

# SINGLE-INCISION LAPAROSCOPIC SURGERY

MA SALAM

Laparoscopy has been demonstrated a valid approach in many gynecologic procedures with better results in terms of minimal perioperative morbidity and shorter hospital stay, with consequent improved quality of life compared to laparotomic approach<sup>1,2</sup>. Despite this well-known advantages, laparoscopy still requires 0.5 to 1.5 cm long incisions and three to five ports to be performed, each working port implying with an inherent risk of bleeding, infection, concordant organ damage, hernia formation, and decreased cosmetic outcome<sup>3</sup>. Recently, some efforts have been made to decrease incisional morbidity related to parietal trauma and improve cosmetic results while maintaining the same standards of surgical care<sup>4,5</sup>.

Single port access (SPA) surgery, also known as laparo endoscopic single-site surgery (LESS), Single Incision Laparoscopic Surgery (SILS) or one port umbilical surgery (OPUS) or single port incisionless conventional equipment-utilizing surgery (SPICES) or natural orifice transumbilical surgery (NOTUS), or Embryonic Natural Orifice transumbilical surgery (E-NOTES) is an advanced minimally invasive surgical procedure in which the surgeon operates almost exclusively through a single entry point, typically the patient's navel. SPA surgical procedures are like many laparoscopic surgeries in that the patient is under general anesthesia; insufflated and laparoscopic visualization is utilized.

In this context, mini laparoscopic approaches and natural orifice transluminal endoscopic surgery (NOTES) have been developed, utilizing the mouth, anus, vagina, or urethra to access through the peritoneum. Laparo endoscopic single-site surgery (LESS) has encompassed recent terminology including single-port incision laparoscopic surgery (SILS) or single port access laparoscopic surgery (SPA). NOTES and LESS techniques have emerged as viable, feasible, and widely applicable minimally invasive procedures<sup>6-8</sup>. Until now LESS has been mainly used in urologic surgery but recent sporadic reports in the literature have hypothesized some applications in gynaecology<sup>9-10</sup>.

In laparo endoscopic single-site surgery (LESS), rather than the traditional four to five small incisions, a single

small incision can be used at the entry point. All surgical instruments are placed through this small incision and also the incision site is located in the left abdomen or umbilicus.

Providing the benefits of fewer scars, the opportunity of less pain, and shorter recovery periods, SILS is one of the newest laparoscopic techniques and it is regarded as non-invasive. In general, SILS techniques take about the same amount of time to do as traditional laparoscopic surgeries. However, SILS is recognized as to be a more complicated procedure because it involves manipulating three articulating instruments through one access port<sup>11,12</sup>.

Along with many benefits, SILS often offers financial advantages to hospitals, patient's health care insurance options, and employers, too. Typically, the patient's hospital stay is shorter as well as less medical assistance than traditional laparoscopic surgeries. Although SILS offers exciting benefits for any wide variety of patients facing weight-loss challenges, not everyone is an applicant for the procedure. Obesity, severe adhesions, or scarring from previous surgeries are a few of the factors that would prohibit patients from getting the surgery.

Although originally designed to concentrate on weight-loss issues, SILS is really a rapidly evolving technique that's also being put on other areas of healthcare. Some surgeons are successfully using this procedure for urological, gynecological, and colon surgeries.

### **How SILS differs from traditional laparoscopic surgery?**

Over the last decade conventional laparoscopic surgery has replaced open surgery in the treatment of several surgical diseases. In traditional laparoscopic surgery, the abdomen is filled with carbon dioxide gas to create a space for the surgeon to work inside with telescope and different other ports for instrument. Metal cannula called ports are then inserted through three to four small cuts, each measuring around  $\frac{1}{2}$  – 1 cm. A telescope attached to a camera inserted through one of the ports allows the surgeon and gynecologists to observe a

magnified picture of the internal organs on a television screen. The surgeon, gynecologists urologists or pediatric surgeon carries out the surgery with the help of instruments introduced through the ports.

In Single incision laparoscopic surgery, the surgeon makes only one incision of around 1.5 cm – 2 cm just below the umbilicus to allow placement of three thin 5mm port side by side parallel to each other. A specially designed SILS port is also available which is inserted into the abdomen; this port carries the telescope as well as the laparoscopic instruments. The surgeon then carries out an operation identical to a traditional laparoscopic one.

As the technique of single incision laparoscopic surgery gets refined and better instrumentation becomes available, the surgeons will be able to carry out many more operations today carried out by traditional laparoscopic surgery using the SILS approach. As there is only one incision the patient experiences much less pain as compared to traditional laparoscopic surgery and recovers faster. The healed incision leaves practically no scar, thus making SILS cosmetically a superior option. All patients enjoy these benefits, but SILS is of particularly great cosmetic value to ladies (as most would prefer to have as few scars as possible) and to busy corporate executives who wish to recover rapidly from surgery so as to get back to work<sup>13-15</sup>.

The surgeon would assess an individual patient to decide whether or not he / she are a suitable candidate for SILS. SILS may not be applicable to some patients, e.g. Those who are very obese. Those who have had multiple previous abdominal operations and patients who are likely to have grossly enlarged or thickened diseased organ. In 5% to 10% patients it may not be possible to complete the operation by SILS due to technical difficulties. The surgeon places one or two additional ports and completes the procedure in the traditional laparoscopic manner. Very rarely, it may be necessary to convert to an open operation. Both these issues are always discussed with patients prior to surgery and they are made aware that conversion to traditional laparoscopy or indeed to open surgery merely represents a sound judgment on part of the surgeon in the interest of patient safety. As SILS involves the use of specialized equipment, it is marginally more expensive as compared to traditional laparoscopic surgery. However, this small extra cost is more than offset by the benefits that the patient reaps.

### **Instrument used in Single Incision Laparoscopic Surgery**

Single incision laparoscopic surgery (SILS) is a new technique that has now been utilized in many hospital all over world for various laparoscopic procedures. The major difficulty with this new technique is the sacrifice that has to be made in terms of comfort and ergonomics. As all instruments and camera are inserted through the same incision, the ability to triangulate instruments around the target is lost. Although this can be partially rectified nowadays by the use of rotator instruments, the surgeon ends up working with his hands very close together, and finds himself often being impeded by the laparoscope and the assistant. The surgeon's right hand will control the left-sided instrument on the screen and the left hand controls the right-sided instrument on screen. These technical difficulties do make SILS a more demanding procedure on the operating surgeon than normal laparoscopic techniques. This led to an initial significant increase in the operation time and need ambidexterity. However, with increasing exposure to the technique, operating times have been reduced significantly, and are now very similar to the average time taken for laparoscopic procedures. Future improvements in instrumentation may help to reduce operating times further.

### **Method of Entry**

Once the incision is made and the fascia is cleared, the entry into the abdomen can be performed in two ways: Veress needle or direct cut down entry. With the Veress technique, the fascia is lifted and also the needle is inserted. Once pneumoperitoneum is achieved, a 5-mm trocar is inserted first, followed by the other trocars. Utilization of a port which allows visualization of tissue layers during entry may be desirable. If the cut down technique is used (for multiple individual trocars, TriPort, or GelPort), a little incision is made in the fascia, and also the peritoneal cavity could be palpated just before keeping the first trocar to prevent possible bowel injury. A little defect is frequently present in the lower umbilicus and can be gently dilated to permit placement of a trocar. Insufficient visualization of subsequent trocars is one of the disadvantages of entry and trocar placement in SILS. Because all the ports are placed alongside each other, their placement is blind. Use of a transparent port for initial entry may allow better visualization. A flexible scope that articulates at least 180 degrees can allow

direct visualization of secondary trocars. If the patient has already established a previous surgery and it is at risk for adhesions, extra care must be taken since the trocars are placed<sup>16</sup>.

### **Incision and Subcutaneous Flap**

When SILS cholecystectomy was first performed, a small 2 to 3cm vertical or horizontal incision is made within the umbilicus and some dissected subcutaneous flaps to more easily place multiple ports. For gastric banding, the position of the adjustment port requires a subcutaneous flap. It's the potential to result in formation of a seroma and infection from the port. But with careful, minimal dissection, this may be avoided. In many single incision laparoscopic surgery procedures, minimal development of the flap is required to place multiple trocars, but surgeons should be cognizant of this possible complication.

### **Trocars**

There are many technical challenges to performing single-incision laparoscopic surgery. Unlike standard laparoscopy, all trocars, usually 3 to 4, are crowded into one skin incision. To allow for greater freedom of movement and reduced clashing, a few modified trocar options are now available and more have been in production. Many prefer the trocars used in standard laparoscopy or slightly modified ports. Some of these trocars have smaller heads, lower profiles, and absence of insufflation ports, such as Apple trocars (Apple Medical Corporation, Marlborough, Massachusetts) and Ternamian EndoTIP™ (Karl Storz Endoscopy, Tuttlingen, Germany). This allows freedom from the hands while maximizing technique incision. Others have placed instruments directly through the fascia with no trocar. Purpose-designed ports include multilumen, single-trocar systems, such as the R-Port (Advanced Surgical Concepts, Wicklow, Ireland), Uni-X single laparoscopic port system, and GelPort (Alexis®). Recently, Covidien received FDA clearance to promote its single incision laparoscopic surgery™ multiple instrument access port.

The GelPort used in SILS is similar to those used in hand-assisted laparoscopic procedures. The GelPort supplies a "flexible fulcrum" for insertion and manipulation of a laparoscope and up to 3 or four 5mm trocars through a single fascial incision. This system also allows the insertion of an instrument directly through the GelPort without using a trocar. Given that we do not know the long-term rate of complications of placing multiple trocars so closely together, this

technique could also prevent hernias. Lastly, the GelPort technique readily maintains the pneumoperitoneum and avoids the leak commonly encountered with multiple individual trocars. However, a single, larger incision may increase pain, the bigger incision size may limit cosmetic benefit, along with a specialized port clearly adds cost<sup>17-19</sup>.

There are now other commercially accessible, single-incision platforms with built-in trocars specifically made for single incision laparoscopic surgery procedures. These devices require a single fascial incision such as the GelPort, but have 3 to 4 ports for instruments, in addition to a separate site for insufflation. They've many of the same advantages and problems as the GelPort, but have less flexibility in port size and site.

### **Flexible Instruments**

In addition to standard laparoscopic instruments, bent or flexible instruments and laparoscopes may be used to minimize the clashing from the instruments. You will find instruments that have varying degrees of flexibility and freedom. Novare Surgical Systems, Inc. makes a products called RealHand® which includes a flexible grasper, needle holder, scissors, and hook that mimic the movements from the surgeon's wrist. Ethicon (Cincinnati, OH, USA) helps make the REALIZE™ Endoscopic Dissector, that has 90-degree flexibility and it is used for retrogastric dissection. Other flexible instruments available include tools from Covidien (Norwalk, Connecticut), Pnavel Systems, Inc. (Morganville, New Jersey), and Cambridge Endo-maker of the Autonomy™ Lapro-Angle™ Instruments (Framingham, Massachusetts). Typically, using one flexible instrument and something rigid instrument is adequate to give enough working space to control and dissect tissue bimanually. Also, combined utilization of long and short instruments keeps the handles and surgeons' hands from interfering with each other. In our experience, using one flexible instrument is satisfactory, and trying to use two may be more mentally challenging and cumbersome. One problem with multiple planes of articulation is wrist fatigue, especially since all articulating instruments often deflect when force is applied<sup>18-22</sup>.

### **Telescopes used in SILS**

For basic laparoscopic procedures for example, a standard 10-mm, 30-degree telescope provides sufficient visualization of the surgical field. However, for other procedures, the length and visibility supplied by the

standard laparoscope may pose some limitations. Because there is only one incision, typically in the umbilicus, the distance in the umbilicus to the surgical field might be longer than with the conventional laparoscopic technique. EndoEye laparoscope of Olympus Surgical & Industrial America Inc, allows panoramic view from the surgical field with minimal movements through the operator. By manipulating just the tip of the laparoscope with the shaft off line, the viewing angle needed can be obtained while allowing the working ports a higher level of freedom.

#### Use of fiber optic endoscope in SILS

Instead of using the traditional telescope, some purchased the flexible endoscope, as with some NOTES procedures, to do SILS. Instead of puncturing with the stomach or even the vagina, the endoscope is placed transabdominally for visualization. Some have inserted a double-channel endoscope directly with the fascia, while others have used a 15-mm trocar for insertion of the endoscope. Another trocar is positioned for insufflation, smoke evacuation, and retraction. Unlike single incision laparoscopic surgery, where the surgeon is applying a using a laparoscope, the main working instrument is the double-channel endoscope. Once the endoscope is positioned, the procedure is performed much like NOTES with slightly less technical difficulty because of distance. Current limitations of the technique, similar to those encountered using NOTES, are that most surgeons don't have the required skills and the available endoscopic instruments are not created for surgical dissection.

#### Retraction

One of the initial cases of single-incision laparoscopic cholecystectomy described using two transumbilical trocars with two transabdominal stay sutures for retraction of the gallbladder. Sutures can allow retraction, lowering the quantity of ports needed. A suture that enters and exits the abdomen in separate areas and passes with an organ having a locked stitch or clips can allow for "puppeteering" or retraction in different directions. Since that time, the use of intrabdominal suture to the anterior abdominal wall with or without endoloop and use of the penrose like a sling are also described. Using percutaneous sutures for retraction begs the question of more punctures and incisions. At what point is it no longer a single-incision procedure? Another technique for retraction involving a magnetic system might be adaptable from the use within NOTES procedures.

#### Benefits of Single Incision Laparoscopic Surgery.

Typically, this surgery requires only one small incision. Health and cosmetic benefits – Since there are fewer incisions, there is less possibility of infection, less scarring and better cosmetic results. The surgery is recognized as minimally invasive to cause shorter recovery times. Laparoscopic surgery has generally replaced the need for traditional open surgeries in the abdominal or pelvic cavities.

For many years, large incisions were necessary to perform abdominal surgical procedures. Although effective, multiple morbidities were related to this method, including postoperative pain, wound infection, incisional hernia, and prolonged hospitalization. The present rate of wound infection is 2 to 25 percent, and occurrence of incisional hernia is 4 to 18 percent in US patients. Some surgeons and gynecologist perceptions that complications and morbidities were associated with the size and extent of the incision led these phones minimize their incision length. By making smaller incisions that were protected by a port, there was an excellent decrease in incision-related complications. There is faster postoperative recovery, pain reduction, less requirement for narcotics, respiratory function improvement, reduction in infection and hernias, and overall cosmesis. However, with the introduction of the new technique came a price<sup>16-19</sup>.

Prior to the safety from the technique might be verified and standardized, the procedure was introduced with haste, causing higher rates of common bile duct injury along with other complications. Over time, the complication rates decreased and advantages of minimal, small incisions were recognized and accepted as the defacto standard. Surgeons continued to create modifications to reduce the number of incisions. For instance, laparoscopic cholecystectomy, which typically requires four incisions, was modified to 2 or three trocar incisions. Others reduced how big incisions and instrumentation to 2 to 3mm.

Although endoscopic technology continues to be accessible, it was initially limited to the luminal walls. However, when accidental puncture of the stomach during polypectomy showed another way to access the peritoneal cavity, the potential of scarless, incisionless surgery was introduced. Natural orifice transluminal endoscopic surgery (NOTES) was envisioned as probably the ultimate form of non-invasive surgery-with many potential benefits, including complete removal of wound infection, adhesions, and hernias, decrease in

pain and recovery period, minimal anesthesia and analgesia, and no external scar.

Basically, NOTES involves placing flexible endoscope through among the body's natural orifices, like the mouth, anus, vagina, or urethra, to achieve access to an appearance space to do surgery. Since Kalloo's transgastric peritoneoscopy in 2004, multiple centers have successfully performed many variations of NOTES in humans, including transgastric appendectomy to complete transvaginal cholecystectomy. However, using the creation of every novel technique, you will find limitations and shortcomings. Insufficient specific instrumentation, safe viscerotomy closure technique, and difficulty with patient recruitment in America has limited its implementation. Preliminary experience has proven feasible and suggested that several of the potential benefits, such as cosmesis, pain reduction, and shorter recovery, may in fact be realized. Knowing the importance and also the potential advantages of NOTES yet realizing current limitations from the technique, surgeons are developing single-incision laparoscopic surgery in parallel, perhaps like a bridge between standard laparoscopy and NOTES.

The tenet of single-incision laparoscopic surgery is to lessen the quantity of incisions to one, typically at the umbilicus, for multiple trocar placements. Since single incision laparoscopic surgery procedures are relatively new and in evolution, many techniques happen to be described but no widely accepted standard exists. SILS was first adapted to cholecystectomy and once the strategy was proved to be effective and safe for basic laparoscopic procedures, it was put on a few of the technically simpler bariatric procedures. Laparoscopic gastric banding was one of the obvious transitional procedures since the significant incision necessary for the adjustment port offers the needed space to place multiple trocars. However, laparoscopic banding was more technically difficult due to the camera angles required for dissection of the retrogastric tunnel, the requirement for retraction of an often-fatty liver from a longer distance, and the requirement for suturing. As surgeons gained more experience, the technique became more sophisticated, and cosmesis was improved by placing the incision within the umbilicus. With this particular change, the distance from incision to the surgical field increased and also the angle of dissection became more technically challenging. Some have modified this technique by adding a small, second incision for retraction or using specialized ports. With

tries to overcome these obstacles, multiple techniques and instruments have been developed. Since the primary benefit of single incision laparoscopic surgery seems to be cosmetic, most agree that the umbilicus may be the preferred incision site; however, it's at this time how the techniques diverge<sup>22-25</sup>.

### Future upcoming technologies

Magnetically anchored and guidance systems (MAGS) are designed to maneuver intra-abdominal instruments by use of an external handheld magnet. The fundus from the gallbladder, for instance, could be retracted above the costal margin by coupling the interior aspect of an external magnet. The graspers are situated on the gallbladder with the help of endoscopic biopsy forceps. Magnets may become valuable, but challenges have an exponential reduction in force with thicker abdominal walls and clumping of ferrous objects within the operating room.

Robotic or remotely controlled devices are other technologies that could aid single-incision laparoscopy. The ability to insert instruments and also have the surgeon control them remotely makes it possible for examples of freedom and triangulation not otherwise possible with a single point of origin. Avoiding the requirement for handles and resulting clashing or interference of instrument motion are significant potential advantages of these systems.

Single-incision laparoscopic surgery is gaining interest and associated courses are being taught at many centers. This can be for any number of reasons. Many see a natural progression to reduce the number of incisions from multiple small incisions necessary for laparoscopy to a single incision. Although neither truly scar-less nor as pain-free as NOTES, it may still offer several benefits. SILS has got the potential to improve cosmesis, yet be practiced with already existing instruments and what many view as modified laparoscopic techniques.

As with any new surgical technique, there's a learning curve. We now have learned in the problems encountered with NOTES that lacking the appropriate instrumentation and adjusting to a different setup can be hugely challenging. Although the idea of single incision laparoscopic surgery seems similar to standard laparoscopy, theoretically you will find major differences in technique. Actually, some "rules" of laparoscopy have to be "broken" in order to perform SILS. It involves crowding of all the working instruments within one

incision, and the basic principle of triangulation is therefore lost to some extent. When related to inadequate training and experience, these challenges may increase risk of intraoperative injury. Visualization may be obscured because of crowding of instruments, and longer distance from insertion to operative site presents additional challenges. To some degree, we still lack optimal instrumentation to overcome these issues. Given these challenges, is single incision laparoscopic surgery worth performing for improved cosmesis? May be the hope of slightly faster recovery and decreased pain likely?

Before we are able to answer these questions, there needs to be randomized, prospective studies to compare SILS to standard laparoscopy. The theoretical benefits are obvious, but it's unclear whether the benefits really exist and when they'll outweigh the potential risks. This comparison isn't unlike the development of laparoscopy. Initially, many were skeptical given higher rates of complication, higher cost of instrumentation, and increased operative time. However, it turned out to be extremely beneficial for patients and had become the defacto standard for a lot of procedures. Similar to the development of laparoscopy, it would appear that dissemination from the single incision laparoscopic surgery techniques will precede careful study. The fact that SILS appears like an incremental step (i.e., moving trocars to one location) and involves few new instruments makes it simple for surgeons to adopt. Ideally, careful comparison to existing techniques would precede wide using new technology. Market forces, patient interest, and even industry are driving the advancement of single incision laparoscopic surgery. Although many surgeons are already performing SILS procedures, disciplined, evidenced-based investigations must be performed to determine the proper place of single incision laparoscopic surgery in surgical practice<sup>26-27</sup>.

We now have learned in the introduction of laparoscopy that serious, avoidable complications can occur when embarking on new techniques without adequate training. What specific training is needed and whether credentialing specific to SILS is necessary still be determined. Currently, most surgeons performing single incision laparoscopic surgery feel that some specific didactic training and observation of single incision laparoscopic surgery technique is necessary at the very least. Some feel that hands-on training and proctoring is necessary. Using SILS lacks any significant level of regulation or monitoring. Clearly, some guidelines have

to be implemented to avoid unnecessary complications. As mentioned, this might involve training in an animate or inanimate lab, proctoring, or just didactic education with operating room or video observation<sup>28</sup>.

Single incision laparoscopic surgery (SILS) has got the potential to offer patients real benefits, however the actual connection between SILS will not be positive if training is inadequate. Some believe single incision laparoscopic surgery will be a bridge to NOTES. While there may be some cross-fertilization between techniques, it is likely these techniques will develop running in parallel because SILS is technically simpler and easier for surgeons and patients to conceptualize. Yet, single incision laparoscopic surgery performed with flexible endoscopes may be a step toward NOTES. In summary, the first experience of single incision laparoscopic surgery challenges some basic laparoscopic surgical conventions. Experience and technology may allow SILS to become performed widely and improve surgery<sup>27,28</sup>.

### Conclusion

Single-incision laparoscopic surgery is feasible for urological, surgical, gynecological and even for suitable for pediatric population. However, in the future prospective studies with sufficient power are warranted to demonstrate any statistically significant benefits over the standard laparoscopic method. These are most likely to be in terms of postoperative pain, port site complications, cosmesis, and patient satisfaction<sup>21</sup>.

### References

1. C. P. Desimone and F. R. Ueland, "Gynecologic laparoscopy," *Surgical Clinics of North America*, vol. 88, no. 2, pp. 319–341, 2008.
2. R. F. Medeiros, D. D. Rosa, M. C. Bozzetti, M. G. Fachel, S. Furness, and R. Garry, "Laparoscopy versus laparotomy for benign ovarian tumour," *Cochrane Database of Systematic Reviews*, vol. 2, no. 2, Article ID CD004751, 2009.
3. S. S. Kommu, J. H. Kaouk, and A. Rané, "Laparoscopic single-site surgery: preliminary advances in renal surgery," *British Journal of Urology International*, vol. 103, no. 8, pp. 1034–1037, 2009.
4. G. Mostafa, B. D. Matthews, R. F. Sing, K. W. Kercher, and B. T. Heniford, "Mini-laparoscopic versus laparoscopic approach to appendectomy," *BMC Surgery*, vol. 1, article 4, 2001.

5. T. Bisgaard, B. Klarskov, R. Trap, H. Kehlet, and J. Rosenberg, "Microlaparoscopic vs conventional laparoscopic cholecystectomy: a prospective randomized double-blind trial," *Surgical Endoscopy*, vol. 16, no. 3, pp. 458–464, 2002.
6. J. Kaouk, G. Haber, R. Goel, et al., "Single-port laparoscopic surgery in urology: initial experience," *Urology*, vol. 71, no. 1, pp. 3–6, 2008.
7. J. Zhu, "Scarless endoscopic surgery: NOTES or TUES," *Surgical Endoscopy*, vol. 21, no. 10, pp. 1898–1899, 2007.
8. M. Whiteford, P. Denk, and L. Swanstrom, "Feasibility of radical sigmoid colectomy performed as natural orifice transluminal endoscopic surgery (NOTES) using transanal endoscopic microsurgery," *Surgical Endoscopy*, vol. 21, no. 10, pp. 1870–1874, 2007.
9. P. Bucher, F. Pugin, and P. Morel, "Single port access laparoscopic right hemicolectomy," *International Journal of Colorectal Disease*, vol. 23, no. 10, pp. 1013–1016, 2008.
10. F. Fanfani, A. Fagotti, A. Ercoli, et al., "A prospective randomized study of laparoscopy and minilaparotomy in the management of benign adnexal masses," *Human Reproduction*, vol. 19, no. 10, pp. 2367–2371, 2004.
11. A. A. Gumbs, L. Milone, P. Sinha, and M. Bessler, "Totally transumbilical laparoscopic cholecystectomy," *Journal of Gastrointestinal Surgery*, vol. 13, no. 3, pp. 533–534, 2009.
12. P. Bucher, F. Pugin, N. Buchs, S. Ostermann, F. Charara, and P. Morel, "Single port access laparoscopic cholecystectomy (with video)," *World Journal of Surgery*, vol. 33, no. 5, pp. 1015–1019, 2009.
13. A. Rané, P. Rao, and P. Rao, "Single-port-access nephrectomy and other laparoscopic urologic procedures using a novel laparoscopic port (R-port)," *Urology*, vol. 72, no. 2, pp. 260–263, 2008.
14. G. Mostafa, B. D. Matthews, R. F. Sing, K. W. Kercher, and B. T. Heniford, "Mini-laparoscopic versus laparoscopic approach to appendectomy," *BMC Surgery*, vol. 1, article 4, 2001.
15. T. Bisgaard, B. Klarskov, R. Trap, H. Kehlet, and J. Rosenberg, "Microlaparoscopic vs conventional laparoscopic cholecystectomy: a prospective randomized double-blind trial," *Surgical Endoscopy*, vol. 16, no. 3, pp. 458–464, 2002.
16. J. Kaouk, G. Haber, R. Goel, et al., "Single-port laparoscopic surgery in urology: initial experience," *Urology*, vol. 71, no. 1, pp. 3–6, 2008.
17. M. Whiteford, P. Denk, and L. Swanstrom, "Feasibility of radical sigmoid colectomy performed as natural orifice transluminal endoscopic surgery (NOTES) using transanal endoscopic microsurgery," *Surgical Endoscopy*, vol. 21, no. 10, pp. 1870–1874, 2007.
18. P. Bucher, F. Pugin, and P. Morel, "Single port access laparoscopic right hemicolectomy," *International Journal of Colorectal Disease*, vol. 23, no. 10, pp. 1013–1016, 2008.
19. A. A. Gumbs, L. Milone, P. Sinha, and M. Bessler, "Totally transumbilical laparoscopic cholecystectomy," *Journal of Gastrointestinal Surgery*, vol. 13, no. 3, pp. 533–534, 2009.
20. P. Bucher, F. Pugin, N. Buchs, S. Ostermann, F. Charara, and P. Morel, "Single port access laparoscopic cholecystectomy (with video)," *World Journal of Surgery*, vol. 33, no. 5, pp. 1015–1019, 2009.
21. A. Rané, P. Rao, and P. Rao, "Single-port-access nephrectomy and other laparoscopic urologic procedures using a novel laparoscopic port (R-port)," *Urology*, vol. 72, no. 2, pp. 260–263, 2008.
22. A. Fagotti, F. Fanfani, F. Marocco, C. Rossitto, V. Gallotta, and G. Scambia, "Laparo-endoscopic single site surgery (LESS) for ovarian cyst enucleation: report of first 3 cases," *Fertility and Sterility*, vol. 92, no. 3, pp. 1168.e13–1168.e16, 2009.
23. A. N. Fader and P. F. Escobar, "Laparoendoscopic single-site surgery (LESS) in gynecologic oncology: technique and initial report," *Gynecologic Oncology*, vol. 114, no. 2, pp. 157–161, 2009.
24. R. E. Offer, S. A. King, A. Atogho, et al., "Single port access (SPATM) salpingoophorectomy: 25 cases of a novel minimal access technique," *Journal of Minimally Invasive Gynecology*, vol. 15, no. 6, supplement 1, p. 8S, 2008, Abstracts of the Global Congress of Minimally Invasive Gynecology 37th Annual Meeting of the AAGL.
25. J. A. Shepherd, S. King, C. Della Badia, et al., "Single port access (SPATM) hysterectomy in a

- teaching institution: comparison of single port to traditional multiport laparoscopy,” *Journal of Minimally Invasive Gynecology*, vol. 15, no. 6, supplement 1, p. 87S, 2008, Abstracts of the Global Congress of Minimally Invasive Gynecology 37th Annual Meeting of the AAGL.
26. P. T. Ramirez, “Single-port laparoscopic surgery: is a single incision the next frontier in minimally invasive gynecologic surgery?” *Gynecologic Oncology*, vol. 114, no. 2, pp. 143–144, 2009.
27. P. M. Yuen, K. M. Yu, S. K. Yip, W. C. Lau, M. S. Rogers, and A. Chang, “A randomized prospective study of laparoscopy and laparotomy in the management of benign ovarian masses,” *American Journal of Obstetrics and Gynecology*, vol. 177, no. 1, pp. 109–114, 1997.
28. L. J. Havrilesky, B. L. Peterson, D. K. Dryden, et al., “Predictors of clinical outcomes in the laparoscopic management of adnexal masses,” *Obstetrics and Gynecology*, vol. 102, no. 2, pp. 243–251, 2003.

**Author:**

Professor & Chairman, Department of Urology, BSMMU, Dhaka