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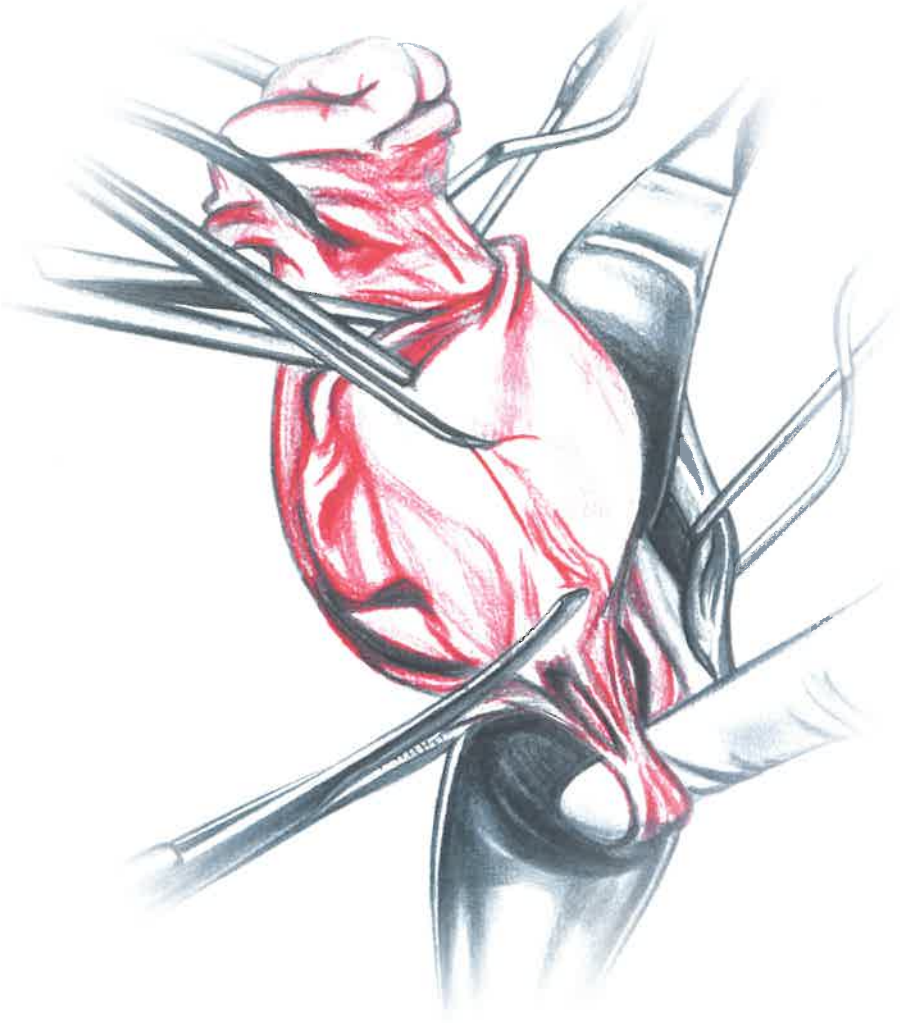

# DIFFICULT VAGINAL HYSTERECTOMY

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618

***We dedicate this book to all gynecologyst who want to carry on the tradition of vaginal surgery.***

***Authors***

# Foreword

Hysterectomy is the most frequent gynecological surgery performed everywhere. The idea to extract the uterus by vaginal route is lost in antiquity. The history of modern hysterectomy dates back over 200 years.

Vaginal hysterectomy dominated for a long time the gynecological surgery for benign and malignant diseases of the uterus. Vaginal hysterectomy was dethroned by abdominal hysterectomy with the introduction of modern anesthesia, asepsis and antisepsis, and antibiotics. „At the beginning of 80, after 30 years of vaginal hysterectomy revived. For a short period, it's back in the news. Unfortunately, the surgical progress marked by the introduction of laparoscopic hysterectomy in 1989 by Harry Reich triggered a new wave that tends to cover the vaginal hysterectomy again.

Vaginal surgery was the only surgical branch where the gynecologist could enhance his surgical abilities until laparoscopic surgery appeared. Although a difficult surgery performed through a natural orifice, vaginal surgery brings an undeniable advantage for patients. This minimally invasive nature confers a good postoperative evolution, low complications, and quick recovery. Vaginal hysterectomy is the cheapest alternative for uterus ablation who does not need anything but proper instrumentation and a trained surgeon.

Currently, most vaginal interventions used in clinical practice are reconstructive and mainly refer to pelvic floor disorders, the ablative surgery of the uterus, and adenexes being reserved for the open or laparoscopic abdominal route in the vast majority of cases.

From the first vaginal hysterectomy and to date, many technical variants have been described that were intended to give the patient safety and give the surgeon a logical sequence of operative steps. Unfortunately, the surgery is not an exact science, and the variability of human pathology often puts the surgeon in the face of situations that make each case a special one.

This book aims to provide solutions for most situations where vaginal hysterectomy can become difficult. It is a book derived from an experience of over 4500 cases of vaginal hysterectomies for unprolapsed uterus, which we dedicate to all gynecologists who want to carry on the tradition of vaginal surgery.

Authors



# Table of contents

Before opening the rectouterine peritoneal fold, we will see a variable amount of fatty tissue, which forms the *yellow line* that announces to the surgeon the dissection layer and the imminent appearance of the underlying rectum. *The fat belongs to the rectum and not to the vaginal wall.*

Campbell identified three distinct histologic regions of the sacrouterine ligament. At the cervical attachment, the ligament consisted of carefully packed bundles of smooth muscle, large, medium-sized, and small blood vessels, and minor nerve bundles. The intermediate third of the ligament was predominantly connective tissue and only a few scattered smooth muscle fibers, nerve elements, and blood vessels.

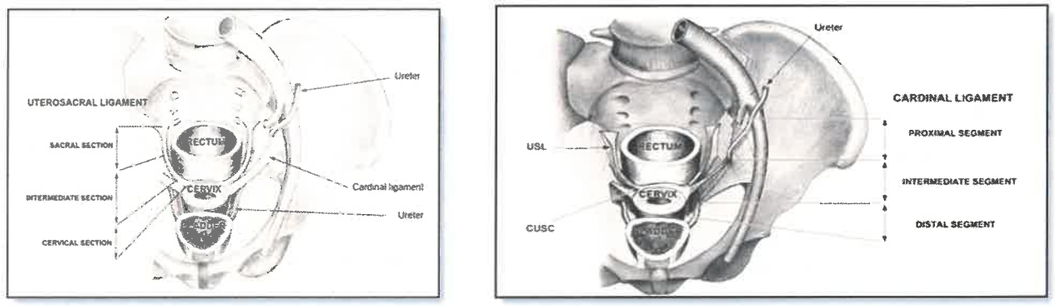



Fig. 2.4 Definition of three segments of uterosacral and cardinal ligaments

The sacral third was almost entirely composed of loose strands of connective tissue and intermingled fat, few vessels, nerves, and lymphatics.

Unlike the sacrouterine, the cardinal ligaments can also be identified in three segments. Only the distal segment that fuses with the sacrouterine ligament can be considered a support structure. The proximal and intermediate sections represent only a mesenteric structure for the vessels and nerves.

The mechanical strength of the uterosacral ligaments is remarkable. The cervical and intermediate portions of the uterosacral ligament supported more than 17 kg of weight before failure. (Nichols)

### b. *Middle Pedicle*

The middle connective-vascular pedicle consists of the cardinal ligaments, uterine vessels, and a variable contingent of fibers that are part of the uterosacral ligaments. The middle pedicle has a fibrous-connective segment consisting of inferior fibers of the uterosacral ligament and a cranially located vascular segment, which includes the superior bundle of the cardinal ligament and uterine vascular pedicle. The two segments can be surgically treated as a single pedicle or separate, depending on the thickness and insertion area of the uterine edge. (Shiff)

From the vaginal point of view, the uterine artery is the first to appear before the ureter. The distance between the lateral side of the cervix and isthmus and the wall of the pelvis is approximately 4–5 cm. The ureter crosses the cardinal ligament halfway, about 2– 2.5 cm from the cervix. The ureteral risk is reduced in vaginal hysterectomy. Once cutting thelower pedicle, the cardinal ligament is elongated, removing the ureter from the operator's field. (Kovak)



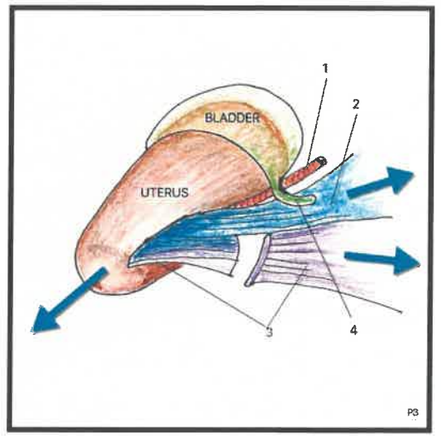



Fig. 2.5 Middle pedicle. 1 = uterine artery, 2 = cardinal ligament, 3 = inferior pedicle cut, 4 = parametrial ureter. Once cut, the uterosacral ligament's traction on the cervix makes the cardinal ligament elongated and removes the ureter from the surgical field.

### c. *Upper Pedicle*

The upper pedicle comprises *round ligaments*, *uterine tubes*, and *utero-ovarian ligaments*. The tubes and ovaries are indirectly supported by the *infundibulopelvic ligament*, which supports the pelvic wall. The upper pedicle maintains the uterus in an anatomical position and stands against the force that tends to push it through the pelvic opening. Duringthe vaginal hysterectomy, the upper pedicle is the most problematic one in terms of strategyregarding the extraction of the uterus from the pelvic cavity.

The disconnection of the uterus from the upper pedicle can be done in two ways: interanexially or by bilateral adnexectomy. Most vaginal hysterectomies are carried out inter-anexially, adnexectomy having indications. The possibility of doing an adnexectomy during a vaginal hysterectomy is over 80% (Seth S). The adnexectomy will be done as the last operative time after the inter-adnexal extraction of the uterus.

The resistance of the superior pedicle to traction is due to the intrinsic elasticity of the connective elements in the ligament structures and the resistance of the posterior leaf of broad ligaments. Chronic inflammatory processes may cause the adhesion of ovaries to the posteriorleaf of the broad ligament or parietal peritoneum of fossa ovaries, which leads to the fixation of the adnexa to the walls of the pelvis. Vaginal adnexectomy is difficult in these cases.

## The cleavage spaces

Vaginal hysterectomy is performed by disconnecting the main connective-vascular pedicles that keep the uterus in anatomic position in the pelvis. The vagina and uterus are necessary to isolate from the nearby organs, the bladder, and the rectum to give access to the connective vascular pedicles. Dissection of cleavage spaces allows to be entering the peritoneal cavity necessary for extraction of the uterus.

The so-called *cleavage spaces* are providing anatomical and functional individuality topelvic organs. *The anterior cleavage* space separates the uterus and vagina from the lower urinary tract. *The* posterior *cleavage space* separtes the vagina and cervix from lower digestivetract.

*1. The anterior cleavage spaces.*

The anterior cleavage space has two divisions: *the vesicovaginal space* and the *vesicouterine space* separated from *cervicovesical septum.* The anterior cleavage space formed between the adventitial layers of the anterior vaginal wall and the bladder wall.

The *vesicovaginal space* is closed distally by the fusion of vaginal wall with the perineal membrane, and proximally by the cervicovesical septum.

The *vesicouterine space* is bordered distally by a the cervicovesical septum andproximally by vesicouterine peritoneal fold.

Except for the distal part, the anterior cleavage space separates the organs through a layer of lax cellular tissue that allows relatively easy to dissect. The primary condition is to find this space that can be done by hydrodissection surgically. It is essential to find this dissection plan from the beginning because the dissection between the muscular and adventitialplane of the vaginal wall represents a false route susceptible to bleeding throughout the intervention.

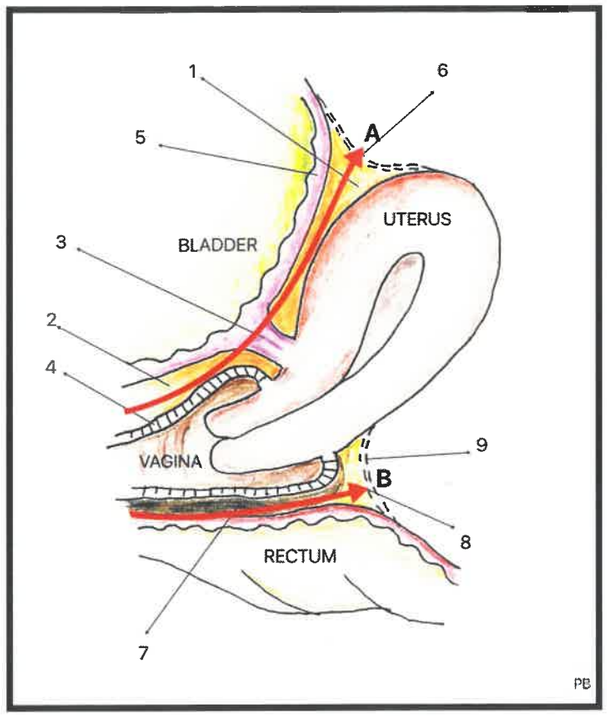



Fig. 2.6 Cleavage spaces in vaginal hysterectomy.

A= *The anterior cleavage spaces*. 1 = vesicouterine space, 2 = vesicovaginal space, 3 = cervico-vesical septum, 4 = vaginal wall, 5 = bladder wall, 6 = vesico-uterine fold. Red arrow = route from vesico-vaginal space to vesico-uterine fold.

B= *The posterior cleavage spaces*. 7 = recto-uterine septum, 8 = recto-uterine space, 9 = recto-uterine fold. Red arrow = route to recto-uterine fold. The rectovaginal septum remains adherent to the posteriorvaginal wall.



In a vaginal hysterectomy, the dissection of the anterior cleavage space is carried out in three phases:

1. Entering in *vesico-vaginal* space at the level of *sulcus vesicalis.* It is a short routeof about 1-2cm that follows after the incision of the anterior vaginal wall whichaims to highlight the *cervicovesical septum.*
2. Sectioning the *cervicovesical septum.* This septum is constantly encountered andis bounded cranially by the vaginal wall, caudal by the cervix, and laterally by the *cervicovesical ligaments* (bladders pillars). The sectioning of the septum is done at the cervix insertion between the two bladder pillars.
3. Entering the *vesicouterine space* and opening the vesicouterine peritoneal fold. This phase may be the simplest or most complicated during vaginal hysterectomy.

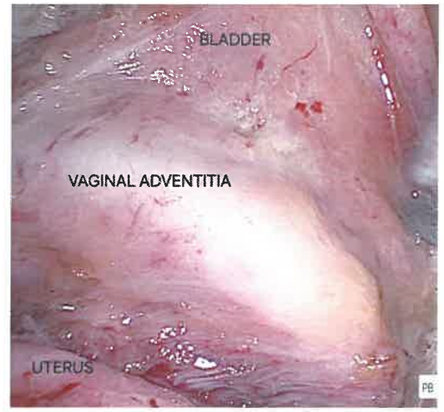



Fig. 2.7 Laparoscopic hysterectomy. Dissection of vesicovaginal space. The bladder is very easy to dissect from the vaginal wall. The adventitial layer belonging to the vagina is visible as a resistance structure that covers the muscular layer. No other histologic structures interpose between the bladder and vaginal wall.

Through the standard technique, the vesicouterine space is essential to reach for detaching the bladder from the uterus. The two cleavage spaces are easy to access, but in certain situations, difficulties may appear when accessing and dissecting these spaces.

*2. The posterior cleavage spaces*

Posteriorly between the rectum, vagina, and cervix, *the rectovaginal cleavage* space is interposed. To date, a fascial structure to separate the rectum from the vagina has not been identified. A detailed study of the structure of the posterior vaginal wall previously done by Karaam has shown that ... *Histologically, there is no evidence of adistinct fascial layer between the posterior vaginal wall and anterior wall of the rectum.Clinically, it is the splitting of the adventitia and fibromuscular layers of the vagina that are used in defect-specific rectocele repairs to support the anterior rectal wall...*

Kleeman describes three anatomic zones of attachment of the posterior vaginal wall tothe anterior rectal wall:

- *The distal zone* - between the vaginal and rectal walls do not interpose other tissue. This zone is in connection with the perineal body challenging to dissect.
- *The middle zone* -represents approximately one-half of the length of the posterior vaginal wall. Here a fibrilar net adheres intimately to the vaginal wall covered by cellular tissue vessels and nerves, which separates it from the anterior rectal wall. This zone offers a cleavage space between the vagina and the adventitial layer of the rectum, easily to dissect. Many surgeons consider the adventice of the rectum as a rectovaginal septum.
- *Proximal zone* – is an area of fusion between the posterior vaginal wall and anterior wall of the rectum. Here a net of collagen fibers extends to lateral attachments of the vagina to the first level of suspension (rectal pillars).

From the surgical point of view, the proximal zone is interested in the opening of the rectovaginal fold. Sometimes the lateral fibrous extension of the vagina and adhesion to the rectal wall can predispose to damage to the rectum during clamping and sectioning of the lowerpedicle.

## Uterine Blood Supply

The uterus is a highly vascular organ with two arterial and two venous systemsintertwined.

The primary arterial system is composed of the *uterine* and *vaginal arteries*, which originate from the hypogastric artery. *The ovarian arteries*, which originate from the aorta on each side and the *funicular artery*, from the external iliac artery, form the second arterial system. The two systems communicate through *utero-ovarian anastomotic* vessels.

Between the *uterine artery* and the *vaginal artery*, there are many anastomotic branches, and simple occlusion of the uterine and ovarian artery is not enough to stop blood flow in the uterine body.

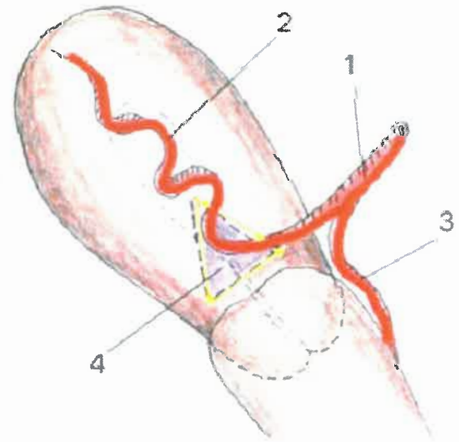
The venous system is composed of the *uterine veins* (superficial and deep), which drainthe blood in the *hypogastric veins* on each side, and *the ovarian veins* which drain on the rightside into the vena cava inferior and on the left side into the left renal vein.

The arterial blood supply is provided by three different sources: the *uterine artery*, the *utero-ovarian artery,* and the *vaginal arteries.*

### *Arterial blood supply*

*a. The uterine artery* is the primary blood supply source for a uterus in a reasonable condition. During pregnancy, the utero-ovarian artery becomes the second significant source, doubling its diameter. In non-pregnant women, the diameter of the left uterine artery is 1.6 mm,and for the right artery, it is 1.4 mm. The diameter of the uterine artery may vary for large uteri, up to 5 mm.





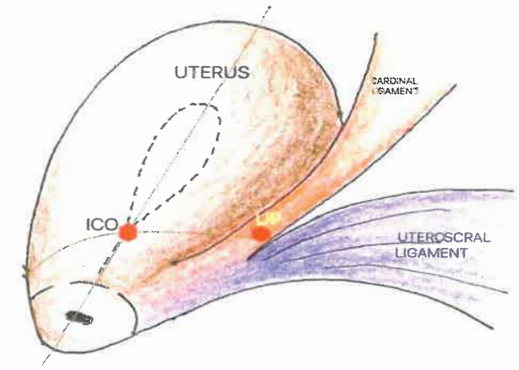




Fig. 2.8 The point where the uterine artery reaches the uterus is constant at the level of the internalcervical orifice. ICO = internal cervical orifice, UP = uterine point. 1 = main uterine artery, 2 = ascending branch of the uterine artery, three = descending branches of the uterine artery. 4 = Beliaeva triangle.

The uterine artery reaches the uterus in a triangular zone near the isthmus (Beliaeva triangle) situated in the base of the broad ligaments at three o clock for the right side and nine o clock for the left side (from the vaginal point of view). The descending uterine artery supplies the isthmus, cervix, and upper vagina. The ascending uterine artery supplies the body of the uterus. The ascending uterine artery is tortuous and gives rise to 10–12 arcuate arteries that course between the outer and middle thirds of the myometrium.

The crossing point of the uterine artery with the ureter is located sideways, approximately 20 mm away from the cervix and 10–12 mm cranially from the lateral vaginal fornix. At this level, there are two venous currents, one in front and another in the back of the ureter, which is predisposed to bleed during maneuvers to unroof the parametrial ureter.

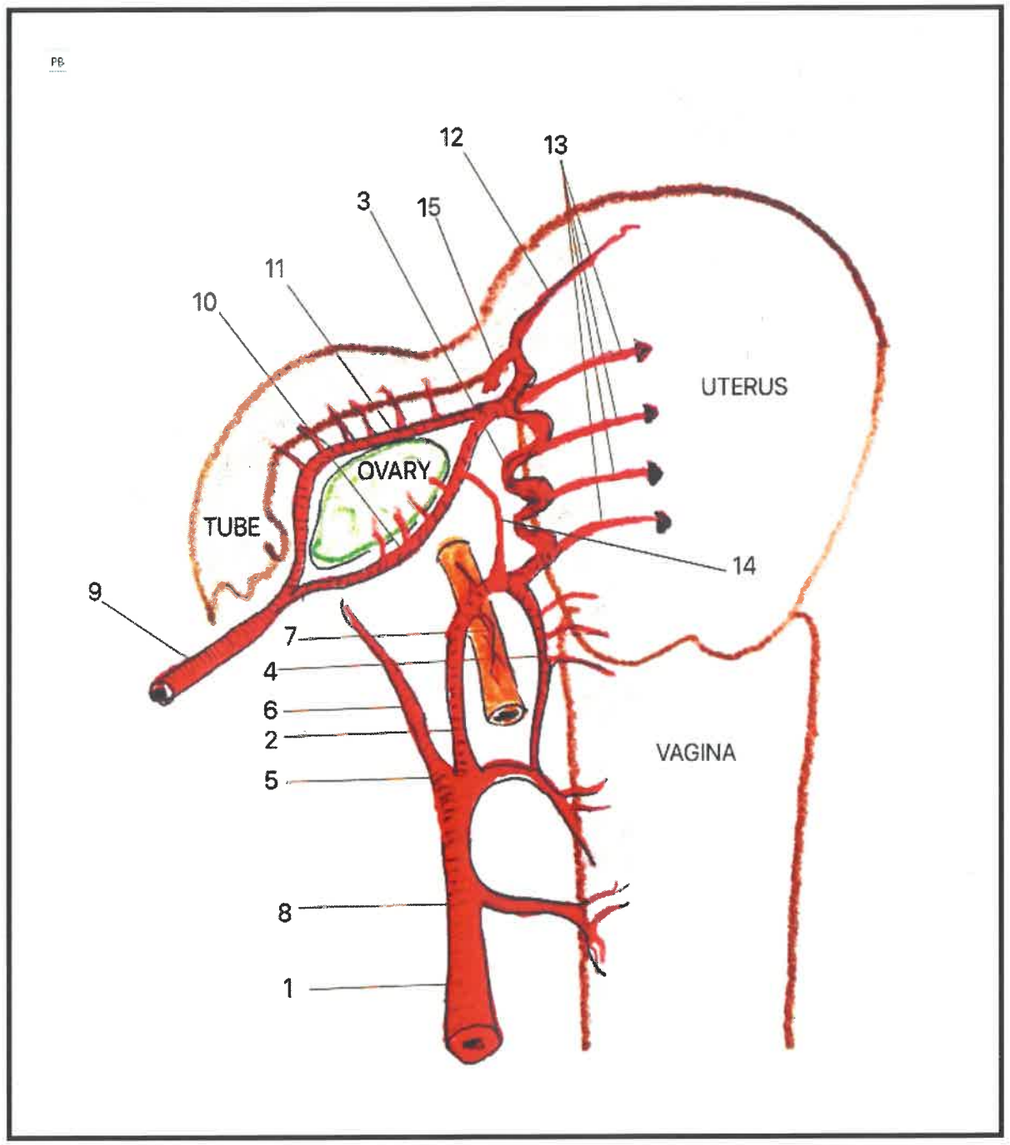



Fig. 2.9 Arterial supply of uterus and vagina. 1 = Arterial trunk of hypogastric artery, 2 = Main trunk of the uterine artery, 3 = The ascending branch of the uterine artery, 4 = The descending branch of uterine artery (superior vaginal artery), five =inferior vaginal artery, 6 = umbilical vesical artery, 7 = ureteral branches from the uterine artery, 8 = middle hemorrhoidal artery, nine = ovarian artery, ten = ovarian arch between ovarian and uterine branches, 11 = tubal arch between ovarian and uterine branches, 12 = fundal branch of the uterine artery, 13 = arcuate arteries from right side, 14 = anastomotic branch between the uterine artery and ovarian arch, 15 = funicular branch (round ligament) artery.



b. *The ovarian artery* included in the *infundibulopelvic* ligament, after crossing the external iliac artery and vein, emits two branches, a tubal and an ovarian one, which is anastomosed between them by short arteries. The uterine artery provides the primary blood flow, but conditions, such as after uterine embolization or in pregnancy, more than 80% of blood flow can be provided by the ovarian artery.

c. *Vaginal arteries*, in more than 90% of cases, have their origin in the descending branch of the uterine artery, but it may also come directly from the hypogastric artery. Arterial blood flow of the vagina has three primary sources:

- A branch from the uterine artery.
- The vaginal artery.
- The middle hemorrhoidal artery.

The source of the uterine artery is composed of vesicovaginal and cervicovaginal branches and ensures the blood flow for the upper part of the vagina. The correct vaginal artery (lower vaginal artery or large vaginal artery) originates from the hypogastric artery. The artery from both sides anastomoses in the midline and form the longitudinal artery from the cervix to the vulva named the *azygos artery of the vagina*. The hemorrhoidal artery emits some branches for the posterior side of the vagina.

d. The *funicular artery* (artery of the round ligament) is an auxiliary blood supply source that can become a significant source in case of bilateral ligation or embolization of the hypogastric artery.

e. The *anastomotic branch* between the ovarian and ascending branches of the uterine artery can be found in broad ligaments.

The bilateral ligature of the anterior trunk of hypogastric arteries cannot stop the blood flow into the pelvis. Two primary sources ensure arterial collateral circulation of the pelvis:

***Branches of the hypogastric artery***

- Iliolumbar arteries
- Lateral sacral arteries
- Middle hemorrhoidal arteries

***Sytemic circulation***

- Lumbar areteries
- Middle sacral artery
- Superiorhemorrhoidal arteries

*Venous Blood Supply*

Venous blood from the uterine body comes from the veins located in the thickness of the myometrium, which is venous sinuses with reduced endothelial cover. Venous blood drains into two collecting veins on each side of the uterus, with anastomoses in between. The collateral venous blood supply is significant concerning the alternative route for blood flow in case of significant obstruction of main venous branches.

Collateral venous circulation of the uterus can be done in three main ways:

- The *veins of the round ligament* that drain into the superficial epigastric vein and femoral vein.
- The *utero-ovarian veins* arranged in an anterior plane in the mesosalpinx and in a posterior plane that is a satellite of the utero-ovarian ligament. On the external extremity of the broad ligament, these two venous networks are anastomosed, forming the *pampiniform plexus* that is part of the constitution of *infundibulopelvic* ligaments. These plexuses go up through the lumbar region and drain into the inferior vena cava on the right and into the left renal vein on the left.
- The *uterovaginal veins* are organized in two planes, a preureteral one and a retroureteral one, which are anastomosed with the perivesical, perivaginal plexus and

The venous blood supply of the vagina consists of veins that come from each side of the vagina and anastomose on the median line on the same path as the azygos arteries. The blood flow is oriented to uterine veins at the level of the cervix.

Veins are mainly located on the sides of the vagina and anastomose each other at the extremities of the vaginal canal. In the middle region of the vagina, anastomoses are carried out in the azygous arteries draining the blood to the uterine veins at the level of the cervix. The uterine veins are anastomosis with the average hemorrhoidal veins, which, in turn, communicate with the upper hemorrhoids, forming at this level a porta-cave anastomose. The *long vaginal vein* is the artery satellite of the same name when it exists, and it flows into the hypogastric vein.



## Local Hemodynamic Changes During Vaginal Hysterectomy

Unlike with abdominal hysterectomy, regardless of the method, open or laparoscopic, vaginal hysterectomy produces a particularly favorable effect by reducing bleeding, especially in the case of large uteri due to special hemodynamic conditions. During a vaginal hysterectomy, a series of hemodynamic events occur concerning the uterine circulation, especially for a large uterus:

- Vaginal hysterectomy has as its first step the disconnection of the upper vagina from the cervix and uterine body. As a result, the anastomotic flow between the uterus and vagina is interrupted.
- After the middle pedicles are cut, due to caudal traction of the cervix in the vaginal canal, the transversal segment of the uterine artery elongates, and it can be secured by occluding both the ascending and descending branch. After that, all the maneuverers in the uterus, until the upper pedicles, are bloodless.
- If the diameter of the uterus exceeds the lower pelvic brim, as the uterus is released, the bleeding is stopped by compressing the vessels on the hard plane of the pelvis.
- After extracting a large uterus, important bleeding may occur, caused by either ligature sliding or from the tearing of veins in the broad ligament.
- Many vaginal hysterectomies may result in insignificant bleeding as compared to those in abdominal hysterectomies.

Traction exerts on the cervix of a large uterus almost throughout the operation, so that blood flow is significantly diminished. After the bilateral ligature of the uterine arteries, which can affect both the ascending and the descending branches, the blood flow is completely stopped, allowing maneuvers for dimensional reduction of the uterus with no risk of significant bleeding.

During the vaginal hysterectomy, after the ligature of uterine arteries, visible bleeding does not come from vascular pedicles, but blood stored in the myometer.