

New Advances in Magnetic Resonance
Imaging of Prostate cancer

Essay

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توطئه للحصول على درجه الماجستير فى الاشعه التشخيصيه

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Summary & conclusion

Prostate cancer being one of the relatively controllable, slowly progressive, and one of the least morbid cancers in its early stages, has provoked many studies to try, predict, diagnose, and stage it.

Diagnostic assessment of the prostate on MRI was improved with the introduction of the endorectal surface coil which improves the image quality and accuracy in the preoperative staging of prostate cancer compared with the whole body-coil. However, the accuracies obtained with the endorectal coil in staging prostate cancer vary widely, from 51% to 89%. An improvement of the staging accuracy was also achieved using the combination of endorectal coil and body phased-array coil.

Magnetic resonance spectroscopic imaging has shown very promising results, being a method of obtaining biochemical information from a series of voxels placed over the prostate gland, and can be performed as part of endorectal prostate MRI with a commercial MRI scanner.

Combined endorectal MR imaging and MR spectroscopic imaging has an accuracy rate similar to that of biopsy for prostate cancer sextant localization, and is more accurate than biopsy of the prostate apex.

It is unclear how specific the ADC is for prostate cancer. The ADC then reflects various physical and physiologic characteristics of tissue but is not specific for cancer itself. This non specificity of ADC for cancer tissue may result in an overlap of ADC between cancer and noncancerous tissue. Therefore, we suggest that the ADC map is helpful

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CONTENTS

	Page
• Acknowledgement	3
• List of figures	5
• List of tables	7
• List of abbreviations	8
• Introduction	10
• Aim of work	12
• Chapter 1:	
- Anatomy	13
- Pathology	39
• Chapter 2:	
- Technique of endorectal MR imaging	64
- Technique of MR Spectroscopic imaging	71
- Technique of Diffusion weighted imaging	82
- Technique of Dynamic contrast enhancement	93
• Chapter 3:	
- Manifestations of endorectal MR imaging	101
- Manifestations of MR Spectroscopic imaging	118
- Manifestations of Diffusion weighted imaging	143
- Manifestations of Dynamic contrast enhancement	148
• Monitoring of treatment	164
• Summary	184
• References	187
• Arabic summary	210

LIST OF FIGURES

FIGURES	OPPOSITE PAGE
FIG. 1 (Lateral view of the male pelvis)	16
FIG. 2 (Lobar description of the prostate)	17
FIG. 3 (Divisions of the prostate gland)	20
FIG. 4 (Zonal description of the Prostate)	24
FIG. 5 (Axial, coronal and sagittal sections of the Prostate)	29
FIG. 6 (Coronal view of the prostate)	34
FIG. 7 (Normal anatomy in T2-weighted parasagittal MR images)	38
FIG. 8 (Normal anatomy in T2-weighted axial MR images)	39
FIG. 9 (Age is the strongest risk factor for prostate cancer)	43
FIG. 10 (Trends in prostate incidence and mortality rates by race)	43
FIG. 11 (The Gleason grading system)	54
FIG. 12 (TNM-the four stages of local prostate tumor growth)	62
FIG. 13 (Divisions of the prostate into sextants)	70
FIG. 14 (MR Spectroscopy of normal prostate gland)	78
FIG. 15 (3D MRSI spectra demonstrate metabolic differences between normal zonal anatomy)	81
FIG. 16 (DWI and ADC map showing normal prostate)	84
FIG. 17 (DWI and ADC map showing BPH)	86
FIG. 18 (DWI and ADC map showing two hypointense focal lesions)	88
FIG. 19 (DWI and ADC map showing left PZ hypointense focal lesion)	90
FIG. 20 (Combined DWI and MRS of the prostate)	92
FIG. 21 (Color coded scheme of dynamic contrast enhancement)	98
FIG. 22 (Comparison of concentration versus time curve)	100
FIG. 23 (Axial & sagittal T2 WI showing direct invasion of the urinary bladder)	106
FIG. 24 (Axial and sagittal T2 WI showing direct invasion of the urinary bladder and rectum)	108
FIG. 25 (Feromuxtran enhanced T2* gradient WI showing LNs)	110
FIG. 26 (Relation between MR signal and tumor aggressiveness)	115
FIG. 27 (Axial T2 WI and MRS of BPH)	122
FIG. 28 (CART-based decision- making tree for voxel-by voxel analysis of MR spectroscopic imaging data.)	125
FIG. 29 (MRS showing standardized 5 point scale)	127
FIG. 30 (Axial and coronal T2 WI and MRS of prostate cancer)	128

FIG. 31 (Axial T2 WI and MRS showing LT PZ hypointense lesion (Score 5))	130
FIG. 32 (MRS showing different histological categories)	136
FIG. 33 (Axial T2 WI and MRS showing HGPIN)	139
FIG. 34 (Axial T2 WI and MRS showing directed voxel guided Biopsy)	141
FIG. 35 (DWI and ADC map showing left PZ hypointense focal lesion)	146
FIG. 36 (Combined axial T2 WI and dynamic contrast enhanced showing left apex lesion)	151
FIG. 37 (Combined axial T2 WI and dynamic contrast enhanced color coded based showing right PZ lesion)	153
FIG. 38 (Axial T2, T1 before & after contrast injection and color coded image showing right PZ lesion)	155
FIG. 39 (Axial T2 WI and color coded four contrast enhancement parameters)	158
FIG. 40 (Axial T2 WI and color coded dynamic contrast enhancement showing right PZ lesion with ECE)	160
FIG. 41 (Axial and coronal T2 WI acquired with torso phased array coil at 3T)	163
FIG. 42 (Axial T2 WI showing recurrence after radical prostatectomy)	168
FIG. 43 (Axial T2 WI showing recurrence after radical prostatectomy)	168
FIG. 44 (Axial T2 WI showing recurrence after radical prostatectomy)	171
FIG. 45 (Axial T2 WI showing recurrence after radical prostatectomy)	171
FIG. 46 (Axial T2 WI & MRS showing recurrence in left hemiprostata post radiation therapy)	173
FIG. 47 (Axial T2 WI showing radiation therapy seeds)	176
FIG. 48 (Axial T2 WI showing radiation therapy seeds)	176
FIG. 49 (Axial T2 WI showing radiation therapy seeds)	178
FIG. 50 (Axial T2 WI showing radiation therapy seeds)	178
FIG. 51 (Axial T2 WI showing radiation therapy seeds)	178
FIG. 52 (Axial T2 WI showing radiation therapy seeds)	178
FIG. 53 (Axial T1 WI post contrast enhancement post cryosurgery)	180
FIG. 54 (Axial T1 WI post contrast enhancement post cryosurgery)	180
FIG. 55 (MR spectrum post cryosurgery)	182

LIST OF TABLES

TABLES	PAGES
Table (1) (Correspondance between the lobar and zonal descriptions of the prostate anatomy)	21
Table (2) (Histological features of prostatic adenocarcinoma)	52
Table (3) (Gleason grading scale)	54
Table (4) (Gleason score)	56
Table (5) (Classification of Whitmore 1956 modified by Jewett 1975)	57
Table (6) (Clinical staging of prostate cancer)	58
Table (7) (The TNM classification of prostate cancer)	60
Table (8) (MRI protocol)	68
Table (9) (Resonance of MR spectroscopy of prostate)	75
Table (10) (Statistical Analysis Results of T2-WI, Dynamic Contrast-Enhanced MRI, and Both Sequences Combined for the Detection of Prostate Cancer.)	96
Table (11) (Extra-capsular Extension Criteria on MR Images)	105
Table (12) (Seminal Vesicle Invasion Criteria on MR Images)	108
Table (13) (Criteria for Extracapsular Extension and Seminal Vesicle Invasion for T2-weighted MR Images and Fused T2-weighted Parametric MR Images)	159

LIST OF ABBREVIATIONS

3D	<i>Three Dimensional</i>
3D MRSI	<i>Three Dimensional Magnetic Resonance Spectroscopy Imaging</i>
AAH	<i>Atypical Adenomatous Hyperplasia</i>
ADC	<i>Apparent diffusion coefficient</i>
AUC	<i>Area under the receiver operating characteristic curve</i>
BAC	<i>Body-array coil</i>
BASING	<i>Band-selective inversion with gradient dephasing</i>
BPH	<i>Benign Prostatic Hyperplasia</i>
C/C	<i>Choline to creatine</i>
CART	<i>Classification and regression tree</i>
CC/C	<i>Choline-creatine-to-citrate ratio</i>
CG	<i>Central gland</i>
Cho	<i>Choline</i>
CI	<i>Confidence interval</i>
Cit	<i>Citrate</i>
Cr	<i>Creatine</i>
CZ	<i>Central Zone</i>
DCE MRI	<i>Dynamic Contrast Enhanced Magnetic Resonance Imaging</i>
DRE	<i>Digital rectal examination</i>
DW	<i>Diffusion weighted</i>
ECE	<i>Extra Capsular Extension</i>
En MRI	<i>Endorectal coil Magnetic Resonance Imaging</i>
ERC	<i>Endorectal coil</i>
FDG	<i>Fluorodeoxyglucose</i>
FLASH	<i>Fast low-angle shot</i>
FOV	<i>Field of view</i>
FSE	<i>Fast Spin Echo</i>
GRASS	<i>Gradient-recalled acquisition in the steady state</i>
HGPIN	<i>High-grade prostatic intraepithelial neoplasia</i>
LN	<i>Lymph Node</i>
LMN	<i>Lymph node metastasis</i>
Lt	<i>Left</i>
Min	<i>Minute</i>
MIP	<i>Maximum intensity projection</i>
MRI	<i>Magnetic Resonance Imaging</i>
MRSI	<i>Magnetic Resonance Spectroscopy Imaging</i>

NPV	<i>Negative predictive value</i>
NVB	<i>Neurovascular Bundle</i>
OCPC	<i>Organ confined prostate cancer</i>
PA	<i>Polyamine</i>
PACS	<i>Picture archiving and communication system</i>
PCa	<i>Prostate Carcinoma</i>
PIN	<i>Prostatic Intraepithelial Neoplasia</i>
PNI	<i>Perineural invasion</i>
PPA	<i>Pelvic phased array</i>
PPV	<i>Positive predictive value</i>
PRESS	<i>Point resolved spectroscopy</i>
PSA	<i>Prostatic Specific Antigen</i>
PZ	<i>Peripheral Zone</i>
RF	<i>Radiofrequency</i>
ROC	<i>Receiver operating characteristic</i>
ROI	<i>Region of interest</i>
Rt	<i>Right</i>
SE	<i>Spin echo</i>
Sec	<i>Seconds</i>
SI	<i>Signal intensity</i>
SNR	<i>Signal-to-noise ratio</i>
STEAM	<i>Stimulated echo acquisition mode</i>
SUV	<i>Standardized uptake value</i>
SV	<i>Seminal vesicle</i>
SVI	<i>Seminal vesicle invasion</i>
TE	<i>Echo time</i>
TE_{eff}	<i>Effective Echo time</i>
TIC	<i>Time Intensity Curve</i>
TR	<i>Repetition time</i>
TRUS	<i>Transrectal Ultrasound</i>
TZ	<i>Transitional Zone</i>

INTRODUCTION

Carcinoma of the prostate is an important health problem (**Engelhard et al., 2001**). The incidence of prostate cancer has increased in the past ten years and is now the second cause of cancer related deaths in males (**Parker et al., 1997**).

The major goal for prostate cancer imaging in the next decade is more accurate disease characterization through the synthesis of anatomic, functional, and molecular imaging information (**Hricak et al., 2007**).

The ability to identify early organ-confined and therefore potentially curable disease has improved considerably by prostatic specific antigen (PSA) serum testing and transrectal ultrasound (TRUS) guided needle biopsy (**Schlemmer and Corvin, 2004**).

For years the diagnosis of PCa has depended on the combination of digital rectal examination (DRE), serum PSA concentrations, TRUS and ultimately TRUS guided biopsies (**Oyen, 2003**).

It is unfortunate that there is no single imaging method that embodies all of the optimal characteristics for the integration of diagnostic and interventional procedures for prostatic cancer detection and staging (**Atalar and Menard, 2005**).

Routine tools for early diagnosis and localization of cancer within the prostate include digital rectal examination and assessment of serum

prostate-specific antigen followed by transrectal ultrasonographically (US) guided biopsy (**Testa et al., 2007**).

TRUS being widely applied can provide a complete overview of the prostatic zonal anatomy as well as that of the bladder and seminal vesicles. Hence, visualization and sometimes diagnostic information on many pathological conditions of the prostate (**Patel and Rickards, 2002**).

However, ultrasound techniques suffer from several disadvantages e.g. being subjective, non specific and inaccurate in staging (**Oyen, 2003**).

The sensitivity of systematic sextant ultrasonography (US)-guided biopsy for prostate cancer detection is low (39%-52%) because more than 40% of prostate cancer lesions are isoechoic and central gland tumors are difficult to detect. Use of magnetic resonance (MR) imaging may result in higher localization rates (**Futterer et al., 2006**).

Magnetic resonance (MR) imaging has shown great promise as a non invasive diagnostic tool in the evaluation and management of prostate cancer. By aiding in the detection, localization, and staging of prostate cancer, multiplanar T2-weighted endorectal MR imaging can facilitate more appropriate treatment selection and planning (**Mazaheri et al., 2008**).

Metabolic information from 3D 1H MR spectroscopic imaging has been shown to improve tumor localization and volume estimation with MR imaging and to provide valuable information about the aggressiveness of prostate cancer (**Mazaheri et al., 2008**).

Aim of the work

To assess the value of the advanced MRI techniques in accurate detection, localization, staging and post treatment follow-up of prostate cancer.