Ainshams University
Faculty of Medicine
Diagnostic and Interventional Radiology Department

Can Quantitative Diffusion Weighted MRI Provide A Potential Non Invasive Substitute To Transrectal Sonography-Guided Prostate Biopsy in Determining Aggressiveness Of Prostatic Cancer?.

By

Sara Mohamed Arafa Ismail

(M.B.B.Ch)

Supervised by

Dr.Reem Hassan Bassiouny

Ass Prof. of Diagnostic and Interventional Radiology
Faculty of Medicine, Ainshams University

Dr. Samar Ramzy Ragheb

Lecturer of Diagnostic and Interventional Radiology
Faculty of Medicine, Ainshams University

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LIST OF ABBREVIATIONS

TRUS	Transrectal ultrasound
GC	Gleason Score
ADC	Apparent Diffusion Coefficient
PZ	Peripheral zone
CZ	Central zone
TZ	Transitional zone
IP	Inferior pedicle
DF	Denenvilliers facia
NB	Neurovascular bundle
AJCC	American joint committee on cancer
SP	Superior pedicle
LPF	Lateral pelvic fascia
V-N	Large vertical subclavian .
PCa	Prostatic cancer
PIN	Prostatic intra epithelial Neoplasia
AAH	Atypical adeomatous hyperplasia
DRE	Digital rectal Exam .
PSA	Prostate –specific Antigen
PSAD	Prostate –specific Antigen density
PSAV	Prostate –specific Antigen velocity
RF	Radiofequency pulse
ROI	Region Of Interest
DWI	Diffusion Weighted Imaging
DCE-MRI	Dynamic contrast-Enhanced magentic Resonannce Imaging

ECE	Extra capsular Extension
SVI	Seminal Vesicle Inavsion
BPH	Begin Prostatic Hyperplasia
FOV	Field Of View
NSA	Numder of signals acquired
SPSS	Statistical Package for the Social Sciences
AUC	Area under the curve

AIM OF WORK

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To illustrate the usefulness of quantitative diffusion weighted MRI with measured ADC values in predicting the aggressiveness of prostate cancer..

Introduction

INTRODUCTION

Prostate cancer is the most frequently diagnosed solid malignant tumor among men.The morbidity and mortality directly attributable to this common malignancy are considerable. However, in a non negligible proportion of patients, the disease may be considered relatively indolent(**De Cobelli et al .,2015).**

The diagnosis of prostate cancer is based on a digital rectal examination (DRE) and assessment of serum prostate specific antigen (PSA) followed by transrectal ultrasound (TRUS)-guided biopsy **(Anwar et al.,2014).**

T2-weighted MRI has been commonly used to detect prostate cancer. Recently, diffusion-weighted MRI (DW-MRI) has been widely introduced in the clinical setting. It is advantageous as it offers increased diagnostic accuracy due to the clear delineation between normal and prostate cancer, namely the high signal of cancerous lesions and the restricted signal of normal tissue DW-MRI is a non-invasive imaging technique that quantifies the diffusion of water molecules in tissues without any contrast agents, tracers, or exposure to radiation .DW-MRI may also provide qualitative information regarding the pathophysiological character of prostate cancer**(Bae et al.,2014).**

The assessment of local aggressiveness of prostate cancer (PCa) is of key importance for appropriate management of this disease. The increase in life expectancy of the general population combined with efficient screening methods will lead to an increase in the number of new PCa cases. These cases will tend to be more localized and at an earlier stage**(Lebovici et al., 2014)**

The Gleason scoring (GS) system has been accepted internationally as a reference grading system for prostate cancer With respect to tumor aggressiveness, tumors are classified as low risk (Gleason score, ≤6), intermediate risk(Gleason score, 7) or high risk (Gleason score, ≥ 8)**(Dooetal., 2012).**

To establish the ADC as a robust biomarker for predicting prostate cancer Gleason scores, standardization of quantitative ADC metrics is of crucial importance**(Donati et al., 2014).**

Anatomy of The prostate

ANATOMY OF THE PROSTATE

The word 'prostate' originates with Ambroise Pare, a sixteenth-century French surgeon who believed that the prostate's role was a 'door keeper' to the bladder-a role it serves well, protecting the male from the minor stress leakage not uncommon in females of any age**(Ezquer et al., 2015).**

The prostate gland, the largest of the accessory reproductive glands, lies retroperitoneally in the pelvis dorsal to the inferior border of the symphysis pubis**(Cross, 2018).**

The prostate is an ovoid structure with the appearance of an inverted bilobed cone, located between the urinary bladder superiorly and the pelvic floor inferiorly. The urethra traverses this gland, entering at the broad base of the cone just below the bladder neck and exiting near the narrowed apex of the cone at the level of the urogenital diaphragm. The rounded anterior surface is behind the pubis and the posterior surface is flattened with a midline depression (the median sulcus) that lies against the rectal ampulla. The lateral and inferior surfaces of the gland are in contact with the levator ani muscles. The ejaculatory ducts enter the posterior surface laterally and pass obliquely toward the midline, where they end at the verumontanum on the posterior surface of the prostatic urethra**(Villers and Walz, 2018).**

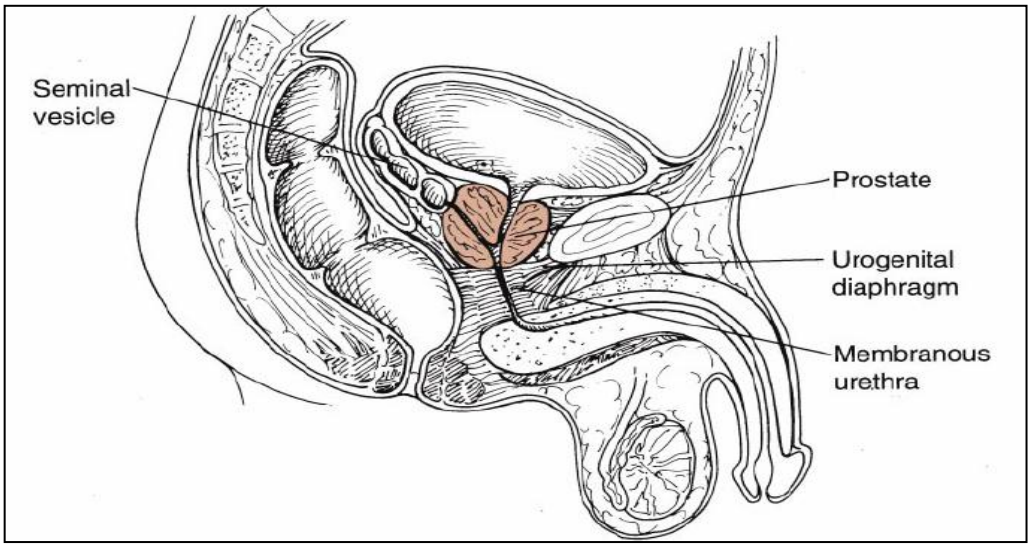
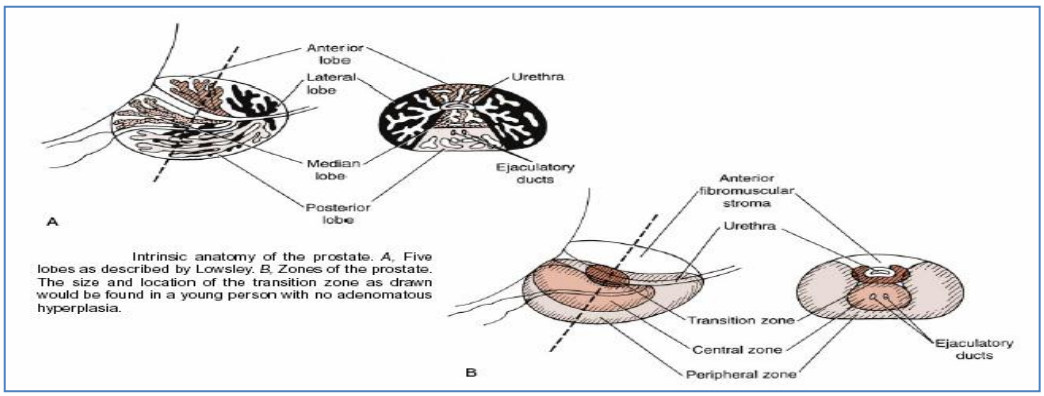


Figure (1): Diagrammatic representation of the pelvic Anatomy. **(Villers and Walz, 2018)**.

Lobar Anatomy

According to Lowsley 1912, the prostate can be divided into five lobes. Anterior to urethra lies the isthmus or the anterior lobe, which contains fibro-muscular tissue and scanty amount of glandular tissue. Posterior to the urethra and inferior to the ejaculatory ducts is posterior lobe that is readily palpable by rectal examination. Its ducts end below the ejaculatory ducts in posterior wall of the urethra. The lateral lobes form the major part of prostate on either side of the urethra. Their ducts end in the lateral grooves of the urethra. The median lobe is present between the urethra and the ejaculatory ducts. It is closely related to the

neck of the bladder above. Its ducts open into the urethra above the



ejaculatory ducts**(Reeves et al., 2016).**

Figure (2): Diagrammatic representation of the lobar and zonal anatomy of the prostate**(Villers and Walz, 2018).**

Zonal Anatomy (McNeal)

Thereupon, McNeal established the current and most widely accepted concept of various zones rather than lobes of the prostate. (**Wang et al., 2018).**

A) Glandular tissue:

• **The peripheral zone (PZ)**(almost 75% of the glandular prostate):

Peripheral zone forms disc of tissue on the posterolateral aspects of the gland, representing posterior and lateral lobes**(Reeves et al., 2016).**

The PZ is the region of the prostate most susceptible to the development of carcinoma (70% of prostatic cancers), as well as the most common location of the post-inflammatory and cystic atrophy**(Babu and Sujatha, 2014).**

• **The central zone (CZ)**(almost 25% of the glandular prostate):

The CZ is cone shaped with its base at the base of the prostate and apex extending up to the verumontanum.

The CZ is relatively resistant to disease processes, being less active & dormant throughouta male's life time. It is the site of origin of about 5-10% of prostatic cancers**(Villers and Walz, 2018).**

• T**he transitional zone (TZ):**(almost 5% of the glandular prostate):

The transitional zone is represented by two small lobules immediately lateral to the preprostatic sphincter**(Cunha et al., 2018).**

Finally, it is of clinical importance to distinguish the TZ as a separate region, as it is less prone to the development of cancer but is the site of origin of BPH, while the adjacent cancer-prone PZ does not produce BPH**(Cunha et al., 2018).**

The TZ is the site of origin for 10-20% of prostatic carcinoma**(Babu and Sujatha, 2014).**

• **Peri-urethral gland region**(<1% of the glandular prostate):

These are small glandular areas actually embedded within the longitudinal smooth muscle of the proximal urethral segment. BPH nodules also develop, although to a lesser extent, in this fourth region of the glandular prostate**(Yacoub and Oto, 2018).**

This zone may become hyperplasic with age to form the 'median lobe' which may obstruct the bladder neck**(Torrealba et al., 2018)**

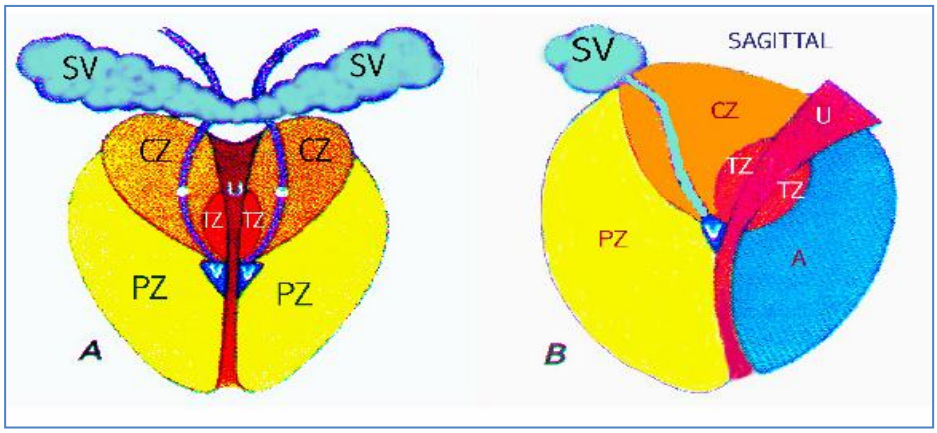


Figure (3): Diagrammatic representation showing coronal (A) and sagittal (B) planes demonstrating the different zones: peripheral zone (PZ), central zone (CZ), transitional zone (TZ), anterior fibromuscular stroma, (SV) seminal vesicle, (U) urethra, (V) verumontanum(Torrealba et al., 2018).

B) Fibromuscular structures (33%)

• The anterior fibromuscular stroma.

• The post prostatic sphincter.

• The pre prostatic sphincter.

• The longitudinal smooth muscle:

It is actually a part of the urethra itself immediately outside the submucosa **(Wang et al., 2018).**

NORMAL PERIPROSTATIC ANATOMY

Prostatic Capsule