Role of Diffusion-weighted MR Imaging in the Evaluation of Ovarian Tumors

Thesis

Submitted For Partial Fulfillment of the M.Sc. Degree

In Radio diagnosis

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2012

بسم الله الرحمن الرحيم

"قَالُوا سُبْحَانَكَ لاَ عِلْمَ لَنَا إِلاَّ مَا عَلَّمْتَنَا إِنَّكَ أَنتَ الْعَلِيمُ الْحَكِيمُ"

صدق الله العظيم

سورة البقرة الآية (٣٢)

Acknowledgment

First of all I would like to thank ***ALLAH*** *for giving me the power to complete this work, may he be generous on me and give me the knowledge to help others.*

Words can never express my feelings, respect and gratitude to ***Prof. Dr. Soha Talaat Hamed*** *Professor of Radiodiagnosis, Faculty of medicine, Cairo-University, for her continues care, support and for her invaluable guidance, constructive criticism in supervising this work.*

Also special thanks for ***Dr. Fatma Mohamed Awad*** *Assist. Prof. of Radio diagnosis, Faculty of medicine, Cairo-University for her effort and support in this thesis.*

I wish to express my deep gratitude to ***Dr. Sahar Mansour*** *Lecturer of Radiodiagnosis, for her help, concern and being always giving and caring.*

It is my pleasure to express my deep appreciation to my professors and colleagues in the Radiology department, Cairo University. My especial thanks and deep appreciation to ***Dr. Reham Osama*** *Assist. Lecturer for her patience and unlimited kind support. Also special thanks for women's imaging unit nurses and all MRI unit operators.*

Last, but not least, I would like to express my respect, appreciation and thanks to my ***Parents*** *and my* ***Brothers*** *for their continues praying, everlasting love and care.*

Contents

Abstract

Ovarian cancer is a leading cause of death among women. Preoperative tissue characterization can help the surgeon to plan for adequate procedures.

DWI is one of the evolving functional MR imaging. When added and interpreted together with the conventional MR imaging, the specificity and accuracy of conventional MR imaging findings have shown to be increased.

Keywords

Ovarian cancer - Difussion Weighted Imaging - functional imaging.

List of Abbreviations

ADC	:	Apparent diffusion coefficient
BOT	:	Borderline ovarian tumors
DCE-MRI	:	Dynamic Contrast Enhanced MRI
DWI	:	Diffusion-weighted imaging
FOV	:	Field of view
FSE	:	Fast spin echo
Gd	:	gadolinium
HCG	:	Human chorionic gonadotropin
MRS	:	Magnetic Resonance Spectroscopy
NPV	:	Negative predictive value
PET/CT	:	Positron emission tomography - computed tomography
PPV	:	Positive predictive value
RF	:	Radiofrequency
SE	:	Spin-echo.
SPAIR	:	Spectral Adiabatic Inversion Recovery

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Introduction

Functional imaging is becoming increasingly important in the evaluation of cancer patients because of the limitations of morphologic imaging, particularly in the assessment of response to therapy. Recent technical advances allow the use of diffusion MR imaging in abdominal and pelvic applications after it has been established as a useful functional imaging tool in neurologic applications for a number of years. **(Whittaker et al, 2009)**

This unique noninvasive modality has demonstrated the capacity to help discriminate between benign and malignant lesions, increase the contrast between lesions and surrounding tissues, and improve the detection and delineation of peritoneal implants at both initial staging and follow-up. Moreover, diffusion-weighted imaging provides quantitative information about tissue cellularity that may be used to distinguish viable tumors from treatment-related changes **(Kyriazi et al, 2010)**

When diffusion-weighted MR imaging is used in gynecologic applications, cancers have shown lower apparent diffusion coefficient (ADC) values. Increasing ADC values is noted in carcinomas responding to radiation therapy, so it can be used as a biomarker for treatment response, and in the evaluation of recurrence, discriminating localized from multifocal disease which is a critical factor in opting for secondary cytoreduction **(Inada et al, 2008), (McVeigh et al, 2008).**

As for peritoneal implants from ovarian cancer, the diagnosis represents a privilege for diffusion weighted MR imaging, as the small seeds invaginated within peritoneal reflections, or coating the serosal surface of intestinal loops and solid viscera, are often masked by the similarity of their attenuation or signal intensity to that of adjacent structures using CT or conventional MRI. On diffusion-weighted imaging, malignant deposits on the visceral peritoneum are more conspicuous because of signal suppression from surrounding ascites, bowel contents, and fat **(Low et al, 2009)**

Avoiding the potential pitfalls, of the technique, can be accomplished when diffusion weighted images are interpreted in association with anatomic MR images. Increasing familiarity with diffusion coefficient calculation and software manipulation, will allow radiologists to provide new information for the diagnosis of patients with known or suspected gynecologic malignancies **(Fujii et al, 2008)**

Limitations of diffusion weighted MR imaging, in abdomen and pelvis, due to motion and susceptibility artifacts has been overcome by the development of new imaging techniques, particularly novel methods of data acquisition and parallel imaging, allowing much faster data acquisition with fewer artifacts, resulting in significant improvement in image quality in body applications **(Qayyum, 2009)**

Aim of the work

This study aims at the reviewing and emphasizing the role of diffusion-weighted MR imaging in the diagnosis of ovarian tumors.

Anatomy of the ovary

Gross Anatomy

The ovaries are almond shaped but may vary in size, position, and appearance, depending on the age and the reproductive activities of the individual ***(DeLancey et al, 1997).***

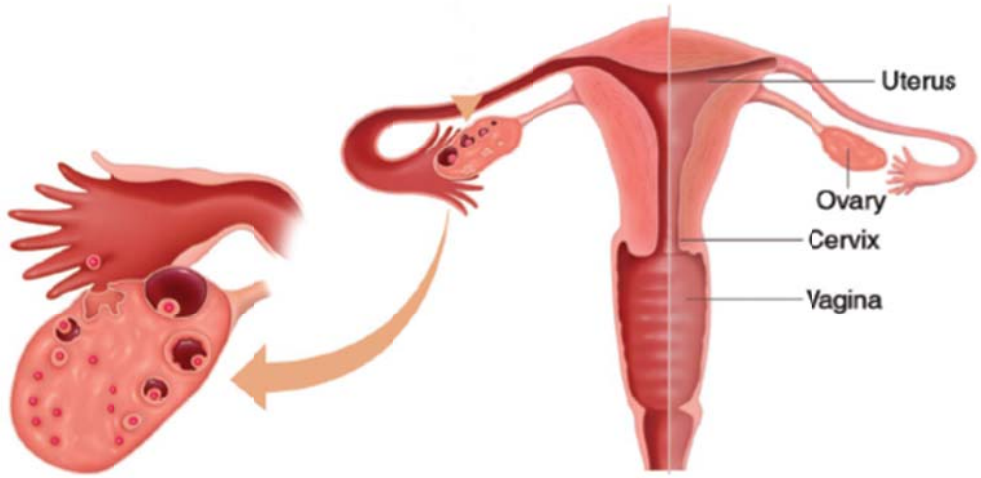

Fig (1.1): showing normal anatomy of the female reproductive system (***Tanakaet al, 2004)***

The normal adult woman ovaries range from 2.5–5 cm long, 1.5–3 cm thick, and 0.7–1.5 cm wide, with a weight of 3–8 gm. ***(kleeman, 2007).***

The ovary is encapsulated by a thin whitish fibrous Capsule called the tunica albuginea. ***(Tortora et al, 1998).***

The ovary can be divided into:

- Outer cortex which consists of a cellular connective tissue stroma in which the ovarian follicles are embedded.
- Inner medulla which is composed of loose connective tissue which contains blood vessels and nerves ***(Kleeman, 2007).***

The ovary is attached by the mesovarium to the posterior surface of the broad ligament. Further support is given by the ovarian ligament proper and the suspensory ligament of the ovary that is continuous with the broad ligament attaching to the pelvic sidewall and in which the ovarian vessels and lymphatics run ***(Federle et al, 2006).***

Blood supply of the ovary

The ovarian artery originates from the abdominal aorta, below the level of the renal arteries. The ovarian arteries supply the ovaries, uterine tubes, the upper portion of the body and fundus of the uterus, and anastomose with the uterine arteries ***(Winkler et al, 1986).***

The ovarian vein is typically single but may be multiple and will fuse forming single vein which accompanies the ovarian artery along its retroperitoneal course. The right vein drains into the inferior vena cava and the left one drains into the left renal vein ***(Tukeva et al, 1999).***

Lymphatic drainage of the ovary

The ovarian lymphatics ascend with the ovarian vessels drain almost exclusively into to the para-aortic lymph nodes, close to the origin of the ovarian arteries ***(Reynolds et al, 2006).***

Other small branches drain via the broad ligament to the external, internal, and common iliac groups of nodes ***(Livengood et al, 2006).***

MR appearance of the ovary (Paul et al, 2004)

***On T1WIs**:*

- The adult ovary appears of intermediate signal intensity with low-signal follicles (unless hemorrhagic).

On T2WIs:

- Multiple high-signal follicles of varying sizes within low signal intensity central stroma
- Low-signal intensity capsule.

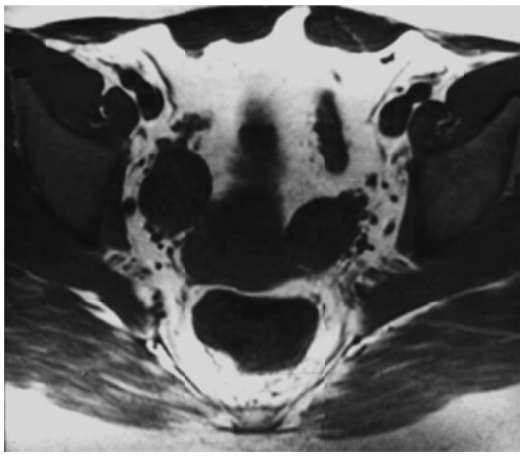

Fig (a)

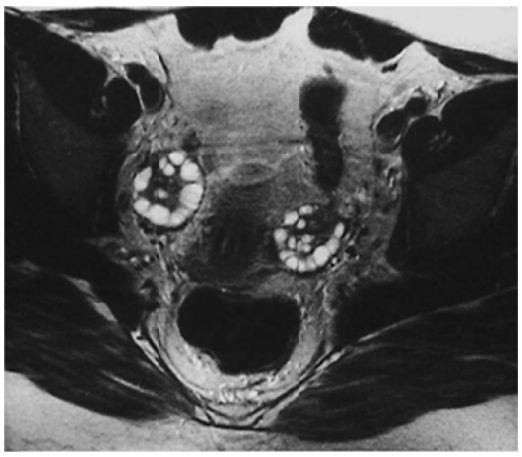

Fig (b)

Fig.(1.2). Normal zonal anatomy in a premenopausal woman. Axial T1-WI (a) and axial T2-WI (b). Both ovaries display multiple small follicles in subcortical location which show intermediate signal on T1-weighted images and very bright signal on the T2-weighted images ***(Paul et al, 2004)***

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 ***(Hongju et al, 2011).***

It is considered the second most common gynecologic malignancy (after cervical Cancer) and most of women are diagnosed in late stages of the disease, (stage III or stage IV cancer), with five year survival reaching 20%. Less than 30% of women are diagnosed with stage I ovarian cancer, and, of these, 90% will survive to five years. (***Hippisley-Cox et al, 2012).***

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.
- Genetic syndromes ***(Folsom et al, 2004).***
- Nulliparity.
- Childbirth after 35 years.
- Late menopause.
- Estrogen replacement therapy for more than five years.
- Early onset of menses ***(Sam et al, 2002).***