MANUAL OF
LAPAROSCOPIC SURGERY

First 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

Diagnostic Laparoscopy was being practiced in Singapore in the late 1960s (Professor K. T. Chan) with limited instrumentation then available. Laparoscopic activity has had a significant impact in Obstetric and Gynaecology ever since the stimulating visit of Kurt Semm in the 1970s. In Orthopaedic Surgery new horizons have been opened up with minimal access to joints and the spine. However, since the first laparoscopic cholecystectomy in Singapore (1990, M. Chellappa), the phenomenon of minimal access to the abdominal cavity (including rectroperitoneum and thorax) has radically changed our approach and practice, and most importantly training of the abdominal surgeon.

It is now mandatory for the surgical trainee (basic and advanced) to be completely familiar with all aspects of access, surgical procedure, camera technique, intra-abdominal gases and pressures, etc., but the surgeon must also understand the principles and fundamental workings of the hardware support systems. As technology is being continuously updated it will be necessary for all to keep abreast of these advances.

The aim of this manual is to lay down the basics of the minimal access approach for the neophyte, advanced surgical trainee and the practicing surgeon. It is hoped that it will also benefit the operating theatre staff to understand the rationale of Minimally Access Surgery (MAS). Lastly, it is the intention of this manual to disseminate the benefits of MAS and establish training standards at various levels by continued update of current information as it becomes available.

Professor Abu Rauff
PREFACE

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.

Davide Lomanto,
Cheah Wei-Keat
EVOLUTION OF LAPAROSCOPIC SURGERY

The historical development of laparoscopy can be traced back to 1901 when George Kelling 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, reduces systemic and immune response, and reduces 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. It’s faster to close smaller wounds. 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
- Endoscopic Neck Surgery

d) Abdominal Wall
- 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 the performance of surgeons so that patients benefit from the high quality of care given to them.