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Robotic Surgery Versus Abdominal and Laparoscopic Radical Hysterectomy in Cervical Cancer

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1. Introduction

The first abdominal radical hysterectomy has been performed by Ernst Wertheim, one of the most famous 19th century surgeons, and still remains the basis for many surgeons nowadays. The technique was then modified by Meigs in 1950s. Piver and colleagues have described five classes of surgery based on the estimated risk of cervical carcinoma involvement; moreover, a new classification has been recently proposed by Querleu (Jhingran & Levenback, 2007; Martinez & Ramirez, 2009).

First laparoscopic hysterectomy has been done in January 1988 and defined as the laparoscopic ligation of the major vessels supplying the uterus; it is considered the most efficacious way to perform a hysterectomy (Reich, 2011). Besides, laparoscopic radical hysterectomy has been performed by C. Nezhat in 1992. Every gynecologic oncologist must be familiar with this procedure because of its feasibility and safety for the patient.

Following a pilot study performed by the Gynecologic Oncology Group it has been shown that laparoscopic staging is feasible with acceptable complications and a superior quality of life as compared with the open approach (Magrina, 2008; Mendivil & Boggess, 2009).

The da Vinci Surgical Robotic System has been approved by Food and Drug Administration (FDA) in 2005, while robotic surgery designed for radical hysterectomies has been reported for the first time by Sert in 2006. Despite the fact, in an attempt to minimize morbidity and recovery time, gynecologists have increasingly utilized robotic surgery to treat gynecologic cancers since these procedures were first described in the early 1999s.

Potential benefits of robotic technology include 3-dimensional, high-definition, optics instrumentation that allows greater range of motion, precision, scaling and surgeon autonomy.

As we mentioned before, robotic surgery was utilized for gynecologic procedures, such as laparoscopic benign hysterectomy and sacral colpopexy, myomectomy and radical

hysterectomy. In addition, robotic-assisted laparoscopic surgeries in gynecology include tubal re-anastomoses, lymph node dissection and sacro-colpopexies (Breda, 1991; Reich, 2011).

Well-designed prospective studies with well defined clinical long term outcomes including complications, costs, pain, return to normal activity and quality of life are needed to fully assess the value of this new technology.

The da Vinci Surgical System offers certain advantages over traditional laparoscopy and laparotomy like decreased blood loss, an increased lymph node yield and shorter length of stay (Basil & Pavelka, 2011). Average estimated blood loss for the da Vinci Surgical System is less than that seen in the laparotomy and laparoscopy (Leblanc, 2009).

An increase in the lymph node yield in the robotic surgery in gynecologic cancers when compared with the laparotomy and laparoscopic cohorts has also been reported (Basil & Pavelka, 2011).

Robotic assistance may make lymphadenectomy easier and more comprehensive by overcoming anatomic barriers to the process of stopping for uterine cancer, without increasing patient morbidity and may result in the increased use of minimally invasive treatment of uterine cancer (Reich, 2011; Sert & Abeler, 2007; Tang & Obermair, 2009).

Robotic technology would allow us to implement a program using robotic technology at our primary institution and to offer greater safety than conventional laparoscopic techniques.

Laparoscopic hysterectomy demonstrated a greater interest in the scientific community and was considered a substitute for abdominal hysterectomy but not for vaginal hysterectomy.

Additionally, hospitals may benefit because of the technique; advantages are multiple, including reduced duration of hospitalization and recovery, an extremely low rate of complication such as infection and ileus.

On the other hand, the surgeon must remember that if the patient is more comfortable with vaginal hysterectomy these should be done.

The purpose of this review is to compare abdominal radical hysterectomy, laparoscopic and robotic radical hysterectomy used in the management of gynecologic pathology, particularly in cancers.

2. Laparoscopic hysterectomy

2.1 Equipment

Trendelenburg's position (20-40^0) with shoulder braces and the arms at the patient's sides has been used in laparoscopic hysterectomy (Beste, 2005; Breda, 2001; Diaz-Arrastia, 2002; Reich, 2011).

A Valtchev uterine mobilizer is extremely valuable to delineate the posterior vagina and uterus can be moved from the horizontal in an arc between 45 and 120^0 (Diaz-Arrastia, 2002; Frumovitz, 2007; Reich, 2011).

For defining the rectovaginal space, an rectovaginal intraoperative examination is necessary. 5.5 mm diameter trocar and a 5 mm trocar sleeves with a retention screw grid around the external surface cannulas are adequate (Beste, 2005; Frumovitz, 2007; Meeks & Harris, 1997; Reich, 2011).

A little pneumoperitoneum is lost.

Vienna retractors are used for vaginal extractions of a large fibroid uterus (Beste, 2005; Frumovitz, 2007; Reich, 2011).

Monopolar cutting is used (Bipolar forceps) for coagulate vessels like uterine and ovarian arteries (Beste, 2005; Diaz-Arrastia, 2002; Reich, 2011).

Also the Kleppinger bipolar forceps is used for large vessel hemostasis (Beste, 2005; Frumovitz, 2007; Reich, 2011).

To maintain a fixed distance between the electrodes, for irrigation, and to identify bleeding sites microbipolar forceps are used (Beste, 2005; Frumovitz, 2007; Reich, 2011).

Richard Wolf Medical Instruments are used for evacuation of tissue. All laparoscopic surgical procedures are done by laparoscopic surgeon trained to hold the camera with the dominant hand, ambidexterity separates them from those trained traditionally (Beste, 2005; Diaz-Arrastia , 2002; Frumovitz, 2007; Reich, 2011).

The routine use of preoperatively antibiotics and general anesthesia are recommended in all cases.

Infections are very rare: less than 1% (Reich, 2011).

All incisions are closed with 4-0 Vicryl.

2.2 Indications and contraindications

The main indications are the following (Beste, 2005; Frumovitz, 2007; Meeks & Harris, 1997; Reich, 2011):

- *symptomatic uterine fibroids* (hypermenorrhea, pelvic pressure and, rarely, pain); all these cases can be performed laparoscopically after measurement of uterine size and weight;
- *benign pathology;*
- *endometriosis;* endometriosis can involve the posterior cervix and cause painful periods, pain all day or every day. Hysterectomy should be done only to remove possible deep intrauterine endometriosis (adenomyosis). In patients with stage IV endometriosis and extensive cul-de-sac obliteration hysterectomy lives the deep fibrotic endometriosis behind and is preferable to preserve the uterus. If the endometriosis is carefully removed, oophorectomy is no longer necessary;
- *stage I endometrial, ovarian and cervical cancer;*
- *abnormal uterine bleeding*; irregular uterine bleeding for more than eight days during more than a single cycle is defined as abnormal uterine bleeding;
- *pelvic reconstruction procedures;*
- *laparoscopic procedures* allowing cuff suspension, retropubic colpo-suspension and rectocele repair simultaneously;
- *obese woman;* the surgeon would be able to make an incision above the panniculus.

The main contraindications are represented by cases with a history of extensive abdominal adhesion should be referred to an expert laparoscopic surgeon because the medical status may prohibit surgery: anemia, diabetes, cardiac diseases, lung disorders and bleeding diathesis (Reich, 2011).

Both inexperience training of the surgeon and stage III ovarian cancer are also contraindications to the laparoscopic technique (Harris, 1997; Reich, 2011).

2.3 Surgical interventions

The laparascope is commonly used to a variety of operations, comprising:

- *Diagnostic laparoscopy with vaginal hysterectomy* to determine if vaginal hysterectomy is possible, if vaginal cuff and pedicle hemostasis is complete and to allow clot evacuation.
- *Laparoscopic assisted vaginal hysterectomy* used for vaginal hysterectomy after laparoscopic adhesiolysis and endometriosis excision.
- *Laparoscopic supracervical hysterectomy*, a less risky procedure than total hysterectomy. The uterus is removed with decreased risk of dissection of the ureter.
- *Total laparoscopic hysterectomy*. The laparoscopic dissection continues until the uterus is removed through the vagina and vaginal suture is done.
- *Laparoscopic hysterectomy.* This procedure may be performed when all surgical steps including ligation of the uterine vessels, anterior and posterior vaginal entry by transection cardinal and utero-sacral ligament division, uterine removal and vaginal closure have been done.
- *Hysterectomy*: partial, subtotal, fundectomy. If the cervix is left better names of hysterectomy would be partial hysterectomy, fundectomy or subtotal hysterectomy.
- *Laparoscopic pelvic reconstruction with vaginal hysterectomy.* This procedure is necessary when vaginal hysterectomy cannot repair the vaginal prolapse.

2.4 Total Laparoscopic Hysterectomy technique (TLH)

2.4.1 Incisions and vaginal preparation

Three laparoscopic puncture sites are typically used: one of 10 mm umbilical and two of 5 mm (left and right), in the lower quadrant. The uterus is removed in the anteverted position to delineate the posterior vagina for the laparoscopic hysterectomy. After the Voltchew uterine mobilizer is inserted and the endocervical canal is dilated, the cervix sits on a mide pedestal making the vagina visible (Beste, 2005; Cadiere, 2001; Reich, 2011; Tang & Obermair, 2009).

2.4.2 Exploration

After exploration of the upper abdomen and pelvis, if appendiceal pathology is present, appendectomy is done.

2.4.3 Ureteral dissection

Medial, superior and lateral approaches have been used for laparoscopic ureteric identification. The laparoscopic surgeon should skeletonize the ureterus during the performance of a laparoscopic hysterectomy. If the ureter is not dissected, cystoscopy should be done after vaginal closure to check for ureteral patency.

2.4.3.1 The medial approach (Reich)

The ureteral dissection is performed before the uterus is anteflexed and peristalsis is inhibited by surgical stress. This allows the peritoneum above the ureter to be incised and to grab the ureter and its peritoneum on the pelvic sidewall below. For safe division of the adnexal pedicle an atraumatic grasping forceps is classically used to grab the ureter on the pelvic sidewall below caudal to the ovary and lateral to the uterosacral ligament. Scissors are used to divide the ureter and the uterine vessels, allowing the safely ligation of the uterine artery at this time and diminishing bleeding from the upper pedicles (Beste, 2005; Cadiere, 2001; Reich, 2011; Tang & Obermair, 2009).

2.4.3.2 The superior approach

The superior approach is dissecting the infundibulo-pelvic ligament vessels from the roof of the broad ligament in order to identify the ureter

2.4.3.3 The lateral approach (Kadar)

The blunt dissection may be inserted alongside and lateral to the pelvic sidewall peritoneum into the loose areolar tissue, permitting the identification of both the uterine vessels and the uterus. The peritoneum recognized in the middle of the triangle formed by round ligament, external iliac artery and the infundibulo-pelvic ligament, is incised with scissors to expose the ureter at the place it crosses the common or external iliac artery (Beste, 2005; Cadiere, 2001; Reich, 2011; Tang & Obermair, 2009).

Consecutively, the operator explores for the ureter distal to the pelvic brim and lateral to the infundibulo-pelvic ligament. Thereafter, the dissection is carried bluntly underneath and caudal to the round ligament, until the obliterated hypogastric artery is visualized in the extraperitoneal space.

If any impediment is coming across, the artery if primarily identified intra-peritoneally (where it hangs from the anterior abdominal wall), traced proximally to (where it passes behind the round ligament), with both its intraperitoneal portion and the dissected space under the round ligament in view, the intra-peritoneal part of the ligament is moved back (Beste, 2005; Cadiere, 2001; Reich, 2011; Tang & Obermair, 2009).

Once the paravesical and pararectal spaces was opened uterine artery, cardinal ligament and the internal iliac artery on its lateral border became visible.

2.4.4 Retroperitoneal dissection

The laparoscopic surgeon makes an incision behind the round ligament for oophorectomy and in front of the round ligament for ovarian preservation. After that, the peritoneum is opened just to the retroperitonial space behind the uterus for oophorectomy and parallel to it for ovarian preservation (Beste, 2005; Cadiere, 2001; Reich, 2011; Tang & Obermair, 2009).

2.4.5 Bladder mobilization

The spoon electrode or scissors are used to make an incision in the round ligaments are their mid portion. The vezico-uterine peritoneum is opened at the left side and continuing across the midline to the right round ligament. Once the bladder is mobilized off, the uterus and the anterior vagina are identified with ring forceps (Beste, 2005; Cadiere, 2001; Reich, 2011; Tang & Obermair, 2009).

2.4.6 Upper uterine blood supply

If the ovary is to be preserved, the utero-ovarian ligament and fallopian tube may be suture-ligated to the uterus, using laparoscopic Metzenbaum type scissors and 2/0 – Vicryl.

If the ovarian preservation is not indicated, the anterior and posterior leaves of the broad ligament are opened to create a window. Through the windows thus created a free ligature is used. Two proximal and one distal suture are tied around the ovarian vessels, so that the ligament then divided (Beste, 2005; Cadiere, 2001; Reich, 2011; Tang & Obermair, 2009).

2.4.7 Uterine vessel ligation

The uterine artery is suture-ligated with 0-Vicryl at their origin each side; a single suture placed on the uterus or at the site where they cross the ureter is tied using a Clarke-Reich Knot pusher.

2.4.8 Division of cervico-vaginal attachments and circumferential culdotomy

The cardinal ligaments are incised using the spoon electrode and the utero-sacral ligaments are divided using the bipolar forceps. A vaginal delineator is placed in the vagina for preventing the loss of pneumoperitoneum (Beste, 2005; Cadiere, 2001; Reich, 2011; Tang & Obermair, 2009).

The operator then searches for the anterior cervico-vaginal junction and the lateral fornices to complete the culdotomy. Then the uterus can be morcellated and pulled out of the vagina.

2.4.9 Morcellation

If necessary, the uterus can be morcellated or not. The vaginal and laparoscopic morcellation is performed with the Steiner Electromechanical Morcellator. Laparoscopic vaginal vault closure and suspension is realized with McCall culdeplasty, vaginal closure being necessary for maintaining pneumoperitoneum. A 0-Vicryl suture on a CT-1 needle is placed through the left utero-sacral ligament and through the left cardinal ligament just below the uterine artery just along the vaginal cuff apex. This suture is used to fix the right side. The rest of the vagina is closed with two 0-Vicryl interrupted sutures. Once the vaginal cuff is closed the peritoneum is elevated and in most cases it is not closed (Beste, 2005; Cadiere, 2001; Reich, 2011; Tang & Obermair, 2009).

2.4.10 Cystoscopy

If the ureter is not dissected, the laparoscopic technique involves cystoscopy to check for ureteral pantency, ten minutes after indigo carmine dye administration.

2.4.11 Underwater examination

The peritoneal cavity is vigorously irrigated to detect bleeding. The operator then searches for any further bleeding from vessels and a microbipolar forceps is used to coagulate through the electrolyte solution.

2.5 Postperative considerations

In most cases patients return to their routine activities two weeks after the operation. Pelvic examination is usually indicated between 6-12 weeks, mainly are indicated for pain or pyrexia. Sexual activity may be allowed after six weeks.

2.6 Complications

Complications of laparoscopic hysterectomy include thromboembolic phenomenon, respiratory compromise, urinary retention, large vessel or ureters and bladder injury, trocar site incisions hernias, infections and subcutaneus emphysema (Reich, 2011).

2.6.1 Infection

Since the introduction of prophylactic antibiotics, febrile morbidity is less than half that of the abdominal hysterectomy (Jhingran & Levenback, 2007; Reich, 2011). Main complications of infections include cellulitis, vaginal cuff abscesses, adnexal abscesses, thrombophlebitis and septicemia. All patients with abscesses were responders to in hospital intravenous antibiotics and only few cases were treated by laparoscopic draenage, ultrasound guided aspiration and laparatomy draenage. To eliminate postoperative infection, the laparoscopic surgeon should do copious irrigation in the peritoneal cavity, to dilute the fibrin and to prevent prostaglandins arising from operated area.

2.6.2 Hemorrhage

Postoperative hemorrhage situations should be avoided by doing careful laparoscopic dissection during hysterectomy; moreover, if necessary blood transfusion should be performed for replacement of intra-operative blood loss.

2.6.3 Cuff dehiscence

Vaginal repair using chronic catgut is indicated when laparoscopic closure was accomplished by vaginal cuff dehiscence.

2.6.4 Urinary tract complications

Cistoscopy is done in all hysterectomy cases at the conclusion of the procedure to check for ureteral and bladder injuries. Potential complications include secondary ureteral stricture, ureteral ligation, bladder injury during uterine vessel ligation. Careful techniques of ureteral and bladder dissection are important to avoid urinary retention as a common complication. In patients who underwent general anesthesia, the Foley catheter should be removed postoperatively no longer than two hours, until the patient is awake. Signs of some injuries include: abdominal pain, fever or abdominal distention, low urine output relative to fluid intake, hematuria, hydronephrosis and ureteral colic. The treatment for vesico-vaginal fistula and uretero-vaginal fistula is based on Latsko surgical procedure and re-implantation or long term catheter placement, respectively. In most cases, ureteral injuries may occur during cutting severe pelvic adhesion by bipolar cautery. If the ureter is cut or coagulated, immediate reanastomosis is indicated by using a combined double J silicon catheter and

laparoscopic end-to-end anastomosis with four extramucosal absorbable sutures. The Cook, Bard or Meditech stents can be removed six weeks later. Subsequently, the operator searches for the anastomosis patency; if necessary, uretero-neocystostomy should be done (Beste, 2005; Cadiere, 2001; Reich, 2011; Tang & Obermair, 2009).

2.6.5 Bladder injury

11Bladder injury may result from either a trocar puncture (if the bladder has not been drained of urine during dissection of it) or from an inflamed adnexa. If laceration is greater than 7 mm, it should be closed laparoscopically (Reich, 2011). Treatment consists of prophylactic antibiotics and placement an indwelling catheter for the next 7 to 10 days.

2.6.6 Bowel injury

Small bowel injuries are very uncommon during laparoscopic hysterectomy and should be closed with interrupted 3-0 Vicryl. If the defect involves more than 50% of the bowel circumference a segmental enterectomy is necessary in order to reduce the risk of stricture. Therefore, a side to side stapled anastomosis is constructed to avoid the risk of stricture, using a GIA60. An adequate umbilical incision to approximately 2.5 cm is necessary to permit extrusion and repair of the involved bowel. The bowel is than replaced to the abdominal cavity, while the pneumoperitoneum should also be re-established. Anastomotic inspection is made laparoscopically.

2.6.7 Peritonitis after unrecognized perforation

Peritonitis is the result of bowel perforation, after termal damage or Veress needle puncture that is not recognized during the laparoscopic hysterectomy. The laparoscopic surgeon inspects for some injury signs like abdominal pain, unexplained fever, abdominal distension and altered bowel function. Once verified, the patient should be investigated. Treatment consists of a transversally bowel resection of all necrotic area with end-to-end anastomosis, lavage and antibiotics. However, prompt recognition can prevent multiple surgical procedures. Also, mini-dose heparin therapy is used.

2.7 Complications unique to laparoscopy

2.7.1 Subcutaneous emphysema

After using laparoscopic techniques, subcutaneous emphysema should result from placement of the Veress needle into the extraperitoneal space or during prolonged procedures. Patient's companions should be told that during laparoscopic hysterectomy may secondarily occur subcutaneous emphysema as gas gains access through enlargement of the trocar incision in the parietal peritoneum and usually dissolves in 12-24 hours (Harris, 1997; Jhingran & Levenback, 2007; Kim, 2007; Li, 2007; Reich, 2011; Rhodes, 1999; Tang & Obermair, 2009).

2.7.2 Injury to abdominal wall vessels

The percentage of trocar-induced vascular damage to the abdominal wall is less than 2% (Reich, 2011). Rupture of superficial or deep vessels to the anterior abdominal wall can

cause bleeding and hematoma. Therefore, this damage should be avoided by placement of the trocar with the laparoscopic visualization to the rectus muscles. Treatment depends on the location of the injury as well as the damage is arterial or venous. The greatest amount of clinical experience has been with use of a through-and-through loop of suture around the bleeding site (Harris, 1997; Jhingran & Levenback, 2007; Kim, 2007; Li, 2007; Reich, 2011; Rhodes, 1999; Tang & Obermair, 2009).

2.7.3 Injury to large vessels

The vascular surgeon must promptly repair vascular defects such as penetration to aorta, iliac vessels or vena cava that can occur on rare occasion during laparoscopic surgery. Thus, the laparoscopic surgeon and the vascular surgeon must perform direct laparatomy and repair the blood vessels.

2.7.4 Trocar site incisional hernias

If incisional hernia is suspected, symptoms usually occur within 10 days after surgery and laparoscopic reduction should be considered as therapeutic option.

2.7.5 Instrument failure

The incidence of these complications is low (Reich, 2011). If any instruments are faulty within the abdomen, it should be withdrawn from the abdomen laparoscopically in the majority of cases.

The indication for the role of laparoscopy in the future will be determined by the increased familiarity of gynecologic surgeons with these procedures.

3. Robotic hysterectomy. How the robotic system works?

There is no major difference between robotic-assisted hysterectomy and the laparoscopic hysterectomy regarding postoperative considerations and complications (Basil & Pavelka, 2011). Robotic surgery provides all the benefits of the laparoscopic technique with greater precision and effectiveness. However, we have to point out several considerations about the equipment and about how the robotic system works.

The robotic system, particularly the da Vinci System approved by the US Food and Drug Administration for gynecologic surgery since 2005 is superior to laparatomy and provides a shorter hospital stay, less morbidity than laparatomy and easier recovery (Beste, 2005; Carlson, 1994; Chitwood, 2000; Degueldre, 2000; Diaz-Arrastia, 2002; Reich, 2011; Tang & Obermair, 2009).

The da Vinci System allows gynecologists to performed hysterectomies more precise than conventional surgery. Robotic surgery is useful for the treatment of gynecologic cancers and other conditions such as fibroids, vaginal prolapsed (Beste, 2005; Reich, 2011; Stovall & Mann, 2011).

The technique may also be applied for several other therapeutic indications such as sacral colpopexy, tubal reanastomosis, endometriosis and pelvic pain (Cadiere, 2001; Basil & Pavelka, 2011; Reich, 2011; Stovall & Mann, 2011).

The variety and extent of surgery may be performed using a surgeon's console connected to three robotic arms with increased precision and effectiveness. Moreover, the variety of procedure is easier because of 3-dimensional visualization (Cadiere, 2001; Reich, 2011).

Robotic radical hysterectomy is typically indicated in the management of both cervical cancer (tumors more than 2 cm or tumors under 2 cm with lymphatic invasion up to stage IIA) and endometrial cancer with cervical stromal invasion. The da Vinci and Vinci S Robotic Systems are currently used (Cadiere, 2001; Chitwood; 2001; Reich, 2011; Stovall & Mann, 2011).

The robotic column is placed between the patient's lower extremities, at the feet level. Four main trocars are currently used including a 12 mm transumbilical trocar, two trocars of 8 mm placed at 10 cm to the right and left of the umbilical one, while the last trocar is positioned 10 cm lateral and 5 cm caudal to the right robotic trocar, respectively. The assistant trocar of 10 mm is located 3 cm cranial to the umbilical and left trocar. The instrumentation consists of an Endo Wrist PK grasper and an Endo Wrist monopolar that are used on the left and the right robotic arm, respectively; the Endo Wrist Prograsper that is used in the fourth robotic arm to assist with retraction, while an Endo Wrist needle holder is used to replace the monopolar spatula to suture the vaginal cuff; the Enseal device used for division of vascular pedicles. After removal of the specimen, a colpo-occluder balloon is placed in the vagina to maintain pneumoperitoneum (Chitwood; 2001; Reich, 2011; Scott, 1999; Stovall & Mann, 2011).

The robotic system is a technique that uses a remote control, two interactive mechanical arms and a 3D-image processing system, being considered the greatest advance in surgery in the past decades. The patient is placed in the same operating room as the unit. The motions of the surgeon are translated to the robotic arms by using the remote control unit, whereas the robotic arms hold interchangeable surgical instruments that can be moved in a specific manner. Although the robotic system has progressed from simple surgical tasks to more complicated surgery in the past decade, robotic surgery is still in stage of development (Cadiere, 2001; Degueldre, 2000; Diaz-Arrastia, 2002; Stovall & Mann, 2011).

Following the procedure, a second surgeon is positioned within the operation room, at the operating table to help with exchanging the instruments on the robotic "hands".

The da Vinci Robotic Surgical System uses 7 degrees of freedom of motion by the combination of the instruments wrists and the abdominal wall trocar positioned arms.

Robotically assisted gynecologic procedures are generally performed using a combination of remote control, foot pedals and hand controls. These include hand control for operating the instruments, one pedal which is capable to move camera resulting in precise orientation and focus on and a second pedal for repositioning and centering the hand controls. The surgeons first performed bilateral tubal ligations with robotic assistance before progressing to total hysterectomies using the system.

The da Vinci System offers some improvements over traditional laparoscopy: 3-dimensional images, hand tremors and dexterity limitations, but the additional costs, set-up time and limited tactile feedback are major boundaries. In some cases, adequate hemostasis is not advisable with ultrasonic energy; bipolar cautery should be used to assure hemostasis before dividing the entire cardinal ligament (Breda, 2001; Rhodes, 1999; Reich, 2011; Scott, 1999; Stovall & Mann, 2011).

The gynecologic surgeon should master the anatomy of female reproductive tract and the intricacy of lower urinary tract, large intestins and internal genital organs to avoid key surgical complication.

4. Abdominal hysterectomy

Abdominal hysterectomy is a surgical procedure in which the surgeon detaches the uterus from the ovaries, fallopian tubes and upper vagina, as well as from the blood vessels and connective tissue (Baggish & Schellhas, 2011; Beste, 2005; Carlson, 1994; Jhingran & Levenback, 2007; Scott, 1999).

The uterus is a hollow thick walled, muscular organ located in the lower abdomen and pelvis of the female. The lower portion of the uterus namely the cervix may be removed (total hysterectomy), but also may be left in place (partial or supracervical hysterectomy) (Baggish & Schellhas, 2011; Beste, 2005; Carlson, 1994; Jhingran & Levenback, 2007; Scott, 1999).

At its upper end, the uterus narrows into the fallopian tubes and end by curling around the ovary. At the time of the hysterectomy, ovaries and fallopian tubes may also be removed.

The decision concerning appropriate therapy and extent of the abdominal hysterectomy should be made by the woman in consultation with the surgeon for a number of conditions (Baggish. & Schellhas, 2011; Beste, 2005; Carlson, 1994; Jhingran & Levenback, 2007; Scott, 1999).

4.1 Reasons for abdominal hysterectomy

The main reasons for abdominal hysterectomy include abnormal uterine bleeding, fibroids or leiomyoma, pelvic organ prolapsed, cervical abnormalities, endometrial hyperplasia, cancers (uterus, cervix, ovary), severe bleeding after childbirth and chronic pelvic pain. Detailed presentation is presented below.

4.1.1 Abnormal uterine bleeding.

All women with any uterine bleeding before or after menopause should undergo evaluation (Jhingran & Levenback, 2007; Reich, 2011; Scott, 1999).

4.1.2 Fibroids or leiomyoma.

Fibroids produce symptoms of prolonged and excessive regular uterine bleeding; besides, fibroids may cause pelvic pain and excessive bleeding or pressure (Jhingran & Levenback, 2007; Reich, 2011; Scott, 1999).

4.1.3 Pelvic organ prolapsed

Pelvic organ prolapsed occurs due to failure of various anatomic structures to support the pelvic viscera. Pelvic muscles and ligaments are often weakened by vaginal childbirth and other pelvic trauma, life-style factors, chronic constipation and aging process. The patient should not undergo hysterectomy until all ulcers of cervix and vagina are healed. If

necessary, vaginal or abdominal hysterectomy is performed carefully with a vaginal vault suspension (Jhingran & Levenback, 2007; Reich, 2011; Scott, 1999).

4.1.4 Cervical abnormalities.

An abdominal or vaginal hysterectomy is rarely needed (Jhingran & Levenback, 2007; Reich, 2011; Scott, 1999).

4.1.5 Endometrial hyperplasia.

Simple or complex hyperplasia without atypia can often be treated with medication. For older patients with complex atypical hyperplasia and those who fail progestin therapy, the risk of developing endometrial cancer is increased. Therefore hysterectomy is needed or preferred to medical therapy.

4.1.6 Cancer of the uterus, cervix or ovaries.

Classic or laparoscopic surgery is the primary treatment modality for carcinoma of uterus, cervix or ovaries. In addition, radiation therapy alone may be used in patients with significant medical comorbidities.

4.1.6.1 Endometrial carcinoma

It is important to realize a throughout inspection of the peritoneal cavity, peritoneal washing and staging biopsies in all cases of endometrial carcinoma. In addition, the surgeon should combine laparoscopic hysterectomy with laparoscopic lymphadenectomy. In patients with stage I grade 1 tumors an extrafascial total abdominal hysterectomy with bilateral salpingo-oophorectomy is always recommended. Furthermore, postoperative irradiation can be used if myometrial invasion to the outer third is diagnosed. In patients with stage I grades 2 and 3 tumors the use of paraaortic lymphadenectomy has gained popularity over the last years. Postoperative radiation is recommended for grade 2 or 3 tumors that invade the myometrium, full pelvic irradiation offering some benefit (Carlson, 1995; Jhingran & Levenback, 2007; Scott, 1999).

Patients with stage II endometrial carcinoma are treated with extrafascial hysterectomy and pelvic node dissection beam: a combination of external irradiation or brachytherapy followed by operation and simple hysterectomy followed by postoperative irradiation.

In stage III, tumor metastases has spread to the adnexa, serosa and/or positive cytology, but remains confined to the pelvis (exception of stage IIIc) in comparison to stage IV where disease spread outside the pelvis (Carlson, 1995; Jhingran & Levenback, 2007; Scott, 1999).

Therapeutic options may vary depending on the histologic type of endometrial carcinoma. Cytotoxic therapy may provide a potential benefit, while radiotherapy may be useful for patients who underwent operation as primary therapy. However, the patient should have a routine preoperative evaluation (Carlson, 1995; Jhingran & Levenback, 2007; Scott, 1999).

4.1.6.2 Cervical cancer

According to the FIGO staging system, radical hysterectomy and bilateral pelvic lymphadenectomy represent the standard technique in the management of patients with

cervical cancer stage IB-IIA. Traditional radical hysterectomy includes removal of the uterus and cervix, one third of the vagina, the parametrial tissue at the pelvic sidewall and ligature of utero-sacrals (Carlson, 1995; Jhingran & Levenback, 2007; Reich, 2011; Scott, 1999; Stovall & Mann, 2011).

Recently, there has been a great interest in laparoscopic surgery regarding treatment in carcinoma of the cervix. These procedures permit a through exploration of the abdomen and the tumor itself. Pelvic and paraaortic lymphnodes can be removed through laparoscopic ports. Patients with gross adenopathy should be excluded from laparoscopic technique. CT and MRI provide information for identifying the extent of disease (enlarged nodes), to arrive at an accurate clinical staging. In considering the therapy of cervical carcinoma, patient suspected of having cervical carcinoma should first have biopsy of the tumor. The diagnosis of microinvasive cervical cancer cannot be established by biopsy of the tumor, therefore a cervical conisation must be performed. Occasionally, conisation can be used as safe therapy if the margins are free of tumor. If a decision is made to treat patients with stage IB and early stage IIA, radical hysterectomy and radiation therapy can be used. These are equally effective as treatments for minimal spread to the vagina (Carlson, 1995; Jhingran & Levenback, 2007; Reich, 2011; Scott, 1999; Stovall & Mann, 2011).

The five surgery classes proposed by Piver and colleagues according to the extent of the operation are the following (Jhingran & Levenback, 2007; Scott, 1999; Stovall & Mann, 2011):

- class I that completely removes the uterus and cervix, usually treating barrel-shaped cervix; the ureter is not dissected from its place;
- class II or modified radical hysterectomy in which the removal includes more tissue, but the ureters are not yet dissected; all cases are treated by radical hysterectomy and pelvic lymphadenectomy including utero-sacral ligaments ligature;
- class III operation involves uterine artery ligature at its origin from the hypogastric artery; the utero-sacrals are ligated to their distal attachments near to the rectum;
- class IV operation, the uterer being separated from its bed and the superior vesical artery divided at its origin.
- class V operation includes ureteroneocystostomy.

In fact, some investigators have reported that the carcinoma of the cervix is closely associated with endometrial cancer. Therefore, a brief review of methods of management is also presented.

It should be noted that patients with cervical carcinoma characteristically present symptoms such as bleeding, back pain, loss of appetite, weight loss and a history of not having had a cervical cytology (pap smear) for a long period. Several studies have shown there has been a great interest in molecular markers for prognosis and treatment in cervical cancer: the serum squamous cell carcinoma antigen, epidermal growth factor receptor, cyclooxygenase-2, DNA-ploidy, tumor vascularity and S-phase fraction.

4.1.6.3 Ovarian cancer

Despite numerous investigations currently used, ovarian cancer is the second cause of malignancy of the female genital tract and is characterized by advanced stage disease and high mortality. However, women with late menopause, a history of nulliparity and late

childbearing appear to have an increase in risk for ovarian cancer (Carlson, 1995; Reich, 2011; Scott, 1999; Stovall & Mann, 2011).

Several screening modalities have been proposed for the diagnosis of malignancy in adnexal mass, such as physical examination, biomarkers (CA125), proteomics/genomics and ultrasonography (Jhingran & Levenback, 2007; Scott, 1999; Stovall & Mann, 2011).

In case of benign epithelial ovarian tumors like serous cystadenoma, hysterectomy and bilateral salpingo-oophorectomy are usually performed. As well, mucinous tumors can lead to the deposits in the peritoneal cavity by perforation and rupture. Adenofibromas are also treated by simple excision, while Brenner tumors are rare and almost benign, therefore oophorectomy is usually proposed. When these tumors occur in perimenopausal or postmenopausal period, hysterectomy and bilateral salpingooophorectomy offers the best treatment option. Most of the ovarian tumors can be approached surgically through a Phannenstiel incision or by laparoscopic excision. After the diagnosis of malignancy is established by histologic examination of tumor tissue excised at operation, a second procedure can be performed (Jhingran & Levenback, 2007; Scott, 1999; Stovall & Mann, 2011).

The most common borderline ovarian tumors tend to occur in young women aged between 38 and 45 years old (Markovska & Grabowski, 2009). Because several studies confirmed that the cells of these tumors do not invade the stroma of the ovary, it is desirable to ascertain the safety of conservative treatment for women with stage IA disease. Fertility sparing surgery with abdominal cavity inspection and biopsy of peritoneum and controlateral ovary is indicated (Markovska & Grabowski, 2009). Moreover, unilateral adnexectomy is performed. Mucinous borderline tumors are frequently associated with large amounts of mucinous material in the peritoneum; sometimes, an appendiceal adenoma or an appendiceal carcinoma which require appendectomy is identified. Based on these findings, surgery offers the best treatment for such tumors (Jhingran & Levenback, 2007; Scott, 1999; Stovall & Mann, 2011).

4.1.6.3.1 Invasive epithelial carcinomas

A total abdominal hysterectomy with bilateral salpingo-oophorectomy is performed once patient's abdomen is explored through laparatomy. Biopsy and cytologic evaluation is performed to obtained samples from the peritoneum or any suspicious nodules. Current evidence suggests that paraaortic and pelvic lymphnodes sampling is indicated (Benedetti, 2008; Benedetti, 2009). Additionally, surgical treatment may involve splenectomy, diaphragmatic stripping, posterior exenteration and bowel resection (Harris, 1997; Jhingran & Levenback, 2007; Scott, 1999; Stovall & Mann, 2011).

Criteria for preserving childbearing function in woman with stage IA include the following (Jhingran & Levenback, 2007; Scott, 1999; Stovall & Mann, 2011):

- tumor diagnosis confined to one ovary;
- tumor growth limited to one ovary; well differentiated tumor with no dissemination (capsule, lymphatics or mesoovarium);
- negative cytologic peritoneum samples;
- negative biopsy or preferable excision of omentum;
- younger women with stage IA diagnosis, for preserving future childbearing potential.

4.1.6.3.2 Stage I

The assessment of entire peritoneum, retroperitoneal paraaortic pelvic nodes and subdiafragmatic area is important before removal of the omentum, uterus, tubes and controlateral ovary (Jhingran & Levenback, 2007; Scott, 1999; Stovall & Mann, 2011).

4.1.6.3.3 Stage II

The primary treatment relays on removal of the uterus, tubes, ovaries and omentum. In addition, the pelvic and paraaortic nodes biopsies is currently performed (Jhingran & Levenback, 2007; Scott, 1999; Stovall & Mann, 2011). Postoperatively, three options are currently available in such cases: no postoperative treatment, postoperative radiation and postoperative chemotherapy.

4.1.6.3.4 Postoperative therapy for stage III and IV

Several randomized clinical trials using the taxane/platinum combination have been considered as the first line therapy for ovarian cancer. Neoadjuvant chemotherapy is performed as an alternative to extensive therapy. Moreover, certain studies have concluded that such therapy is able to improve the performance status. However, several other prospective and retrospective studies have suggested that many patients with negative second look operation develop recurrent disease. Therefore, some surgeons perform a second look procedure and they recommend such operation not to be done for patients who initially have stage I or II of disease (Jhingran & Levenback, 2007; Scott, 1999; Stovall & Mann, 2011).

4.1.7 Severe bleeding after childbirth

A few women with severe bleeding after childbirth should undergo hysterectomy too.

4.1.8 Chronic pelvic pain

Pelvic pain can be caused by many sources, including endometriosis, gastrointestinal and urinary systems. On the other hand, it is important for women with chronic pelvic pain to ask about the probability that her pain will improve after hysterectomy. Also, laparoscopic presacral neurectomy should be reserved for the patients with significant pain refractory to an adequate trial of conservative treatment.

4.2 Abdominal hysterectomy procedure

4.2.1 Pre-operative preparation

Before hysterectomy, preoperative testing may include a physical examination, ECG, chest X-ray and blood testing, depending upon medical condition and age. In addition, heart rate, blood pressure loss and respiration are closely observed before general or spinal anesthesia is given (Jhingran & Levenback, 2007; Reich, 2011; Scott, 1999).

4.2.2 Technique

Total hysterectomy requires the complete removal of the uterus, the fundus and the cervix, while partial hysterectomy will leave the cervical stump. There are several types of

hysterectomy procedures and it is possible for a less invasive procedure to be performed, such as a laparoscopic hysterectomy or a vaginal hysterectomy. These procedures are not practical for complications; in such cases, therefore, the surgeon will made than likely have to revert to an abdominal hysterectomy.

Simple abdominal hysterectomy differs from radical hysterectomy with pelvic lymphadenectomy. The ureter should be identified and dissected after the peritoneum is entered by clamped, cut and sutured-ligated the round ligament. At this point, the peritoneum, the tissue containing lymphnodes and fat are all dissected and the psoas muscle, external iliac vessels and the ureter identified. The external iliac artery, external iliac vein and internal iliac artery are cleared of fat. The surgeon exposes the obturator fossa under the external iliac artery and vein. Second, the obturatory artery and nerve are cleaned of fat and lymphnodes (Baggish & Schellhas, 2011; Meeks and Harris, 1997; Reich, 2011; Rhodes, 1999; Scott, 1999; Stovall & Mann, 2011).

When the node dissection of the external iliac and of the obturator fossa is complete, the operator turns to the common iliac node dissection. Next, the uterine arteries are clamped, cut and suture-ligated distal to their origin from the hypogastric arteries. First, the ureter is dissected inferiorly. Also, at the place where the ureter penetrates the cardinal ligaments to the wall of the bladder, a right angle clamp should be inserted between the ureter and cardinal ligament. When the ureter is clearly free and mobile, the bladder pillars are clamped, cut and sutured. The ureters tunnel to the cardinal ligament must be cut. At that point, the vesico-uterine and retrouterine spaces should be dissected down-ward bellow the cervix and the utero-sacral ligaments are clamped, cut and suture-ligated (Baggish & Schellhas, 2011; Meeks and Harris, 1997; Reich, 2011; Rhodes, 1999; Scott, 1999; Stovall & Mann, 2011).

Then, the ureter is retracted to allow the operator to expose the lower cardinal ligament below the cervix and paravaginal fat. The vagina is clamped at 4 cm below the cervix. Now, the uterus and the attached parametria are removed and the anterior and posterior peritoneum is sutured with Vicryl. Finally, a catheter is placed retroperitoneally before the peritoneum is sutured. At the end the abdominal wall is closed (Baggish & Schellhas, 2011; Meeks and Harris, 1997; Reich, 2011; Rhodes, 1999; Scott, 1999; Stovall & Mann, 2011).

4.2.3 Recovery after abdominal hysterectomy

After operation, patients are transferred to post-anesthesia care unit where they will spend one or two nights. During this period, early recognition and management will preclude larger problems from developing. Thus, patients will resume to their normal daily activities as soon as possible. Pain drugs are given as needed and move from parental medication to oral drugs. Also, being active is important since it helps to prevent blood clots, pneumonia and gas pains (Frumovitz, 2007; Reich, 2011; Scott, 1999).

4.2.4 Complications

Several complications have been described (Jhingran & Levenback, 2007; Kim, 2007; Li, 2007; Reich, 2011; Scott, 1999).

4.2.4.1 Hemorrhage

The patient should return into the operation room to identify and stop the bleeding.

4.2.4.2 Infection

A high or persistent fever may be caused by infection. Finally, in less than 10% of patients, another surgical procedure is necessary. Most of the cases should be treated with intravenous antibiotics.

4.2.4.3 Constipation

Constipation occurs in most patients following operation, and can lie prevented with dietary fibers. Laxatives may be given to some women to control it.

4.2.4.4 Urinary retention

Urinary retention is more common in patients who underwent vaginal hysterectomy and can usually be controlled with a catheter within 24 to 48 hours.

4.2.4.5 Blood clots

The risk of developing blood clots is increased after hysterectomy. Medication such oral contraceptives or hormone replacement should be discontinued prior to surgery. Current guidelines recommend that hormone replacement therapy should be stopped for at least 30 days prior to surgery (Ardern, 2002).

4.2.4.6 Damage to adjacent organs

The urinary bladder, ureter and intestine injuries may occur during hysterectomy, but are usually detected and corrected during the time of surgery. If detected after hysterectomy, another intervention is commonly indicated.

4.2.4.7 Early menopause

Patients who have underwent hysterectomy with bilateral salpingo-oophorectomy may develop menopause earlier that the average age of menopause. Also, this may be related to an interruption in blood flow to the ovaries.

5. Conclusions

Total hysterectomy is currently indicated for a variety of gynecological conditions. Therefore, we haven't focus only on cervical cancer, but also we have made general consideration about hysterectomy in other gynecological cancers, taking into account both traditional and modern methods.

In "Cuza-Voda" Obstetrics and Gynecology Clinical Hospital, Iasi, Romania, most gynecologists are trained to perform abdominal hysterectomy. Unfortunately, they resort to the technique that they learned twenty-thirty years ago when they were residents. Large incisions result in more adhesions, pain and discomfort that if the intervention is done with a laparoscope.

Laparoscopic hysterectomy was introduced at the same time as laparoscopic cholecystectomy and represented a significant advance in clinical surgery. Patients require a shorter hospital stay, a more rapid convalescence and return to work and normal daily living.

Abdominal and vaginal hysterectomy techniques have become established as classic techniques. There is still no consensus between users and non-users. Unfortunately, after a

century of experience, the gynecologists have no clear indications of the optimal method to be performed in different situations. Laparoscopic and abdominal hysterectomy has attracted very few comparative studies until the recent introduction of laparoscopic hysterectomy.

There has been a great interest in laparoscopic surgery regarding hospital stay, quicker recovery time, less blood loss, significant less pain and lower costs.

The goal of robotic and classic gynecologic surgery is to provide excellent patient's outcomes. The decision as to which technique is the best depend upon the risks, benefits of each types of surgery and the women's particular medical problems.

Well-designed case control studies are the most commonly used method to study each type of treatment. The goal of randomized clinical trials is to recruit as sufficient number of patients for providing adequate statistical power. But there are several problems including knowledge and surgeon experience with laparoscopic instrumentation in many countries.

Operative procedures should be performed depending on surgeon preference, available treatment options, patient's medical background, female pelvic condition, the average cost per case and other reasons. The reasons for the high costs are varied but frequently poor management systems are often found in many service areas, especially in operating rooms.

The provider who manages his funds for investment in equipments and new projects will be the winner in health care of the following years.

Also, a good communication system should effectively meet the needs of surgeons and patient's wishes. The training of residents and physician will be positively impacted as well.

Finally, the number of surgeons performing robotic surgery is growing as the technique has proven to be a far less difficult hysterectomy procedure than a traditional abdominal hysterectomy. This procedure does everything that a traditional abdominal hysterectomy would do but recovery time, hospital stay, complications and infection after a laparoscopic procedure are significantly reduced.

However, the robotic surgery allows the surgeon more precision, dexterity and control along with better view of the structures of the pelvis. Also, many of the risks have been eliminated by technological advances, therefore more women choosing robotic-assisted surgery instead of traditional "open" hysterectomy.

In contrast, the robotic system cannot make decisions nor can it performed any type of regulated and controlled movements without the surgeons input.

Finally, we can conclude that robotic surgery offers all the benefits of laparoscopic surgery along with increased precision and effectiveness, being more precise than conventional surgery, giving a reduced tissue trauma, a less use of pain medication and a quick return to normal activities for the patient.

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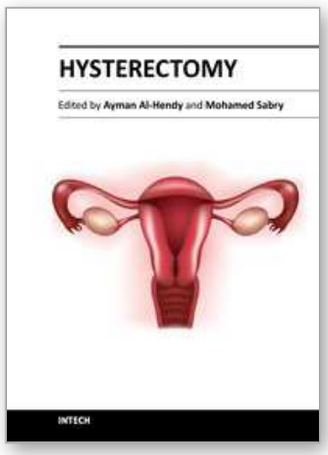

Hysterectomy

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This book is intended for the general and family practitioners, as well as for gynecologists, specialists in gynecological surgery, general surgeons, urologists and all other surgical specialists that perform procedures in or around the female pelvis, in addition to intensives and all other specialities and health care professionals who care for women before, during or after hysterectomy. The aim of this book is to review the recent achievements of the research community regarding the field of gynecologic surgery and hysterectomy as well as highlight future directions and where this field is heading. While no single volume can adequately cover the diversity of issues and facets in relation to such a common and important procedure such as hysterectomy, this book will attempt to address the pivotal topics especially in regards to safety, risk management as well as pre- and post-operative care.

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