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A Stasyshyn
Department of Surgery and
Endoscopy, Faculty of post-
graduate medical training,
Danylo Halytsky Lviv National
Medical University, Lviv,
Ukraine

The first experience of robotic da Vinci procedures in Ukraine

A Stasyshyn

Abstract

We have analyzed the first minimally invasive interventions in the clinic of surgery and endoscopy affiliated to the Faculty of postgraduate training of the Danylo Halytsky Lviv National Medical University and communal non-profit institution "Clinical Hospital of Emergency Aid in Lviv" and the clinical cases associated with first robot-assisted operations.

Results and Discussion: Until the early 1990th, the development of surgical technology took place mainly due to the talents of individual surgeons and their persistence in implementing new treatments. The directions of work of our Department of endoscopic surgery included the introduction of minimally invasive (laparoscopic) surgical interventions and endoscopic interventions using flexible endoscopy.

Robot-assisted operation of the patient with diaphragmatic hernia using da Vinci surgical system was performed with three 8.5 mm robotic instruments and two 5 mm laparoscopic ones. The operation had been lasting for 6 hours. There were no intra- and postoperative complications. The patient was discharged home on the 3rd post-op day in satisfactory condition. Robot-assisted surgery for complicated gallstone disease was performed with three 8.5 mm robotic instruments and one 5 mm laparoscopic one. The operation had been lasting for 3 hours.

Conclusions: 1. The introduction of modern technologies and minimally invasive interventions results primarily from activities of the clinic's staff, the head of the structural unit and the hospital administration, as well as from the high professional level of surgeons.

2. The usage of minimally invasive, laparoscopic, endoscopic techniques, as well as that of da Vinci surgical system in clinical practice will improve therapeutic outcomes and quality of life among patients with surgical disorders.

Keywords: Minimally invasive procedures, robotic and endoscopic surgery

Introduction

Until the early 1990th, the development of surgical technology took place mainly due to the talents of individual surgeons and their persistence in implementing new treatments [4, 7]. In 1987, Phillipe Mouret performed the first laparoscopic cholecystectomy in France [11, 12]. In 1992 in Lviv a surgical team including Igor Lukavetsky and Ostap Mogilyak accomplished the first laparoscopic cholecystectomy in Ukraine [10]. In 1993 and 1994, the first laparoscopic operations were performed at the Lviv regional hospital for military disabled persons and victims of repressions (B. Soloviy) and the Lviv regional clinical hospital (Ya. Gavrysh) [7, 14]. On December 9, 2020, the first time in Ukraine Nissen fundoplication using da Vinci surgical system was performed by Andrii Stasyshyn - Professor Department of Surgery and Endoscopy, Faculty of post-graduate medical training Danylo Halytsky Lviv National Medical University, Ukraine.

The Department of Endoscopic Surgery, as a structural subdivision of the Municipal clinical hospital of emergency aid in Lviv, was established in 2002. The direction of the department's work included the introduction of minimally invasive (laparoscopic) surgical interventions and endoscopic interventions using flexible endoscopy.

During the existence of the Department (2002-2019) laparoscopic operations on the esophagus, stomach, hepatobiliary area, colon were introduced, as well as in gynecology and urology. Endoscopic retrograde cholangiopancreatography (ERCP), papillosphincterotomy (EPST), endobiliary drainage in benign and malignant disorders of the hepatobiliary zone were implemented to comprehensively address the treatment of gallstone disease's complications.

Since 2007 a 24-hour laparoscopic service has been organized for diagnostic and operative interventions in situations of emergency surgery and gynecology, combined trauma.

The hospital's department was the base of the Department of surgery and endoscopy of the Faculty of postgraduate training of Danylo Halytsky Lviv National Medical University (Head of the Department – Doctor of Medical Sciences, Professor Bogdan Matviychuk).

Corresponding Author:
A Stasyshyn
Department of Surgery and
Endoscopy, Faculty of post-
graduate medical training,
Danylo Halytsky Lviv National
Medical University, Lviv,
Ukraine

The head of the hospital's department is Artur Huraevskiy - a surgeon with the highest qualification category, surgeon-in-charge, lecture assistant of the mentioned above university Department of surgery and endoscopy.

Since 2011 a separate OR for emergency laparoscopy has been created on the 5th floor of the operation section. Patients were hospitalized to 10 beds allocated in the 1st surgical department and the 3rd surgical department, as well as in other specialized departments.

In the Department of endoscopic surgery about 1000 surgeries are performed annually: minimally invasive laparoscopic operations for diseases of the hepatobiliary zone: cholecystectomy for acute and chronic cholecystitis, operations on the bile ducts with choledochotomy. Urgent operations such as appendectomy for acute appendicitis, suturing of perforated gastric and duodenal ulcers, dissection of adhesions in adhesive disease were not rare. Doctors of the Department performed fundoplication with crurorraphy for hiatal hernias and gastroesophageal reflux disease and cardiac achalasia, excision of renal cysts, removal of ovarian cysts and uterine fibroids, diagnosis of infertility, minimally invasive treatment of ectopic pregnancies and other diseases. Surgical interventions on the colon (right and left hemicolectomy, resection of the sigmoid colon), stomach and duodenum (subtotal gastrectomy, removal of stromal tumors – GIST) were mastered and implemented.

Another area of the department's activity was endoscopic interventions on the major duodenal papilla. The following manipulations were performed: ERCP, suprapapillary choledochostomy, lithoextraction with lithotripsy, endobiliary drainage, balloon dilatation of choledochal strictures, stenting of the bile and pancreatic ducts. In the department also were performed endoscopic operations on pancreatic pseudocysts. Treatment was performed by papillary drainage of the major pancreatic duct or of the the pseudocyst directly, by endoscopic cystogastro- and cystodoudenostomy with the endoscopic sonographic control if necessary.

Much attention was paid to the study of gastric and esophageal disorders, in particular, hiatal hernia (HH) and gastroesophageal reflux disease (GERD). HH, today, occupies a major place in the occurrence of GERD, is associated with a high risk of complications such as esophageal bleeding, strictures, perforations, metaplasia, compression of the mediastinum ^[1, 3, 6]. The cause of HH and GERD is dysfunction of the antireflux barrier, which includes: the lower esophageal sphincter (LES), abdominal segment of the esophagus, esophageal hiatus (EH), gastro-diaphragmatic ligament, acute angle of His, fold of mucous membrane. In severe GERD, acid damage of the esophagus leads to a decrease of its contractility and LES tone, they do not restore after healing of erosions due to the pharmacological treatment. Sliding HH causes relaxation of the diaphragmatic-esophageal apparatus and an increase in the EH diameter. At the same time the cardiac part of a stomach moves to a thoracic cavity through EH. Mixed HH occurs more often than a typical paraesophageal hernia. In this case, there is a general weakness of the phrenoesophageal membrane combined with its local tear, so not only the esophageal-gastric junction slides up through the hiatal foramen of the diaphragm, but also larger or lesser part of the stomach ^[2].

Nissen performed the first open fundoplication in 1956, the first laparoscopic Nissen fundoplication was performed by Dallemagne in 1991, and the first robot-assisted one was performed by Chapman in 1999. In Ukraine, the first robot-

assisted Nissen fundoplication using da Vinci surgical system was performed on December 9, 2020 in Lviv by Andrii Stasyshyn.

Today, da Vinci surgical technology (Intuitive Surgical Inc., USA) is a computer control system for endoscopic instruments, most often used in surgical operations. The US Food and Drug Administration (FDA) has allowed the usage of this system for general surgical, urological, gynecological, transoral otolaryngological operations, benign and malignant tumors, laparoscopic and thoracoscopic interventions ^[5].

The advantages of robot-assisted surgery over laparoscopic methods can be divided into technical and clinical ones. Technical advantages include: improved stabilized three-dimensional stereoscopic control of the operative field, increased image clarity and depth perception beyond the standard laparoscopic monitor. Digital magnification of high resolution provides greater confidence in the accuracy of surgical manipulations. The increased maneuverability of the instruments has created an additional degree of freedom from five movements to seven, improving the agility of surgeons and providing greater accuracy in the surgical field, which more closely mimics open surgery. In combination with this technology, hand stabilization eliminates the surgeon's tremors and allows you to restore scaled movements. One of the latest additions to the system is a new integrated ability to visualize fluorescence, which provides identification of key anatomical structures in real time using infrared technology. This allows the surgeon to visualize the final perfusion of the tissue, which has considerable clinical interest. Operations can be performed over long distances. Clinical benefits: greater accuracy, smaller incisions, absent fatigue during prolonged surgery results in reduced blood loss, less pain, faster healing, reduced duration of in-hospital stay, faster return to normal activity, lower mortality and morbidity, possibility to operate patients with obesity or severe surgical anatomy ^[13, 15].

While Jacques Perrisat of Bordeaux (France), presented the laparoscopic cholecystectomy technique for the Association of American Endoscopic Surgeons (SAGES) in Atlanta (USA), in the 1990s, a group of researchers began to consider developing a system that could be used for minimally invasive surgery. In 2001, in a dramatic demonstration of telesurgery, Jacques Marescaux used the da Vinci surgical system for the first time to perform a cholecystectomy on a patient in Strasbourg (France), while a surgeon was in New York (USA) at a distance of 4,000 km. This operation was called "Operation Lindberg" and lasted 54 minutes. No technical complications were observed ^[8, 9].

The development of robotic surgery in Lviv began with da Vinci-assisted surgery for HH (9.12.2020), and on February 26, 2021 for the first time was operated a child with adhesive bowel obstruction. On March 12, 2021, a robotic cholecystectomy was performed using the da Vinci surgical system (Andrii Stasyshyn, Artur Huraevskyy, Andrii Dvorakevych).

The goal of our work is to analyze the history of the minimally invasive surgery in a clinical emergency hospital and to present the clinical cases of the first robotic operations.

Materials and Methods

The history of laparoscopic and endoscopic operations during 2002-2019 is analyzed and the implementation of the first minimally invasive interventions in the clinic of surgery and endoscopy of the Faculty of postgraduate training of the

Danylo Halytsky Lviv National Medical University and communal non-profit institution "Clinical Hospital of Emergency Aid in Lviv" is studied.

Clinical cases of the first robot-assisted operations are presented and analyzed: patient K., 50 years old, with sliding HH, type I, II degree, GERD, who was admitted to the clinic of surgery and endoscopy of the Faculty of postgraduate training of the Danylo Halytsky Lviv National Medical University and communal non-profit institution "Clinical Hospital of Emergency Aid in Lviv", and was operated on December 9, 2020, robot-assisted Nissen fundoplication was performed. Patient M., 69 years old, with gallstone disease, choledocholithiasis, mechanical jaundice, acute calculous cholecystitis was admitted on March 5, 2021. We conducted general clinical tests (CBC, urinalysis, urine diastase, blood biochemistry, coagulation tests), esophagogastroduodenoscopy, abdominal ultrasound, thoracic and abdominal radiography, ECG, echocardiography, the patient was consulted by an internist.

Results and Discussion

The directions of activity of the Department of endoscopic surgery were the introduction of minimally invasive laparoscopic surgical interventions and endoscopic interventions using flexible endoscopy. The development of surgical technologies was mainly due to the talents of individual surgeons and their persistence in implementing new treatments.

The robot-assisted Nissen fundoplication was performed as follows: five trocars (three 8.5 mm robot-assisted and two 5 mm laparoscopic ones) were inserted into the abdominal cavity, and a 12 mm Hg carboxyperitoneum was applied. The lower segment of the esophagus was dissected and mobilized, the Lymer-Bartelli ligament was crossed with a LigaSure electro coagulator (Covidien, USA), the hepatic branch of the n. vagus was isolated, the EH, and subsequently the right and left crura of diaphragm were identified. The esophagus together with the posterior branch of the n. vagus was fixed by the handle and exposed to traction. We mobilized the gastric fundus by crossing the short vessels of the stomach. The EH was narrowed by suturing the crura of the diaphragm with two Z-shaped sutures behind the esophagus so that the distance between the esophagus and the sutures bilaterally was 5 mm. An antireflux cuff (2 cm long) was formed by moving the bottom of the stomach behind the esophagus by 360° using three Endo Stitch sutures to capture the esophagus. The distance between the diaphragm and the upper suture on the cuff was 2 cm. The patency of the esophagus was checked with a "marker" of the inflated cuff of the probe with a diameter of 2 cm. The duration of the operation was 6 hours. There were no intra- and postoperative complications. The patient was discharged home on 3rd post-op day in satisfactory condition.

On March 5, 2021, using intravenous anesthesia we performed ERCP, during which the dilation of the common bile duct up to 10 mm, combined with the presence of three concretions sized 3-4 mm, was revealed. Endoscopic papillosphincterotomy with lithoextraction was performed. Postoperative period was without complications. It resulted in normalization of general clinical assays + abdominal ultrasound was within normal range.

On March 12, 2021, a robot-assisted cholecystectomy was performed using the da Vinci surgical system, which was conducted as follows: four trocars (three 8.5 mm robotic and

one 5 mm laparoscopic) were inserted into the abdominal cavity, and a 14 mm Hg carboxyperitoneum was applied. At revision of an abdominal cavity - a gall bladder is violet-cyanotic, thick-walled, enlarged, strained, in a loose infiltrate with an omentum and a liver. Using robotic system we alternately separated, clipped and cut off d. et a. cystica. Cholecystectomy from the cervix was done by electrocoagulation. The gallbladder was removed in a container from the abdominal cavity through the trocar port in the paraumbilical region. Hemostasis control. Debridement of the abdominal cavity. The infrahepatic space was drained with one tube, which was led through the right infracostal area in the site of the trocar port. Instruments and gas were removed with the optical control. 5 sutures and aseptic bandages were applied to the skin. The duration of the operation was 3 hours. There were no intra- and postoperative complications. The patient was discharged home on 3rd post-op day in satisfactory condition.

Conclusions

1. The introduction of modern technologies and minimally invasive interventions results primarily from activities of the clinic's staff, the head of the structural unit and the hospital administration, as well as from the high professional level of surgeons.
2. The usage of minimally invasive, laparoscopic, endoscopic techniques, as well as that of da Vinci surgical system in clinical practice will improve therapeutic outcomes and quality of life among patients with surgical disorders.

Conflict of interest

The authors of the manuscript attest to the absence of a conflict of interest.

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