

# Initial Experience of Robotics in General Surgery Procedures of the Gastrointestinal System

## Experiência Inicial da Robótica em Procedimentos de Cirurgia Geral e do Aparelho Digestivo

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### ABSTRACT

**Introduction:** Robotic technology is considered one of the most important innovations in abdominal surgery over the past decade. This review provides an overview of the initial experience of robotics in General Surgery in Brazil. **Methods:** Data were collected from Albert Einstein Hospital database of the robotic general surgery program and from MEDLINE in order to generate tables and identify publications. **Discussion:** The incorporation of robotic technology by Brazilian hospitals and its evolution will continue over time providing better outcome for complex surgeries and facilitating difficult surgeries.

**Key words:** Robotic. Surgery. Minimally invasive surgery. Pancreatectomy. Gastrectomy.

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### INTRODUCTION

Since the introduction and development of laparoscopy, reduced need for analgesia, faster recovery, improved cosmesis, and reduced wound complications were reported as the principal benefits of minimally invasive surgery. These benefits are the reason for the worldwide dissemination of laparoscopic surgery, and explains why minimally invasive techniques are considered standard of care for certain operations, such as cholecystectomy, fundoplication, rectal tumors, left pancreatic tumors, and bariatric surgery.<sup>1,2,3,4,5</sup>

Indication for minimally invasive techniques have recently expanded, moving from simple resective procedures to more sophisticated resective/reconstructive surgery requiring manipulation in a narrow working space or at non-ergonomic wide angles for conventional laparoscopy.<sup>6,7</sup> More complex laparoscopic surgeries require very skilled surgeons in order to obtain desired surgical outcomes.

Robotic technology is considered one of the most important innovations in abdominal surgery over

the past decade. It has the potential to compensate for the drawbacks of conventional laparoscopy, such as limited degree of instrumentation, limited 2D vision, limited range of motion and access to anatomic areas such as the pelvis and the diaphragm. Robotic systems and instrumentation enhance surgeon comfort and reduce fatigue, as well as allow solutions including 3D view, intuitive motion, augmented reality, auxiliary innovations (fluorescein, single incision surgery) and additional degrees of instrumentation.<sup>8,9</sup>

### OBJECTIVE

This review provides an overview of the history of medical robotics in General Surgery in Brazil.

### METHODS

Data were collected from database of the Albert Einstein Hospital robotic general surgery program and MEDLINE in order to generate tables with accurate historical data and to obtain publication citations.

## RESULTS

In 1995, Intuitive Surgical Inc. was founded. The company acquired the SRI Green Telepresence Surgery system, a U.S. Department of Defense funded master-slave robotic system. The company developed the system into the master-slave da Vinci® surgical system and launched it in 1999. It used true three-dimensional (3D) visualization and the EndoWrist® gear.<sup>10</sup> Table 1 presents robotic surgery milestones.

To overcome the drawbacks of laparoscopic surgery, the Da Vinci consists of a console, a laparoscopic tower, and a patient-side cart with four robotic arms. The Da Vinci system provides a 3D magnified view of the surgical field using a stereo endoscope with 2 cameras, one for each eye (right and left). The surgeon sits at a console and looks at two fixed monitors with high resolution providing depth perception.

The advantages and disadvantages of robotic-assisted surgery are currently being evaluated in various specialties including urology, cardiovascular surgery, gynecology, and general surgery. Each robotic system has been used for a large number of different surgical procedures, and there are now many published case reports,

small series, and small randomized trials.<sup>11,12,13,14,15</sup>

The first robotic system in Brazil was acquired in 2007, the same year that Albert Einstein Hospital (AEH) acquired its first robotic system. A robotic general surgery program was established at AEH in 2008. Thirty robotic cholecystectomies were performed at AEH in the first 3 months. After this period, surgeons were permitted to perform a broader range of surgical procedures.

Since that time more than 400 robotic general surgeries have been performed at AEH. (Table 2). Between 2009 and 2012 Macedo and Schraibman were pioneers in Latin America, performing robotic surgeries of the digestive tract, among them, left pancreatectomy, esophagectomy, gastroduodeno-pancreatectomy, colectomy, splenectomy, total and vertical gastrectomy. Machado and Abdalla performed the first robotic hepatectomy in Latin America and Averbach, rectosigmoidectomy for deep invasive endometriosis.

## DISCUSSION

As history shows, there will always be a continuing evolution of surgical techniques and

**Table 1 - Robotic Surgery Milestones.**

Year	
1985	First surgical robot used to perform brain biopsies
1989	First urologic robot for Transurethral Resection of the Prostate (Probot)
1993	First commercially available robot approved by the FDA (AESOP, Computer Motion Inc.)
1998	Zeus system (Computer Motion Inc.) made commercially available
2000	da Vinci system for general surgery (Intuitive Surgical Inc.)

**Table 2 – Number of robotic cases performed at Albert Einstein Hospital by year.**

Speciality	2008	2009	2010	2011	2012
Head & Neck surgery	0	3	2	1	8
Thoracic surgery	0	0	6	4	10
Cardiac surgery	0	0	12	7	1
Gynecologic surgery	3	23	44	115	98
Gastrointestinal surgery	2	89	98	128	103
Urology	80	114	107	216	304
<b>Total</b>	<b>85</b>	<b>229</b>	<b>269</b>	<b>471</b>	<b>524</b>

technology, with the ultimate goals 'ideal' access, perfect vision, minimally aggressive instrumentation, and low cost,.

In our series the complexity of cases and the number of cases performed increased over time. Several papers have been published by our group and other Brazilian surgeons.<sup>16-19</sup> Our group has also made presentations abroad. As of mid-2013, we estimate that there are 10 robots in Brazil and perhaps 20 in all of Latin America. Worldwide there are almost 1800 robots currently in use, with almost 1000 in the United States. We believe that robotic surgery will increase worldwide as it enables more complex and delicate surgeries to be performed in a minimally invasive fashion.

As a developing country, expensive technology and instrumentation was first acquired by private hospitals in Brazil, which established the first robotic programs. In the past year, several public hospitals in Brazil have acquired robotic systems, making the most advanced surgical technology available to a growing number of patients treated in the public healthcare system. The sharing of

knowledge and experience by public system and private practitioners is contributing to the rapid increase in the number of successfully performed cases.

In the next few years we expect more advances in the use of robotic surgery in total mesorectal excision, and esophageal, gastric, and pancreatic surgery. We expect more public hospitals acquire robotic systems, prices for the systems will be decline, knowledge will expand and public demand for robotic surgery will increase.

## CONCLUSION

The incorporation of robotic technology by Brazilian hospitals and its evolution will continue over time providing better results for complex surgeries and facilitating difficult surgeries.

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## RESUMO

**Introdução:** Tecnologia robótica é considerada uma das mais importantes inovações na cirurgia abdominal na última década. Esta avaliação fornece uma visão geral da experiência inicial da robótica em Cirurgia Geral no Brasil. **Métodos:** Os dados foram coletados a partir do banco de dados do programa de cirurgia geral robótica do Hospital Israelita Albert Einstein e MEDLINE, a fim de realizar metas e corrigir os dados históricos e publicados. **Discussão:** O avanço da incorporação de robótica nos hospitais brasileiros e sua evolução tecnológica continuarão, a fim de proporcionar melhores desfechos para cirurgias complexas e facilitar cirurgias difíceis.

**Palavras chave:** Robótica. Cirurgia. Cirurgia minimamente invasiva. Pancreatectomia. Gastrectomia.

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