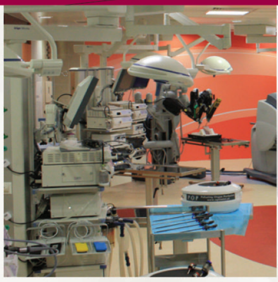

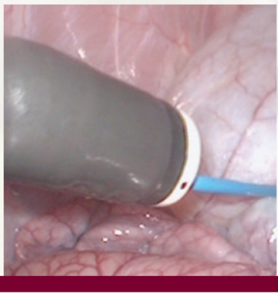

Manual of **Endo-Laparoscopic and Single-Port Surgery**

2nd Edition

Editors: D Lomanto, W K Cheah

Minimally Invasive Surgical Centre Singapore

Manual of
Endo-Laparoscopic and Single-Port Surgery

Second Edition

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Our Mission:

To promote and coordinate minimally invasive and endoscopic surgery in multiple surgical disciplines, to provide outstanding care and service for patients and to have leadership in clinical, educational and research programs in advanced minimally invasive surgery through the application of new and innovative technologies.

If you are thinking one year ahead, you plant rice.
If you are thinking twenty years ahead, you plant trees.
If you are thinking a hundred years ahead, you educate people.

Chinese Proverb

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FOREWORD

A Rauff

Since its breakthroughs in the 90s, minimally invasive surgery have changed significantly the practice of general surgery as a result of increasing number of surgical procedures today can be carried out with minimal discomfort to the patient. These changes have occurred in a very short period of time and suddenly we also need to modify the way we train and teach the new generations of surgeons. Today it is mandatory for the surgical trainee after they have completed their basic training to enter and familiarize with the practice of laparoscopic procedures because with time it will become an important part of their future surgical activities. Video-laparoscopic surgery, using images transmitted to a video monitor from the interior of the human body, made also another important change in our life as the need for new knowledge and a continuous updating in terms of technologies. These changes involve also the entire staff of the operating theatre like our colleagues, anesthetists and nurses. Many are involved in the development and dissemination of the minimally invasive procedure and I hope that this comprehensive manual will be a valuable tool to help the neophytes of all the surgical specialties and everybody that are involved in MIS daily practice to surmount the learning stage of endo-laparoscopic surgery.

The Minimally Invasive Surgical Centre in NUH has been charged with the responsibility to disseminate the knowledge and to assure a proper standard training and I am sure that with the experience of local and international experts, they will ensure a high standard of educational activities.

PREFACE

D Lomanto, WK Cheah

In almost a century surgery, few advances can be compared to the changes engendered by the introduction of minimally invasive surgery, representing in the last decade a revolution in surgical practice and patient care. Since 1987, when the first laparoscopic cholecystectomy was performed, laparoscopic procedures have been the standard of care for many routine diagnostic and therapeutic procedures for conditions such as appendicitis, gallstones, hernia, hyperhidrosis, gastro-esophageal reflux, etc. The success of the laparoscopic technique has been due mainly to patient demand, which has contributed to a rapid expansion in the number of laparoscopic procedures performed. Today, more than 90 % of cholecystectomies are performed laparoscopically, and the approach has been adapted successfully for other surgeries of the abdomen, thorax, and vascular system. The benefits conferred to patients by less invasive procedures, decreased pain, and shorter recovery have to be weighed against overenthusiasm of application and the problems created by a lack of familiarity with new techniques and instruments.

The laparoscopic revolution brings also new concepts of training and gaining experience along the learning curve. And with technological advancements, a new frontier in training program is started. Practice with hands-on-training, video-tape reviewing, operating on live tissue- all these have been basic activities in the training program. Today, technology has added the use interactive CD- Rom, suturing and training of different tasks with laparoscopic virtual simulator, and E-learning softwares, for similar tasks. These tools are, mandatory and necessary in current training centres to enforce the skills needed for both basic and advanced procedural training. But of course, all these activities must complement also an active clinical practice.

The decision to write this Manual is mainly to provide to trainees a Compendium of core information and knowledge, and also pearls and tips to improve their surgical skills.

This Manual has been an effort of MISC team members and is organized into three main sections: general laparoscopic principles, anaesthesia in laparoscopic surgery, and basic laparoscopic procedures. In general principles, the characteristics and functions of all instruments and devices are analyzed; in the second section, the role of anaesthesia and the anaesthetic implications during laparoscopic surgery are described; while in the final section, the authors describe how to safely enter the abdominal cavity, laparoscopic suturing, and step-by-step basic laparoscopic procedures.

We would like to extend our sincere appreciation to all the authors for their contributions, our secretary who has been helpful throughout the editorial process, and our families for their continuous support.

HISTORICAL ANCEDOTES FROM EUROPE

J Perissat

Singapore 2009 - a world leading country in Minimally Invasive Surgery

During the 80's of 20th century, surgery was reaching its apogee. Every kind of operations was possible to be done properly and successfully to treat human being diseases even the most severe of them. The constraint was the necessity of large openings of the patients to obtain efficient access to every corner of human body to surgeons' hands in charge of fixing disorders under visual control. The price to pay was insuperable immediate post operative pain discomfort, temporary interruption of normal physical and professional activities, sometimes severe complications, even lethal ones. It was tolerated because their rates were acceptable having dropped down dramatically along the former decades and also because no alternative was existing. Surgery was meaning "open approach", size of incisions was determining the importance of the procedure. Everybody knows the famous saying: "to great surgeons, great incisions" That could explain partially the happening a phenomenon of collective incredible surgeons' blindness around 1988. A fantastic event occurred at that time: thanks to the tremendous development of high technologies in optics and images transmission, the vision obtained by endoscopes became so good that presence of the surgeon's hands inside the body of theirs patients appeared to be less and less necessary. Gynaecologists were accustomed to explore their patients by using laparoscopes since the 50's. Thus, the more skill of them were more or less ready to step forward from exploration to intervention. The majority of general surgeons, including our major Academic Leaders, having no or wrong ideas about laparoscopy were not prepared to understand a so enormous change. They preferred to ignore it or denied it, even sometimes to reject it as a stupidity. Nearly unanimously, surgeons so proud of their dazzling performances were considering endoscopy a marginal technique relegated to physicians or…possibly to surgeons of low skill category! Fortunately some surgeons were not sharing such opinion but they were few and scattered around the world without connections between them. It took at least 5 years 1985-1990 for gathering enough of them to obtain the critical mass able to engender a breakthrough that changed the feature of surgical practice forever: the advent of Minimally Invasive Surgery (**MIS**). Each of those forerunners was following his proper professional record but all of them encountered with endoscopy one day, often fortuitously. That triggered in their minds the certainty that regular use of endoscopes in surgical procedures will improve significantly the quality of post operative patients' comfort. In France that critical mass to move forward was reached in 1989. You can understand how happy I am to celebrate the 20th anniversary of that event in Singapore under the invitation of Professor Lomanto by visiting MISC. Seeing your so up-to-date realizations brings me the feeling to live in real the dream I had 20 years ago.

I had already at that time the unwavering conviction that surgery will follow this kind of evolution. I see with extreme happiness to day, that it is a reality. Your institute is delivering every day the highest standard of education and training in MIS to the new generations of surgeons in Asia and around the world thanks to your super modern equipment for telesurgery teaching. I am impressed also looking to your advanced equipment for robotic surgery.

I appreciate very much your scientific contribution in research and innovation. Having the opportunity to visit many institutes of MIS around the world I can assess your one in Singapore is of very unique outstanding format. Predicting the existence of such centre in 1989 was not evident at all. Laparoscopic surgery was still regarded by the very respectable academics societies as a fringe phenomenon, a short-lived fashion with no future in it, promoted by a bunch of non-conformist, so-called surgeons. I have heard one day the phrase "Let them trust in their Mickey Mouse Surgery". This is how the surgical establishment viewed it. Professor Peter Goh, the founding father of your centre, can confirm he experienced the same offending comments that seem now so ridiculous. A long lasting hard fight was necessary to obtain the acceptance of the reliability of MIS by the surgeons' community. May I describe as example the way I followed along those years practicing in Europe?

My first meeting with endoscopy was in 1965. I was senior resident in surgery. I was strongly against the habits of my seniors who were using extensively exploratory laparotomy instead of less invasive technique to assess acute abdominal emergency cases. I was seeing at same time my colleagues of the next door gynaecology department using exploratory laparoscopy. That technique seemed so smart to me that I learned it from them. I could introduce it into the general surgical department thanks to its open minded chairman. He was so happy seeing the rate of exploratory laparotomy dropping down dramatically that I could go further. I could become familiar with basic interventional gestures as tissue sampling even gallbladder puncturing to secure by cholangiography origin of jaundice on difficult cases. But the equipment was in its infancy providing vision of poor quality. Abdominal insufflation using air was hazardous. Thus I gave up that technique when non aggressive methods as ultrasound and CT scanning came up around 1970. However that laparoscopic experience remained recorded in my mind for ever. My second meeting with endoscopy occurred in 1975. I was full time professor of surgery running in parallel a surgical unit specialised in treating liver biliary and pancreas disorders and a university laboratory of experimental surgery orientated to education, training, research and development in surgical techniques and innovation on surgical devices.

I could establish good relationship with gastroenterologists through my very close friend Doctor Claude Liguory, famous interventional flexible endoscopist. He is the one who introduced endoscopic sphincterotomy in France around 1974. I could commission him as consultant in my department. He taught interventional flexible endoscopy to selected fellows surgeons who became the permanent trainers of my unit. From then by 1982 our surgical team was using flexible endoscopy at daily practice level. As example open surgical approach to common bile duct stones in risky patients was replaced by endoscopic sphincterotomy. This type of practice in a surgical unit by surgeons themselves was and remained unique during long time in France. That drew strong criticism against me coming either from gastroenterologists or Professors of surgery. As a reply, Claude, three like-minded surgeons, two interventional radiologists and I founded the French Society of Endoscopic Surgery and Interventional Radiology (SFCERO) in April 1987. At that time it was a revolutionary concept. Today it would be considered as the most fashionable way to make "hybrid operators"! That new society became an independent launching platform for our new concept. Through it we could by-pass the traditional surgical societies that were rejecting our proposals of new educational program in endoscopic surgery. Through SFCERO we could recruit new people supporting our ideas either among surgeons, gastroenterologists and radiologists or CEO of corporate companies involved in surgical equipment making. I could also establish international relationships. I met surgeons sharing my ideas in Europe as Hans Troidl and B C Mannegold in Germany; in Italy I met Alberto Montori who was a Professor of surgery already well-known expert in flexible interventional endoscopy. He introduced me to Gerald Marks, one of the founding fathers of the newly borne SAGES in the USA. That provided us a precious ally. Beginning of 1988 I was at the head of a surgical team mastering interventional flexible endoscopy as well as open surgery. I was also general secretary of an independent scientific society, SFCERO, on the way to weaving a national and international network of surgeons attracted by Endoscopic Surgery. I was optimistic as regards to further successful implementation of MIS concept in the mind of future generations of surgeons. However, in my daily clinical practice, one question, apparently of minor importance, was still irritating me: "**how to get rid of open surgery drawbacks patients carrying on only**

few small gallbladder stones causing occasional isolated episodes of biliary colic?" Retrieving gallbladder stones by ERCP was not possible. Looking for other access, I reminded how I was puncturing gallbladders under laparoscopic guidance in 1965.The idea was born. All along 1988 I focus the energy of the whole team on that question. At first I had to refresh my skill in laparoscopy. I was fascinated by the newer tools such as the video camera which made it possible operating with two hands. We trained in the lab on animal models. I took advantage of my close cooperation with urologists and gynaecologists to borrow their equipment and to assist them in their clinical practice. In September 1988, we had designed a technique of laparoscopic treatment of gallbladder stones combining intracorporeal lithotripsy followed by cholecystectomy. We were technically ready to move on to clinical applications. December 1988 we performed our first laparoscopic cholecystectomy (L.C). I thought I was the very first surgeon doing such a procedure. In fact I learned from a gynaecologist friend two weeks later, that Doctor Philippe Mouret, a general surgeon in Lyon was doing that operation since 1987. I could meet him some weeks later. He told me his very unique professional record. He completed his residency training in general surgery in 1968 .I moved straight to private practice in partnership with a friend gynaecologist surgeon who already had good command of interventional laparoscopy in his specialty. Philippe was immediately seduced by that approach. He learned it from his colleagues. He moved step by step from exploration to intervention. In 1983 he performed his first laparoscopic appendectomies; in March 1987 he performed his first laparoscopic cholecystectomy. He was fascinated by the quality of his results. He tried to publish them in vain. Having no academic titles, working alone in his private hospital, his presentations were rejected by the peer selection committees of medical journals and meetings arguing his kind of surgery was against the major guidelines of good practice. To my utter amazement, I realised that I was speaking with a colleague having at least ten years of experience in interventional laparoscopic abdominal surgery, a very unique person indeed. Philippe informed me also he showed his technique of L.C. to Professor François Dubois from Paris few months earlier. François, well-known as the promoter of minilaparotomy approach for cholecystectomy gave up immediately that technique for adopting laparoscopic approach. I learned that day we were three people working on the same project following different paths at the same time, without connection between them. Philippe Mouret freed from his gag, François Dubois and I unified our efforts to promote interventional laparoscopy in general surgery using L.C, a rather difficult procedure, as emblematic example. SFCERO was an excellent already prepared launching platform to do so. We organised symposium, hands' on training courses around France. That generated an enormous wave of interest among young generations of surgeons and the birth of enthusiastic new working groups which joined us. SFCERO grew up rapidly and became mostly a laparoscopic society. Outside of France, thanks to the international contacts tied through SFCERO, Gerald Marks and George Berci invited me to attend the SAGES annual meeting in April 1989 in Louisville Kentucky. I showed there a video tape on my technique of L.C.. Comments of American surgeons were more than enthusiastic "Unbelievable! We must do that tomorrow". **That day a huge group of American surgeons (SAGES was celebrating its 1000th elected member) suddenly became aware that opening a patient's body was no longer necessary to successfully perform difficult procedures in general surgery**. A so unanimous response expressing the famous American spirit of enterprise reinforced my conviction I was on the right track. The impact of that presentation at Louisville meeting can be considered as the first major "breakthrough" in the history of MIS. The acceptance of the concept of laparoscopic surgery swamped the whole surgical community with the strength and at the speed of a tsunami. On my way back to Europe after Louisville meeting, I thought a society gathering European adepts of laparoscopic surgery could be of great interest. Thanks to the strong support of the board of SFCERO, of the German group led by Hans Troidl, Gerard Buess, of the Italian group led by Alberto Montori, of the Benelux group led by Jack Jakimowics, of UK group led by Sir Alfred Cuschieri and thanks to the support of many individual people from other European countries, European Association for Endoscopic Surgery (EAES) was founded in Paris October 1990. I organized June 1992 in Bordeaux the 3rd World Congress of Endoscopic Surgery under the auspice of SFCERO, EAES and SAGES. That meeting gathered more than

2000 participants. Along three consecutive days of video forum, brilliant operators demonstrated the feasibility of performing major procedures on the digestive tract by laparoscopy. Those innovators were members of new societies of endo-laparoscopic surgery recently born on every continent. Asia had a huge contingent of attendees belonging to JSES, Japan and…to ELSA the society recently born in Singapore thanks to the efforts of Peter Goh and his team. Peter became the star of that meeting by showing a "première" a laparoscopic distal gastrectomy. For the first time also we met officially laparoscopic surgeons from Latin America gathered in two societies ALACE and FELAC. Looking to such a huge rally around the same concept, Gerald Marks and I suggested unifying those new societies to coordinate their actions by creating the International Federation Societies Endoscopic Surgeons (IFSES), Its aim is to promote MIS and to make its access easy for everybody world wide. IFSES received mission to determine the venue of each other year World Congress of Endoscopic Surgery (WCES). IFSES inauguration occurred June 19th 1992. That was celebrated the same night during a memorable banquet in the cellars of a famous "Château de Bordeaux grand cru" in Saint Emilion. ELSA, was represented by Professor Peter Goh.

Bordeaux meeting marked the launching of MIS at world scale. It triggered the faithful sustainable support of the major surgical equipment manufacturers from the USA, Japan, and Europe. After Bordeaux meeting nobody would dare suggest that laparoscopy is the fad of a week as I heard in 1989. However we saw also during Bordeaux meeting many reports on severe complications, even lethal ones induced by laparoscopic approach. The only way suppressing such non tolerable issues was evidently to establish pertinent educational programs delivered by reliable institutions. Bordeaux marked the definitive acceptance of MIS. It opened also the era of better organized education for MIS and more evidence based accreditation methods of its procedures. It was indeed and still is the Aim of our IFSES society members. But the demand was so enormous that it was obviously mandatory to extend those missions to all the existing schools of surgery and to create also new institutes specialised in training, research and development in MIS. The 8 last years of the 20th century were very busy in that domain. Year 2000 was a perfect time for assessing and endorsing the realised progresses. ELSA having already obtained the venue in Singapore of the 7th WCES in 2000 from IFSES Board, Peter Goh named President- Organizer could set up with his team a very smart scientific program that could give a global vision on the stage of implementation of MIS worldwide. The picture was comforting and promising. In industrialized countries, nearly every teaching hospital had at least one active MIS unit functioning at the level of colo rectal and/or fundoplicatio procedures. In most of western European countries every general hospital even those located in remote places had one laparoscopic tower and surgeons well trained to use it. 85% of cholecystectomies were performed laparoscopicaly with good result. Some leaders in MIS were already running Institutes for education and research they could built thanks to their ability to attract the cooperation of the corporate sector, grants from public institutions, financial supply of generous sponsors. In Europe I had the chance to be part of the inauguration of IRCAD run by Jacques Marescaux in Strasbourg. June 2000 in Singapore, Peter Goh himself guided my visit of MISC during the 7th WCES. I was voiceless impressed because I could measure the progress accomplished since my first visit to Singapore. It was in1993. I was there as President of EAES, invited by Peter who had organised on behalf of ELSA the first Asian international congress of laparoscopic surgery. MISC was at its embryonic stage at that time. In 2000 I was blown away! I took a lesson of suturing on a Zeus robot under the tutorship of Davide Lomanto, when at same time I could not raised enough funds to afford for having Zeus in my training centre! What a tremendous development along seven years! In fact, I was not really astonished having met Peter several times during international meetings since 1991. It was largely sufficient to appreciate his energy, his persistency to obtain what he wants, his great power of persuasion. . The 7th WCES in Singapore was of outstanding scientific level. It was also the first time IFSES board involved societies from Latin America in organizing a world congress. It was also a memorable moment: we were stepping on the threshold of the 3rd Millennium. **IFSES Singapore 7th World Congress will remain in the History of Surgery the moment MIS crossed over the non return point on the line**

of its rise. 10 years later, no one event happened denying that issue. To day my third visit to MISC under the guidance of Davide Lomanto confirms and comforts my opinion that such institutes are the driving forces of MIS for further successful development. No doubt, Singapore hosts a major hot spot for MIS on the world map.

We can predict that along the 21st century step by step the majority of elective surgical procedures will be done by minimally invasive techniques. The reason is that MIS matches perfectly the hopes and the needs of our patients that are to be treated successfully with minimum of adverse side effects.

Beginning of last decade of 20th century, a small group of surgeons opened the gate of the era of a surgery having as first priority the comfort of the patients. It has changed the feature of surgical practice as dramatically as the respect of the rules of asepsis and antisepsis changed the surgical practice end of the 19th century. Looking back to the past, that sort of successive leaps forwards appears as the more frequent process of evolution in the History of Surgery. To Peter Goh, I and plenty of others "gate openers" it is a great matter of joy and pride seeing the successful achievement we could obtain. It is also a great matter of happiness seeing our successors continuing our works by adding constant brilliant improvements. Let me congratulate them. I wish them they will initiate new leaps forwards in MIS for our patients greatest benefits. Let me remind them they have received from us as legacy efficient tools to launch and achieved their projects: Institutes like MISC and scientific specialised societies like IFSES and its society members. I am sure they will take advantage of that.

Long and fruitful life to MISC, to its Creator, Director and entire Staff.

Address dedicated to Professors Peter Goh and Davide Lomanto, and to the staff of MISC Singapore.

Bordeaux, September 2009

HISTORICAL ANECDOTES FROM EASTERN EUROPE

J Sándor

In 1985 in Böblingen - a nice town of Germany - Erich Mühe performed the first laparoscopic cholecystectomy. Next year at the Congress of German Surgical Society he reported his experiences gained by the new method of gallbladder removal, but after his lecture there were only critical remarks, refusing this „key hole" procedure. After the 96th successful operation he had a fatal complication. Although it was not the consequence of the procedure but the not careful anesthesia Mühe was sentenced to stop to apply his new method.

In 1987 Phillipe Mouret, a French gynecologist in Lyon- after finishing his laparoscopic procedure in the pelvis - turned his devices to the subhepatic region and removed the gallbladder of his patient. Francis Dubois in Paris analysed this operation, trained the procedure in experimental animals and successfully introduced it for human surgery. Soon after Jacques Perissat in Bordeaux was inspired by Dubois's method and performed a series of laparoscopic cholecystectomy and presented the method in Louisville in April, 1989 at the Congress of the Society of American Gastrointestinal Endoscopic Surgeons (SAGES).

In August of the same year Perissat repeated his video presentation at the Congress of the International Society of Surgery (ISS/SIC) in Toronto. This is the starting point of my history.

As an active member of ISS/SIC I have also participated in the work of the Toronto congress where my friend, George Berci invited me to see a very interesting video presentation of the French surgeon, Jacques Perissat. The Great Auditorium was full of with the congress attendants. And what could we see? Projection from a human abdominal cavity.

Instead of the usual long incision, 1cm diameter tubes were inserted into the abdomen and through these metal tubes special devices were used for dissection of the pericholecystic tissues and the gallbladder was removed through the periumbilical port.

This was a breathtaking video. The interest was enormous, two days later Perissat had to repeat his presentation. Those who were present were excited discussing the possible advantages and disadvantages of the new method.

I have to confess: at first I was not delighted by the laparoscopic cholecystectomy.

Is it worth to change the one hundred years old and safe method – a long incision through the abdominal wall to remove the gallbladder - which procedure can be extremly difficult even with the large operative space? Isn't it to risky to apply only the small diameter tubes to operate in the abdominal cavity?

My scepticism was characterized by my lecture presented several months later in 1990 in Budapest at the Spring Meeting of the Hungarian Surgical Society. I was asked to summarize the non-surgical treatment posibilities of gallstone disease. Dissolution therapy (litholysis) and lithotripsy seemed possible alternatives of surgery. At the end of my lecture I have also mentioned: „By the way, there is a new surgical method of gallbladder removal, which is called laparoscopic cholecystectomy"

I have used parallel slide projection for my presentation. At this point one of my slides was El Greco's wonderful painting: how St. Sebatian was sentenced to death by arrows in his body. The other slide was a sketch of laparoscopic cholecystectomy: a human body with tubes pushed into the abdomen. I have continued: „This is St.Sebastian with arrows in his body and this is laparoscopic cholecystectomy. No comment!"

I was lucky as George Berci also attended this meeting in Budapest and he decided to wash my brain. I participated in hands-on courses in the US and had opportunity also to train in live animals. In September at the Congress of IHBPA in HongKong I met again George Berci and we made an agreement to perform together the first laparoscopic gallbladder removal in Hungary. Three months later we celebrated the success of our work.

We enjoyed this challenging new surgical technique and the number of the laparoscopic operations was continuously increasing.

One day I have admitted to my surgical department a nice American business-women who was working in Budapest. She came from Texas - wearing typical boots and hat -and suffered from biliary colic. I have recommended to remove the gallbladder and I have also mentioned that there is a new method for this procedure, the laparoscopic operation that I have learned in the USA and I will operate by applying this laparoscopic technique. She was thinking for a while and asked me:

Are you a good surgeon?
No, sorry madam - I answered - I am not a good surgeon, I am excellent!

She laughed at me, I performed the laparoscopic procedure and after the short uneventful recovery she left the hospital. She asked me to tell her Professor Berci's address and she sent him a letter of congratulation…

I have organized a series of courses to educate and train our colleagues in Hungary and in other countries. For the elder generation of surgeons – chief surgeons, professors - it was not easy to accept the new principles, the new method: they have operated thousands of patiens previously by the open procedure.

We went through also all the stages of the acceptance of laparoscopic cholecystectomy:
It is too risky
Only for animal experiments
Only for selected patients
Only specially trained surgeons can perform
Only I (the professor, the chief of the department) can perform
We can perform also this procedure in our department
This is the procedure of choice in our department
Conversion is not a shame

B.M.Jaffe has written in 1991: "In many ways the introduction of this new technology (LC) has tested the ability and flexibility of the surgical community"

My personal attitude turned from the scepticism to the enthusiastic support of the laparoscopic surgery and in 2001 I have been elected Honorary Member of the Society of the American Gastrointestinal and Endoscopic Surgeons (SAGES) and in 2009 I have become Honorary Member of the Japan Society of Endoscopic Surgery.

I remember with the most respect of an old friend of mine, professor of surgery in the USA. Laparoscopic cholecystectomy was already an everyday method in his department, many surgeons performed it, except he, the old professor. At last after practicipating in a hands-on course he started his first laparoscopic procedure. He was working precisely and very slowly. He finished the procedure successfully and was applauded by the assistants and nurses int he OR – and the next day the professor retired! He wanted to have the challenge and enjoyment of the new era of the surgical science, but he understood also that this is a method of the new, younger surgical generation.

Just a quater of century passed from the first laparoscopic cholecystectomy. 25 years mean a long period in the surgical history; we could observe the rapid spread of the laparoscopic tehnique in every field of surgical interventions.

Those colleagues who started their laparoscopic operations in the early nineties have now twenty years practice in this field – they are about 45 years old, many of them are in leading positions. Now they have to face the new challenges: the NOTES and single access procedures. Today special centers help to educate and train the surgeons and offer possibilities for surgical research. Those who are educated in The Khoo Teck Puat Advanced Surgery Training Centre in Singapore are especially lucky: beyond the conventional laparoscopic methods, robotic and virtual 3D technology can be studied there – the gate is open for the future.

HISTORICAL ANECDOTES FROM ASIA

PMY Goh

It was 1988 at the Massachussetts General Hospital in Boston. I came across a newspaper clipping. Someone had succeeded in removing the gall bladder through several 1cm incisions using a scope and a camera. How totally incredible. Surgery without big incisions. It was a futuristic dream. Now it was possible. I was training in therapeutic GI Endoscopy as a Harvard Medical School Fellow in Surgery. We could remove stones in the common bile duct through an endoscope, so this was not so incredible. The time had come.

April 1990. I sat in a darkened conference hall listening to Prof. Alfred Cuschieri talking about Laparoscopic Cholecystectomy. Next to me was a very large man with curly white hair. Later he turned out to be the famous Prof. Hans Troidl from Cologne. Prof. Cuschieri said the operation was challenging and required special skills. It should not be attempted by anyone without extensive experience in diagnostic laparoscopy. Prof. Troidl said either to himself or to anyone within earshot that it was pure rubbish what Cuschieri had said. He could teach any surgeon within 3 days how to do a Laparoscopic Cholecystectomy.

I turned to him and said, "Do you mean it? I will come at once to your clinic if you do." He said, " Come." In a few weeks, I was in Cologne. We did a few cases together and I scrubbed in. I had already ordered the equipment. Prof, Abu Rauff was the chief of my department. He thought it was a fad. To his credit he was willing to give it a try and allowed the order for the equipment to go through. He never ever stood in the way of progress. A short time after returning from Cologne in June 1990 we did the first case at the National University Hospital in Singapore.

We just missed being the first in Asia. Another group at the Singapore General Hospital down the street started a few months earlier. I believe, they were the first in Asia and perhaps we were the second. No one else in Asia by the middle of 1990 had done the operation. It doesn't matter however. If you are not first in the World in doesn't mean much. By the end of the year we had done 26.

In November of 1990 I organized a workshop on endoscopy in surgery and included a laparoscopic cholecystectomy live demonstration. At that time, I thought it to be just an advanced form of GI therapeutic endoscopy. It was the first workshop in Asia to include a laparoscopic cholecystectomy. I did the operation myself. A month later, Prof Sydney Chung at the Prince of Wales Hospital in Hong Kong included a laparoscopic cholecystectomy in his annual endoscopic workshop. I chaired the session. Both were successful demonstrations and fascinated the audience.

At the November meeting in Singapore a group of Asian surgeons numbering about 20 people from many different countries decided to form a club to promote this new type of Surgery. Some were famous guys like Sydney Chung, most were not. We had not agreed on a name. We exchanged addresses and promised to stay in contact.

By the end of the year, we had also done appendicectomy and inguinal hernia repair by the new laparoscopic technique. We tried to think of new applications. When you have a new hammer, every thing looks like a nail! In 1991 we had expanded into laparoscopic vagotomy using the Taylor-Katkhouda technique. There were lots of peptic ulcer cases in my country and many were resistant to medical treatment.

At the SAGES meeting in 1991, I was asked to sit on the International Advisory Board of SAGES. People from all over the world were trying to get organized to promote laparoscopic surgery. I met Gerald Marks whom I liked immediately. He was a very distinguished looking man. A real old school American Professor and a true gentleman. He was very cultured and artistic. He was the Chairman of the Board. Also there were Frederick Greene from USA, Jacque Perissat from France, Alberto Montori from Italy and Tatsuo Yamakawa from Japan. It was decided that we would form a World body which would manage the World Congresses. Gerald Marks told me to go back to Asia and form a large society which would represent the interest of Asian Surgeons. This would be in the style of SAGES in North America, and EAES in Europe.

I went back to Singapore and wrote the constitution for a new society. It was registered several months later. I called it ELSA, the Endoscopic and Laparoscopic Surgeons of Asia. Everyone thought it was a catchy name. A girl's name. It would become my "girlfriend" for the next 10 years and I would have to work hard for her! We had a business meeting in Hong Kong and we elected Sydney Chung the President and I became the first General Secretary, a post which I stayed in for 4 years.

In the beginning of 1992, we began to do really major operations by laparoscopy. In January 1992, my very good friend Ngoi Sing Shang and I did the first right colectomy by laparoscopy. Two weeks later, I did our first sigmoid resection. They were probably the first laparoscopic colon resections to be done in our region, maybe in Asia even.

Peter Birtcher from US Surgical (Autosuture) had made a big present to me when I visited their headquarters in Norwalk Connecticut. Several of the new Endo GIAs with 14 cartridges. They were just being introduced into the USA and not available anywhere else in the World at this time. I had a totally crazy idea. Seigo Kitano (who later became one of my best friends) in Japan had done the first laparoscopic assisted gastric resection that year. Part of the operation including the anastamosis was done by open surgery. Dennis Fowler had tried to do a totally laparoscopic Billroth II Gastrectomy but the operation failed because he left the pylorus and part of the antrum behind and had to convert.

We planned the operation meticulously. Everyone thought it was totally crazy. Especially my good friend John Isaac who was always a sceptic. Nevertheless he was my conscience. We chose a thin patient, a 72 year old man with a large gastric ulcer who was otherwise healthy. The operation took about 4 hours. Once we had resected the distal stomach and approximated the small bowel loop to the proximal stump, I knew that we were going to succeed. We didnt even know how to suture laparoscopically. We had done the World's first totally laparoscopic Billroth II Gastrectomy. This was February 1992. The operation was a big success and we had a big celebration that night for the whole team. The patient could walk around the next day and went home after 4 days. This was history.

I took the video tape to Washington DC for the SAGES meeting. It wasn't on the program. John Hunter organized a special presentation in a large hall. It was packed. Surgeons from all over the world were there and no one had seen anything like it. The World Congress was held in Bordeaux that year in June. It was a great place to hold it. Gerald Marks and I got lost in a taxi trying to get to a party in Chateaux Margaux. Both of us couldn't speak French and the taxi driver couldn't speak anything else. I promised myself to learn this beautiful language.

Jacque Perrissat was the President and he held the Congress dinner in a marvelous celler in St. Emilion. The party had a medieval atmosphere. The International Federation of the Societies of Endoscopic Surgeons (IFSES) was formally inaugurated at this party. There were four original member societies, SAGES, EAES, JSES and ELSA. I was proud to represent ELSA. The four representatives posed with the new IFSES flag for a famous picture. Funnily the flag was upside down! The food during the party was super. We had Comfit du canard and the best Bordeaux wine. Many Asian surgeons however could not tolerate waiting so long for the food and fell asleep. In Asia we generally eat early.

ELSA held the first Asian Pacific Congress in 1993. It was our first big scientific meeting. We did it at the Shangri La Hotel which was a fabulous venue, really a tropical paradise. Participants came from all over Asia and we were well supported by our International Friends, all of whom were famous pioneers. I was the Scientific Chairman but Yaman Tekant from Istanbul helped me a great deal. He was my Endoscopic Fellow at the time and we had just established the Minimally Invasive Surgery Center at the National University Hospital in Singapore. It was later to become one of the best equipped Laparoscopic surgery facilities in the World. It gave me great pleasure to make Hans Troidl, Gerald Marks, Jacque Perrisat and Tatsuo Yamakawa honorary ELSA members at this meeting. I then had another crazy idea. We would bid for the World Congress in the year 2000.

Yaman Tekant went on to organize the first Euro Asian Joint Congress in 1997 under the auspices of both EAES and ELSA. It was held most appropriately in Istanbul, a city straddling two continents. Despite early European reservations, the scientific program was outstanding and the social program, which included cruises along the Bosphorus and parties in palaces with exotic belly dancers, was spectacular.

We made our intentions known at the Kyoto World Congress in 1994. I knew we could count on support from the Europeans, Japanese and South Americans. Competition would come from SAGES because they wanted to hold the meeting in this special year. Two things were in our favor. Firstly the 1996 meeting was going to be in Philadelphia and no one was keen to go back to the USA so soon and secondly the Americans were not prepared. We were already totally organized to make our bid with all the material at hand. A vote was taken and we won. We were going to hold the Millenial World Congress! It was too incredible to believe.

It took 6 years to organize and I had no rest during this whole time. It was the wildest ride. We promoted at every major endoscopic surgery meeting in the World. I employed a beautiful model to run our Congress booth. She was a hit. Every surgeon visited our booth, at least twice! We had to meet every medical company and win their participation. Companies like USSC (now TYCO), Johnson and Johnson, Storz, Olympus and many others were unbelievably supportive. A huge amount of money had to be raised. My small team at the MISC in Singapore worked tirelessly. Kum Cheng Kiong who was scientific chairman did a tremendous job with an immense program. We had about 1000 scientific submissions and 200 invited speakers. Our overseas fellows during this time were Davide Lomanto from La Sapienza in Rome and Jorge Lenzi from Argentina. Davide subsequently became my successor at the MISC. They were a great help in the congress organization. Finally at the Rome Congress in 1998, Alberto Montori, who was one of our keenest supporters handed us the Flag of the Congress at a spectacular ceremony on the Campidoglio (Capitoline Hill) where the Temple of Jupiter used to stand in Ancient Rome. We had formally inherited the next World Congress. ELSA was going to host this very meeting in 2 years time in Singapore and I was going to be the President of the meeting. June 2000 was the target.

I wanted to make one last conquest before the great meeting. I wanted Asia to enter the age of Robotic Surgery. I had spent 3 years getting the ZEUS robotic surgery system for our center and raising the more than 1 million dollars the project required. On 20th December 1999, Asia entered the robotic surgery age. We did a telemanipulated laparoscopic cholecystectomy on a middle aged female patient. This was the first totally robotic surgery in Asia and we were the second in the world to do a lap. chole using ZEUS, the first outside Europe. The operation took 45 minutes and went as smooth as silk. The patient went home the next day. I wanted to do this before the Millenia ended. Singapore and Asia had entered the age of robotic

Historical Anecdotes from Asia

telemanipulators before the end of the 2nd millennia.

Finally the day of the Congress arrived. I never knew till the last day whether it would succeed or be a financial disaster. We had invested so much time and money. My fears were unfounded. Everyone who was anyone in the laparoscopic world came to Singapore. Instrument companies sent big contingents and Ethicon even held its Annual summit meeting in Singapore. There were many parties. Michel Gagner Chaired a Video Master Class and John Hunter held the SAGES Postgraduate course. Eugene Sim who is the Asian pioneer of minimally invasive cardiac surgery made a program for cardiac surgeons. Prof. Arthur Li who was Vice Chancellor of the Chinese University and is now Minister of Education in Hong Kong was the Guest of Honor at the Opening ceremony. The President of ELSA that year was Michael Li who is also from Hong Kong. He was a really hard working and enthusiastic President. Totally committed. I wanted it to be an Asian affair, not just a Singapore one. We handed the conference flag to the Americans to the song "New York, New York" playing in the background and scantily clad girls with top hats and walking sticks dancing the traditional American number.

The 2000 congress marked the end of the Laparoscopic Surgery revolution. It had swept the World like a storm. Surgery would never be the same again. By 2000, almost every operation known could be done by the minimally invasive technique. It was one of the most incredible events in the history of Surgery. It was the mother of many offspring. The spinoffs included revolutions in technology, robotics, instrumentation, teaching and training, teleconferencing and telesurgery and a new emphasis on safety. Most important of all, it made surgeons and the public realize that surgery need not be a traumatic, painful, incapacitating and horrible experience. Patients can now look forward to having surgery with minimal pain and discomfort and expect a quick recovery. This is a revolutionary change in thinking. History will not forget this moment.

INTRODUCTION

WK Cheah

Evolution of Laparoscopic Surgery

The historical development of laparoscopy can be traced back to 1901 when George Killing of Germany inserted a cystoscope into the abdomen of a living dog after creating a pneumoperitoneum using air. A century ahead, we are now more technical and technological. With the culmination of technological advances, laparoscopic surgery is ingrained in our surgical practice and we are able to perform diverse and complex laparoscopic procedures, also termed minimally invasive surgery.

Laparoscopic surgery is defined by its three main components of image production (light source, laparoscope or rod lens system, and camera), pneumoperitoneum- the insufflation of carbon dioxide gas to create space for operation, and laparoscopic instruments. With this combination, surgeons could perform diagnostic and some basic gynaecological procedures since the 1960's.

However, a major revolutionary shift in surgical practice and thinking came in 1988 when Mouret of France performed the first laparoscopic cholecystectomy. Instead of removing the gallbladder through a Kocher's incision, he did it through a few small wounds each not larger than 1 cm. This exciting concept sparked intense developments in instrumentation, innovation in advanced technical procedures, proliferation of training programs, and setting-up of laparoscopic centres. We are indeed in an era of modern surgery.

Laparoscopic surgery and traditional open surgery is likely to co-exist together. It is part of the repertoire a young surgeon in training should develop skills in. This brings us back to the objectives of this manual- for training development and safety in practice.

Why should we do Laparoscopic Surgery?

The answer is simple: because patients can and do benefit from it. As long as the evidence suggests- and there is ample data by now- that laparoscopy has its benefits, it can be justified to be performed in various procedures. Laparoscopic cholecystectomy has replaced the traditional open approach to non-complicated gallbladder disease as the new gold standard because it results in less postoperative pain, less postoperative pulmonary dysfunction, faster return of bowel function, shorter length of hospital stay, faster return to normal activities and work, and greater patient satisfaction. These benefits also generally extend to other laparoscopic procedures.

The advantages mentioned above result from the most obvious difference between laparoscopic and open surgery- that of less surgical trauma to the wound in laparoscopy. The access scar is minimized, leading to less pain, less wound infection and dehiscence, and better cosmetic result. In addition, laparoscopy also reduces tissue trauma during dissection, and subsequent blood loss, systemic and immune response, and adhesive complications.

From the surgeon's point of view, the projected image on the monitor is a magnified image, resulting in better definition of structures. The smaller wounds take shorter duration to close. And the recorded procedure can be used for review and training purposes.

As in all surgical techniques and technologies, minimally invasive surgery also has its limitations and disadvantages. First, there may be problems encountered during access into the abdominal cavity, such as iatrogenic injuries to the bowel or major vascular structures. The incidence is about 0.05 to 0.1%. This incidence is reduced by practicing the open technique of introduction, rather than using the "blind" Veress needle technique, and using blunt-tipped trocars. Second, there may be undesirable side-effects of the carbon-dioxide pneumoperitoneum, such as hypercarbia, etc (see chapter on physiology of pneumoperitoneum). And third, from the surgeon's perspective, the migration from open to laparoscopic skills means that the 3D vision is reduced to monocular 2D vision on the screen, depth perception and field of view is much reduced, and haptics, or the "feel" and tactile sensation of tissues, is limited to gross probing of tissues. However, these limitations, once understood and overcome have not hampered the development of laparoscopy.

In a way, the surgeon is required to master a new set of skills to perform laparoscopy safely. With training and experience, surgery can be performed at a new standard that benefits patients.

Is which types of surgery is laparoscopy applicable?

Laparoscopy can now be performed in three main areas of the body- the abdomen, the thorax, and closed spaces. Laparoscopy can be used to resect tissues or to reconstruct tissues.

In the abdomen, we group laparoscopic techniques according to major systems, as shown below.

a) Gastrointestinal tract
- Laparoscopic-assisted oesophagectomy
- Laparoscopic cardiomyotomy for achalasia
- Laparoscopic fundoplication for gastro-oesophageal reflux disease
- Laparoscopic bariatric surgery (banding, bypass) for morbid obesity
- Laparoscopic gastrectomy and small bowel procedures
- Laparoscopic appendicectomy
- Laparoscopic colectomy
- Laparoscopic adhesiolysis and diagnostic laparoscopy

b) Hepato-biliary-pancreatic system
- Laparoscopic cholecystectomy
- Laparoscopic liver and bile duct procedures
- Laparoscopic management of pseudocysts and pancreatic procedures
- Laparoscopic bypass procedures
- Laparoscopic splenectomy

c) Endocrine system
- Laparoscopic adrenalectomy
- Laparoscopic enucleation of benign pancreatic islet tumours

d) Hernia
- Laparoscopic inguinal hernia repair
- Laparoscopic repair of incisional hernia

e) Urologic system
- Laparoscopic nephrectomy
- Laparoscopic procedures for ureteric and bladder conditions

f) Gynecology
- Laparoscopic management of tubo-ovarian conditions
- Laparoscopic hysterectomy

In the thorax, some procedures include,
- Thoracoscopic sympathectomy for palmar hyperhidrosis
- Thoracoscopic pleurodesis
- Thoracoscopic bullectomy and partial lobectomy

With the use of novel devices, adequate operating space can be created in "closed" spaces so that endoscopic techniques can be performed, such as,
- Endoscopic extraperitoneal inguinal hernia repair
- Endoscopic ligation of saphenous venous perforators in the leg
- Endoscopic approach to neck organ such as the thyroid and parathyroid glands

One can see that laparoscopy is widely applied. It's important, however, to realize that for certain conditions, laparoscopy is feasible but does not necessarily replace open techniques. The practice will depend on the expertise available and also on literature evidence that laparoscopy is superior to the open approach.

Training Issues

Surgical training is the core reason for the conception of this training manual. Surgeons in training are taught well established skills in open surgery. However, learning of laparoscopic skills is now becoming an increasingly important part of the training program because of the new set of skills that need to be acquired. The main focus is to operate efficiently and minimize surgical errors, i.e. operate safely. Training and constant practice are ways to overcome the learning curve. A case point is the dramatic increase by three to five fold in bile duct injuries in the early years when laparoscopic cholecystectomy was performed by inexperienced and poorly trained surgeons; the rate has since dropped to acceptable levels.

Effective teaching and learning involves dedicated staff with experience in laparoscopic surgery who are good educators and enthusiastic students who are keen to acquire new knowledge and skills. This is facilitated by modern teaching instruments such as laparoscopic trainers, virtual simulators, CD-ROMs, the Internet, and software programs, all available in the in-house skills lab in the Minimally Invasive Surgical Centre (MISC). In addition to these activities, meetings and workshops all contribute to CME activities.

Training programs comprise of two broad categories- Basic and Advanced Laparoscopic skills. In the basic program, the student is taught about familiarization with equipment and instruments, physiology of pneumoperitoneum, access and port placements, diathermy and dissection techniques, and safety issues. This is extended in the advanced program to suturing skills, use of instruments in advanced techniques, and familiarization with advanced procedures. The training program at the MISC, NUH runs twice yearly. Each course has four modules that total 12 hours of training.

The Future of Minimally Invasive Surgery

Minimally invasive surgery, as it stands today, has been the result of intense and continuous development and innovation on the part of surgeons in techniques, private industries in instrumentation, and in no small part by public demands and patient requests. Surgical innovation will and should continue, however, while maintaining a balance of not escalating costs of healthcare delivery.

The progress of MIS will mirror that of developments in instrumentation, because technical innovation and expansion into previously "difficult" territories and advanced procedures has reached a plateau. With better and newer instruments, procedures can be performed faster and more effectively, with the potential of reducing operating duration and overall costs.

With progress in information technology (IT), mass data can be exchanged faster along the Internet and ISDN lines, thus enabling more use of teletransmission and teleproctoring to remote areas. Robotic devices have been developed to assist in surgery and may one day also allow surgeons to operate from remote locations. And interconnectivity of information will streamline the process of surgery.

In conclusion, laparoscopy is a marriage of surgical skills, surgical innovation, and technology advancements. Training is at the core of improving surgeons so that patients benefit from the high quality of care given to them.

INSTRUMENTS AND DEVICES

I Shridhar, D Lomanto, M Lawenko

Introduction

The proper hardware and instruments are essential for performing safe endo-laparoscopy. There should be sufficient backup of instrumentation to cover for instrument failure. Access of the abdominal cavity and other virtual planes like preperitoenal space or the prefascial areas can now be approached either from the conventional technique or through a single port device. Existing instruments are continuously being upgraded while new ones are developed to conform with single port surgery. Technology is changing at a vast rate and endo-laparoscopic surgery is coping with this change.

Instruments for Access

Veress needle: The Veress needle is designed to create a pneumoperitoneum prior to insertion of a trocar in a closed fashion. It consists of an outer sharp cutting needle and an inner blunt spring-loaded stylet. During insertion of the Veress needle into the peritoneal cavity, resistance at the fascia causes the blunt tip to retract backwards enabling penetration by the sharp outer needle. Once the cutting edge penetrates freely into the peritoneal cavity, the blunt stylet springs forward beyond the cutting needle, preventing injury to the intraperitoneal structures. The inner stylet is hollow with a side hole near its tip to allow insufflation of air. (Figure 1)

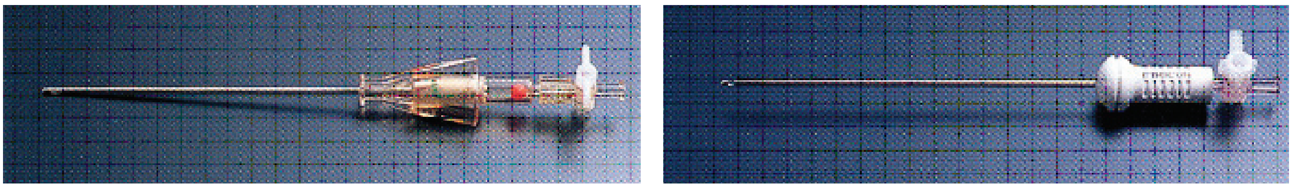


Figure 1

Open access trocars

Hasson's trocar: This is used for gaining initial access to the abdominal cavity with an open cutdown technique. This trocar consists of a cone shaped sleeve, a metal or a plastic sheath with a flap valve and a blunt tipped obturator. The cone shaped sleeve is fitted into the cutdown site and buttressed in place with fascial sutures attached to the wings of the trocar. (Figure 2)

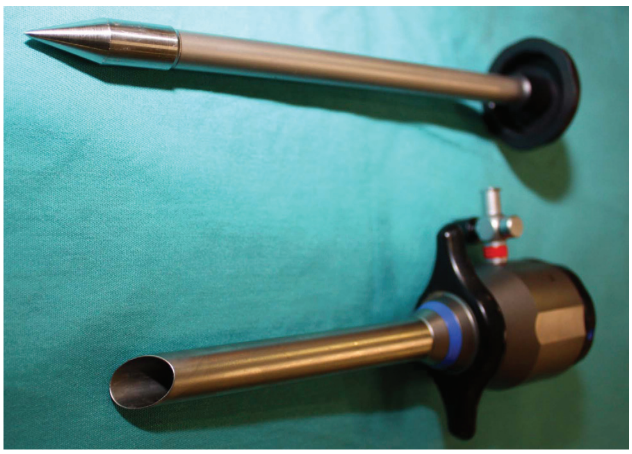


Figure 2

Optical trocar: This allows visualization of the tissues as the blade cuts through the layers of the abdominal wall. This happens by putting a zero degree scope inside the trocar and pushing the trocar through the abdominal wall while visualizing the layers of the abdomen. (Figure 3a,3b)

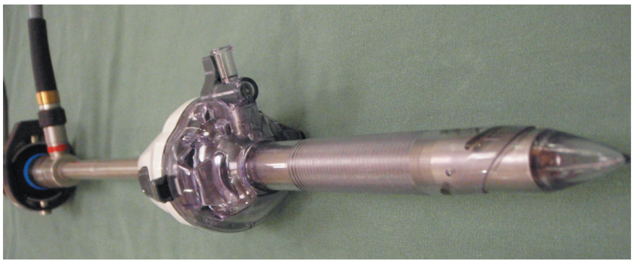


Figure 3a Excel Optiview, Johnson & Johnson

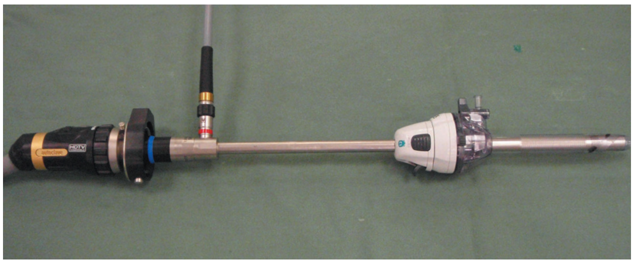


Figure 3b Visipoint, Covidien, USA

Single Port Devices

This is a multi-instrument access port for endo-laparoscopic surgery. (Figure 4a, 4b) It allows all the instruments to be used simultaneously through a single incision. The problems of decreased triangulation inside the abdominal cavity as well as clashing of instruments outside are the challenges currently faced with this device. This however is compensated by using pre -bent instruments (Figure 4c, 4d) or articulated instruments (Figure 4e, 4f) within the abdominal cavity and a 5mm scope with the light cable attached posterior to the camera head (Endoeye™, Olympus, Tokyo, Japan, Figure 4g).

Figure 4a Triport, Olympus, Japan

Figure 4b SILS, Covidien, USA

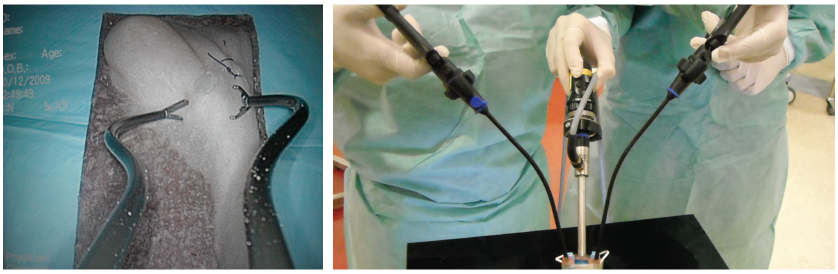
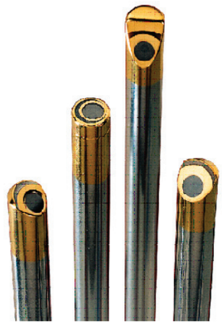


Figure 4c, 4b Pre-bent instruments

Figure 4e, 4f Articulated Instruments

Optical Devices



Telescope: This endoscope is made of surgical stainless steel containing an optical lens train comprised of precisely aligned glass lenses and spacers (Rod Lens System). It comprises of the objective lens, which is located at the distal tip of the rigid endoscope, which determines the viewing angle. The light post at right angles to the shaft, allows attachment of the light cable to the telescope. The eyepiece or ocular lens, remains outside of the patient's body and attaches to a camera to view the images on a video monitor. Telescopes or laparoscopes come in various sizes 10mm, 5mm, 2-3mm needlescopes. And with various visualization capabilities such as a zero degree forward viewing, 30 or 45 degree telescope with 6 mm instrument channel (operating laparoscope) (Figure 5)

Figure 5

Light Source: This is critical for visualization of the operative field. A typical light source is composed of a lamp or bulb, a condensing lens, heat filter and an intensity controlled circuit. Light quality is dependent on the type of lamp that is used. Most light sources nowadays use the high intensity xenon light source which provides white light illumination. (Figure 6) The previous light sources used a quartz halogen bulb, incandescent bulbs and metal halide vapor arc lamps.

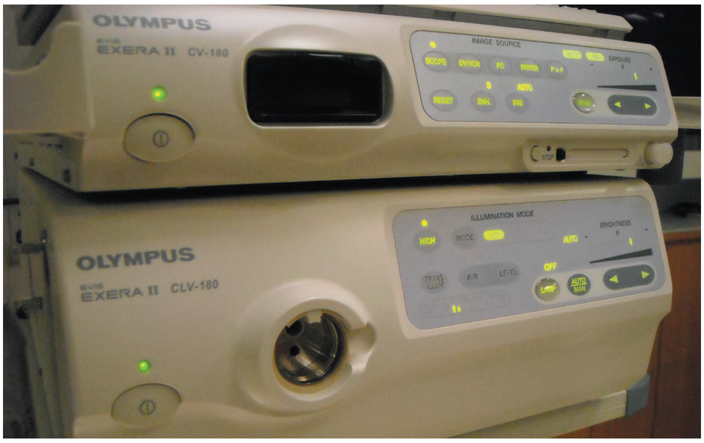


Figure 6

Light Cable: Light is transmitted from the lamp to the laparoscope through cables. (Figure 7) The two types of cables are the fiberoptic and the liquid crystal gel cable. The principle of fiberoptic cables is based on the total internal reflection of light wherein light would enter one end of the fiber after numerous internal reflections and go out through the other end with virtually all its strength intact. Fiberoptic cables are flexible but do not transmit a precise light spectrum. Liquid crystal gel cable is composed of a sheath that is filled with a clear gel, these cables transmit more light and a complete spectrum but are more rigid. Liquid crystal gel cables require soaking for sterilization and cannot be gas sterilized.

Figure 7

Video Camera system: from one Chip to HD: The camera (Figure 8) for endo-laparoscopic surgery contains a solid state silicon chip or the charged coupled device (CCD). This essentially functions as an electric retina and consists of an array of light sensitive silicon elements. Silicon emits an electrical charge when exposed to light. These charges can be amplified, transmitted, displayed and recorded. Each silicon element contributes one unit (referred to as a pixel) to the total image. The resolution or clarity of the image depends upon the number of pixels or light receptors on the chip. Standard cameras in endo-laparoscopic use contains 250,000 to 380,000 pixels. The single chip camera has a composite transmission in which three colors of red, blue and green are compressed in a single chip. The three chip camera has a separate chip for each color with a high resolution. The clarity of the image eventually displayed or recorded will also depend on the resolution capability of the monitor and the recording medium. The resolution is defined as the number of vertical lines that can be discriminated as separate in three quarters of the width of the monitor screen. Standard consumer grade video monitors have 350 lines, monitors with about 700 lines are preferred for laparoscopy.

Figure 8

Video Monitor: High resolution liquid crystal display (LCD) monitors (Figure 9) is ideal for a suitable reproduction of endoscopic image. This is a type of monitor wherein a grid of liquid crystals are arranged in RGB (red-green-blue) triads in front of a light source to produce an image. In general the resolution capability of the monitor should match that of the video camera. Three chip cameras require monitors with 800 to 900 lines of resolution to realize the improved resolution of the extra chip sensors. Two separate monitors on each side of the table are commonly used for laparoscopic procedures. The use of special video carts for housing the monitor and other video equipments allows greater flexibility and maneuverability.

Figure 9

Documentation: A digital recorder which can be transferred to an optical media device such as a digital video disc (DVD) and a digital printer for video snapshots are standard documentation equipment housed in the video cart. (Figure 10)

Figure10

Equipment for creating and maintaining domain

Trocars: The basic endo-laparoscopic port consists of an outer hollow sheath or cannula that has a valve to prevent the CO2 gas from escaping and a side port for insufflation of gas. An inner removable trocar fits through the outer sheath and is used while inserting the port through the abdominal wall. Trocars are available in various diameters and sizes according to the requirement wherein 10mm and 5mm are the most commonly used. Disposable trocars are equipped with a retractable safety shield that sheaths the trocar tip upon entry into the peritoneal cavity. Disposable rubber converters or reusable metallic reducing sheath are available for reusable trocars to prevent leakage from the cannula when smaller diameter instruments are used. (Figure 11)

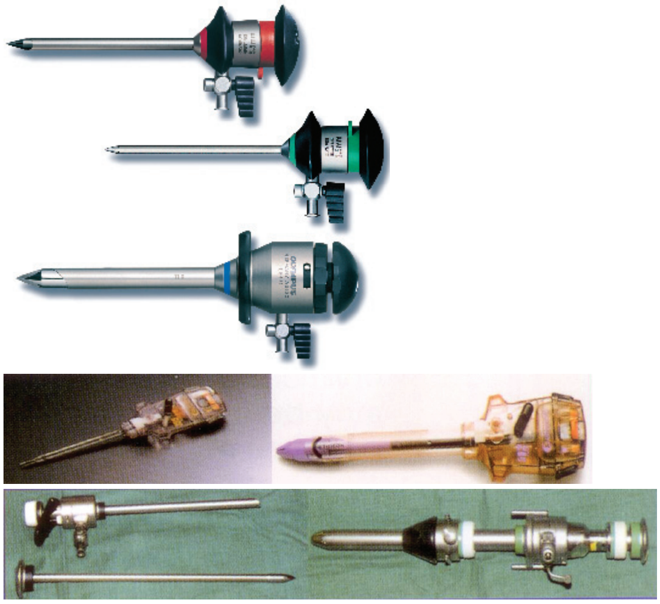


Figure 11

Gas Insufflation: The creation of a working space in the abdominal cavity is done by using gas for insufflation creating pneumoperitoneum. The ideal insufflating gas should be physiologically inert, have a high blood solubility, colorless and non explosive in the presence of thermal instruments. Carbon dioxide (CO2) is currently the agent of choice due to the low risk of gas embolism, low toxicity to peritoneal tissues, rapid reabsorption, low cost and inhibits combustion. Other less common insufflating agents would be nitrous oxide which has unpredictable absorption and may support combustion, helium which is inert but risk of gas embolism is significant and argon which contributes to cardiac depression. Insufflation is generally done using CO2 delivered via an automatic, high flow, pressure regulating insufflator. This delivers gas at a flow rate of up to 20 liters per minute. It also regulates the intra abdominal pressure and stops delivery of CO2 when the pressure exceeds the predetermined level. The level is usually set at 12 to 15 mmHg due to the risk of hypercarbia, acidosis and adverse hemodynamic and pulmonary effects at higher pressure. The insufflator (Figure 12) is equipped with an alarm, which sounds when the pressure limit is exceeded (usually > 15 mmHg). Never ignore any alarm that sounds during laparoscopic surgery!

Figure 12

Gasless Laparoscopy: This has some theoretical advantages in some high risk patients with compromised cardio-respiratory function, decreased diaphragmatic splinting. It facilitates the creation of an operative space by mechanical means like the abdominal wall lifting devices. However the exposure may be sub optimal due to a tent like retraction of the abdominal wall. There may be localized trauma to the abdominal wall, parietal peritoneum resulting in more pain.

Operative Instruments

Laparoscopic hand instruments vary in diameter (1.8mm-12mm) and in length (18cm-45cm). Majority of instruments are designed to pass through either a 5-mm or a 10-mm trocar and the length would usually vary from the type of patitent (adult or pediatric) and the type of procedure (i.e. bariatric surgery). Instruments also have degrees of freedom in terms of rotation (360 degrees) and articulation along the shaft.

Mechanical Dissecting Instruments: Most endo-laparoscopic instruments are 30-40 cm in length with a shaft diameter of 3 to 10-mm. The shafts of the instruments are insulated with non-conductive material with only the working tip exposed to allow diathermy through coagulation adapters. Most endo-laparoscopic forceps have atraumatic tips and have a mechanism to rotate 360 degrees for optimal adjustment of the instruments when used in different planes. (Figure 13a, b)

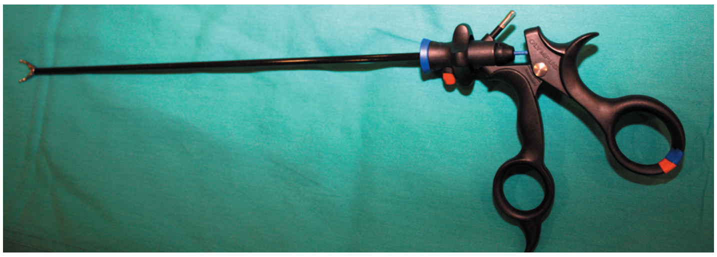


Figure 13a

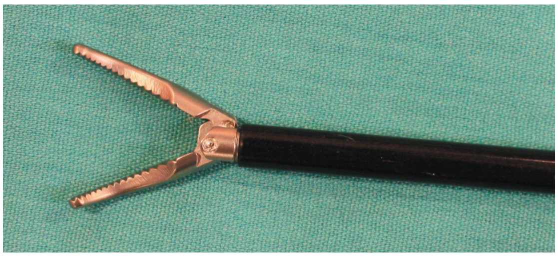


Figure 13b

Grasper Forceps: Grasping forceps are used for dissection, hemostasis and holding tissues. Dissecting forceps are straight or curved with blunt tips. There are instruments with articulation up to 80 degrees for access to areas which are not easily reached to provide comfortable hand and arm position for the surgeon. Grasping instruments come with either atraumatic or toothed jaws. Atraumatic jaws are usually used for bowel handling. The handles have a ratchet mechanism for locking onto the tissues to prevent fatigue when the surgeon holds the tissue for a long time. (Figure 14a, b)

Figure 14a

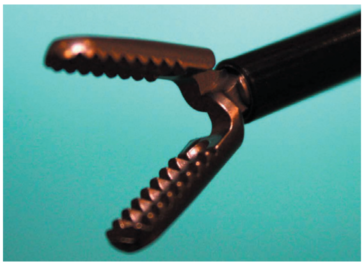


Figure 14b

Scissors: There are a variety of scissors for dissecting , mobilizing and cutting tissues which include straight and curved types. Hook scissors are used to cut sutures, tough fibrous tissues. Most dissecting scissors have adapters for diathermy. Hook scissors should always be kept in view while entering and exiting. Repeated use of diathermy at the sharp edge may tend to blunt the scissors. (Figure 15a, b)

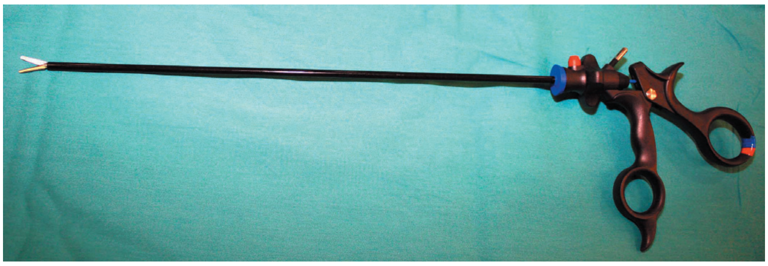


Figure 15a

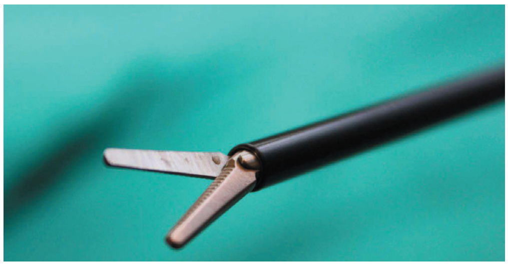


Figure 15b

Bowel and Lung Clamps: tubular tipped structures with atraumatic tips,bowel and lung can be held without injury to these structures. (Figure 16)

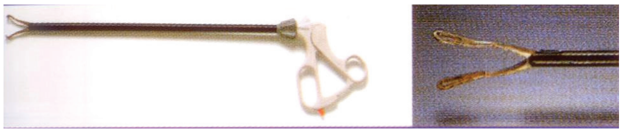



Figure 16

Fan retractor: Exposure may be facilitated by pneumoperitoneum which provides uniform retraction of the peritoneal cavity, gravity i.e. tilting the table, instruments for retraction. Instrumental retraction: Retraction may be achieved using large grasping instruments. Instruments lying outside the visual field may cause inadvertent damage to unvisualised structures. A form of retractor that fans out and articulates and is specifically designed for solid organs like the liver. (Figure 17a, b)

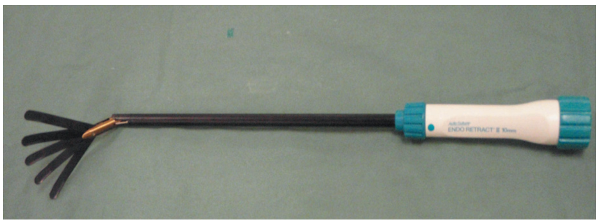


Figure 17a

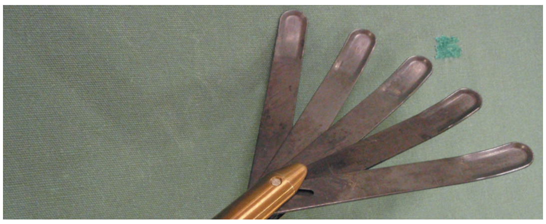


Figure 17b

Tissue Approximation and Hemostasis

Laparoscopic ligating suture delivery system: A pre-tied sliding knot (Figure 18) with a loop is available with nylon carrier rod to ligate stump or tubular structures. The push rod and suture loop are inserted laparoscopically via a hollow reducing sleeve; the suture is then looped around the structure to be ligated and the knot is slid down to close the loop. Useful in appendectomy and large cystic ducts.

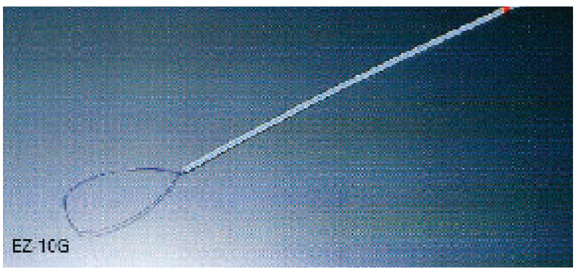


Figure 18

Needle drivers: A number of endo-laparoscopic needle holders (Figure 19a) have been designed for intra-corporeal suturing with either a spring loaded or ratchet handle mechanism. This instrument is designed for easy of rotation, allowing a good angulation of the needle as it drives into tissues. The tip also has a fine grip so as to avoid slippage of the needle.

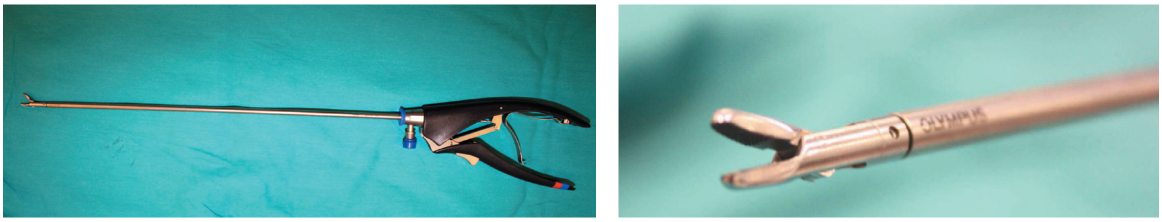


Figure 19a

A disposable suturing device (Endo Stitch™)(Covidien, USA) is available for intracorporeal laparoscopic suturing. (Figure 19b). This is a 10mm diameter, 35cm long device which features jaws that holds on to a double pointed needle. The suture is attached at the center of the needle as opposed to the more commonly seen distal part of the needle. The double-ended needle is passed between the two jaws of the suturing device. Its advantages include easy introduction, atraumatic needle manipulation, good security and easy accurate needle placement. Disadvantage is that it is difficult to manipulate the thickness of tissue as the needle passes. Recently, with the advent of single port surgery, this device has become advantageous in the sense that it does not need triangulation as opposed to the conventional laparoscopic suturing technique.

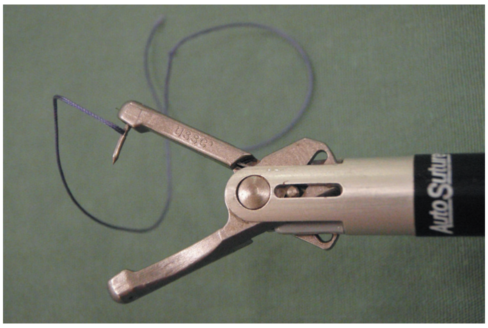


Figure 19b

Clip Applicators: (Figure 20a, b) Clip applicator is the primary modality for ligating blood vessels and other tubular structures. Disposable clip appliers contain up to 20 clips, whereas reusable clip appliers carry one clip at a time. Clips are made of titanium though now plastic locking clips: Hemo-Lock™(Weck, North Carolina, USA) provide a more secure ligation.

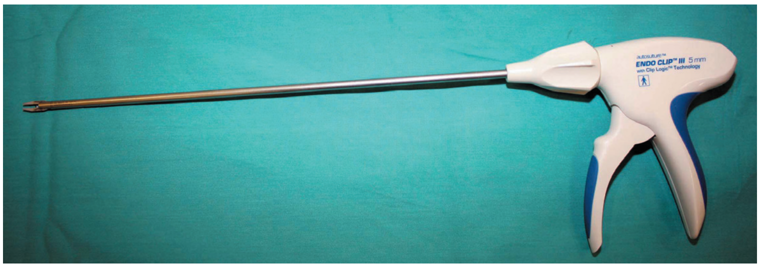


Figure 20a

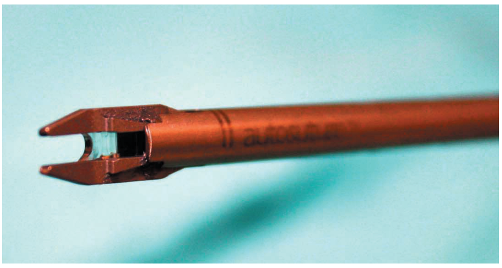


Figure 20b

Mechanical Stapling Instruments: (Figure 21a-d) Laparoscopic staplers are modifications of stapling devices of open surgery. Staplers are used for transecting and anastomosing bowel, transecting mesentery. The linear cutting staplers contains a blade that cuts between two or triple staggered rows of staples. A range of stapler cartridges (30 - 60mm) is available depending on the thickness(2.5 - 4.8mm) and the type of tissue to be divided.

Figure 21a

Figure 21b

Figure 21c

Figure 21d

Aspiration and Irrigation probes: (Figure 22) This is essential for most endo-laparoscopic procedures in order to maintain a clear operative field. Irrigation and aspiration channels may be incorporated into other surgical instruments but working channels are small and subject to repeated clogging.

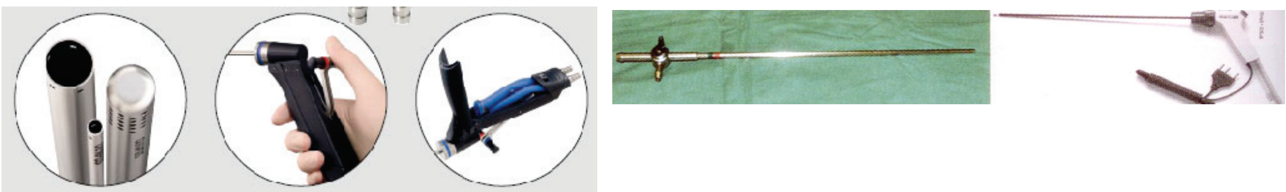


Figure 22

Hand Assisted Laparoscopic surgery: The Hand Access Device is intended to provide extracorporeal extension of the pneumoperitoneum and abdominal access of the surgeon's hand to assist in the procedure and also for large specimen extractions. (Figure 23a, b). It has application in colorectal, urological and general surgical procedures.

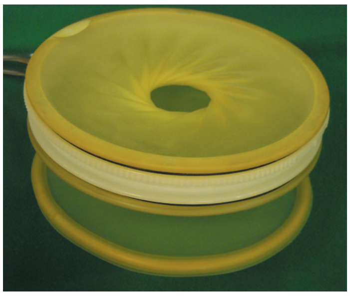


Figure 23a

Figure 23b

Organ Extraction devices: These are pre loaded specimen retrieval pouches made of strong plastic material, which is impervious to cancer cells (Figure 24). The mouth of the pouch is bought out of the incision site and opened following specimen extraction. **The pouch itself must not be pulled out against resistance at it may tear with undue force**

Figure 24

Tissue Morcellators: These are used to reduce the size of the resected specimen prior to retrieval. Drawback is that it may render a difficult pathological examination.

Space creators: The balloon dissector (Figure 25) is a space creator which functions when the balloon is inserted into the intended region and the space is created as the balloon is pumped with air. This is intended for endoscopic extraperitoneal surgery like extraperitoneal hernia repair, subfascial endoscopic perforator vein ligation, endoscopic hemithyroidectomy.

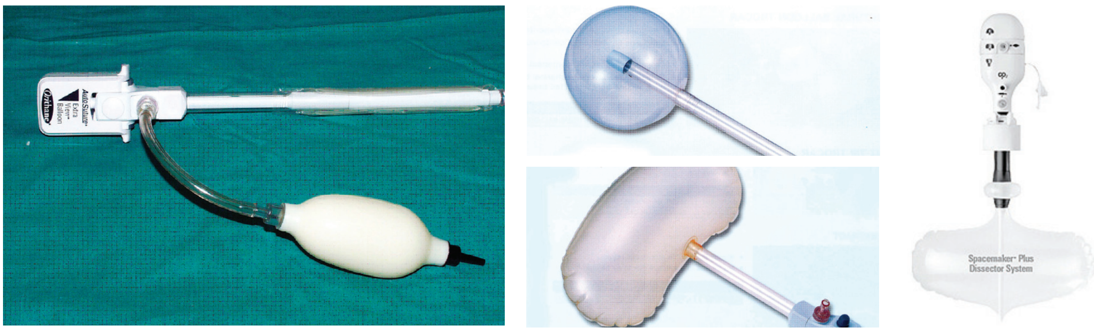
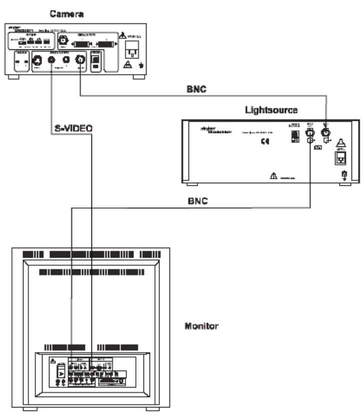


Figure 25

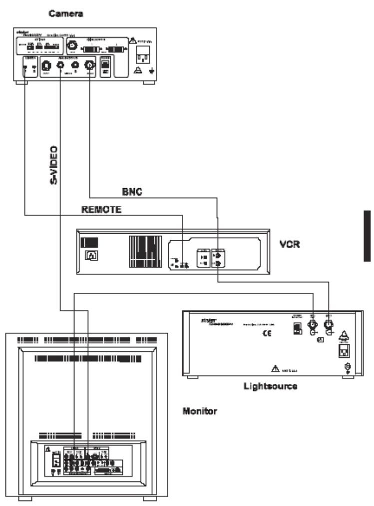
Camera and Light Source Setup

Illustrated, below are the most common connection between camera imaging system and light source (system 1), camera imaging system, recording system, and light source (system 2), and camera imaging system, recording system, printer, and light source (system 3).



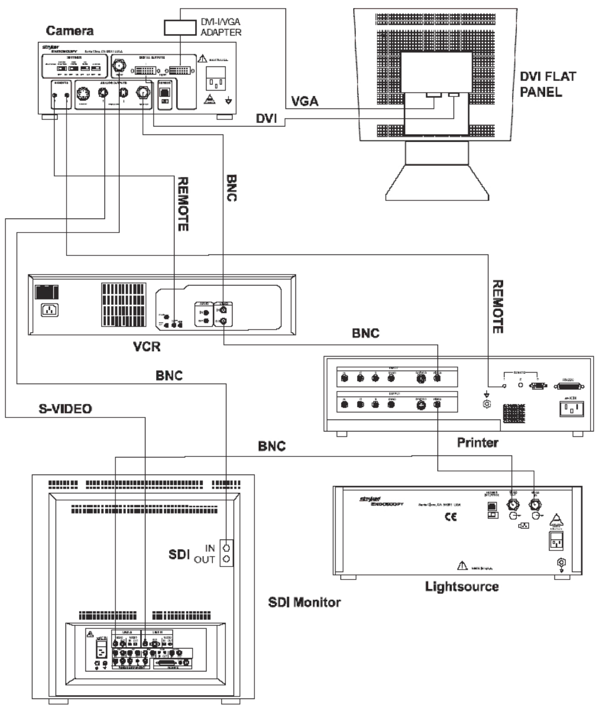
SYSTEM 1

Equipment Used: Camera, Light Source and Monitor



SYSTEM 2

Equipment Used: Camera, Light Source, Video Peripheral and Monitor. The video peripheral may be a video printer, digital capture, Hermes or VCR.



SYSTEM 3

Equipment Used: Camera, Light Source, Stryker Printer, Stryker VCR, SDI Monitor, DVI Flat Panel.

Technical Aspect and Troubleshooting of MIS Camera System

Problems	Solution
No Color Bar	- Ensure video out from camera is connected to the video monitor and all video systems are powered on
Picture Color Incorrect	- White balance against clean white surface, see WHITE BALANCE section - Check color settings on monitor
Picture Too Dark	- Adjust light level from camera head - Adjust light source for higher output - Check fiber optic light cable for excessive broken fibers - Press GAIN switch to increase illumination - Set auto SHUTTER to OFF
Picture Too Bright	- Adjust light level from camera head - Adjust light source for lower output - Select auto SHUTTER mode - Ensure GAIN is OFF
Noise or Snow on Picture (no electro-cautery)	- Ensure GAIN is OFF - Reduce Enhancement - Select auto SHUTTER mode to OFF - Check and replace faulty video cables
Noise or Snow on Picture When Using Electro-Cautery	- Plug electro-cautery into separate electrical outlet and separate power cords - Separate camera cable and electro-cautery cable - Reposition electro-cautery grounding pad on patient
No Video Picture When Camera Head Is Plugged In	- Check to ensure that all components in the video systems are plugged in and power is on - Check connector on camera head cable for broken pins
Image Not Centered	- Release scope from the coupler and re-connect. Make sure the scope is seated correctly in the coupler

Problems	Solution
Variability In Color Reproduction With Various Light Sources Or Peripherals	- WHITE BALANCE on the camera - Check settings on video peripherals - Ensure light source has proper infrared filter (check with manufacturer specifications)
Foggy Picture (loss of definition & clarity)	- Check camera focus and refocus - Optics are dirty. Clean and dry both the scope and the coupler glass face - Moisture may exist between the camera head and the coupler. Remove coupler from the camera head and clean this area thoroughly
Cleaning Dirty Optics	- Rotate the scope. If dust particles in the picture rotate, dust is located on the scope itself. Follow manufacturer's instructions for cleaning the eyepiece and negative lens. - If particles do not move when rotating, particles are behind the scope. Remove the scope and clean the window on the front of the coupler with a dry or alcohol tipped cotton swab - If dust particles lie between the coupler and camera, remove the coupler and clean the window on the coupler and the window on the camera head. - BE SURE the entire area is completely dry before reassembling or fogging may result
Blurry Picture	- Check that coupler is in focus - Check that the Flex Filter switch is turned off
No White Balance (WB)	- Picture too dark (see above for troubleshooting) - Picture too bright (see above for troubleshooting) - Color temperature too low - WB with light source connected and use metal halide or xenon lighting (no fluorescent lighting)

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ENERGY SOURCES

J Lopez-Gutierrez, M Lawenko

Electrosurgery: Current flows occurs when electrons flow from one atom to the orbit of an adjacent atom. Voltage is the "force" or "push" that provides electrons with the ability to travel from atom to atom. If electrons encounter resistance, heat will be produced. The resistance to electron flow is called impedance. A completed circuit must be present in order for electrons to flow. A completed circuit is an intact pathway through which electrons can travel.

Current = Flow of electrons during a period of time, measured in amperes

Circuit = Pathway for the uninterrupted flow of electrons

Voltage = Force pushing current through the resistance, measured in volts

Resistance = Obstacle to the flow of current, measured in ohms (impedance = resistance)

Electrocautery refers to direct current (electrons flowing in one direction) whereas electrosurgery uses alternating current. During electrocautery, current does not enter the patient's body. Only the heated wire comes in contact with tissue. In electrosurgery, the patient is included in the circuit and current enters the patient's body. The electrosurgical generator is the source of the electron flow and voltage. The circuit is composed of the generator, active electrode, patient, and patient return electrode. Pathways to ground are numerous but may include the operating table, stirrups and equipment. The patient's tissue provides the impedance, producing heat as the electrons overcome the impedance. Standard electrical current alternates at a frequency of 60 cycles per second (Hz). Electrosurgical systems could function at this frequency, but because current could be transmitted at body tissues at 60 cycles, excessive neuromuscular stimulation and perhaps electrocution would result. Because nerve and muscles stimulation ceases at 100,000 cycles per second (100khz), electrosurgery can be performed safely at radio frequencies well above 100 khz. An electrosurgical generator takes 60 cycles current and increases the frequency to over 300,000 cycles per second. At this frequency electrosurgical energy can pass through the patient with minimal neuromuscular stimulation and no risk of electrocution.

Bipolar: In bipolar electrosurgery, both the active electrode and return electrode functions are performed at the site of surgery. The two tines of the forceps perform the active and return electrode functions. Only the tissue grasped is included in the electrical circuit. Figure 1 is an example of a bipolar circuit.

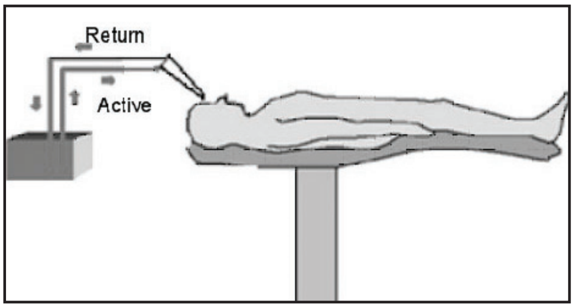

Figure 1

Monopolar: The active electrode is in the wound. The patient return electrode is attached somewhere else on the patient. The current must flow through the patient to the patient-return electrode to complete the circuit.

Monopolar Circuit :
There are four components of the monopolar circuit (Figure 2):

- Generator
- Active electrode
- Patient
- Patient return electrode

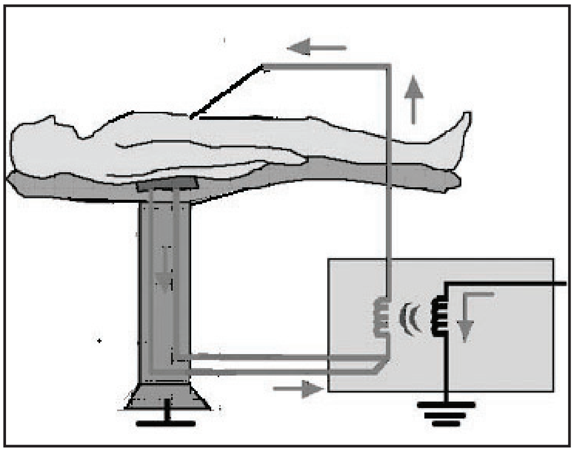

Figure 2

Electrosurgical generators (Figure 3) are able to produce a variety of electrical waveforms. As waveforms change, so will the corresponding tissue effects. Using a constant waveform, like "cut" allows the surgeon vaporize or cut tissue. Using an intermittent waveform like coagulation causes the generator to modify the waveform so that the duty cycle is reduced. This interrupted waveform will produce less heat. Instead of tissue vaporization, a coagulum is produced. A blended current is not a mixture of both cutting and coagulation current but rather a modification of the duty cycle. Heat produced rapidly causes vaporization. Low heat produced more slowly creates a coagulum.

Figure 3

Safety considerations during Electrosurgical Laparoscopic Surgery

Direct Coupling: Direct coupling occurs when the user accidentally activates the generator while the active electrode is near another metal instrument. The secondary instrument will become energized. The energy will seek a pathway to complete the circuit to the patient return electrode. There is potential for significant patient injury.

Do not activate the generator while the active electrode is touching or in close proximity to another metal object.

Insulation Failure: (Figure 4) Many surgeons routinely use the coagulation waveform. This waveform is comparatively high in voltage. This voltage or "push" can spark through compromised insulation. Also, high voltage can "blow holes" in weak insulation. Breaks in insulation can create an alternate route for the current to flow. If this current is concentrated, it can cause significant injury.

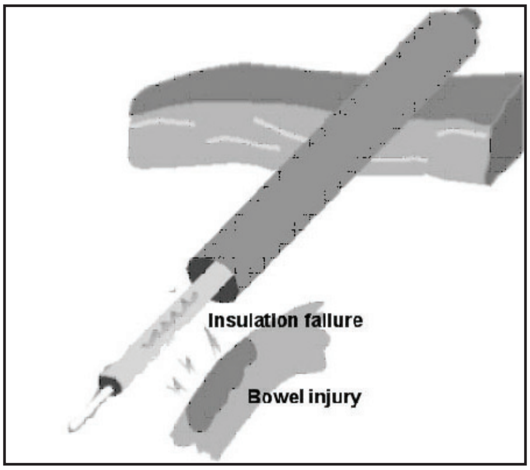

Figure 4

You can get the desired coagulation effect without high voltage, simply by using the "cutting" current while holding the electrode in direct contact with tissue. This technique will reduce the likelihood of insulation failure. By lowering current concentration you will reduce the rate at which heat is produced and rather than vaporize tissue you will coagulate - even though you are activating the "cutting" current.

Capacitive Coupling: A capacitor is not a part labeled "capacitor" in an electrical device. It occurs whenever a nonconductor separates two conductors. During laparoscopic procedure, an "inadvertent capacitor" maybe created by the surgical instruments. The conductive active electrode is surrounded by nonconductive insulation. This, in turn, is surrounded by a conductive metal cannula.

A capacitor creates an electrostatic field between the two conductors and, as a result, a current in one conductor can, through the electrostatic field, induce a current in the second conductor.

In the case of the "inadvertent capacitor" in a laparoscopic procedure, a capacitor may be created by the surgical instrument's composition and placement.

Avoiding Electrosurgical Complications

Most potential problems can be avoided by following:

- Inspect insulation carefully
- Use lowest possible power setting
- Use a low voltage waveform (cut)
- Use brief intermittent activation vs. prolonged activation
- Do not activate in open circuit
- Do not activate in close proximity or direct contact with another instrument
- Use bipolar electrosurgery when appropriate
- Select an all-metal cannula system as the safest choice. Do not use hybrid cannula systems that mix metal with plastic
- Utilize available technology, such as a tissue response generator to reduce capacitive coupling or an active electrode monitoring system, to eliminate concerns about insulation failure and capacitive coupling.

NOTE: Any cannula system may be used if an active electrode monitor is utilized

- **The Electrosurgical unit should not be used in the presence of flammable agents (i.e., alcohol and/or tincture-based agents)"**
- **Avoid oxygen-enriched environments.**
- **ALWAYS use an insulated safety holster to store active electrodes when not in use.**

Monopolar current may be used through most of the dissecting and cutting laparoscopic instruments. The dissecting `Hook` is a useful instrument for effectively using blunt dissection and for diathermy.

Argon-Enhanced Electrosurgery: Argon-enhanced electrosurgery incorporates a stream of argon gas to improve the surgical effectiveness of the electrosurgical current. Argon gas is inert and noncombustible making it a safe medium through which to pass electrosurgical current. Electrosurgical current easily ionizes argon gas, making it more conductive than air. This highly conductive stream of ionized gas provides the electrical current an efficient pathway.

- Inert
- Noncombustible
- Easily ionized by RF energy
- Creates bridge between electrode and tissue
- Heavier than air
- Displaces nitrogen and oxygen

Ultrasonic Energy

This is a unique energy form that allows both cutting and coagulation at the precise point of impact, resulting in minimal lateral thermal tissue damage. An example of which is the Harmonic scalpel™ (Johnson and Johnson, New Jersey, USA) (Figure 5) which cuts and coagulates by using lower temperatures than those used by electrosurgery or lasers. It controls bleeding by coaptive coagulation at low temperatures ranging from 50°C to 100°C. Vessles are coaptated (tamponaded) and sealed by a protein coagulum. Coagulation occurs by means of protein denaturation when the blade, vibrating at 55,500 Hz, couples with protein, denaturing it to form a coagulum that seals small vessels. When the effect is prolonged, secondary heat is produced that seals larger vessels. It offers greater precision in tight spaces near vital structures. Fewer instrument changes are needed, less tissue charring and desiccation occur, and visibility in the surgical field is improved.

Figure 5: Harmonic Scalpel™ Generator

Cutting speed and coagulation are inversely related. With ultrasound technology, the balance between cutting and coagulation is in the hands of the surgeon. Cutting speed and extent of coagulation are easily controlled and can be balanced by varying four factors: power, blade sharpness, tissue tension, and grip force/pressure.

Power Setting: The Harmonic Scalpel™ has five power levels. Increasing the power level increases cutting speed and decreases coagulation. In contrast, less power decreases cutting speed and increases coagulation. More power results in increased distance traveled by the blade: at level 1, blade excursion is approximately 50 microns; at level 3, approximately 70 microns; at level 5, it is approximately 100 microns. The ultrasonic vibration of 55,500 Hz remains the same at all power levels.

Tissue Tension: More coagulation can be achieved with slower cutting when tissue tension is reduced. Faster cutting with less coagulation is achieved by increasing the tissue tension.

Grip Force/Pressure: Grip force, or pressure, is another factor controlling the balance between cutting and coagulation. Application of a gentle force, or light pressure, achieves more coagulation with slower cutting. A firmer grip force achieves less coagulation with faster cutting.

Vessel Sealing Generator

The Force Triad™ (Covidien, Norwalk, USA) (Figure 6) and intergrated generator providing monopolar, bipolar energy and Ligasure™ (Covidien, Norwalk, USA) tissue sealing/fusion energy. The Ligasure™ (Covidien, Norwalk, USA) has a generator that produces a high-current, low-voltage output. It corresponds to at least four times the current of a standard electrosurgery generator, with one-fifth to one-twentieth the amount of voltage.

It recognizes changes in tissue 200 times per second, and at the same time it has a self regulation mechanism that consist in adjust the voltage and the current accordingly in order to maintain appropriate power.

The feedback control adjusts the pulsed generator output to the exact tissue type and quantity in the instrument jaws to create a consistent, reliable tissue effect.

Figure 6: Ligasure™ vessel sealing device

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CARE AND HANDLING OF LAPAROSCOPIC INSTRUMENTATION

SKP Khor

Laparoscopic instrumentation ranging from operating telescopes and fibre optic light cables to its surgical instruments represent a substantial investment for the operating theatre department. The delicate and complex nature of these devices and the high cost involved to repair them when damaged, warrants surgeons, nurses and reprocessing personnel to handle them carefully and appropriately at all times. Proper care and handling of laparoscopic instrumentation can help to prolong their lifespan and maintain their functionality at an optimum level. It also ensures that they are safe to be used on the patient. In addition, reprocessing of laparoscopic instruments is one of the biggest challenges for the operating room personnel. Laparoscopic instrumentations comes in different configurations with long narrow shaft and complex jaw assembly which make cleaning difficult and time consuming.

With the goal of delivering the safest and highest quality in patient care, all surgical team members and reprocessing personnel must be familiar with the recommendations for care and handling of all laparoscopic instrumentation before, during and after a surgical procedure.

Care and Handling of Telescopes

The telescope is the most expensive and fragile component of laparoscopic instrumentation. It is also an integral part of the instrumentation, providing image and light through two distinct systems. As such, telescopes must be handled with care from the start to the end of surgery, and also during the cleaning and sterilization process.

All surfaces of a telescope should be inspected on a regular basis for any scratches, dents or other flaws. Telescope should also be inspected before each use to assess functional integrity. The eyepiece should be examined to evaluate the clarity of image from the reflected light. In addition, it is also important to check the optical fibers surrounding the lens train at the tip of the telescope by holding the light post toward a bright light. If image is discolored or hazy or there is presence of black dots or shadowed areas, it may be due to improper cleaning, a disinfectant residue, a cracked or broken lens, the presence of internal moisture, or external damage.

When using a metal cannula, the telescope should be inserted gently into the lumen, so as not to break the lens. In the process of cleaning and disinfection, telescopes should not be bent and placing heavy instruments on top of the telescope should be avoided. The telescope also should never be placed near the edge of a sterile trolley or surgical field to prevent it from accidentally dropping. When transferring the telescope, it is to be handled by gripping the ocular lens in the palm of the hand and never by the shaft. Immediately after use, wash the surfaces of the telescope with a soft cloth or sponge using a neutral pH enzymatic solution and thorough rinse with distilled water to remove any residual cleaning solution.

Care and Handling of Light Cables

Another important component of laparoscopic instrumentation is the use of a light source cable to transmit light through the telescope to view the operative field. Light cables are made of hundreds of glass fibers to transmit the light, and these fibers can be broken if the cable is dropped, kinked or bent at extreme angles. Following are some general guidelines regarding the care and maintenance of light cables:

- Avoid squeezing, stretching, or sharply bending the cable at any point of time during use and cleaning process
- Grasp the connector piece when inserting or removing the light cord from the light source. Never pull on the cable directly when disconnecting it from the light source
- Avoid puncturing the cable with towel clips, when securing the cables to the drapes
- Do not turn the light source on before connecting the light cable to the telescope to prevent igniting a fire on the drapes
- Inspect the cable for broken fibers before each use
- Inspect both ends of the cable to ensure they have a clean, reflective, polished surface
- Wipe the fibre optic light cable gently to remove all blood and organic materials immediately after use using a mild detergent
- Never placed light cables in the ultrasonic washer for cleaning, as the vibratory motion can destroy tiny fiber bundle

Cleaning, Disinfecting and Sterilizing of Laparoscopic Instruments

Reprocessing laparoscopic instruments is a complex and time consuming task. Proper cleaning and decontamination of laparoscopic instruments is vital in order to achieve effective sterilization, which renders it safe to be used on patients.

Laparoscopic instruments are extremely difficult to clean because of their long shaft and complex jaw assemblies, which may trap infectious bioburden and debris. The positive pressure of the CO2 in the insufflated abdomen may also cause blood and other body fluids to flow up into these channels, and making them difficult or impossible to remove. Many of these instruments cannot be disassembled to facilitate manual cleaning, and ultrasonic cleaning system may be contraindicated due to the small joints and jaws. Nevertheless, for effective sterilization to take place, it is absolutely vital for surgical instruments to be clean and free from all bioburden. Meticulous cleaning should begin at the point of use and immediately after a surgical procedure.

To assist in subsequent cleaning process, the instruments should be periodically wiped down with a wet sponge and flushed with solutions during surgery to prevent bioburden solidification. The instruments should be immersed in an enzymatic solution immediately following a procedure to initiate the decontamination procedure. Items in these instruments that can be disassembled should be disassembled to its smallest parts, and those with flush ports should be flushed and irrigated, prior to soaking and cleaning. For the cleaning process, a detergent with a neutral pH of 7.0 is recommended, and avoids using abrasives, such as steel wool, that could disrupt the surface of the instruments. Instead use appropriate cleaning tools, such as soft bristle brushes, to adequately clean ports, lumens, serrations, fulcrums, box locks and crevices. Both external and internal surfaces of the instruments must be cleaned thoroughly, if not, they cannot be sterilized. If available, ultrasonic cleaners and automatic cleaning devices, with port and lumen flusher systems can be used to assist in completely cleaning the instruments.

Following the cleaning process, the devices should be submitted to high-level disinfectants or chemical agents. Glutraldehyde is one of the most appropriate chemical high-level disinfectants for soaking laparoscopes and accessories because they do not damage rubber, plastics or lens cements. However, there are many health hazards concern with use of glutraldehye, and it only can achieve high level disinfection and not sterilization which is a the preferred method for reprocessing such devices.

For sterilization, steam, liquid immersion are some of the sterilization modalities that can be used. Nevertheless, since the manufacturers are responsible for developing instructions for a process, which will render a properly cleaned instrument sterile while preserving its function, it is best that the instruments be sterilized according to manufacturers' written instructions.

Proper care and handling of laparoscopic instrumentation can help prevent malfunctions and rapid deterioration, which in turn eliminates costly repairs and replacements. Most importantly, it allows maximum instrument performance and safe patient outcomes.

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ANESTHESIA IN LAPAROSCOPIC SURGERY

J Choy

Preoperative Assessment

The preoperative assessment seeks to assess the patient's airway and ensure that all medical conditions are optimized before surgery. Particular attention is paid to the cardiovascular system (all murmurs should be investigated for the risk of paradoxical embolism as 25-40% of the population has a potential patent foramen ovale), respiratory system and those conditions, which predispose a patient to the risks for aspiration (eg. Obesity, incompetent lower oesophageal sphincter in hiatus hernia).

Premedication

Premedication is generally unnecessary. However, for the anxious patient, a benzodiazepine can be given. The dose given will commensurate with the patient's age and associated medical conditions.

Choice of anaesthesia

General anaesthesia with intubation using a muscle relaxant is usually chosen. The institution of intermittent positive pressure ventilation allows the anaesthesiologist to manipulate the tidal volumes and respiratory rates necessary to counteract the respiratory changes resulting from the pneumoperitoneum and positioning of the patient. On the rare occasion, local and/or regional anaesthesia with intravenous sedation can be used for certain short procedures.

Positioning and preparations

The patient should be securely strapped to the operating table with his/her bony points padded. He/she may be put in either the reverse Trendelenburg or Trendelenburg or lithotomy position depending on the type of surgery. Attention should be paid to protecting the face (especially the eyes) from inadvertently being hit by the laparoscopic instruments or the surgeon's arm. If the patient's arm is extended, care should be taken to avoid hyperabduction thus reducing the risk of brachial plexus injury. Padding the elbows protects the ulnar nerve whilst the common peroneal nerve needs to be attended to in the lithotomy position.

Intraoperative Monitoring

Routine monitoring during laparoscopic surgery include pulse oximetry (approximates the partial pressure of oxygen in the blood), end-tidal carbon dioxide monitoring (approximates the partial pressure of carbon dioxide in the blood), non-invasive blood pressure monitoring (gives an indication of the cardiac output), and electrocardiography (to detect arrhythmias). Airway pressure monitoring is also considered desirable as it warns against excessively high airway pressures and may detect the presence of a pneumothorax.

Postoperative Management

Major postoperative problems after laparoscopic surgery include pain and nausea. The former can be reduced with the appropriate use of various classes of analgesics (eg. NSAIDS, opioids, etc) in conjunction with local anaesthetics for local or regional blockade wherever possible. The classical shoulder tip pain can be reduced by having the surgeon attempt to remove as much of the pneumoperitoneum as possible at the end of surgery.

Postoperative nausea and vomiting (PONV) can be reduced by avoiding over-inflation of the stomach during mask ventilation, identifying those at risk of PONV, reducing the use of opioid analgesics where possible and the liberal use of anti-emetics.

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METHODS OF ACCESS, PNEUMOPERITONEUM AND COMPLICATIONS

D Lomanto

The purpose of this chapter is to describe the fundamental step on how to safely enter the abdominal cavity and create the pneumoperitoneum. This is the first maneuver to learn and even though it seems to be simple it still is not risk free. The complications range from 0.05 to 0.2%, although low, represents almost 20- 30% of complications in laparoscopic surgery.

There are different methods of laparoscopic access with numerous modifications. The most common utilized are: open access using Hasson's trocar, Veress needle access, direct trocar insertion and optical trocar access. The preference is a surgeon's choice and must be also related to different patients and different situations. Gaining access to the peritoneal cavity is essential to the success of laparoscopic surgery. Occasionally, it can be difficult especially for obese patients and it can create potentially dangerous complications in some patients.

Veress Needle Technique *(Figure 1)*

This special needle has an outer cannula with a beveled needle. The length of the needle ranges from 7 to 15 cm, with an external diameter of 2 mm. The cannula is an inner stylet that springs forward in response to sudden decrease in pressure upon crossing the abdominal wall and entering the peritoneal cavity. The dull stylet serves to protect the underlying viscera.

Technique: A small incision is made above or below the umbilicus. The anterior abdominal wall is lifted up using a clamp by the surgeon and assistant on either side of umbilicus to create a negative abdominal pressure. The Veress needle is then inserted into the peritoneal cavity wherein a "give" can be felt. The patient should be in Trendelenburg's position and it should aim towards the pelvis. Once inserted and held in a steady position, position of the needle can be verified with a syringe and injection of saline, and is inside the abdominal cavity if there is no resistance to injection of saline. Suctioning of air from the abdominal cavity and the drop test are the other methods. Subsequently, a low flow insufflation of CO2 is started with a careful reading of the electronic insufflator. The intra-abdominal pressure (around -1 and 4 mmHg) is very important and also the percussion of the abdomen over the liver that, obliteration of the liver dull sounds, show a diffusion of the gas into the abdominal cavity.

Once the intra-abdominal pressure reach 13-15 mmHg, the needle is removed and the first sharp trocar can be inserted. After the port is inserted, a rapid introduction of the telescope is very important to verify the correct entry and to explore the abdominal cavity for injuries. The remaining trocars are placed differently under direct vision according to the procedure.

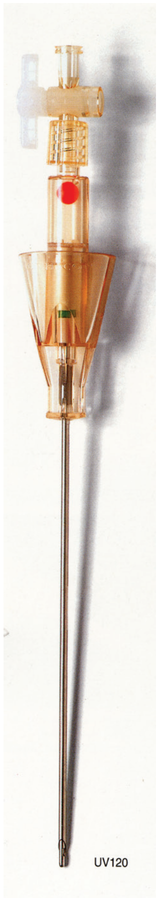


Figure 1

Open (Hasson) Technique *(Figure 2)*

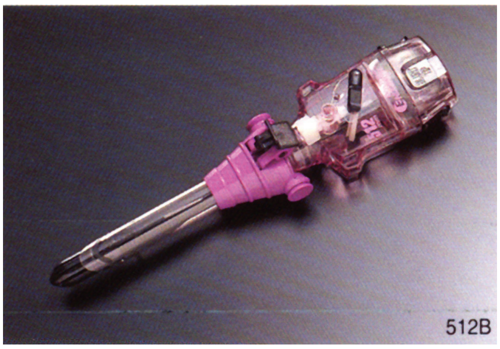


Figure 2

In order to avoid inadvertent injuries to the underlying bowel associated with blind technique, Hasson proposed a blunt minilaparotomy access. A 2 cm incision either vertical or curvilinear is made to the skin above or below the umbilicus or differently accordingly to the procedure to be done. Occasionally, supraumbilical incision can be used if adhesion in the pelvis is suspected. The linea alba and the peritoneum is incised under direct vision. Once the peritoneal cavity is entered,using a finger, a gently exploration of the periumbilical area is suggested to verify the presence of abdominal adhesion. Then the Hasson's trocar can be inserted. This trocar is blunt and can be disposable or reusable. Usually the trocar is held in place by two sutures anchored on either side of the abdominal fascia. The laparoscope is inserted to confirm to be into the abdominal cavity. Insufflation of CO2 is started at low pressure (2-4 L/ min) to avoid a rapid increase of the intra-abdominal pressure with a consequent rapid expansion of the diaphragm (vagal stimulation, bradyarrhythmias). Advantages of this technique is its safety and cost effectivity. It is recommended by most of general surgeons especially in patients with previous abdominal operations.

Direct Trocar Insertion *(Figure 3)*

Figure 3

We believe that this technique must be carried out only by experienced and skilled laparoscopic surgeons. It is a form of blind direct insertion. One of the matters in favor of the insertion of blind trocar is that avoiding the use of the Veress needle we can avoid a double blind puncture of the abdomen. This technique has some special requirements as an adequate skin incision (to avoid skin resistance during the sleeve insertion), the periumbilical skin must be lifted up using towel clamps on either site, a disposable trocar (trocar must be sharp) and a complete abdomen muscle relaxation. The trocar must be held like a pen avoiding in this way to penetrate too deep. Once the trocar is inserted, an explorative laparoscopy must be carried out to verify intra-abdominal or retroperitoneal injuries.

Optical Trocar Insertion *(Figure 4a, b)*

Figure 4a

These are hollow trocars with a transparent tip which allows direct visualization during inserteion through the abdominal cavity. They are very useful in obese patients or in patients underwent previous major abdominal surgery. A zero degree telescope is inserted into the sheath and fixed, The tocar is inserted with the camera using a rotating movement as visualization is achieved along the layers of the abdominal wall.

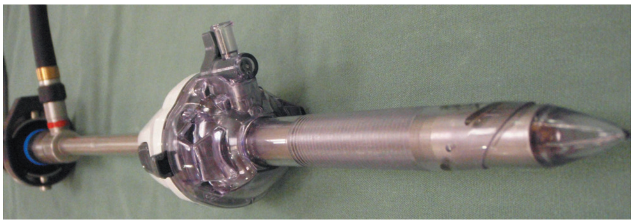
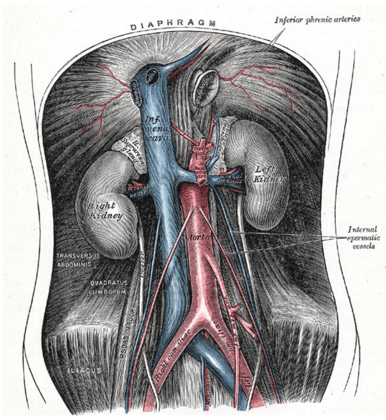


Figure 4b

Pneumoperitoneum

The entry of peritoneal cavity needs to be confirmed before any insufflation. As previously described, this can be done by syringe and test insufflation of 1litre/min. The initial pressure on the monitor should be less than 6mmHg. The insufflation test should produce a small rise in the pressure level. Once the position is confirmed, CO2 of 4-6 L/min can be insufflated into the peritoneal cavity. The gas pressure on the insufflators should be around 12-14 mmHg.

Complications and management



The complication rate ranges from 0.05 to 0.2%. Although low, this represents almost 20-30% of the complications in laparoscopic surgery. The most common is extra peritoneal gas insufflation, vascular injury, bowel injury. Insufflation of gas into the preperitoneal space is the most common complication and can be prevented by inserting the Veress needle in a perpendicular fashion and also by avoiding displacement of the needle during the gas insufflation. If during the creation of the pneumoperitoneum, the CO2 pressure does not arise (always below 6 mmHg) and there is no obliteration of the liver dull sound, we must verify the correct intraperitoneal position of the Veress needle or convert to the open Hasson's technique.

We recommend using the open Hasson technique in high-risk patients and those with a previous surgery. Visceral injury can be also be made during the first trocar blind entry. If a bowel injury is suspected a rapid identification of the location is very important. A complete bowel examination must be carried out and the injury sutured via open laparotomy, minilaparotomy or laparoscopy. The choice of the method of repair is related to the severity of the injury, the skill and the preference of the surgeon. Other organs that can be injured, although rarely is the bladder and stomach. The incidence of vascular injury ranges from 0.03 to 0.05%. The injury is caused by blind insertion of the trocar and is usually catastrophic and requires a prompt surgical intervention. A conventional laparotomy with vascular repair must be carried out. The most common vessels injured are: abdominal aorta; iliac vessel at the level of aorta bifurcation; inferior vena cava. If during the insertion of Veress needle, blood returns after the syringe test, a retroperitoneal vascular injury must be suspected. The puncture of retroperitoneal vessels is more difficult to recognize and, a careful inspection of the retroperitoneal area must be done to look for any hematoma formation. The vascular injuries are mainly due to an uncontrolled forced entry. Vessel injury can be avoided positioning the patient in Trendelenburg position's (15-20 degree) and inserting the Veress needle or the first trocar towards the sacrum.

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DIAGNOSTIC LAPAROSCOPY

M Lawenko

There are several situations in which the role of diagnostic laparoscopy is very useful in the effort to reduce the number of unnecessary laparotomies: acute abdominal pain, chronic abdominal pain, staging for malignancy, intestinal ischemia, bowel perforation or obstruction, pelvic inflammatory disease, gynecological causes (salpingitis, rupture of ovarian cyst or abscess, ovarian torsion, etc). We will resume in two main situations when diagnostic laparoscopy (DL) is indicated: in Acute abdomen and in Malignancy.

Patient and ports position

Under general anesthesia the patient is on supine position (Figure 1), the pneumoperitoneumwas created using an umbilical access. In acute situation an open entry technique (Hasson, optical trocar) must be considered. The 30 degree telescope is then inserted through the 12 mm trocar and an initial exploration of the abdominal cavity is performed. Usually, two 5 mm trocars are necessary and inserted laterally at the umbilicus in the RIF and LIF. A diagnostic laparoscopy is started with the patient in a flat position. Subsequently a change in table positions (Trendelenburg, anti-Trendelenburg, right or left side up,etc) will allow us to explore all the abdominal cavity and related organs. Bowel clamps and atraumatic graspers are widely utilized to inspect the abdomen.

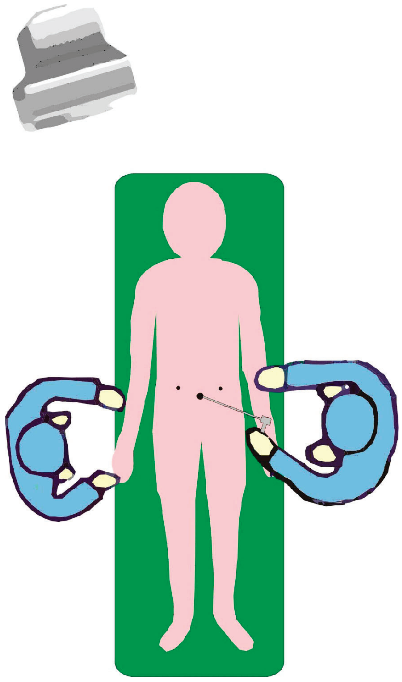

Figure 1

DL in acute abdomen:

- intra-abdominal pain, especially RIF pain in adult female
- Acute peritonitis where the origin is uncertain
- Stable penetrating trauma for diagnosis of peritoneal penetration
- suspected mesenteric ischemia

Access to the abdomen is more difficult and risky in cases of bowel dilatation and previous abdominal operations.

DIAGNOSTIC LAPAROSCOPY

Indications:
- Acute abdominal pain
- Chronic abdominal pain/pelvic pain
- Staging for malignancy
- Abdominal trauma
- Ascites
- Liver disease
- Infertility
- Evaluation of an abdominal mass
- Second look post treatment evaluation

Contraindications:
- Hemodynamic instability
- Known diaphragmatic hernia
- Obstruction with distended bowels (relative)
- Uncorrected coagulopathy (relative)
- Generalized peritonitis (relative)
- Severe cardiopulmonary disease (relative)
- Large hiatus hernia (relative)
- Abdominal wall infection (relative)

Preoperative Preparation:
- Routine blood tests
- Imaging modalities relative to the suspected pathology
- Therapeutic Antibiotics

Operating room setup

Instrumentation required
- Hasson's Trocar
- Veress Needle (Optional)
- 30 degree telescope 10 mm
- Atraumatic Graspers (2) 5mm
- Curved Maryland dissector (1) 5mm
- Curved Scissors (1) 5mm
- Suction/Irrigation device
- Aspiration needle

Patient Position
- Standard supine position (Figure 2)

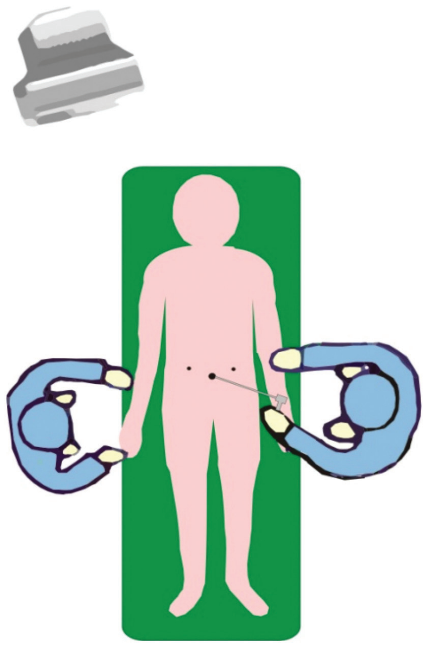

Figure 2

DIAGNOSTIC LAPAROSCOPY

Trocar size and position

- 10 mm trocar (1)
- 5 mm trocar (2)
- 10mm port is inserted below the umbilicus using the open technique
- Initially a 5 mm port is placed lateral in the right or left lower quadrant

Surgical Technique

1. Under general anesthesia, the pneumoperitoneum is created using an umbilical access, preferably an open entry technique using the Hasson's or and optical trocar. The 30 degree telescope is then inserted and an initial exploration of the abdominal cavity is performed.
2. Usually, two 5 mm trocars are necessary and inserted laterally at the umbilicus in the right and left lower quadrant.
3. A diagnostic laparoscopy is started with the patient in a flat position. Subsequently changes in table positions (head up, head down, right or left side up) will allow exploration of the whole abdominal cavity and related organs. Bowel clamps and atraumatic graspers are widely utilized to inspect the abdomen.
4. Adhesions should be taken down to expose the area of interest
5. A routine order of areas to be explored will ensure complete exploration.

When to convert

1. Complication not amenable to laparoscopic control or repair
   - Massive bleeding
   - Complex enterotomies
   - Ureter injury
   - Other organ injury that cannot be assessed properly
2. Instrumentation problems
   - Inappropriate angulation of instruments
   - Obese patients with trocar and instrument length problems
3. Lack of visualization
   - Anatomic details unclear
   - Exposure difficulties
   - Bloody field

DIAGNOSTIC LAPAROSCOPY

Post Operative Care

- Standard Analgesia as required
- Regular diet as tolerated
- Discharge the patient when comfortable and able to drink, eat and walk
- Return to normal activities when tolerated and usually after 2-3 days

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LAPAROSCOPY SUTURING

SSL Chew

Laparoscopic suturing is the ultimate skill desired by most laparoscopic surgeons as it is considered the most difficult to master and teach. Laparoscopic suturing skills are also indispensable in many advanced endoscopic procedures eg. total laparoscopic hysterectomy, laparoscopic Burch Colposuspension, laparoscopic bowel and bladder repair etc.

During the courses conducted at our centre, we will demonstrate the various steps and techniques essential for successful laparoscopic suturing. Fundamental issues covered will include the following:

1. The proper location and positioning of port sites for optimal endoscopic suturing.
2. The proper handling technique for laparoscopic needle holders and the common mistakes committed.
3. We recommend our trainees master the use of curved needles because of their versatility as well as their widespread availability.
4. The various techniques of needle introduction as well as safe needle removal will be covered.
5. Once the needle has been safely introduced into the peritoneal cavity, these must then be correctly loaded in the needle holder before any endoscopic suturing can begin. This step is crucial and is often overlooked by our trainees who are often more interested in tying endoscopic knots.
6. Once needle loading has been mastered, the next stage would be that of accurate needle placement during tissue repair. This, as well as principles of gentle tissue handling during laparoscopic suturing, will also be covered.
7. Endoscopic knot tying

There are basically 2 types of knots that are commonly used during laparoscopic suturing.

a. Intra-corporeal knots
   - These are knots which are tied entirely within the peritoneal cavity.
b. Extra-corporeal knots
   - These knots are tied outside the body and then 'slipped down" into the abdominal cavity to secure the tissue.

Both types of knots should be mastered and we recommend our trainees learn to tie and deploy the intra-corporeal surgeons knot as well as the extra-corporeal Weston knot.

LAPAROSCOPY SUTURING

Tying the Weston Knot

1. Creating the First Half Hitch

   The first half hitch is formed by tying the right (pink) strand over the left blue strand as shown in Figure 1. The surgeon then places his finger (arrow) in the loop formed by the right strand (Figure 1). Notice that the assistant's finger (A) is also positioned over the trocar opening during knot tying. This is will help to keep the 2 suture limbs apart while the surgeon forms his slip knot. In addition, the surgeon may also choose to use a small artery forceps to help him manipulate the sutures during knot tying.

2. Round and Round again

   The right end suture is then wound around the two suture limbs according to the following sequence :

   a. Over Right

      The right end of the suture is first wound over (arrow) the right (pink) limb (Figure 1).

   b. Under Right

      The right end then passes between the two suture limbs and winds itself over (arrow) the left (blue) suture strand (Figure 2)

   c. Under Right

      The right end now passes under (arrow) the right (pink) limb as shown in Figure 3.

3. Into the Loop again

   Next, the right suture limb (pink) is passed into the loop (arrow, Figure 4) and the sutures tightened. The completed Weston knot (Figure 5) is now ready to be passed or slided down.

4. To lock the knot, pull the links in opposite directions. (Figure 6)

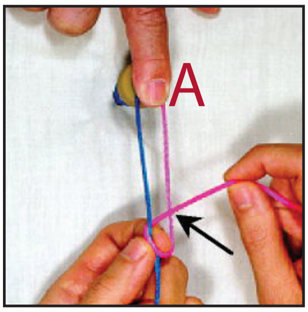

Figure 1

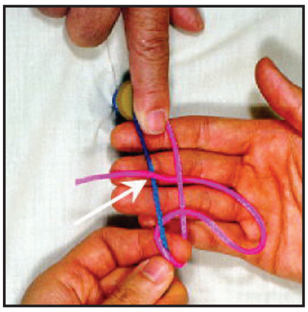
Figure 2

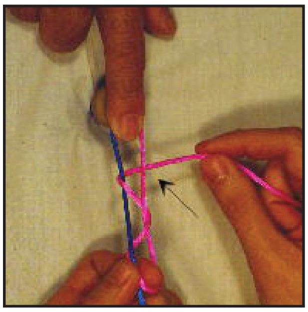
Figure 3

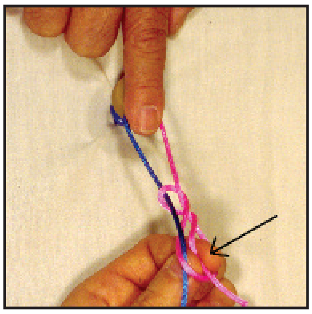
Figure 4

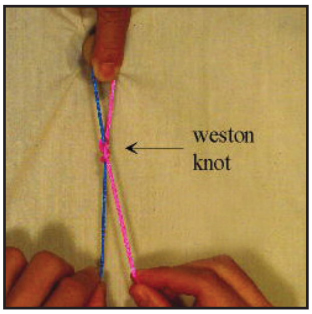

Figure 5

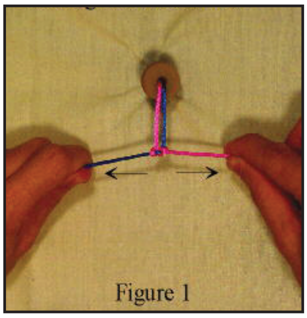

Figure 6

LAPAROSCOPY SUTURING

Tying the Intra-Corporeal Surgeons Knot

In Figure 1, the suture has been passed through the simulated tissue from left to right. Note that the long end is held by the right needle holder (RNH) which creates a 'C' shape. The Left Needle holder (LNH) is getting ready to execute the twirling motion.

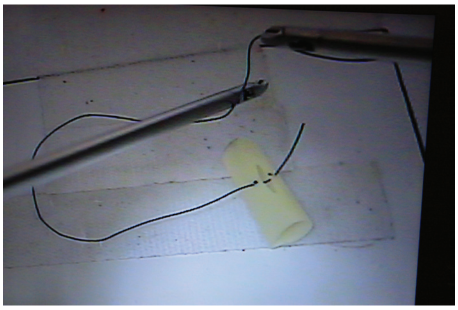

Figure 1

In Figure 2, the LNH has formed 2 throws as indicated by the two white arrows in Figure 2.

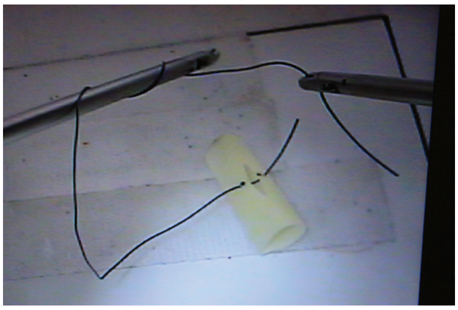

Figure 2

The LNH is then used to grasp the short end (Figure 3) of the suture and pulls this through to tighten the first 'double' throw knot (Figure 4)

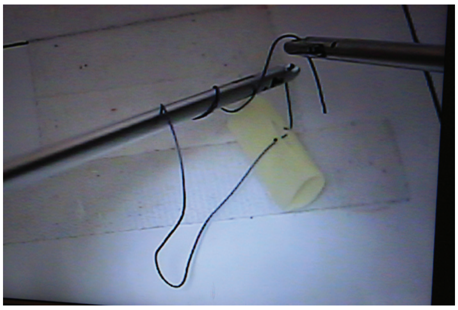

Figure 3

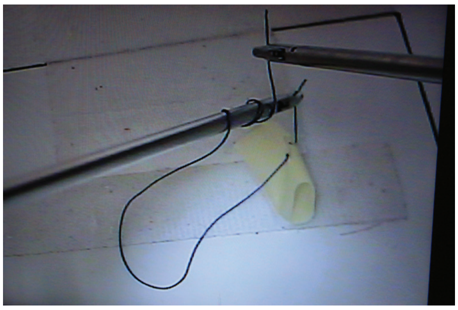

Figure 4

LAPAROSCOPY SUTURING

In Figure 5, the long end is now being held by the LNH to automatically create a 'reverse C' configuration. Notice the RNH preparing to execute the next twirling action.

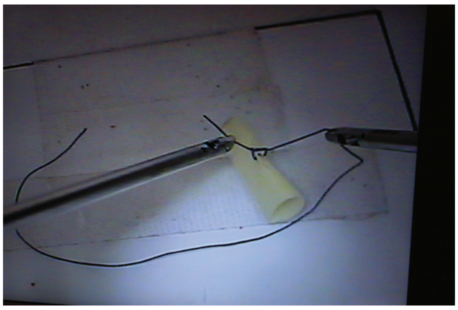

Figure 5

In Figure 6, the RNH has successfully formed a single throw as indicated by the arrow

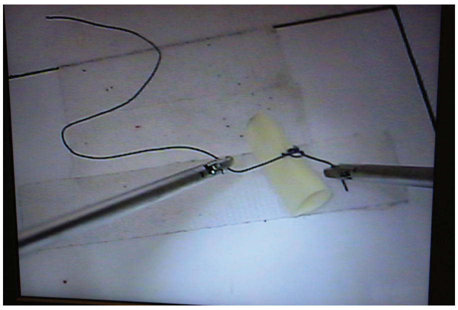

Figure 6

The RNH then proceeds to grasp the short end as shown in Figure 7

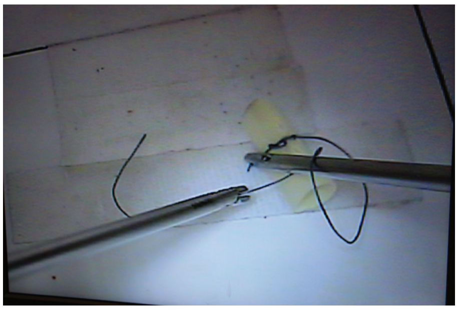

Figure 7

Finally in Figure 8, both needle holders are used to tight and secure the intra-corporeal surgeons knot.

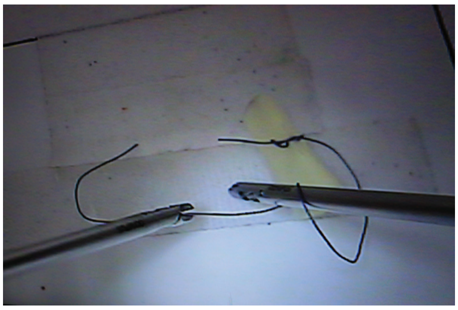

Figure 8

LAPAROSCOPY SUTURING

Through the years, I have encountered much difficulty in trying to teach endoscopic knot tying using drawings or diagrams because laparoscopic knot tying is very much a 3-dimensional activity in motion!

Therefore, the actual technique of tying the intra-corporeal surgeon's knot will be demonstrated during our course using live video clips and colour footage. We will also highlight the common difficulties encountered as well as the usual mistakes we all make as beginners.

Suggested Readings:

1. Stephen Chew , Lan Chomicki, Arnaud Wattiez. Basic Laparoscopic techniques and Advanced Endoscopic Suturing. World Scientific 2001
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LAPAROSCOPIC DRAINAGE OF HEPATIC CYST AND ABSCESS

J Lopez-Gutierrez

The most common is the congenital cyst. True hepatic cysts are classified as simple (solitary or multiple), polycystic, hydatid and cystic neoplasm. Most of them are asymptomatic and detected incidentally.

The advancement of imaging techniques has improved diagnostic capabilities. Symptoms is directly related to size and manifested as:

- Pain
- Nausea
- Vomiting
- Early satiety
- Obstructive jaundice

The treatment modalities include percutaneous drainage, hepatic resection and surgical unroofing or fenestration. Laparoscopic approach is now considered as a valid option.

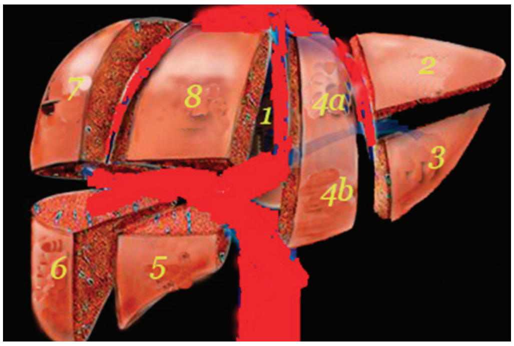
Simple Cysts

Usually congenital malformations that result from failure of the intralobular ducts to involute or connect to the extrahepatic bile ducts which results in fluid accumulation. They have no communication with the billiary tree and are histologically characterized as simple cuboidal epithelium. These lining cells are uniform with no evidence of atypia. Can be solitary or multiple, lacking true septations, but membranes can be seen within them, that actually are residual bridges of bile ducts and vessels remaining from atrophied liver. The fluid is most often clear but may be bilious, cloudy or bloody. Sonographically, they are totally anechoic, well circumscribed and have sharp, smooth borders. Strong posterior wall echoes indicate a well-defined tissue-fluid interface. CT scan shows a well circumscribed lesion while MRI gives off an extremely bright lesion which is consistent with fluid.

The indications for treatment is based on the presence and intensity of symptoms. When nonspecific upper abdominal symptoms are present, care must be taken to ensure that the symptoms are due to the cyst, particularly when the cyst is small and not adjacent to the liver surface. Cyst aspiration results in recurrence in most cases. Instillation of ethanol or other sclerotic agents can reduce the recurrence rate but can be associated with complications. The symptomatic cysts are most often optimally managed with surgical therapy, consisting in excision and unroofing.

Laparoscopic approach to simple hepatic cyst

The laparoscopic approach is indicated for large superficial cysts located in segments 3, 4, 5 and 6.

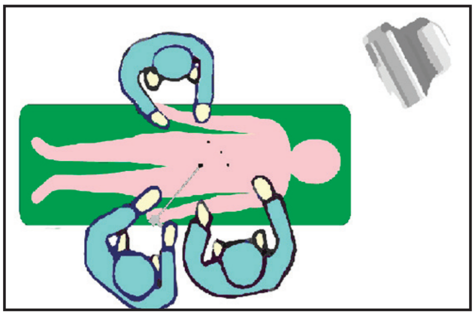


Cysts located in the superior and posterior right liver or in deeper locations are more difficult to access laparoscopically. Patients with previous upper abdominal operations and/or dense adhesions, or recurrent symptomatic cysts and an unclear diagnosis should be considered for open procedure.

LAPAROSCOPIC DRAINAGE OF HEPATIC CYST AND ABSCESS

The position of the trocars depends on the location and size of the cyst. After diagnostic laparoscopy is performed, the cyst is examined to assess its nature, external component and extent. Laparoscopic ultrasound (LUS) may be useful. Any evidence of septations or papillary projections should arise suspicion of cystic neoplasm, and conversion should be considered. LUS may also identify the hepatic vascular anatomy.

Surgical technique



- Diagnostic laparoscopy and laparoscopic ultrasound to assess the size and nature of the cyst
- Insertion of the sub xiphoid trocar of 5 to 10 mm
- Insertion of one or two 5 mm subcostal trocars.
- Cyst aspiration with needle
- Entering the cyst with electrocautery or scissors prior to aspiration of the fluid contents.
- Opening and examination of the cyst cavity
- Excision of a generous portion of the cyst wall with ultrasonic shears.
- Intraoperative histologic confirmation (highly advised).
- Running suture, or laparoscopic staplers in case of bleeding on the cyst's edge.
- Reassessment of the remaining wall to identify any bleeding or bile leaks.
- Omentum may be placed within the residual cavity (for less than 50% of surface area excised) to reduce the risk of recurrence.
- Cholecystectomy is advisable if there are stones, to avoid returning to the same operative field.
- Drainage placement into the cavity of the residual cyst.

* When the omentum is placed on the residual cavity, it is dissected free of the transverse colon and adhesions, and is placed within the residual cavity without tension, and can be fixed with sutures or clips.

Polycystic liver disease

Frequently renal cysts (as well as polycystic kidney disease) precede hepatic cysts. Symptoms usually present in adults, and can be merely vague complaints of abdominal pain to severe pain, obstructive jaundice, massive hepatomegaly, bleeding from varices and sepsis. The progress of the disease is slow, and liver function usually remains preserved. The surgical treatment is palliative, since almost 100% of the patients recur. The surgical options include aspiration, fenestration, and liver transplantation. Cyst expansion is controlled by pressure of the surrounding structures. Superficial cyst decompression can lead to unrestrained expansion of deep-seated cysts. Laparoscopic excision may be indicated when there are relatively few large superficial cysts located in the anterior segments, an technique is similar to the one described in the previous pages.

LAPAROSCOPIC DRAINAGE OF HEPATIC CYST AND ABSCESS

Complications of laparoscopic hepatic cystectomy

The main complications are:

- Bleeding.
- Ascities.
- Pleural effusion.
- Biloma.

Morbidity can be up to 21% manifested as infection, hemorrhage and trocar-induced bowel perforation. The recurrence rate of laparoscopic unroofing ranges from 0 to 23%.

Liver abscess

At the moment, the gold standard to treat liver abscess is the radiology guided percutaneous drainage. The abscess can be identified as a protuberance over the liver surface, the presence of adherences or fibrin between liver and parietal peritoneum, and a change of color in the hepatic surface. Not all the abscesses are suitable for percutaneous drainage.

The indications of surgical drainage are: Medical failure

- Imminent rupture
- Ruptured abscess
- Concomitant abdominal pathology requiring surgical treatment.
- Size of abscess (more than 10 cm in diameter).
- Multiple abscesses.
- Multilobulated abscesses.
- Failure of percutaneous drainage
- Contraindication to percutaneous drainage
  - ascites, proximity to vital structures, left lobe location

Surgical approach:

- 10-12mm transumbilical trocar
- 5-10mm subxiphoid trocar
- 5 mm trocar subcostal at mid-clavicular line
- 5mm trocar at mid-axillary line.
- diagnostic laparoscopy.
- puncture and suction of contents
- closed drainage in abscess cavity

The advantages of the laparoscopic drainage are earlier ambulation, oral intake and recovery

LAPAROSCOPIC DRAINAGE OF HEPATIC CYST AND ABSCESS

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LAPAROSCOPIC SURGERY IN ACUTE ABDOMEN

D Lomanto, A Lee-Ong

Evaluation of acute abdominal pain

Evaluation of acute abdominal pain can be at times challenging despite the aid of modern radiology. This may result in an inappropriate delay in providing proper surgical treatment or, at the other end of the spectrum, an unnecessary exploratory laparotomy. Negative laparotomy is painful, with morbidity rate of 5% to 22% and is not cost-effective. Most surgeons face a diagnostic dilemma in evaluating lower abdominal or right iliac fossa pain in premenopausal women in whom gynecologic causes are a part of differential diagnosis. Sugerbaker et al proposed the use of preoperative diagnostic laparoscopy (DL) in the diagnosis of acute abdominal pain in 1975. Diagnostic laparoscopy has the potential advantage of excluding or confirming the diagnosis of acute intra-abdominal disorders expeditiously without performing a laparotomy.

Laparoscopy for Suspected Intraabdominal Sepsis

Geis et al. published series of 154 patients who underwent laparoscopy under general anesthesia in the operating room for suspected inraabdominal sepsis. Only one abscess was not identified at laparoscopy. One hundred and forty-nine patients (96%) were treated successfully using the laparoscopic approach and only five patients' required formal laparotomy. The diagnostic and therapeutic versatility of the laparoscopic approach avoids extensive preoperative diagnostic studies, averts delays in operative intervention, and appears to minimize morbidity and shorten the postoperative hospitalization. It may be argued that the ready availability of interventional radiologic means to achieve the same limits the use of laparoscopy. Nevertheless, laparoscopy is a valuable tool for those institutions in which such expertise is not readily present.

Laparoscopy in the ICU

Intensive care unit (ICU) patients are at increased risk of developing a number of acute intra-abdominal pathologies such as acalculous or calculous cholecystitis, large bowel perforation, duodenal and gastric perforation, intestinal ischemia, pancreatitis, bowel obstruction, and intra-abdominal hemorrhage. The presence of multiple organ pathologies in these patients, ambiguities in the physical examination, and equivocal results of conventional diagnostic modalities may cause diagnostic dilemma. This may lead to an unwarranted nontherapeutic laparotomy, increasing the mortality and morbidity in these patients, or an unacceptable delay in the provision of appropriate surgical care. Diagnostic laparoscopy is a viable safe and accurate tool for managing critically ill patients in an ICU in whom there is a question of a life-threatening abdominal condition. David Brooks has aptly summarized the advantages and disadvantages of bedside laparoscopy in ICU patients. The advantages included (1) avoiding transportation of critically ill patients; (2) rapid establishment of the correct diagnosis; and (3) avoiding unnecessary ancillary tests. However, DL is an invasive procedure that needs expertise and great patience, carries a small but definite morbidity, requires significant material and financial resources, and carries a low sensitivity for intestinal or retroperitoneal diseases. However bedside laparoscopy represents an important armamentarium the management of critically ill ICU patients.

LAPAROSCOPIC SURGERY IN ACUTE ABDOMEN

Laparoscopy in Small bowel Intestinal Obstruction

The sine qua non of treatment of acute small bowel obstruction is to intervene before gangrenous bowel develops. Clinically it can be difficult to unequivocally distinguish a complete from a partial small bowel obstruction. Diagnostic laparoscopy can be helpful in this situation.

Points to remember:

1. Initial entry must be with open technique
2. Enter away from the scar of previous surgery
3. Atraumatic instruments must be used when manipulating distended bowel
4. In the presence of gross bowel distension convert!

Criteria that can be used to select patients for laparoscopic management of small bowel obstruction:

1. Mild abdominal distention, allowing adequate room for visualization
2. Proximal obstruction
3. A partial obstruction
4. An anticipated simple, "single band" obstruction
5. An obstruction that readily improves with nasogastric suction

Contraindications:

- Patients with matted adhesions
- Carcinomatosis and those who remain distended following nasogastric intubation
- Previous intraabdomianl sepsis

Following diagnostic laparoscopy the procedure may be converted to:

- Therapeutic laparoscopy e. g division of adhesion band
- Laparoscopy assisted procedure e.g. bowel resection
- Open laparotomy

Suspected Acute Appendicitis

Recent evidence suggests laparoscopic appendectomy has lesser pain, faster recovery and lower incidence of post-operative wound infection. However there seems to be a trend toward higher intraabdominal absceses (though not statistically significant). A policy of early diagnostic laparoscopy in patients with suspected appendicitis decreases the risk of appendiceal perforation but also improves the diagnostic accuracy and reduces the number of negative appendectomies. It provides the surgeon with a tool not only to rule out appendicitis but also to inspect other organs simultaneously to determine the real cause of the patient's symptoms. The two important groups of patients who benefit most from diagnostic laparoscopy are (1) premenopausal women, in whom the differential diagnosis with gynecologic conditions can be difficult, and (2) obese individuals, in whom a large laparotomy incision might be required to perform a conventional appendectomy or to allow a thorough inspection of the abdominal contents. At

LAPAROSCOPIC SURGERY IN ACUTE ABDOMEN

times laparoscopic assisted approach may be used, to accurately place the incision. The disadvantages of a laparoscopic approach include complications related to the laparoscopy such as bowel, bladder, and vascular injuries, increased cost because of the expensive equipment needs, and longer operating time, though these can be reduced with better training, credentialing and experience. The issue of increased cost remains though it may be argued that earlier return to activity may offset the higher cost.

Laparoscopy in Perforated Peptic Ulcer

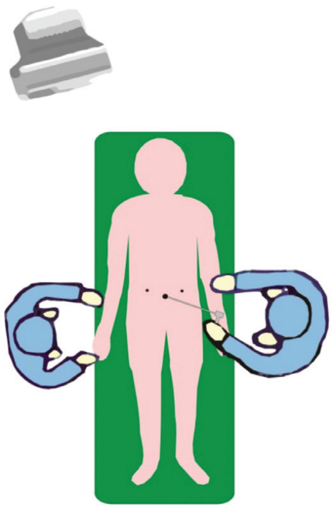
Perforated peptic ulcer requires early recognition and prompt management because delay in the diagnosis translates to higher morbidity and mortality. Early diagnostic laparoscopy can determine the type of fluid present along with food debris and can locate the site of perforation in the majority of cases. However, some controversy remains regarding the efficacy of a laparoscopic repair of a perforated peptic ulcer following a significant delay in the diagnosis as delay leads to inflammatory changes, which make the repair difficult and hazardous.

Laparoscopic repair of a perforated duodenal ulcer can be achieved by simple suture closure, omental patch, use of fibrin glue, placement of an oxidized cellulose sponge, falciform ligament patch, or ligamentum teres patch. Many studies have shown a decreased need for analgesia requirements in the postoperative period but no benefit in terms of the length of hospital stay, time to resume normal diet, visual analogue pain score in the first 24 hours, or early return to normal activity could be demonstrated. However, large, well-controlled prospective randomized trials are required to ascertain the exact role for the laparoscopic approach.

Techniques

After a laparoscopic examination, the peritoneal fluid was aspirated for bacteriological examination. A single stitch (3/0 vicryl) was applied with a bite of healthy tissue taken longitudinally across the perforation. A surgeon’s knot was made intracorporeally. After completion of three throws, a bite was made to a piece of healthy omentum and a surgeons knot was secured again. A thorough peritoneal lavage was then carried out.

Patient and ports position (Figure 1)



LAPAROSCOPIC SURGERY IN ACUTE ABDOMEN

Laparoscopy and Emergency Groin Hernia Repair

Irreducible or obstructed hernias need to be tackled by and open approach. However in a subset of patients in whom the bowel has spontaneously reduced and the viability of bowel is in question, a diagnostic laparoscopy may be done and if bowel is viable an intraperitoneal onlay mesh (IPOM) or trans-abdominal Pre-peritoneal repair (TAPP) may afford definitive treatment. Alternatively a laparoscope may be passed though the hernia sac to assess the viability at an open operation.

Laparoscopy and Acute abdomen in Pregnancy

Unfortunately, urgent surgical intervention in the gravid patient is occasionally necessary. The two most common situations encountered by the general surgeon are acute appendicitis and acute cholecystitis. Delayed diagnosis and resultant appendiceal rupture may have dire fetal and maternal consequences. Acute cholecystitis leads to surgical intervention less frequently but despite the effectiveness of non-operative care, pregnant patients with symptomatic gallstones have a high rate of recurrent symptoms. Nearly 70% of patients with gallstone pancreatitis will have recurrent biliary pain usually requiring hospitalization.

Potential advantages of laparoscopic appendectomy and cholecystectomy in the pregnant patient include decreased fetal depression due to lessened postoperative narcotic requirements, lower risks of wound complications and diminished postoperative maternal hypoventilation, possible rapid maternal recovery. The risks include uterine injury during Veress needle and/or trocar placement (hence open technique is recommended), decreased uterine blood flow or premature labor from the increased intra-abdominal pressure, and increased fetal acidosis or other unknown long term effects due to CO2 pneumoperitoneum.

Society of American Gastrointestinal Endoscopic Surgeons (SAGES) recommendations for laparoscopy in pregnancy:

1. Obstetrical consultation should be obtained preoperatively.
2. When possible, operative intervention should be deferred until the second trimester, when fetal risk is lowest.
3. Pneumoperitoneum enhances lower extremity venous stasis already present in the gravid patient and pregnancy induces a hypercoagulable state. Therefore pneumatic compression devices should be utilized whenever possible.
4. Fetal and uterine status, as well as maternal end tidal CO2 and/or arterial blood gases, should be monitored.
5. The uterus should be protected with a lead shield if intraoperative cholangiography is a possibility. Fluoroscopy should be utilized selectively.
6. Given the enlarged gravid uterus, abdominal access should be attained using an open technique.
7. Dependent positioning should be utilized to shift the uterus off of the inferior vena cava.
8. Pneumoperitoneum pressures should be minimized (to 8 - 12 mm Hg) and not allowed to exceed 15 mmHg.

LAPAROSCOPIC SURGERY IN ACUTE ABDOMEN

Summary

Laparoscopy should be incorporated into the general surgeon's armamentarium for the management of patients with abdominal pain as just another tool to be used selectively when indicated. It is also important that laparoscopy in increasingly new settings be carefully evaluated and judiciously used with strict protocols to obtain objective data. Only then new guidelines will be put forth for safe and effective use of new devices.

Suggested Readings:

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LAPAROSCOPIC SURGERY IN TRAUMA

J Lopez-Gutierrez

Despite the reluctance of several groups of surgeons to incorporate laparoscopy in the management of trauma, the number of papers published on this matter increases day by day. To employ laparoscopy successfully and safely, surgeons need to have the skill and maintain focus on the care of the trauma patient. The primary survey still holds true for immediate and life-threatening injuries, followed by a more complete secondary survey. In a hemodynamically stable patient, the evaluation of the abdomen becomes of paramount importance. The shortcomings of the current diagnostic tests, in combination with the increasing potential to repair and treat abdominal injury with laparoscopic surgery, have opened the door to trauma laparoscopy. Laparoscopy may be able to reduce the rate of negative laparotomies for blunt abdominal trauma.

Indications:

- CT scan of the abdomen
  - free fluid without solid organ injury – Identifies the source of the free fluid, and may allow repairing the injuries
  - suspicious diaphragmatic injury
  - suspicious hollow viscus injury (free air, fluid, thickening of bowel wall, mesenteric stranding)
    - Laparoscopy is the gold standard for confirming the diagnosis, recognizing any associated injuries and allowing their repair
  - solid organ (spleen and liver) injury with decreasing hemoglobin and hematocrit on a HEMODYNAMICALLY STABLE patient
- Penetrating thoracoabdominal trauma – Identifies the presence or absence of peritoneal penetration, detect diaphragmatic injury, reduce the rate of negative and non-therapeutic laparotomies
- Hemodynamically stable patients with gunshot wounds – to confirm penetration.
- Hemodynamically stable patients with stab wounds.

Contraindications :

- Moderate to severe head injury.
- Morbid obesity – Relative contraindication.
- Previous, multiple abdominal operations.
- Patients with obvious peritonitis.
- Hemodynamic instability:
  1. The operating room setup should be less than 15 minutes, and in the case of laparoscopic surgery, this time considerably increases.
  2. There is a need of time to establish the pneumoperitoneum and trocar setup.
  3. Peritoneal insufflation by itself may exaggerate the hypotension.
  4. When vascular injuries are present, there is a potential risk of air embolism.

Complications:

- Increased intracranial pressure
- Tension pneumothorax
- CO_2 embolism

LAPAROSCOPIC SURGERY IN TRAUMA

Preoperative Preparation:

- Primary survey – To rule out immediate life threatening injuries
- Secondary survey
- Evaluation of the abdomen (stable patients)
  - CT scan – Non invasive, permits the evaluation of the retroperitoneum, may evaluate the diaphragm, grades of intra-abdominal organ injury.
  - Unstable patient FAST (Focused Abdominal Sonography in Trauma) or DPL (Diagnostic peritoneal lavage)

Preoperative Preparation

The patient must be secured to the operating table with straps on the feet, legs and thighs and a foot-board setup. Rolls should be placed under the knees. Arm(s) should be tucked at the patient's side. One extremity (usually right arm) should be abducted for intravenous and arterial access.

OT Setup

Two monitors should be placed at the head of the bed, for the surgeon and the assistant. The surgeon and assistant should begin the procedure standing at the patient's left side.

Equipment: Instruments for advanced laparoscopic surgery, electrocautery unit, ultrasonic scalpel and generator, 5 and 10 mm 30° laparoscopes, laparotomy instruments OPEN on side table, suction-irrigation equipment, and cell saver.

Patient's position and Trocars Placement

Supine position. After the initial assessment, rotation of the operating room table, and Trendelenburg and reverse Trandelenburg's position can be helpful to perform a complete laparoscopy.

The trocar placement should be flexible, according to the findings of the initial laparoscopic exploration. However, in the absence of obvious injuries, initially a transumbilical port of 10 mm should be placed for the laparoscope. Two 5 mm port on the left mid clavicular line, one on the hipocondrium and one on the iliac fossae.

If the injury suspected by preoperative image is confirmed by the initial laparoscopy, then port placement should be triangulated for inspection and repair of that injury. Initial ports should be 5 mm in diameter, and their size can be increased as necessitated by the injuries and the intervention required.

In the case of segmental bowel repair, or resection and anastomosis, the simplest method is exteriorization through a limited mid line incision. Also in this case, as in the case of splenectomy/splenorrhaphy, a hand assist device may be placed to facilitate the procedure.

LAPAROSCOPIC SURGERY IN TRAUMA

Surgical Technique (narrative)

Insertion of the first port at the umbilicus, using a 10 or 12 mm trocar. Use the lowest possible insufflations pressure. However, up to 15 mmHg may be used if needed keeping in mind that it can induce hypotension in an under-resuscitated patient. If hypotension is not encountered, an initial survey should be performed to identify obvious hemorrhage or source of injury: liver, spleen, anterior wall of the stomach, small bowel and mesentery, colon, pelvic fluid, pelvic hematoma. If no obvious lesion is identified, ports should be placed to allow efficient laparoscopic exploration. Initially, working clockwise, inspect the right upper quadrant and left upper quadrant with the patient in reverse Trendelenburg's position inspect:

1. Gallbladder, liver and right hemidiaphragm.
2. Retroperitoneum over the second portion of the duodenum.
3. Anterior wall of the stomach, left hemidiaphragm and spleen.
4. Divide a portion of the gastrocolic omentum for inspection of the lesser sac for blood or hematoma.

After this, change the patient in the Trendelenburg's position, identify the ileocecal junction and run the small bowel to the ligament of Treitz, inspect the right and left iliac fossae: visible portions of colon; ascending, descending and sigmoid. Inspect and evacuate any fluid pooling in the pelvis. Treat injuries or convert to laparotomy as necessary.

When to Convert:

- In the case of an uncontrollable hemorrhage.
- The presence of massive hemoperitoneum (massive $\geq$1 Lt).
- In the case of hypotension following pneumoperitoneum.
- Complex bowel injuries

Post-operative Care

In general, this management is no different than that of the trauma patient following laparotomy. If there is a delay in recovery or any deterioration in the patient's condition, this should make us think of the possibility of a missed or iatrogenic injury, which should be repaired as soon as possible, either laparoscopically or open.

LAPAROSCOPIC SURGERY IN TRAUMA

Suggested Readings:

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LAPAROSCOPIC SURGERY IN PREGNANCY

D Lomanto, M Fuentes

Unfortunately, urgent surgical intervention in the gravid patient is occasionally necessary. The two most common situations encountered by the general surgeon are acute appendicitis and acute cholecystitis.

Delayed diagnosis and resultant appendiceal rupture may have direct fetal and maternal consequences. Acute cholecystitis leads to surgical intervention less frequently but despite the effectiveness of non-operative care, pregnant patients with symptomatic gallstones have a high rate of recurrent symptoms. Nearly 70% of patients with gallstone pancreatitis will have recurrent biliary pain usually requiring hospitalization.

Potential advantages of laparoscopic appendectomy and cholecystectomy in the pregnant patient include decreased fetal depression due to less postoperative narcotic requirements, lower risks of wound complications, diminished postoperative maternal hypoventilation, and possible rapid maternal recovery.

The risks include uterine injury during Veress needle and/or trocar placement (hence open technique is recommended), decreased uterine blood flow or premature labor from the increased intra-abdominal pressure, and increased fetal acidosis or other unknown long term effects of CO_2 during insufflation.

Society of American Gastrointestinal Endoscopic Surgeons (SAGES) recommendations for laparoscopy in pregnancy:

1. Obstetrical consultation should be obtained preoperatively.
2. When possible, operative intervention should be deferred until the second trimester, when fetal risk is lowest.
3. Pneumoperitoneum enhances lower extremity venous stasis already present in the gravid patient and pregnancy induces a hypercoagulable state. Therefore pneumatic compression devices should be utilized whenever possible.
4. Fetal and uterine status, as well as maternal end tidal CO_2 and/or arterial blood gases, should be monitored.
5. The uterus should be protected with a lead shield if intraoperative cholangiography is a possibility. Fluoroscopy should be utilized selectively.
6. Given the enlarged gravid uterus, abdominal access should be attained using an open technique.
7. Dependent positioning should be utilized to shift the uterus off of the inferior vena cava.
8. Pneumoperitoneum pressures should be minimized (to 8 - 12 mm Hg) and not allowed to exceed 15 mmHg.

Summary: Laparoscopy should be incorporated into the general surgeon's armamentarium for the management of patients with abdominal pain as just another tool to be used selectively when indicated. It is also important that laparoscopy in increasingly new settings be carefully evaluated and judiciously used with strict protocols to obtain objective data. Only then new guidelines will be put forth for safe and effective use of new devices.

LAPAROSCOPIC APPENDECTOMY

M Lawenko

Appendectomy is one of the most frequently performed surgical procedures in general surgery. Today, in developed countries, about 8% of the population has had their appendix removed for acute appendicitis at some point during their lifetime. Laparoscopic appendectomy (LA) has been practiced since Kurt Semm from Switzerland performed the first laparoscopic appendectomy in 1980 but the method has not achieved as great appreciation as laparoscopic cholecystectomy.

Indications:

- Virtually any patient with suspected appendicitis can undergo Laparoscopic appendicitis

Contraindications:

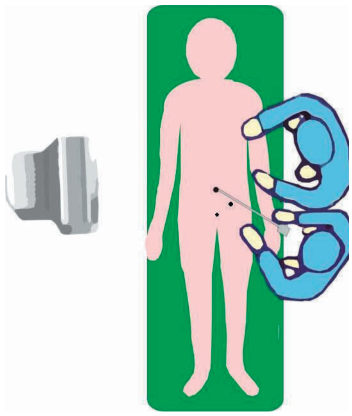
- severely septic with generalized peritonitis
- previous lower abdominal operations
- severe lung disease
- women in the advanced stage of pregnancy

Preoperative preparation:

- adequate menstrual history
- pregnancy test
- full blood count
- adequate intravenous hydration
- prophylactic intravenous antibiotics with coverage for gram negative and anaerobes
- informed consent with the potential to convert to an open procedure

Patient and trocar positions (see Figure):

- supine position
- 15 degree Trendelenburg position with the right side up
- surgeon stands on the patients left side
- first assistant stands on the surgeon's right
- monitor is on the patient's right side
- 10mm port is placed thru the umbilicus using the open technique
- 5mm working port in the left lower quadrant position is then inserted
- 5mm port at suprapubic area (indwelling urinary catheter may reduce the chances of urinary bladder injury)



LAPAROSCOPIC APPENDECTOMY

Operative Techniques:

After the pneumoperitoneum is created, a diagnostic laparoscopy is done to exclude other pathologies. The appendix is lifted up with the left hand, mesoappendix is then divided with caution using various approaches like the bipolar cautery (Figure 1) clip applier or with ultrasonic energy. The base of appendix must be exposed completely. Ligation of the appendiceal base (Figure 2) is carried out with 3 pre-formed ligatures (Endoloop™, Johnson & Johnson, USA or Surgite, Covidien, USA). Alternative method suggested in case of severe acute inflamed or perforated appendix is the use of an articulated linear-cutter stapler (EchelonFlex™, Johnson & Johnson, USA or Endo-GIA II Guides, USA) using 4.5mm cartridge (blue) or using a 3.2mm vascular cartridge (white). The appendix is then divided with scissors (Figure 3) and removed from the peritoneal cavity with the use of a specimen retrieval bag. If a commercially available specimen retrieval bag is used, a 5mm scope is introduced into the left working port while the retrieval bag is manipulated through the 10 mm port. Peritoneal lavage could be carried out and hemostasis is ensured before ending the proceure. A closed suction drain can be inserted in case of perforated appendix or severe acute inflammation. The umbilical port is closed in layers to prevent hernia formation.

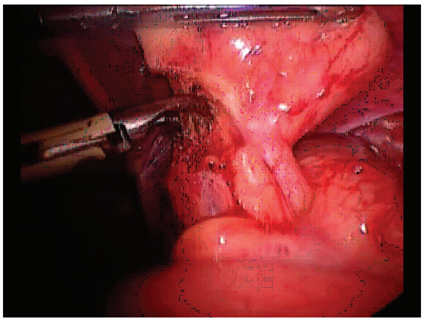


Figure 1: Bipolar cauterization of the appendiceal artery

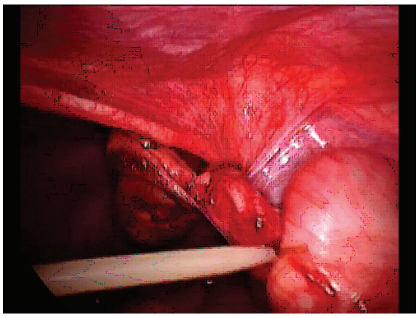


Figure 2: Ligation of the appendicular stump with Endoloop™

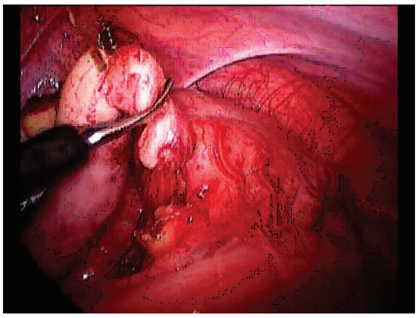


Figure 3: Transection of the appendicular stump

LAPAROSCOPIC APPENDECTOMY

Society of American Gastrointestinal Endoscopic Surgeons (SAGES) guidelines for laparosopic appendectomy

1. The indications for appendectomy are identical whether performed laparoscopically or open. (Level III, Grade A)
2. Laparoscopic appendectomy is a safe and effective method for treatment of uncomplicated appendicitis and may be used as an alternative to standard open appendectomy. (Level I, Grade A)
3. Laparoscopic appendectomy maybe performed safely in patients with perforated appendicitis and is possibly the preferred approach. (Level III, Grade C)
4. Laparoscopic approach for fertile women with presumed appendicitis should be the preferred method of treatment. (Level I, Grade A)
5. Laparoscopic approach maybe the preferred treatment in elderly patients (Level II, Grade B)
6. Laparoscopic appendectomy may be safely performed in pediatric patients.
7. Laparoscopic surgery may be performed safely in pregnant patients with suspicion of appendicitis. (Level II, Grade B)
8. Laparoscopic appendectomy is safe and effective in obese patients and maybe the preferred approach. (Level II, Grade B)
9. If no other pathology is identified, the decision to remove the appendix should be considered but based on the individual clinical scenario. (Level III, Grade A)
10. Developing a consistent operative method decreases costs, operating room time, and complications. (Level II, Grade B)

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LAPAROSCOPIC APPENDECTOMY

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LAPAROSCOPIC CHOLECYSTECTOMY AND BILE DUCT EXPLORATION

D Lomanto

Indications:

- Symptomatic gallbladder stones
- Suspicion of gallbladder and bile duct stones
- Acute cholecystitis

Contraindications:

- Coagulopathy (relative)
- Previous upper abdominal surgery (relative)
- Early pregnancy
- Unable to tolerate general anesthesia

Preoperative Preparation:

- Same day admission
- Routine blood test
- Ultrasound hepato-biliary
- Antibiotic prophylaxis

OT Setup , Patient's position and Trocars Placement:

- Monitor position
- Instrumentation required
    1. Veress needle (Optional)
    2. 30 degree telescope 10 mm and 5 mm
    3. Atraumatic graspers (2) 5 mm
    4. Curved Maryland dissector (1) 5mm
    5. Clip applier (1) 5mm
    6. Curved scissors (1) 5 mmz
    7. Hook diathermy (1) 5 mm
    8. Suction/irrigation device
    9. Specimen extraction bag
    10. Toothed grasper (optional)
    11. Aspiration needle (optional)
    12. Cholangiographic clamp (Olsen's clamp) (optional)
    13. Cholangiographic catheter (3-4 Fr) (optional)

LAPAROSCOPIC CHOLECYSTECTOMY AND BILE DUCT EXPLORATION

Patient Position:

- Standard supine position (Figure 1)
- Split legs (optional)
- After the insertion of the trocars the patient is head-up and right side-up positions

Trocars size and position *(see Figure 1)***:**

- 12 mm trocar (1)
- 5 mm trocars (3)
- 12 mm port inserted below the umbilical using open technique
- 5 mm port inserted 1 cm below and on the left of the subxiphoid process
- 5 mm port inserted right subcostal on the right mid-clavicular line (perpendicular at the cystic duct);
- 5 mm trocar inserted on the anterior axillary line (2 fingers breath below the right subcostal margin)

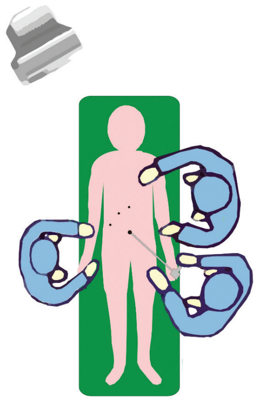

Figure 1

Surgical Technique

Cholecystectomy (retrograde):

1. After a 30 degree laparoscope is inserted through the umbilical port, a diagnostic laparoscopy is carried out. Then the 3 three other working trocars (5mm) were inserted under direct vision accordingly. All the trocars should be inserted under direct vision

2. Exposure of the gallbladder. The assistant surgeon using graspers, retracts the fundus of the gallbladder cranially to expose the Calot's area. The surgeon using a grasper on the left hand, retracts the neck of the gallbladder laterally in order to open up the peritoneum and the Calot's triangle (either anteriorly and posterior).

3. Dissection should start from the neck of gallbladder and proceed medially and laterally, by exposing the cystic duct- gallbladder junction's with lateral movement. The dissection can be made by blunt dissection or using a hook diathermy. It's recommended to spare the use of monopolar diathermy in this area, in order to prevent and avoid late ischemic injury of the extrahepatic structures.

4. Once the cystic artery and cystic duct were identified, the artery was then clipped and divided. Then, the both ends of cystic duct were clipped and the duct was divided.

5. Once the cystic duct and the artery are divided, the gallbladder is retracted away from the liver bed and slowly dissected from the liver bed using a scissors or a hook diathermy. Optimal aspiration and irrigation improved visual clarity, especially during difficult dissection. The gallbladder is then removed through the umbilical port using a retrieval bag and the wounds closed. Hemostasis is secured. A subhepatic suction drainage is positioned according to the surgeon's preference and it is usually inserted through the right lateral port.

LAPAROSCOPIC CHOLECYSTECTOMY AND BILE DUCT EXPLORATION

Bile Duct Exploration:

A. According to the indication and to the technique, if an intraoperative cholangiography is needed then it is performed at this point.

B. After clipped both cystic artery and cystic duct cranially without divide the structures, the infundibulum of the gallbladder is retracted using a grasper through the left subcostal access. A scissors (straight scissor is preferred) is inserted through the right subcostal port, to make a small cut on the anterior site of the cystic duct. The scissors is removed and cholangiographic clamp (Olsen clamp) is inserted through the same port. A 4 Fr uretheral catheter is inserted into the cholangiographic clamp and connected with a syringe and filled with saline to avoid artifact like air bubble. The 4 Fr. catheter is commonly utilized to cannulate the cystic duct and to inject the contrast agent. The duct is clamped to avoid the spillage of contrast medium during the cholangiography. A dynamic cholangiogram is performed to visualize either the biliary tree anatomy or eventually filling defect like stones. If the fluoroscopic imagine and the static radiographic films are normal the clamp is removed and the cystic duct is secured by clips and divided. If not a transcystic duct exploration of the biliary duct can be performed using a wire basket or choledocoscopy.

C. If the cholangiographic clamp is not available a disposable percutaneous cholangiographic catheter can be utilized and it is inserted through the abdominal wall at the level of the mid-clavicular line.

When to Convert:

- According to the surgical experience
- If the intraoperative progress is slow and time-consuming
- If the anatomy is unclear and undefined

Post-operative Care:

- Standard analgesia as required
- Regular diet as tolerated
- Discharge the patients when is comfortable and able to drink, eat and walk.
- Return to normal activities when tolerated and usually after 2-3 days

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LAPAROSCOPIC CHOLECYSTECTOMY AND BILE DUCT EXPLORATION

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ENDO-LAPAROSCOPIC INGUINAL HERNIA REPAIR

M Lawenko, D Lomanto

Endo-laparoscopic repair of inguinal hernia includes the totally extraperitoneal (TEP) repair of inguinal hernia which involves placement of a prosthetic mesh in the preperitoneal space and the transabdominal pre-peritoneal (TAPP) which enters the abdominal cavity to bring down the peritoneum for access to the pre-peritoneal space. Both have the objective of covering all potential hernial sites in the myopectineal orifice with a synthetic mesh. Both approaches offers postoperative benefits in terms of reduced pain, faster recovery, earlier return to work and normal activity with better long term comfort. The complication rate for laparoscopic repair of inguinal hernia ranges from less than 3% to as high as 20%.

Indications:
- A patient who is fit for general anesthesia

Contraindications:
- History of lower abdominal surgery
- Acute abdomen with strangulated and infected bowel
- Respiratory distress
- Pediatric patients
- Pregnancy

Preoperative preparation:
- Thorough history and physical examination
- Routine investigations as to hospital protocol for fitness to undergo general anesthesia
- Ultrasound or CT scan to those with a questionable diagnosis of a inguinal hernia
- Bladder decompression for bilateral inguinal hernias
- Stop warfarain 4 doses preoperatively
- Stop all NSAIDS and antiplatelets 7 days before surgery
- Prophylactic antibiotics because wound infection is a major risk factor for recurrence

Patient and trocar positions:
- Patient in supine position with both arms tucked by the side (Figure1)
- Surgeon stands on the opposite side of the defect
- Assistant is beside the surgeon at the cephalad part of the patient
- Video monitor is at the caudal part of the patient
- 10 mm vertical midline infraumbilical incsion for the Hasson's trocar
- 5mm working port 3 finger breadths above the symphysis pubis
- 5mm working port in between the 10mm port and the first 5 mm port

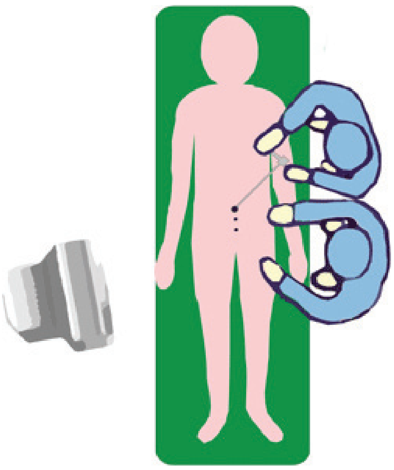

Figure 1: Patient's position

ENDO-LAPAROSCOPIC INGUINAL HERNIA REPAIR

Operative Techniques (TEP)

General anesthetic with muscle relaxation is administered. A 10mm, vertical, infraumbilical incision is made, the anterior rectus sheath is incised and the rectus muscle retracted laterally to expose the posterior rectus sheath. This plane is then maintained and a space is created inferiorly towards the symphysis pubis, using a gauze, a finger or a dissecting balloon. A Hasson's trocar is then introduced in this plane followed by the 30 degree scope to confirm the plane, which is subsequently insufflated with carbon dioxide gas at 8-10 mm Hg. This creation of the extraperitoneal space allows for laparoscopic dissection to take place. The preperitoneal space can be created using a balloon dissector. Two different models are in the market for unilateral (Figure. 2) or bilateral hernias (Figure 3). The device is very useful in the early stage of the learning curve and helps the surgeon to create a wide preperitoneal space without facing difficulties related to the narrow working area. Two 5-mm trocars are inserted under direct vision in the midline for placement of laparoscopic graspers (Figure 4). Care must be achieved so as to prevent injury to the bladder, peritoneum or bowels. The pre-peritoneal space must be clearly defined, starting with the pubic arch and symphysis in the midline. The bladder should be gently dissected off the pubis and rectus muscle superolaterally (Figure 5a, b). The medial dissection is done in the zone in between the inferior epigastric vessels on either side, allowing adequate contralateral dissection. The ipsilateral set of inferior epigastric vessels is reflected upwards (anteriorly) with the help of one 5 mm blunt dissector, while the other dissector opens up the plane laterally. The lateral dissection (Bogros space) is done beyond the anterior superior iliac spine, all the way up to the psoas muscle inferolaterally, thereby exposing the nerves in the "lateral triangle of pain". Once dissection is complete the anatomical landmarks are clearly visualized. These are the pubic bone, Cooper's ligament, spermatic cord, inferior epigastric vessles (IEV) running superiorly and the type of hernia in relation to it (direct hernia medial to IEV, indirect and femoral hernia lateral to IEV).

Upon identifying all the potential hernial sacs in the myopectenial orifice, the next step is to reduce the hernia sac from the inguinal wall. An indirect hernia sac must be carefully separated from the spermatic cord and its contents. If a lipoma of the cord is present, it must be meticulously dissected to prevent any recurrence. Occasionally, a long indirect sac cannot be completely reduced from the deep inguinal ring; in such cases the sac can be divided and the peritoneal side ligated (using a pre-made absorbable loop).

Figure 2

Figure 3

Figure 4

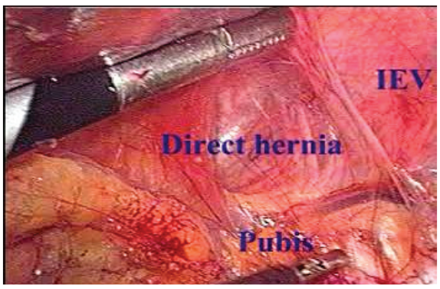

Figure 5a

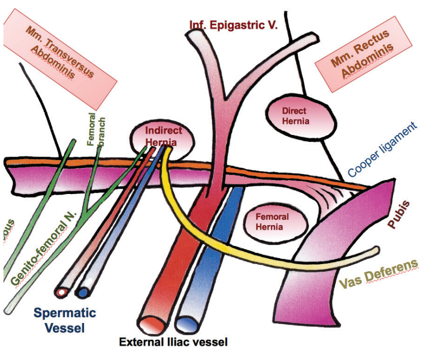

Figure 5b

ENDO-LAPAROSCOPIC INGUINAL HERNIA REPAIR

Continued from Operative Techniques (TEP)

In the final step, a rolled polypropolene mesh (10 cm by 15 cm in size) is inserted through the 10 mm port, and with the use of graspers , the mesh is placed horizontally covering the inguinal wall from the midline of the pubis to lateral to the deep inguinal ring. The mesh is then anchored with laparoscopic tackers to the Cooper's ligament to prevent any mesh migration. Tacking is avoided near the iliac vessels or laterally near the ilio hypogastric nerve, the genitor femoral nerve and the lateral femoral cutaneous nerve of thigh. In all bilateral repairs, two separate pieces of mesh are placed and fixed. At the conclusion, the gas is released and the three wounds are closed with absorbable sutures or glue.

Operative Technique (TAPP)

In this technique, 3 trocars are used, a 10mm subumbilical port and two 5-mm ports, one in the right lower quadrant and the other in the left lower quadrant in the same axial plane as the subumbilical port approximately 5 to 7 cm apart. The peritoneum is incised above the peritoneal defect from the edge of the median umbilical ligament towards the anterior superior iiac spine. Dissection is performed in the pre-peritoneal avascular plane between the peritoneum and the transversalis fascia to provide visualization of the myopectenial orifice. From here on the same technique as TEP is done. Closing of the peritoneal flap is done with a running absorbable stitch.

When to convert:

- Uncontrollable vascular injury
- Dense adhesions due to a previous hernia repair
- Bladder injury

Postoperative Care:

- Diet is resumed as clinically indicated and tolerated
- All patients are prescribed abdominal binders post operatively
- Analgesia is required
- Discharge is possible on the same day, if diet is tolerated, ambulating and pain is bearable
- Advised against lifting greater than 5 kilos for 1 month
- Wound infection is managed medically in majority of cases
- Seromas can me managed conservatively with observation for 2 weeks
- Symptomatic seromas and non-resolving seromas can be aspirated with a gauge 19 needle as a bedside procedure
- Recurrence and chronic pain is monitored on the 3rd month, 6th month, 1 year then yearly afterwards

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ENDO-LAPAROSCOPIC INGUINAL HERNIA REPAIR

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LAPAROSCOPIC VENTRAL HERNIA REPAIR

M Lawenko, D Lomanto

There have been few operative challenges more vexing in the history of surgery than the incisional hernia. The development and outcome of incisional hernia may have major social and economic implications. The increasing prevalence of laparoscopic ventral hernia repair (LVHR) underscores the need for a thorough understanding of its indications, technique, potential complications. Ventral hernia is a broadly inclusive term, incorporating incisional, umbilical, epigastric and suprapubic hernias. An estimated 2 to 20% of laparotomy incisions ultimately develop incisional hernia.

Indications:

- Any ventral hernia larger than 4cm
- A patient who is fit for general anesthesia

Contraindications:

- Densely scarred abdomen
- Acute abdomen with strangulated and infected bowel or the presence of pus in the abdomen
- An extremely large hernia with insufficient lateral space to place a functional trocar
- Major loss of abdominal domain
- Respiratory distress
- Pediatric patients
- Pregnancy
- Portal Hypertension
- Renal failure with presence of peritoneal dialysis catheter

Preoperative preparation:

- Thorough history and physical examination
- Routine investigations as to hospital protocol for fitness to undergo general anesthesia
- Ultrasound or CT scan to those with a questionable diagnosis of a ventral hernia
- Bowel preparation to those with colonic involvement or previous repair with a mesh
- Stop warfarain 4 doses preoperatively
- Stop all NSAIDS and antiplatelets 7 days before surgery
- Prophylactic antibiotics because wound infection is a major risk factor for recurrence
- Gastric and bladder decompression

LAPAROSCOPIC VENTRAL HERNIA REPAIR

Patient and trocar positions: (Figure 1)

- Thorough history and physical examination
- Routine investigations as to hospital protocol for fitness to undergo general anesthesia
- Ultrasound or CT scan to those with a questionable diagnosis of a ventral hernia
- Bowel preparation to those with colonic involvement or previous repair with a mesh
- Stop warfarin 4 doses preoperatively
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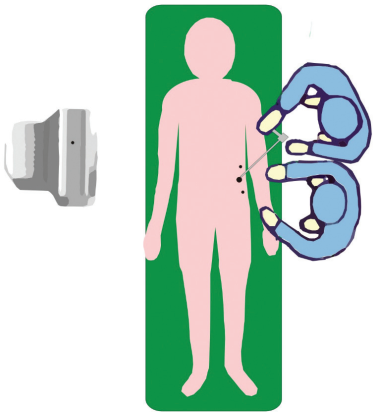

Figure 1:

Operative Techniques

After the pneumoperitoneum is created, a diagnostic laparoscopy is done to exclude other pathologies. Adhesiolysis is then done under direct vision via sharp dissection utilizing bimanual palpation of the anterior abdominal wall. All hernia contents must be reduced. The defects are carefully drawn onto the skin of the anterior abdomen (Figure 2). In case of multiple defects, the area drawn should include all of the defects. The mesh must be 3 to 5 cm larger than the defect because the mesh shrinks through time. The biomaterial of choice is a composite mesh with two surfaces (Figure 3). The surface resting against the visceral side should prevent adhesions and the other side should promote adhesions to the anterior abdominal wall. The mesh is rolled like a scroll, in its long axis. Once inserted, the mesh is unfurled and oriented correctly; the preplaced sutures are pulled transabdominally using a suture passer through the previously marked locations. The sutures are then tied once all have passed through the abdomen. Spiral tackers are placed circumferentially along the peripheral margin of the mesh every 2-3cm (Figure 4). Careful attention must be emphasized not to tack the inferior epigastric vessels. Air dessuflation and fascial closure of the 10 mm port to prevent port site hernias.

Figure 2: Size of defect encircled with the size of the mesh corners marked

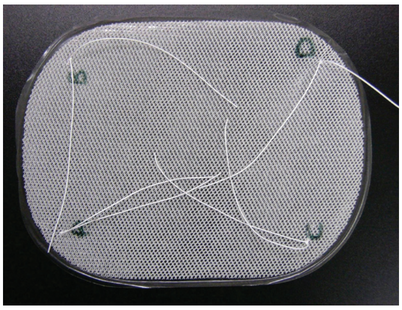

Figure 3: Composite mesh with an anti-adhesive barrier

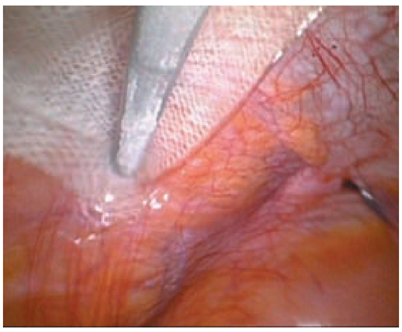

Figure 4: Fixation of mesh with spiral tackers

LAPAROSCOPIC VENTRAL HERNIA REPAIR

When to convert:

- Bowel injury with spillage of intestinal contents
- Dense adhesions
- Massive blood loss

Postoperative Care:

- Diet is resumed as clinically indicated and tolerated
- All patients are prescribed abdominal binders post operatively
- Analgesia is required
- Discharge is possible if diet is tolerated, ambulating and pain is bearable
- Advised against lifting weight for 3 months

Suggested Readings:

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LAPAROSCOPIC VENTRAL HERNIA REPAIR

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LAPAROSCOPIC SPLENECTOMY

J Lopez-Gutierrez

In the past years, laparoscopic splenectomy has become the gold standard for patients with less than 25cm spleen. The practice of this technique requires a proper understanding of the anatomy, as well as advanced skills.

Indications:

1. **Primary Splenic Processes**
   - Trauma.
   - Abscess
   - Cysts
   - Malignancy
   - Hyperesplenism
   - Symptomatic splenomegalia

2. **Hematologic disorders**
   - Idiopathic thrombocytopenic purpura
   - Thrombotic thrombocytopenic purpura
   - Hereditary spherocytosis
   - Hereditary elliptocytosis
   - Autoimmune hemolytic anemia
   - Hodgkin's or non-Hodgkin's lymphoma
   - Myelofibrosis
   - Chronic lymphocytic leukemia
   - Hairy cell leukemia

3. **Storage Disorders**
   - Gaucher's disease
   - Niemann-Pick disease
   - Amyloidosis

4. **Others**
   - Sarcoidosis
   - Felty's syndrome

Contraindications:

- Hemodynamically unstable patient with splenic trauma
- Pregnancy – Relative.
- Morbidly obesity – Relative.
- Marked splenomegaly (more than 25 cm in length or 1.5 Kg) – (Relative. contraindications)

Preoperative Preparation:

- We must be cautious with the patients with portal hypertension, because of the risk of bleeding.
- Also with the patients with splenic abscesses for the risk of infective complications.

LAPAROSCOPIC SPLENECTOMY

- It is advisable to vaccinate against Streptococcus pneumoniae, Haemophilus influenzae (type B) and Neisseria meningitidis, all the patients undergoing splenectomy. This should be done 14 days before the procedure.
- The specific hematologic deficiencies should be corrected.
- Anemic patients should be transfused to increase hemoglobin level to >10 g/Dl.
- Platelet transfusion if the level drops below 50000 (after splenic artery ligation).
- Prophylaxis for deep venous thrombosis.
- Preoperative broad spectrum antibiotics. Orogastric tube and Foley catheter.

OT Setup, Patient's position and Trocars Placement: (Figure 1)

- Monitor position: Two video monitors are used. The surgeon and 1st assistant stand on the opposite sides facing the patient

- Instrumentation required: High-Flow insufflator, video imaging setup (5 mm 30° laparoscope and camera, two monitors), Veress needle, 3 ports of 5 mm, 1 port of 10-12 mm, 5 mm grasper, 5 mm laparoscopic scissors, 5 mm ultrasonic scalpel, laparoscopic linear stapling (vascular load), retrieval bag.

- Patient Position: Most of the surgeons prefer right lateral approach, using an inflatable bean bag, axillary roll, elevated kidney rest, padding at the pressure points.

- Trocars size and position: Three to four trocars. The first of 10 to 12 mm in the anterior axillary line immediately cephalad of the anterior superior iliac spine. The second trocar of 5 mm in the midepigastrium. The third port, 5 mm, in the left lumbosacral angle to facilitate splenic mobilization and retraction. If necessary, a fourth trocar 10 mm trocar may be placed suprapubic just above the pubis symphysis.

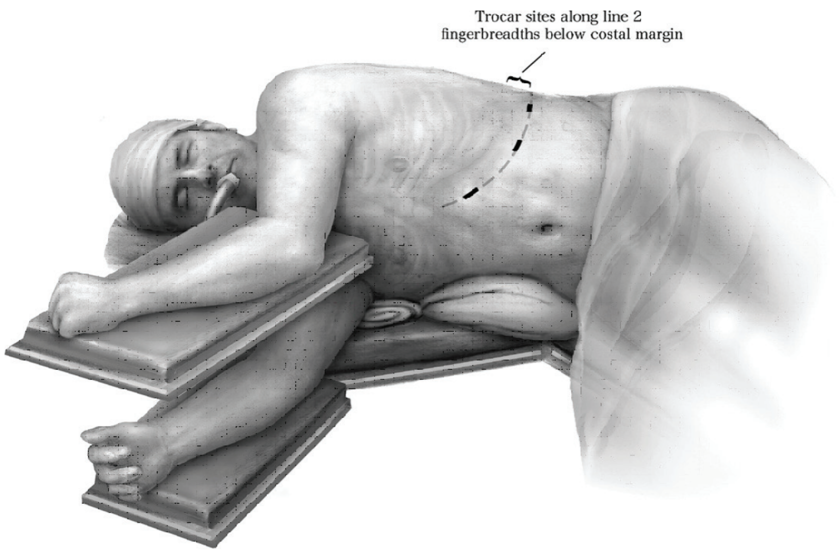


Figure 1

LAPAROSCOPIC SPLENECTOMY

Surgical Technique (narrative)

The first step is to establish pneumoperitoneum inserting a Veress needle on the left upper quadrant mid axillary line. A Hassan technique of open access is acceptable. After getting an abdominal pressure of12 to 15 mmHg a 30° 5 mm laparoscope may be inserted. Additional ports may be placed under direct vision. A diagnostic laparoscopy should be done to detect accessory splenic tissue. Special attention on the splenic helium, vascular pedicle, greater omentum, pancreatic tail, intestinal mesentery, splenocolic ligament, and left ovary. The dissection begins with division of the splenocolic ligament. The lateral peritoneal attachments are divided with ultrasonic dissection or electrocautery. A 5 mm blunt grasper is introduced to grasp the peritoneum attached and rotate the spleen or to elevate the lower pole. Further dissection in the medial direction provides access to the lesser sac and the short gastric vessels. The short gastric vessels may be divided between staples, using diathermy or ultrasonic dissection. Rotate the spleen to ensure that all the vessels are completely divided. After this, the splenic hilium is carefully dissected to allow for optimal vascular control. If possible, splenic artery and vein should be separated prior to division. Graspers and right angle dissector may be used to complete the dissection laterally and posteriorly. An endoscopic linear stapling device, outfitted with a vascular cartridge, is then used to divide the vessels individually.

If separate division is not possible, then mass hiliar stapling is a safe alternative. Once stapling is completed, a bag is introduced through the large working port. The spleen is placed in the bag and the final splenophrenic attachments are divided. The drawstring is closed and the mouth of the bag is exteriorized at the port site, the bag is opened, and the spleen is morcellated within the sac using a blunt instrument. The splenic tissue may be extracted piecemeal. A final survey is performed to ensure adequate hemostasis. Instruments withdrawal and port site closure complete the procedure. An alternative technique is to perform the splenectomy with the assistance of a small incision or HALS. Care should be taken not to perforate the bag, because this may allow the spillage of its contents with subsequent splenosis.

When to Convert:

- Splenic weight more than 1 – 1.5 Kg.
- Massive blood loss.
- Distorted anatomy for previous surgeries with the risk of bowel perforation.

Post-operative Care:

- The patient must remain vigilant to fever as it may be the beginning of a fulminant sepsis.
- The orogastric tube is withdrawn at the end of the case.
- Mobilization on the first postoperative day.
- Liquid intake on the first postoperative day.
- Solid intake on the second postoperative day.
- In the case of transient thrombocytosis above 1’000’000 platelets/mL, oral antiplatelet therapy should be considered.

LAPAROSCOPIC THYROIDECTOMY

CTK Tan

Thyroidectomy is a common surgical procedure in general surgery to treat goiters. 90 % of thyroidectomies are for benign nodules. Surgery in the neck leaves a scar which is obvious and often not concealed by clothing; unlike abdominal scars. Endoscopies have been used in thyroid surgeries, however, most of them still involve scars in the neck. SET is a procedure whereby the thyroid is removed from a site remote of the neck, thus leaving no scars in the neck. At present, the accesses are through the axilla and breast. The surgery does take longer than open surgery, involves more costly instrumentation and is associated with more post-operative pain. There is not more morbidity with the procedure compared with the open method and the patients, of whom women make up the majority, are very happy with the cosmetic outcome.

Indications:

- small thyroid nodules (<5cm)
- benign

Contraindications:

- large goitres
- malignant thyroid disease

Preoperative preparation:

- prophylactic intravenous antibiotics
- informed consent with the potential to convert to an open procedure

Patient and trocar positions:

- supine position
- access through the axilla of the side which the thyroid is to be removed
- upper limb is flexed 90 degrees, internally rotated 90 degrees and secured in position over a bar with crepe bandage
- surgeon and assistant stand on the side to be operated on
- screen monitor is on the patient's other side
- subcutaneous plane created through axilla
- 10mm optical port and one 5mm working port in axilla
- One 5mm port at subclavicular postition

Figure 1: patient position with the upper limb in the flexed and internally rotated position.

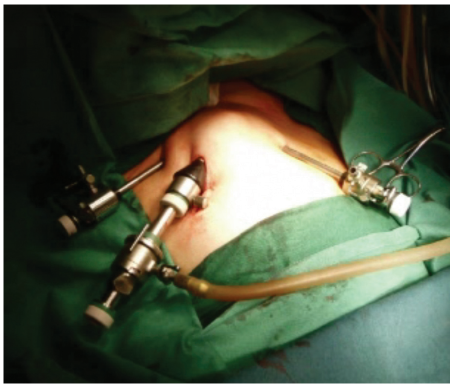


Figure 2: 10mm optical port with two 5mm working ports.

LAPAROSCOPIC THYROIDECTOMY

Operative Techniques

The pressure in the operating space is set at 15-20mmHg. Dissection is performed with the ultrasonic dissector. The strap muscles are divided from the sternocleidomastoid. Thyroid nodule is separated from the strap muscles and elevated superiorly. The recurrent laryngeal nerve is then identified. Dissection of the superior pole of the thyroid gland off its attachments and security of the vascular pedicle can be performed with the ultrasonic dissector. The same is done for the inferior pole. The thyroid nodule is then dissected off the trachea and divided at the isthmus. Care is taken to preserve the recurrent laryngeal nerve and parathyroids. The specimen is removed from with the use of a specimen retrieval bag. If a commercially available specimen retrieval bag is used, a 5mm scope is introduced into the other 5mm port while the retrieval bag is manipulated through the 10 mm port. Lavage and haemostasis is ensured before ending the procedure. A closed suction drain is inserted.

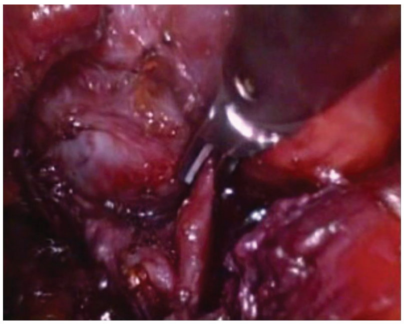


Figure 3: Isolation and division of the middle thyroid vessels

Figure 4: Visualization and preservation of the recurrent laryngeal nerve

Postoperative Care:

- The patients may experience more pain than the conventional open thyroidecotomy
- The patients may have subcutaneous bruising and emphysema
- They discharge on the first post-operative day.

LAPAROSCOPIC ADRENALECTOMY

A Lee-Ong, M Lawenko, WK Cheah

Indications:

- Small to medium sized (<6cm) benign functioning and non functioning adrenal lesions
- Suspected primary adrenal malignancies (<6cm) (controversial)

Contraindications:

- Large adrenal lesions (>8cm)
- Unstable comorbidities
- Contraindications to anesthesia and pneumoperitoneum
- Previous abdominal surgery

Preoperative Preparation:

- Control of hypertension, correction of electrolyte abnormalities
- Preoperative evaluation and optimization
- Screening laboratory tests: ECG, chest x-ray, electrolytes, clotting parameters, blood type, etc.

Instruments:

a. Veress needle
b. 10mm port (1)
c. 5mm port (3)
d. 0 or 30 degree scope
e. Atraumatic graspers(2)
f. Maryland dissector(1)
g. Clip applicator (1)
h. Needle holder (2)
i. Curved scissors (1)
j. Hook diathermy
k. Harmonic scalpel
l. Suction/irrigation device
m. Specimen retrieval bag

LAPAROSCOPIC ADRENALECTOMY

Types of Approach:

There are different approaches to the adrenal gland: 1) transabdominal, anterior 2) transabdominal, lateral, and 3) retroperitoneal, posterior. We describe the two most common procedures in our practice.

1. **Transabdominal**
   a. Lateral transabdominal LEFT adrenalectomy

   Patient Position
   - lateral decubitus position with the left side up.
   - Cushion and protective roll under the right flank and right axilla respectively.
   - Both arms extended, parallel to each other and secured to board.
   - Right leg flexed, left leg extended over, with cushion between legs.
   - Flexed at the hip to achieve maximal distance between costal margin and iliac crest.

   Monitor
   - both side of patient's head

   Surgeon and 1st Assistant
   - facing the patient's abdomen

   2nd Assistant
   - stays on the side of patient's back

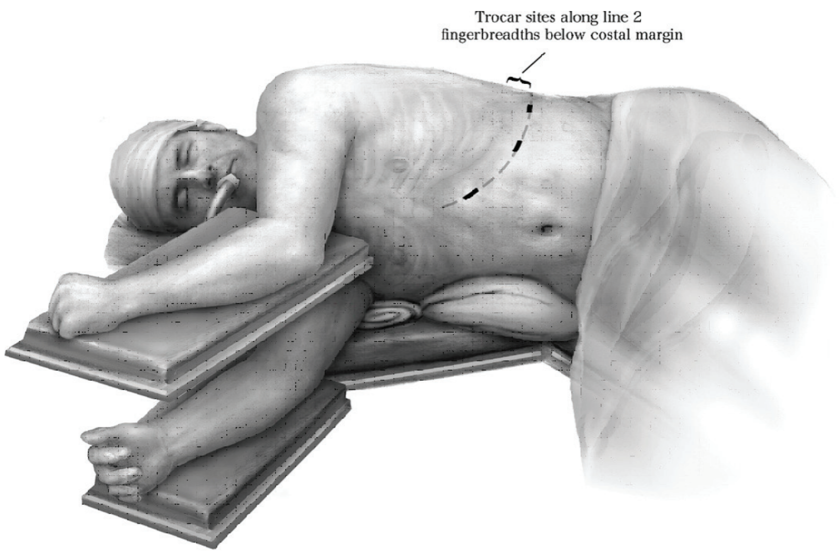
   Trocar/ Port Placement

   i. Port 1
      1. 10mm port
      2. Anterior axillary line, about 2cm below costal margin
      3. Laparoscope port

   ii. Port 2
      1. 5mm port
      2. Below 11th rib at midaxillary line
      3. For right hand instruments

   iii. Port 3
      1. 5mm port
      2. Anterior to Port 1, at midclavicular line and lateral to the rectus muscle
      3. For left hand instruments

   iv. Port 4 (optional)
      1. 5mm port
      2. Costovertebral angle
      3. Optional port for instruments



LAPAROSCOPIC ADRENALECTOMY

Surgical Technique

- Patient on slight reverse trendelenberg position, to clear the operative field of bowels and facilitate exposure
    i. Mobilization of the splenic flexure of the colon
        - Retract the descending colon with an atraumatic graspers antero-medially
        - Dissect the peritoneal reflection using scissors or diathermy
        * Margin of dissection runs from the left paracolic gutter up to the inferior pole of the spleen
    ii. Dissection of the splenorenal ligament
        - Dissection margins from area lateral to the spleen down to the tail of the pancreas
        * upper margin should reveal the stomach and short gastric vessels. Allows the spleen and tail of pancreas to rotate medially
    iii. Locate the left adrenal gland
        - The left adrenal gland should be between the spleen and the upper pole of the left kidney
        - Carefully dissect around and close to the gland, to define its borders clearly and ligate its blood supply
        - The left adrenal vein should be at its inferomedial border on its junction to the left renal vein. Ligate in continuity the left adrenal vein using vascular clips
    iv. Specimen retrieval using appropriate retrieval devices

b. Lateral transabdominal RIGHT adrenalectomy

Patient Position

- lateral decubitus position with the right side up.
- Cushion and protective roll under the left flank and left axilla respectively.
- Both arms extended, parallel to each other and secured to board.
- Left leg flexed, right leg extended over, with cushion between legs.
- Flexed at the hip to achieve maximal distance between costal margin and iliac crest.

Monitor

- both side of patient's head

Surgeon and 1st Assistant

- facing the patient's abdomen

2nd Assistant

- the side of patient's back

Trocar/ Port Placement

i. Port 1
    1. 10mm port
    2. Anterior axillary line, about 2cm below costal margin
    3. Laparoscope port

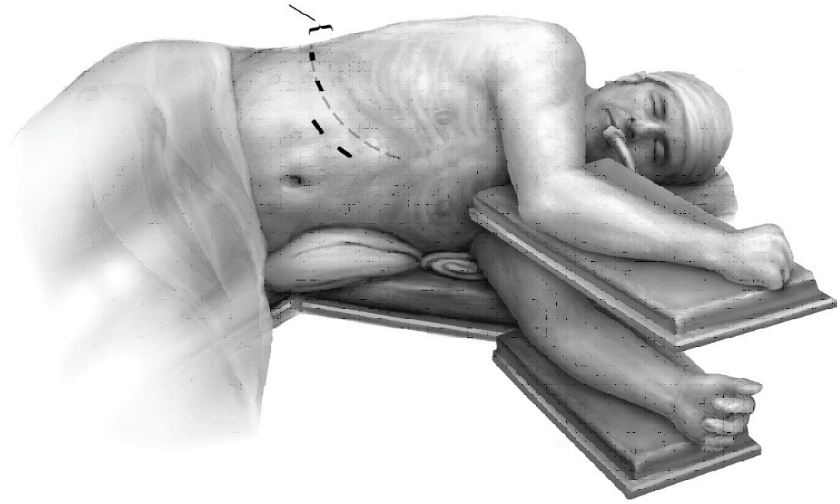
LAPAROSCOPIC ADRENALECTOMY

(Continued from Trocar/Port Placement)

ii. Port 2
  1. 5mm port
  2. Below 11th rib at midaxillary line
  3. For right hand instruments

iii. Port 3
  1. 5mm port
  2. Anterior to Port 1, at midclavicular line and lateral to the rectus muscle
  3. For left hand instruments

iv. Port 4 (optional)
  1. 5mm port
  2. Costovertebral angle
  3. Optional port for instruments



Surgical Technique

- Liver retracted medially, dissect the right triangular ligament to the liver.

* margins of dissection runs from the inferior vena cava to the diaphragm, this will allow the liver to rotate and fall medially away from the area of interest, exposing the right retroperitoneum, adrenal gland, and inferior vena cava.

- Careful blunt and sharp dissection of the peritoneum between the adrenal and the inferior vena cava should reveal the adrenal gland close to the inferior vena cava.
- Dissection around the gland to get a clear border around it. Dissect the medial border of the gland between it and the inferior vena cava, until the right adrenal vein is identified.
- Ligation of the right adrenal vein in continuity using two clips proximal near the vena cava and one clip distally. The arterial branches may be ligated using clips or using different energy sources.
- Retrieval of specimen using appropriate retrieval devices.

LAPAROSCOPIC ADRENALECTOMY

2. Retroperitoneal

Patient Position

- Prone or semi-jacknife position with the hips flexed

Port Positions

i. Port 1 - 1.5 cm incision in the midaxillary line , below the tip of the 11th rib
   - optical port

ii. Port 2 - 5 mm trocar posteriorly, on vertebral side close to 11th rib
   - dissecting trocar

iii. Port 3 - - medial to the 1st port

Surgical Technique

- Retroperitoneal space expanded with balloon expander using port 1
  - insuflate with 12 mmHg CO_2 pressure
- Open the lateral coronal fascia and start dissecting at the less vascular border of the adrenal starting from lateral to superior then medially
  RIGHT : adrenal vein is at the posteromedial aspect of the gland
  LEFT : adrenal vein is in the medioinferior part
- Clip the adrenal vein once properly identified

Indications for Conversion

- uncontrolled hemorrhage
- severe intraperitoneal organ injury
- cardiac arrhythmias

Postoperative Care:

- Most patients can be cared for in the regular nursing unit following surgery. Patients with hemodynamic disturbance or severe cardiopulmonary disease are best cared for in the intensive care unit
- Patients are allowed liquids on the morning after surgery and progressed as tolerated.
- Diagnostics such as full blood count and electrolytes may be done if clinically indicated
- Patients are usually discharged within 24 to 48 hours after surgery.
- Patients requiring steroid replacement are observed for 72 to 96 hours and discharged.
- Periodic glucose monitoring in Pheochromocytoma patients.
- First follow-up usually at about 2 weeks after surgery.

LAPAROSCOPIC ADRENALECTOMY

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LAPAROSCOPIC GASTRIC BANDING

A Lee-Ong, D Lomanto,
M Fuentes

Indications:

- BMI >40kg/m2, or body weight >100lbs above ideal body weight
- BMI 35-40kg/m2 + >1 high-risk comorbid condition, or body weight >80lbs above ideal body weight + 1 comorbidity
- Failure to respond to, low likelihood of responding to, or refusal to undergo medically sound weight loss program
- Well informed & motivated and accepts operative risk

Contraindications:

- Absolute
  - Mentally impaired, unable to weigh risk and benefits of surgery
  - Active neoplastic disease
  - Cirrhosis with portal hypertension
  - Unstable or incurable pre-existing comorbidities (CAD, DM, asthma, AIDS, etc.), or uncontrolled psychiatric condition
  - Pregnancy
  - Immobility
  - Inability or refusal to comply with postoperative regimens
  - Active substance abuse
  - Lack of social support
  - Unable to tolerate general anesthesia

- Relative
  - Age
  - Coagulopathy
  - Previous abdominal surgery

Preoperative Preparation:

- Psychological evaluation
- Thorough history and physical examination
- Referral to appropriate specialty
- Screening laboratory tests (FBC, liver function, HgbA1c, iron, total iron binding capacity, vit B12, folate, vit D, calcium, thyroid function, serum lipid)
- Gallbladder ultrasound
- Upper GI evaluation
- Dietary counseling
- Preoperative weight loss, esp. BMI >60kg/m2

LAPAROSCOPIC GASTRIC BANDING

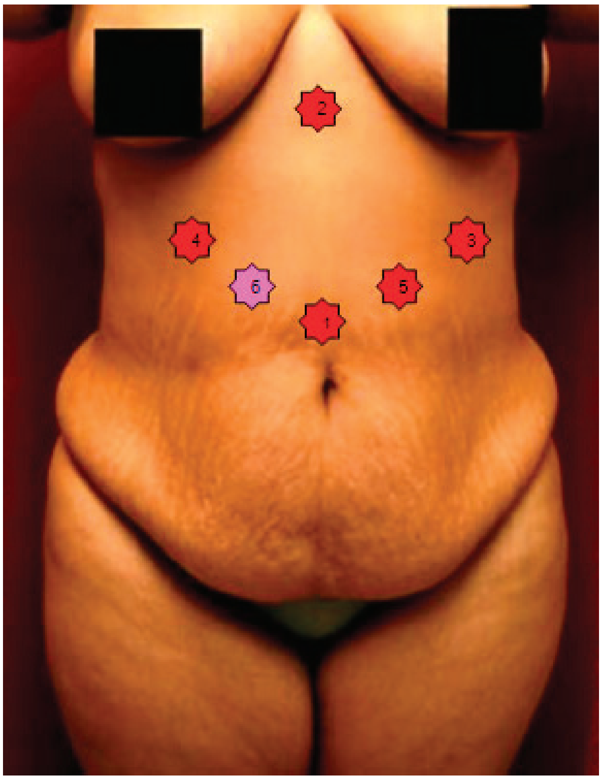
OT set-up, Patient position, and Operative team position:

- Video monitor over at patient's left and right shoulders
- Patient supine with arms out, preferably split leg, secured to operative table, reverse Trendelenburg (about 25o)
- Surgeon between patient's legs or on the patient's right side if not split leg;

Instrumentation:

- Veress needle (optional)
- 5mm ports (4)
- 15-18mm port (1)
- 30-45 degree scope, 5 or 10mm (1)
- Nathanson liver retractor (1)
- Atraumatic graspers, 5mm (2)
- Maryland dissector, 5mm (1)
- Curved scissors, 5mm (1)
- Hook diathermy, 5mm (1)
- Harmonic scalpel, 5mm (1)
- Goldfinger (Obtech, Ethicon) (1)
- Band placer (1)
- Needle holder (2)
- Permanent sutures
- Gastric band with access port (1)
- Suction/irrigation device (1)

LAPAROSCOPIC GASTRIC BANDING



Trocar / Port Placement:

- Port 1
  - 15-18mm port
  - Midline supra-umbilical, placed optimally to view the operative field/ working space
  - For initiation of working field, for the laparoscope/camera, for passage of gastric band

- Port 2
  - 5mm port
  - Just below the xiphoid
  - For Nathanson liver retractor

- Port 3 (optional)
  - 5mm port
  - Below left costal margin, at the
  - anterior axillary line
  - For left hand assisting instruments

- Port 4
  - 5mm port
  - Below the right costal margin, at the anterior axillary line
  - For right hand instruments

- Port 5
  - 5mm port
  - Approximately 6cm left of midline, at the level of or just about the camera port (port 1)
  - For left hand instruments

- Port 6 (optional)
  - 5mm port
  - Approximately 6cm right of midline at the level of the camera port
  - For right hand assisting instruments

LAPAROSCOPIC GASTRIC BANDING

Surgical Technique (Pars Flaccida Technique):

- Dissection at the Angle of His
  - Retract the liver up and to the right with a Nathanson retractor, exposing the diaphragm at the esophageal hiatus
  - Using graspers draw down the fundus
  - Dissect the gastrophrenic peritoneal attachment to expose the left crus, using hook diathermy or harmonic scalpel

- Dissection at the Lesser Curve
  - Draw the mid-lesser curve to the left, with graspers
  - Divide the pars flaccida of the lesser omentum
  - Retract the posterior wall of the lesser sac to expose anterior margin of the right crus
  - Make a small opening in the peritoneum about 5mm in front of the anterior margin of the right crus
  - Dissect the retroesophagogastric opening using a blunt articulating dissector "Goldfinger" (Obtech, Ethicon), until it exits at the left crus

- Band Placement and Calibration of Gastric Pouch
  - Band placer passed gently thru the retroesophagogastric tunnel in a counterclockwise advancement until it exits at the left crus
  - Band tubing is inserted into the slot of the placer
  - Band placer withdrawn along its path to the lesser curve and retrieve the tubing
  - Draw the tubing until band is in place, partially close the buckle
  - Inflate the calibration balloon with 25ml of air, withdraw the calibration tube until it touches the esophago-gastric junction
  - Position the band over the equator of the balloon
  - Deflate the calibration ballooon, bring band to complete closure
  - Anterior fixation of the fundus and anterior gastric wall over the band, with three to four sutures
  - Withdraw the calibration balloon

- Placement of Gastric Band Calibration Port
  - 5mm port
  - Below the right costal margin, at the anterior axillary line
  - For right hand instruments

- Securing the access port
  - Bring out band tubing through a port site, with a large loop remaining within to prevent tube
  - from ripping off the calibration port due to extensive movement of patient
  - Connect band tubing to access port, and secure to anterior rectus sheath with permanent sutures

LAPAROSCOPIC GASTRIC BANDING

Postoperative Care:

- Upper GI gastrograffin study on the 1st postoperative day; if normal findings, patient allowed to take fluids then structured diet

- Adjustment of gastric band usually starts 6 weeks after operation; and every 4-6 weeks thereafter

- Goal of gastric band adjustment
  - Loss of excess weight within 18 months to 3 years
  - Weight loss of 0.5-1.0kg per week
  - Sensation of prolonged satiety
  - No negative symptoms

- Adjustment of Gastric Band
  - Type (high volume, low pressure)
    - 3-4cc of fluid added at first adjustment
    - 1-1.5cc of fluid on subsequent adjustment
    - Final total volume of 6-8.5cc
  - Type (low volume, high pressure)
    - 0.5-1.0cc of fluid added at first adjustment
    - 0.3-0.5cc of fluid on subsequent adjustment
    - Final total volume of 3-5cc

- Adjustment Guidelines
  - Adjustment not necessary
    - Adequate rate of weight loss
    - No negative symptoms
    - Eating reasonable range of food
  - Consider adding fluid
    - Inadequate weight loss
    - Rapid loss of satiety after meals
    - Hunger between meals
    - Increased volume of meals
  - Consider removing fluid
    - Vomiting, heartburn, reflux into the mouth
    - Choking, coughing spells, wheezing; especially at night
    - Difficulty with a broad range of food
    - Maladaptive eating behavior

LAPAROSCOPIC GASTRIC BANDING

Suggested Readings:

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LAPAROSCOPIC GASTRIC BANDING

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LAPAROSCOPIC SLEEVE GASTRECTOMY

M Lawenko, D Lomanto, E Cabrera

Sleeve Gastrectomy is a restrictive bariatric procedure for morbid obesity. In this procedure, 80% of the stomach, mainly the body and fundus is removed, leaving behind a sleeve of the stomach along the lesser curve that leads to a significant weight loss. Another factor is the decrease in blood levels of ghrelin, the hunger stimulating hormone, majority of which is found in the fundus which is removed in sleeve gastrectomy. This is a relatively new procedure for obesity which started out as the first stage of a bariatric surgery, which is to achieve significant weight loss prior to performance of a more extensive mixed restrictive and malabsorptive procedure.

Indications:

- First stage procedure before a more complex procedure (for BMI > 60) like duodenal switch
- Sole bariatric procedure for the high risk obese BMI 35-40
- Revision of previous laparoscopic gastric banding
- Re-do LSG

Contraindications:

- Extensive previous surgery
- Crohn's Disease
- Elderly patients with extensive co-morbidities
- Adolescents
- Patients with low BMI (35-40) kg/m2) with co-morbidities

Preoperative preparation:

- Weight and height measurement on a standard electronic scale
- Nutritional parameters
- Evaluate cardiopulmonary function
- Obstructive sleep apnea tests
- 2 weeks on a very low protein diet
- Helicobacter pylori serology (optional)
- Upper GI endoscopy (optional)
- Psychiatric evaluation
- Chemoprophylaxis
- Thromboprophylaxis

Patient and trocar positions: (Figure1)

- Modified lithotomy position
- 5 trocars inserted in upper abdomen
- Camera port is inserted with a direct viewing trocar
- Left lobe of the liver is retracted using a snake or Nathanson retractor
- Needle holders
- Nasogastric tube
- 36 Fr/42 Fr bougie
- Linear articulated staplers 45-60 mm
- 2 green cartridges
- 5-6 blue cartridges
- Seamguards™ (WL Gore, USA) or Duet (Coridien, USA)

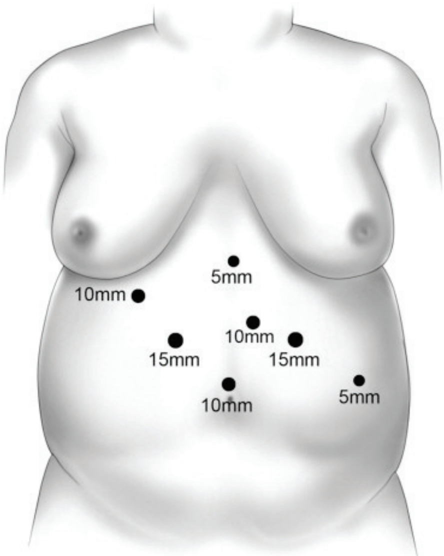

Figure 1

LAPAROSCOPIC SLEEVE GASTRECTOMY

Operative Techniques

After the pneumoperitoneum is created, a diagnostic laparoscopy is done to exclude other pathologies. The liver is retracted cranially and the GE junction exposed. A 36 Fr/42 Fr bougie is inserted transorally for precise calibration of the gastric sleeve so as to prevent stenosis. A point 6 cm proximal to the pylorus along the greater curvature is measured as the distal extent of the resection. Division of the vascular supply is achieved by using an energy source (Ligasure™, Covidien, Norwalk, USA) or an ultrasonic shears (Harmonic scalpel, Johnson & Johnson, USA) along the gastrocolic and gastrosplenic ligaments up to the angle of His. The greater curvature must be completely freed up to the left crus of the diaphragm. The second step is the longitudinal gastrectomy that sleeves the stomach to reduce it into a narrow tube. Linear cutting staplers are used to vertically transect the stomach creating a narrow gastric tube with an estimated capacity of less than 150 ml. The transection starts 6cm from the pyloric vein or vertically towards the incisura using a green cartridge Seamguard™ (WL Gore, USA) to prevent bleeding. A bougie must be in place to avoid stricture formation. Then 5-6 more blue/gold scartridges are fired up to the angle of His. It is suggested to keep the bougie at the left side while firing the stapler to obtain an acceptable sleeve. It is important to compress the line of transection of the gastric tissue with the staple for at least 15 seconds prior to firing in order to get adequate stapling of gastric tissues. Suturing of the staple line meeting points is done. A large bore drain is placed in the subhepatic space adjacent to the stomach tube. The resected stomach is placed in a specimen bag and extracted through the supraumbilical port site. Fascial defects larger than 10mm are closed with absorbable sutures.

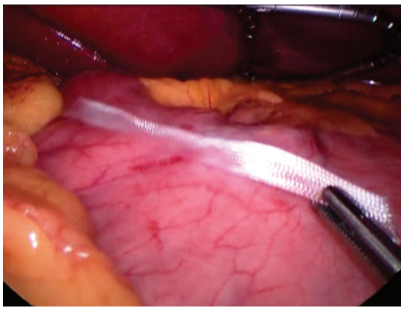

Figure 2: Tape utilized to measure 6cm from pyloric vein as a starting point for the stomach transection

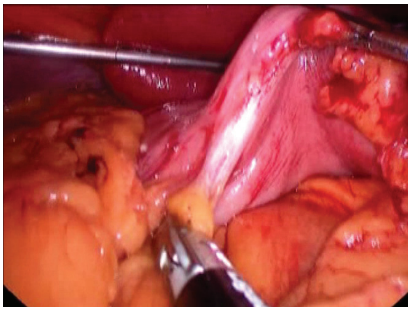

Figure 3: The greater curvature of the stomach is transected using ultra-sonic shears

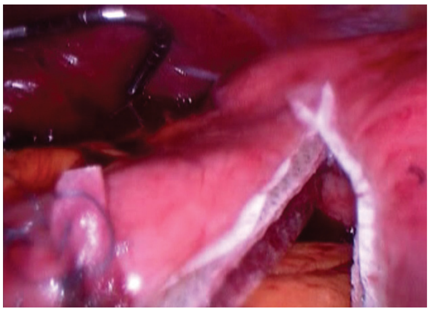

Figure 4: The stomach is transected using a combination of green and blue cartridge

When to convert:

- Massive blood loss
- Dense adhesions
- Incidental gastric tumor
- Splenic injury

LAPAROSCOPIC SLEEVE GASTRECTOMY

Postoperative Care:

- High dependency ward care to monitor cardiac and pulmonary issues
- Fever, tachycardia or oliguria should prompt the physician to think of a leak and appropriate steps such as a second look must be brought to mind
- Drains are left in place until the time that the risk for leakages has passed: 2-5 days
- Foley catheters may be removed on the 3rd post op day
- Sequential compression devices are maintained until the patient is ambulatory
- Start deep venous thrombosis prophylaxis using either unfractionated heparin given every 8 hours or low-molecular weight heparin given once a day
- Small portions of low calorie, low fat, low sugar items are started after the gastrograffin swallow is negative usually on day 2 postop
- Intravenous pain medications routinely given and stepped down once patient is feeding
- Continuation of pre-operative antibiotics is on a case to case basis.

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BASIC PRINCIPLES IN VIDEO-ASSISTED THORACOSCOPIC SURGERY

JKC Tam

Indications

Thoracoscopic surgery, commonly known as Video-Assisted Thoracic Surgery (VATS) has been used to perform minor thoracic procedures for many years. Conventional indications for VATS in the past include exploratory thoracoscopy, lung biopsy, pleural biopsy, drainage of pleural effusion, pleurodesis, and thoracoscopic sympathectomy.

With improvements in techniques and technology, thoracic surgeons with advanced minimally invasive skills can apply VATS to perform major thoracic resections. Current applications of minimally invasive thoracic surgery include:

- Major anatomical pulmonary resections including lobectomy, segmentectomy, and pneumonectomy for lung cancer patients
- Esophagectomy for esophageal cancer patients
- Lung volume reduction surgery for COPD patients
- Surgeries in the mediastinum, including resection of mediastinal mass
- Mediastinal lymph node dissection
- VATS pleurectomy or decortication
- Pleural drainage and pleurodesis
- Lung and pleural biopsy
- Thoracoscopic sympathectomy for hyperhydrosis
- Diagnostic and therapeutic thoracoscopy

These operations can be technically challenging and often require expert training in minimally invasive surgery. In the United States, it is shown that only a minority of major thoracic resections are currently performed using VATS.

Contraindications

Relative:

- Tumors larger than 6cm
- Chest wall or mediastinal involvement
- Endobronchial tumor within major bronchi
- Neoadjuvant chemotherapy
- Neoadjuvant radiotherapy
- Pathologic adenopathy

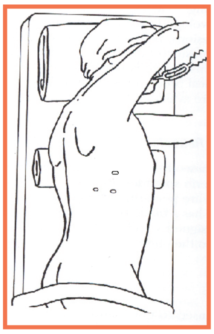
Absolute:

- Complete pleural symphysis
- Inability to tolerate single lung ventilation

BASIC PRINCIPLES IN VIDEO-ASSISTED THORACOSCOPIC SURGERY

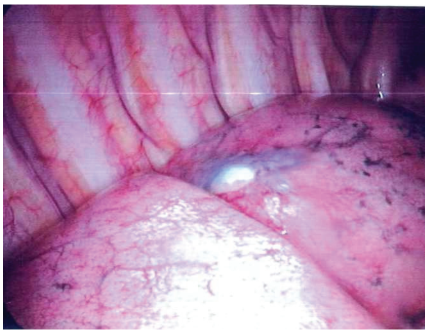
Patient position, trocar placement, and surgical technique: The patient is usually placed in the standard lateral decubitus position. VATS procedures are performed with only two to four small incisions as opposed to a large thoracotomy incision. Majority of VATS incisions are 1 cm in length through the intercostal space. A thoracoscope is inserted, and anatomic dissection is performed using either specialized minimally invasive instruments or standard surgical instruments to perform major resection through the small incisions. Tumors are removed within special retrieval bags to minimize the risk of tumor wound implantation.

Postoperative care: The use of thoracoscopy eliminates the need for rib spreading. As a result, patients have no risk of rib fractures and have significantly less postoperative pain. Pulmonary function is also much better preserved after surgery. Patients are mobilized to walk on the first postoperative day and they recover more quickly after surgery.



Patients are placed in the lateral decubitus position and small one centimeter incisions are made for access into the intra-thoracic cavity. No rib spreading is needed.

Small 1 cm incisions are placed on the right hemithorax to perform minimally invasive resection.



A 3 cm x 2 cm tumor is seen in the right upper lobe using thoracoscopy. After confirming the diagnosis of malignancy, a right upper lobe lobectomy can be performed using minimally invasive thoracic surgery techniques.

Minimally invasive thoracic surgery confers many advantages to the patients including significant reduction in postoperative morbidity, mortality, and pain. It is reported that VATS lobectomy is associated with fewer complications than conventional approach. There is significantly less intra-operative blood loss and operative mortality is rare.

These benefits translate to significantly shorter duration of hospitalization and earlier return to full normal activities both at home and at work.

Most importantly, VATS resections are shown to have equal or improved long term survival compare to open surgeries.

With these advantages it is not surprising that patients and families favor minimally invasive thoracic surgery over conventional approach and they express great satisfaction with the surgical results.

SINGLE PORT ENDO-LAPAROSCOPIC SURGERY (SPES)

D Lomanto, J Lopez-Gutierrez, M Lawenko

Since the first laparoscopic cholecystectomy more than two decades ago, laparoscopic surgery has evolved from basic procedure to most advanced surgical operations. This is a result of the better clinical outcome compared to conventional surgery. The success of many procedures like cholecystectomy, GERD surgery, obesity surgery and more has been driven because of the shorter hospital stay, better cosmesis and less pain, becoming a gold standard approach for many of them. Subsequently, Laparoscopic surgery has also evolved by minimizing the size of the wound with the use of mini-instruments called mini-laparoscopic surgery or needlescopic surgery. Several studies showed that procedures with mini-intrumentations were feasible, with lesser postoperative pain and smaller scar compared to standard laparoscopic surgery but the worldwide acceptance of this technique was not achieved as expected.

The desire to be less invasive has been one of the main reasons for the development and success of laparoscopic surgery and needlescopic surgery. In the last decade the trend to be lesser aggressive brought research centres worldwide to develop a new endo-surgical approach. In fact with advent of the Natural Orifice Trans Endoscopic Surgery (NOTES) in 2004 a lot of interest has been created and new idea, new research interest raised because of the difficulties to translate NOTES from the bench to the clinical setting. In fact, several researchers worldwide started to work in developing new tools to overcome the challenges and difficulties encountered during NOTES procedures. There are still many issues to be resolved before NOTES can be widely accepted but since then many surgeons have pursued a new direction to find other less invasive surgical options to treat patients. As a consequence, a so-called single access device surgery started using old and new idea and very early clinical report showed that Single Port Endoscopic Surgery is feasible with few innovative changes from the past and seems to be a less risk surgical option to develop

After multi-incision laparoscopic surgeries has been perfected, the idea of Single port surgery is currently being introduced to further minimize the surgical invasiveness.

Today with single incision surgery we are trying to prove that same point of minimizing the surgical aggression that was addressed with needlescopic surgery. Special devices are now being designed and many surgeons are considering this as the next generation of minimally invasive surgery

There are many early reports on feasibility study for procedure like cholecystectomy, appendectomy, endoscopic hernia repair and bariatric surgery. From initial experience, few challenges seem to emerge like lack of working space, fighting of instruments, difficulties in retraction or dissection and approximation of tissues. The previous concept of triangulation for multiple incision laparoscopic surgery now have minimal application for this single port access. Since with in-line viewing, a movement of an instrument results to movement of adjacent camera compromising operative exposure. Hand collision due to limited working space prolongs surgery and increases the anesthetic risk for the patient.

Industry has adjusted to the need of progressing single port surgical procedures by altering the instruments and devices to date. Articulating and use of pre-bent instruments for single port device avoids hand collision during surgery. Use of flexible scopes provide the critical view for anatomical structures that need to be identified prior to dissection. Certainly the utilization of an in-line telescope like Visera Endo-Eye (Olympus, Japan) will facilitate the movement and avoid the clashes, another option can be a long telescope or a flexible tip telescope. The telescope action and the view is also affected by the concomitant movement of the instrumentation. The single port device is all-in-one device and every movement of every instrument

SINGLE PORT ENDO-LAPAROSCOPIC SURGERY (SPES)

will reflect on the movement of the telescope and of the surgical field. Certainly limited and slow movement will improve the surgeon vision. This modern device and instruments assist in delivering good surgical exposure and ergonomic positions both for surgeon and the assist holding the camera. Expert worldwide have accepted this new surgical challenges and many working group worldwide try to address all the issues. For example, Laparoendoscopic Single Site Surgery Consortium for Assessment and Research (LESSCAR), an international multidisciplinary organization for laparoendoscopic single site surgeries, came up with standardized nomenclature for this single port surgery that will encompass the following concepts: single incision length and location (abdominal, thoracic or pelvic); approach (transperitoneal, retroperitoneal, percutaneous intraluminal or transluminal); number and type of ports used; type of surgery (laparoscopic, endoscopic or robotic) ; type of laparoscope used (straight or flexible); type of instruments used (straight, curved, bent, articulating or flexible); and whether any ancillary 2-mm needlescopic instrument is used. Suggesting that to better understand, all publications to be released should contain this type of surgical description for solidarity.

New enthusiasm among surgeons and new tools in the market push many centres worldwide to adopt this new approach. Clinical studies are on going to verify the feasibility, reproducibility and the clinical benefits of this new surgical approach and before a full acceptance, more RCTs and technologies are needed

In the last two decade, surgery experienced a great revolution in daily clinical practice with new challenges for all surgeons and looking at the new technology, this seems to be an emerging trend for the future.

Lastly, from our short clinical experience, the group of patients who really had a greater benefits from the single port endoscopic were the ones that underwent a double surgical procedure; with conventional laparoscopic surgery, especially if we have to work in different abdominal quadrants like for inguinal hernia repair and cholecystectomy or stomach surgery and ovary, etc, additional ports are necessary to be inserted in order to perform the different procedures. Whereas in our series and in three patients that underwent SPES for double procedures, the whole set of instruments has been rotated in-line towards the different abdominal areas without the need of additional port insertion.

SPES is gaining favour rapidly among patients, surgeons, industry and investors. Public demand will probably facilitate the explosion and development of SPES, in the same way that other techniques were forced to develop faster because of the people's demand, and industry investment.

SINGLE PORT ENDO-LAPAROSCOPIC SURGERY (SPES)

Single Port Devices

TriPort (Olympus, Japan) – Designed to be deployed through a 1 to 1.5 cm incision typically through the umbilicus.

AirSeal (SurgiQuest, USA) – Does not use a mechanical barrier as in traditional laparoscopic port, but rather a pressure barrier that exceeds that of the pneumoperitoneum.

SILS Port (Covidien, USA) – Has four openings, one for insufflation and three that can have trocars 5 to 12 mm in size.

Uni-X Single Port (Covidien, USA) – It is funnel shaped.

X-Cone (Karl Storz, Germany)

SSL (Ethicon, USA)

Technical Aspects

In Single-port surgery, the patient is positioned similarly to that when doing conventional laparo-endoscopic surgery according to the surgical needs, and under general anesthesia. In intra-abdominal procedures, the port is usually inserted in the midline. The authors of this chapter prefer and recommend an infraumbilical, semicircular incision of about 1.5-2.5mm, dissection up to the fascia, and insertion of the port with the Hasson open technique, under direct vision. Camera is initially inserted to perform a diagnostic laparoscopy, after which additional instruments may be inserted for the commencement of the surgical procedure.

SINGLE PORT ENDO-LAPAROSCOPIC SURGERY (SPES)

Indications

- All procedures with limited surgical fields seem to be the indication for this newest approach (appendectomy, hernia repair, GERD surgery, etc.)
- General Surgery: The largest series of procedures reported on literature consist in appendectomy, cholecystectomy, splenectomy, abscesses and cysts drainage.
- Urology: There largest report series consisting in nephrectomy, renal cryotherapy, and varicocelectomy.
- Colorectal surgery: There are isolated reports of cases performing right hemicolectomy.
- Bariatric Surgery: There are reports of cases of sleeve gastrectomies as well as gastric banding. The greatest concern in the obese population is the appearance of incisional hernia.

Contraindications

- Same as Laparoscopic Surgery
- Hemodynamically unstable patient.
- Trauma patients.
- Pregnancy.
- Multiple abdominal surgeries.
- Morbidly obesity – Relative.

OT Setup, Patient's position and Trocars Placement

- Monitor position: Two video monitors are used. The surgeon and 1st assistant stand on the opposite sides facing the patient
- Instrumentation required: The Single Port device. High-Flow insufflator, video imaging setup (5 mm 30° laparoscope and camera, two monitors), 2 ports of 5 mm, 1 port of 10-12 mm, 5 mm grasper, 5 mm laparoscopic scissors, retrieval bag.
- Patient Position: Supine or Prone with split legs give a better ergonomics to the surgeon

When to Convert

- Conversion can be prevented by inserting additional ports to improve retraction or dissection. Convert to open surgery if anatomy is unclear.
- No progress with the procedure.
- Massive blood loss.
- Distorted anatomy from previous surgeries.

Post-operative Cares

- Similar to standard laparoscopic surgery

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Challenges:

- **Triangulation:** The current conventional laparoscopic working instruments are straight, in conventional laparoscopic surgery they are inserted through different port sites directed toward the target work site, allowing us triangulation of the work area. In single-port surgery, we work through a single general site, this forces us to work in a single general direction (parallel) eliminating the triangulation that we are familiar with and which facilitates the surgical procedure. The loss of triangulation is partially solved with the use of articulated (Figure 1a&b) or pre-bent instruments (Figure 2a,b and 3), which afford approach to the working site from a slightly different direction and the use of novel retraction devices/technique.

- **Working field:** Both the external and internal working spaces represent another challenge, the single port technique forces us to work in a limited space caused by proximity of the instrument ports and with the present conventional straight laparoscopic instruments with their bulky external profiles causes frequent clashing of the instruments. The use of specially designed intruments (Figure 1a&b, 2a&b, 3) and cameras like the Flexi-tip & Endoeye (Olympus, Japan) with more streamlined external profiles lessens some of the instrument clashing and opens up the working space (Figure 2b). Another technique is to use instruments of varying length, so the bulky profiles will be at different levels and thus lessen collision during the procedure.

Figure 1a: Handle of Roticulator™ (Covidien, USA)

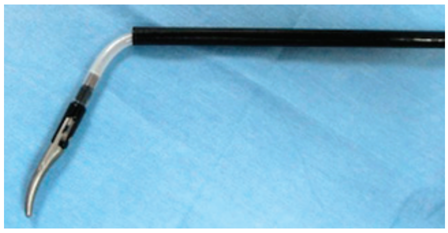

Figure 1b: Articulating end of Roticulator™ (Covidien, USA)

Figure 2a: Working end of the pre-bent instruments (Olympus, Japan)

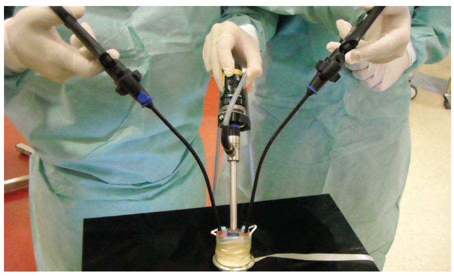

Figure 2b: Handle end of the pre-bent instruments (Olympus, Japan) and view of the opened up external working space

Figure 3: Autonomy™ instruments (CambridgeEndo, UK)

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- **Optics:** Currently, with in-line viewing, the movement of the camera may result in the movement of the other instruments. This problem may be minimized using angled or flexible scopes. A very useful instrument is the Flexitip or EndoEYE scopes (Fig 4, a-c) (Olympus, Japan). Flexitip is a very useful instruments. EndoEYE's scope with two models have the light online with the camera system and come in HD format. Without light cable there is no conflict between hands. Seems to be an optimal solution for single port surgery

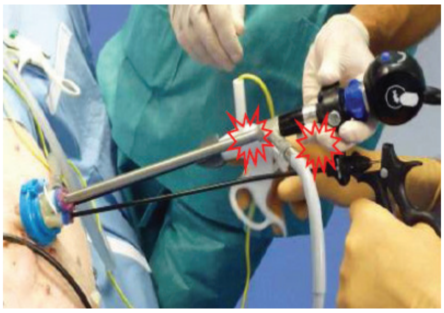

Figure 4: View of clashing instruments due to work space limitation

Figure 4a: Flexitip (Olympus, Japan)

Figure 4b: EndoEYE, Olympus Japan

Figure 4c: Endoeye LS, Olympus Japan

SINGLE PORT PROCEDURES

Appendectomy

General anesthesia is used in the same fashion as for a traditional laparoscopic appendectomy. The patient is positioned supine. A small 15 mm subumbilical incision is made and the abdomen is entered in an open fashion. The single port device is inserted. In our early experience either Triport (Olympus, Japan) or SILS (covidien, USA) devices are used. In case of SILS device, the device need to be inserted using a large surgical clamp. Another optional entry is through the umbilicus. In this case the umbilicus is everted using a littlewoods forceps. Dissection is continued down to the linea alba, and an incision is made in the fascia. In both cases once the peritoneumis is opened under direct vision, two absorbable stay sutures are inserted into the fascia. Pneumoperitoneum is established, and a 5 mm, 30 degree EndoEYE (Olympus, Japan) laparoscope is utilized to visualize the peritoneal cavity. A diagnostic laparoscopy is performed.

Once the appendix is identified, two straight instruments like graspers and bipolar dissector are used to divide the mesoappendix at the base. In some case an articulated grasper can be useful to eliminate clashing in case of further retraction and dissection.In our experience the appendectomy is carried out using endoloop positioned at the base of the appendix (2 loops) and one at the top. Lavage is performed using warm saline. The appendectomy can be also performed using endostapler with white cartridge. The appendix can be removed using Endocatch (Covidien , USA) or if Triport is utilized just using the port as bag removing the cap of the device. Skin and fascia are closed as standard procedure

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Cholecystectomy

General anesthesia is used in the same fashion as for a traditional laparoscopic cholecystectomy. Optionally a nasogastric tube is useful for deflating the stomach and improving visualization during the procedure.

The patient is positioned supine. A small 15 mm subumbilical incision is made and the abdomen is entered in an open fashion. The single port device is inserted. In our early experience either Triport (Olympus, Japan) or SILS (covidien, USA) devices are used. In case of SILS device, the device need to be inserted using a large surgical clamp. Another optional entry is through the umbilicus. In this case the umbilicus is everted using a littlewoods forceps. Dissection is continued down to the linea alba, and an incision is made in the fascia. In both cases once the peritoneumis is opened under direct vision, two absorbable stay sutures are inserted into the fascia. Pneumoperitoneum is established, and a 5 mm, 30 degree EndoEYE (Olympus, Japan) laparoscope is utilized to visualize the peritoneal cavity. A diagnostic laparoscopy is performed. One or Two transfascial suture are utilized to lift up and manipulate the gallbladder (so called "Puppet Technique"). For this porpouse, we use a nonabsorbable on straight needle. The suture are placed thorugh the abdominal wall, passing through the gallbladder fundus and exit through the skin again using a standard needleholder. An additional liftling suture can be placed at the level of the infundibulus. This technique has been already described in 2001 (D. Lomanto et al. Surg Lap Endosc Percutan Tech 11 (4): 248-51, 2001). The patient is tilted into the reverse Trendelenburg position with the right side up as in standard laparoscopic cholecystectomy.

A Roticulator grasper (Covidien, USA) is introduced into the peritoneal cavity to assist for the retraction and dissection of the Calot's triangle. Retraction and exposure of Calot's triangle.

At this point, pericholecystic adhesions can be cleared if any and the Hartmann's pouch identified. Dissection of Calot's triangle now can proceed using a combination of roticulator grasper and dissector as well as hook diathermy. The surgeon operates essentially one handed, with his other hand free to hold the telescope. The assistant in case of crossing instrument can help to hold the grasper hoding the gallbladder pouch. After isolated and clipping the cystic duct and artery using Haemolock, a retrograde cholecystectomy is carried out as standard. The gallbladder can be removed using Endocatch (Covidien , USA) or if Triport is utilized just using the port as bag removing the cap of the device. Skin and fascia are closed as standard procedure.

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Inguinal Hernia Repair

This novel technique is gaining much popularity due to the huge acceptance of patients for a single scar after surgery. This technique is perceived to produce better cosmesis and less postop pain. The fundamental idea is to have a device that allows all the working ports to enter the abdominal wall through the same incision. There are two ports that we currently use, the Triport™ (Olympus, Tokyo, Japan) and the SILS™ port (Covidien, Norwalk, USA). The incision can be vertical 2-cm through the umbilicus so as to hide the scar or a 2-cm transverse incision infraumbilically. We prefer the latter due to the smaller chance of forming a wound infection. Once the preperitoneal space has been created, the port is guided through the incision with the use of the introducer which comes with the Triport™ (Figure 5) or a Roberts clamp if using the SILS™ port (Figure 6). We prefer using the Endoeye™ (Olympus, Tokyo, Japan), which is a 5-mm, 30 degree scope with the light cable behind the camera head to minimize clashing of the light cable with the surgeon's hands. Special articulated instruments or pre-bent instruments are preferred so as to increase the instrument's triangulation inside the preperitoneal space. We still use conventional straight instruments to carry out the whole procedure.

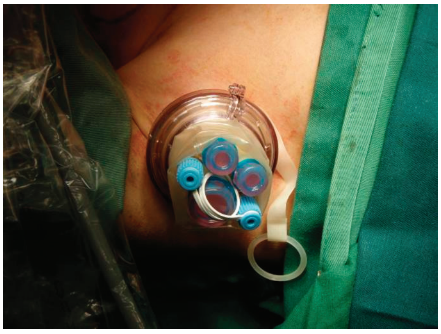

Figure 5

Figure 6

Points of note with the use of the SPES technique in TEP surgery is that the camera will move together with the instrument's movements which makes the image unstable. In the absence of special pre-bent or reticulated instruments, clashing of instruments will be felt as well as clashing of the surgeon's hands with each other.

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Suggested Readings:

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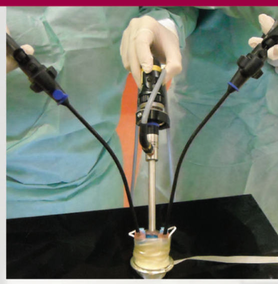

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