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Original Research Paper

Radio-Diagnosis

RETROSPECTIVE STUDY OF ADC CORRELATE IN PROSTATIC CARCINOMA

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ABSTRACT

Introduction: Prostatic carcinoma is one of the most prevalent cancers in males is prostate cancer (PCa), which can develop bone metastases in up to 70% of cases and frequently need more severe treatment. High accuracy in identifying tumors and describing their characteristics and level of aggression is possible by diagnostic imaging. Due to great contrast resolution, MRI has taken on a prominent role in this respect.The purpose of this study is to retrospectively evaluate the relationship between apparent diffusion coefficient (ADC) in prostate cancer with reference to normal prostatic parenchyma. **Methods:** This is a retrospective study conducted in Department of Radiology in Sree Mookambika Institute of Medical Sciences, Kulasekharam, Tamil Nadu, for a period of 6 month from June 2022 to November 2022. All histopathologically proven cases of prostatic carcinoma who underwent multiparametric MRI evaluation were selected as cases (15 participants) and patients who underwent routine MRI abdomen and pelvis for other complaints with no prostatic complaints (morphologically prostate appears normal)were selected as controls (15 participants). The collected study data were entered in Microsoft Office Excel 2013 and analyzed usìng SPSS 21 software. Descriptive analytics was applied. ADC values were defined as mean ± standard deviation. **Results:** The mean age of cases was found to be 72.13 ± 6.760 years and that of controls was 65.2± 8.8576. The mean ADC value of cases was 0.6467 ± 0.0737 and that of controls was 0.7993 ±0.0576. The ADC values obtained in all groups decreased with the increase in diffusion gradients. **Conclusion:** It is important to determine basic cutoff ADC value in suspecting prostatic carcinoma. DWI MRI with ADC measurement may be used as a complementary imaging method in differentiation of prostate cancer from normal prostate parenchyma.

KEYWORDS : Prostate Carcinoma (PCa), Apparent Diffusion Coefficient (ADC), multiparametric magnetic resonance imaging (multiparametric MRI),diffusion weighted imaging (DWI)

INTRODUCTION:

One of the most prevalent cancers in male populataion is prostate cancer (PCa), which can develop bone metastases in up to 70% of cases and frequently need more severe treatment. Age-related increase in PCa incidence range from 34% in the fifth decade to 70% by the time a person is 80 years old. PCa detection was improved with the rise in survival (almost 99%) and the creation of minimally invasive PCatreatments[1].

Since most prostate cancers are slow-growing and indolent rather than aggressive, they rarely show any symptoms until they are far along in their development. Therefore, in addition to assisting in the selection of one of the many possible treatment options, an early detection of prostate cancer can result in better treatment outcomes[1].Prostate-specific antigen assays (PSA), digital rectal examinations (DRE), and transrectal ultrasonography guided biopsies are the commonly used techniques (TRUS). Prostate cancer can only be definitively diagnosed with a biopsy, typically an 8-core TRUS biopsy. All of these techniques, meanwhile, have their own drawbacks and restrictions[1].

High accuracy in identifying tumors and describing their characteristics and level of aggression has been attained by diagnostic imaging. Due to its great contrast resolution, MRI has taken on a prominent role in the research of diverse regions and disorders in this respect.Particularly, MRI has been useful in the therapy of urogenital pathology. The most common instrumental approach for the diagnosis of PCa, multiparametric prostate magnetic resonance imaging (mp-MRI), which combines morphological and functional data and also allows accurate biopsy, hence boosting its diagnostic yield, confirms these indications[2].

Compared to the other methodologies, DWI has the combined advantage of short acquisition time, no need for intravenous contrast, and low technical demand for image post-processing. DWI measures restriction of water diffusion in biological tissues, corresponding to properties such as cellular density, membrane permeability, and space between cells. For example, the luminal space in benign human prostate tissue has been reported to average several hundreds of microns wide; whereas, in PCa, water molecules diffuse over tens of microns. This may be what makes it possible for DWI to distinguish malignant from benign prostate tissues[3].

The molecular diffusion of water molecules in biological tissues serves as the foundation for diffusion-weighted magnetic resonance imaging (DWMRI). A quantitative DWMRI measure known as the apparent diffusion coefficient (ADC) value represents water diffusion in extracellular and extravascular space as well as capillary perfusion. Hypercellularity has been demonstrated to cause a drop in ADC values in a variety of cancers affecting different organs[4–6]. Recent research found that using DWMRI, ADC measurement may distinguish between benign and cancerous prostate tissue. It has recently been shown that the apparent diffusion coefficient (ADC) value correlates with the histological grade for several malignant cancers[6].The purpose of this study is to retrospectively evaluate the relationship between ADC in prostate cancer and normal patients.

OBJECTIVE:

- To analyse the ADC value correlate in proven cases of prostatic carcinoma with relevance to normal prostate (control).

METHODS:

Study design:

This is a retrospective case-control study conducted in Department of Radiology in Sree Mookambika Institute of Medical Sciences, Kulasekharam, Tamil Nadu

Study duration:

This study was conducted for a period of 6 month from June 2022 to November 2022.

Study population:

The target population was all histopathologically proven cases of prostatic carcinoma who were admitted at chosen Sree Mookambika health facility during the study period.

Selection criteria

Inclusion criteria:

- All prospective histopathologically proven cases of prostatic carcinoma who underwent multiparametric MRI evaluation

Exclusion criteria:

- Any prostatic abscess/post surgical/post interventional/ post instrumentation cases.

Sample size: 30 (15 cases and 15 controls)

Methodology:

Data collection:

All clinically suspected patients with histopathologically proven cases of prostatic carcinoma referred by pathologists, physiciansfor MRI of prostate at Sree Mookambika Institute of Medical Sciences, Kulasekharam, Kanyakumari, Tamil Nadu.

Equipment:

the machine used in this study was 1.5 Tesla MRIscanner. All 30 participants were subjected to 1.5 multiparametric MRI. DWI-ADC plot ADC standardized area of 5 pixel. If multiple nodule – mean average considered.ROI-area with restricted diffusion followed by COW ADC for cases. Analyzed by experienced radiologist. Control- normal appearing prostate with no areas of restricted diffusion restriction to low ADC

All prospective histopathologically proven cases of prostatic carcinoma who underwent multiparametric MRI evaluation were selected as cases (15 participants) andpatients who underwent routine MRI abdomen and pelvis for other complaints with no prostatic complaints (morphologically prostate appears normal) were selected as controls (15 participants).

MRI protocol:Dynamic contrast enhanced MRI and DWMRI of patients were performed with 1.5 multiparametric MRI. DWI-ADC plot ADC standardized area of 5 pixel. If multiple nodule – mean average considered.ROI-area with restricted diffusion followed by COW ADC for cases. Analyzed by experienced radiologist. Control- normal appearing prostate with no areas of restricted diffusion restriction to low ADC.

Statistical analysis:

The collected study data were entered in Microsoft Office Excel 2013 and analyzed usìng SPSS 21 software.

Descriptive statistics:

Qualitative data: were presented by frequency tables (number and percentages).

Quantitative variables: the normality of data was first tested with Shapiro-Wilk test and presented data by central indices and dispersion: Mean ± Standard deviation (SD) for normally distributed variables. Median and range (Minimum – Maximum) for non-normally distributed variables.

Analytical statistics:

Chi-square test is used to test association between categorical variables. It is replaced by Fisher Exact Test if the expected cell count was less than 5 in four-cells tables,

Ethical considerations:

Ethical approval was obtained from the Institutional Human Ethics committee of Sree Mookambika Institute of Medical Sciences.

RESULTS:

Out of 15 cases, the mean age was found to be 72.13± 6.760 years. Minimum age was 56 years and maximum age was 83 years. Among 15 controls the mean age was found to be 65.2± 8.8576 years. Minimum age was 50 years and maximum was 78 years. (Table: 1) The mean age of cases was found higher than that of controls.

Table: 1 Descriptive statistics of age of cases and controls

	Age in years (Mean ± SD)	Minimum	Maximum
Cases (n=15)	72.13± 6.760	56	83
Controls(n=15)	65.2± 8.8576	50	78

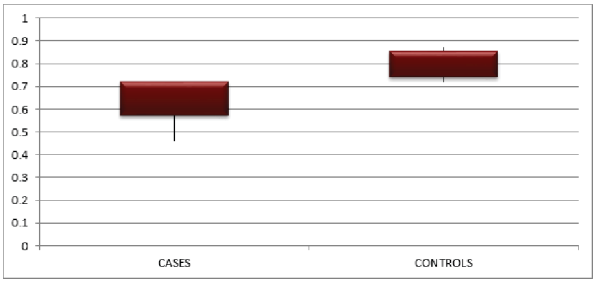

Figure: 1 Box and whisker plot describing the mean diff/ADC between cases and controls.

Table: 2 Descriptive statistics of DIFF/ADC among cases and controls

	Mean DIFF/ADC (Mean ± SD)	Minimum	Maximum
Cases (n=15)	0.6467± 0.0737	0.46	0.72
Controls(n=15)	0.7993 ±0.0576	0.72	0.87

The mean ADC value of cases was 0.6467 ± 0.0737 and that of controls was 0.7993 ±0.0576. the minimum ADC value among cases was 0.46 and maximum was 0.72. The minimum value of ADC among the controls was 0.72 and maximum value was 0.87. (Table: 2)

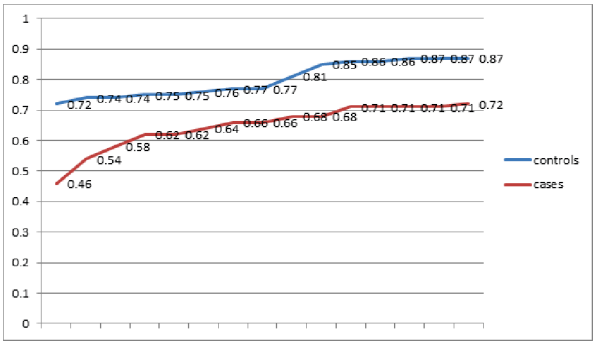

Figure: 2 Line diagram showing ADC values of cases and controls.

Prostate cancers manifested with intense enhancement at arterial phase and exhibited wash-out at late phase on dynamic contrast enhanced MR images. Early enhancement with heterogeneous appearance and patchy pattern was observed on contrast enhanced MR images in patients with prostate carcinoma. The ADC values obtained in all groups

decreased with the increase in diffusion gradients. The distribution of ADC values of normal prostate parenchyma and prostate cancer group was illustrated in figure: 2.

DISCUSSION:

Many earlier studies have clearly demonstrated diffusion restriction in prostate cancer and concomitant signal dropouts on ADC mapping. Few past research have looked at the connection between prostate cancer ADC value and aggressiveness, despite the fact that significant reduction in diffusion restriction and low ADC valuesare well recognized in this disease[7–11].

Increased water proton in rapidly expanding tumor cells in the extracellular and intracellular environments, which have constrained motions and hence yield lower ADC values as compared to the typical, healthy prostatic tissue, is the pathophysiology behind these signals.[12,13].

DWI has many advantages over other MRI techniques, according to Mazaheri et al[14], including less subjectivity in T2WI signal intensity interpretation, greater spatial resolution with less partial-volume impact than MRS, and quicker acquisition times. By minimizing the amount of gradient echoes and sampling time needed, as well as the susceptibility and motion artifacts, parallel imaging techniques significantly enhance DWI.

Zelhof et al[15] established the inverse relationship between ADC values and cellular density, suggesting that as cellular density and poor differentiation increase in adenocarcinomas, the diffusion restriction of water protons increases, indicating a decrease in ADC values with increasing tumor aggressiveness.

Based on a 3 Tesla phased array coil research at 0 and 1000 s/mm2, Kim et al[16] previously shown that ADC is a viable technique to distinguish between malignant and benign tissue in both peripheral and transitional zone.

The ESUR recommendations state that at least two b-values should be used to produce an ADC map, with the lower value being between 50 and 100 sec/mm2 and the larger value being between 800 and 1,000 to 2,000 sec/mm[2][17]. Higher b-values than 2,000 s/mm^2 have demonstrated significantly lower sensitivity due to the artifacts intrinsic to the high b-value, as demonstrated by the accurate meta-analysis provided by Shaishet al.[18], even though there is no evidence in the literature addressing what is the most accurate high b-value to use in ADC computation. But ADC maps with high b-values have demonstrated strong ability in the extracapsular expansion of PCa[19].

There isn't a consensus ADC tumor cut-off value, nevertheless, that might be utilized to identify abnormally low ADC within a lesion[20,21]. However, a threshold of 750–900 mm^2/s is recommended as the problematic ADC range value in PI-RADS version 2, which corresponds to our observations. Given that the chosen b-value may have an impact on the absolute ADC values, the best way to measure the ADC value is still up for debate. Therefore, alternatives to the ADC tumor mean value, such as the minimum ADC value (ADCmin) and the normalized ADC value, are being researched (ADCratio: expressed as the ratio between tumor and non-tumor ADC values). A substantial correlation between a lower ADC value and astrocytic brain tumors indicates that ADCmin is still a viable choice[22].

The limitations of this retrospective analysis are numerous. First, because this study only included individuals who underwent histopathologically examination of prostate, the patient pool may have been prejudiced. Second, the interrater variability was not examined in the study because just one reader was used to interpret the images. Third, rather than using whole-mount specimens, pathologic correlation was performed using rebuilt histologic maps. Fourthly was insufficient sample size to generalize the study findings.

CONCLUSION:

In conclusion, our results suggest that mean ADC values of the cases of prostate cancer are inversely correlated with the controls.Therefore ADC values my potentially aid in the presurgical assessment of prostate cancers.It is important to determine basic cutoff ADC value in suspecting prostatic carcinoma. DWMRI with ADC measurement may be used as a complementary imaging method in differentiation of prostate cancer from normal prostate parenchyma.

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