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Learning Experiences in Robotic-Assisted Laparoscopic Surgery

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With the use and adoption of computer-assisted laparoscopic technology gaining more prominence, important issues pertaining to the learning process are raised. Several modalities can be incorporated into a training program for robotic surgical development. The role and utility of various methods, including didactic instruction, virtual reality simulators, dry and wet laboratories, bedside assistance, mentoring, as well as proctorship, are still in the process of being assessed and validated. Integration of robotic training in residency and fellowship programs as well as the formation of a structured didactic robotic curriculum continues to be a challenge. Finally, methods to assess competency of training and the process for credentialing robotic surgeons still require further structuring and codification.

Introduction

The advent of computer-enhanced surgical technology has enabled many surgeons to overcome difficulties associated with conventional laparoscopy [1]. Today, these telemanipulation systems represent the latest developments in minimally invasive surgery as they offer an improved ergonomic position to the surgeon, three-dimensional visualization of the operating field, fine instrumentation, and increased maneuverability of the instruments with 6df [2]. The da Vinci® Surgical System

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(Intuitive Surgical, Inc., Sunnyvale, CA, USA) has become the most popular system for robotic-assisted laparoscopic surgery (RALS) [3]. In the past decade, over 1.5 million operations have been performed with the da Vinci Surgical System [3] and an increasing number of national and international centers are adopting robots in specialties including gynecology, urology, cardiac, thoracic, as well as head and neck and general surgery [4].

Due to the rapid uptake of robotic-assisted surgery, proper training and guidelines for safe use of this technology are necessary. Currently, no standardized system exists to evaluate surgeon competency and safety with the robotic platform. In addition, robotic surgical training poses unique challenges to educators, trainees, and institutions. During video laparoscopy and open surgery, the mentoring surgeon is scrubbed in the surgical field next to the trainee, is able to operate in tandem with the trainee, and is able take over the case at any given moment where patient safety may be compromised. This is currently not the case with robotic-assisted procedures as only one surgeon can be operating at any given time. Therefore, a certain level of skills and competency should be achieved prior to performing live cases on the console.

From the trainees' perspective, with limits in working hours, fear of litigation, and financial constraints, the prospect of training in robotic surgery can be a daunting task [5–7]. Currently, training surgeons for robotic techniques has been unstructured and the requirements have differed from hospital to hospital [7]. Trainees and program directors have recognized that the traditional “on-the-job” training can be difficult in the context of robotic surgery. Therefore, alternative methods such as structured didactic courses, simulation training, mentoring of cases, proctorship, and minimally invasive surgery fellowship programs need to be sought to achieve competency [8].

Knowledge-based Training

In addition to the basic knowledge of anatomy, energy, and devices, the trainee/surgeon must understand robotic technology by acquiring knowledge about device functions and parameters, basic trouble shooting, and limits of the system. Didactic training must be also dedicated to acquiring knowledge of pelvic and abdominal anatomy that are specific to minimally invasive surgery. Inherent in endoscopic surgery, magnification of the surgical field and panoramic and close-up views make the orientation and manipulation different from laparotomy [8]. Nezhat et al. proposed a formal gynecological endoscopy curriculum for obstetrics and gynecology residents, fellows in AAGL/SRS-sponsored fellowship programs [8]. The curriculum defines several core objectives that should be mastered at various stages of training of minimally invasive surgery [8]. Didactic objectives from this curriculum are applicable for didactic education in robotic surgery. After the first quarter, the trainer should be able to do the following [8]:

1. Identify normal female pelvic anatomy
2. Identify divergence from normal anatomy
3. Identify and endoscopically trace major pelvic blood vessels, ureters, bowel, anatomic hallmarks, and abdominal wall ligaments, among other features
4. Know major branches of anterior and posterior divisions of the internal iliac artery and the implication of injury to a particular branch
5. Name the major nerve supplies to the pelvis (e.g., superior and inferior hypogastric plexuses, obturator nerve, and ilioinguinal and genitofemoral nerves
6. Understand the physiology and principles of creating and maintaining pneumoperitoneum
7. Understand the principles of electrosurgery
8. Know the difference between monopolar and bipolar electrosurgery
9. Understand the principles of ultrasonic energy.

The next step of knowledge-based training is the understanding of the fundamentals necessary to performing specific surgical procedures. This includes knowledge of appropriate patient selection and indications for an RALS, preoperative preparation, patient and system positioning, port placement,