Role of Dynamic Contrast Enhanced MRI and DWI in the Pre-operative Assessment of Endometrial & Cervical Carcinoma

Thesis

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By

Amal Adel Mohammed Elhady Elsayed

M.B., B.Ch, M.Sc

Benha University

Supervised By

Dr. Fatma Salah Eldeen Mohammed

Professor of Radiology

Faculty of Medicine

Ain Shams University

Dr. Nivine Abd Elmonem Chalabi

Assistant Professor of Radiology

Faculty of Medicine

Ain Shams University

Dr. Nermeen Nasry Halim

Lecturer of Radiology

Faculty of Medicine

Ain Shams University

Dr.Zeinab Mostafa Mostafa Metwally

Fellow of Radiology

National Hepatology& Tropical Medicine Research Institute

Faculty of Medicine

Ain Shams University

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Abstract

Recent developments in diagnostic imaging techniques have magnified the role and potential of MRI in female pelvic imaging. Functional imaging by means of dynamic multiphase contrast-enhanced magnetic resonance imaging (DCE-MRI) and diffusion weighted magnetic resonance imaging (DW-MRI) is now part of the standard imaging protocols for evaluation of the female pelvis.

In this review, we give an overview of both DCE-MRI and DW-MRI techniques, concentrating on their main clinical application in preoperative staging and their role in tail or in treatment options and therapy in patients with uterine malignancies. We were aiming to compare DW-MRI with DCE-MRI in a way to highlight the most cost effective method in management of patients with uterine malignancy.

DCE-MRI improves the accuracy of T2WI in staging of endometrial cancer. It also increases reader's confidence in assessment of parametrial infiltration and adjacent organ invasion in cancer cervix. DW-MRI is valuable in preoperative staging of patients with endometrial and cervical cancer, specially in detection of extra-uterine disease. It increases the confidence for detection of recurrent disease in uterine malignancies and improves detection of small peritoneal implants.

Key words: endometrial carcinoma, cervical carcinoma, dynamic contrast enhanced MRI, Diffusion weighted MRI, functional imaging.

List of Abbreviations

ADC	Apparent Diffusion Coefficient
CE	Contrast Enhanced
CT	Computed Tomography
D&C	Dilatation & curettage
DCE-MRI	Dynamic contrast enhanced magnetic resonance imaging
DWI	Diffusion Weighted Image
DW-MRI	Diffusion weighted magnetic resonance imaging
EUA	Examination Under Anesthesia
ESS	Endometrial Stromal Sarcoma
FDG-PET	Fluorodeoxyglucose-positron emission tomography
FIGO	International Federation of Gynecology and Obstetrics
fMRI	Functional MR Imaging
FOV	Field of view
FSE	Fast Spin Echo
Gd	Gadolinium
Gd-DTPA	
GRE	Gradient Echo
HPV	Human Papilloma Virus
IV	Intravenous
JZ	Junctional Zone
LN	Lymph Node
LVSI	Lympho-vascular space invasion
MPG	Motion-Providing Gradient
MRI	Magnetic resonance imaging
NCCN	National Comprehensive Cancer Network
NPV	Negative Predictive Value
PPV	Positive Predictive Value
RF	Radio-Frequency

ROI	Region Of Interest
SI	Signal Intensity
SEE	Sub-Endometrial Enhancement,
TAH/BSO	Total abdominal hysterectomy/ Bilateral salpingo-oophorectomy
T1WI	T1 weighted image
T2 WI	T2 weighted image
TVUS	Trans-vaginal ultrasound
TR	Time to Repetition
TE	Time to Echo
3T	3 Tesla
T stage	Tumor stage
US	Ultrasound

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Introduction

Endometrial carcinoma is the most common gynecological malignancy and the sixth most common neoplasm worldwide. It typically presents with abnormal uterine bleeding in 75% to 90% of patients.***(Jemal et al, 2011)***

Uterine cervical cancer is the fourth most common female malignancy and has a high mortality rate. Most women with cervical cancer are diagnosed before the age of 50. However; older women remain at risk. More than 20% of new cases are diagnosed in women over 65. Cervical cancer in women younger than age 20 is rare. ***(Ferlay et al, 2015)***

The treatment planning depends on staging of the tumor; therefore pre-operative assessment is closely related to patient survival and prognosis.***(Zheng et al, 2015)***

The traditional and reliable staging of endometrial carcinoma relies on the surgical staging system, which was revised in 2009 by the International Federation of Gynecology and Obstetrics (FIGO). Therefore, there is a clinical need for noninvasive imaging modalities that can provide accurate preoperative staging information for endometrial carcinoma.***(Zheng et al, 2015)***

Magnetic resonance imaging (MRI) is considered a noninvasive method giving excellent soft tissue contrast resolution with multiplanar capabilities when evaluating the female pelvis. ***(Zheng et al, 2015)***; It depicts the key prognostic factors such as depth of myometrial invasion, cervical stromal& pelvic lymph nodes involvement preoperatively,thus it plays an increasing role in clinical decisions regarding endometrial carcinoma***. (Rauch et al, 2014)***

Cervical cancer is the only gynecologic malignancy that is still clinically staged according to the revised 2009 FIGO classification system. However, the committee encourages the use of imaging as clinical staging is inaccurate in 22%–75% of

patients. The use of MRI can detect the tumor extension into the lower part of the uterus, para-metrium, and para-cervical fat thus enables patients to be more appropriately triaged for hysterectomy or chemoradiation therapy.***(Rauch et al, 2014)***

Thus MRI now has an established role in staging, management & follow up of the tumor. Both clinicians and radiologists currently agree that MRI is superior to transvaginal sonography and CT.***(Zheng et al, 2015)***

DCE-MRI improves the accuracy of T2WI in staging of uterine cancer and is highly accurate in evaluating the depth of myometrial invasion as the majority of tumors are hypovascular compared to the adjacent enhancing myometrium.***(Sala et al, 2010)***

In spite of being the standard modality for evaluating gynecological malignancies but MRI has several limitations. Consequently, there has been a growing interest in functional imaging modalities. Diffusion-weighted imaging (DWI) with the aid of quantitative apparent diffusion coefficient (ADC) measurement is a unique, noninvasive modality that was shown to improve the radiological diagnosis of malignant tumors. ***(Levy, et al, 2011)***

Diffusion-weighted magnetic resonance imaging (DW-MRI) is a functional imaging technique whose contrast derives from the random motion of water molecules within tissues, thus no exogenous contrast medium administration is required, so that diffusion-weighted sequences can now be included in routine patient assessment.***(Whittaker et al, 2009)***