Robotic application in gynecological diseases

Conventional laparoscopy has led to notable improvements in surgery, however, optics and instrumentation are limited and advanced surgical training is required to perform complex procedures. In addition, poor ergonomics can lead to fatigue or joint strain in the surgeon.

Robot-assisted laparoscopy has features, which overcome the difficulties of conventional laparoscopy and may also introduce new surgical options.

The goal of robot-assisted laparoscopic surgery is to help surgeons, to improve patient care by converting procedures that would have been performed by laparotomy into minimally invasive procedures. Robot-assisted laparoscopic surgery has all of the advantages of minimally invasive surgery, including less postoperative pain, smaller and possibly more cosmetically appealing incisions, shorter hospital stay, shorter recovery time, and faster return to work.

A surgical robot is a self-powered, computer-controlled device that can be programmed to aid in the positioning and manipulation of surgical instruments, enabling the surgeon to carry out more complex tasks. Systems currently in use are not intended to act independently from human surgeons or to replace them. Instead, these machines act as remote extensions completely governed by the surgeon and thus are best described as master slave manipulators.

Since FDA approval of robotic surgical system for use in gynecologic surgery in 2005, the growth of robotic for the treatment of benign and malignant disease has exploded in recent years, especially in case of procedures requiring advanced technical skills as sacrocolpopexy, myomectomy, deep endometriosis, radical hysterectomy, lymphadenectomy, sentinel lymph node mapping with the development of different systems with several functions, including:

(I) Passive: robotic movements are set preoperatively or act to guide the surgeon to a surgical target. Types of passive robots are:
  (i) Autonomous: robot performs a sequence of movements, which are programmed preoperatively;
  (ii) Supervisory: robot serves as a navigational aid or a precise positioning system (usually using preoperative imaging studies) to direct the surgeon to a lesion or other surgical target.

(II) Active: surgeon directs the robot intra operatively to move the surgical instrument.

(III) Teleoperated or telerobotic—the robot is manipulated by input devices under the surgeon's control remote from the operating table.

(IV) Telepresence surgery—teleoperated/telerobotic surgery in which the surgeon is located outside of the operating room (e.g., in another city or country).

(V) Telementoring—Transmission of audio and video information from a robotic set-up to a remote site, thereby allowing an expert surgeon to guide a novice through a procedure.

(VI) Telestration—For use in telementoring, a surgical mentor can draw on the operating surgeon's video display.

(VII) Dual-console system—an innovation in surgical training involving two consoles with the option to swap control of instruments and increase robotic surgical exposure from one surgeon to two per procedure. The surgeon is able to mentor another surgeon by maintaining control of various instruments and swapping instruments.

(VIII) Robot workstations can transmit video and audio information to a surgical simulator. Robotic simulation could allow rehearsal of procedures with the potential for reduction in complication rates and learning curves, and even for the development of new technical approaches. In addition to providing input integration of imaging registered with an interventional robotic platform, robots can capture data regarding how a surgeon performs specific tasks.

Major obstacles to the clinical use of robots are cost, training, but there is no doubt that robotic technology is fulfilling its promise to allow both generalists and subspecialists to gain competence in complex laparoscopic procedures.

New technologies, such as virtual reality, haptics, and telementoring, can powerfully ally with surgical robots to create a new medium for acquisition and assessment of surgical skills through simulation of all operations that can be done via the robot. Performance of robotic procedures requires specialized training and specific curriculum recently developed by SERGS.

Technology development is going fast and we have to remember that in the medical field the adoption of new surgical technique should be driven by what is best for the patient as determined by evidence-based medicine.

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