EDITORIAL

Minimally Invasive Surgery: Can We See Inside the Future

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Introduction and rationale:

The substantial developments in surgery, over the last century with the advent of antiseptic substance, anesthetic agents, antibiotics, surgical nutrition, and organ transplantation, haven't changed neither the basic surgical tools nor the surgical techniques. Minimally invasive surgery (MIS), was first proposed by Wickham in 1986 because of the radical changes in the treatment of kidney stones between 1979 and 1983. This new concept of (MIS) has revolutionized the management of surgical disorders in a very short period of time. It has moved the focus of surgery towards reducing the morbidity without compromising on the quality of healthcare[(1)]. (MIS) is getting in more and more in all fields of surgery, laparoscopic and endoscopic surgery are no exception[(2)]. It basically entailed entering the body cavities or lumina through the skin or through a natural orifice incurring the least damage to those organs or structures. . Collectively called minimal access surgery it has developed so much to the extent of being impossible to halt or withdraw it back. Recently computerized designing of laparoscopic instrument is introduced and microprocessor controlled safety features are added. MIS has proved a boom for patients over the last 25 years. It has significantly reduced hospital stay, grossly reduced the patients' recovery time, and greatly improved the cosmetic consequences of operations with less pain and less strain of the organism. Despite the improvement in outcomes with laparoscopy, the technique still has some limitations. Apart from grand cost and training needs, there is definite loss of tactile perception and of course the surgeon's eyesight is limited by the two dimensional view[(3)].

Laparoscopy is a technologically dependent surgery and before starting surgery every surgeon should have reasonably good knowledge of these instruments.

Historical background:

It is difficult to give the credit to one single individual to be named the pioneer of laparoscopic surgery approach. The earliest recorded references to laparoscopy dates back to the ancient times of Hippocrates. In his description there is explanation of rectum examination with a speculum. Hippocrates also advised injecting a large quantity of air into the intestines through the anus in the case of intestinal obstruction[(4)]. Hippocrates also advocated the insertion of suppository that was 10 digits long [(5,6,7)].

In1585, Aranzi was the first person to use a light source for an endoscopic procedure, focusing sunlight through a flask of water and projecting the light into the nasal cavity. The term "trocar," was coined in 1706, and is thought to be derived from trochartor troise-quarts, a three-faced instrument consisting of a perforator enclosed in a metal cannula.

In the year 1806, Philip Bozzini, built an instrument that could be introduced in the human body to visualize the internal organs. He called this instrument "LICHTLEITER".

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In the year 1853, Antoine Jean Desormeaux, a French surgeon first introduced the 'Lichtleiter" of Bozzini inside the patient. For many surgeons he was considered the "Father of Endoscopy". In the year 1867, Desormeaux, used an open tube to examine the genitourinary tract and in the year In1868, Kussmaul performed the first esophagogastroscopy on a professional sword swallower, initiating efforts at instrumentation of the gastrointestinal tract. Mikulicz and Schindler, however, were credited the advancement of gastroscopy

In1869, Commander Pantaleoni used a modified cystoscope to cauterize a hemorrhagic uterine growth. Pantaleoni thus performed the first diagnostic and therapeutic hysteroscopy.

The first experimental laparoscopy was performed in Berlin in 1901 by a German surgeon Georg Kelling, who used a cystoscope to peer into the abdomen of a dog after first insufflating it with air. Kelling also used filtered atmospheric air to create a pneumoperitoneum[8,9].

Jacobaeus of Sweden presented his series of patients who had laparoscopy in 1910 (published a series of over 100 laparoscopy and thoracoscopy (LAPAROSCOPY)[10,11].

In the year 1911, Bertram M. Bernheim, from Johns Hopkins Hospital introduced the first laparoscopic surgery to the United States. He named the procedure of minimal access surgery as "organoscopy". The instrument used was a proctoscope of a half inch diameter and ordinary light for illumination was used.

In 1918, O. Goetze, developed an automatic pneumoperitoneum needle characterized for its safe introduction to the peritoneal cavity. The next decade and a half saw an interruption of technological advances and a lack of any substantial development in endoscopy due to the first and second World Wars.

In1920, Zollikofer of Switzerland discovered the benefit of CO2 gas to use for insufflation, rather than filtered atmospheric air or nitrogen. In 1929, Kalk, a German physician, introduced the forward oblique (135 degree) view lens systems. He advocated the use of a separate puncture site for pneumoperitoneum. Goetze of Germany first developed a needle for insufflations[12].

In the 1934, John C. Ruddock, an American surgeon described laparoscopy as a good diagnostic method, many times, superior to laparotomy[13]. 1936, Boesch of Switzerland was credited doing the first laparoscopic tubal sterilization. 1938, Janos Veress of Hungary developed a specially designed spring-loaded needle. Interestingly, Veress did not promote the use of his Veress needle for laparoscopy purposes. He used Veress needle for the induction of pneumothorax.[14]

In 1939, Richard W. Telinde, tried to perform an endoscopic procedure by a culdoscopic approach, in the lithotomy position. In 1939, Heinz Kalk published his experience of 2000 liver biopsies performed using local anaesthesia without mortality. In the year 1944, Raoul Palmer, of Paris performed gynaecological examinations using laparoscopy and placing the patients in the Trendelenberg position.[15]

In 1953, the rigid rod lens system was discovered by Professor Hopkins. The credit of videoscopic surgery goes to this surgeon who has revolutionized the concept by making this instrument.[16]

In the year 1960, Kurt Semm, a German gynaecologist, invented the automatic insufflator. In 1966, Semm introduced an automatic insufflation device capable of monitoring intra-abdominal pressures and allowed safer laparoscopy.[17,18]

In1970, Gynaecologists had embraced laparoscopy and thoroughly incorporated the technique into their practice. General surgeons, despite their exposure to laparoscopy remained confined to traditional open surgery.

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In 1972, H.Coutnay Clarke first time showed laparoscopic suturing technique for hemostasis. 1973, Gaylord D. Alexander developed techniques of safe local and general anaesthesia suitable for laparoscopy. 1977, First Laparoscopic assisted appendicectomy was performed by Dekok. Appendix was exteriorized and ligated outside. 1977, Kurt Semm demonstrated the endoloop suturing technique in laparoscopic surgery.[18]

In the year 1978, Hasson introduced an alternative method of trocar placement. And in 1980, In United Kingdom Patrick Steptoe, started to perform laparoscopic procedures. In 1983, Semm, a German gynaecologist, performed the first laparoscopic appendicectomy.[19]

1985, The first documented laparoscopic cholecystectomy was performed by Erich Mühe in Germany. 1987, Phillipe Mouret, has got the credit to perform the first laparoscopic cholecystectomy in Lyons, France using video technique. Cholecystectomy is the laparoscopic procedure which revolutionized the field of laparoscopy in general surgery. By June 1988, Barry mckernan and William Saye performed the first laparoscopic cholecystectomy in the United States. This led to explosive acceptance of laparoscopic procedures previously unparalleled in the history of surgery.

Within 5 years, the National Institutes of Health had a consensus conference that declared laparoscopic cholecystectomy the procedure of choice for uncomplicated cholelithiasis.[20]

In 1994, A robotic arm was designed to hold the telescope with the goal of improving safety and reducing the need of skilled camera operator. In 1996, the first live telecast of laparoscopic surgery performed remotely via the Internet,[21].

On the 7th September 2001 the first transatlantic telesurgery procedure took place. It was known as 'Operation Lindbergh', a surgeon in New York City, USA, performed a minimally invasive gall bladder operation on a patient (4,000 miles) away in Strasbourg, France. During the procedure the surgeon's hand movements in New York City were transmitted by high-speed fibre-optic cable and replicated by robotic instruments in France; an endoscopic camera was also used to allow the surgeon to see what was happening inside the patient's body[22]. The first unmanned robotic surgery took place in May 2006 in Italy.

In the year 2007, three MIS innovations were introduced and popularized namely robotic surgery, natural orifice transluminal endoscopic surgery (NOTES), "a hybrid trans-vaginal cholecystectomy performed in New York" and single-incision laparoscopic surgery (SILS). Compared to traditional laparoscopy each one of these three innovation had its advantages and disadvantages.[23]

Robotic and tele-surgery:

The *Da Vinci surgical robot* is the first operative surgical robotic system to be cleared and the latest generation of minimally invasive surgical tools which is met with a great degree of acceptance. It has overcome certain limitations of conventional laparoscopy by offering three dimensional, high definition vision, and seven degrees of freedom to the articulating instruments. Newer robots provide image integration, telestration and the dual-console capability for training purposes has been introduced in surgical practice.[24]

So, where are we in 2011? Can we see into the future? None of us is certain how these concepts will

evolve. However most are sure that, once again, traditional concepts will be challenged and the way patients are treated will change. Future possibly still around the robots, harmonic scalpels that vibrate at a rate of 8,000 times per second, bipolar coagulators that seal vessels up to 6 mm in size by melting the intima, retractors that can be straightened to go through a port but bent into various shapes once within a cavity, suturing devices, 30 degree laparoscopes, the list is endless. On the other end is the poor old surgeon, who has been busy playing on the Xbox with the children to develop and maintain hand-eye co-ordination. But some experts see the use of robots as the future of surgery techniques, still facing considerable debate about the usefulness and cost-effectiveness.[25,26]

Future , challenges and forward progress:

The technological innovations in surgery are only beginning, the future will be very attractive, and the potential is enormous. Consistent advancements should be anticipated; technology never stops evolving. New advances are being made daily, including the incorporation of robotics and remote surgery. These technological innovations in the field of robotics and telemedicine will drive the future of minimally invasive surgery and none of us is certain how these concepts will evolve.

Despite the tremendous impact of minimally invasive surgery on the practice of surgery over the past 25 years, minimally invasive surgery faces many challenges that must be addressed. The most important of these challenges is residents and surgeons training[27]. Training needs to be restructured to incorporate sufficient exposure to core MIS procedures. Despite learning opportunities continue to evolve, which include some experience during residency, postgraduate short courses or mini-apprenticeships, and full time fellowship programs, still we are lagging behind. The academic institutions plans and curriculum should add laparoscopic and virtual reality simulators to their curricula within the next 5 years. Therefore, new educational strategies and techniques that are assisted with the integration of cost-effective technology are needed. Telecommunications will allow the availability of new training capabilities. Institutions, resident training programs, and individual surgeons must get committed to partake in these cutting-edge programs. Considering the increased volume of patients, with the higher cost of disposable equipment, and the typically higher physician fee it is likely that minimally invasive surgery will be considered more technically and financially demanding than traditional open surgical methods, which has resulted in a net increase in costs.[28,29,30]

Medical literature is filled with articles about MIS that address topics such as cost-effectiveness,[31,32] identification of surgical procedures that benefit from endoscopic technique, outcome data, and surgical patient selection.[34]

A high priority must be placed on the resolution of these issues. A growing number of patients are demanding to have MIS, providers of the technique are willing to excel via good training and the industry and the researchers should address the patient need and seek their satisfaction.[34,35]

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Where are we in Sudan ?

Minimally invasive surgeries are growing in type and volume of interventions internationally and regionally. In Sudan stakeholders must be aware that the proliferation of these technologies has occurred in parallel within many surgical specialties, with a large variation in level of implementation and in spite of formal and informal efforts to catching the train of MIS, still we are lagging behind.

In the era of reforming and rehabilitation of health services ,we believe there is a great chance to integrate multi-personal implemented efforts in Sudan which will guide the future development of MIS centre at the national level. The establishment of a Chair in Minimally Invasive Surgery will extend and enhance the mandate of Sudan Medical Specialisation Board (SMSB) and Federal Ministry of Health (FMOH). Development of curricula for surgery trainees and development of innovative teaching paradigm for surgeons is also needed.

References:

1. Igbal M. Future of Minimally Invasive Surgery in Pakistan.2008; Rawal Med J; 33:(2):130.).
2. Harrell AG., Heniford BT. Minimally invasive surgery 2005 The Am. J of Surg.2005;190: 239 – 243.
3. Ballantyne GH. The pitfalls of laparoscopic surgery: challenges for robotics and Telerobotic surgery. Surg Laparosc Endosc Percutan Tech 2002;12:1–5
4. Adams F, The Genuine Works of Hippocrates, [trans] (London: Sydenham Society, 1849) 820-821.
5. Gunning JE, Rosenzweig BA.. "Evolution of endoscopic surgery,".(Boston: Mosby- Year Book, 1991) 1-9.
6- Kelling G (1902) uberoesophagoskopie .Gastroskopie und Kolioskopie.Munchner Med Wochenschr 49:21-24.
7. Haubrich WS., "History of endoscopy," in Gastroenterologic Endoscopy, M V Sivak, ed (Philadelphia: W B Saunders Co, 1988) 2-19.
8. Litynski GS. Laparoscopy—the early attempts: spotlighting Georg Kelling and Hans Christian Jacobaeus. J Soc Laparoendosc Surg 1997;1:83–5.
9. Litynski GS. Highlights in the history of laparoscopy: the development of Laparoscopic techniques—a cumulative effort of internists, gynecologists, and Surgeons. Frankfurt/Main: Barbara Bernert Verlag; 1996.
10. Jacobaeus HC. Possibility of the use of a cystoscope for investigation of Serous cavities. Munch Med Wochenschr. 1910;57:2090-2092.
11. Goetz RH,Marr JAS(1944)The imprtanance of second ganglion for the Sympathetic supply of the upper extremities.Twonew approaches for its Removal.Clin Proc J Cape Twon Postgrad Med Ass 3: 102-114.
12. Kalk H (1929) Erfahrungen mit der Laparoskopie (zugleich mit Beschreibung Eines neuen Instruments).Z Klin Med 111:303-348.

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13. Semm K.(1983) Endoscopic appendicectomy. Endoscopy 15: 59-64.
14. NIH Consensus Conference. Gallstones and laparoscopic Cholecystectomy. JAMA 1993;269:1018 – 24.
15. Hanly EJ, Talamini MA. Robotic abdominal surgery. Am J Surg 2004;188(Suppl):19S–26S.
16. Doctors claim world first in telesurgery'. BBC News Sci/Tech (accessed 8 September 2009).
17. Vivian E. Von Gruenigen, Mark D. Sawyer, Lee E. Ponsky, William W. Hurd Recent Innovations in Minimally Invasive Surgery and Implications for Gynecology.J of Gyne. Surgery 2009; 25(2): 67-72.
18. Kekis,S.Current status of robotics in general surgery.Hellenic J of surg.2010;82: 152-154.
25. Murphy D, Hall R, Tong R, et al. 'Robotic technology in surgery: Current status in 2008' ANZ Journal of Surgery, 78(12): 1076-1081.
26. 'Robotic surgery'. Brown University Division of Biology and Medicine, Brown University, Providence, RI 02912, (accessed 16 September 2009).
27. Park A., Witzki D.,Donnely M. Ongoing deficits in resident training for minimally Invasive surgery J of Gastrointestinal Surg . 2010; 6(3) 501-509.
28. Rosser JC,Murayama M,Gabriel NH. Minimally invasive surgical training solutions For the twenty-first century. Surg clin north Am. 2000;80(5):1607-1624.
29. Phillip M. , Pierorazio .,Mohammed E A. Minimally invasive surgical training: Challenges and solutions J of society of Urol. Onco.2009;27 (2):208-213.
30. Hemal AK., Goel R., Goel G. "Cost-effective laparoscopic pyeloplasty: Single center Experience," International Journal of Urology. 2003; 10: 563-568.
31. Zeh HJ 3rd, R Udelsman, "One hundred laparoscopic adrenalectomies: A single Surgeon's experience," Annals of Surgical Oncology .2003; 10: 1012-1017.
32. Heslin MJ., et al, "Laparoscopic adrenalectomy and splenectomy are safe and Reduce hospital stay and charges," The American Surgeon 2003; 69: 377-381.
33. Skattum J., et al, "Outpatient laparoscopic surgery: Feasibility and consequence Education and healthcare costs," Surgical Endoscopy 2004; 18: 796-801.
34. S P Dodds SP., et al, "Patient satisfaction with daycase laparoscopy," Journal of Obstetrics and Gynaecology 1998;18: 471-473.
35. Cleary P D., et al, Using patient reports to improve medical care: A preliminary Report from 10 hospitals," Quality Management in Health Care 1993; 2: 31-38.