ROLE OF MAGNETIC RESONANCE IMAGING IN ASSESSEMENT OF OVARIAN TUMORS

Essay

submitted for partial fulfilment for the master degree in radiodiagnosis

By

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وَلَقَدْ خَلَقْنَا الإِنسَانَ مِن سُلالَةٍ مِّن
طِينٍ (12) ثُمَّ جَعَلْنَاهُ نُطْفَةً فِي
قَرَارٍ مَّكِينٍ (13) ثُمَّ خَلَقْنَا النُّطْفَةَ
عَلَقَةً فَخَلَقْنَا العَلَقَةَ مُضْغَةً فَخَلَقْنَا
المُضْغَةَ عِظَاماً فَكَسَوْنَا العِظَامَ
لَحْماً ثُمَّ أَنشَأْنَاهُ خَلْقاً آخَرَ
فَتَبَارَكَ اللَّهُ أَحْسَنُ الخَالِقِينَ

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Introduction

Ovarian tumors are classified on the basis of tumor origin as epithelial tumors (serous and mucinous tumors, endometrioid and clear cell carcinomas, Brenner tumor), germ cell tumors (mature and immature teratomas, dysgerminoma, endodermal sinus tumor, embryonal carcinoma), sex cord–stromal tumors (fibrothecoma; granulosa cell, sclerosing stromal, and Sertoli-Leydig cell tumors), and metastatic tumors ***(Koonings, et al., 1989).***

US remains the study of choice in the initial evaluation of suspect adnexal masses because it is relatively inexpensive, noninvasive, and widely available. Transabdominal US was unable to help identify morphologic characteristics that would allow differentiation of benign from malignant masses in early-stage ovarian carcinoma. The advent of high-frequency endovaginal probes allowed high-resolution imaging of the pelvic organs in general and of the ovaries in particular. The disadvantage of US is being operator dependant ***(Jeong, et al., 2000).***

Color Doppler US of ovarian masses helps identify vascularized tissue and can assist in differentiating solid tumor tissue from nonvascularized structures. Problems associated with Doppler US include operator dependence and lack of standard criteria in distinguishing benign from malignant waveforms ***(Brown, et al., 1998).***

CT of the abdomen or pelvis allows comprehensive evaluation of all potential sites of peritoneal implants or lymphadenopathy as well as of the primary tumor site but using ionizing radiation is a major disadvantage of this modality ***(Kurtz, et al., 1999).***

The principal advantage of MR imaging is that it combines some of the best features of CT and US. The MRI have many advantage including multiplaner capability and better tissue characterization that's accentuated by using safe contrast agents ***(Jung, et al., 2002).***

Magnetic resonance (MR) imaging is better reserved for problem solving when US findings are nondiagnostic or equivocal because, although it is more

accurate for diagnosis, it is also more expensive. The signal intensity characteristics of ovarian masses make possible a systematic approach to diagnosis. Mature cystic teratomas, cysts, endometriomas, leiomyomas, fibromas, and other lesions can be accurately diagnosed on the basis of T1- weighted, T2-weighted, and fat-saturated T1-weighted MR imaging findings ***(Jeong, et al., 2000).***

The aim of this study is to assess the role of magnetic resonance imaging in the assessment of the ovarian tumors.

Anatomy of the Ovaries

The ovaries are paired structures, homologous with the testes, developing like them from the genital ridges on the posterior abdominal wall adjacent to the kidneys but descend into the pelvis as the kidneys ascend. They can thus lie high in the abdomen but usually lie along the superior margin of the broad ligament at birth. The ovaries are the only truly intraperitoneal adnexal structures. The ovaries lie against lateral walls, each enclosed within the mesovarium of the broad ligament ***(Schneck, et al., 1990).***

The ovaries are paired somewhat flattened ovoid organs. Although they are somewhat obliquely oriented, they have relatively lateral and medial surfaces, meso-ovarium and free borders, tubal and uterine poles. The tubal or superior pole of the ovary is attached to the lateral pelvic wall by the suspensory ligament of the ovary (infundibulo - pelvic ligament). The uterine pole is attached to the uterus by the ovarian ligament ***(Schneck, et al, 1990).***

When the uterus and adnexa are in normal position, the long axis of the ovary is nearly vertical, but it bends somewhat medially and forward at the lower

end so that the lower pole tends to point towards the uterus ***(Krantz and Litt, 1994).***

The exact position of the ovary is subjected to a wide range of variation in women who have born children as it is displaced in the first pregnancy and probably never returns again to its original position ***(Jeffocate, 1975).***

In the living they are greyish-pink and present a smooth exterior before regular ovulation begins, but thereafter their surfaces are distorted by the scarring which follows the degeneration of successive corpora lutea. Each ovary is classically described as almond-shaped (amygdaloid), about 3 cm long, 1.5 cm wide and 1 cm thick, with a volume of approximately 6 cm3. (However, ultrasonic measurements of the ovaries in situ, in a large number of women have given higher values for the volume of the ovaries: about 11 cm3 in the reproductively mature state, 6 cm3 postmenopausally and 3 cm3 before menarche (the first menstrual period) ***(Cohen, et al., 1990).***

a. Location:

The ovaries are located just lateral to the uterus, close to the wall of the lesser pelvis a little below the pelvic brim. They are attached to the posterosuperior aspect of the broad ligament, posteroinferior to the fallo-

pian tubes. Typically the ovaries are located in a depression called the ovarian fossa on the pelvic side wall ***(Warwick and Williams, 1980).***

The actual position of the ovaries within the pelvis is variable and is related to the laxity of ligamentous support of the ovary. The two ligaments that are continuous with the ovary, the utero-ovarian and infundibular ligaments behave more like mesenteries than actual elements of fixation. Consequently, the ovary can be found in a variety of positions within the pelvis and its orientation relative to the uterus can be variable. In general, however, when the patient is examined with a full bladder, the ovary is displaced laterally along the pelvic side walls and is usually oriented with its long axis in the sagittal plane. Thus, the ovaries seem to overlie the iliac vessels when they are examined with maximal bladder distention ***(Warwick and Williams, 1980).***

The position of the uterus seems to be of particular importance in determining ovarian position. This is due to the ovarian ligament which connects the ovary to the uterine fundus is shorter than the infundibulo-pelvic ligament. The ovary, therefore, tends to follow the uterus. When the uterus is normally anteflexed and midline, the ovaries are usually directly lateral or posterolateral to it. When the uterus is

deviated to one side, the ipsilateral ovary is frequently superior to the uterine fundus, but may on occasion be imaged within the cul-de-sac posteriorly. When the uterus is retroverted and midline, both ovaries are commonly lateral, superior, and close to the uterine fundus near the midline ***(Krantz and Litt, 1994).***

b. Boundaries and relationship:

The medial surface is round and posteriorly may have numerous scars or elevations that mark the position of developing follicles and sites of ruptured ones. The upper portion of this surface is overhung by the fimbriated end of the uterine tubes and the remainder lies in relation to coils of intestine ***(Krantz and Litt, 1994).***

The lateral surface is similar in shape and faces the pelvic wall,, where it forms a distinct depression, the fossa ovarica. This fossa is lined by peritoneum and is bounded above by the external iliac vessels and below by the obturator vessels and nerve; its posterior .boundary is formed by the ureter and uterine artery and vein, and the pelvic attachment of the broad ligament is located anteriorly ***(Krantz and Litt, 1994).***

The mesovarian or anterior border is fairly straight and provides attachment for the mesovarium, a peritoneal fold by which the ovary is attached to the posterosuperior layer of the broad ligament. Since the vessels, nerves, and lymphatics enter the ovary through this border it is referred to as the hilum of the ovary ***(Krantz and Litt, 1994).***

The posterior or free border is more convex and broader and is directed freely into the recto uterine pouch. The upper or tubal pole is large and rounded. It is overhung closely by the infundibulum of the uterine tube and is connected with the pelvic brim by the suspensory ligament of the ovary, a peritoneal fold. The lower or uterine pole is smaller and directed toward the uterus ***(Krantz and Litt, 1994)*** **(fig.1).**

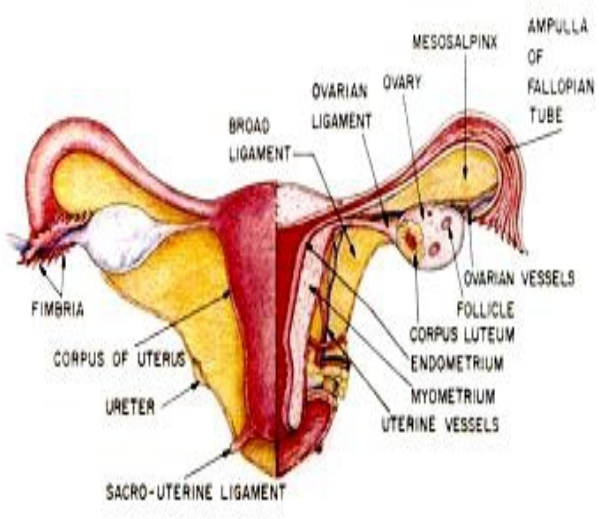

Figure 1. Drawing depicts anatomy of the uterus, ovary, and associated structures.

c. Structure of the ovary:

The ovary is divided into three regions.:

1. The hilum: Is the small area which adjoins the mesovarium and which receives the twigs of the ovarian vessels, lymphatics and nerves which enter from the broad ligament.

2. The medulla (inner zone): This subtends the hilum as a semi lunar area enclosed by the cortex.

3. The cortex (outer zone): This is the specialized functioning part of the ovary forming the main mass of the organ. It is composed of:

a- Connective tissue stroma :

This consists of closely packed fibers which form a dense matrix for the vessels and Graffian follicles. Just under the covering epithelium, it is thickened to form the tunica albuginea, a dense connective tissue layer which encloses the ovary, and the presence of which gives the whitish color to the surface of the organ.

b- Epithelial structures : These are:

i. Surface epithelium:

A sheet of cubical cells one layer deep which cover the free surface of the ovary as far as the hilum, where

transition into the endothelium of the peritoneum takes place.

ii. The interstitial glands of ovary:

This consists of epithelial cells scattered irregularly throughout the stroma which are inconspicuous.

iii. The graffian follicles:

They are formed around the ova which they enclose and nourish throughout their ovarian existence.

Only a small number of follicles however, reach full maturity. The majority undergo atresia characterized by death of the ovum and gradual degeneration and disappearance of the surrounding granulosa cell leaving behind a small cicatrized structure ***(Jameison, 1969)*** **(fig. 2).**

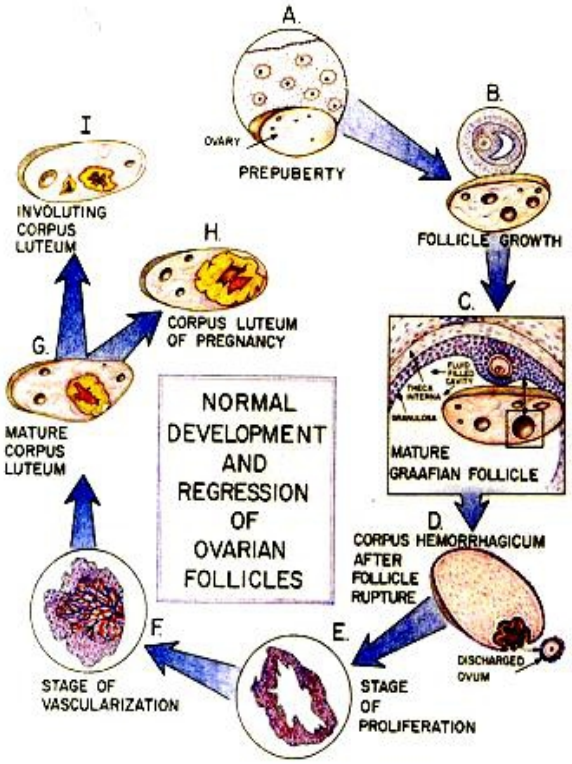

Figure 2. Drawing illustrates the stages of normal development and regression of the ovarian follicle.

d. Changes in the ovaries with age and parity:

In infancy and childhood the ovary is a tiny elongated structure with a smooth surface, situated near the pelvic brim, and packed with the primary oocytes. Although in the newborn baby, it may show small follicular cysts resulting from stimulation by chorionic gonadotrophins, it later contains only primordial or atretic follicles ***(Jeffocate, 1975).***

In the prepubertal ovary the cortex forming about 35% and the medulla about 20%, and interstitial cells up to 45% of the volume. Much of the cortical volume is occupied by interstitial cells. It gradually increases in size with body growth, and the interstitial tissue decreases ***(Cohen, et al., 1990).***

After the menopause the ovary becomes smaller in size and shriveled in appearance. These changes are the result of atrophy of the medulla, and not of scarring following repeated ovulation as is sometimes stated. At a later age the surface becomes smooth again as in childhood. Very few follicles are found in old age ***(Jeffocate, 1975).***

Blood supply:

The ovary is supplied by the ovarian artery, a branch of the abdominal aorta originating just below the renal artery. The vessel runs down behind the peritoneum of the infracolic compartment crossing the ureter obliquely on the psoas muscle. It crosses the pelvic brim and enters the suspensory ligament of the ovary. It gives off a branch to the fallopian tube and then anastomoses with the uterine artery before ending by entering the ovary ***(Ammann and Walsh, 1985).***