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Review

Emergence of robotic assisted surgery in gynecologic oncology: American perspective

Alberto Mendivil [a,1], Robert W. Holloway [b,2], John F. Boggess [a,*]

[a] University of North Carolina, Chapel Hill, Department of Obstetrics and Gynecology, Division of Gynecologic Oncology, 101 Manning Drive, CB 7572, Chapel Hill, NC 27599-7572. USA
[b] Gynecologic Oncology Program, Florida Hospital Cancer Institute, 2501 N. Orange Avenue, Suite 689, Orlando, FL 32804, USA

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ABSTRACT

Objectives. To discuss the emergence of robotic surgery in gynecologic oncology and describe the growth of robotic surgery in a university medical center and a community based practice.

Methods. In addition to the historical evolution of the robotic assisted surgery medicine, a survey of robotic cases was performed on two robotic programs since the inception of the programs. A review of the current literature on the use of the da Vinci robot in gynecologic oncology was also performed.

Results. The robotic surgery programs at UNC Hospital and Florida Hospital are growing steadily since the inception of the programs in 2005 and 2006, respectively. Since 2005 there have also been numerous publications detailing the effectiveness, safety, and efficiency of the robot.

Conclusions. Robotic surgery is gaining acceptance and is rapidly growing as evidenced by an increased number of publications on the topic; these publications demonstrate the safety, efficacy, and improved outcomes compared to open surgery and conventional laparoscopy.

Contents

* Corresponding author. Fax: +1 919 843 5387.
E-mail address: jboggess@med.unc.edu (J.F. Boggess).
[1] Fax: +1 919 843 5387.
[2] Fax: +1 407 303 2435.

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Introduction

Surgery is a controlled injury. In order to treat disease, surgeons balance complications and invasiveness with clinical outcomes in order to determine which techniques are best. Minimally invasive surgery (MIS) is a method to reduce the morbidity of surgery and has been shown in general to reduce blood loss, complications, post-operative pain and length of hospital stay compared with traditional laparotomy [1]. While laparoscopic tools have evolved significantly over the last three decades, there has not been widespread adoption in gynecology and gynecologic oncology [2,3]. The development and introduction of robotic assisted MIS addresses many of the limitations of traditional laparoscopy instruments by restoring dexterity and intuitive instrument movement, 3-D vision, ergonomics and autonomy. Although robotic surgery in gynecology is in its infancy, the use of the da Vinci surgical system is quickly becoming an integral tool for treating gynecologic malignancies [4]. Since 2005, robotic surgery has emerged as an effective MIS tool in gynecologic oncology that in early feasibility studies appears to decrease surgical morbidity beyond that seen with traditional laparoscopy [5–12]. The following review will outline the development of robotic surgical applications in gynecologic oncology and will describe the development of two successful robotic surgical programs – one university based and the other private practice based – in order to illustrate the specific issues inherent to both academic and private practice robotic surgery program development.

Evolution of surgical robotics

Historical perspectives

The first surgical robots were utilized in the 1980s. The first surgical robots were industrial robots that were modified to assist with surgical procedures. In 1984 the PUMA-560, a revamped industrial robot, assisted with a stereotactic brain biopsy under CT guidance [13]. After the PUMA was used to assist with prostate surgery, further, specialized surgical robots were developed [14]. The PROBOT was developed in England specifically to assist in transurethral prostate surgery. The PROBOT had an ultrasonic tip, which allowed for reconstruction of the prostate and adequate removal of the organ [15]. Thus, prostatectomy is considered the first truly robotic operation. In the late 1980s, the ROBODOC was developed by Integrated Surgical Supplies, Inc. to specifically perform hip replacements (Fig. 1). ROBODOC was the first surgical robot approved by the FDA.

Robotic surgery and tools for broader applications were further developed in the 1990s. Abdominal robotic assisted procedures became possible with the advent of Computer Motion's AESOP (Automatic Endoscopic System for Optimal Positioning). In 1994, the first FDA approval of a robotic device for intra-abdominal surgery was granted. AESOP was a robotic arm that allowed surgeons to control the orientation of a traditional laparoscope via foot pedal and later voice command (Fig. 2). AESOP was the first voice-controlled robot to receive FDA approval. Four years later, Computer Motion introduced ZEUS, a second-generation robotic system. Zeus was the first robotic system to provide instrument control in addition to camera control. Zeus was composed of three robotic arms — one for a 2-dimensional laparoscope and two arms to control surgical instruments. The camera was operated with voice commands similar to AESOP while the surgeon controlled the instrument arms from a remote console. A computer translated the surgeon's movements into the laparoscopic instruments, which were scaled according to surgeon preference. The Zeus system had a 2D video screen identical to laparoscopy (Fig. 3).

Fig. 2. Computer Motion's AESOP (Automatic Endoscopic System for Optimal Positioning) has allowed surgeons to control the orientation of the laparoscope via foot pedal and later voice commands, freeing both hands for surgery.

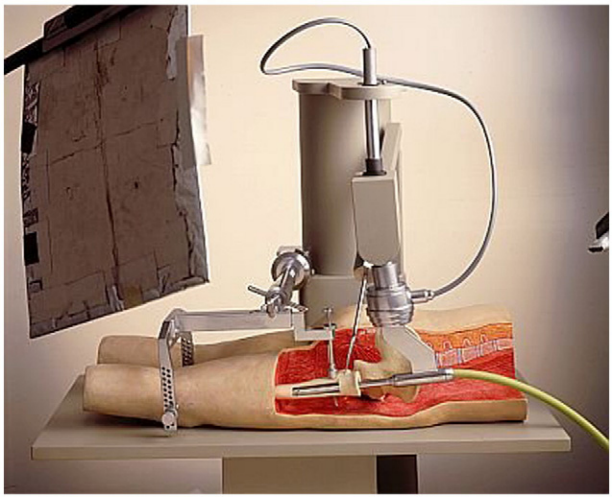

Fig. 1. ROBODOC developed by Integrated Surgical Supplies, Inc.

Fig. 3. ZEUS robotic system; first robotic system to combine instrument and camera control.