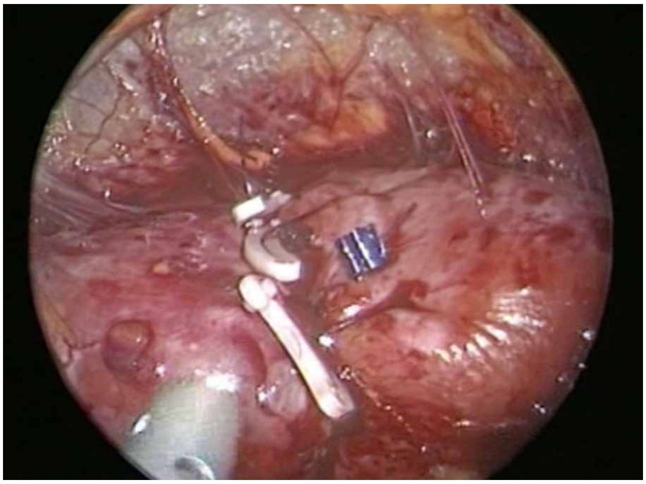

Fig. 13 Right mini-retroperitoneoscopic partial nephrectomy. Final aspect of suturing, captured with a 3-mm scope, 0°.

For this operative step, the authors commonly prefer the use of 3- (3.5)-mm instruments. In case of hemorrhage, and in case the 3-mm suction tube has shown to be inappropriate, the 10-mm scope is replaced with a miniature scope introduced through one of the mini-ports (the authors commonly use the right one). Thus, a standard suction tube and 5-mm instruments can be used; moreover, clamping of the renal artery is again an option, if needed.

The 10-mm scope is replaced with the miniature scope introduced through the right (anterior) mini-port. In this way, the surgeon can work with the right hand through the 10-mm port and with the left hand through a mini-port.

At the end of the procedure, a 15-cm 2/0 monofilament suture with a Lapra-Ty absorbable clip (Ethicon Endosurgery Inc., Cincinnati, Ohio, U.S.A.) is applied through the 10-mm port and the renorraphy is performed. Hem-o-lok® clips can be placed through the standard port and suturing is completed as in standard laparoscopy (Figs. 12, 13). Finally, hemostatic agents can be used.

A retrieval bag is introduced through the 10-mm port under laparoscopic vision by use of a 3-mm scope. Prior to specimen extraction, haemostasis is carefully accomplished after interruption of carbon dioxide insufflation, and finally, a drain is placed.

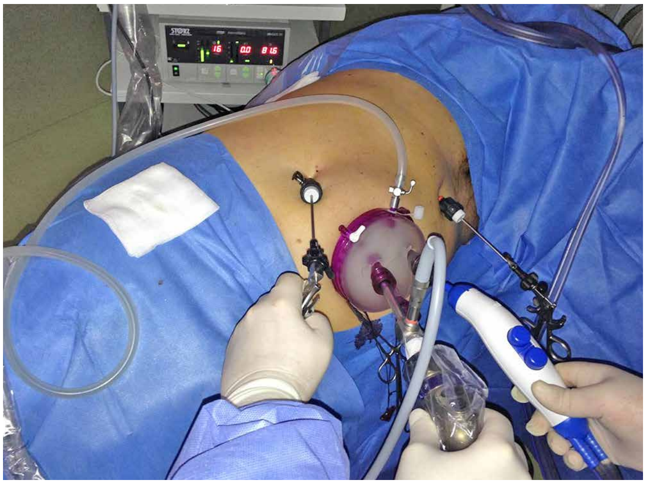

Fig. 14 Right mini-hybrid LESS nephrectomy. The surgeon uses a 3-mm forceps, inserted through the left (caudal) mini-port with the left hand, to retract the tissues. All other instruments (suction device in the picture) are controlled through one of the 10-mm ports of the GelPoint® device using the right hand. The assistant controls the camera via the GelPoint® device. The right (cranial) mini-port is used by the assistant to lift the liver. In this case, the forceps grasped superficially the inner part of the thoracic wall and 'become' auto-static. Note, that no dedicated (precurved or extra-long) instruments are used.

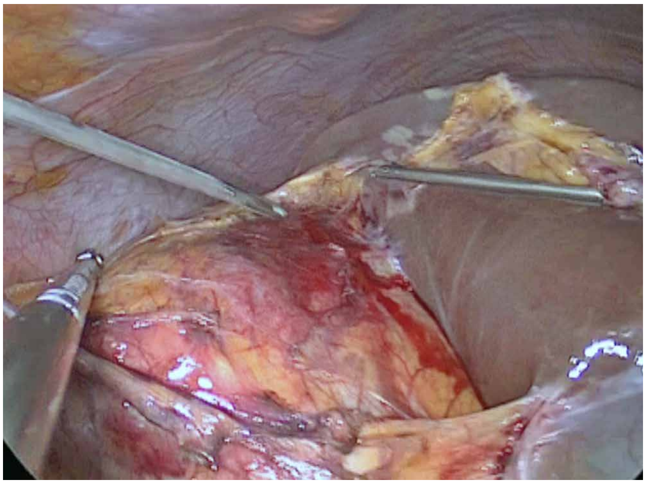

Fig. 15 Right mini-hybrid LESS nephrectomy. Initial step of nephrectomy for large renal tumour. Note two 3-mm grasping forceps: the first one is used through the right (cranial) mini-port to retract the liver, the second one is used by the surgeon to retract the peritoneum. A tissue sealer is introduced through the GelPoint® device.

Hybrid LESS Nephrectomy with Transperitoneal Approach

In the following, the authors present their preferred technique for hybrid LESS nephrectomy performed via adjunctive mini-ports (mini-hybrid LESS nephrectomy). The procedure has the same indications as those applicable in a standard LESS nephrectomy and can be used for large renal tumours not amenable to treatment by partial nephrectomy.

In slim patients, the authors prefer the use of a periumbilical access. A 4-cm incision is made at the level of the umbilicus. Following suspension of fascial layers, a GelPoint® Advanced Access Platform (Applied Medical, California, USA) is placed. Three 10-mm trocar ports are installed through this device: the first one is used for the scope, the others are available to the first surgeon. The use of this system obviates the need for using an extra-long laparoscope and precurved rigid instruments. Indeed, the authors routinely use a standard 10-mm scope with 30° angle of view, along with standard laparoscopic instruments. Following creation of pneumoperitoneum and videoscopic inspection of the peritoneal cavity through one of the 10-mm ports of the GelPoint® access device, two adjunctive mini-ports for 3-(3.5)-mm instruments are established under direct vision.

Right side: The first mini-port is placed just below the xyphoid and used by the assistant who mobilizes the liver upward with a mini forceps. The second mini-port is placed at the level of the anterior axillary line, 4–6 cm cranially to the iliac crest. This mini-port is reserved for the 3- (3.5)-mm forceps controlled with the surgeon's left hand for retraction of tissue. All other instruments (scissors, suction tube, Hem-o-lok® clips or tissue sealing devices) are inserted through one of the 10-mm ports of the GelPoint® device with the surgeon's right hand (Fig. 14). Based on this configuration, proper triangulation of instruments is warranted and clashing is dramatically reduced, thus allowing to overcome the main limitations of pure LESS (Fig. 15).

Owing to the use of these adjunctive ports, mini hybrid LESS nephrectomy can be performed following exactly the same steps as in standard laparoscopic nephrectomy through a transperitoneal approach.

Left side: Patient position and placement of the GelPoint® device are the same as in the procedure performed on the right side.

Even in this case, the authors suggest the use of two adjunctive mini-ports. The first mini-port is placed at the level of the hemiclavear line, 2 cm below the costal arch, the second one is placed at the level of the anterior axillary line, in the midline, 4–6 cm cranially to the iliac crest (Fig. 16).

A 3- (3.5)-mm forceps inserted through the subcostal mini-port is used by the surgeon's left hand to retract the tissues. All other instruments (scissors, suction device, Hem-o-lok® clips or tissue sealing devices) are controlled through one of the 10-mm ports of the GelPoint® device with the surgeon's right hand (Fig. 16). By using this type of configuration, the triangulation of instruments is similar to that of a standard laparoscopic procedure. Besides, the other mini-port can be used by the assistant to retract the colon (in case it gets in the line of sight and obstructs laparoscopic vision) or to mobilize the kidney upward during pedicle identification and surgical exposure.

Owing to the use of these adjunctive ports, mini-hybrid LESS nephrectomy can be performed following exactly the same steps as in standard laparoscopic nephrectomy through a transperitoneal approach.

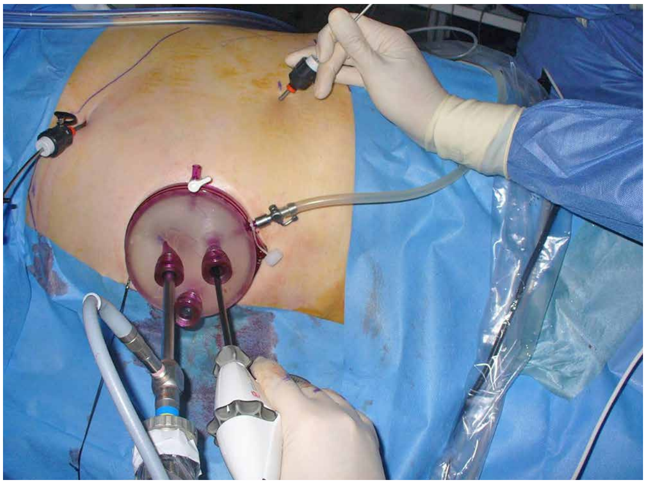

Fig. 16 Left mini-hybrid LESS nephrectomy. The surgeon uses a 3-mm forceps inserted through the left (cranial) mini-port with the left hand. All other instruments are controlled through one of the 10-mm ports of the GelPoint® device using the right hand. The assistant holds the camera that is inserted through the GelPoint®. The right (caudal) mini-port is used by the assistant to retract the bowel.

Other Applications for the Use of 3-mm Instruments

One of the main applications of mini-laparoscopic instruments is related to standard laparoscopy. In daily clinical practice, an adjunctive port is often required, e.g., when the need arises to retract various types of tissue or when traction on a suture is required while placing a running suture. In these cases, a 3-mm port can be used in lieu of a port of larger size, which can be helpful in improving effectiveness of the procedure and the cosmetic results attained from it. This applies to complex nephrectomies, and particularly to procedures performed on the right side of the patient, when a 3-mm port is established just below the xyphoid for retracting the bowel.

During robotic-assisted radical prostatectomy with the three-arm DaVinci® system, one or two mini-ports can be used as a left-hand port by the first assistant, while the other port can be used by the second assistant. During LESS procedure, when an adjunctive port is planned or becomes necessary during the intervention, the use of mini-laparoscopic instruments seems to be the best solution.

Finally, the authors have successfully used mL in patients with a history of abdominal surgery, as suggested by *Gill.*[20] The pneumoperitoneum can be established by passing the Veress needle through a safe abdominal quadrant at adequate distance from the previously treated site. The 3-mm port is placed to visualise the peritoneal cavity, so that the conventional port can be placed under visual control as usual.

2.4. Experience with the Mini-Laparoscopic Technique

In this section, the authors report on their experience with mini-laparoscopic surgery. The number of patients included in the study, specified for each procedure, was noted at the date of press release, while the authors' experience (such as the number of patients) with the mini-laparoscopic technique has been constantly growing since April 2009, the year of initial implementation. Nowadays, the technique is routinely applied in selected patients and for a wide scope of indications.

Pyeloplasty

In 2012, *Porpiglia et al.* reported on the feasibility of pure pyeloplasty on the basis of a prospective study involving 10 patients with ureteropelvic junction obstruction (UPJO).[44] Inclusion criteria were: age > 18 years, body mass index < 25, primary UPJO, and neither previous surgery on the affected kidney nor a history of major abdominal surgery. Demographic and perioperative data, as well as 1-, 3-, 6-, and 12-month follow-up data were recorded. The mean operative time was 134 minutes, and blood loss was negligible. All procedures but one were completed using only 3.9-mm ports and 3-mm instruments. No perioperative complications occurred, and all patients were cured of the disease. For the first time in this setting, the authors evaluated the cosmetic outcomes obtained from a mini-laparoscopic approach by use of an objective tool: the Patient Scar Assessment Questionnaire and Scoring System (PSAQ). The outcomes of this evaluation revealed that the patients tolerated the procedure well and appreciated its excellent cosmetic results.

Standard Versus Mini-Laparoscopic Pyeloplasty

In 2012, *Fiori et al.* compared perioperative and cosmetic outcomes of pure mini-laparoscopic pyeloplasty (mLP) with those achieved by standard laparoscopic pyeloplasty (sLP) in an adult population.[15] The data of 12 patients treated with mL were compared with data of 24 patients that had previously undergone sLP (by using standard ports and instruments) pooled from the database of the institution the authors are affiliated with. In all cases, an Anderson-Hynes transperitoneal approach was used. After surgery, cosmetic outcomes were assessed using a Patient Scar Assessment Questionnaire (PSAQ) whilst functional results after 1 year were controlled by using renal scintigraphy. While both techniques were safe and effective in the treatment of UPJO, postoperative hospital stay for the mLP group was significantly lower and PSAQ scores showed that mLP patients were significantly more satisfied with their cosmetic result (Fig. 17).

Adrenalectomy

Porpiglia et al. (2014) reported on their experience on mini-retroperitoneoscopic adrenalectomy after 50 procedures.[42] Forty eight patients with adrenal tumors < 6 cm in size and body mass index ≤ 35 were included in this prospective study and underwent mini-rA performed with 3-mm instruments. Demographic, endocrine and perioperative data, and cosmetic outcomes (using PSAQ) were recorded and analyzed. All procedures were performed with neither conversion to open surgery nor reoperation or mortality. Median operative time and blood loss were 90 minutes (range, 45–210 minutes) and 50 mL (range, 20–210 mL), respectively. Conversion to conventional laparoscopy was needed in 4 procedures (8%) and postoperative complications (Clavien grade ≤ 2) were recorded in 6 cases. Procedures performed in patients with benign lesions (n = 41) had significantly lower operative times and less complications as compared to those performed in patients with malignant lesions (n = 9). Median Patient Scar Assessment Questionnaire score was 30 (minimum score 28 = the best result; maximum score = 112, the worst result). The authors concluded that mini-rA is a feasible, safe, and effective technique in the treatment of adrenal masses < 6 cm in size, offering excellent results in terms of patient satisfaction with regard to symptoms and cosmesis, which was established by objective evaluation methods.

Fig. 17 Mini-laparoscopic right pyeloplasty: cosmetic results at three months post-surgery. Note, that the scar at umbilical level is invisible and the scars from the mini-ports are almost indiscernible.

Partial Nephrectomy

Porpiglia et al. (2014) reported on their experience with the treatment of 10 consecutive patients suffering from exophytic renal tumours < 5 cm with a PADUA score < 8,[39] who were subjected to mini-retroperitoneoscopic 'unclamped' partial nephrectomy (PN). Mean lesion size was 2.8 cm, and median PADUA score was 7. Operative times were 91.5 min., mean blood loss was 70 cc, no intraoperative complications were recorded and mean hospital stay was 4 days. Preliminary data show that the approach seems to be safe and effective, with comparable outcomes as those of standard LPN. Based on the data obtained from initial experience, mini-retroperitoneoscopic PN is used as first-line option at the authors' institution for the treatment of small, posterior and exophytic lesions.

NOTES-Assisted Nephrectomy

Porpiglia et al. (2011) reported on the feasibility of transvaginal NOTES-assisted mini-laparoscopic nephrectomy (mLN).[43] The port configuration for NOTES-assisted mLN involves that a mini-port is placed at the umbilicus for a 30° laparoscope; two mini-ports are placed in the flank at the same site as in standard transperitoneal nephrectomy; and a 12-mm transvaginal port is created by perforating the vaginal wall (Fig. 18). Kidney dissection is performed according to those operative steps commonly used in traditional nephrectomy (Fig. 19). The specimen is finally extracted through an extended incision made in the posterior vaginal wall. The authors treated five patients: the mean operative time was 120 min, blood loss was 160 ml, and no complications were recorded. Initial experience suggests that transvaginal NOTES-assisted mLN is feasible, simpler than a pure NOTES procedure and allows to yield excellent cosmetic results.

Hybrid LESS Nephrectomy

In a study based on data that has not been published yet, a total of 13 patient were subjected to mini hybrid LESS nephrectomy (malignant tumours in 12 cases and 12 cm angiomyolipoma in 1 case). Mean lesion size was 7 cm and mean PADUA score was 12. Operative times were 120 min, and mean blood loss was 120 cc. Neither intraoperative nor major post-operative complications were recorded. All patients were discharged after a mean of 4.6 days and were very satisfied (12/13, 92%) or satisfied (1/13, 8%) with the outcomes of the intervention. In conclusion, the results were fully comparable with those obtained from a standard procedure.

The port configuration for mini-hybrid LESS nephrectomy involves the use of two ancillary mini-ports (used in all cases: the first one for the surgeon and the second one for the assistant) permitted to perform nephrectomy according to those operative steps commonly used in a standard transperitoneal laparoscopic procedure without the need for using dedicated instrumentation (scopes or precurved instruments) and avoiding clashing of instruments frequently encountered in pure LESS. In terms of safety and effectiveness, the authors managed to draw upon the benefits of a standard procedure and synergistically combine them with those of LESS as regards cosmesis and abdominal wall trauma.

Fig. 18 Port placement for NOTES-assisted minilaparoscopic nephrectomy. The first surgeon uses the 3-mm instruments placed in the abdominal ports while the first assistant works with instruments inserted through the 12-mm port placed in the vagina. The principles of extirpative mL are fully observed.

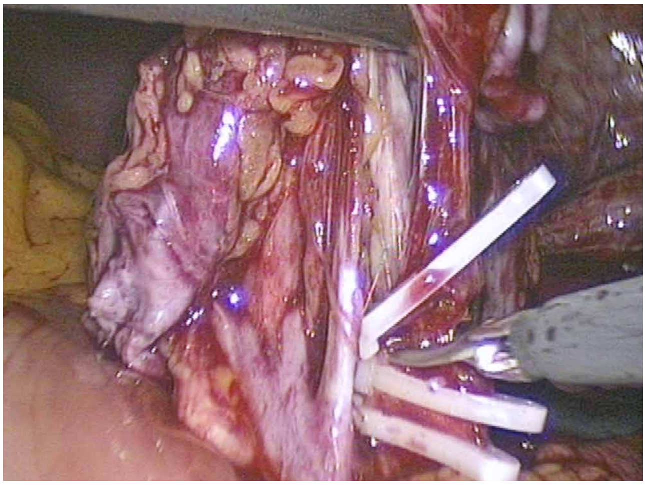

Fig. 19 NOTES-assisted mini-laparoscopic nephrectomy. The renal artery is secured with Hem-o-lok® clips and divided. The Hem-o-lok® applicator is inserted through the vaginal port and controlled by the first assistant.

2.5. Drawbacks of Mini-Laparoscopy

The mini-laparoscopic technique is also associated with some drawbacks described below.

- The quality of laparoscopic vision provided by the 3-mm needlescope is inferior to that of a 10-mm laparoscope in terms of image resolution, clarity and light transmission capacity. In order to improve vision, the camera zoom has to be set to maximum level, which is gained at the cost of a decline in image definition. Normally, image quality is sufficient given a clean operative field, but in case of bleeding, the resulting light absorption is associated with a substantial loss in image brilliance. Recent technological advancements made in video image enhancement systems (see below) have significantly contributed to offset these limitations.
- To date, mini-laparoscopic clips or Hem-o-lok® appliers are not available, and this is a clear limitation, particularly when an extirpative procedure is planned.
- Mini-laparoscopic instruments are more fragile than their 5- and 10-mm counterparts, even though the recent development of 3.5-mm instruments has helped to mitigate this problem. Anyway, a clear headway has been made in terms of sturdiness and durability when compared with 2-mm instruments.[49]
- The small diameter of suction/irrigation cannulas currently used in mini-laparoscopy largely accounts for poor flow rates, which in some cases leads to the inability of maintaining a clear surgical field. Occasionally, evacuation of smoke may also be compromised by the small-caliber ports, especially when an instrument is inserted.
- As is the case with any surgical approach, mini-laparoscopy requires the user to go through a learning curve. The surgeon and all members of the operative team should make themselves familiar with the procedure and acquire the ‘tricks of the trade’, such as those which have shown to be useful during change of instruments through a mini-port or a quick change of the scope.

Above all, prior experience with standard laparoscopy is highly recommended. Moreover, during a mini-laparoscopic procedure, standard instruments should always be on standby in case conversion to standard laparoscopic is required, which can become necessary especially in the sudden event of intraoperative bleeding.

Finally, mL is not indicated for all patients, and strict adherence to patient selection criteria is required, such as non-obese patients with no prior abdominal surgery and with small adrenal or renal masses, in order to reduce to a minimum the risk of complications and to maximise effectiveness of the procedure.

2.6. Digital Image Enhancement and Mini-Laparoscopy

As stated above, quality of laparoscopic images provided by miniature scopes seems to leave a bit to be desired as compared to that offered by standard scopes.

Recent innovations emerging in the field of digital image enhancement have prompted the authors to integrate this new technology in mini-laparoscopy in order to overcome some of its inherent limitations. At the authors’ institution, the decision was made to use IMAGE1 S technology (KARL STORZ Tuttlingen, Germany), a novel camera system equipped with various visualization tools that allow to enhance images obtained by the 3-chip full high-definition camera head.

In a nutshell, the IMAGE1 S camera system provides a very brilliant image. Color rendition and crisp details in full-HD resolution are based on 3-chip technology. An optical parfocal zoom allows the surgeon to digitally magnify the displayed image without any loss in quality.

IMAGE1 S technology allows various visualization tools to be used in different ways:

- Image enhancement in white light mode (CLARA, CHROMA, CLARA and CHROMA).
- Image enhancement by shifting the color spectrum (SPECTRA*).
- Side-by-side view. Parallel display of a standard white-light image along with a duplicate of the same operative site to which one of the above visualization modes (CLARA, CHROMA, CLARA and CHROMA, and SPECTRA*) is applied.
- IMAGE1 S gives the option of simultaneous presentation, processing and documentation of digital images that are derived from two sources, e.g., for hybrid operations.

* *SPECTRA:* **Not for sale in the U.S.**

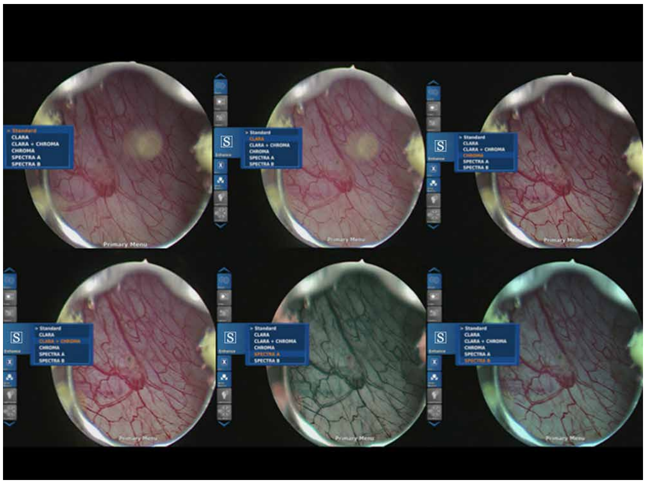

Fig. 20 Endoscopic views provided by a IMAGE1 S FULL HD camera. Note the differences between the various visualization modes offered by the system.

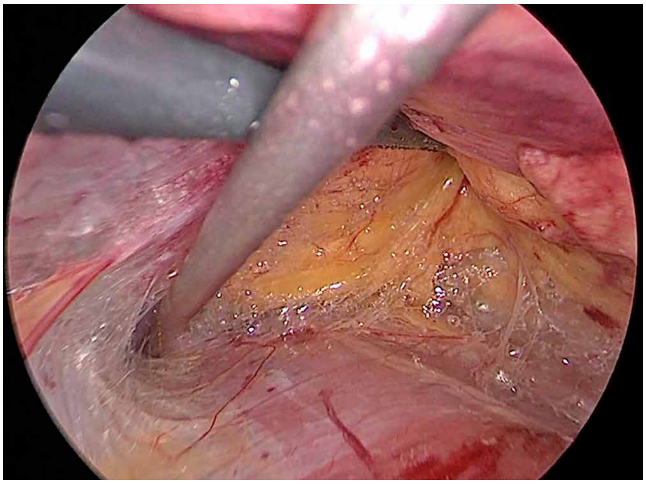

Fig. 21 Right mini-retroperitoneoscopic partial nephrectomy. Initially, dissection of the renal space is carried along the psoas muscle. Note the details of the operative fields (i.e. the small vessels of fatty tissue) obtained by the IMAGE1 S camera (10-mm scope) preadjusted to CLARA. The surgeon is offered a very good endoscopic image, with outstanding clarity of details in both light and dark areas subtly harmonized with each other.

In the following, the authors provide a survey of the main features of the IMAGE1 S system (Fig. 20).

CLARA: on account of its homogeneous illumination properties, the surgeon can benefit from a clear representation of details in both light and dark areas. As a result of real-time digital image processing, both light and dark areas of the image are subtly readjusted and harmonized with each other.

CHROMA: this mode has been designed to intensify color contrast in the image allowing the surgeon to differentiate more clearly between tissue structures / surfaces while retaining the natural color perception in the image.

CLARA and **CHROMA:** combines the above modes. The resulting appearance of the image is very impressive, 'near-to-3D'.

SPECTRA*: this mode allows an improved recognition of finest tissue structures. The bright red portions of the visible spectrum are filtered out and the remaining color portions are expanded. This makes it easier to differentiate between various types of tissue and has shown to be useful in haemostasis in that it facilitates spots of active bleeding to be more readily detected.

In **SPECTRA A*,** red color is totally eliminated while in **SPECTRA B**** it is partially restored with intensification of blue/red colours.

Considering the synergistic effects offered by integration of this technology in clinical practice, the authors decided to routinely use the IMAGE1 S camera system in mini-laparoscopic procedures. According to their experience, the use of this new technology has boosted the use of a fully mini-laparoscopic approach even in advanced surgical procedures because the outstanding intraoperative vision provided by the IMAGE1 S system allows the surgeon to operate with 3-mm miniature scopes (Fig. 21). In other words, the mini-laparoscopic vision offered by this new technology is almost comparable to that of standard scopes, even though this rather subjective assessment may need to be corroborated by checking with other reputable sources.

Porpiglia et al. (2014) reported on their experience with 'IMAGE1 S-assisted' mini-retroperitoneoscopic partial nephrectomy describing the advantages offered by integration of this technology.[39] The authors are convinced that the new approach is well-suited for getting closer to the goal of reduced invasiveness of conventional laparoscopy and allows to maintain high-quality intraoperative vision through integration of an image enhancement system, even when using 3-mm scopes and adhering to the proven concept of triangulation widely accepted in standard laparoscopy (Figs. 22–26, see overleaf).

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

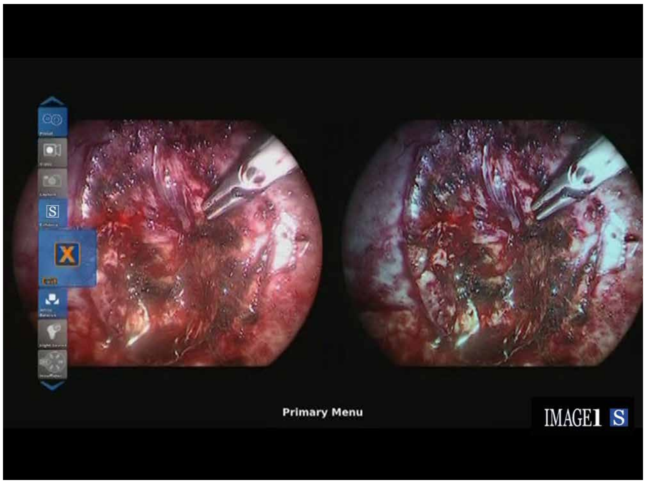

Fig. 22 Right mini-retroperitoneoscopic partial nephrectomy. The lesion has already been removed and the vessels of the resection bed are coagulated. Left side: the image is obtained using the IMAGE1 S camera (3-mm scope) with CLARA and CROMA; right side: The image is obtained using the IMAGE1 S camera (3-mm scope) with SPECTRA B**. Note the difference between both images. With SPECTRA B**, the bright red portions of the visible spectrum are filtered out and the remaining color portions are expanded. This makes it easier to differentiate between various types of tissue which is helpful in haemostasis in that it allows to visualize more readily remaining spots of active bleeding.

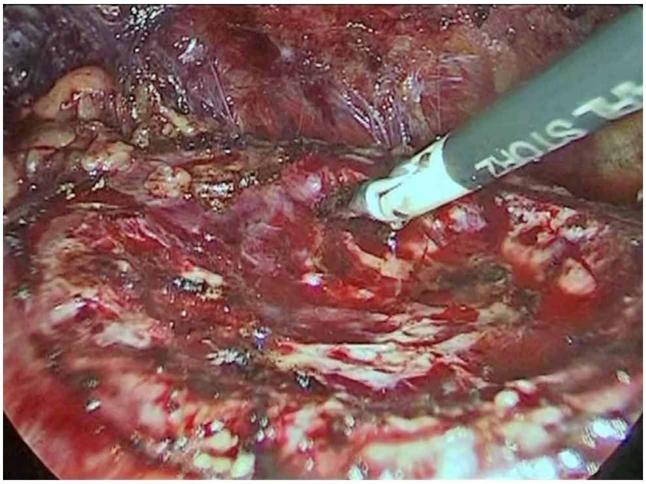

Fig. 23 Right mini-retroperitoneoscopic partial nephrectomy. Coagulation of the resection bed by using 3-mm bipolar forceps. The image is obtained using IMAGE1 S camera (10-mm scope) with SPECTRA B**.

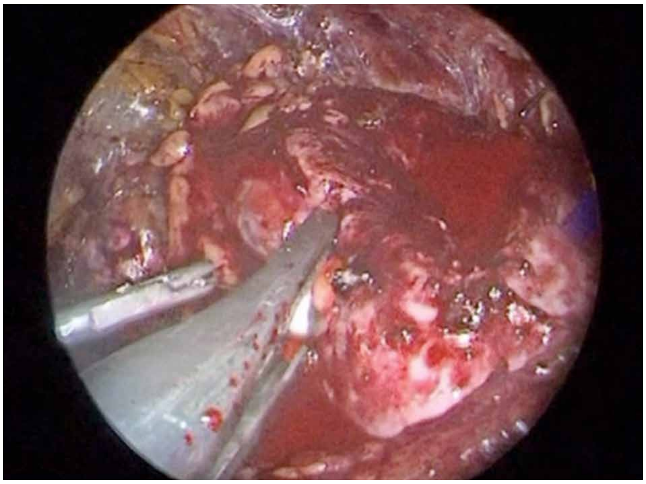

Fig. 24 Right mini-retroperitoneoscopic partial nephrectomy. The suture of renal parenchyma is secured by Hem-o-lok® and Abso lok clips®. The image is obtained using IMAGE1 S camera (3-mm scope) with CLARA and CROMA.

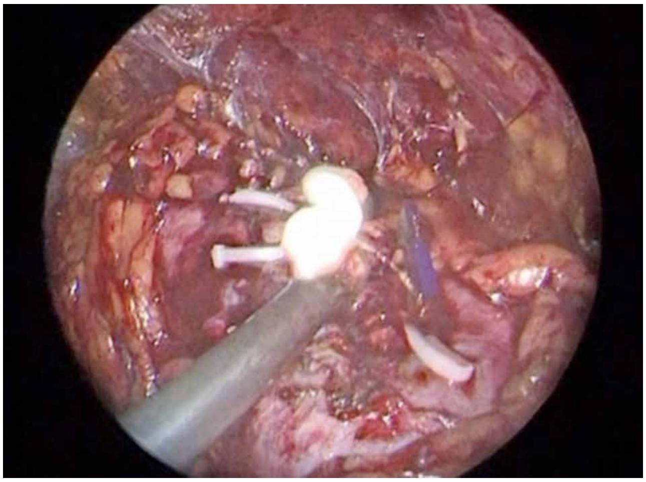

Fig. 25 Right mini-retroperitoneoscopic partial nephrectomy. The suture of the parenchymal defect is completed and a haemostatic agent (Floseal®) is injected through the 10-mm port. The image is obtained using IMAGE1 S camera (3-mm scope) with CLARA and CROMA.

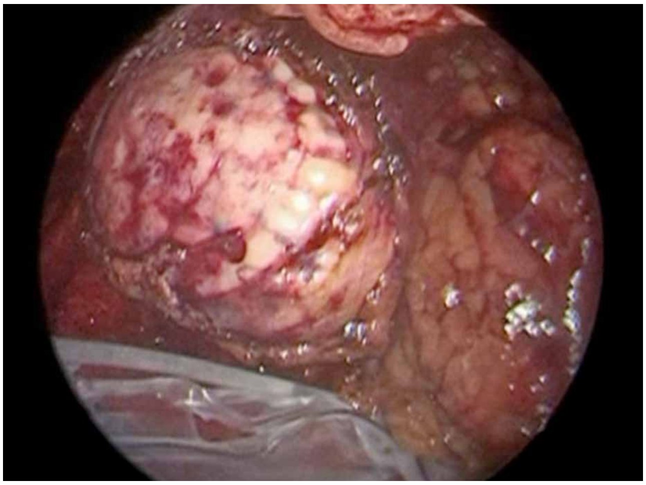

Fig. 26 Right mini-retroperitoneoscopic partial nephrectomy. The specimen is entrapped in plastic retrieval bag introduced through the 10-mm port. The image is obtained using IMAGE1 S camera (3-mm scope) with CLARA and CROMA.

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

3 Discussion

In recent years, the paradigm of 'large incision = great surgeon', which from a historical point of view was part of the mind-set of many surgeons, has dramatically changed with the advent of laparoscopy, a revolutionary technique that is among the most important advancements in the field of surgery during the past two decades. Since the time of its inception, relentless efforts have been made to continuously improve and refine the scientific concepts of laparoscopy and the instruments / technological components that are used in daily practice to further reduce the invasiveness of laparoscopic procedures. The understanding that the surgical wound by itself is a 'disease' with metabolic implications far beyond cosmetics, along with the technological advancements made on the part of the industry, have set the groundwork for minimally invasive surgery.[31,43]

With this objective in mind, a series of medical devices and instruments have been proposed, such as 'single-port' devices and small-calibre instruments (5, 3, 2 mm), designed for being used in new approaches, have been described.[3,5,19,24,30,38]

LESS and NOTES have been proposed as another evolutionary step exceeding the limits of standard laparoscopy.[3,5,19,24]

Even if from a theoretical point of view NOTES represents the real 'scarless' surgery, its use in clinical practice is anecdotal and to date only few cases of pure NOTES procedures have been reported.[24] Conversely, the use of LESS is gaining more widespread acceptance among surgeons worldwide since its introduction.[14,27,33] Based on the current literature, perioperative results of LESS are comparable to those obtained from standard laparoscopy, while outcomes related to postoperative pain control, length of hospital stay and cosmesis remain controversial.[14,33] On the other hand, LESS is fraught with significant drawbacks wuch as lack of triangulation, limited tissue retraction, clashing of instruments and tunnel vision that represent additional challenges for the surgeon compared with standard laparoscopy.[5,19] To overcome these limits, adjunctive ports are often required during LESS procedures In a recent multi-institutional analysis on 1076 cases, *Autorino et al.* and *Kaouk* reported that a planned additional port of standard size was used in 23% of cases of LESS.[27]

Previously reserved for diagnostic purposes only, mini-laparoscopic or needlescopic techniques have been used for therapeutic procedures as well. Some authors, and our group, have demonstrated the feasibility and safety of various mini-laparoscopic procedures including appendectomy, cholecystectomy, Nissen fundoplication, thoracic sympathectomy and, from the urological point of view, pyeloplasty, adrenalectomy, nephrectomy, renal cyst marsupialisation and orchiopexy.[15,20,26,39,42,44,49] Apart from being used in 'pure' mini-laparoscopic procedures, small instruments have also shown to be helpful when used through adjunctive ports in standard procedures, NOTES or LESS or through ancillary ports in robotic-assisted procedures.[2,31]

One of the key advantages of mini-laparoscopic procedures is that the 2- and 3-mm incisions do not necessitate suture closure while the resulting scars are almost invisible.[25,29] In randomized studies comparing mini and standard laparoscopy both patients and blinded observers scored mL wounds significantly better with regard to cosmetic appearance.[8,30,34] In a recent paper, analysis of cosmetic outcomes of open, standard and mini-laparoscopic retropubic radical prostatectomy (RP) concluded that mini-laparoscopic RP is associated with a minimal surgical scar and offers a better cosmetic outcomes when compared to both open and standard laparoscopic RP.[45] One should note that, although the clinical relevance of differential scarring after mL can be questionable, even a small cosmetic benefit can have a positive psychological impact, especially on young woman.

Moreover, some authors have demonstrated that mL significantly improves pain and recovery when compared to conventional laparoscopy. *Novitsky et al.,* for instance, reported on a prospective randomised study on 97 patients treated randomly with mini- or conventional laparoscopic cholecystectomy. The authors concluded that the use of a mini-laparoscopic technique resulted in decreased early postoperative incisional pain and prevented late incisional discomfort.[34] Other investigators in non-urologic RCTs have confirmed these data, even if the direct link between further reduction in wound size and decreased pain has not been consistently confirmed.[1,30]

Moreover, based on the experience of the authors and other specialists in the field, mL is capable of significantly reducing the mean length of hospital stay when compared to a standard approach.[15,32,34]

One of the clear advantages of the mL approach in comparison to LESS and NOTES lies in the learning curve. Even if mL is associated with a certain learning curve, its rise is significantly less steep than those of the other two approaches. As previously mentioned, the surgical steps used in mini-laparoscopic procedures are essentially identical with those of standard laparoscopy. Apart from that, the principle of triangulation, which consitutes a key element of all laparoscopic approaches, is maintained. In an interesting study on a porcine model, *Autorino et al.* reported on the results of LESS, NOTES and mini-laparoscopic nephrectomies performed by 14 different surgeons. The subjective assessments on the level of difficulty experienced during the trial were graded and expectations ahead of the procedure were recorded. In conclusion, mL was considered less challenging and, for all the techniques, expectations were in line with the real experiences.[4]

Moreover, mL seems to reduce surgical stress response as reported by *Yoder et al.,*[52] who measured cortisol and glucose production after nephrectomy when using various surgical approaches in a canine model. Similar results were reported by *Schmidt et al.,*[46] who analysed electroconductivity of representative dermatomes after mL and standard cholecystectomy. Even if not immediately transferable to clinical practice, these findings seem to be interesting.

Finally, mL seems to be an interesting option also when costs are considered as was shown in several studies.[13,22] The authors demonstrated a significant cost-saving effect when compared to open surgery, standard laparoscopy and LESS.

In conclusion, based on the consolidated experience of the authors of this brochure, mini-laparoscopy is a feasible and safe treatment option for many urological diseases and may be used sucessfully for both extirpative and reconstructive procedures in selected cases.

The authors are convinced that laparoscopic procedures performed through ports of reduced size will play an increasingly important role in the field of urology. The recent advancements made in the area of mini-laparoscopy and needlescopy, along with the novelties developed for robotic surgery systems (da Vinci System, Intuitive Surgery) confirmed us that this thought goes in the right direction. Moreover, in the authors' view, the future of mL is strictly related to continuing technical advancements that should be geared toward the availability of 3 (3.5)-mm clip appliers, efficient suction devices and further improvements in the field of miniature scopes. Provided that the next technological refinements meet the needs of surgeons, mL can constitute a solid alternative to conventional laparoscopy, not only in selected centres. The development of 3.5-mm instruments and the integrated use of digital image enhancement systems in mini-laparoscopic procedures (e.g., IMAGE1 S) are the right basic steps in this direction.

In the meantime, we think that the best way to draw advantages of mL is to use it when significant laparoscopic experience has been achieved, in selected cases, and to expand its use by combining it with conventional laparoscopy, NOTES or single-port devices.

4 Summary

Mini-laparoscopy is both safe and effective in the treatment of many urological diseases. One of the most important advantages of mL, which was confirmed by our experience, is the cosmetic result. Strict patient selection and adequate experience with standard laparoscopy are key criteria for limiting the occurrence of complications and maximising the successful outcome of the procedure.

Currently, 3 (3.5)-mm instruments and miniature scopes can be used as the sole components of the endoscopic-surgical equipment. As an alternative option, this setting may be extended to standard laparoscopy, NOTES or a 'single port' approach.

Recent reports confirmed the initial encouraging outcomes of mL, however further studies are needed to determine the validity of other advantages of mL over other minimally invasive approaches. Even though recent advancements have been accomplished in the area of instruments and visualization systems, continuing efforts should be made in this direction and, in the meantime, it is recommended that hybrid techniques be developed.

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Size 3 mm, length 36 cm

26007 AA	**HOPKINS® Straight Forward Telescope 0°,** enlarged view, diameter 3.3 mm, length 25 cm, **autoclavable,** fiber optic light transmission incorporated, color code: green
26007 BA	**HOPKINS® Forward-Oblique Telescope 30°,** enlarged view, diameter 3.3 mm, length 25 cm, **autoclavable,** fiber optic light transmission incorporated, color code: red
26120 JL	VERESS **Pneumoperitoneum Needle,** with spring-loaded blunt stylet, LUER-Lock, **autoclavable,** diameter 2.1 mm, length 13 cm
533 TVB	**Adaptor,** with ergonomic swivel, **autoclavable,** permits telescope changing under sterile conditions
4x 30114 GZG	**Trocar,** with pyramidal tip, with LUER-Lock connector for insufflation, size 3.5 mm, length 10 cm, color code: green
31351 ML	**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 3.5 mm, length 36 cm
31351 R	**CLICKLINE Dissecting and Grasping Forceps,** rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, right-angled, size 3.5 mm, length 36 cm
31352 ON	**CLICKLINE Grasping Forceps,** rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, single action jaws, fenestrated, with especially fine atraumatic serration, size 3.5 mm, length 36 cm
31351 UL	**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, robust, size 3.5 mm, length 36 cm
31351 MW	**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 3.5 mm, length 36 cm
26167 ANL	**Suction and Irrigation Tube,** with lateral holes, size 3.5 mm, length 36 cm, for use with handles for irrigation and suction
30805	**Handle with Two-Way Stopcock,** for suction and irrigation, **autoclavable,** for use with suction and irrigation tubes size 5 mm
38951 ON	**ROBI Grasping Forceps,** CLERMONT-FERRAND model, rotating, dismantling, with connector pin for bipolar coagulation, with especially fine atraumatic serration, fenestrated, double action jaws, size 3.5 mm, length 36 cm
26167 LNL	KOH **Ultramicro Needle Holder,** jaws curved to left, with tungsten carbide insert, straight handle, with disengageable ratchet, size 3.5 mm, length 36 cm
26167 RNL	**Same,** jaws curved to right
26005 M	**Unipolar High Frequency Cable,** with 5 mm plug for KARL STORZ AUTOCON® system (50, 200, 350), AUTOCON® II 400 SCB system (111, 115) and Erbe ICC units, length 300 cm
26176 LE	**Bipolar High Frequency Cable,** to KARL STORZ Coagulator 26021 B/C/D, 860021 B/C/D, 27810 B/C/D, 28810 B/C/D, AUTOCON® system (50, 200, 350), AUTOCON® II 400 SCB system (111, 113, 115) and Erbe coagulator, T and ICC series, length 300 cm

Size 5 mm

26046 AA	**HOPKINS® Straight Forward Telescope 0°,** enlarged view, diameter 5 mm, length 29 cm, **autoclavable,** fiber optic light transmission incorporated, color code: green
26046 BA	**HOPKINS® Forward-Oblique Telescope 30°,** enlarged view, diameter 5 mm, length 29 cm, **autoclavable,** fiber optic light transmission incorporated, color code: red
30160 GZG	**Trocar,** with pyramidal tip, with LUER-Lock connector for insufflation, size 6 mm, length 10 cm, color code: black
33332 ON	**CLICKLINE Grasping Forceps,** rotating, dismantling, without connection for unipolar coagulation, single action jaws, with especially fine atraumatic serration, fenestrated, size 5 mm, length 36 cm, for use with trocars size 6 mm

Minilaparoscopy in Urology

Recommended Basic Set by Prof. PORPIGLIA

34351 MS	**CLICKLINE** METZENBAUM **Scissors,** rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock connector for cleaning, double action jaws, curved, length of jaws 15 mm, size 5 mm, length 36 cm
38361 ON	**ROBI Grasping Forceps,** CLERMONT-FERRAND Model, rotating, dismantling, with connector pin for bipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, fenestrated, with especially fine atraumatic serration, size 5 mm, length 36 cm
37113 A	**Handle, pistol grip, with clamping valve,** for suction and irrigation, **autoclavable**
37360 LH	**Suction and Irrigation Tube,** with lateral holes, size 5 mm, length 36 cm, for use with suction and irrigation handles

Size 10 mm

26003 AA	**HOPKINS® Straight Forward Telescope 0°,** enlarged view, diameter 10 mm, length 31 cm, **autoclavable,** fiber optic light transmission incorporated, color code: green
26003 BA	**HOPKINS® Forward-Oblique Telescope 30°,** enlarged view, diameter 10 mm, length 31 cm, **autoclavable,** fiber optic light transmission incorporated, color code: red
30103 GZG	**Trocar,** with pyramidal tip, with LUER-Lock connector for insufflation, size 11 mm, working length 10 cm, color code: green

Light Cable

495 NAC	**Fiber Optic Light Cable,** with straight connector, extremely heat-resistant, with safety lock, increased light transmission, diameter 3.5 mm, length 230 cm, can be used for ICG applications
495 NCSC	**Fiber Optic Light Cable,** with straight connector, extremely heat-resistant, with safety lock, diameter 4.8 mm, length 250 cm

Sterilisation Container

39501 B2	**Tray for Cleaning, Sterilization and Storage,** of two rigid endoscopes and one light cable, with adaptor and silicone telescope holder, with lid, external dimensions (w x d x h): 487 x 125 x 54 mm, for rigid endoscopes with up to diameter 10 mm and working length 32 cm
39219 XX	**Rack,** with Instrument Tray 39502 V for Wire Tray 39502 X, for storage of up to 12 instruments with diameter 2.5 up to 10 mm, incl. bars with silicone holders, external dimensions (w x d x h): 463 x 238 x 125 mm
39753 A2	**Container,** with microstop, for sterilization and storage, external dimensions (w x d x h): 600 x 300 x 210 mm, internal dimensions (w x d x h): 548 x 267 x 186 mm

It is recommended to check the suitability of the product for the intended procedure prior to use.

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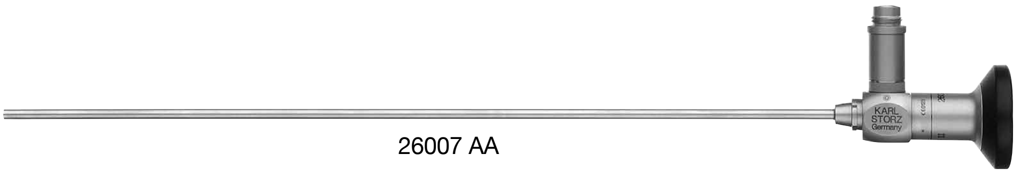
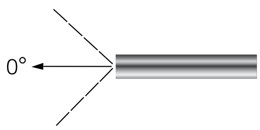
Diameter 3.3 mm, length 25 cm
Trocar size 3.9 mm



26007 AA



26007 AA **HOPKINS® Straight Forward Telescope 0°,**
enlarged view, diameter 3.3 mm, length 25 cm,
autoclavable,
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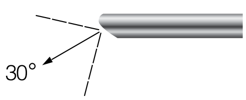
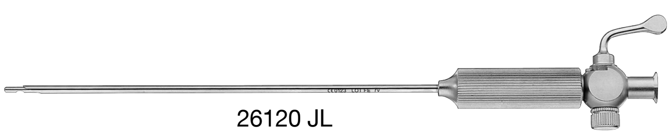
color code: green®



26007 BA **HOPKINS® Forward-Oblique Telescope 30°,**
enlarged view, diameter 3.3 mm, length 25 cm,
autoclavable,
fiber optic light transmission incorporated,
color code: red

VERESS **Pneumoperitoneum Needle**



26120 JL

26120 JL VERESS **Pneumoperitoneum Needle,**
with spring-action blunt inner cannula, LUER-Lock,
autoclavable, diameter 2.1 mm, length 13 cm

533 TVB

533 TVB **Adaptor,** with ergonomic swivel,
autoclavable, permits telescope
changing under sterile conditions

Trocars
Size 3.5 mm

30114 GZG **Trocar,** with pyramidal tip,
with LUER-Lock connector for insufflation,
size 3.5 mm, length 10 cm,
color code: green

including:
Cannula
Trocar only
Valve Seal

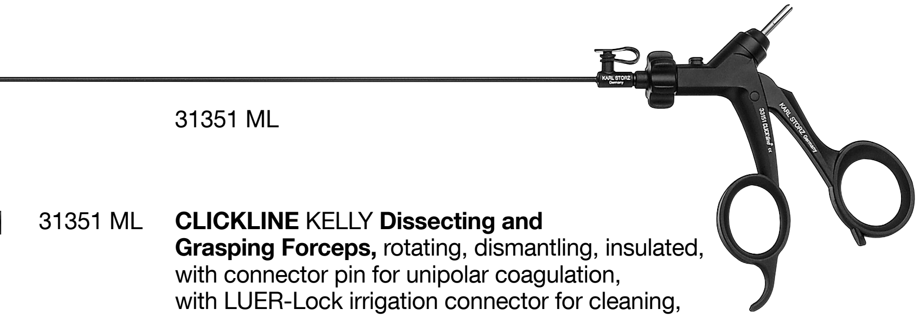
30114 GNS **Trocar,** with blunt conical tip,
with LUER-Lock connector for insufflation,
size 3.5 mm, length 5 cm,
color code: green

including:
Cannula
Trocar only
Valve Seal

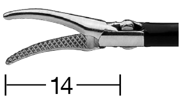
Dissecting and Grasping Forceps, Scissors

CLICKLINE – rotating, with connector pin for unipolar coagulation, double action jaws, insulated outer sheath

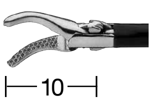
Size 3.5 mm
for use with high frequency surgery units



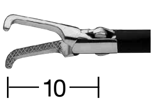
31351 ML



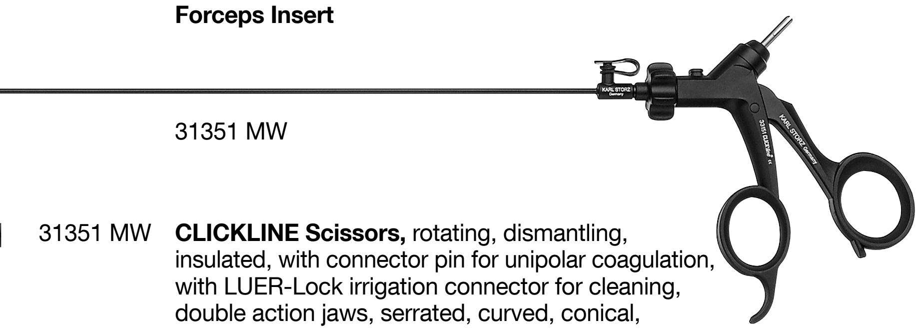
31351 ML **CLICKLINE** KELLY **Dissecting and Grasping Forceps,** rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, long, size 3.5 mm, length 36 cm
including:
Plastic Handle, without ratchet, with larger contact area
Metal Outer Sheath
Forceps Insert



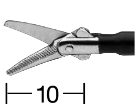
31351 MD **CLICKLINE** KELLY **Dissecting and Grasping Forceps,** rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, size 3.5 mm, length 36 cm
including:
Plastic Handle, without ratchet, with larger contact area
Metal Outer Sheath
Forceps Insert



31351 R **CLICKLINE Dissecting and Grasping Forceps,** rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, right-angled, size 3.5 mm, length 36 cm,
including:
Plastic Handle, without ratchet, with larger contact area
Metal Outer Sheath
Forceps Insert



31351 MW



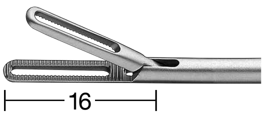
31351 MW **CLICKLINE Scissors,** rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, serrated, curved, conical, size 3.5 mm, length 36 cm
including:
Plastic Handle, without ratchet, with larger contact area
Outer Sheath
Scissors Insert

Dissecting and Grasping Forceps

CLICKLINE – rotating, single and double action jaws, outer sheath not insulated

Size 3.5 mm

31352 ON



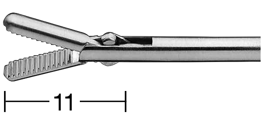
31352 ON **CLICKLINE Grasping Forceps,** rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, single action jaws, fenestrated, with especially fine atraumatic serration, size 3.5 mm, length 36 cm

including:

Plastic Handle, with ratchet, with larger contact area

Metal Outer Sheath

Forceps Insert

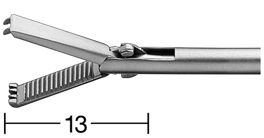


31352 UL **CLICKLINE** REDDICK-OLSEN **Dissecting and Grasping Forceps,** rotating, dismantling, insulated, with connector pin for unipolar coagulation, with LUER-Lock irrigation connector for cleaning, double action jaws, robust, size 3 mm, length 30 cm

including:

Plastic Handle, without ratchet, with larger contact area

Outer Sheath, with forceps insert



30341 MGG **CLICKLINE Dissecting and Grasping Forceps,** “tiger-jaws”, 2x 4 teeth, single action jaws, size 3 mm, length 36 cm

including:

Metal Handle, with disengageable ratchet

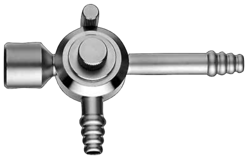
Outer Sheath, with forceps insert

Suction and Irrigation Tube, Two-Way Stopcock

Size 3.5 mm

26167 ANL

26167 ANL **Suction and Irrigation Tube,**
with lateral holes, size 3.5 mm, length 36 cm,
for use with handles for irrigation and suction



30805 **Handle with Two-Way Stopcock,**
for suction and irrigation, **autoclavable,**
for use with suction and irrigation tubes
size 5 mm

ROBI Grasping Forceps

Size 3.5 mm

38951 ON

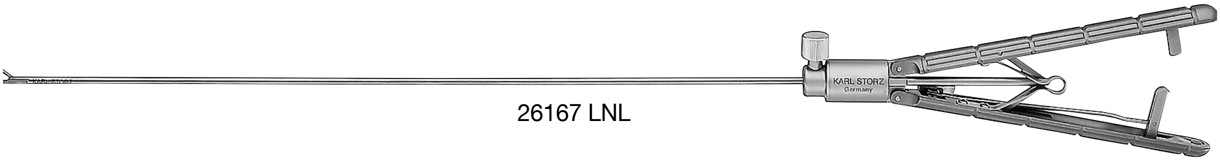
38951 ON **ROBI Grasping Forceps,**
CLERMONT-FERRAND model,
rotating, dismantling,
with connector pin for bipolar coagulation,
with especially fine atraumatic serration,
fenestrated,double action jaws,
size 3.5 mm, length 36 cm
color code: light blue

including:
ROBI Plastic Handle
ROBI Forceps Insert with Outer Sheath

38951 MD **ROBI** KELLY **Grasping Forceps,**
CLERMONT-FERRAND model,
rotating, dismantling,
with connector pin for bipolar coagulation,
especially suitable for dissection, double action jaws,
size 3.5 mm, length 36 cm
color code: light blue

including:
ROBI Plastic Handle
ROBI Forceps Insert with Outer Sheath

Needle Holder



26167 LNL

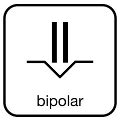
26167 LNL KOH **Ultramicro Needle Holder,**
jaws curved to left,
with tungsten carbide insert,
straight handle,
with disengageable ratchet,
size 3.5 mm, length 36 cm

26167 RNL **Same,** jaws curved to right

Accessories

Unipolar and Bipolar High Frequency Cords

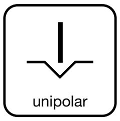
Bipolar High Frequency Cords



KARL STORZ Instrument	High Frequency Surgery Units

26176 LE **Bipolar High Frequency Cable,** to KARL STORZ Coagulator 26021 B/C/D, 860021 B/C/D, 27810 B/C/D, 28810 B/C/D, AUTOCON® system (50, 200, 350), AUTOCON® II 400 SCB system (111, 113, 115) and Erbe coagulator, T and ICC series, length 300 cm

Unipolar High Frequency Cords



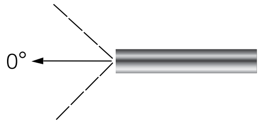
KARL STORZ Instrument	High Frequency Surgery Units

26005 M **Unipolar High Frequency Cable,** with 5 mm plug for KARL STORZ AUTOCON® system (50, 200, 350), AUTOCON® II 400 SCB system (111, 115) and Erbe ICC units, length 300 cm

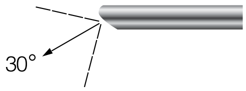
HOPKINS® Telescopes

Diameter 5 mm

26046 AA



26046 AA **HOPKINS® Straight Forward Telescope 0°,**
enlarged view, diameter 5 mm, length 29 cm,
autoclavable,
fiber optic light transmission incorporated,
color code: green



26046 BA **HOPKINS® Forward-Oblique Telescope 30°,**
enlarged view, diameter 5 mm, length 29 cm,
autoclavable,
fiber optic light transmission incorporated,
color code: red

Trocars

size 6 mm

30160 GZG

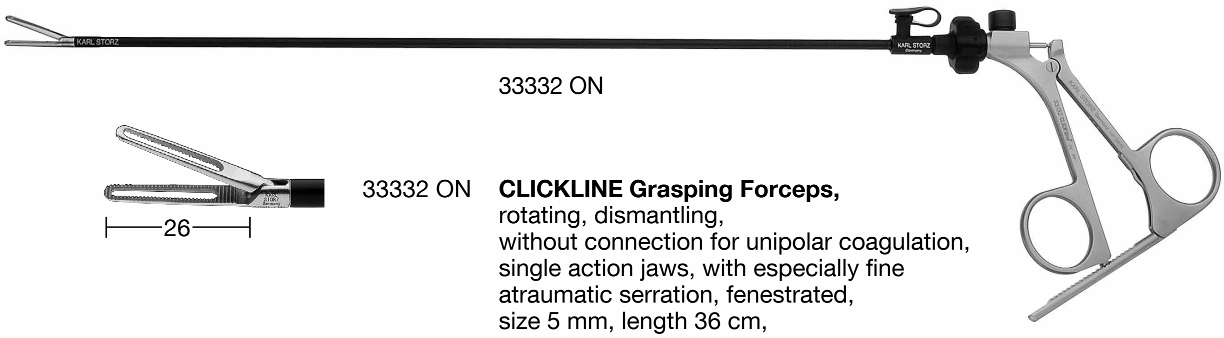
30160 GZG **Trocar,** with pyramidal tip,
with LUER-Lock connector for insufflation,
size 6 mm, length 10 cm,
color code: black

including:
Cannula
Trocar only
Valve Seal

30160 GYG **Trocar,** with conical tip,
with LUER-Lock connector for insufflation,
size 6 mm, working length 10 cm,
color code: black

including:
Cannula
Trocar only
Valve Seal

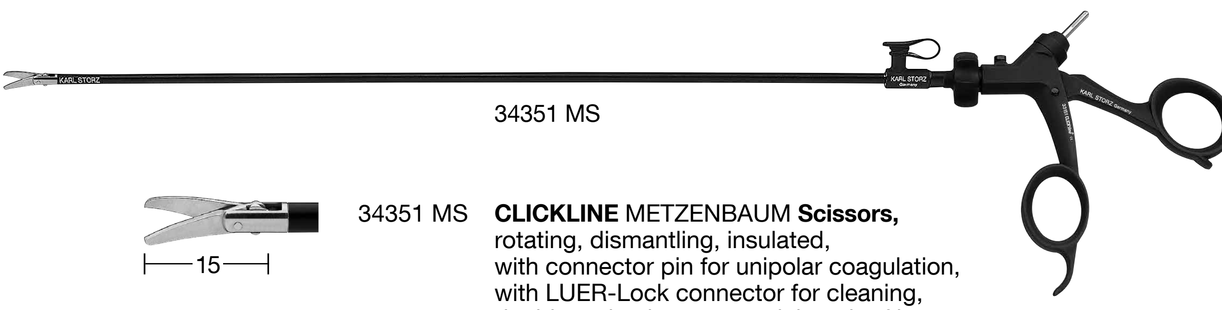
CLICKLINE Grasping Forceps and Scissors
ROBI Grasping Forceps



33332 ON

33332 ON **CLICKLINE Grasping Forceps,**
rotating, dismantling,
without connection for unipolar coagulation,
single action jaws, with especially fine
atraumatic serration, fenestrated,
size 5 mm, length 36 cm,
for use with trocars size 6 mm

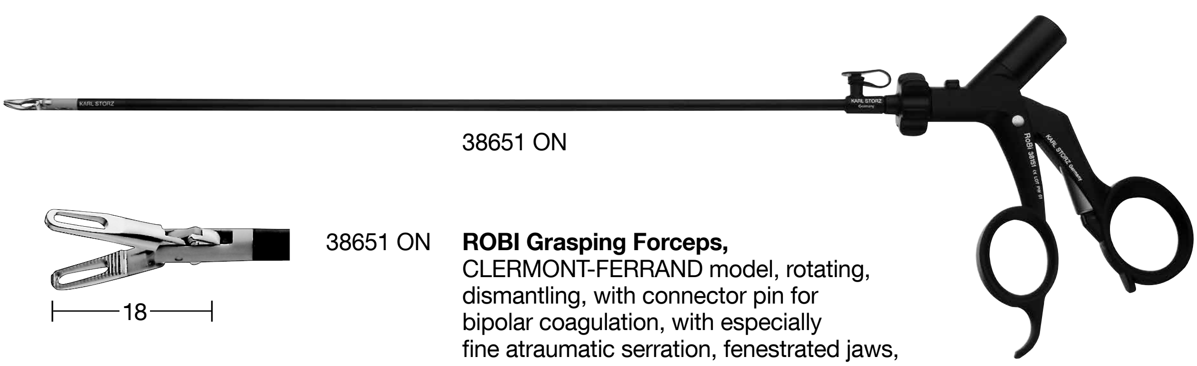
including:
Metal Handle, with ratchet
Outer Sheath, insulated
Forceps Insert



34351 MS

34351 MS **CLICKLINE** METZENBAUM **Scissors,**
rotating, dismantling, insulated,
with connector pin for unipolar coagulation,
with LUER-Lock 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, insulated
Forceps Insert



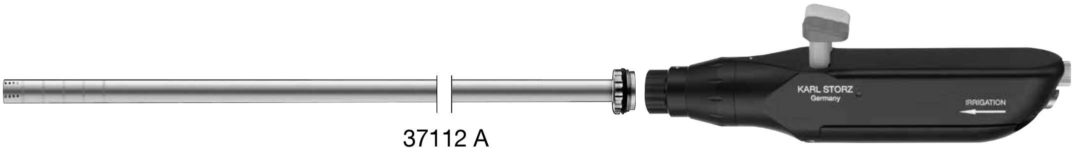
38651 ON

38651 ON **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

Handles for Suction and Irrigation

size 5 mm and 10 mm



37112 A

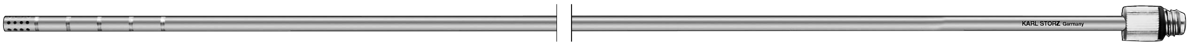
37112 A **Handle, straight, with clamping valve,**
for suction and irrigation,
autoclavable, for use with 3 mm
(in conjunction with Adapter 26167 A)
5 and 10 mm suction and irrigation tubes

37113 A

37113 A **Handle, pistol grip,**
with clamping valve,
for suction and irrigation,
autoclavable, for use with 5 and
10 mm suction and irrigation tubes
with central working channel

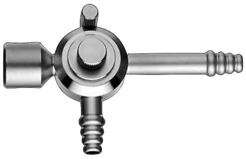
Irrigation and Suction Tubes

size 5 mm, trocar size 6 mm



37360 LH

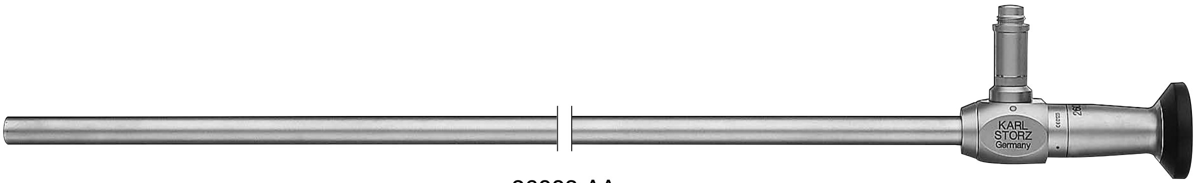
37360 LH **Suction and Irrigation Cannula**,
with lateral holes, size 5 mm, length 36 cm,
for use with suction and irrigation handles



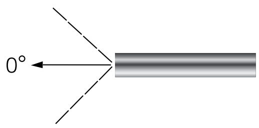
30805 **Handle with Two-Way Stopcock,**
for suction and irrigation, **autoclavable,**
for use with suction and irrigation tubes
size 5 mm

HOPKINS® Telescopes

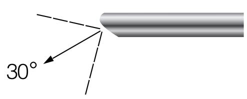
Diameter 10 mm, length 31 cm



26003 AA



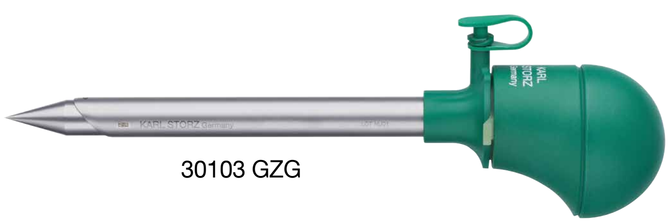
26003 AA **HOPKINS® Straight Forward Telescope 0°,**
enlarged view, diameter 10 mm, length 31 cm,
autoclavable,
fiber optic light transmission incorporated,
color code: green



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

Trocar

Diameter 11 mm

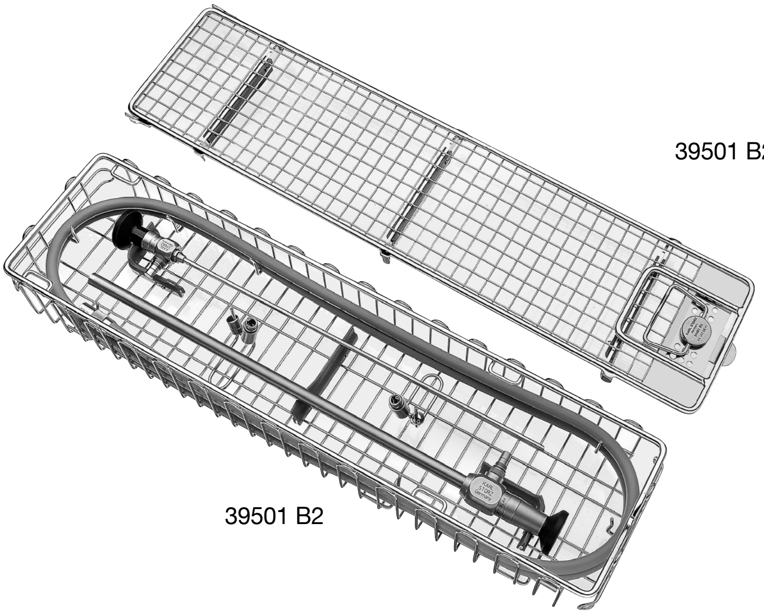


30103 GZG

30103 GZG **Trocar,** with pyramidal tip,
with LUER-Lock connector for insufflation,
size 11 mm, working length 10 cm,
color code: green,

including:
Cannula
Trocar only
Valve Seal

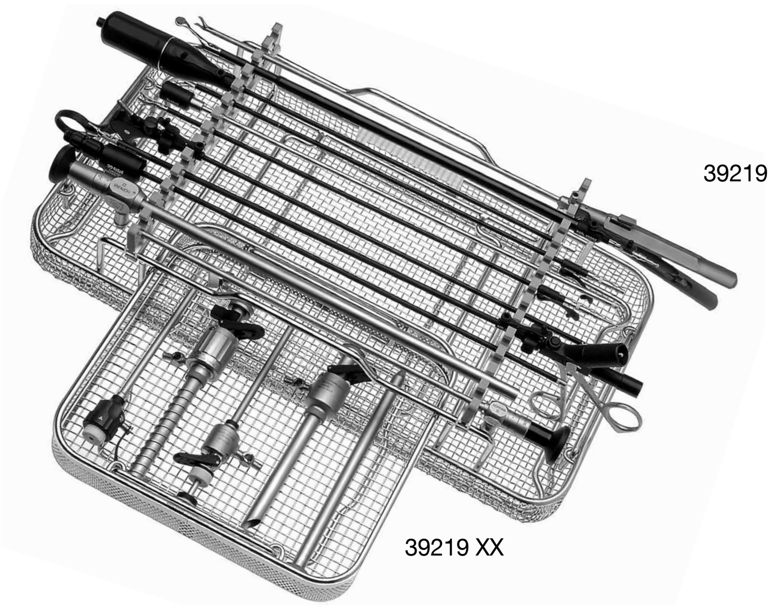
Tray for Cleaning, Sterilization and Storage



39501 B2

39501 B2 **Tray for Cleaning, Sterilization and Storage,** of two rigid endoscopes and one light cable, with adaptor and silicone telescope holder, with lid, external dimensions (w x d x h): 487 x 125 x 54 mm, for rigid endoscopes with up to diameter 10 mm and working length 32 cm

Instrument-rack



39219 XX

39219 XX **Instrument-rack** with basket 39502 V for drawer and wire basket 39502 X, for storage of 12 instruments with diameter from 2.5 to 10 mm, including 2 bars with silicone holders. External dimensions (w x d x h): 463 x 238 x 125 mm

Container with Microstop

39753 A2

39753 A2 **Container with Microstop** for sterilization and sterile storage, 600 x 300 x 210 mm, including:

Container Bottom

Container Lid

Germ retention Disc (MicroStop)
Internal dimensions: (w x d x h)
548 mm x 267 mm x 186 mm

IMAGE1 S Camera System *NEW*

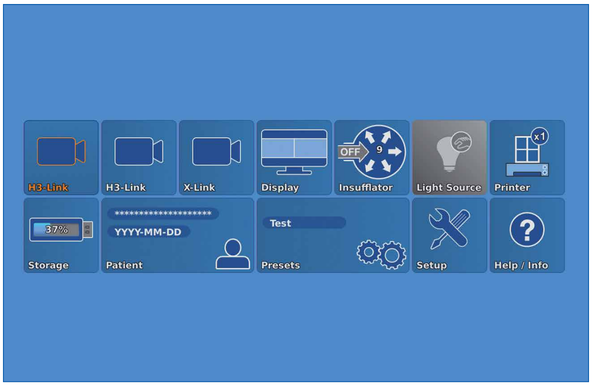
IMAGE1 S

Economical and future-proof

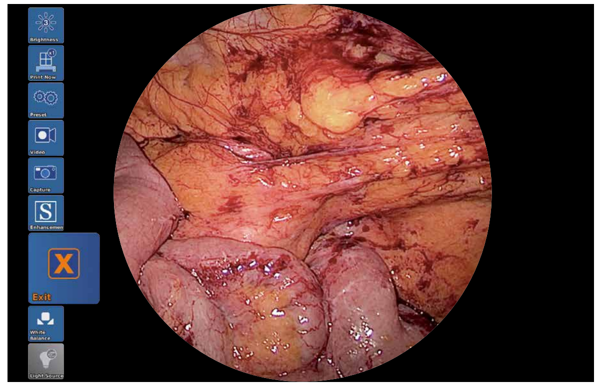
- **Modular concept for flexible, rigid and 3D endoscopy as well as new technologies**
- **Forward and backward compatibility with video endoscopes and FULL HD camera heads**
- **Sustainable investment**
- **Compatible with all light sources**

Innovative Design

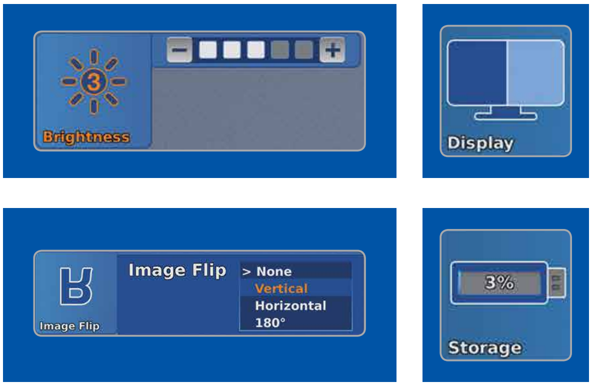
- **Dashboard: Complete overview with intuitive menu guidance**
- **Live menu: User-friendly and customizable**
- **Intelligent icons: Graphic representation changes when settings of connected devices or the entire system are adjusted**
- **Automatic light source control**
- **Side-by-side view: Parallel 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**



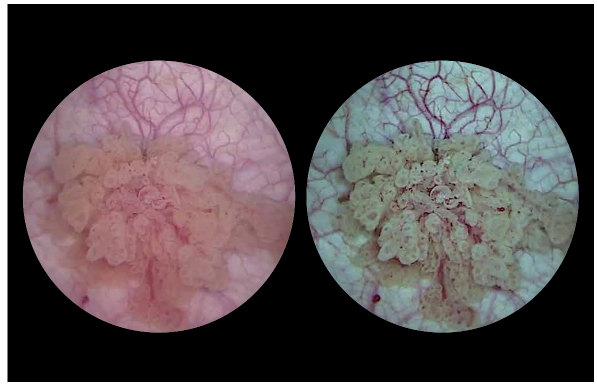
Dashboard



Live menu



Intelligent icons

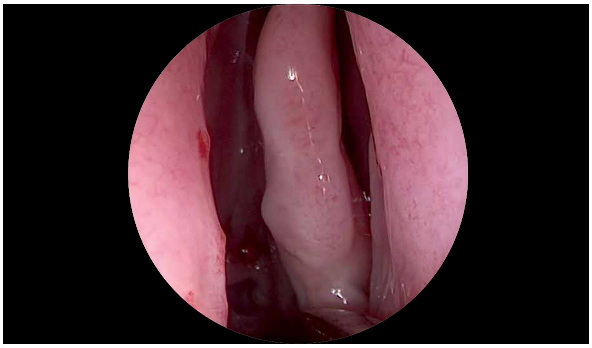


Side-by-side view: Parallel display of standard image and Visualization mode

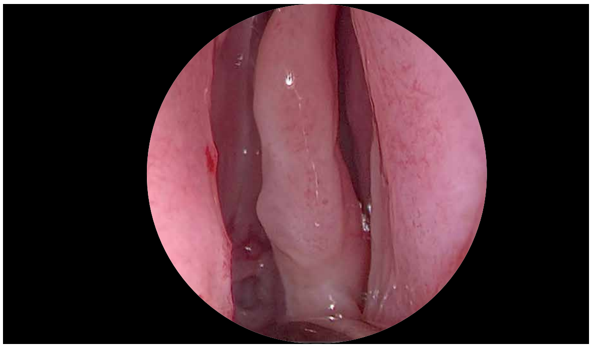
IMAGE1 S Camera System NEW

Brilliant Imaging

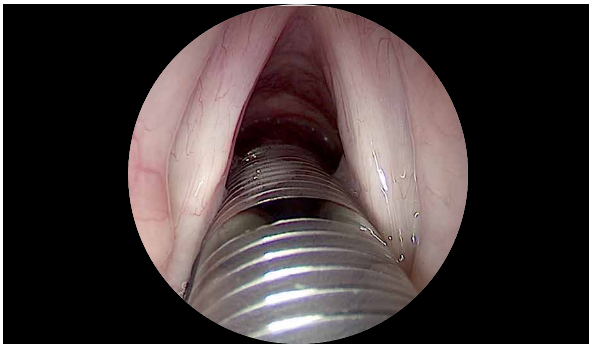
- Clear and razor-sharp endoscopic images in FULL HD
- Natural color rendition
- Reflection is minimized
- Multiple IMAGE1 S technologies for homogeneous illumination, contrast enhancement and color shifting



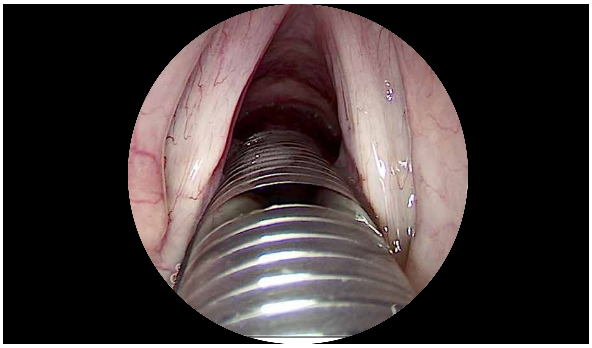
FULL HD image



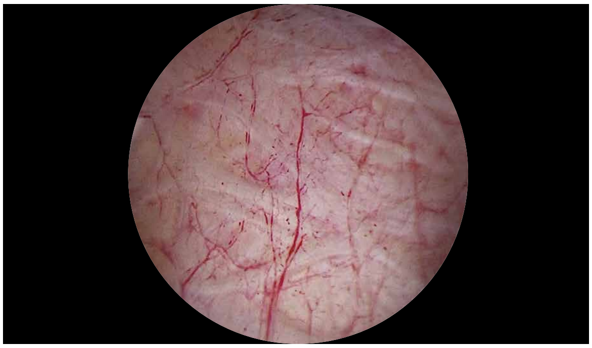
CLARA



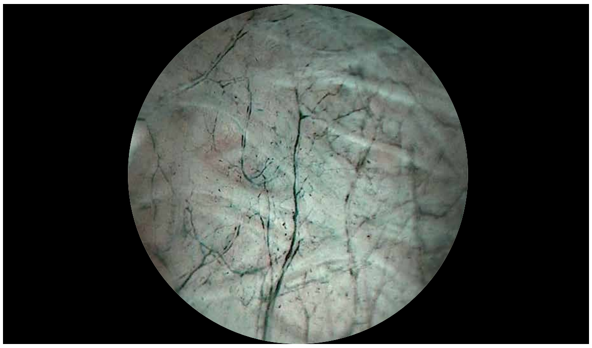
FULL HD image



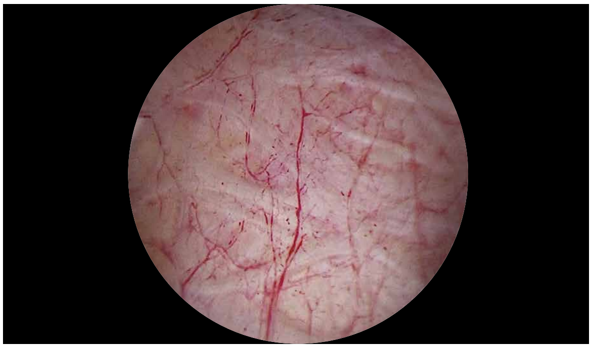
CHROMA



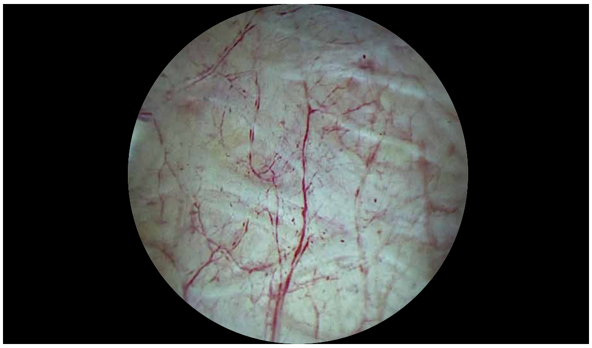
FULL HD image



*SPECTRA A**



FULL HD image



*SPECTRA B***

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

IMAGE1 S Camera System NEW

IMAGE1 S

TC 200EN

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:

HD video outputs	- 2x DVI-D - 1x 3G-SDI
Format signal outputs	1920 x 1080p, 50/60 Hz
LINK video inputs	3x
USB interface SCB interface	4x USB, (2x front, 2x rear) 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

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:

Camera System	**TC 300 (H3-Link)**
Supported camera heads/video endoscopes	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**220085-3 (compatible without IMAGE1 S technologies CLARA, CHROMA, SPECTRA*)
LINK video outputs	1x
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	1.86 kg

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

IMAGE1 S Camera Heads NEW

IMAGE1 S

For use with IMAGE1 S Camera System
IMAGE1 S CONNECT Module TC 200EN, IMAGE1 S H3-LINK Module TC 300
and with all IMAGE 1 HUB™ HD Camera Control Units

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 IMAGE 1 HUB™ HD/HD

Specifications:

IMAGE1 FULL HD Camera Heads	IMAGE1 S H3-Z
Product no.	TH 100
Image sensor	3x 1/3" CCD chip
Dimensions w x h x d	39 x 49 x 114 mm
Weight	270 g
Optical interface	integrated Parfocal Zoom Lens, f = 15–31 mm (2x)
Min. sensitivity	F 1.4/1.17 Lux
Grip mechanism	standard eyepiece adaptor
Cable	non-detachable
Cable length	300 cm

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 IMAGE 1 HUB™ HD/HD

Specifications:

IMAGE1 FULL HD Camera Heads	IMAGE1 S H3-ZA
Product no.	TH 104
Image sensor	3x 1/3" CCD chip
Dimensions w x h x d	39 x 49 x 100 mm
Weight	299 g
Optical interface	integrated Parfocal Zoom Lens, f = 15–31 mm (2x)
Min. sensitivity	F 1.4/1.17 Lux
Grip mechanism	standard eyepiece adaptor
Cable	non-detachable
Cable length	300 cm

Monitors

9619 NB

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

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

KARL STORZ HD and FULL HD Monitors	**19"**	**26"**
Wall-mounted with VESA 100 adaption	9619 NB	9826 NB
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	●	●

Optional accessories:

9826 SF **Pedestal,** for monitor 9826 NB
9626 SF **Pedestal,** for monitor 9619 NB

Specifications:

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

Fiber Optic Light Cable

495 NCS	**Fiber Optic Light Cable,** with straight connector, extremely heat-resistant, diameter 4.8 mm, length 250 cm
495 NCSC NEW	**Same,** extremely heat-resistant, safety lock
495 NA	**Fiber Optic Light Cable,** with straight connector, diameter 3.5 mm, length 230 cm
495 NAC NEW	**Same,** with safety locking device

Cold Light Fountain XENON 300 SCB

20133101-1	**Cold Light Fountain XENON 300 SCB** with built-in antifog air-pump, and integrated KARL STORZ Communication Bus System SCB power supply: 100–125 VAC/220–240 VAC, 50/60 Hz including: **Mains Cord** **SCB Connecting Cable,** length 100 cm
20133027	**Spare Lamp Module XENON** with heat sink, 300 watt, 15 volt
20133028	**XENON Spare Lamp,** only, 300 watt, 15 volt

Cold Light Fountain XENON NOVA® 300

20134001	**Cold Light Fountain XENON NOVA® 300,** power supply: 100–125 VAC/220–240 VAC, 50/60 Hz including: **Mains Cord**
20133028	**XENON Spare Lamp,** only, 300 watt, 15 volt

Cold Light Fountain Power LED 175 SCB

20161401-1	**Cold Light Fountain Power LED 175 SCB,** with integrated SCB, high-performance LED and one KARL STORZ light outlet, power supply 110–240 VAC, 50/60 Hz including: **Cold Light Fountain Power LED** **Mains Cord** **SCB Connecting Cable,** length 100 cm
20132026	**Xenon-Spare-Lamp,** 175 watt, 15 volt

KARL STORZ Touch Screen

200904 02 **19" KARL STORZ Touch Screen,**
wall or swivel-arm mounting, video inputs:
VGA/SVGA/XGA/SXGA,
max. screen resolution 1280 x 102
(SXGA mode),
power supply 100–240 VAC, 50/60 Hz,
incl. 3 touch screen covers,

including:

19" Touch Screen, incl. RS 232 cable, SVGA cable, mains cord, driver CD

RS 232 Connecting Cable, length 600 cm

SVGA Connecting Cable, length 600 cm

Touch Pen,
for **KARL STORZ** Touch Screens

AUTOCON® III 400 High-End

UH 400 **AUTOCON® III 400 High-End,**
power supply 220–240 VAC, 50/60 Hz,
including mains cord,
HF connecting sockets unipolar:
2x 3-pin US type
5 mm connector KARL STORZ/Erbe VIO
2x 4 mm connector (via footswitch)
BOVIE (via footswitch)

bipolar:
2x 2-pin US type (28.58)
3x KARL STORZ/Erbe VIO
Neutral electrode 2-pol.

Can be integrated into OR1
with KARL STORZ-SCB control NEO.
System requirements: SCB-R-UI Software
Release 20090001-46 or higher

ENDOFLATOR® 50 SCB

*

UI500S1 **ENDOFLATOR® 50 SCB,**
integrated SCB module,
power supply 100–40 VAC, 50/60 Hz
including:
ENDOFLATOR® 50 SCB
SCB Connecting Cable, length 100 cm
Universal Wrench
Heated Insufflation Tubing Set, with gas filter, sterile, for single use, package of 3*
HiCap® Trocar, size 11 mm

Subject to the customer's application-specific requirements additional accessories must be ordered separately.

HAMOU® **ENDOMAT® with KARL STORZ SCB**

Suction and Irrigation System

*

26331101-1 HAMOU® **ENDOMAT® SCB,**
power supply 100–240 VAC, 50/60 Hz
including:
Mains Cord
5x **HYST Tubing Set*,** for single use
5x **LAP Tubing Set*,** for single use
SCB Connecting Cable, length 100 cm
VACUsafe Promotion Pack Suction*, 2 l

Subject to the customer's application-specific requirements additional accessories must be ordered separately.

Data Management and Documentation

KARL STORZ AIDA® – Exceptional documentation

The name AIDA stands for the comprehensive implementation of all documentation requirements arising in surgical procedures: A tailored solution that flexibly adapts to the needs of every specialty and thereby allows for the greatest degree of customization.

This customization is achieved in accordance with existing clinical standards to guarantee a reliable and safe solution. Proven functionalities merge with the latest trends and developments in medicine to create a fully new documentation experience – AIDA.

AIDA seamlessly integrates into existing infrastructures and exchanges data with other systems using common standard interfaces.

WD 200-XX* **AIDA Documentation System,**
for recording still images and videos,
dual channel up to FULL HD, 2D/3D,
power supply 100–240 VAC, 50/60 Hz

including:

USB Silicone Keyboard, with touchpad
ACC Connecting Cable
DVI Connecting Cable, length 200 cm
HDMI-DVI Cable, length 200 cm
Mains Cord, length 300 cm

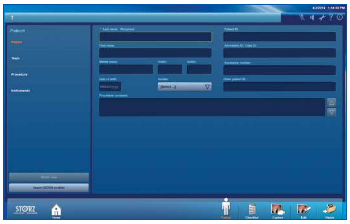
WD 250-XX* **AIDA Documentation System,**
for recording still images and videos,
dual channel up to FULL HD, 2D/3D,
including SMARTSCREEN® (touch screen),
power supply 100–240 VAC, 50/60 Hz

including:

USB Silicone Keyboard, with touchpad
ACC Connecting Cable
DVI Connecting Cable, length 200 cm
HDMI-DVI Cable, length 200 cm
Mains Cord, length 300 cm

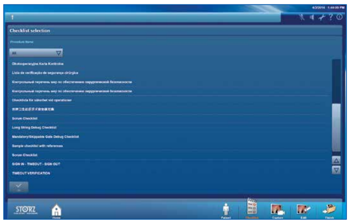
*XX Please indicate the relevant country code (DE, EN, ES, FR, IT, PT, RU) when placing your order.

Workflow-oriented use



Patient

Entering patient data has never been this easy. AIDA seamlessly integrates into the existing infrastructure such as HIS and PACS. Data can be entered manually or via a DICOM worklist.
All important patient information is just a click away.

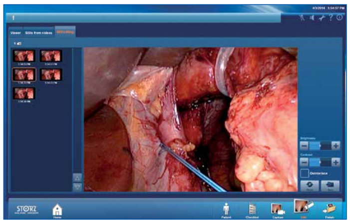


Checklist

Central administration and documentation of time-out. The checklist simplifies the documentation of all critical steps in accordance with clinical standards. All checklists can be adapted to individual needs for sustainably increasing patient safety.

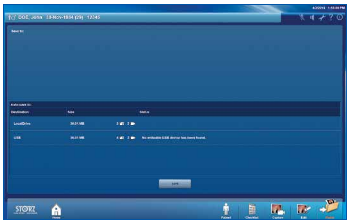
Record

High-quality documentation, with still images and videos being recorded in FULL HD and 3D. The Dual Capture function allows for the parallel (synchronous or independent) recording of two sources. All recorded media can be marked for further processing with just one click.



Edit

With the Edit module, simple adjustments to recorded still images and videos can be very rapidly completed. Recordings can be quickly optimized and then directly placed in the report.
In addition, freeze frames can be cut out of videos and edited and saved. Existing markings from the Record module can be used for quick selection.



Complete

Completing a procedure has never been easier. AIDA offers a large selection of storage locations. The data exported to each storage location can be defined. The Intelligent Export Manager (IEM) then carries out the export in the background. To prevent data loss, the system keeps the data until they have been successfully exported.

Reference

All important patient information is always available and easy to access. Completed procedures including all information, still images, videos, and the checklist report can be easily retrieved from the Reference module.

Equipment Cart

UG 220

UG 220 **Equipment Cart**
wide, high, rides on 4 antistatic dual wheels
equipped with locking brakes 3 shelves,
mains switch on top cover,
central beam with integrated electrical subdistributors
with 12 sockets, holder for power supplies,
potential earth connectors and cable winding
on the outside,

Dimensions:
Equipment cart: 830 x 1474 x 730 mm (w x h x d),
shelf: 630 x 510 mm (w x d),
caster diameter: 150 mm

including:

Base module equipment cart, wide
Cover equipment, equipment cart wide
Beam package equipment, equipment cart high
3x **Shelf,** wide
Drawer unit with lock, wide
2x **Equipment rail,** long
Camera holder

UG 540

UG 540 **Monitor Swifel Arm,**
height and side adjustable,
can be turned to the left or the right side,
swivel range 180°, overhang 780 mm,
overhang from centre 1170 mm,
load capacity max. 15 kg,
with monitor fixation VESA 5/100,
for usage with equipment carts UG xxx

Recommended Accessories for Equipment Cart

UG 310

UG 310 **Isolation Transformer,**
200 V–240 V; 2000 VA with 3 special mains socket,
expulsion fuses, 3 grounding plugs,
dimensions: 330 x 90 x 495 mm (w x h x d),
for usage with equipment carts UG xxx

UG 410

UG 410 **Earth Leakage Monitor,**
200 V–240 V, for mounting at equipment cart,
control panel dimensions: 44 x 80 x 29 mm (w x h x d),
for usage with isolation transformer UG 310

UG 510

UG 510 **Monitor Holding Arm,**
height adjustable, inclinable,
mountable on left or right,
turning radius approx. 320°, overhang 530 mm,
load capacity max. 15 kg,
monitor fixation VESA 75/100,
for usage with equipment carts UG xxx