

Role of diffusion weighted and perfusion weighted imaging in characterization of ovarian tumours

Thesis

Submitted for partial fulfillment of M.D. Degree in Radiodiagnosis

Presented By

Eman Sameh Hussein Mohamed

Faculty of Medicine
Ain Shams University

Supervised By

Prof. Dr. / Randa Hussein Abdallah

Professor of Radiodiagnosis
Faculty of Medicine
Ain Shams University

Dr. / Nermeen Nasry Halim

Lecturer of Radiodiagnosis
Faculty of Medicine
Ain Shams University

Dr. / Eman Ahmed Fouad

Lecturer of Radiodiagnosis
Faculty of Medicine
Ain Shams University

**Faculty of Medicine
Ain Shams University
2018**

Acknowledgement

First and above of all, thanks to the merciful GOD who enabled me to complete this work.

*Grateful thanks to Professor **Dr. Randa Abdallah** Professor of Radiodiagnosis, Ain Shams University, for her great experience, kind heart, great help and support, valuable instructions and I will always remain grateful.*

*I would like to express my deepest gratitude to **Dr. Nermeen Nasry** Lecturer of Radiodiagnosis, Ain Shams University for her kind help and support.*

*I would like to express my great thanks to **Dr. Eman Darwish** Lecturer of Radiodiagnosis, Ain Shams University for her kind support and valuable advice.*

Many thanks to my family, mom, dad and dear sisters for their kind support and great help.

Finally, I would like to thank all the members of Radiology department of Ain Shams University and my dear colleagues who helped me to complete this work.

Contents

1. Introduction.
2. Aim of the work.
3. Anatomical considerations of ovaries.
4. Pathology of ovarian tumours.
5. Technical aspects of DWI & dynamic contrast enhanced MRI.
6. Patients and methods.
7. Results.
8. Illustrative cases.
9. Discussion.
10. Summary and conclusion.
11. References.
12. Arabic summary.

List of figures

<i>Fig. No.</i>	<i>Name of figure</i>	<i>Page No.</i>
1-1	Embryological origin of the ovaries	2
1-2	Illustration shows the ovarian fossa	4
1-3	components of ovary	5
1-4	Ovarian ligaments	6
1-5	The ovarian fossa at the posterolateral pelvic side wall.	7
1-6	Arterial supply of the ovaries	7
1-7	Venous drainage of the ovary	8
1-8	Lymphatic drainage of the ovary	8
1-9	Normal zonal anatomy in a premenopausal woman	9
1-10	Ovaries of a 23-year-old woman	10
1-11	Normal ovarian appearance during premenopausal period	11
1-12	Ovarian appearance in Postmenopausal woman	12
1-13	Ovaries of 64- year old woman	12
2-1	Classification of different ovarian tumors	14
2-2	Gross specimen of resected ovarian Serous cyst adenoma	16
2-3	Gross specimen of resected ovarian mucinous cystadnoma	17
2-4	Gross specimen of resected ovarian endometrioid tumor	17
2-5	Gross specimen of resected ovarian clear cell tumor.	17

2-6	Gross specimen of resected ovarian Transitional cell tumor	18
2-7	Gross specimen of resected ovarian dysgerminoma.	19
2-8	Macroscopic specimen of ovarian yolk sac tumor	20
2-9	Gross specimen of ovarian teratoma with intra-lesional hair within.	21
2-10	Macroscopic specimen of ovarian choriocarcinoma	22
2-11	Mixed germ cell tumor.	22
2-12	Ovarian specimen with malignant carcinoid tumor	23
2-13	granulosa cell tumor adult type.	24
2-14	gross specimen of ovarian thecoma	25
2-15	gross specimen of ovarian fibroma	25
2-16	gross specimen sertoli cell tumor	26
2-17	Gross specimen of sertoli leydig tumor	27
3-1	Diffusion of water molecules	61
3-2	Schematic illustrates the effect of a diffusion-weighted sequence on water molecules	62
3-3	Ovarian cystadenocarcinoma.	64
3-4	Bilateral ovarian cystadenocarcinoma	65
3-5	cystadenoma.in a 52-year-old woman	66
3-6	fibrothecoma in a 27-year-old woman	67
3-7	SI-time curves of benign, borderline and invasive ovarian tumors	73
3-8	features indicates a high likelihood of malignancy	75

3-9	Fibrothecoma	75
3-10	Complex hemorrhagic adnexal cyst in a 40-years-old woman	77
3-11	MR images of a multicystic mass with locules of variable signal intensity	78
3-12	Tuboovarian abscess in a 50-year-old woman	79
3-13	Added value of perfusion and diffusion weighted imaging	80

List of tables

No. of table	Name of table	Page No.
3-1	Protocol for DWI in pelvis	63
3-2	Interpretation of DWI findings	68
5-1	The pathological type	88
5-2	The different patients; age for benign & malignant tumours	88
5-3	The different histological types	90
5-4	The minimum, maximum & mean diameter of the tumours	91
5-5	The different compositions of the tumours	92
5-6	The pathological type according to conventional MRI	92
5-7	Results of conventional conventional-MRI compared to pathology.	93
5-8	The pathological types according to DWI.	93
5-9	Results of DWI imaging compared to pathology.	94
5-10	The ADC values of the benign & malignant masses:	94
5-11	The different curve types and their percentage	95
5-12	The comparison between the MRE values between benign and malignant tumors	96
5-13	The comparison between the TTP values between benign and malignant tumors	96

5-14	The comparison between the SI max values between benign and malignant tumors	97
5-15	The comparison between the WIR values between benign and malignant tumors	97
5-16	Results of DCE-MRI compared to pathology	98
5-17	The correlation between numbers of cases diagnosed as benign or malignant by the conventional MR imaging, DWI, DCE-MRI and their pathological diagnosis	99
5-18	The sensitivity, specificity, PPV & NPV OF Conventional MRI, DWI and the DCE-MRI	99

Table of charts

<i>No. of chart</i>	<i>Name of chart</i>	<i>Page No.</i>
5-1	The different patients complains	87
5-2	The pathological type	88
5-3	The average patients' age for benign & malignant tumours	89
5-4	The average diameters of the tumours	92
5-5	The different curve types & their percentages according to pathology	95

List of abbreviations

abbreviation	Meaning
TTP	Time to peak
MRE	Maximum relative enhancement
SI max	Maximal signal intensity
WIR	Wash in rate
WOR	Washout rate
MRI	Magnetic resonance imaging
DCE-MRI	Dynamic contrast enhanced magnetic resonance imaging
DWI	Diffusion weighted imaging
SI	Signal intensity
T1WI	T1 weighted image
T2WI	T2 weighted image
CT	Computed tomography
Fig	Figure
IV	Intravenous
US	Ultrasound
Vs	Versus
PPV	Positive predictive value
NPV	Negative predictive value
Sd	Standard deviation
ROI	Region of interest
ADC	Apparent diffusion coefficient
PCO	Polycystic ovary
THRIVE	High Resolution Isotropic Volume Examination

ABSTRACT

Background: ovarian cancer is the second most common gynecological cancer and the fifth most common cancer in women. Proper management depends on proper preoperative assessment with the help of clinical examination, laboratory tests and different imaging modalities. Radiological evaluation includes ultrasonography (US), computed tomography (CT) and recently magnetic resonance imaging (MRI). 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. Diffusion weighted imaging (DWI) has been established as a useful functional imaging tool in neurologic applications for a number of years, but recent technical advances now allow its use in abdominal and pelvic applications.

Purpose: it was to evaluate the role of diffusion weighted and perfusion weighted MRI imaging in the characterization of ovarian tumours and differentiation between benign and malignant tumours.

Patients and Methods: this study performed on 24 patients. All patients had US finding of solid or complex adnexal lesions.

Results: DWI & dynamic MRI are significant promising tool factors for characterization of ovarian tumours and differentiation between benign & malignant lesions with high sensitivity, specificity. The sensitivity, specificity and accuracy of detection of the nature of the lesions have been increases after adding of DWI & DCE-MRI to the conventional imaging.

Conclusion: Adding of DWI & DCE-MRI to the conventional MRI improves the sensitivity and specificity of diagnosis and allows confident diagnosis and differentiation between benign and malignant lesions.

Keywords: Ovarian tumours, MRI, DWI, ADC, DCE, TTP, MRE, SI max.

Introduction

Introduction

Ovarian cancer is a leading cause of death among women. It is the second most common gynecological cancer and the fifth most common cancer in women. Unfortunately most women are diagnosed with late stage disease, which has a poor survival rate. Proper diagnosis of cancer can help finding more available treatment options and in turn better prognosis (*Hippisley-Cox et al, 2012*).

Proper management depends on proper preoperative assessment, with the help of clinical examination, laboratory tests and different imaging modalities (*Thomassin-Naggara et al., 2011*).

Accurate characterization of an adnexal mass as being benign can avoid unnecessary surgery especially in postmenopausal women and can help young women wishing to preserve child bearing potential to go for conservative surgery (*Thomassin-Naggara et al, 2009*).

Ultrasonography (US) is the first-line imaging technique for adnexal masses and is particularly useful for the characterization of noncomplex masses that present a low risk of malignancy (*Thomassin-Naggara et al, 2011*).

However, because of its major limitations in terms of spatial resolution and, more importantly, contrast resolution; it is unable to resolve in most of the cases the differential diagnosis between benign and malignant masses (*salvatore Cappabianca et al, 2013*).

Computed tomography (CT) is the modality of choice for staging in patients with ovarian cancer. However, the poor soft-tissue contrast of CT limits its use for local staging (*Evis Sala et al, 2013*).

MR imaging has shown to be more specific and accurate than US and Doppler assessment in preoperative characterization of complex adnexal masses. In addition, it is the best method in delineation of local spread to the pelvic organs. 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 (*Eman Nasr et al, 2014*).

With recent advances in ultrafast MR imaging techniques, perfusion-weighted (DCE-MRI) and diffusion-weighted (DW) imaging are available to assess discriminant microvascular and cellular characteristics in abdominal and pelvic organs. They have recently been shown to be effective in the differentiation of benign from malignant adnexal masses (*Thomassin-Naggara et al, 2011*).

DWI is one of the promising new functional imaging techniques. As long as interpretation of DWI is combined with the conventional MR images and with realizing of the possible pitfalls, it has shown to be effective in the differentiation of benign from malignant adnexal masses (*Thomassin-Naggara et al, 2011*).

DWI increases the contrast between lesions and surrounding tissues, and improves 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 (*Eman Nasr et al, 2014*).

Functional imaging (DCE-MRI) is becoming increasingly important in the evaluation of cancer patient in initial diagnosis and the assessment of response to therapy (*C. Whittaker et al, 2009*).

Aim of The Work