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Review Article

Robotic hysterectomy: A review of indications, technique, outcome, and complications

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ABSTRACT

Hysterectomy is the second most common surgery performed on women after cesarean section. The advantages of minimally invasive hysterectomy such as reduced hospitalization, quick recovery with more rapid return to normal activities, and less postoperative morbidity are well known. Although most guidelines recommend that minimally invasive hysterectomy should be the standard of care, the gynecologists have been slow in adopting minimally invasive laparoscopic techniques to perform this operation. Since its approval in 2005 for gynecological surgeries, robot-assisted hysterectomy has been found to be feasible and safe both in benign and malignant indications. This significant difference is mainly due to ergonomics, endowrist movements of instruments, and stereoscopic three-dimensional magnified vision. The specific indications for hysterectomy where the robotic technology can benefit women are the ones with adhesions such as severe endometriosis, large uterus with large or multiple fibroids, early carcinoma cervix, and/or endometrial carcinoma. However the main benefit of this procedure was seen in the reduction of open surgery including conversions during laparoscopic hysterectomies. In the long run, we need to critically examine the long-term benefits and appropriate indications for robot-assisted hysterectomy especially in benign conditions, thus reducing the incidence of open surgery in gynecology. This review describes the operative procedure of robotic hysterectomy in eight steps.

1. Introduction

Hysterectomy is the second most common surgery performed on women after cesarean section, and most are done for benign condition. Harry Reich was the first to describe laparoscopic hysterectomy in 1989, 50% are still conducted by open method. The gynecologists have been slow in adopting minimally invasive technique to perform this operation. Both the American Association of Gynecologic Laparoscopists (AAGL) and the American Congress of Obstetricians and Gynecologists (ACOG) issued statements that minimally invasive hysterectomy

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should be the standard of care.[1,2] The slow adoption of minimally invasive hysterectomy techniques among practicing obstetrician-gynecologists is mainly due to conventional "straight-stick" laparoscopic skills requiring long learning curve along with insufficient laparoscopic training and exposure during their residency program.[3] So when FDA approved robotic technology for hysterectomy in 2005, the incidence of minimally invasive hysterectomy was expected to rise with 3-dimensional optics, wrist like motion with robotic instruments, and shorter learning curves than traditional laparoscopy for the surgeons.[4] The advantages of minimally invasive hysterectomy are well known such as reduced hospitalization, quick recovery with more rapid return to normal activities, and less postoperative morbidity.[2] These advantages have been also shown in a meta-analysis, comparing total laparoscopic hysterectomy (TLH) with total abdominal hysterectomy (TAH). These advantages are reduction in morbidity—specifically, fewer perioperative morbidity and complications, lower estimated blood loss, and shorter hospital stay.[5]

2. Indication of robotic hysterectomy

Hysterectomy for any benign indication can be performed with robotic assistance. It has its application in gynecological oncology, especially in early cervical carcinoma and endometrial carcinoma. However, choosing the route of hysterectomy in benign cases is important. Vaginal hysterectomy especially non-descent vaginal hysterectomy (NDVH) is the ultimate minimally invasive method of performing hysterectomy. There is no doubt about that. Laparoscopic or robotic hysterectomy should not replace vaginal hysterectomy. Minimally invasive techniques become crucial in situations where NDVH is not feasible or is contraindicated. In today's era, surgical situation that pose difficulty in performing hysterectomy via a laparoscope like pelvic adhesive disease or significant endometriosis, the robotic assistance is of great value and should be used where available to avoid open surgery and its associated morbidity. Robotic hysterectomy is also a good option in patients who need concomitant sacral colpopexy. The route of hysterectomy is often influenced by uterine weight and size, previous surgeries, pelvic adhesions or endometriosis, and presence of uterine descent as well as the body habitus and BMI of the patient. Landeen et al. carried out a retrospective study of 1474 hysterectomies, comparing four techniques: abdominal, vaginal, conventional laparoscopy, and robotically assisted laparoscopy. Their analysis of this study showed reduced blood loss and hospital stay with robotic surgery ($P < 0.0001$), and higher overall complication rate with the laparotomy (14%). However, the rate of complications was lowest with the vaginal hysterectomy. The conversion to open surgery is four-fold higher with the laparoscopic technique.[6]

3. Hysterectomy and robotic assistance

The da Vinci Robotic Surgical System (Intuitive Surgical) is an advanced laparoscopic-assisted surgical system that can address many of the current limitations of conventional laparoscopy. It is a logical next step in performing minimally invasive gynecological surgeries, and is only the beginning of numerous advances in the field of gynecological surgeries in the future.

It has 3 components. The first component of the da Vinci system is the vision cart. It has vision system that provides 2-dimensional imaging through a 12-mm, dual optical endoscope. The endoscope has 2 telescopes that gives a 3D vision to the surgeon on the console. The second component of the da Vinci system is the patient-side cart with robotic arms and endowrist instruments. Most da Vinci system now has provision for 3 robotic arms in addition to the arm that is docked to the camera port. Whether to use two or three instruments will depend on the surgeon's decision depending on the case profile. The third component is the surgeon console that is located away from the patient bedside but in the same operating room. The surgeon seated at this console, with the help of masters can control instruments that are inserted via the 8 mm ports into the patient's abdomen. This is aided by the surgeon's 3D view with the aide of a stereoscopic viewer. The surgeon console has additional foot pedals for energy sources, camera adjustment, and a swapping mechanism that helps the surgeon to control 3 instruments all by herself. Thus, maneuvers such as lysis of adhesions, suturing, and knot tying are easier due to wristed movements of the instruments and magnified vision, thus providing unique advantages over 2D straight stick approach of standard laparoscopy.

4. Selection of cases for robotic hysterectomy

Three situations that often tip the balance towards open surgery are presence of severe adhesions, large uterus, and malignancy. In all these three situations robotic assistance can help overcome the surgical challenges and reduce incidence of open surgery thus reducing the post operative morbidity. Advanced scarring of the pelvis poses challenges to hysterectomy by any route. Especially, when attempted by minimally invasive hysterectomy with conventional laparoscopic equipment, the altered anatomy poses technical limitations and the conventional laparoscopic surgical skill limits the ability to compensate for the altered anatomy. Hysterectomy for the larger uterus is also difficult by minimally invasive method. This is true for both laparoscopic surgery as well as robotic assisted surgery, and to our experience is the most challenging. Port positioning is tricky, the ability to maneuver instruments is compromised in the presence of a large uterus. Moreover, vaginal removal of the specimen is difficult, when the specimen is >150 g and often requires morcellation.

5. Special situations suitable for robotic assisted hysterectomy

5.1. *Endometriosis*

Conventional laparoscopy in endometriosis is a challenging task due to the complexity of pelvic dissection. The adhesive nature of the disease with obliteration of the surgical planes