Mini-laparoscopy in urology
Needleless surgical surgery is here (again) to stay

Dr. Inson Kyranolis
University of Patras Dept. of Urology
Koi-Patras (GR)

Prof. Evangelos Liatsikos
University of Patras Dept. of Urology
Koi-Patras (GR)

Global adaption and widespread use of minimally invasive techniques in urology have created a constant increasing interest in reducing perioperative morbidity in urology. Since the first laparoscopic nephrectomy performed in 1990 by Clamann et al., laparoscopic urologic surgery has been well established as the standard of care for the majority of major urologic operations demonstrating lower blood loss, reduced perioperative pain and shorter hospitalization compared to open surgery. In addition, the introduction of robotic assistance during the last decade reduced the steep learning curve of conventional laparoscopy and eliminated most of laparoscopy limitations including two-dimensional vision and reduced degrees of instrument freedom.

The latter explains the rapid adaptation of robotic assisted laparoscopy worldwide. Nevertheless, despite the reduction of abdominal wall injury, as opposed to open approaches, laparoscopic surgery still inducers significant postoperative pain and carries a risk for bleeding, infection, and hernia formation at all points of instrument entry. In an attempt to reduce even more the morbidity of conventional laparoscopy and to push postoperative cosmesis towards a totally scarless outcome, laparoscopically single site surgery (LESS) and natural orifice transluminal endoscopic surgery (NOTES) were developed. In the first case all instruments are inserted and the whole operation is carried out through a natural body orifice such as a transumbilical abdominal incision. The second technique uses natural orifices (currently only vagina in urological clinical use) to host additional laparoscopic instruments to facilitate specimen extraction. Several reports have documented the feasibility and safeness of both approaches. In LESS, the surgeon is committed to have equivalent perioperative outcomes with conventional laparoscopy in numerous operations including nephrectomy (simple, radical, donor or partial), pyeloplasty, adenectomy, sacrocolpopexy and radical prostatectomy.

Although pioneering, both techniques are not widely adopted by urological community mainly due to several limitations associated with their use. LESS is limited by the lack of instrument triangulation leading to inferior ergonomy, instrument classing, in-line instrument view and troublesome suturing or lateral tissue traction. Transvaginal assisted surgery is associated with unfamiliar working angles, a long distance to upper track and a greater specificity to application of the approach. As a result of these drawbacks, the feasibility and safeness of LESS and NOTES or even their equivalence with conventional laparoscopy seem not enough to deserve the adding difficulties for the surgeons unless their superiority against the well established conventional laparoscopic surgery is with certainty.

The impact of LESS and NOTES
In order data on LESS and NOTES outcomes are available, both techniques should be performed by experienced surgeons in an experimental setting. Notwithstanding, NOTES have been performed, despite being still under evaluation, already have a significant impact on the laparoscopic community. Their introduction established that perioperative morbidity of laparoscopy can and should be further reduced and that cosmetic outcomes matter for both patients and surgeons. In other words, the most important contribution of single-port surgery and NOTES is the matter for even less morbidity, better cosmesis and constant development of advanced instruments.

Indeed, upon introduction of LESS and NOTES several new and refined instruments became available to surgeons to provide some ease in these demanding procedures and overcome most of the presented technical drawbacks. Multi lumens ports, flexible or pre-bent (curved) instruments and angled or flexible cameras provide the necessary triangulation for LESS, while extra-long laparoscopic instruments allow a wide range of upper tract tissue manipulation by the transvaginal access. In addition, hybrid techniques, including a single incision combined with additional mini-laparoscopic instruments, were developed. This new application of minimally invasive laparoscopic instruments, formerly used only for gynaecological and laparoscopic trauma, reformed medical industry on mini-laparoscopy and provided surgeons with second generation mini-laparoscopic instrument which demonstrate superior performance. With the availability of refined mini-laparoscopic instruments and following the trend of further improving laparoscopic morbidity, mini-laparoscopy has recently gained significant popularity.

Mini-laparoscopy
Mini-laparoscopic surgery is an old concept of surgery that utilises miniaturised (also termed needleless) 2-3 mm laparoscopic instruments for the accomplishment of conventional laparoscopy procedures. Initial reports on mini-laparoscopy (endowing 2-3 mm cameras) can be traced back in early 1980s. Nevertheless, the procedure was not applied in adult urologic surgery until recently. The main reason for the latter was that initial mini-laparoscopic instruments were problematic. Pure vision, loose grabbing, defective irritation or suction and decrease instrument durability were the main instrument limitations. Second generation mini-laparoscopic instruments have addressed the former drawbacks and currently, a wide range of needleless instruments have been added in the armamentarium of laparoscopic surgeons.

The main advance offered by the use of needleless instruments is the reduction of abdominal wall trauma. The latter not only benefits postoperative cosmetic outcome (2-4 mm skin incisions result in minimal postoperative scarring but most importantly eradicate the risk for postoperative hernia formation and potentially cause less postoperative pain and faster rehabilitation. An additional advantage of this technology is that upon adaptation there is no need for a new learning curve as mini-laparoscopy maintains the principle of instrument triangulation and provides conventional laparoscopic experience [Figure 1].

The ideal indication for mini-laparoscopy is any procedure that does not require specimen extraction. Currently, pure mini-laparoscopy in adult urological patients has been applied only in case of pyelolithotomy [Figure 2]. Pisit et al reported preliminary results from a mini-laparoscopic pyeloendopy approach using a small incision access retroperitoneoscopic technique (SMART). Using one 6 mm skin incision (for a 5 mm 30° telescope) and two 3 mm trocars (for 3 mm working instruments) authors documented comparable perioperative outcomes with conventional retroperitoneoscopic technique in addition to a superior cosmetic result. Similarly, transurethrally mini-laparoscopic pyeloplasty has been shown to offer better cosmesis and patient satisfaction than conventional laparoscopy.

In the case of mini-laparoscopic operations necessitating incision (e.g. nephrectomy) at least one of the initial incisions will be expanded at the end of the operation. Consequently one of the mini-instruments (mostly the umbilical port) is left larger ports from the beginning increasing the available instrumentation [larger optical, staplers, cold active instruments 40]. In this setting, transurethral assisted LESS (multipor trocar combined with one 3mm instrument) can provide the necessary triangulation missing in pure LESS, assist in suturing or demanding coagulative procedures without compromising the relative scarless cosmetic outcome of LESS [Figure 3]. In the setting of needleless assisted NOTES, the whole procedure is being carried out via mini-laparoscopy and the vagina can be used for specimen delivery without the need for expansion of an abdominal incision.

Future prospects
It should be stressed that mini-laparoscopy is a field constantly expanding in more-urological specialties as well. Mini-laparoscopic cholecystectomy either pure or combined by transvaginal specimen extraction is under clinical evaluation in general surgery. In addition, mini-laparoscopic renal resection followed by specimen extraction through rectum has been shown to be feasible and safe, leading to a totally scarless outcome. Mini-laparoscopic hysterectomy, diagnostic laparoscopy, pain mapping and ovarian biopsy have also been described in gynaecology and urology. Urology has much to gain out of this experience as well.

Future prospects of this technology could be micro-laparoscopy and robotic-assisted mini-laparoscopy. Technological advancements made possible to further miniaturise laparoscopic instruments to < 2 mm introducing micro-laparoscopy as a new field in minimally invasive approaches to surgery. Promising results in the past few years have shown that micro laparoscopic have already been documented in addition, although currently clinically applied robotic technology minimally invasive approach increase ergonomics without compromising the final cosmetic outcomes.

A step forward
Following the transition from open to laparoscopic surgery, mini-laparoscopy presents a step forward towards even less invasive procedures. Whether this technology represents the most we can get from minimally invasive surgery, or if there is still way to go, remains to be seen.

References

This reference list is incomplete due to space constraints. The full references of this article are available from the EUT Editorial Office by sending an e-mail to: EUUroweb.org with reference to the article "Mini-laparoscopy in urology" by Dr. Kyranolis, Dec/Jan issue 2014.