ROBOTIC LAPAROSCPIC SURGERY IN UROLOGICAL ONCOLOGY

Essay

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of Urology

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SUMMARY

The performance characteristics of robotic devices have enabled a variety of industrial applications in that they can perform repetitive tasks quickly with excellent precision and do not fatigue. Based on the success of robotic devices for industrial applications, robots have also been developed for medical applications as couriers, laboratory analysis, rehabilitation, and in the operating room.

Robotic surgery has been touted as a solution to underdeveloped, whereby a single central hospital can operate several remote machines at distant locations. The potential for robotic surgery has had strong military interest as well, with the intention of providing mobile medical care while keeping trained doctors safe from battle.

In recent years, electronic tools have been developed to aid surgeons. Some of the features include:

1. Visual magnification — use of a large viewing screen improves visibility.
2. Stabilization — Electromechanical damping of vibrations, due to machinery or shaky human hands.
3. Simulators — use of specialized virtual reality training tools to improve physicians' proficiency in surgery.

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INTRODUCTION

The involvement of the robots in the 20th century became widespread and versatile. No history of robots and robotics would be complete without mentioning of Asimov's 3 laws of robotics:

1- A robot must not injure a human being.

2- A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.

3- A robot must protect its own existence as long as such protection does not conflict with the First or Second Law **(Hemal and Menon, 2004)**.

The robotic system already consisted of the console where the surgeon was performing the operation, and a three-armed telerobot that received the signals from the console and executed surgical manipulations inside the patient's body. The system showed promise, and it had an advantage over the traditional laparoscopic equipment. Unlike laparoscopy, the system had no fulcrum effect created by the abdominal wall and lack of articulation of the instrument. It also had an advantage over laparoscopy in the degrees of freedom **(Lafranco et al., 2004)**.

The Da Vinci System allows for seven degree of freedom; therefore, it is more suitable for the areas where fine manipulations are required. One of the challenges in the creation of the surgical system was a creation of interface between the wrist of the surgeon and the controls of the machine. After prolonged experimentation, it was determined that the most optimal interaction would be via a tip-to-tip control, where the surgeon's fingers are connected in a virtual manner to the tips of the instruments. The invention enabled the surgeon to implement the familiar hand motions of the open procedures in the robotic cases, unlike pure laparoscopy, where many moves needed to be learned over again, thereby shortening the learning curve of the surgeon **(Ballantyne and Moll, 2003)**.

Proper planning is essential for efficiency in the operating room. Patient positioning and operating room setup should remain consistent and reproducible according to the specific operation **(Mullet et al., 1993)**.

It is imperative that not only the surgeons are proficient in these areas but also that all the staff members (anesthesiologists, nurses, surgical technicians, equipment technicians, and instrument room technicians) are equally knowledgeable of their specific role in the operation. A collaborative effort makes telerobotic surgery a success **(Catarci et al., 2001)**.

Currently, the gold standard for treatment is open radical retro public prostatectomy (RRP), which has demonstrated a reduction in disease specific mortality for patients with localized prostate cancer. However, this treatment option is invasive and can potentially lead to significant morbidity in terms of pain, blood loss, and prolonged recovery. As such, patients and surgeons alike have sought out less invasive surgical options. One such alternative is robotically assisted laparoscopic radical prostatectomy **(Menon et al., 2002)**.

Robotic cystectomy is a considerable surgical endeavor with long operative times, significant fluid shifts, and postoperative morbidity approaching that of the open technique. However, robotic laparoscopy allows unparalleled magnified three-dimensional (3-D) vision of anatomic detail and excellent homeostasis. These features translate into significantly lower blood loss and the potential for a more efficient and meticulous anatomic radical cystectomy **(Esrig et al., 1997)**.

Robotic laparoscopic surgery has expanded to include robotic nephrectomy, partial nephrectomy, and nephroureterectomy. This approach provides superior, stable, magnified three-dimensional visualization within a large transperitoneal working space. The miniature robotic instrumentation with dexterous EndoWrist range of motion provides excellent dissecting capabilities in the renal pedicle the da Vinci Surgical System (Intuitive Surgical, Sunnyvale, CA) can be used efficiently and safely with minimal morbidity, excellent clinical outcomes, and high patient satisfaction **(Nanigian et al., 2006)**.

HISTORY OF ROBOTIC SURGERY

GENERAL HISTORY OF ROBOTIC:

Using Webster's Dictionary, a robot is as follows: **1 a :** a machine that looks like a human being and performs various complex acts (as walking or talking) of a human being; also **:** a similar but fictional machine whose lack of capacity for human emotions is often emphasized **b :** an efficient insensitive person who functions automatically **2 :** a device that automatically performs complicated often repetitive tasks **3 :** a mechanism guided by automatic controls. **Synonyms:** android, automaton **(Hemal and Menon, 2004)**.

The first automaton creation is credited to a Greek inventor, Ctesibius of Alexandria, in 250 B.C. He developed clepsydra, a water clock that substituted a cumbersome sand clock. Sand clock was designed as such that a keeper had to turn it upside down every time an upper chamber ran out of sand. Clepsydra, on the other hand, did not require a man-keeper and therefore is considered to be the first automaton in human history **(Lafranco et al., 2004)**.

Our knowledge of the first humanoid automaton dates to the Renaissance era. Leonardo da Vinci, the ultimate "Renaissance man," a great artist, engineer, and scientist is credited with the first design of a humanoid automaton. It is still unknown whether an actual model was ever built, but several design drawings have been discovered in the 1950s among the lost da Vinci's writings **(Lafranco et al., 2004)**.

The record of the first mechanical automaton that started appearing throughout Europe dates to the eighteenth century. The world's first successfully build automaton is the famous Flute Player, constructed by the French engineer Jacques de Vaucanson in 1737. And his most famous creation was the mechanical duck that was built in 1741. It could flap its wings, eat, and digest grain **(Ballantyne and Moll, 2003)**.

The world first remote-controlled vehicle was build by Croatian- American scientist Nikola Tesla. At the time when understanding of radio waves was primitive at best, he introduced his radiocontrolled submarine at the scientific fair in New York City at the turn of 20^{th} century **(Mullet et al., 1993)**.

The term "robot" was coined by Karel Capek, Czech play writer, in his 1921 play "R.U.R." (Rossum's Universal Robots) term was given to electronic servants that, once given emotions, turned against the humans. The term comes from the Czech word "robota," which means "forced labor." The term "robotics" first appeared in Isaac Asimov's "Runaround" (1942) that was later included in his famous book "I, Robot". The involvement of the robots in the 20th century became widespread and versatile. No history of robots and robotics would be complete without mentioning of Asimov's 3 laws of robotics (mentioned previously in introduction) **(Catarci et al., 2001)**.

The role of the robot became not only to simplify human existence but also to protect its master by taking upon itself various dangerous tasks. The U.S. military developed an automatic system for mine detection that would sit in front of the tank, and, once a mine was detected, it would stop the tank before it got too close to the mine. Obviously, Asimov's law enforcement readily invested in this new military field. Robots are widely implemented now in testing suspicious packages in airports and in deactivation and detonation of explosive devices. Robotics found its application in various fields during and after World War II. With modern warfare turning toward the domination over the sky, radar (another form of a robot) became essential in tracking the enemy. Military continued with its heavy investment in robotics with drone planes and armored vehicles that are now part of the U.S. military **(Gaar, 2004)**.

Industry quickly recognized an enormous potential for robots. In 1961, General Motors installed its first robotic system to the assembly line. In 1978, Programmable Universal Machine for Assembly (PUMA) was first introduced and quickly gained popularity **(Gaar, 2004)**.