Value of Diffusion weighted MR imaging & MR Spectroscopy in characterization of ovarian masses

Essay
Submitted for partial fulfillment of Master Degreein
Radiodiagnosis

By

Shereen Aabdelhady Nooh
M.B.,B.Ch.

Supervised by

Prof.Dr .Sherine Kadry Amin
Professor of Radiodiagnosis
Faculty of Medicine-Ain Shams University

Dr.Aya Yassin Ahmed
Lecturer of Radiodiagnosis
Faculty of medicine-Ain Shams University

Faculty of Medicine
Ain-Shams University
2014

دور الرنين المغناطيسي باستخدام التحليل الطيفي وخاصية الإنتشار في تقييم تكتلات المبيض

بروتوكول

رسالة توطئة تمهيدا للحصول علي درجة الماجستير فى الاشعة التشخصية

مقدمة من

طبيب /شيرين عبدالهادي نوح
بكالوريوس الطب و الجراحة العامة

تحت إشراف

أ.د/ شيرين قدري امين
أستاذ الاشعة التشخصية
كلية الطب- جامعة عين شمس

د/ آية يس أحمد
مدرس الاشعة التشخصية
كلية الطب- جامعة عين شمس

كلية الطب
جامعة عين شمس
٢٠١٤

Introduction

Ovarian cancer is diagnosed in nearly a quarter of a million women globally each year. It is the eighth most common cancer in women and the seventh leading cause of cancer death among women ,responsible for approximately 140,000 deaths each year (**Globocan,2008).**The incidence of ovarian cancer has been steadily increasing over the past 10 years, despite improvements in surgical techniques and new chemotherapeutic regimens**(Jinawathetal., 2011).**

Ovarian cancer is a disease with poor prognosis. Women commonly are diagnosed at late stageswith impact on the prognosis of this dreaded disease **(Fleischer etal.,2009**)asIt frequently does not result in symptoms until the cancer has spread extensively beyond the ovary**(Stoppler,2013).**

The principal aim of oncological imaging is to differentiate between malignant and nonmalignant tissues at all stages of the patient's cancer care. Accurate staging and precise delineation of the extent of malignancy influence therapeutic decisions, therapy outcomes, and,ultimately, patient prognosis**(Moreno etal.,2012).**

Transvaginal sonography (TVS) is the initial diagnostic modality of choice for the evaluation of most pelvic masses.

However, the sensitivity and specificity of TVS for the definitive diagnosis of ovarian cancer are limited. Because of this, the differential diagnosis of morphologically suspicious adnexal masses, especially in postmenopausal women, typically includes ovarian cancer.

Conventional imaging using ultrasound, computed tomography (CT), or magnetic resonance imaging (MRI) detects cancer by identifying anatomical distortion or altered tissue appearances. However, identification of small volume active tumor, either at presentation or at early disease relapse remains challenging because a small volume of disease may not result in detectable structural or morphological changes on conventional imaging (**Moreno et .al,2012).**

PET imaging for oncology has tremendously advanced over the past 10–15 years. The most commonly employed radioisotope for PET imaging is 18-fluorodeoxyglucose (FDG).FDG is not, however, entirely specific for malignant cells, and there are a number of pitfalls when using this radiotracer**(Moreno et.al,2011).**

Although CT is the primary imaging modality for staging ovarian cancer, a Radiologic Diagnostic Oncology Group study showed that MRI may be equal or superior toCT. One advantage

of MRI is that it provides better soft tissue contrast than does CT. Implants measuring 1 cm or less are difficult to detect by CT, decreasing the sensitivity to less of 50% for such small-volume disease**(Tempany et. al,2000**).

MRI is the imagine technique with highest contrast and anatomic resolution, being the modality of choice for morphological evaluation of female pelvis disease. **DWI**, provides information about tissue cellularity and integrity of cellular membranes. DWI does not need contrast medium administration .**(Koh et.al,2006**).

Although the characteristics of lesions examined with magnetic resonance imaging (MRI) provides some indication of the underlying pathology, definitive diagnosis still requires histopathological confirmation. However, **a noninvasive techniques as magnetic resonance spectroscopy (MRS)and Diffusion Weighted imaging** can provide further information prior to any tissue samples being obtained for histology. MRS can be used to measure proton-containing compounds such as amino acids, fatty acids, organic acids, sugars and other metabolites. Thus, it provides a method of chemical analysis that can be used to determine the biochemical make up of living tissues and provide details of tumor metabolism in their 'normal' *in vivo* state**(Booth et al.,2008).**

Although initially used to evaluate neurological diseases, the application of DWI &MRS have been extended to oncologic imaging throughout the body made possible by improvement in MRI hardware and new sequences. The use of these techniques as a complement to conventional MRI methods has led to improvement in the detection and characterization of tumors , treatment response monitoring and detection of recurrence in oncology patients **(Turkbey et al.,2011).**

Aim of the work

The aim of this study is to highlight the role of diffusion weighted imaging (DWI)and MR spectroscopy in the characterization of ovarian masses.

Anatomy of the ovaries

The ovaries are almond-shaped structures, each measuring about 3 cm long. They usually lie near the cornu of the uterus, along the side wall of the pelvis, suspended from the back of the broad ligament of the uterus in a fold of peritoneum called the mesovarium The ovaries are usually medial to the external iliac vessels and anterior to the ureter **(Ansert et al., 2001).** ovary is an ovum- producing reproductive organ . Ovaries in female are homologous to testes in males in that they are both gonads and endocrine glands ***(Lewis et al., 2003).***

Ovarian embryology: The ovaries develop 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 mesoovarium of the broad ligament (**Schneck et al., 1990**).

❖ 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*).**

Location: The ovaries can be quite variable in position and are influenced by the uterine location and the ligament attachments. In the anteflexed midline uterus, the ovaries are usually identified laterally or posterolaterally. When the uterus lies to one side of the midline, the ipsilateral ovary often lies superior to uterine fundus. In a retroverted uterus, the ovaries tend to be lateral and superior, near the uterine fundus. When the uterus is enlarged, the ovaries tend to be displaced more superiorly and laterally. Following hysterectomy, the ovaries tend to be located more medially and directly superior to the vaginal cuff. They can be located high in the pelvis or in the cul-de sac (**Werff et al., 2006**)

The ovary may be in an abnormal position:

• Within the posterior wall of the broad ligament (therefore, the mesovarium is absent).

• Within the recto-uterine pouch (cul-de-sac of Douglas).

• Within the sac of a femoral hernia. (**Yamashita et al., 1995**)

Gross anatomy :(fig: 1.1)

The ovaries are ovoid , almond shaped structures that vary considerably in size depending on age , hormonal status, and the stage of menstrual cycle. The adult ovary is about 2.5-5 cm long , 1.5-3 cm wide, and 1-2 cm thick . The ovaries are of grayish – pink color . It lies in a shallow depression , named the ovarian fossa . This fossa is bounded above by the external iliac vessels , in front by the obliterated umbilical artery , and behind by the ureter **.** In general the ovarian position is influenced by uterine size , ovarian size , degree of filling of urinary bladder , degree of distention of the recto sigmoid colon and the presence of a pelvic mass **(*Faysal et al ., 2004*)**

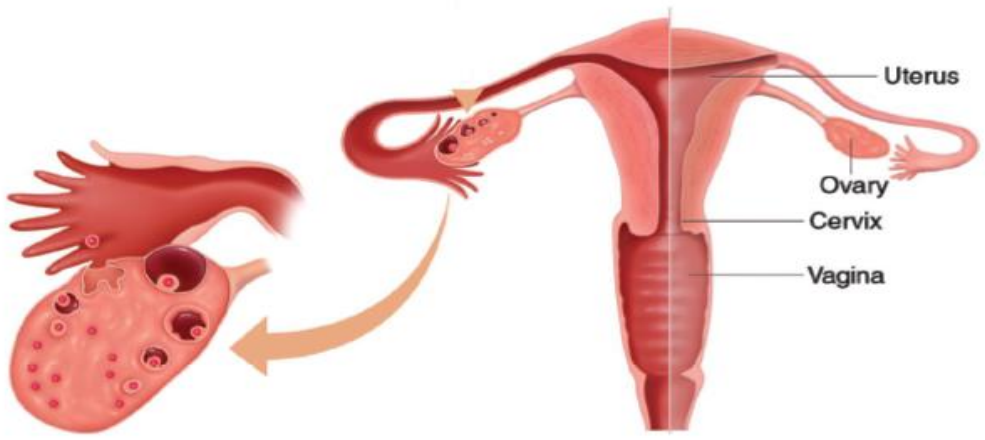


Figure (1.1). Illustration shows the ovarian fossa **(*Faysal et al ., 2004*).**

- **Ligaments:(fig1.2).**

  - ***Utero-Ovarian Ligament***

The utero-ovarian ligament (proper ligament of the ovary) is a cordlike structure invested with the posterior layer of the broad ligament. It consists of smooth muscle and connective tissue. The ovarian ligament extends from the lower ovarian pole to the lateral uterine wall. It is located between the mesosalpinx and the mesovarium (**Dooms et al., 1986**).

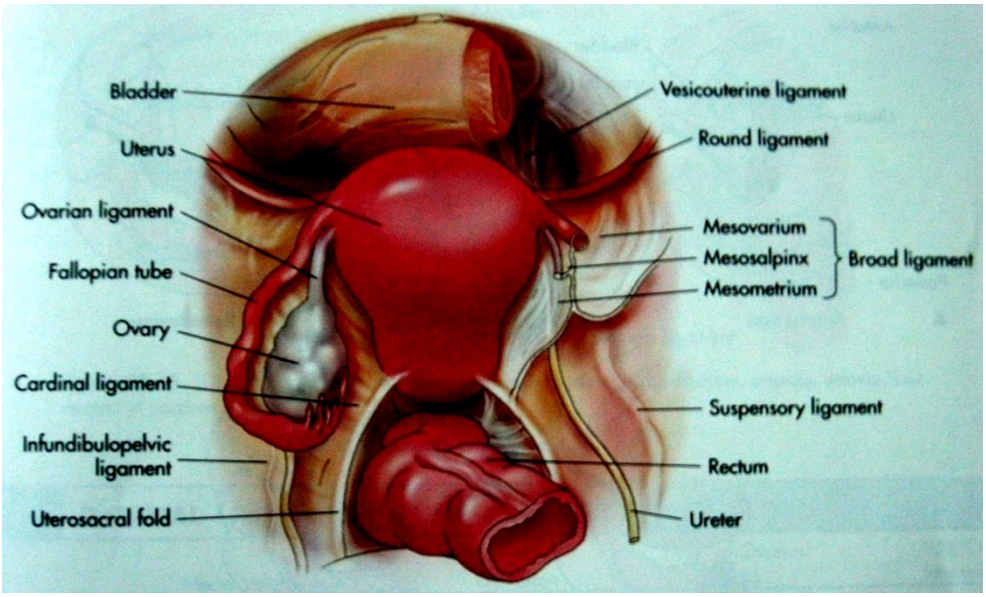
  - ***Infundibulo-pelvic Ligament***

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 short peritoneal fold from the posterior surface of the broad ligament 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 **(*Doherty et al ., 2000*)**



Figure(1.2) ovarian ligaments ***(Faysal et al .,2004).***

Microscopic anatomy:(fig1.3)

Each ovary consists of the following parts:

1- *Germinal epithelium**:***

A layer of simple epithelium (low cuboidal or squamous) that covers the surface of the ovary and is continuous with the mesothelium that covers the mesovarium.

2- *Tunica albuginca*:

A whitish capsule of dense, irregular connective tissue immediately deep to the germinal epithelium.

3- *Ovarian cortex*:

A region just deep to Tunica albuginea that consists of dense connective tissue and contains ovarian follicles.

4- *Ovarian medulla:*

A region deep to the ovarian cortex that consists of loose connective tissue and contains blood vessels, lymphatic and nerves.

5- *Ovarian follicles*:

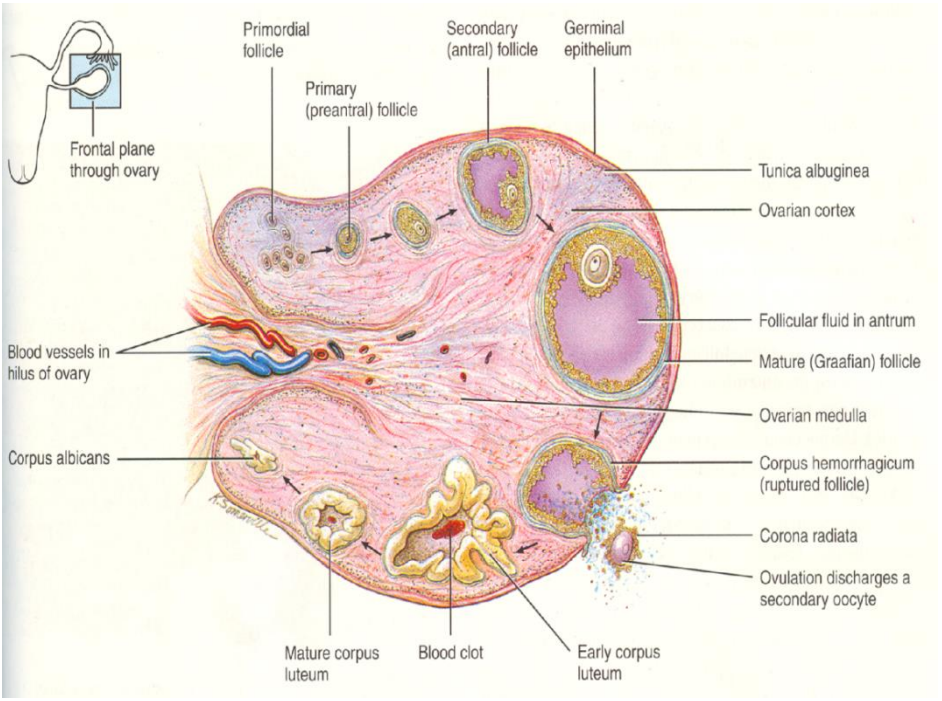
Consist of oocytes in various stages of development and their surrounding cells. When the surrounding cells form a single layer, they are called follicular cells, when they form several layers they are referred to as Granulosa cells.

6- *A mature (Graafian) follicle:*

Is a large, fluid filled follicle that soon will rupture and expel a secondary oocyte, a process called ovulation.

7- *A corpus luteum*

Contains the remnants of an ovulated mature follicle. The corpus luteum produces hormones until it degenerate and turns into fibrous tissue called a corpus alb (**Tortora et al., 1998**)



Fig(1.3): Histology of the ovary *(***Tortora et al., 1998).**

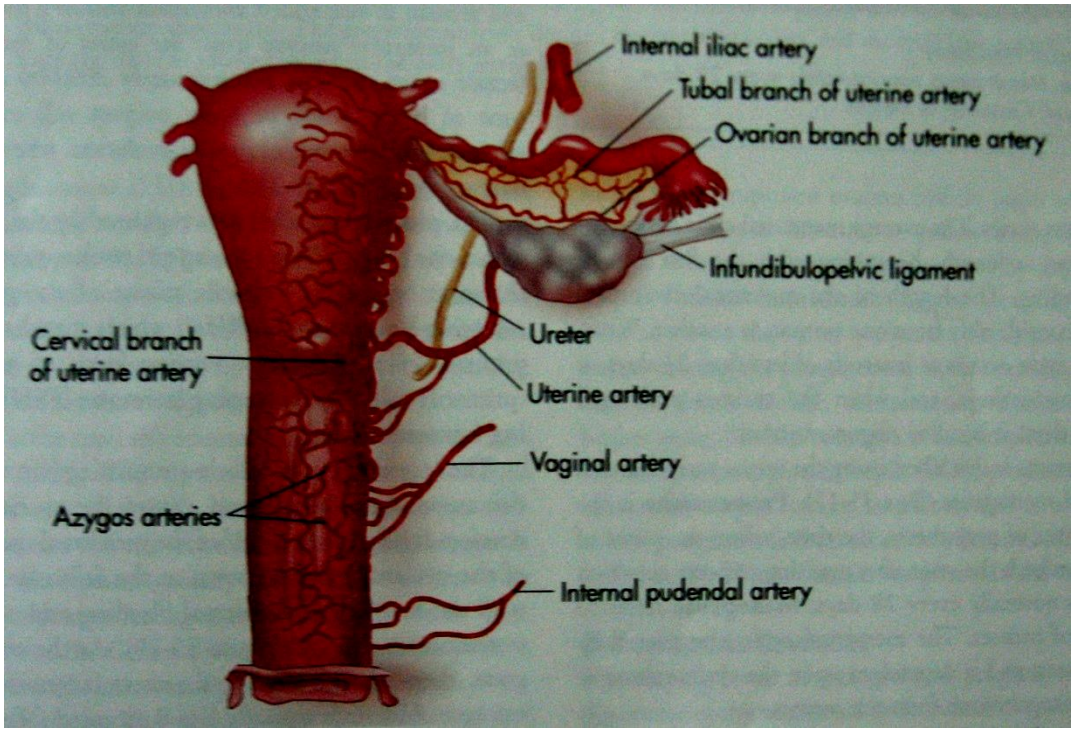
Arterial supply of the ovaries(Fig 1.4) :

- The ovarian arteries arise from the abdominal aorta around the level of L 2 vertebra .

- They descend along the posterior abdominal wall, courses caudally and laterally ventral to the psoas major

- It anastomoses with the uterine artery .

- The artery usually has a tortuous course that is maximum near the level of the ovary **(*Faysal et al .,2004*).**



Figure(1.4) . illustration shows the ovarian blood supply **(*Faysal et al ., 2004).***

Venous drainage of the ovaries .

- The ovarian veins leave the hilum of the ovary and form a net work of vessels, called the pampiniform plexus in the broad ligament near the ovary and uterine tube .

- This plexus of veins communicates with the uterine plexus of veins .