ADVANCED TECHNIQUES OF MAGNETIC RESONANCE IMAGING FOR PROSTATE CANCER

(Essay)

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RADIODIAGNOSIS

by

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Contents

LIST OF ABBREVIATIONS

Abbreviation	Name
1.5T	1.5 Tesla
3D	Three-dimensional
3D 1H MRSI	Three dimensional hydrogen proton magnetic resonance spectroscopy imaging
3T	3 Tesla
AAH	Atypical Adenomatous Hyperplasia
ADC	Apparent diffusion coefficient
AFMS	Anterior fibromuscular stroma
AUC	Area under curve
BASING	Band-selective inversion with gradient dephasing
BPH	Benign prostatic hyperplasia
CG	Central gland
Cho	Choline
Cho + Cr / Cit	Choline and creatine to citrate
Cit	Citrate
Cr	Creatine
CT	Computed tomography
CZ	Central zone
DCE	Dynamic contrast enhanced
DHT	Dihydrotestosterone
DRE	Digital rectal examination
DW MRI	Diffusion weighted magnetic resonance imaging

DWI	Diffusion weighted imaging
ECE	Extra capsular extension
ERC	Endorectal coil
FSE	Fast spin echo
Hz	Hertz
IV	Intra venous
kPa	Kilo pascal
Lt	Left
mm	Millimeter
mmol	Millimol
MR	Magnetic resonance
MRI	Magnetic resonance imaging
MRS	Magnetic resonance spectroscopy
MRSI	Magnetic resonance spectroscopy imaging
NVB	Neurovascular bundle
PC	Prostate cancer
PIN	Prostatic intraepithelial neoplasia
ppm	Peak per minute
PRESS	Point-resolved spectroscopy
PSA	Prostatic specific antigen
PZ	Peripheral zone
ROI	Region of interest
Rt	Right

s or sec	Second
SNR	Signal to noise ratio
SV	Seminal vesicles
SVI	Seminal vesicle invasion
T1 WI	T1 weight image
T2 WI	T2 weight image
tCho	Total choline
TNM	Tumor, Nodes, Metastasis
TRUS	Trans rectal ultrasound
TTP	Time to peak
TURP	Transurethral radical prostatectomy
TZ	Transition zone
US	Ultrasonography

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Introduction

Prostate cancer is the most frequently diagnosed cancer in males and the second leading cause of cancer-related death in men ***(Bonekamp et al., 2011)***.

Detection and localization of prostate cancer is an important given in the emergence of disease- targeted therapies. Knowledge of the tumor location within the prostate can help to direct maximal therapy to the largest focus of tumor while minimizing damage to the surrounding structures, such as the neurovascular bundles, the rectal wall, and the neck of the bladder ***(Haider et al., 2007)***. Magnetic resonance imaging (MRI) has shown great promise as a noninvasive diagnostic tool in the evaluation and management of prostate cancer ***(Mazaheri et al., 2008).***

Recent advances including additional functional and physiologic MRI techniques allow extension of the obtainable information beyond anatomic assessment ***(Bonekamp et al., 2011).***

Multi parametric magnetic resonance imaging includes diffusion-weighted imaging (DWI), dynamic contrast enhanced MRI (DCE MRI) and magnetic resonance spectroscopy (MRS). These new MRI techniques are increasingly being used to supplement conventional T 2 and T 1-weighted MR sequences in prostate imaging ***(Franiel, 2011)***.

MR spectroscopy is a promising development in the radiological evaluation of possible prostate malignancy ***(Westphalen et al., 2008).***

MR Elastography is a new imaging method with potential in the diagnosis of prostate cancer ***(Li et al., 2011)***.

Furthermore, MRI has been used for follow-up of prostate cancer after irradiation therapy, hormonal ablation, and cryosurgery ***(Graser et al., 2007).***

Aim of the work

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

Anatomy of the prostate

The prostate is the largest accessory gland of the male reproductive system ***(Keith and Agur, 2007),*** normally it is a conically shaped organ about the size of a walnut and is situated deep in the male pelvis ***(Barker et al., 2010).*** The gland is 4 cm transversely, 2 cm in anteroposterior and 3 cm in its vertical diameters, and weighs 8 g in youth, but invariably enlarges with the development of benign prostatic hyperplasia (BPH) ***(Standring, 2008).***

The prostate is a fibromuscular gland which surrounds the prostatic urethra from the bladder base to the membranous urethra and is itself surrounded by a thin but tough connective tissue capsule. Being somewhat pyramidal, it presents a base or vesical aspect superiorly, an apex inferiorly and posterior, anterior and two inferolateral surfaces **(Fig1)** ***(Standring, 2008).***

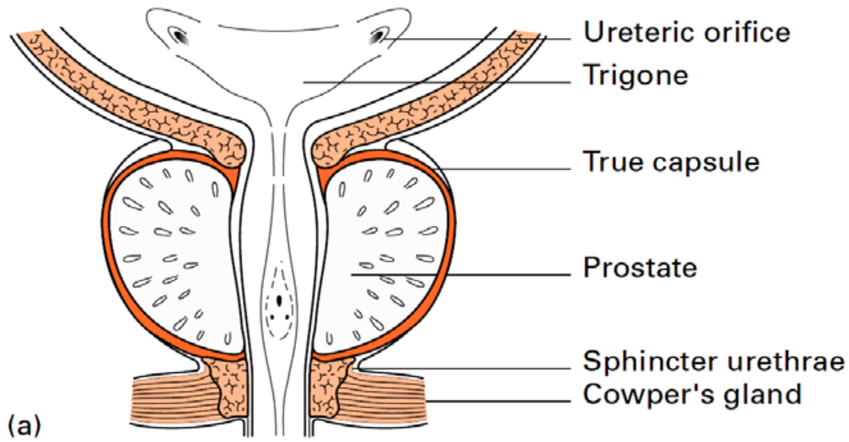

Fig (1): Normal prostate in vertical section with true capsule surrounding ***(Quoted from Ellis, 2006).***

Superiorly its base is largely continuous with the neck of the bladder. The urethra enters it near its anterior border **(Fig2)** ***(Ellis, 2006).***

The apex is inferior, surrounding the junction of the prostatic and membranous parts of the posterior urethra ***(Standring, 2008).*** It is in contact with fascia on the superior aspect of the urethral sphincter and deep perineal muscles ***(Keith and Agur, 2007),***

The anterior surface lies in the arch of the pubis, separated from it by a venous plexus (Santorini's plexus) and loose adipose tissue extraperitoneal fat) in the retropubic space (cave of Retzius). It is extending from the apex to the base and near its superior limit it is connected to the pubic bones by the puboprostatic ligaments. The urethra emerges from this surface anterosuperior to the apex of the gland, it is relatively deficient in glandular tissue and is largely composed of fibromuscular tissue **(Fig2)** ***(Standring, 2008).***

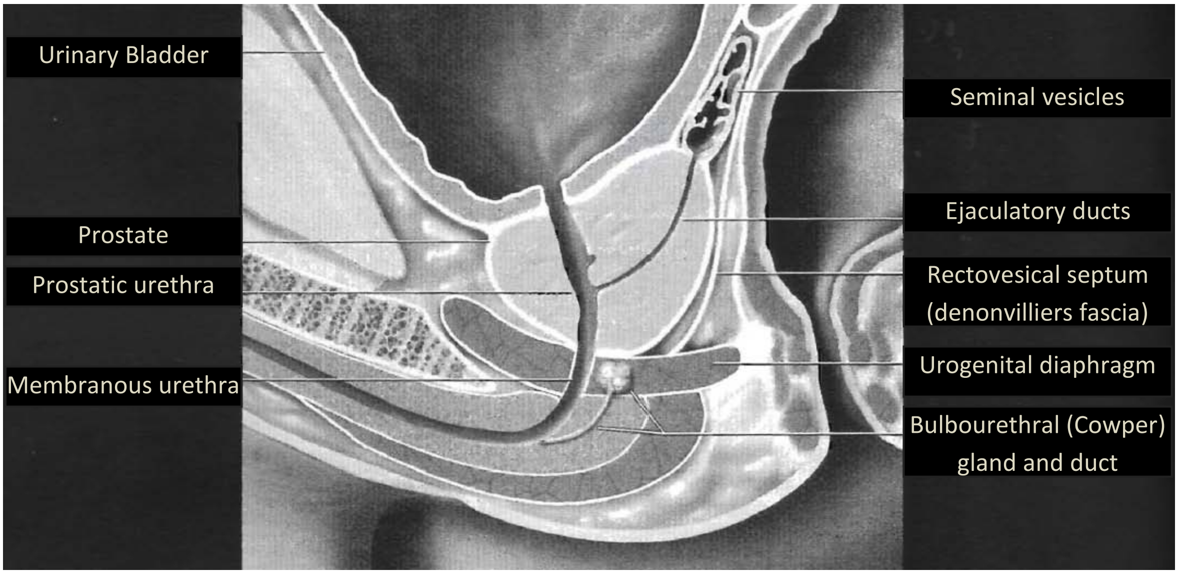

Fig (2): Graphic illustrates the relationships of prostate gland with the male pelvic organs. The prostate surrounds the upper part of urethra. The base of the prostate is in direct contact with the neck of the urinary bladder and its apex is in contact with the superior fascia of urogenital diaphragm. The posterior surface is separated from rectum by rectovesical septum (Denonvilliers fascia) ***(Quoted from Federle et al., 2006).***

The posterior surface is separated from the rectum by Denonvillier's fascia, a dense condensation of pelvic fascia which develops by obliteration of the rectovesical peritoneal pouch **(Fig2)**. The posterior surface is transversely flat and vertically convex. Near its superior (juxtavesical) border is a depression where it is penetrated by the two ejaculatory ducts **(Fig3)**. Below this is a shallow, median sulcus, usually considered to mark a partial separation into right and left lateral lobes ***(Standring, 2008).***