Chapter

Introductory Chapter: Endoscopy and ERAS

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1. The history of endoscopy

I am honored that the editorial department gave me this opportunity and provided a platform for me to write this book *Endoscopy*. I have been majoring in Hepatobiliary and Pancreatic Surgery for more than 20 years. I have witnessed the vigorous development of modern medicine and experienced the rise of minimally invasive treatment of digestive surgery. Invasive treatment and examination of digestive surgery have passed from large incisions more than 20 cm to several 1 cm-length Trocar holes, from surgery to endoscopic treatment, and from laparotomy to endoscopy or laparoscopy, which have changed the idea of the diagnosis treatment and management of digestive surgery, enhanced the recovery after surgery, and benefited the patients needing to undergo surgical procedures. It is for this reason that I plan to introduce the development of endoscopy and laparoscopy in digestive surgery and enhanced rehabilitation medicine.

An endoscope is a tube equipped with a light that can enter the body through the natural orifice of the body or through a small incision made by surgery. The original endoscope was made of hard tubes and was invented more than two centuries ago. Endoscopes are inserted into a canal or cavity to examine and obtain medical images directly, compared to other imaging techniques. With the improvement, the endoscopy varies into different types according to the sites of the body or the techniques of the system. The electronic endoscopy system is the most popular nowadays, which is mainly composed of three main parts: endoscope, video information system center, and television monitor.

Although had the first generational endoscopy gradually improved since the invention, they had still not been widely used. Later, Philipp Bozzini developed the first endoscope with a light conductor, which made the examination of orifice visible in 1806. In the 1950s, endoscopes were made of hoses, so they could easily bend around every corner of the body. In 1965, Harold Hopkins installed a lens on the endoscope to make the field of vision clearer. Today's endoscopes usually have two fiberglass tubes through which light enters the body. Through another tube or camera for observation, some endoscopes even have micro integrated circuit sensors to feed back the observed information to the computer [1].

The use of light source is an important step in the development of endoscopes, making the examinations and surgeries via cystoscopy, hysteroscopy, colonoscopy, and laparoscopy, thoracoscopy, and even nasaloscopy routine procedures since sir Francis Cruise applied an external light source into the system, which was replaced by a small internal bulb decades later.

Hans Christian Jacobaeus has been recognized as the first physician to explore the abdominal and thoracic cavity in his publications of laparoscopy (1912) and thoracoscopy (1910) [2]. Actually, laparoscopy is a kind of endoscopy, which was used first to diagnose the diseases of liver and gallbladder by Heinz Kalk in the

1930s. Followed by the application of gaseous distention of the abdomen with CO_2, gastrointestinal, hepatobiliary, and gynecologic laparoscopy developed [3].

In the early part of last century, laparoscopic technologies have been developing vigorously and many groundbreaking events have taken place, such as performing the first laparoscopic procedure in dogs by Georg Kelling of Dresden, Germany, and performing the first laparoscopic operation in humans by Hans Christian Jacobaeus [4].

In the following decades, many physicians have further refined and popularized laparoscopic procedures. The emergence of television cameras based on computer chips is a groundbreaking event in the field of laparoscopy. This technological innovation simplifies the implementation of complex laparoscopic procedures by providing a magnified view of the surgical field onto the monitor and releasing the surgeon's hands.

In 1944, a gynecologic laparoscopic operation was performed by Raoul Palmer on a patient with artificial pneumoperitoneum in Trendelenburg position, resulting in the abdominal organs moving to the head and enhanced security of the procedure [5].

In the 1960s, the rod lens greatly improved the image quality of the endoscope, and Basil Hirschowitz invented a glass fiber with excellent light guiding properties to create a flexible endoscope. This innovation not only created the first practical medical endoscope, but also led to the evolution of endoscopes and to the era of fiberscopes (endoscopes where both light sources and images are transmitted by optical fibers and curved bodies).

Endoscopes with both inspection and surgical functions did not appear until the 1970s, and were only used for young, physically healthy patients. In the 1980s, laparoscopic tubal ligation and pelvic examination had become essential procedures for obstetricians and gynecologists.

Cuschieri started animal experiments for laparoscopic cholecystectomy in 1986. At the first World Congress of Surgical Endoscopy in 1988, he reported a successful laparoscopic cholecystectomy for experimental animals. It was applied in clinics in February 1989. French surgeon Philipe Mouret, who had carried out a successful laparoscopic cholecystectomy for the first time in humans, succeeded in performing laparoscopic cholecystectomy for the same patient in 1987, but it was not reported.

In 1988, Dubois in Paris also used this in clinical practice based on laparoscopic cholecystectomy in pigs. The results were first published in France and the surgery was screened at the annual meeting of the American Society of Gastroenterologists in April 1989. The video hit the world in one fell swoop [6]. It first shocked the surgical community in the United States, and a surge in laparoscopic cholecystectomy was initiated in the United States, which enabled laparoscopic cholecystectomy to progress from animal experiments and clinical exploration to clinical developments.

After this century, laparoscopy began to be applied in various kinds of surgeries from laparoscopic gastrectomy and colectomy, to laparoscopic liver resection, and even laparoscopic pancreaticoduodenectomy. Indeed, its safety has also been demonstrated by surgeons around the world, and it has shown its safety and perioperative mortality is no less than that of open surgery in high volume centers [7–9].

The first transatlantic surgery ever performed was a laparoscopic gallbladder removal in 2001. Remote surgeries and robotic surgeries have since become more common and are typically laparoscopic procedures. With the invention of the surgical robot arm, the physician can remotely control the robot arm for surgery. The first case of transatlantic surgery was called Lindbergh surgery.

2. ERAS and endoscopy

Endoscopic or laparoscopic procedures alleviate the pain and trauma from surgical treatments or examinations. Thus, enhanced recovery after surgery has been possible due to minimal invasion.

ERAS is the acronym for Enhanced Recovery After Surgery. The name was established by a group of surgeons from Northern Europe who formed a research group with the aim to explore the ultimate care pathway for patients undergoing colonic resections.

Henrik Kehlet had pioneered this work with his groundbreaking work on fast track surgery [10], showing that most patients had recovered enough to be discharged 2 days after open sigmoidectomy [11]. This was at a time when the length of postoperative stay for these operations was 10 days or more in most countries. These reports were met with skepticism but work within the group showed that this was possible, with the use of multimodal approach to recovery [12].

During the following years, the initial group published several reports showing that best practice as proposed by the scientific literature was not in use. In fact, care was very different in different countries [13]. Later work confirmed marked differences in outcomes between countries in Europe [14].

Since practice differed widely among the involved centers, it was decided to promote practice changes in all participating units based on guidelines produced by the study group. This proved to be more cumbersome than initially thought and was often done in steps with re-launches of protocol. However, as perioperative management improved, it became evident that the addition of several care management items was of importance rather than isolated protocol elements. Which elements of the enhanced recovery protocol were the most important depended on the starting point for each participating unit.

As these management measures were implemented, the group decided to record and assess the changes during the time when centers were changing their perioperative management practice. This proved to be very useful. It was very common to find that complete data collection of the process revealed in fact problems with unexpected areas of the protocol [15]. Of note, it was observed that the more items the protocol used in perioperative care, the better the outcomes [16]. This was initially shown in a single center and later in a multinational multicentric study across Europe and New Zealand as well [17]. In a larger trial with >2300 consecutive colorectal patients, all complications significantly decreased with better compliance, including major complications. Although increasing evidence suggested clear short-term benefits of the ERAS protocol [18], a follow-up in >900 colorectal cancer patients demonstrated a significant higher 5-year survival associated with higher compliance with the ERAS protocol. This may also be associated with the fact that patients with higher compliance to the protocol also had fewer complications, a factor shown to be strongly associated with poorer long-term outcomes [19].

The group grew over time with colleagues joining from several other countries. The Dutch group piloted the implementation of the first guidelines developed and reported dramatic improvements in recovery time [20]. Finding that the guidelines could be implemented in a structured way with prompt improvement in results, it was decided to make an effort to help spread the ERAS concepts more widely alongside further development of research. This formed the basis for the ERAS® Society that was created officially and registered in Sweden in 2010 (www.erassociety.org). This is an international nonprofit medical academic society with members from different professions involved in surgical care.

Although the group focused primarily on colorectal surgery, soon the principles were adapted for other major operations such as Hepato-Pancreatico-Biliary, upper gastrointestinal, urology, and gynecology, and today ERAS covers surgical specialties broadly. Since inception, a range of guidelines have been published and updated, authored by experts from around the world. The ERAS Society continues to develop guidelines addressing additional surgical specialties. The Society has published a manual on ERAS, in addition to running an annual international congress since 2012.

The ERAS implementation program is a structured systematic implementation program successfully employed internationally in >25 countries. In this program, hospital teams of surgeons, anesthetists, nurses, and allied health professionals come together in workshops over a period of 8–10 months and are coached while implementing ERAS in their own unit. The current ERAS Society implementation program was initiated in Sweden, then disseminated in the Netherlands, United Kingdom, and Switzerland and later to Canada, Australasia, and the United States. Further units were trained by Swedish and Swiss implementation teams in France, Spain, and Latin America. The work done by the Alberta Health Service in Canada is of particular note. The entire state is implementing ERAS protocols and clinical researchers have been very active in developing ERAS protocols for a range of surgical disciplines. More recently, in October 2016, an ERAS Society sister organization was started in the United States, ERAS (www.erasusa.org), to spread the mission of ERAS in the United States.

The ERAS implementation program introduces the use of the ERAS Interactive Audit System (EIAS) created and developed by the ERAS Society. This audit system provides real-time quality control, in addition to being a very powerful research tool. Data in the ERAS database are updated hourly and become available in the EIAS. This audit system helps teams to continuously keep track of outcomes and processes as well as benchmarking with other hospitals. This system also serves as a source and a platform for research for individual units as well as for the network involved with the ERAS Society.

Several reports from single centers have shown major savings for implementing ERAS into daily care. A report from Alberta, describing cost savings for ERAS in colorectal surgery statewide, showed return of investments of at least 240% [21]. Other publications have shown major cost saving in pancreas and in liver surgery [22, 23].

ERAS is a new type of multidisciplinary teamwork with readiness to make changes as better care is developed. For this reason, ERAS is not just a single, rigid protocol as protocols continuously change and improve as knowledge evolves. The ambition of the ERAS Society is to disseminate evidence-based principles for perioperative care and to support the development of new knowledge in perioperative medicine and surgical pathophysiology.

Physicians have been trying and experiencing ERAS appliance in Hepatopancreatobiliary (HPB) Surgery for more than 10 years. Many principles of Enhanced Recovery After Surgery management have been extracted from the ones in colorectal surgery. As a result, these principles may not be easily applied into HPB surgery. Consequently, the operations may be more complex and may require a longer postoperative stay. For example, there are differences in preoperative infusion. In the liver surgery, it is preferred to reduce the blood loss in the operation to the greatest extent via low central venous pressure, a relative hypovolemia and avoidance of excessive preoperative infusion.

In colorectal surgery, minimally invasive surgery is often used as part of ERP, although its positive effects have yet to be confirmed [24]. Laparoscopic hepatectomy is under study and is currently a hot topic of many reviews [25, 26]. It has been reported that patients with benign disease were hospitalized for 5 days after major resection [27]. Laparoscopic minimally invasive surgery eliminates large upper abdominal incisions. Besides, anesthesia and analgesia in the perioperative surgical incision area, it shortens the postoperative hospital stay, and guarantees successful ERAS. In fact, laparoscopic resection has been challenged by open surgery during the initial stage of ERAS [28], and one of the RCTs for colon cancer surgery showed no difference in mortality, morbidity, readmission rate, or length of hospital stay [29].

Laparoscopic hepatobiliary and pancreatic surgery is still a concern due to its 8–15% open conversion rate secondary to major bleeding and 2% positive margin rate. There is also concern that pneumoperitoneum increases the risk of tumor spread and extra incisions required to remove large samples [30].

Although laparoscopic hepatectomy is widely used in most HPB centers, especially in atypical or wedge resection, laparoscopic techniques are not applied at the same speed in pancreatectomy. In particular, the application of laparoscopic surgery in complex operations such as pancreaticoduodenectomy, even in the leading institutions of robotic surgery, has not shown an improvement in length of hospitalization or morbidity, which needs further data to demonstrate [31, 32].

Among the indicators used to evaluate the effectiveness of ERAS, the length of hospital stay was considered to be more important. However, it may not best reflect the recovery of body function after surgery, and the incidence of complications may be a better quantitative indicator of safety. Therefore, we recommend the implementation of standardized multimodal approaches in HPB surgery to increase awareness of the goals of improving safety and clinical outcomes, which is of greater importance. Laparoscopic pancreaticoduodenectomy has been routinely carried out in our center. According to our own experience, gastrointestinal function of patients undergone LPD recovered quickly after surgery and intra-abdominal infection rate was reduced.

The illuminant of endoscope lights the cavity or tract of human body or organs, changes the managements of kinds of diseases, and benefits patients with minimally invasive approaches. Finally, I hope to introduce the appliance of endoscopic and laparoscopic procedures in digestive system via *endoscopy* and make the examinations and treatments more minimally invasive and effective [33–36].

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