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Main Story

Minimal Access: Why Laparoscopy is Better

*Better known as keyhole surgery, laparoscopy as a surgical technique has made headway in the field of medicine. **Sonal Shukla** offers a peek into the recent advancements in laparoscopy*

Access to body cavities for surgical procedures by means other than making a large cut constitutes laparoscopy. A form of minimal access surgery, laparoscopy has gained prominence as a technique of the new millennium for most abdominal and thoracic operations and is being applied to a growing number of other surgical procedures. Patients are attracted by the reduced pain and faster recovery associated with the procedures and surgeons are finding that laparoscopy matches traditional open procedures in effectiveness.



"Because there is less pain with laparoscopy, more patients sought treatment (ie their threshold to submit to an elective operation was lowered). They challenged physicians to apply the concept of minimal access therapy to other diseases," states Dr Arun Prasad, Senior Consultant, General Surgery, Indraprastha Apollo Hospital, New Delhi. Today, with the development of the technique and increasing application in various fields of surgery, laparoscopy is rapidly evolving.

Bigger Bag of Tricks

Improvements in the telescopes, camera systems, better optics enabling better vision and smaller sized instruments, availability of good technology for arresting bleeding during surgery like harmonic scalpel/ligasure, new devices to facilitate suturing inside the abdomen, newer ergonomically-designed instruments to replicate hand movements inside the abdomen, high resolution LCD screens, and advent of Da Vinci Robotic Surgery system have allowed surgeons to perform increasingly complex operations by laparoscopy. Surgery has become safer for patients.



With the new generation ligasure, the surgeon can grasp, cauterise, and



The robotic technology may also bring



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surgeon can grasp, cauterise, and transect permanently tissue bundles

The robotic technology may also bring the more difficult technical operations within the realm of laparoscopic surgery

Light source: Over the years, the light source has changed from lamps, to ordinary bulbs to halogen light to Xenon lights. The new Hopkins II Rod-Lens System has replaced the old lens system. Also, the cameras used have changed from single-chip to three-chip, digital to high definition and the recent three-dimensional ones. This, along with the high quality medical grade monitors, has given surgeons clear vision. "3D cameras have brought better vision. The two point discrimination—which is not possible to show with single chip camera—can now be seen," explains Dr Raman Goel, Laparoscopic and Bariatric Surgeon and Associate Professor of Surgery at Grant Medical College, Mumbai. As Dr Shabeer Ahmed, Gastrointestinal and Minimal Access Surgeon, Wockhardt Hospital, Bangalore explains, the 2D image of the laparoscope was a major limitation for some procedures because of the poor depth perception.

Ultrasonic shears: "The surgeon can choose from the basic diathermy electro-cautery to harmonic scalpel (ultrasonic shears) to sealing device like ligasure," explains Dr Pradeep Chowbey, Chairman, Department of Minimal Access Surgery, Sir Ganga Ram Hospital, New Delhi. Haemostasis, arresting of bleeding from an injured blood vessel, is a key component for successful surgery. The initial use of laser to ablate bleeding during laparoscopic cholecystectomy proved to be cumbersome and ineffective.

"The latest energy sources have added to the comfort of the surgeon and the safety of the patient"



- Dr Pradeep Chowbey
Chairman
Department of Minimal Access
Surgery
Sir Ganga Ram Hospital
New Delhi

However, the development of devices like ultrasonic shears and vessel sealing systems has taken minimal access surgery to greater heights, believes Dr Deepraj Bhandarkar, Consultant, Department of Minimal Access Surgery, PD Hinduja Hospital, Mumbai. The blades of ultrasonic shears vibrate 55,000 times a second, cut through tissues and simultaneously seal the blood vessels in them, reducing the blood loss significantly. Vessel sealing devices allow the surgeon to seal vessels up to seven mm in diameter without having to tie or clip them.

"The prohibitive initial outlay and cost required to use the robot per case does not make robotic surgery a viable option"



- Dr Deepraj Bhandarkar
Consultant Department of Minimal Access Surgery, Hinduja Hospital Mumbai

Insufflators: Better insufflators, which blow gas into the abdomen to move away muscle and skin from the intestine, have changed from low to high flow. With low insufflators, the rate of flow was 8 to 10 litres per minute. With high flow insufflators, the gas can be pushed at the rate of 20 to 40 litres per minute. This helps during difficult surgeries as the dome remain intact and if bleeding occurs it can be dealt with faster. With newer insufflators, the gas is supplied at body temperature, rather than at room temperature, reducing the possibility of the telescope getting fogged.

Endo-staplers: Laparoscopic bowel surgery for removal of diseased portions of intestine is becoming increasingly common. Suturing ends of bowel by laparoscopy is tedious. Endo-staplers allow surgeons to divide and anastomose parts of the bowel and speed up the surgery.

Trocars: The diameter of trocars used to perform laparoscopic surgery has reduced from 15 mm to five mm. The availability of two-mm trocars today has made mini laparoscopy possible. Today's bloodless trocars have moved from metal to plastic, and have become standard in Western countries. They have made

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Ligasure vessel sealing system: The ligasure vessel sealing system was initially created for open procedures. Despite its effectiveness, the first ligasure generator for open procedures never got wide acceptance, since the surgeon could not cauterise and cut the vessel using the same instrument. With the new generation ligasure, the surgeon can grasp, cauterise, and transect permanently tissue bundles and vessels up to and including seven mm in diameter. "The process is simple and uncomplicated: tissue is grasped by the ligasure. After the jaws of the instrument are closed, tissue is compressed. The instrument is activated by the surgeon. When the instrument determines that the seal is complete, a tone sounds and output to the hand piece is automatically shut off avoiding damage to nearby structures," explains Dr Ahmed. It can be used for several open and laparoscopic procedures, including adhesiolysis, nissen fundoplication, colectomies, appendectomy, hysterectomy, salpingo-oophorectomy, and splenectomy.

Hand-assist laparoscopy: In certain advanced laparoscopic procedures where the size of the specimen being removed would be too large to pull out through a trocar site (as would be done with a gallbladder), an incision larger than 10 mm must be made. The most common of these procedures are removal of all or part of the colon (colectomy), or removal of the kidney (nephrectomy). Some surgeons perform these procedures completely laparoscopically, making the larger incision toward the end of the procedure for specimen removal, or, in the case of a colectomy, to also prepare to reconnect the remaining bowel (create an anastomosis). Many other surgeons feel that since they will have to make a larger incision for specimen removal anyway, they might as well use this incision to have their hand in the operative field during the procedure to aid as a retractor, dissector, and to be able to feel differing tissue textures (palpate), as they would in open surgery. This technique is called hand-assist laparoscopy. Since they will still be working with scopes and other laparoscopic instruments, CO2 will have to be maintained in the patient's abdomen, so a device known as a hand access port (a sleeve with a seal that allows passage of the hand) must be used.

According to Dr Arbinder Kumar Singal, Assistant Professor, Department of Paediatric Surgery, MGM Hospital, Navi Mumbai, human and social factors have also fuelled the positive change in the advancement of this surgical technique. "More surgeons are getting trained in laparoscopic surgery with the training courses available at least in five centres in India and in many centres abroad. New procedures are added everyday to the list of possible laparoscopies," he adds.

The Technological Leap

In the 1970s and 80s, some of the surgical pioneers used laparoscopy for diagnosis of intra-abdominal conditions that could not be diagnosed with the help of investigations then available.

The surgeons had to introduce the laparoscope inside the abdomen and literally put an eye to it to be able to see inside. A significant breakthrough came around 1985 with the introduction of the computer camera. This camera housed a charged couple device (CCD) in the form of a tiny silicon chip acting as a sensor. The sensor picked up the image from the laparoscope; the image was transmitted electronically through a cable first to the camera-processing unit and then to a television screen. As the team members shared the view with the operating surgeon, they were able to assist effectively at the operation. "This was one of the most significant advances responsible for propelling laparoscopy to its present heights. Appreciating the potential for treating diseases, instruments to allow surgeons to perform laparoscopic surgery were developed in the late 1980s and early 1990s. This culminated in the arrival on the surgical scene of laparoscopic cholecystectomy and the embracing of laparoscopic surgery by surgeons around the world within a few short years," states Dr



Deepraj Bhandarkar, Consultant, Department of Minimal Access Surgery, PD Hinduja Hospital, Mumbai.

Proving Credentials



One concern is training of surgeons. According to Dr Bhandarkar, at present, the exposure gained by surgical residents in India to laparoscopy surgery appears inadequate and haphazard. "For the development of the speciality and its safe practice the formal incorporation of theoretical as well as practical aspects of laparoscopic surgery in postgraduate surgical training is important," he opines. According to Dr Arvind Kumar, Professor of Surgery, AIIMS, New Delhi, training has been and continues to be an issue as unfortunately bureaucracy initially kept Indian medical colleges away from adopting this technology.

A recent case, in which Silverman, the wife of a London lawyer died in a private hospital from peritonitis after perforation of the bowel during a laparoscopic procedure, has resulted in some private London hospitals demanding accreditation before allowing consultants to perform laparoscopic procedures. There has recently been much media attention on the complications of minimal access surgery, and this has raised public concerns over training and accreditation. According to Dr Ahmed, the question of accreditation in minimally invasive surgery needs to be addressed urgently. "Criteria for accreditation would have to be laid down, and clearly a mechanism of appeal for those who fail accreditation would also need to be organised," he adds.

If accreditation is to be introduced, who should be responsible for it? This could be done in association with the surgical societies with a specific interest in minimally invasive surgery. "Surgical societies should form centres in various cities. These centres will teach with simulators and videos, and trainees will be able to observe surgical procedures being performed. However, they will not be able to use porcine models. The centres may act as a focus for the organisation of hands-on courses and proctorships in the regions but are unlikely to be able to run them by themselves," states Dr Ahmed.

Moreover, experts feel that comprehensive audit should be introduced with training and accreditation. The centres for minimally-invasive surgery may have an important part to play in the development and running of such audits on a regional basis and co-ordinating results to produce a national picture.

Different Strokes

Over the years, many specialities other than general surgery have embraced laparoscopic surgery. Removal of a diseased organ like gall bladder, uterus, appendix, kidney, adrenal gland and spleen are the most commonly performed laparoscopic surgeries. Surgeries which require reconstruction are difficult to perform laparoscopically, but they are also increasingly done these days with excellent results like hernia repairs, correction of oesophageal reflux, gynaecological surgeries, renal surgeries, pancreatic surgeries, liver resections, cysts in belly, and resection of intestine. Widespread use of laparoscopic bariatric surgery (for treating patients who are morbidly obese) has been another exciting advance. For patients who are significantly overweight, surgery is the only option to lose weight in the long term. Particularly in obese high-risk patients, operations performed through small incisions significantly reduce the potential for complications and allow for faster recovery. "Laparoscopic obesity surgery has come to the rescue of the morbidly obese who are struggling not only with their weight but also with various co-morbidities they develop because of obesity," explains Dr Muffazal Lakdawala, Bariatric Surgeon, Dr LH Hiranandani Hospital, Mumbai.



Lowering Expense

Development of new instruments and innovation in technique is also required for widespread use of advanced laparoscopy for the treatment of abdominal conditions. "New technologies may overcome many of the limitations of standard laparoscopic techniques. Two particularly promising technologies are hand access devices and robotic surgery," opines Dr Ahmed. He feels the cost of the surgery is high although much cheaper than in Europe where disposable instruments are almost exclusively used. Manual suturing reduces this cost, but obviously needs training. Another way to cut costs is to get local manufacturers to produce instruments indigenously.

The success of a laparoscopic operation can be measured in terms of patient outcome and complications encountered. If the patient is adequately assessed prior to surgery and the surgeon is well trained to perform it, the laparoscopic surgery can be completed by laparoscopy without complications. However, all the patients undergoing laparoscopic surgery are made aware that if for any reason the operating surgeon feels that it is unsafe to proceed with laparoscopy, the surgery is converted to open surgery and the operation completed that way. "Such a conversion is not a complication but rather prudent judgment exercised by a mature surgeon who puts the safety of his patients above everything else. Despite best efforts on part of the surgical team, complications may occur after laparoscopic surgery-as with any form of surgery. Patients are given a fair idea of what the complications are likely to be, but their likelihood is put in proper perspective. When complications do occur, they are recognised promptly and treated diligently to ensure a good outcome for the patient," explains Dr Bhandarkar.

Risks & Limitations

Laparoscopy may be risky for patients with cardiac or lung diseases as they would not be able to breathe out carbon dioxide absorbed into the circulation during laparoscopy. Distension of the abdomen also creates a mechanical disadvantage in breathing in such patients. It may also be difficult to do laparoscopic surgery in these patients due to the lack of space. Also, children tend to absorb carbon dioxide into circulation faster and may have difficulty in respiring it out. To overcome the risk, case selection and proper fitness from a good anaesthesiologist is mandatory. It is also important to de-select the patients in whom laparoscopy is not justified, say experts.

Robotic Future?

Experts opine robotic surgery is the next big thing in the field of laparoscopic surgery. Robotic devices for use in general surgery have now been developed. The latest is the Da Vinci Robotic System for laparoscopic surgery, approved for use in the US in July 2000. It allows a three dimensional view and more precision for certain surgeries. It offers the promise of improvements to laparoscopic surgery that will allow most surgeons to perform complex laparoscopic operations. The robotic technology may also bring the more difficult technical operations (currently performed via incisions) within the realm of laparoscopic surgery. Experts think even more substantial advantages are likely to emerge in the future as technology advances.

3D CT imaging will be added to the already digitised image stream, so that the surgeon will be able to 'see' the structures beneath the visual operative surface. Also, heart motion will be 'gated', which will allow coronary artery bypass to be performed on the beating heart with robotic arms that move in parallel with the heart motion, while the surgeon sees a still heart. Even though not the first commercially available surgical robot (that distinction should probably go to the orthopaedic robotic device, Robodoc), it is part of a family of budding robotic instruments in various stages of research and clinical use in the US and around the world.

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 or research and clinical use in the US and around the world. Common to these devices is a remote surgeon interface which transmits the hand movements of the surgeon to robotic arms that enter the abdomen via laparoscopic ports and manipulate tissue. These machines cost approximately \$1 million. "While this sounds expensive for surgical equipment, most invasive radiology suites have equipment worth that much and a great deal more. Whether such expense is justified is as yet undetermined," states Dr Ahmed. According to him, the objective of these devices is not to replace surgeons, but to add technology to improve surgery, "Laparoscopic surgery has hit a roadblock somewhere between the technical expertise required for a cholecystectomy and anti-reflux surgery. Only select surgeons are moving beyond these to more technically difficult operations," he laments. For Dr Arvind Kumar, the only major drawback of robotic surgery today is its extravagant cost, "There is only one company providing this technology, making it even more expensive for the end users due to lack of competitive pricing—a handicap which is barring its rapid spread worldwide," says Dr Arvind Kumar. About the cost dynamics he says, "Apart from Rs 5-10 crore of initial investment, every instrument used in Da Vinci Robotic System has a life of only 10 uses, and every instrument costs about Rs 3-4 lakh. In one procedure we need at least four to five such instruments. Thus if we have one set for about Rs 12 lakh, that will give us about 10 cases."

According to Dr Bhandarkar, currently there is no clear evidence that operations performed with the robots result in better outcome for the patients. "Moreover, the prohibitive initial outlay as well as enormous costs required to use the robot per case does not make robotic surgery a viable or attractive option right now in our country. It is possible that over the years, robots may become a cost effective way of performing complex laparoscopic operations," he concedes.

Natural Orifice Transluminal Endoscopic Surgery (NOTES)

Today, the medical fraternity is also gung ho about an experimental surgical technique whereby scarless abdominal operations can be performed with an endoscope passed through a natural orifice (mouth, urethra, anus, etc.) then through an internal incision in the stomach, vagina, bladder or colon, thus avoiding any external incisions or scars.

Proponents and researchers in this field recognise the potential of this technique to revolutionise the field of minimally invasive surgery by eliminating abdominal incisions. The potential advantages include reduced anaesthetic requirements, faster recovery and hospital stay, avoiding potential complications of abdominal wound infection and hernias, less immunosuppression, better postoperative pulmonary and diaphragmatic function. However critics challenge the safety and advantage of this technique in the face of effective minimally invasive surgical options such as laparoscopic surgery.

Says Dr Tarun Gupta, Laparoscopic & Consultant Surgeon, Rockland Hospital, New Delhi, "The concept of NOTES challenges surgical norms taught to us in college. Going through an oral cavity, which is an infected area does not sound good surgically." According to Dr Arvind Kumar, NOTES is still nascent and can only be considered as an experimental tool. "For this technology to really come of age we need to wait till the industry makes better equipment, which will happen definitely in the next 5 to 10 years," he predicts. "Only time will tell whether in the future NOTES as is being practiced today develops into a form of patient-friendly, and safe surgery, or fades into oblivion as yet another chapter that never had its potential fully realised," says Dr Bhandarkar.

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