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Robotic Assisted Surgery for Women Undergoing Gynecological Surgery

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Abstract

One of the current alternatives to open gynecological surgery and laparoscopy is Robotic Assisted Laparoscopic Surgery (RALS), which is done utilizing Robotic Assisted Surgical Devices (RASD). These alternatives present another dimension to the cascade of decisions women make regarding surgery and recovery. Nurses are often called upon to help the women in the decision making process by providing education and current information. This requires requisite knowledge on the part of the nurses and collaboration with all members of the health care team. The purpose of this paper is to fully explain the trending new technology of robotic assisted gynecologic surgery, its advantages and disadvantages, and its implications for nursing through examining the available research and clinical literature on the topic.

Keywords: Robot surgery; Education; Nursing; Safety

Introduction

Women undergoing surgery for gynecological issues have choices to make. They include when to have surgery, what to tell supervisors and co-workers, and how to plan for family needs with the absence of wife, mother, daughter or sister. The potential of having the fairly recent option of minimally invasive Robotic Assisted Laparoscopic Surgery (RALS) adds another dimension to the cascade of decisions. Nurses are often called upon to help in the women's decision making process through providing education and current information which requires specific knowledge on the part of the nurse and collaboration with all members of the health care team.

Purpose

Although surgery via robot technology is fairly new, it is becoming more common. Because utilizing a robot in surgery is unique, nurses may be unfamiliar with the procedure but face a need to answer the women's questions on the topic. The purpose of this paper is to fully explain the trending new technology of robotic assisted gynecologic surgery, its advantages and disadvantages, and its implications for nursing through examining the available research and clinical literature on the topic.

Definition of Robotic Assisted Surgical Devices (RASD)

The Robot Institute of America defines a robot as "a reprogrammable, multifunctional manipulator designed to move material, parts, tools, or specialized devices through various programmed motions for the performance of a variety of tasks" [1]. Robotic assisted devices, used in various surgeries in reality are not true robots, but are computer assisted devices because they lack independent motions or preprogrammed actions [2]. Robotic assisted surgery is defined by the SAGES-MIRA Robotic Surgery Consensus Group [3] as "a surgical procedure or technology that adds a computer technology enhanced device to the interaction between a surgeon and a woman during a surgical operation and assumes some degree of control heretofore completely reserved for the surgeon". The procedure evolved from standard laparoscopic surgery for the purpose of resolving the limitations of the standard laparoscopy [4].

History of Robotic Assisted Surgery

The history of robotic surgery is discussed extensively by Lanfranco, et al. [5] in their literature review of the history, development and current application of robotic surgical devices. The authors state that the first instance of robotic surgery was the performance of a neurosurgical biopsy, using a robotic arm (Puma 560) in 1985 by Kwoh and associates Lanfranco, et al. [5]. The

purpose in applying this technology was to attain more precision in obtaining biopsies. The creation of other robotic devices soon followed: PROBOT for transurethral resection; ROBODOC for hip replacement; AESOP operated by voice commands; daVinci a modification of AESOP and the Zeus system. Currently, the daVinci and the Senhance are the only RASDs that are approved for use by the FDA [6,7]. The daVinci is the only system used for all contemporary approved surgical robotic procedures for adults and pediatrics [8]. The Senhance System is FDA approved for selected adult surgical procedures [9].

Trends

There has been a surge in the use of RASDs in surgery, mainly driven by manufacturers and surgeons [10]. According to an ACOG committee opinion in 2015, Gynecologic Robot Assisted Surgery is currently performed nationally at more than 2,025 academic and community hospitals with a growth factor of greater than 25%. Statistics from the daVinci company web page in 2015 show that minimally invasive surgery, using the daVinci robotic device has increased to 7.2 million procedures worldwide [11].

Cost

The use of robotic devices in surgery is more costly to the hospital [12]. Barbash and Glied state that robot assisted surgery has high fixed costs, ranging from one million dollars to two and a half million dollars for each unit [13]. In addition, these systems require lengthy surgeon training, costly maintenance, and additional consumables for the device. The costs associated with the da Vinci procedure range from $3,000 to $6,000 more than traditional laparoscopic surgery [14]. The Senhance System cost is approximately 1.5 to 2 million dollars. The company's Chief Executive Officer claims that the device can reduce costs of medical operations by two-thirds [15]. Given the increased competition between the already approved RASDs and the increasing numbers of companies developing new RASDs, the price of the equipment should decrease. The lower cost of the devices and the shortened length of stay should reduce hospital costs to insurance companies and consumers.

The Device

The da Vinci RASD is indicated for general, cardiothoracic, urology, ENT, and colorectal surgery [16]. Gynecological diagnoses which are appropriate for use of the RASD are: Uterine fibroids, endometriosis, excessive menstrual bleeding, pelvic prolapse, and gynecologic cancers. Sullivan, Frost, & Lew provide a vivid description of the da Vinci RASD and its components [2]. The daVinci is composed of three distinct parts. The first section contains the control console which has hand attachments, a three dimensional mirror, the computer system, robot instruments, foot pedals, and a video camera. The second section has a video tower which can record and display images of the surgical site onto two dimensional monitors, which can be viewed by the operating room team. Other surgical instruments are also attached to the tower. The third component is the robot itself which has three to four arms. The central arm holds the video camera while the other two arms are used for manipulations. The fourth arm can be used as a stationary retractor.

The Senhance System was cleared for use by the U.S. Food and Drug Administration in 2017. The device is manufactured by the medical device company TransEnterix. The Senhance System RASD is described by Peters, et al. as a console with remote control station unit, manipulator arms, and a connection node [17]. The system also has three/four robotic arms, each equipped with the specific surgical instruments required [7,18]. The Senhance RASD also features haptic feedback which transmits touch to the surgeon's hand and an eye-sensing cameral control [17]. The Senhance is approved for inguinal hernia repair, cholecystectomy, laparoscopic colorectal and gynecological procedures [3,9].

Advantages and Disadvantages of RASD

Advantages of using RASD versus laparoscopy and open surgery are numerous. They include an improved operative field and visualization because of the three dimensional camera, restored hand-eye coordination, tremor reduction, increased dexterity and allowance for ergonomic, anatomic control of instruments [2,5,10]. Other benefits of RASD include smaller incisions, decreased blood loss, shorter hospital stays, faster return to work, improved cosmesis and lower incidence of some surgical complications [4].

There are disadvantages to RASD [2,5]. The device requires large amounts of operating space, potential collision of staff and equipment with the large size of the robot, extra staff training and lack of tactile feedback from device components. The initial and subsequent costs of the device, frequent replacement of consumable instruments, increased OR set up time, and increased surgical operating times for inexperienced surgeons are also problematic.

RASD and Gynecological Surgery

There are several gynecological procedures that can be safely done using the minimally invasive RASD. Hysterectomy, myomectomy, sacrocolpopexy, adnexal surgery, endometriosis, tubal re-anastomosis are procedures which have been performed under RASD [19]. The Committee on Gynecologic Practice, Society of Gynecologic Surgeons, in their position paper on the topic, states that there is no advantage using RASD for the following procedures: Tubal ligation, simple ovarian cystectomy, surgical management of an ectopic pregnancy and prophylactic bilateral salpingo oophorectomy [20].

Preparing the RASD

Pre-operative preparation

The procedure requires a team approach. Tabor provides a succinct description of nursing actions required for any type of surgery utilizing the robotic device. One of the most important activities is preparing the robotic system [21].

Circulating Nurse

This is the responsibility of the circulating nurse. Preparing the system activities include: Connecting the proper cords from the video tower to the surgeon's console and from the robotic arms to the robotic console. Tabor also states to avoid having the cords in the way of those who are walking around the operating table to prevent accidentally disrupting the system while it is in use. The author advises inspecting the cords for any damage, and labeling the cords for any damage that could create an electrical hazard. The health care institution's policy for electrical safety should be followed; use the appropriate electrical power outlets and follow instructions to home the system. Any faults or system errors should be reported to the surgical team, as the system won't complete the homing process if there are issues with the system. The robotic instrument cart should be fully stocked. The location of the emergency hex wrench that can be utilized during system failure or a power outage should be communicated.

Scrub Nurse

Tabor states that the scrub nurse covers the robotic arms with sterile drapes that house the sterile instruments and camera adapters. The scrub nurse works with the circulating nurse to prepare the unsterile camera and sterile scope for surgery. When these activities are complete, the robot is placed in position for docking.

Post-Operative Activities

At the conclusion of the surgical procedure, nurses and surgical technicians are responsible for undocking the robot and doing an inventory of the robotic instruments, cleaning up and setting up for the next surgery [22].

Patient Education for RASD

Preoperative

Nurses play a vital role in planning, implementing and evaluating patient education. Irani, et al. found that many women do not understand the differences between open, laparoscopic and robotic approaches to gynecological surgery. This makes informed decision-making questionable [23]. Nurses can educate regarding the differences in these surgical procedures and their implications in terms of hospital stay and potential surgical complications. The American College of Obstetricians and Gynecologists recommends prior to surgery that a discussion of the indications for surgery and the risks and benefits involved with robotic surgery compared to other surgical approaches occur prior to surgery [20]. Nurses can collaborate with surgeons to achieve informed consent for robotic gynecologic surgery.

Another aspect of education might involve classes for women undergoing robotic surgical procedures either in the hospital or the outpatient surgery setting. Delano's research, indicates that patient education classes could reduce anxiety in men undergoing robotic surgery for prostate cancer. Certainly this approach can be extrapolated to women undergoing robotic surgery for gynecologic conditions [24].

Content

Preoperative education classes include preparation for surgery, managing medical conditions, and contacting the healthcare provider. A review of the check-in procedure and pathway on the day of surgery is presented. Potential complications and their prevention are discussed, as well as the criteria for discharge from the hospital or ambulatory surgical center. Equipment needed after surgery and post-surgical follow-up are the final components of a preoperative education program. Collin, Bellas, Haddock and Wagner state that another aim of preoperative classes prior to robotic surgery is to decrease calls to the office for routine information leaving staff to respond to urgent situations [25].

Iavazzo and Gkegkes describe an enhanced recovery program for women undergoing robotic hysterectomy. The program includes educating women for the preoperative, intraoperative, and postoperative phases of the experience specific to robotic hysterectomy [26]. Gadler, Crist Brandstein, and Schneider found that an educational video for robotic prostate cancer surgery reinforces knowledge, reduces anxiety, increases satisfaction and saves provider time in the postoperative period [27]. Again, this approach would apply to women undergoing robotic surgery for gynecologic conditions.

Postoperative

Post-operatively, educational activities continue. When working with the woman and/or the family, the nurse provides education regarding level of activity and expected gastrointestinal and urologic function. Dietary dos and don'ts are discussed if pertinent. The latter would be beneficial if a nutritionist were available. Potential complications of the surgery and recommended actions are presented. Women are reminded to make follow up appointments with the surgeon. Table 1 illustrates a teaching plan for women undergoing gynecological surgery using RASD.

Topic	Objective(s)	Content	Evaluation
Pre-Operative Preparation	Provide information as to needed medical clearance	Components of medical clearance	Pre-operative clearance on record
	Assess baseline vital signs	Meaning of vital signs	Vital signs within normal limits
	Discuss potential complications of surgery	Describe complications	Feedback from patient
	Identify areas of concern regarding surgery	Specific areas of concern	Feedback from patient
Post-operative care	Prevention of potential complications	Notify surgeon of any complications	Patient does not experience complications
	Vital signs within normal limits	Note any signs of bleeding	Operative site clean and intact
	Operative site intact	Assess vital signs	Vital signs within normal limits
	Pain under control	Assess operative site for infection	Pain below 5 on 0-10 scale
		Administer pain medication as prescribed	
Post-operative teaching	Review potential complications	Teach about bleeding, infection, pain control	Patient verbalizes understanding of all instructions
	Reinforce when to seek medical care	Teach danger signs and when to seek medical care	Patient leaves surgical facility with follow-up arranged
	Reinforce scheduled follow-up	Review post-op appointment	

Table 1: Teaching Plan for Gynecological RASD.

Nursing Implications /Patient Care

Preparation for Surgery

Medical Clearance: Preoperative nursing care for women undergoing a RASD gynecological procedure mirrors preoperative preparation for open or laparoscopic surgery. Preoperative preparation for gynecological robotic surgery includes preoperative medical clearance such as the ordered laboratory, imaging tests, and EKG [28]. The nurse documents that the required tests were done.

Nursing Assessment

Nursing assessment includes taking and evaluating vital signs to determine a baseline for postoperative assessment. Data obtained from the patient on the pre-operative check list is documented. Specific physician's orders are carried out. For example, bowel preparation may be ordered by the physician and implemented by the nurse [28]. The nurse confirms that the woman understands the procedure to be done during the consent process. After confirming with the woman that she has no allergies, pre-operative medication is given.

Intraoperative

Nurses in the operating room impact the woman's experience via proper positioning of the woman during robotic surgery and prevention and recognition of complications. Trendelenberg position is commonly used for Robotic Assisted Laparoscipic surgery (RALS) [29]. Potential complications from positioning in this manner include increases in intra-cranial and intra-ocular pressure, compartment syndrome, occipital necrosis, hypothermia, hypercapnia, and laryngeal edema. Protection of woman's limbs and attention to pressure areas are also important. Kartal and Yazici confirm the importance of positioning [30]. Preparing the robotic equipment, maintaining asepsis and interpreting the data on the video screen accurately and quickly are additional nursing responsibilities in the operating room. Park, et al. suggest that the Modified Surgical APGAR Score (MSAS) could be useful in predicting complications during robotic assisted minimally invasive surgeries [31].

Post-operative

Post-operative care for women undergoing robotic surgery is held to the same standards as woman's undergoing minimally invasive surgery [32]. Critical to woman safety is accurate post-operative assessment.

All women receiving general anesthesia or regional anesthesia in the operating room are taken postoperatively to the Post Anesthesia Care Unit (PACU) accompanied by a member of the anesthesia team [19]. The anesthesia team member then gives a report to the PACU nurse including anesthetic agents, reversal agents, blood loss, fluids administered, any narcotic administration, and any adverse events in the operative room.

Once discharged from the PAR and admitted to the assigned room, nursing assessment continues [32]. Nurses ensure the stability of the airway, vital signs, intake and output and condition

of the surgical incision, if present. They assess the woman for complications, for readiness for discharge.

Education is provided regarding home care and postoperative follow-up. Best, et al. [33] conclude that women undergoing robotic assisted total abdominal hysterectomy had reduced lengths of stay, shorter lengths of procedure, lower estimated blood loss, and lower pain in the immediate postoperative period as compared to women undergoing traditional total abdominal hysterectomy. Nurses caring for these women need to be aware of these differences in the post- operative trajectory.

Safety

As with any part of nursing care, safety is of utmost importance. This is true throughout the surgical journey. Nurses in the operating room impact the woman's experience via proper positioning of the woman during robotic surgery and prevention and recognition of complications. Post-operative safety is concerned with monitoring vital signs, oxygenation, and activity. Vigilance regarding potential post-surgical complications is a hallmark of safety. Park, et al. [31] suggest that the Modified Surgical APGAR Score (MSAS) could be useful in predicting complications during robotic-assisted minimally invasive surgeries [34].

Conclusion

Gynecological surgery performed with an assisted robotic device is becoming more common. Nurses providing care for these women are knowledgeable regarding all aspects of the procedure and the recovery period. Preparation by the nurse, who delivers nursing care and education for woman and family, is necessary to be an effective care-giver. As technology progresses in medicine and nursing, nurses must find ways to keep abreast of these new innovations.

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