Introduction

The uterine and ovarian malignant tumors are the most common gynecological cancers. Malignant uterine tumors are responsible for up to 9% of all new cancer cases and for 4.5% of all cancer related deaths in women. The three important uterine cancers are endometrial carcinoma, uterine sarcomas and cervical carcinoma. At First, Endometrial carcinoma occurs when cells of the endometrium undergo a degenerative change or malignant transformation and begin to grow and multiply without the control mechanisms that normally limit their growth. As the cells grow and multiply, they form a mass called a cancer or malignant tumor and the risk factors increase with obesity,early puberty,late menopause,treatment with unopposed estrogen and family history ***(William, 2015).***

Endometrial carcinoma are typically found in elderly women and are > 70% hormone sensitive (type I) or (type II) which is often less differentiated and not hormone sensitive ***(Mundhenke, 2007).***

Secondly, uterine sarcomas are uncommon tumours from mesenchymal elements. They are thought to arise primarily from endometrial stroma and uterinemuscle, respectively. When endometrial stroma undergoes malignant transformation. Leading to malignant

mesenchymal uterine tumours; leiomyosarcoma, endometrial stromal sarcoma, undifferentiated uterine sarcoma and carcinosarcoma ***(Wu et al., 2011).***

Thirdly, cervical cancer is the fourth most frequent cancer in women worldwide.it is occurs when the cells of the surface of cervix change in a way that leads to abnormal growth and invasion of other tissues or organs of the body.Invasive cancer means that the cancer affects the deeper tissues of the cervix and may have spread to other parts of the body. This spread is called metastasis. Cervical cancers don't always spread, but sometime spread to the regional lymph nodes, the lungs, the liver, the bladder, the vagina, and/or the rectum.The most common symptom is abnormal vaginal bleeding and abnormal vaginal discharge .the cause of almost all cervical cancers is infection with humanpapillomavirus (HPV) other risk factors include early sexual contact and multiple sexual partners ***(Melissa and Chief, 2015).***

Finally, Ovarian cancer is the fifth most common malignancy in women; it is the most common fatal gynecologic malignancy and the fourth most lethal of all cancer types in females.it is occurs in women of all ages, even infancy and childhood, however the largest number of new cases are diagnosed in women from 60 to 74 years of age. The risk that an ovarian tumor is malignant also

increases with age, with an overall risk of 13% in premenopausal women and 45%in postmenopausal women ***(Merino and Jaffe, 2005).***

Conventional magnetic resonance (MR) imaging has an established role in gynecologic imaging. It is a method with high contrast resolution widely used in the assessment of pelvic gynecological diseases like uterine and ovarian tumors.

However, increasing clinical demand for improved lesion characterization and disease mapping to optimize patient management has resulted in the incorporation of newer sequences, such as diffusion-weighted (DW) imaging, into routine protocols for pelvic MR imaging. DW imaging provides functional information about the microenvironment of water in tissues, hence augmenting the morphologic information derived from conventional MR images. It can depict shifts of water from extracellular to intracellular compartments, altered cell membrane permeability, disruption of cell membrane depolarizationand increased cellular density. Such changes may be associated with tumors. DW imaging has emerged as an important cancer biomarker and takes the role of the radiologist from the level of mere macroscopic diagnosis to more active participation in determining patient prognosis and management through a better understanding of the tumor microenvironment ***(Dhanda et al., 2014).***

Although positron emission tomography/computed tomography is extremely useful for detecting tumor recurrence in cervical and ovarian carcinomas, it has a limited specificity in the immediate post-treatment setting. DW imaging may aid in detection of residual or recurrent tumors in such situations. DW imaging is a potentially useful adjunct to conventional MR imaging for evaluation of gynecologic tumors, thus improving overall diagnostic accuracy, tumor staging, prediction of response to therapyand treatment follow-up ***(Dhanda et al., 2014).***

Based on molecular diffusion, diffusion-weighted imaging (DWI) is a unique, non-invasive modality that provides excellent tissue contrast and was shown to improve the radiological diagnosis of malignant tumors. Using quantitative apparent diffusion coefficient (ADC) measurement of DWI provides a new tool for better distinguishing malignant tissues from benign tumors.DWI studies would improve the diagnosis of cervical and endometrial tumors. It may also improve the assessment of tumor extension in patients with peritoneal carcinomatosis from gynecological malignancies. However, since the signal intensity of some cancers can range from high intensity to low intensity, a degree of uncertainty was demonstrated due to the proximity of the normal uterine myometrium and ovaries. Interestingly, there is also evidence that ADC might improve the follow-up and

monitoring of patients who receive anticancer therapies, including chemotherapy or radiation therapy ***(Levy et al., 2011).***

Diffusion-weighted MRI are important MR imaging techniques which enable the radiologist to move from morphological to functional assessment of diseases of the female pelvis. This is mainly due to the limitations of morphologic imaging, particularly in lesion characterization, accurate lymph node staging, assessment of tumour response and inability to differentiate post-treatment changes from tumour recurrence. DW-MRI is valuable in preoperative staging of patients with endometrial and cervical cancer especially in detection of extra-uterine disease. It does increase reader's confidence for detection of recurrent disease in gynaecological malignancies and improves detection of small peritoneal implants in patients with ovarian cancer ***(Sala et al., 2010).***

Aim of the Work

The aim of this study is to highlight the role of diffusion-weighted MR in the imaging of uterine and ovarian malignant tumors.

Normal Anatomy of the Uterus and Cervix

The uterus is a pear-shaped muscular organ. Its major function is to accept a fertilized ovum which becomes implanted into the endometrium, and derives nourishment from blood vessels which develop exclusively for this purpose (Fig. 1.1) ***(Blackburn et al., 2011).***

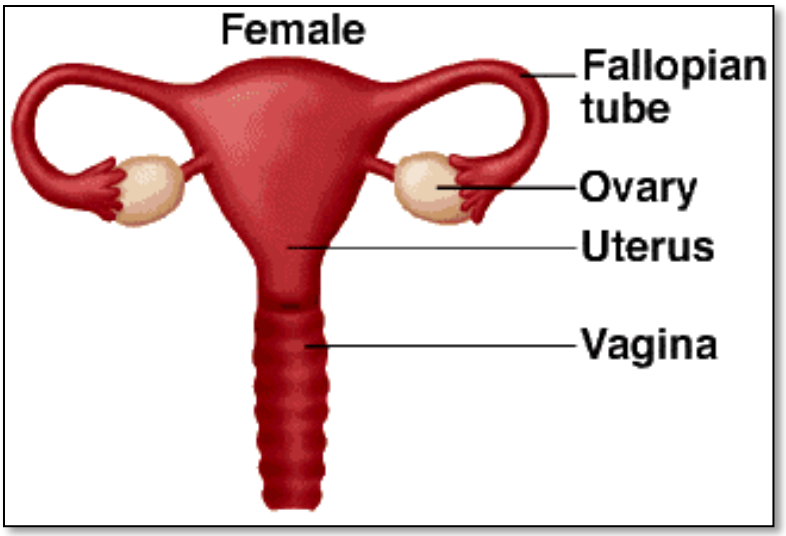


Fig. (1.1): Female reproductive organs ***(Blackburn et al., 2011)***

The uterus varies considerably in size, shape and weight depending on the status of parturition and estrogenic stimulation. The uterus is a fibromuscular organ that can be divided into the upper muscular uterine corpus and the lower fibrous cervix, which extends into the vagina (Fig 1.2). The upper part of the uterus above the insertion of the fallopian tubes is called the fundus. The narrow portion

situated between corpus and cervix is known as the isthmus and lies approximately at the level of the course of the uterine artery and the internal OS of the cervix. The endometrial cavity lies within the uterine corpus and is surrounded by a thick, muscular wall. The musculature of the uterus is in several layers. There is an outer longitudinal layer (stratum supra-vasculare) continuing into the fallopian tubes and round ligaments. The vascular layer (stratum vasculare) consists of many interlacing spiral groups of smooth muscles and contains many blood vessels. An inner layer consists of muscle fibers arranged both longitudinally and obliquely (Fig. 1.3) ***(Sokol and Glob liber, 2011).***

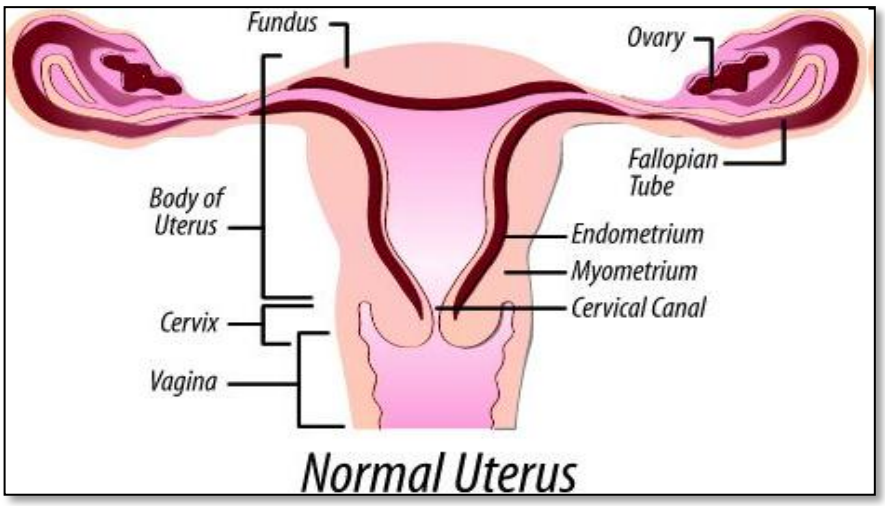


Fig. (1.2): Diagram of the normal uterus

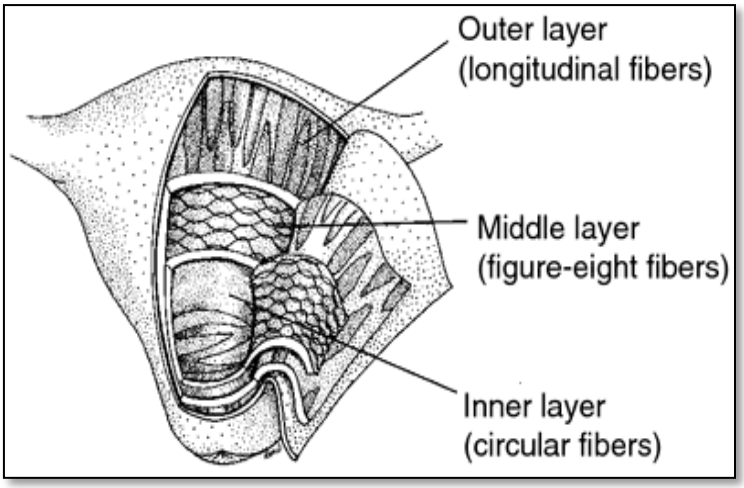


Fig. (1.3): Diagram of the normal uterine muscles
(Sokol and Glob liber, 2011).

Layers:

The three layers, from innermost to outermost, are as follows:

Endometrium:

The endometrium lines the uterine cavity and is considered to have three layers: **the pars basalis**, **the zona spongiosa**, and the **superficial zona compacta**. The straight branches of the radial arteries of the uterus terminate in capillaries in the basal layer, while the spiral or coiled branches penetrate to the surface epithelium, where they give rise to superficial capillaries. Sinus-like dilatations of the capillaries in the superficial layer are called "lakes". These vascular lakes and capillaries are drained by small veins ***(Skandalakis et al., 2004).***

The endometrium varies greatly depending on the phase of the menstrual cycle. Proliferation of the endometrium occurs under the influence of estrogen; maturation occurs under the influence of progesterone. The uterine endometrial cycle can be divided into three phases: the follicular or proliferative phase, the luteal or secretory phase, and the menstrual phase. The follicular, or proliferative phase, spans from the end of the menstruation until ovulation. Increasing levels of estrogen induce proliferation of the functionalis from stem cells of the basalis, proliferation of endometrial glands, and proliferation of stromal connective tissue. Endometrial glands are elongated with narrow lumens and their epithelial cells contain some glycogen. Glycogen, however, is not secreted during the follicular phase. Spiral arteries elongate and span the length of the endometrium ***(Skandalakis et al., 2004)***.

After formation of the corpus luteum, the endometrial glands grow, become tortuous, and secretery. The luteal, or secretory, phase begins at ovulation and lasts until the menstrual phase of the next cycle (Fig. 1.4) ***(Sokol and Glob liber, 2011).***

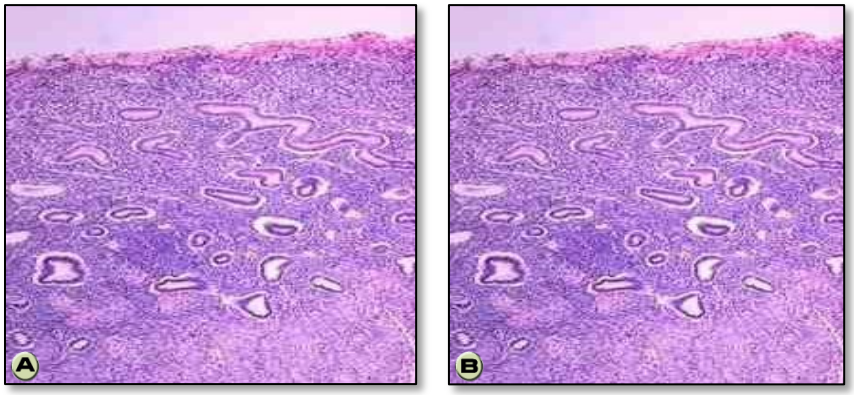


Fig. (1.4): Luteal phase and Menstrual phase endometrium ***(Sokol and Glob liber 2011).***

Myometrium:

The uterus mostly consists of smooth muscle, known as "myometrium." The innermost layer of myometrium is known as the junctional zone, which becomes thickened in adenomyosis.

Parametrium:

The loose connective tissue around the uterus ***(Sokol and Glob liber, 2011).***

Support:

The uterus is partially supported by three pairs of ligaments. The paired round ligaments extend from the anterosuperior surface of the uterus through the internal inguinal rings and through the inguinal canals to end in the labia majors. They are composed of muscle fibers,

connective tissue, blood vessels, nerves, and lymphatics. The round ligaments stretch with relative ease, particularly in pregnancy. The uterosacral ligaments are condensations of endopelvic fascia that arise from the posterior wall of the uterus at the level of the internal cervical OS. They fan out in the retroperitoneal layer and attach broadly at the second, third, and fourth segments of the sacrum. They are predominately composed of smooth muscle but also contain connective tissue, blood vessels, lymphatics, and parasympathetic nerve fibers. The paired cardinal (Mackenrodt's) or transverse cervical ligaments arise from the anterior and posterior marginal walls of the cervix and fan out laterally to insert into the fascia overlying the obturator muscles and the levator ani muscles. The cardinal ligaments form the base of the broad ligament. They are composed of perivascular connective tissue and nerves that surround the uterine artery and veins. The cardinal and uterosacral ligament complex is collectively called the parametrium ***(Skandalakis et al., 2004).***

The broad ligament is formed by folds of peritoneum covering the fallopian tubes, the infundibulopelvic vessels, and the hilus of the ovary. It contains a number of structures: fallopian tube, round ligament, ovarian ligament, uterine and ovarian blood vessels, nerves, lymphatics, and mesonephric remnants. Below the infundibulopelvic structures, the anterior and posterior

leaves of peritoneum lie in opposition, leaving a clear space below the tube with its tubal branch of the uterine artery. This avascular area is useful to the surgeon in isolating the adnexal structures and in avoiding blood vessels while performing tubal ligations ***(Sokol and Glob liber, 2011)***.

Major ligaments:

The uterus is held in place by several peritoneal ligaments, of which the following are the most important (there are two of each) (table. 1) ***(Skandalakis et al., 2004).***

Name	From	To
Uterosacral ligament	Posterior cervix	Anterior face of sacrum
Cardinal ligaments	Side of the cervix	Ischial spines
Pubocervical ligament	Side of the cervix	Pubic symphysis

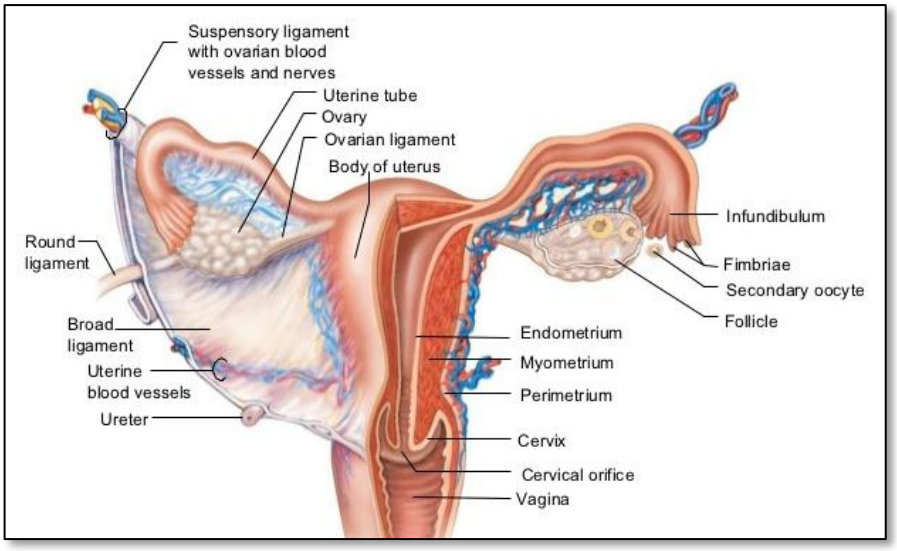
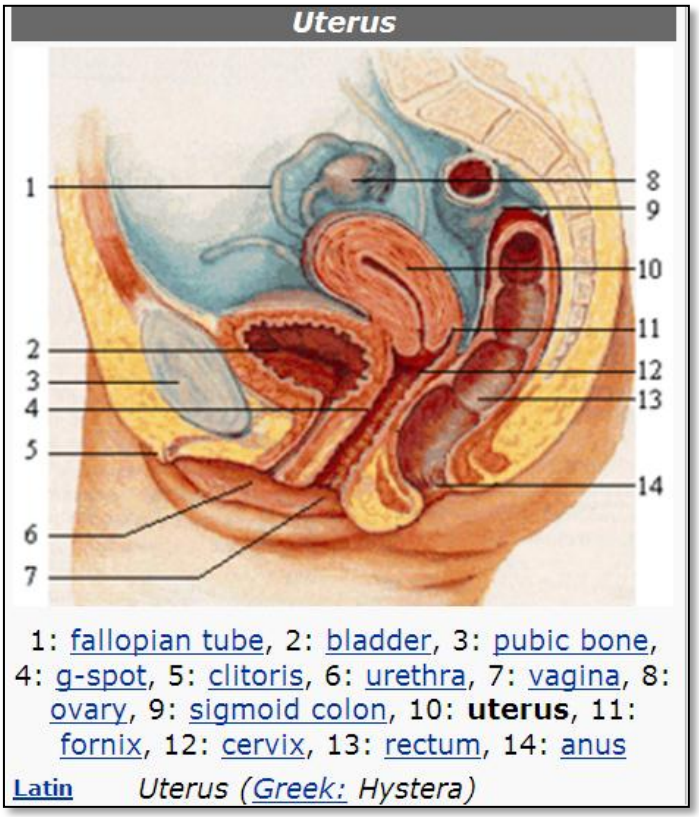


Fig (1.5): Diagram showing the uterus and associated ligaments ***(Gray et al., 2001)***

Position:

The uterus is in the middle of the pelvic cavity in frontal plane (due to ligamentum latum uteri). The fundus does not surpass the linea terminalis, while the vaginal part of the cervix does not extend below interspinal line. The uterus is mobile and moves under the pressure of the full bladder or full rectum anteriorly, whereas if both are full it moves upwards. Increased intraabdominal pressure pushes it downwards. The mobility is conferred to it by musculo-fibrous apparatus that consists of suspensory and sustentacular part. Under normal circumstances the suspensory part keeps the uterus in anteflexion and anteversion (in 90% of women) and keeps it "floating" in the pelvis ***(Skandalakis et al., 2004).***

Relations of the uterus: (Fig. 1. 6)



- **Anterior relations**
  - Vesicouterine pouch
  - Some loops of small bowel
  - Supravaginal and intravaginal cervix
  - Anterior fornix of vagina
- **Posterior relations**
  - Rectouterine pouch of Douglas with small bowel loops