ROBOTIC ONCOLOGY- A REVIEW

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***Abstract*: Robotic surgery is a significant advance in the realm of urologic surgery esp. for urogenital cancers and for reconstructive procedures. It is associated with ease in dissection, incision and suturing with less steep learning curve in comparison to laparoscopy. It provides all benefits of minimally invasive surgery. laparoscopic surgery (SPLS), was also introduced in the field of MIS. Both robotic platform and SPLS are emerging concepts in MIS. The development of Robotic surgery is slower in Asian countries due to high cost of the robotic system and instruments. Robotic surgery is practiced in few hospitals in Asia. The overall cost of robotic surgery is less in Asian countries in comparison to USA and Europe with similar outcomes. For widespread use of robotic surgery, cost of the robotic system and instruments has to come down to make it affordable for a large Asian population. We hope the cost of the robotics and their instruments will come down to make it affordable for a large population. By using the computerized method is that the surgeon does not have to be present, but can be leading to the possibility for remote surgery.**

***Keywords*: Oncology, Robotic surgery, laparoscopy.**

INTRODUCTION:

Oncology refers to a branch of medical science that deals with tumors and cancers. “Onco” means mass or tumor, and “-logy” means study. An oncologist is a doctor who manages a person’s care and treatment once he or she is diagnosed with cancer.

[1]

Fig No.1 Symbol Of Oncology

Over the past 30 years, more people have had skin cancer than all other cancers combined. “Each year there are more new cases of skin cancer than the combined incidence of cancers of the breast, prostate, lung and colon,” reports the Skin Cancer Foundation. If detected and treated early, skin cancer is the easiest to cure.

Breast cancer is the second most common newly diagnosed cancer and second leading cause of cancer death among women in the U.S., exceeded only by lung cancer. There are more than 2.8 million breast cancer survivors in the U.S., including women still being treated and those who have completed treatment, reports the Breast Cancer Research Foundation.

Colorectal cancer (CRC) is the third most common newly diagnosed cancer and the third most common cause of cancer death among U.S. men and women. Like skin cancer, CRC is one of the most preventable common cancers.

ONCOLOGIST:

A medical professional who practices oncology is an oncologist

Types of oncologists:

- A **medical oncologist** treats cancer using chemotherapy or other medications.
- A **hematologist-oncologist** diagnoses and treats blood cancers, such as lymphoma, leukemia and myeloma.
- A **surgical oncologist** performs biopsies and removes the tumor and nearby tissue during an operation
- A **radiation oncologist** treats cancer using radiation therapy.
- A **gynecologic oncologist** treats gynecologic cancers, such as ovarian, uterine and cervical cancers.

• A **pediatric oncologist** treats cancer in children.

ROLE OF ONCOLOGIST

Oncologists have several specific roles on a cancer patient's team. After a diagnosis is confirmed, one of the most important functions of the oncologist is helping newly diagnosed patients understand their disease and the staging. Staging refers to "where a cancer is located, if or where it has spread and whether it is affecting the other parts of the body." This information helps to determine treatment and prognosis: the chance of recovery and the chance of recurrence[2]

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[3]

Fig No. 2 Oncology Device

Definition of onchlogy:

It is a branch of science that deals with the prevention, diagnosis, and treatment of cancer.[4]

TYPES:

It includes medical oncology (the use of chemotherapy, hormone therapy, and other drugs to treat cancer), radiation oncology (the use of radiation therapy to treat cancer), and surgical oncology (the use of surgery and other procedures to treat cancer).

Medical oncology – focused on the diagnose and treatment of the patients with chemotherapy, treatment surgery, immunotherapy, hormonal therapy as well as taking care for their follow-up.

Surgical oncology – in this subspecialty the physicians specialize in performing surgery and biopsies*on* patients with cancer.


[5]

Fig No: 3 Surgical Oncology.

Radiation oncology – a subspecialty focused on the use of radiotherapy to treat cancer, cancer diagnosis through x-ray imaging and **other imaging techniques**. Since there is a huge amount of research going on in all fields of oncology we, as cancer specialists, need to stay up-to-date with all progress.[6]

[7]

Fig No. 4 Radiation Oncology.

Recent advances in oncology

- Multidisciplinary treatment teams specialising in specific organ sites have been recognised as being important for optimal cancer care and for improving outcome
- The organisation and delivery of supportive care to patients with cancer has improved
- Treatment goals are more clearly defined
- Public awareness and understanding of the clinical trials that are driving clinical research has increased
- Research has started on potential treatments such as matrix metalloproteinase inhibitors, gene therapy, and cancer vaccines.[8]

ROBOTIC ONCOLOGY

Robotic surgery, computer-assisted surgery, and robotically-assisted surgery are terms for technological developments that use robotic systems to aid in surgical procedures. Robotically-assisted surgery was developed to overcome the limitations of pre-existing minimally-invasive surgical procedures and to enhance the capabilities of surgeons performing open surgery.

✓ In the case of robotically-assisted minimally-invasive surgery, instead of directly moving the instruments, the surgeon uses one of two methods to control the instruments; either a direct telemanipulator or through computer control. A telemanipulator is a remote manipulator that allows the surgeon to perform the normal movements associated with the surgery whilst the robotic arms carry out those movements using end-effectors and manipulators to perform the actual surgery on the patient. In computer-controlled systems the surgeon uses a computer to control the robotic arms and its end-effectors, though these systems can also still use telemanipulators for their input. One advantage of using the computerized method is that the surgeon does not have to be present, but can be anywhere in the world, leading to the possibility for remote surgery.

✓ In the case of enhanced open surgery, autonomous instruments (in familiar configurations) replace traditional steel tools, performing certain actions (such as rib spreading) with much smoother, feedback-controlled motions than could be achieved by a human hand. The main object of such smart instruments is to reduce or eliminate the tissue trauma traditionally associated with open surgery without requiring more than a few minutes' training on the part of surgeons. This approach seeks to improve open surgeries, particularly cardio-thoracic, that have so far not benefited from minimally-invasive techniques.

✓ Robotic surgery has been criticized for its expense, by one estimate costing $1,500 to $2000 more per patient.[9]


[10]

Fig No: 5 Robotic Oncology

HISTORY:

♣ The first robot to assist in surgery was the *Arthrobot*, which was developed and used for the first time in Vancouver in 1983. Intimately involved were biomedical engineer, Dr. James McEwen, GeofAuchinleck, a UBC engineering physics grad, and Dr. Brian Day as well as a team of engineering students. The robot was used in an orthopaedic surgical procedure on 12 March 1984, at the UBC Hospital in Vancouver. Over 60 arthroscopic surgical procedures were performed in the first 12 months, and a 1985 National Geographic video on industrial robots, *The Robotics Revolution*, featured the device. Other related robotic devices developed at the same time included a surgical scrub nurse robot, which handed operative instruments on voice command, and a medical laboratory robotic arm.

♣ In 1985 a robot, the Unimation Puma 200, was used to place a needle for a brain biopsy using CT Guidence.[11]


[12]

Fig no 6:*The Unimation Puma 200*

THE USE OF ROBOTICS IN SURGERY:

IMPORTANCE:

There is an ever-increasing drive to improve surgical patient outcomes. Given the benefits which robotics has bestowed upon a wide range of industries, from vehicle manufacturing to space exploration, robots have been highlighted by many as essential for continued improvements in surgery.

OBJECTIVE:

The goal of this review is to outline the history of robotic surgery, and detail the key studies which have investigated its effects on surgical outcomes. Issues of cost-effectiveness and patient acceptability will also be discussed.

The Future of Robotic Surgery

What's most remarkable about robotic surgery is what the future might hold. [15]

Recent advances of robotic surgery and single port laparoscopy in gynecologic oncology

Two innovative approaches in minimally invasive surgery that have been introduced recently are the da Vinci robotic platform and single port laparoscopic surgery (SPLS). Robotic surgery has many advantages such as 3-dimensional view, the wrist like motion of the robotic arm and ergonomically comfortable position for the surgeon. Numerous literatures have demonstrated the feasibility of robotic surgery in gynecologic oncology. However, further research should be performed to demonstrate the superiority of robotic surgery compared to conventional laparoscopy. Additionally, cost reduction of robotic surgery is needed to adopt robotic surgery into gynecologic oncology worldwide. SPLS has several possible benefits including reduced operative complications, reduced postoperative pain, and better cosmetic results compared to conventional laparoscopy. Although several authors have indicated that SPLS is a feasible approach for gynecologic surgery, there have been few reports demonstrating the potential advantages over conventional laparoscopy. Moreover, technical difficulties of SPLS still exist. Therefore, the advantages of a single port approach compared to conventional laparoscope should be evaluated with comparative study, and further technologic development for SPLS is also needed. These two progressive technologies take the lead in the development of MIS and further studies should be performed to evaluate the benefits of robot surgery and SPLS.[13]

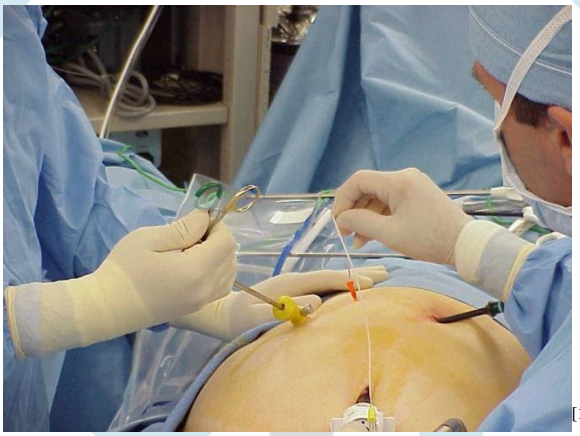
[14]

Fig no 7: Laproscopy

Laproscopy

Operative laparoscopy developed earlier on in the field of gynecology and the appearance of minimally invasive surgery (MIS) led to advances in general surgery as well. Operative laparoscopy was initiated in the 1970s, and tubal ligations for contraception were conducted with laparoscopy in women by the mid 1970s.1 Since laser and electric energy technology was integrated into laparoscopic surgery in the early 1980s, operative laparoscopy extended to complicated gynecologic procedures including hysterectomy, adnexal surgery and uterine myomectomy. Now, laparoscopic surgery has become an essential part of surgical treatment for gynecologic diseases, including gynecologic cancers. Compared with laparotomy laparoscopic approach offers several advantages, such as faster return to normal activity, better cosmetic results, shorter length of hospital stay, lower cost, and reduced pain. The technology and techniques related to laparoscopic surgery are still evolving to the direction of easier and less invasive laparoscopic surgery. Despite several advantages of laparoscopic surgery, the weakness of conventional laparoscopy including an unstable camera platform, the limited mobility of straight laparoscopic instruments, two-dimensional imaging, a poor ergonomic position for the surgeon, and a steep learning curve still remains. As easier laparoscopic approach, the robotic platforms that address many of the current limitations of conventional laparoscopy were developed and integrated into laparoscopic surgery. Recently, another innovative technique, single port laparoscopic surgery (SPLS), was also introduced in the field of MIS. Both robotic platform and SPLS are emerging concepts in MIS. The purpose of this study is to provide an overview of these cutting edge technologies in gynecologic oncology.

ROBOT ASSISTED LAPAROSCOPIC SURGERY USING THE DA VINCI SURGICAL SYSTEM

The da Vinci robotic system, which is the only FDA approved and commercially available robot in gynecology, consists of three main components: the robotic cart, the vision cart, and the operating console. Four robotic arms are mounted on the robotic cart, which can be placed freely next to the patient. The robotic cart docked to the laparoscopic trocars on the patient's abdomen is connected to the operating console through a cable. The da Vinci surgical system is equipped with a 3-dimensional vision system, in which double endoscopes generate two images resulting in the perception of a 3D image. In addition, robotic arms with surgical instruments have three or four joints, which reproduce the range of motion and dexterity of the surgeon's hand. The surgeon sits at the surgical console and performs the surgery by manipulating the controller in it. The movement is translated from

the surgeon's fingers to the tip of the surgical instruments. During this process, the physiologic tremor is eliminated by the robotic system. These instruments including the 3-D vision system and endowrist allow the surgeon to conduct more precise surgical procedures during surgery.

ROBOT ASSISTED LAPAROSCOPIC SURGERY IN GYNECOLOGIC CANCER

Cervical cancer is the leading cause of cancer-related death in women worldwide and accounts for 5.7% of all new cancer cases in Korean women in 2005, with approximately 3,737 invasive cervical cancer cases being diagnosed. Endometrial cancer is also one of the most common malignancies of the female genital tract in developed countries. Surgery for these gynecologic cancers is considered to be one of the major management modalities for treating cancer, determining disease stage of patients, and obtaining the information for adjuvant treatment. However, laparotomic approaches in all patients with cervical or endometrial cancer have increased operative and post-operative morbidity. To reduce the surgical morbidity, robot assisted laparoscopic surgery was introduced as an alternative surgical method for laparotomic surgery in gynecologic cancers. Therefore, examining the surgico-feasibility of robotic approach in these cancers is an essential step for further discussion about the feasibility in all aspects. In cervical cancer, Kim et al. offered the evidence for the feasibility of performing robot assisted laparoscopic radical hysterectomy in their case series report. Since the study by Kim and colleagues was published, several authors elaborated on the surgical outcomes, which were obtained with robotic procedures compared to those of conventional laparoscopic or laparotomic surgeries. Magrina et al., reported that robotic and conventional laparoscopic surgeries are preferable to laparotomy for patients requiring radical hysterectomy in terms of blood loss and length of hospital stay. Boggess et al. conducted a case-control study of robot assisted laparoscopic radical hysterectomy compared with laparotomic approach, and this study showed that robot assisted laparoscopic radical hysterectomy is superior to open radical hysterectomy with regard to blood loss, operative time, hospital stay, and lymph node retrieval. Lowe et al. also reported the experience of multi-institution consortium which consists of five gynecologic oncologists in distinct geographical regions of the United States for radical hysterectomy using the da Vinci robotic platform. Through the analysis of 42 patients who underwent a type II or III robotic radical hysterectomy, the authors concluded that robot assisted laparoscopic type II/III radical hysterectomy is associated with a shortened hospital stay, few operative complications, acceptable lymph node yields, and acceptable operative times.

Doctors are anticipating the growth of **tele-medicine** and **long-distance operations,** where a doctor could conceivably operate on a patient in another city, state, or even a different continent. Practically, this would mean that surgical centers would be set up in different parts of the world and a doctor could go to a surgical center and sit in a control console while a patient in a different surgical center would be operated on by a robot controlled by that doctor.

"In the future there will be tele-medicine, where you can operate on someone somewhere else in the world," Palese said. "I don't think that's far-fetched science fiction anymore. I think that I'll see that in my lifetime."

The Drawbacks

Palese explained that today the majority of urological surgical procedures are performed via the da Vinci robot. While that's an amazing phenomenon — especially considering that the technology is only about ten years old — there are drawbacks.
That means that younger doctors are not necessarily being trained to perform traditional open surgeries, still a crucial skill. In most other countries, which have not yet embraced robotics, surgeons are still performing traditional open surgery.

"This technology is great but we still need to keep the traditional skills."

As robotic surgery has taken over these surgical fields, there's also been an interesting shift in age dynamics. [13], .[15]

CONCLUSION

The numerous benefits of MIS are better cosmetic results, reduced operative morbidity, reduced postoperative pain, and shorter length of hospital stay compared with laparotomic surgery. MIS has taken the place of laparotomic approach and has become an imperative part of surgical approach in gynecologic oncology. However, technical difficulties have prevented the widespread adoption of MIS in gynecologic oncology. Over the last three decades, laparoscopic technologies have evolved remarkably, and robotic surgery using the da Vinci system has been introduced. Although it is not evident that robotic surgery is superior to conventional laparoscopic surgery in terms of surgical outcomes, current evidence demonstrates the positive feasibility of robot assisted laparoscopic surgery in gynecologic oncology. Robotic surgery is considered a stepping-stone to jump over the technical barriers of MIS, and contributes to widespread adoption of MIS. However, the economic feasibility of robotic surgery still remains as another obstacle to be solved. It is expected with further development of robotic technology and the emergence of a competitor to the da Vinci robotic platform, the issue of high cost will be resolved. On the other hand, SPLS is a cutting edge technology requiring high degree of technique. Despite its demonstrated feasibility in gynecology and newly introduced devices, there are several matters that need to be solved, such as demonstrating superiority of the SPLS compared with conventional laparoscopic approach, and relieving technical difficulties. Therefore, further research should focus on the evaluation of the

potential benefits of the SPLS and prompt technological progress. In the 21st century, these two innovative approaches; robot and SPLS takes the lead in the development of MIS.

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