

Pregledni članek

Review article

Endoscopic surgery in the 21st century

Endoskopska kirurgija v 21. stoletju

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To paraphrase Bernard of Chartres:

“Only by standing on the shoulders of giants will you see beyond the horizon” –

“Pigmaei gigantum humeris impositi plusquam ipsi gigantes vident”

Abstract

In the last quarter of the 20th century, endoscopic procedures replaced most of the traditional abdominal operations. They shortened hospital stay and reduced morbidity. At the beginning of the 21st century, the progress in technology enhanced the development of transluminal endoscopic surgery in the field of gastroenterology. Parallel, the New European Surgical Academy founded the first European based Working Group on Natural Orifice Surgery (NOS). This group concentrates on the development of transdoulas procedures in women by using the transdoulas endoscopic device (TED). This is a wide multi-channel instrument, which will enable surgeons to perform most of the surgical, urological and gynaecological operations through a single entry. This article describes the logic behind this approach and the expected challenges.

Key words. *Natural orifice surgery, transdoulas procedures.*



Izveček

Zadnjih 25 let 20. stoletja je endoskopska kirurgija nadomestila večino klasičnih abdominalnih operacij. Omogočila je krajšo ležalno dobo in zmanjšala pooperativne zaplete. Na začetku 21. stoletja pa so zaradi tehnološkega napredka gastroenterologi razvili transluminalno endoskopsko kirurgijo. Sočasno je New European Surgical Academy (NESA) ustanovila prvo Evropsko delovno skupino za kirurgijo skozi naravne telesne odprtine (European based Working Group on Natural Orifice Surgery (NOS)). Ta skupina razvija operativne postopke skozi Douglasov prostor pri bolnicah z uporabo endoskopskih inštrumentov za tak postopek (Transdouglas Endoscopical Device, TED). To je inštrument z več delovnimi kanali, ki omogočajo izvedbo večine kirurških, uroloških in ginekoloških operacij skozi eno odprtino. V članku je opisana logičnost takšnega pristopa in pričakovani rezultati.

Ključne besede. Kirurgija skozi naravne telesne odprtine, postopki skozi Douglasov prostor

Introduction

A new surgical discipline is being evolved these days. The existing natural openings of the body are used for introducing surgical instruments and performing surgical procedures, without penetrating the abdominal wall.

This idea is not entirely new. Different operations like trans-sphenoidal hypophysectomy or vaginal hysterectomy were already performed in the past, but the continuation of this trend seems to constitute a natural step towards future surgical progress.

It is now 200 years since the first successful laparotomy was performed: in 1809, Mrs. Crawford in Kentucky survived a cystectomy performed by Ephraim McDowell without anaesthesia (1).

At the beginning, laparotomies were performed longitudinally, first sporadically, but became routine when general anaesthesia was introduced (William Morton, Boston, 1846) (2). Gynaecological laparotomies were optimized in 1897, when Johannes Pfannenstiel (3) introduced his lower abdominal transverse incision.

Surgeons tend to be conservative. For many years, both, the longitudinal and the transverse incisions, were used as traditional incisions in different institutions. However, the first comparison between both incisions (by caesarean section) was done only 75 years after the introduction of the transverse incision (4).

In the 20th century, a wave of innovations emerged in numerous fields, including general surgery. In 1901, Georg Kelling in Germany

performed the first experimental laparoscopy (5,6). This surgical approach could have never developed further if the endotracheal intubation had not been introduced (7). The intraabdominal pressure needed for endoscopical operations requires active respiration, which would have been impossible without endotracheal respiration.

When the right conditions were provided, a variety of endoscopical procedures emerged, which gradually replaced the majority of laparotomies. The first laparoscopic cholecystectomy was performed by Erich Mühe in 1985 (8), and was followed by the first laparoscopic assisted vaginal hysterectomy carried out by Harry Reich in 1989 (9). This trend has continued until today, and most abdominal operations have laparoscopic alternatives. Today cholecystectomies are mostly performed laparoscopically (10). We believe that in the future the caesarean section will remain as the only elective laparotomy.

Laparoscopic operations are expected to yield the same results as laparotomies, yet without the extended abdominal scars and the associated pain, febrile morbidity, limitation of movement and prolonged hospital stay (11,12).

The Natural Orifice Surgery (NOS) concept

In order to optimise the existing surgical procedures, the New European Surgical Academy (NESA) was founded in 2004. NESA promotes the excellency, minimalism and adjustment of procedures to their correct indications. NESA's



main principle is: "Nothing lacking, nothing superfluous". With this principle in mind, NESA promotes and develops some evaluated and analysed operations, such as the Misgav Ladach caesarean section (13) or the ten-step vaginal hysterectomy (14).

Laparoscopic procedures, despite their advantages, have not proved to be free of risk: in a series of 3,572 patients undergoing laparoscopic assisted vaginal hysterectomy, a total of 67 complications occurred. One patient died because of injury to the aorta caused by insertion of the trocar. Other complications related to insertion of the Verres needle, principal and accessory trocars, were noted in 25 cases (38.2%). Intraoperative complications were seen in 32 patients (47.8%) and postoperative complications in 10 (14.9%) (15). Typical laparoscopic complications result from anaesthesia (gas embolism, cardiovascular failure due to the hyperinsufflation of the abdomen, blind insertion of the Verres needle, insertion of the trocar, bleeding from major blood vessels and damage to the intraabdominal organs) (15,16).

The tremendous development of new technologies coupled with the current possibilities to simulate procedures prior to their clinical application enables us to plan operations which were previously designed on a trial-and-error basis. The simulation is needed to create future high-quality and safe operations, associated with lower morbidity.

The natural orifice approach in general surgery, though it is still in an experimental phase, is an important step taken in this direction. Peritoneoscopy, appendicectomy, liver biopsy, splenectomy and partial hysterectomy have already been performed transgastrically using an endoscope (17).

The transgastric approach is feasible, but may be associated with potential problems: the stomach acidity, iatrogenic perforation of the stomach, bacteriological contamination of the instruments introduced through the mouth, oesophagus and stomach and the limitations involved with the diameter of the instruments used. The American term for this surgical approach is NOTES (Natural Orifice Transluminal Endoscopic Surgery). Parallel, the NESA founded last year the first European based Working Group on Natural Orifice Surgery (NOS), It was decided to concentrate on the transdouglass endoscopic procedures.

The terminological difference is not coincidental. The "T" in NOTES stands for Transluminal. NOS is a generic term, which includes the NOTES. NOS stands for all surgical procedures performed through natural openings in neurosurgery, otorhinolaryngology, gastroenterology, general surgery, urology and gynaecology (18).

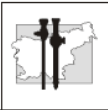


Figure 1
Wide multi-channel instrument

In the past, some procedures were performed through the pouch of Douglas: removal of the gallbladder at the end of endoscopic cholecystectomy (19), appendicectomies following vaginal hysterectomy (20,21) and various gynaecological procedures, such as myomectomy (22). However, routine transdouglass approach for abdominal operations, such as cholecystectomies, colectomies and splenectomies, is now planned for the first time.

The use of the vaginal route for abdominal operations in women is expected to involve more benefits and to entail less risk because of the following considerations:

1. The need for traditional 15 mm Hg pressure for creating space between the abdominal wall and the great blood vessels has been obviated; only the necessary optimal pressure will be used.
2. Surgical instruments are introduced under direct vision, avoiding the risk of injury to the abdominal organs or blood vessels, which may occur with the blind introduction of the Verres needle.



3. Many procedures can be performed with epidural anaesthesia because of the lower intraabdominal pressure needed.
4. The instruments are introduced parallel to and not perpendicular to the major blood vessels, thus minimizing the risk of injury.
5. The pouch of Douglas allows for the introduction of wide-bodied, multi-channel device, affording a single entry surgical procedure.
6. The vagina, unlike the mouth or oesophagus, can be cleaned and disinfected, which minimizes the risk of infections.
7. The vaginal wall repairs itself rapidly and integument without leaving any visible scars.
8. The transdouglass approach provides optimal ergonomic working conditions for the surgeon who performs the operation while sitting.
9. There is no risk of herniation or eventration.

Challenges confronting the development of the transdouglass approach.

The main challenge is the development of special transdouglass endoscopic instrumentation, which should take into account the special anatomy of the pelvis.

In order to reach the upper abdomen, an S-shaped device was designed, bending first anteriorly, and then posteriorly. A relatively wide diameter of the device and its multi-channel shape enable the operating surgeon to use simultaneously different instruments, thereby obviating the need for the second puncture.

This method will be used in a wide variety of intraabdominal operations in women, covering various surgical disciplines: cholecystectomy, splenectomy, different biopsies, colectomies, nephrectomies, adrenalectomies, lithotomies etc. A U-shaped variant of the instrument has been designed for the lower abdomen, respecting the anatomy of the pelvis. Various operations of the lower abdomen, such as appendectomy, cystectomy and hysterectomy will thus become possible.

Parallel to the technical development of the instrument, a multidisciplinary team should be created. Surgeons and urologists will need the

assistance of gynaecologists to enter the peritoneal cavity. NESAs are planning a surgical subspecialty, which will emerge from this interdisciplinary cooperation.

The first European based NOS Working Group

The NESAs founded the first European based NOS Working Group comprising different disciplines and representatives of the industry, coming from Canada, France, Germany, Israel, Italy, Japan, Switzerland, and the United States.

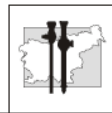
The first meeting of the Working Group took place in Berlin on 23 June 2006. The concept of NOS was presented and discussed, the pharmacological and physiological challenges concerning the transgastric approach were defined and considered, and the published experimental achievements discussed. The European NOS Working Group comprising scientists and surgeons finally decided to focus on the use of the transdouglass approach in women, and to examine the possibility to use the transdouglass endoscopic device in men transrectally.

The reasons for this decision are the following:

1. Transdouglass operations carry less risk of bacterial contamination than the transgastric approach.
2. The opening and the closure of the vaginal wall are done under direct vision; the procedure is safe, and the suturing does not leave any scars or long-term dysfunction.
3. The potential diameter of the adapted surgical instruments enables the surgeon to work in a safe and comfortable manner.
4. It is assumed that it will be possible to perform most of the transdouglass operations using epidural anaesthesia.
5. The operating surgeon will perform the procedure under optimal ergonomic conditions.

In order to realize this project, the following expert working groups were created:

1. A basic science group
2. A surgical-urological-gynaecological group
3. An interdisciplinary group
4. An instrumentation group and



5. A scarless surgery group, the NSO Working Group, which addresses the issue of scarless operations. A new evolving approach promotes methods, such as the axillo-bilateral-breast (ABBA) operation on the thyroid (23).

The working groups meet twice a year, and maintain constant contacts through the NESAs web site (www.nesacaemy.org). Simulation of various intraabdominal operations using TED has been done, and the construction of the device is in progress.

Conclusions

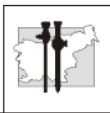
In the past, surgical methods were mostly a result of experience gathered in daily clinical practice. Only few operations resulted from pre-planned thinking and designing, based on theoretical considerations and experience, one of these being the ten-step vaginal hysterectomy (14). Today, surgical techniques, based on surgical skills and knowledge, are designed systematically, and the required equipment is designed parallel to the planned operation. New procedures should be based on sound anatomical and physiological knowledge, and should be bio-simulated prior to implementation.

New techniques can be introduced only if they meet high quality and safety standards, and never just for the sake of novelty.

NESA believes that the transdouglass surgery will replace many endoscopic operations, and will create a spectrum of innovative, high-quality and safe operations, performed by an interdisciplinary team.

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