INTRODUCTION

The accurate characterization of an adnexal mass as benign or malignant is crucial to avoid unnecessary surgery. Magnetic resonance imaging (MRI) is an important clinical tool in making this determination. A spectrum of morphologic and signal intensity features of adnexal lesions using conventional MR sequences can be used to favor benignity or malignancy ***(Kierans et al., 2013).***

Diffusion-weighted imaging has been widely accepted as a powerful imaging technique in neuroradiology. Until recently, the inclusion of diffusion-weighted sequences in body imaging protocols has been hindered by technical limitations. The addition of diffusion-weighted sequences to routine abdominopelvic MR imaging protocols has been found to yield diagnostically useful information with only a minimal increase in imaging time ***(Whittaker et al., 2009).***

MR imaging has been shown to improve the preoperative characterization of complex adnexal masses. With recent advances in ultrafast MR imaging techniques, dynamic contrast enhanced (DCE) and diffusion-weighted (DW) imaging are available to assess discriminant microvascular and cellular characteristics in abdominal and

pelvic organs. DCE and DW imaging have recently been shown to be effective in the differentiation of benign from malignant adnexal masses ***(Thomassin-Naggara et al., 2011).***

Diffusion-weighted imaging is useful method for differentiating between benign epithelial ovarian tumors with solid components and malignant ovarian tumors, and is associated with high sensitivity and specificity ***(Zhang et al., 2012)*** and not only helpful in differentiating benign from malignant processes, but it can also be used to assess metastatic lesions, possible tumor recurrence, and treatment response ***(Namimoto et al., 2009).***

MR spectroscopy can provide further information prior to any tissue samples being obtained for histology. MRS provides a method of chemical analysis that can be used to determine the biochemical make up of living tissues and provide details of tumour metabolism in their 'normal' in vivo state ***(Booth et al., 2009).***

Dissemination of tumor to lymph nodes is one of the principal routes of metastatic disease. The presence or absence of nodal disease is an important prognostic factor in gynecologic malignancies. Current imaging techniques such as computed tomography and magnetic resonance (MR) imaging have limitations because they rely almost

exclusively on size criteria. MR lymphography uses a lymph node-specific contrast agent (ferumoxtran-10). It allows differentiation from malignant nodes on the basis of alterations in signal intensity. This technique has been shown to increase the sensitivity and specificity of detection of lymph node metastases independent of nodal size ***(Narayanan et al., 2009).***

AIM OF THE WORK

This study aims at the reviewing and emphasizing the role of new MR imaging modality in the diagnosis of ovarian tumors.

ANATOMY OF THE OVARIES

The female gonads are a pair of symmetrical organs which produce egg cells and female hormones (estrogen, progesterone and a small amount of androgen). ***(Olivetti et al., 2009).***

Embryology:

- The ovaries develop high on the posterior abdominal wall then descend before birth ***(Drake et al., 2014)***.
- The ovary is composed of four main components, each with different embryologic origins: surface epithelium, stroma, germ cells, and sex cord.
- Coelomic epithelium forms the ovarian surface epithelium.
- Subcoelomic mesoderm forms the ovarian stroma.
- Primordial germ cells migrate from the yolk sac endoderm to the developing ovary.
- Invaginations of coelomic epithelium in the superficial ovarian cortex form the sex cords (pregranulosa cells).

(Schneck et al., 1999)

Gross anatomy: (Fig. 1)

The ovaries are typically located within the ovarian fossae on the lateral wall of the pelvis and, in a position posterolateral to the corpus uteri, anterior and medial to the ureter, posterior to the round ligament, and medial or posteromedial to the external iliac vessels. Usually location of the ovaries is variable in parous women, because they are displaced during pregnancy and do not subsequently return to their original position. In addition position may change in response to such factors as intestinal activity or filling of the bladder; ovaries can be further displaced from typical positioning by mass lesions of adjacent organs (e.g., subserous myoma) or by pregnancy.

Age and hormonal status coalesce to influence ovarian size and appearance, with the typical ovaries are ovoid , almond shaped structures measuring 3 mm in length in neonates and 3-5 cm in women of childbearing age; in general, ovarian size begins to decrease starting at age 30, with the length of a typical ovary shrinking to 2 cm in postmenopausal women. Pregnancy leads to increase of ovarian size, as does the use of hormone replacement therapy ***(Freiwald-Chilla et al., 2013).***

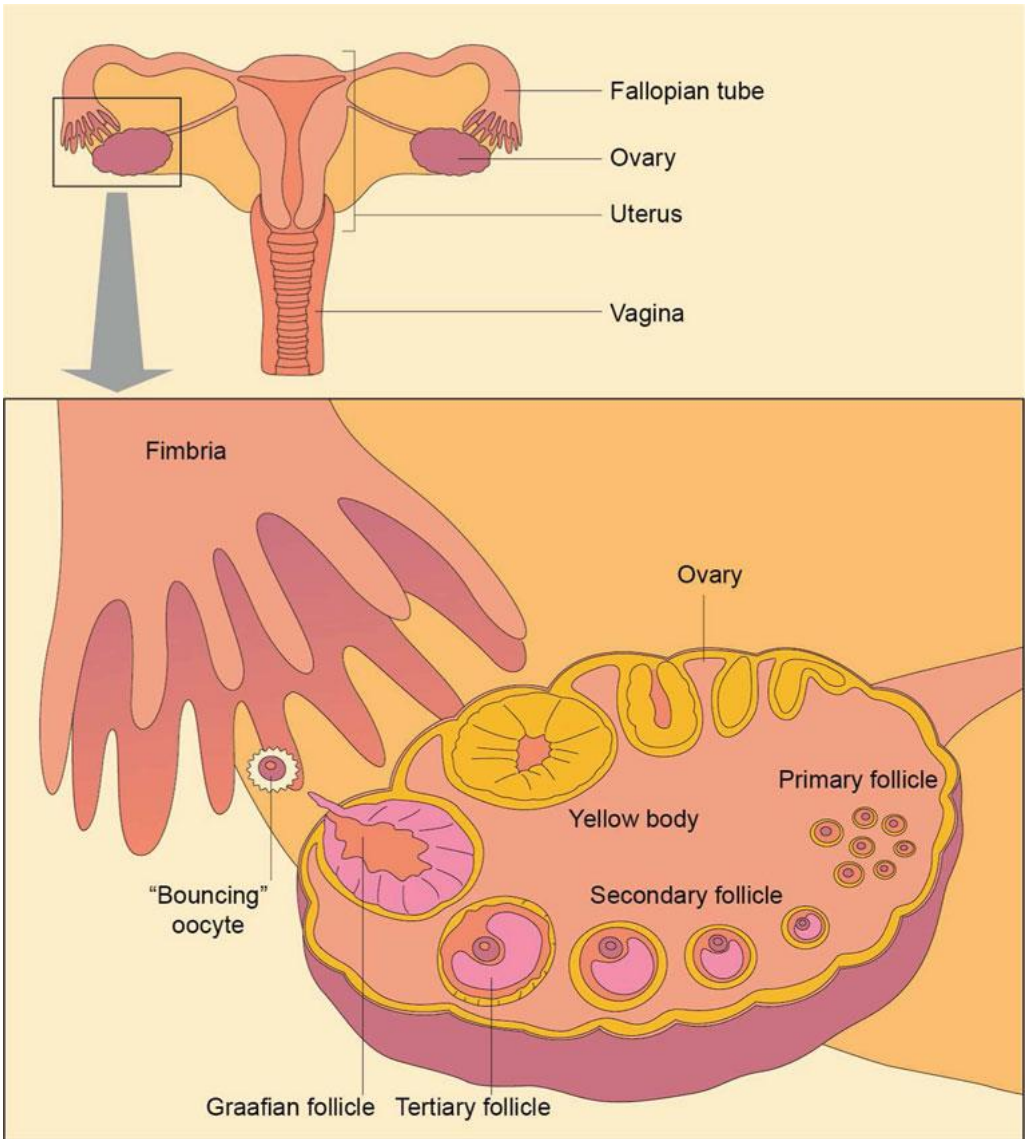

Figure (1): Illustration shows the ovarian fossa and cycle **(*Freiwald-Chilla et al., 2013*).**

Ligaments: (Fig.2)

- *Utero-Ovarian Ligament:*

The utero-ovarian ligament (Ovarian ligament) attaches the inferomedial extremity of the ovary to the lateral angle of the uterus. It lies in the posterior aspect of the broad ligament and is continuous with the medial border of the round ligament ***(Butler et al., 2012).***

- *Infundibulo-pelvic Ligament:*

The Infundibulo-pelvic ligament (suspensory ligament of the ovary) is a fan-shaped band of fibromuscular visceral connective tissue containing arteries, veins, lymphatics, and visceral nerves extending from the upper ovarian pole to the lateral pelvic wall. This ligament passes from the abdominal cavity into the pelvic cavity at the level of the pelvic brim, superficial to the bifurcation of the common iliac artery, just lateral to where the ureter passes over the bifurcation of the common iliac vessels ***(Ascher et al., 1997).***

- *Mesovarium:*

The mesovarium is a sheet-like peritoneal fold extension from the posterior surface of the broad ligament which attach to the anterior ovarian wall. It facilitates the

passage of ovarian vessels and nerves into the ovarian hila. The mesovarium, the infundibulo pelvic ligament, and the utero-ovarian ligament together support the ovary in its position along the pelvic sidewall ***(Drake et al., 2014).***

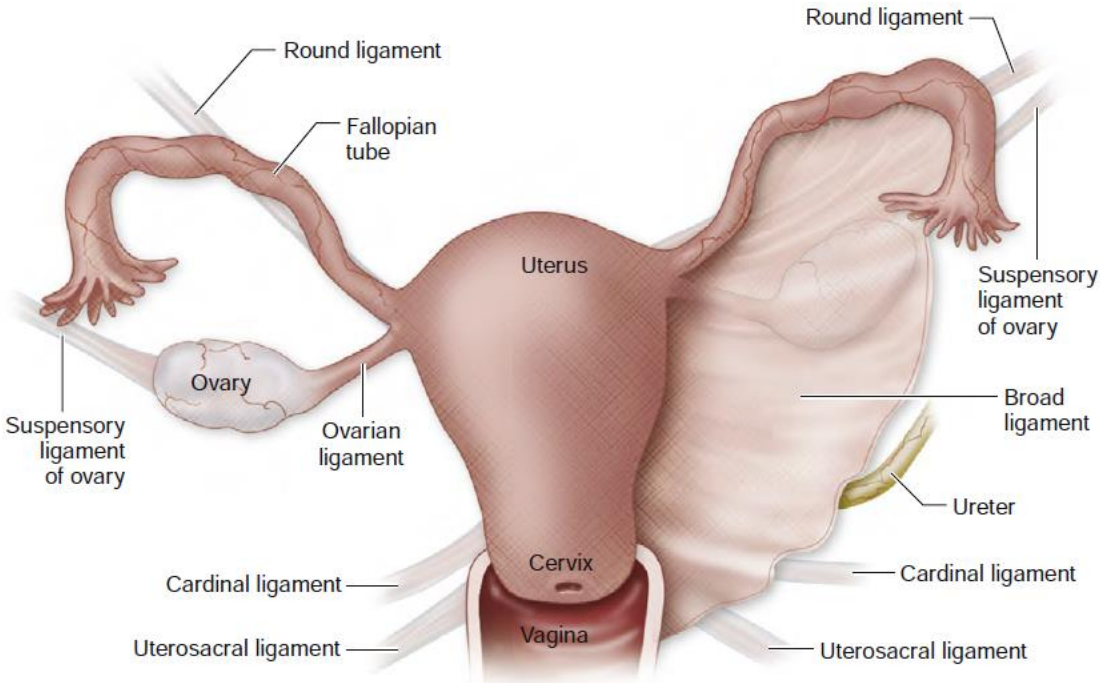

Figure (2): Ovarian ligaments ***(Aganovic et al., 2011).***

Microscopic Anatomy:

- The ovary consists of a central vascular medulla and a outer cellular cortex.
- The cortex is composed of reticular fibers and spindle shaped cells which contain the follicles and corpus lutea.

- The surface is not covered by peritoneum but by a single layer of cuboidal/columnar cells called the germinal epithelium that becomes continuous with the peritoneum at the hilum.
- Beneath the germinal epithelium the connective tissue of the cortex is condensed to form the tunica albuginea - a fibrous outer capsule.
- The medulla is composed of fibrous tissue and vessels.

(Butler et al., 2012)

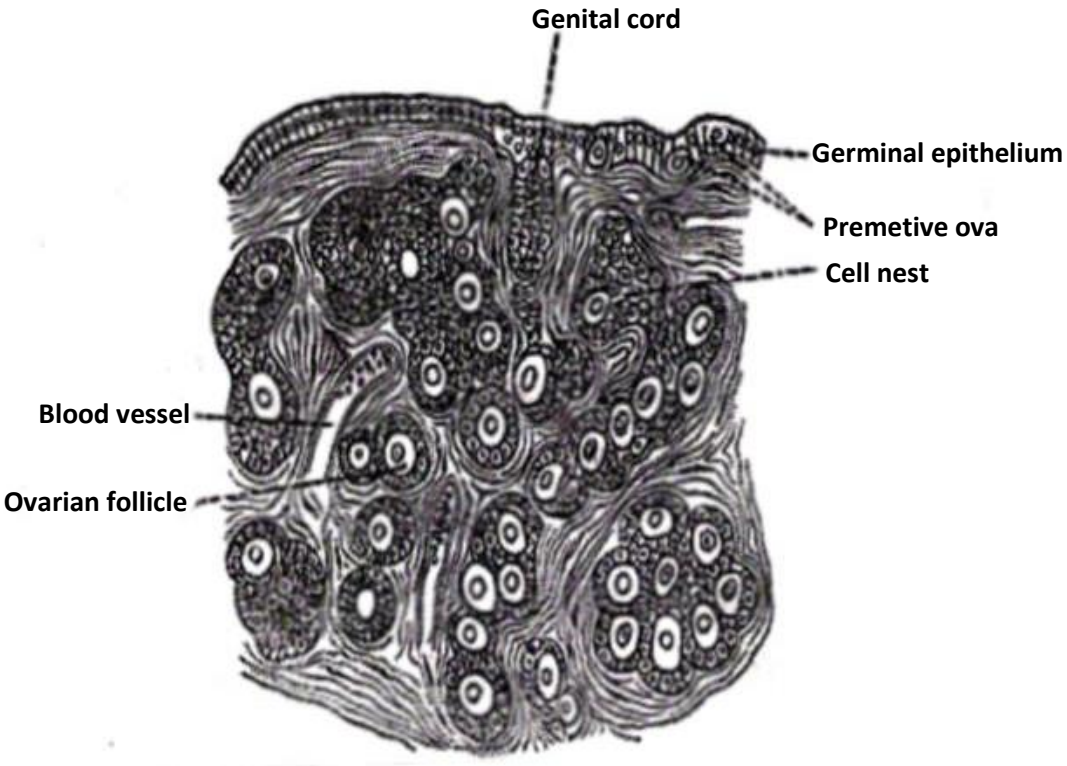

Figure (3): Illustration shows the structure of the ovary ***(William et al.,2006).***

Arterial supply of the ovaries: (Fig. 4)

- The ovarian artery originates from the aorta at L1/2 near the renal hilum.
- It is accompanied along its retroperitoneal course by the ovarian vein and the ureter on the anterior surface of the psoas muscle.
- It then crosses the ureter and common iliac vessels near the pelvic brim to enter the suspensory ligament of the ovary.
- The ovarian artery courses inferiorly and medially between the two layers of the broad ligament near the mesovarian border.
- It forms multiple branches that enters the ovarian hilum via the mesovarium. It has a tortuous course that is most pronounced near the ovary.

(Baert et al., 2007)

Venous drainage of the ovaries:

- The venous network forms a rich pampiniform plexus at the level of the ovarian hilum.
- The veins arising from the plexus merge to form the ovarian vein, which initially runs inside the suspensory ligament and then empties into the renal vein on the left and theinferior vena cava on the right.

(Olivetti et al., 2009)

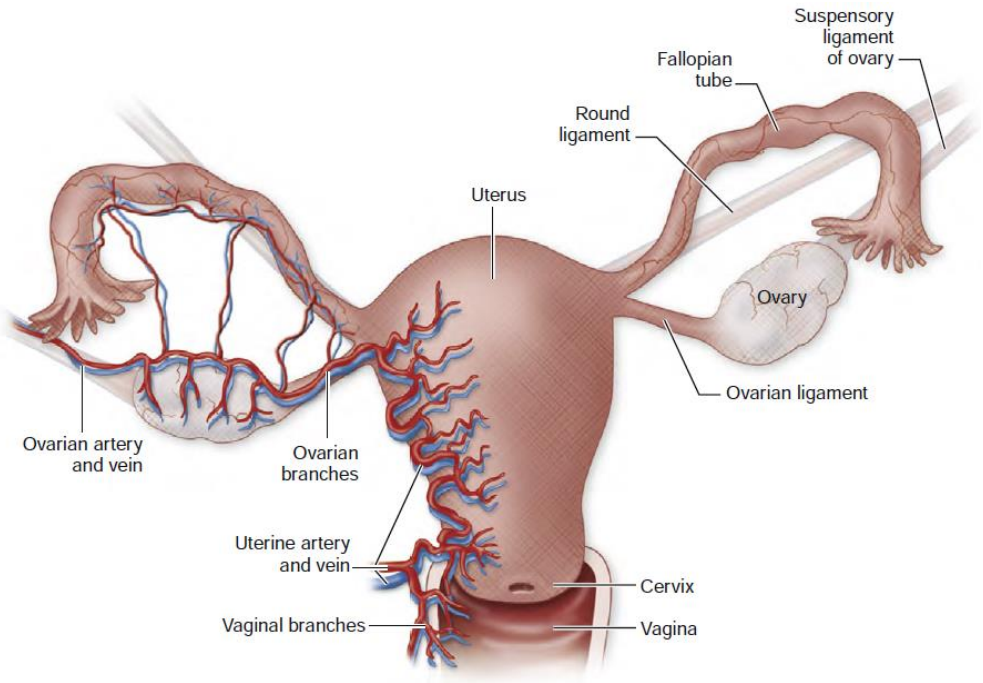

Figure (4): Illustration shows the ovarian blood supply ***(Aganovic et al., 2011).***

Lymphatic drainage of the ovaries

- The ovarian lymphatics ascend with the ovarian vessels along the psoas muscle and drain almost exclusively into the para-aortal lymph nodes at the level of the lower pole of the kidneys.
- In some patients, accessory channels pass the broad ligament and drain into the internal and common iliac and interaortic lymph nodes, or course along the round ligament to the external iliac and inguinal lymph nodes.

(Baert et al., 2007)

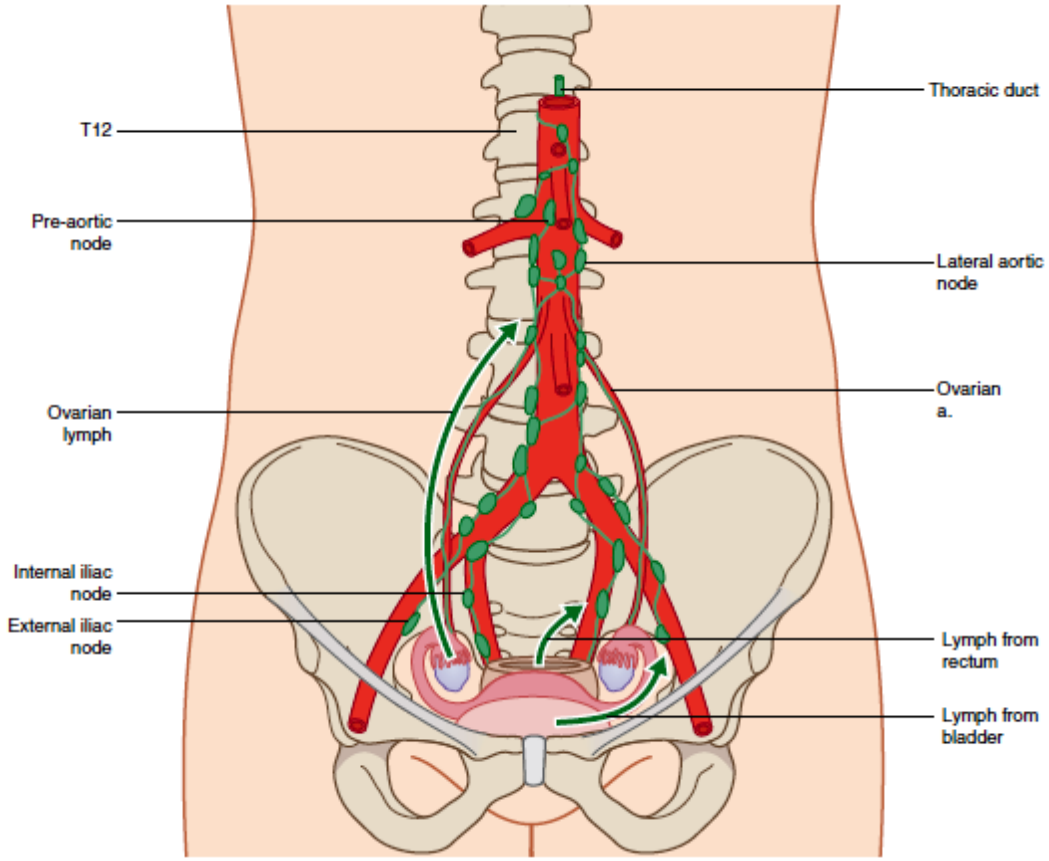

Figure (5): Ovarian lymphatic drainage ***(Drake et al., 2012).***

Innervation of the ovaries:

- Ovarian plexus formed from the aortic, renal, superiorand inferior hypogastric plexuses.

PATHOLOGY OF OVARIAN TUMORS

Incidence:

Ovarian cancer is the fifth leading cause of cancer death among women after (lung, breast, colorectal, and pancreatic cancers) and has a high likelihood of recurrence despite aggressive treatment strategies ***(Son et al.,2011).***

Ovarian cancer is the second most common gynecologic malignancy (after cervical cancer), with a lifetime risk of 1.7%. Although its incidence has decreased slightly over the past 30 years, it is currently the most common cause of death among women with gynecologic malignancies ***(Saba et al., 2013).***

Epidemiology:

The diagnosis is primarily in women above the age of 50. Its diagnosis before the age of 30 is rare, even among women affected by hereditary syndromes. After the age of 30, the incidence of ovarian cancer starts to rise ***(Chu et al., 2008).***

Risk Factors:

- Positive family history , obesity and nutritional factors.
- Genetic syndromes & mutations of BRCA1 and BRCA2 Genes. ***(Saba et al.,2013)***

- Nulliparity, childbirth after 35 years, and early onset of menses are also under an increased risk ***(Baert et al., 2007)***
- Late menopause.
- Reproductive hormone, manly "incessant ovulation" and the "gonadotropin hypothesis". ***(Saba et al., 2013)***

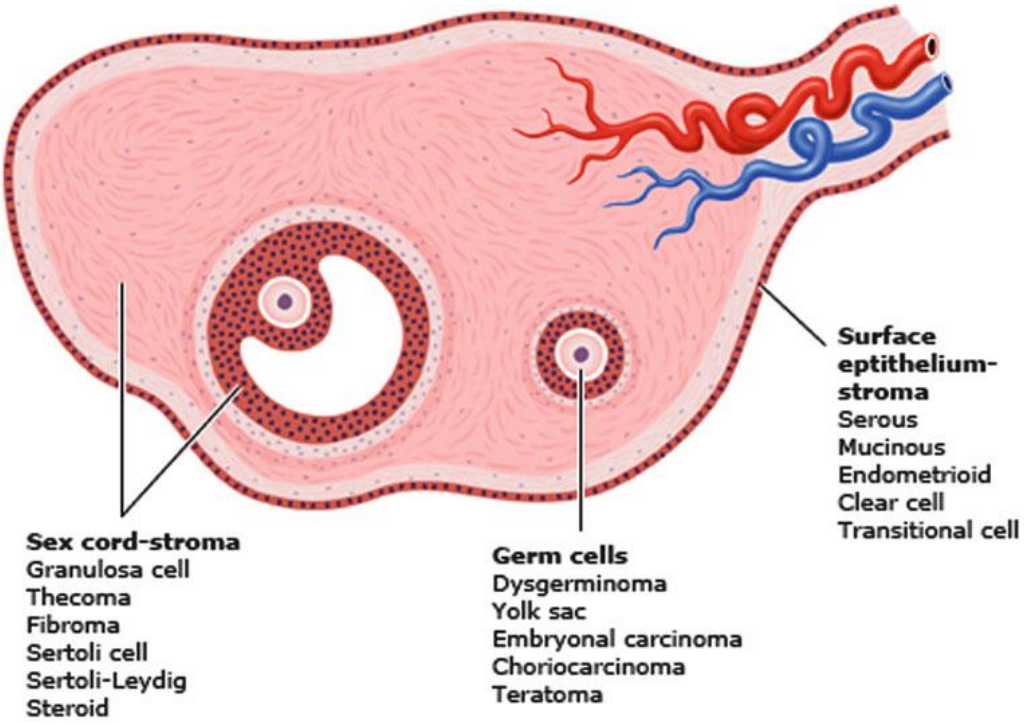

Figure (6): Schematic drawing showing sites of origin of all different types of ovarian tumors ***(Saba et al.,2013).***