

## Alterations of Packed Cell Volume, Red Blood Cell, Total Protein and Albumin in Patients Diagnosed with Prostate Cancer in Imo State, Nigeria

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**Abstract: Background:** Prostate cancer is a common cancer that grows slowly and tends to metastasize to bones, lungs, and the liver. Most Malignancies have established patterns in presentation, localization, and organ where they metastasize. **Objective:** The purpose of this study was to evaluate the levels of packed cell volume (PCV), red blood cell(RBC), total protein, and albumin in patients diagnosed with prostate cancer.

**Method:** This was a cross-sectional study carried out at Imo Specialist Hospital, Umuguma, Owerri, Imo State, Nigeria, from the month of May to August, 2023. This study consisted of 50 male patients with prostate cancer and an equivalent number of age – matched apparently healthy subjects who served as the controls. Blood Samples collected for PCV, RBC, total protein and albumin were analyzed using standard laboratory methods. **Result:** The mean values of PCV ( $27.84 \pm 4.62$  %), RBC ( $3.152 \pm 3.47$ )  $\times 10^{12}/\mu\text{L}$ , and Albumin ( $2.42 \pm 6.47$ )g/dl, were significantly lower in prostate cancer patients when compared to controls( $36.86 \pm 3.18$ %), ( $5.97 \pm 8.96$ )  $\times 10^{12}/\mu\text{L}$ , and ( $4.93 \pm 9.01$ )g/dl (p=0.000), while the mean value of total protein

( $2.43 \pm 64$ )mg was significantly higher in prostate cancer when compared to controls ( $5.50 \pm 1.47$ ) (p=0.000). **Conclusion:** This study has shown that prostate cancer alters the levels of PCV, RBC, total protein and albumin. Therefore, early evaluation of these parameters is encouraged to monitor prostate cancer patients and prevent complications.

**Key words:** Prostrate Cancer, Packed Cell Volume, Red blood Cell, Total Protein, Albumin

### 1.0 Introduction

Cancer is a large group of diseases that can start in almost any organ or tissue of the body when abnormal cells grow uncontrollably, go beyond their usual boundaries to invade adjoining parts of the body and/or spread to other organs. The latter process is called metastasizing and is a major cause of death from cancer. The prostate is a walnut-sized gland located behind the base of the penis, in front of the rectum, and below the bladder. It surrounds the urethra, the tube-like channel that carries urine and semen through the penis. The

prostate's main function is to make seminal fluid, the liquid in semen that protects, supports, and helps transport sperm. Prostate cancer is the second most common cancer in men and the fifth leading cause of cancer mortality worldwide (Ferlay et al., 2018). Established risk factors for prostate cancer include age, family history, ethnicity and genetic factors (Pernar et al., 2018). Although there are large differences in the global incidence of prostate cancer, little is known regarding potential modifiable risk factors.

Prostate cancer affects middle-aged men between the ages of 45 and 60 and is the highest cause of cancer-associated mortalities in western countries (Chen et al., 2013). Many men with prostate cancer are diagnosed by prostate biopsy and analysis, prostate-specific antigen (PSA) testing, digital rectal examination, magnetic resonance imaging (MRI), or health screening. The risk factors related to prostate cancer include family risk, ethnicity, age, obesity, and other environmental factors. Prostate cancer is a heterogeneous disease both on the basis of epidemiology and genetics. The interplay among genetics, environmental influences, and social influences causes race-specific prostate cancer survival rate estimates to decrease, and thus, results in differences observed in the epidemiology of prostate cancer in different countries (Hjelmberg et al., 2014). There is documented proof of a genetic contribution to prostate cancer. Hereditary prostate cancer and a genetic component predisposition to prostate cancer have been studied for years. One of the most predisposing genetic risk factors for prostate cancer is family inheritance. Twin studies and epidemiological studies have both proven the role of hereditary prostate cancer (Termini et al., 2020). Many researchers have looked into the possible role of genetic

variation in androgen biosynthesis and metabolism, as well as the role of androgens (Wen et al., 2015 and Cittadini et al., 2021). Genomics research has identified molecular processes that result in certain cancer developments, such as chromosomal rearrangements (Hjelmberg et al., 2014). Prostate cancer can either be classified as androgen sensitive or androgen insensitive, which is an indicator of testosterone stimulation and the possible treatment option (Takayama et al., 2019). Treatment options available for prostate cancer are active surveillance, chemotherapy, radiation therapy, hormonal therapy, surgery, and cryotherapy. Prostate cancer is a major public health concern, and there is a need to identify reliable biomarkers for the diagnosis and management of the disease. Some studies have suggested that alterations in these blood parameters, including PCV, RBCs, total protein, and albumin, may serve as indicators of disease severity, prognostic markers, and predictors of treatment response in prostate cancer patients (Yuvaraja et al., 2014 and Banerji et al., 2018). For instance, lower PCV and RBCs have been associated with advanced stages of prostate cancer (Banerji et al., 2018). It is important to note that these findings may vary across different studies, populations, and clinical settings. Furthermore, the precise mechanisms underlying these alterations in blood parameters in prostate cancer patients are not fully understood and require further investigation. Although several research work have been done on prostate related issues in Owerri but only few worked on alterations of haematological and biochemical parameters in this geographical location. Hence the need for this research. Understanding the alterations in these parameters will provide valuable insights into the pathophysiology and management of the disease. These findings

will encourage early evaluation and management of prostate cancer.

## 2.0 Materials and Methods

### 2.1 Study Area

The research was conducted from May to August, 2023 at Imo Specialist Hospital Umuguma, Owerri, Imo State, Nigeria.

### 2.2 Study Design

This study was a cross-sectional research which involved men with prostate cancer and apparently healthy men which served as controls.

- Phase 1: Administration of questionnaire and informed consent form.
- Phase 2: Determination of packed cell volume, Red blood cell counts, total protein and Albumin levels.

### 2.3 Study Population

The subjects that were recruited for this study were fifty (50) prostate cancer patients (50 male) who were currently attending the medical outpatient clinic of Imo State Specialist Hospital Owerri, and also, fifty (50) apparently healthy subjects served as controls. All the subjects were of ages 40-80 years (males).

### 2.4 Ethical Consideration

Ethical approval was obtained from the ethics review committee of Imo State Specialist Hospital Umuguma Owerri, Imo State before sample collection.

### 2.5 Sample Collection

Seven milliliters (7mls) of blood was collected from each subject by means of a hypodermic syringe and needle. Two milliliters (2mls) was aliquoted into ethylenediaminetetraacetic acid (EDTA) anticoagulated tube and used for estimation of packed cell volume, and red blood cell, while five milliliters (5mls) was dispensed

into a sterile plain bottle for the analysis of total protein and albumin.

### 2.6 Laboratory Assay

The packed cell volume was estimated using microhaematocrit centrifuge technique. Red blood cells was estimated using neubauer counting chamber. The total protein was performed using Biuret kit, while the albumin was analysed using bromocresol green method.

### 2.7 Statistical Analysis

The statistical analysis was performed using the statistical package for the social sciences, version 2010. Students unpaired two-tailed t-test was used to determine whether a parameter from 2 different groups differ significantly or not. Comparison with regard to prostate cancer were analyzed using one-way analysis of variance and statistical significance was calculated using post hoc test to analyze the result of the experimental data. p-value < 0.05 was considered to be statistically significant.

## 3.0 Results

Table 1: The mean values of PCV ( $27.84 \pm 4.69\%$ ), RBC ( $3.15 \pm 3.47$ )  $\times 10^{12}/L$  and Albumin ( $2.43 \pm 6.47$ )g/l were significantly lower than the controls ( $36.86 \pm 3.18\%$ ), ( $5.97 \pm 8.96$ )  $\times 10^{12}/L$  and ( $4.93 \pm 9.01$ )g/l respectively (p=0.000). Furthermore, the mean value of total protein ( $8.39 \pm 1.47$ )g/l was significantly higher in prostate cancer patients when compared to non-prostate patients ( $5.50 \pm 1.47$ ) (p=0.000).

Table 2: There were no significant differences in the mean values of PCV: <57 ( $29.00 \pm 2.51\%$ ) 64-70 ( $24.33 \pm 1.53\%$ ), 71-80 ( $26.33 \pm 2.08\%$ ) and 81-84 ( $31.75 \pm 2.87\%$ ) RBC <57 years ( $2.60 \pm 0.38$ )  $\times 10^{12}/L$ , 64-70 ( $2.40 \pm 0.57$ )  $\times 10^{12}/L$ , 71-80 ( $2.43 \pm 0.29$ )

$\times 10^{12}/L$ , and 81-84 years ( $2.88 \pm 0.66$ )  $\times 10^{12}/L$ .

Total protein: <57 years ( $8.90 \pm 0.87$ )g/l, 64-70 ( $8.55 \pm 0.57$ ) g/l, 71-80 years ( $8.63 \pm 0.98$ )g/l, 81-84 years ( $8.75 \pm 0.92$ )g/l, and Albumin <57 ( $2.90 \pm 1.07$ )g/l, 64-70 ( $2.25 \pm 1.20$ )g/l, 71-80 years ( $2.10 \pm 0.57$ )g/l, and 81-84 years ( $2.35 \pm 0.49$ )g/l, based on age ( $p=0.332$ ,  $p=0.353$ ,  $p=0.831$ , and  $p=0.775$ ).

**Table 1: Mean Values of Packed Cell Volume, Red Blood Cells, Albumin and Total protein in Prostate Cancer Patients Compared to Controls. (Mean  $\pm$ SD)**

Parameter	Test	Control	t-value	P-value
PCV (%)	$27.84 \pm 4.69$	$36.86 \pm 3.18$	41.881	0.000*
RBC ( $\times 10^{12}/L$ )	$3.15 \pm 0.47$	$5.50 \pm 1.47$	6.313	0.000*
Total Protein (g/l)	$8.39 \pm 1.47$	$4.93 \pm 9.01$	40.117	0.000*
Albumin (g/l)	$2.43 \pm 0.67$		25.984	0.000*

Key: PCV = Packed Cell Volume, RBC = Red Blood Cell

**Table 2: Comparison of the Mean values of Packed Cell Volume, Red Blood Cells, Total Protein and Albumin in Prostate Cancer Patients based on Age (Mean  $\pm$ SD)**

Parameter	<57	64-70	>70-80	>80-84	F-value	P-value
PCV (%)	$29.0 \pm 2.51$	$24.33 \pm 1.53$	$26.33 \pm 2.08$	$31.750 \pm 2.8$	1.186	0.332
RBC ( $\times 10^{12}/L$ )	$2.60 \pm 0.38$	$2.40 \pm 0.57$	$2.43 \pm 0.29$	$2.88 \pm 0.66$	1.159	0.353
TOTAL PROTEIN (g/l)	$8.90 \pm 0.87$	$8.55 \pm 0.57$	$8.63 \pm 0.98$	$8.75 \pm 0.92$	0.664	0.831
ALBUMIN	$2.90 \pm 1.067$	$2.25 \pm 1.20$	$2.10 \pm 0.57$	$2.35 \pm 0.49$	0.724	0.775

**Keys:** PCV = Packed Cell Volume, RBC = Red Blood Cell

#### 4.0 Discussion

Prostate is a leading cause of cancer related to morbidity and mortality in elderly male population. Some studies have suggested that alterations in blood parameters, including PCV, RBCs, total protein, and albumin, may serve as indicators of disease severity, prognostic markers, and predictors of treatment response in prostate cancer patients (Yuvaraja et al., 2014 and Banerji et al., 2018). The present study revealed that the mean values of PCV, RBC were significantly lower in prostate cancer patients when compared to controls. A decrease level in packed cell volume and red blood cell in prostate cancer patients may be due to androgen deprivation, nutritional decline or bone marrow infiltration (Mansour et al., 2017). In this study, albumin was also significantly lower in prostate cancer patients when compared to the control group. This might be due to the decreased production of albumin by the liver as well as the increase loss of albumin in the urine in patients with advanced prostate cancer. A similar study in Assam Medical College and hospital Dibrugarh, India reported a significant difference in albumin. The mean value of total protein was significantly higher in prostate cancer patients when compared to controls. This increase in total protein may be due to the production of various proteins by cancer cells (Liao et al., 2015). From the result of the present study there were no significant differences in the mean values of PCV, RBC, total protein and albumin when compared based on age. The result of this study is in agreement with the findings by Okeke et al., (2015).

#### 5.0 Conclusion

The study concludes that levels of packed cell volume and red blood cells are significantly lowered in prostate cancer especially at the advanced age. The total protein is raised, while albumin is reduced. Therefore, early evaluation of these parameters is encouraged to monitor prostate cancer and prevent complications.

## References

- 1) Banerji J.S., Lee K.M., Paul R (2018): Alterations in red blood cell parameters in prostate cancer patients: a systematic review and meta-analysis. *Prostate exam Cancer Prostatic Disease*; 21(3):356-364.
- 2) Chen J., Zhang D., Yan W., Yang D., Shen B. (2013): Translational Bioinformatics for Diagnostic and Prognostic Prediction of Prostate Cancer in the Next-Generation Sequencing Era. *BioMed Reponse International*: 901578.
- 3) Cittadini A., Isidori A.M., Salzano A (2021): Testosterone therapy and cardiovascular diseases. *Cardiovascular Response*.118:2039–2057.
- 4) Ferlay, J, Ervik, M, Lam, F. (2018): *Global Cancer Observatory: Cancer Today*. International Agency for Research on Cancer; Lyon, France.
- 5) Hjelmborg J.B; Scheike T., Holst K., Skytthe A., Penney K.L., Graff R.E., Pukkala E., Christensen K., Adami H.-O., Holm N.V (2014): The Heritability of Prostate Cancer in the Nordic Twin Study of Cancer. *Cancer Epidemiology Biomarker Preview*.23:2303–2310.
- 6) Liao A.C, Li C.F, Shen K.H (2015): The plasma proteome of prostate cancer patients: an exploratory study. *Proteomics* 5(13):3366-3375.
- 7) Pernar CH, Ebot EM, Wilson KM, Mucci LA (2018): The epidemiology of prostate cancer. *Cold Spring Harbor perspectives in medicine*, 8(12)3-16.
- 8) Termini D., Hartogh D.J.D., Jaglanian A., Tsiani E. (2020): Curcumin against Prostate Cancer:Current Evidence. *Biomolecules*, 10:1536.
- 9) Wen S., Chang H.-C., Tian J., Shang Z., Niu Y., Chang C (2015): Stromal Androgen Receptor Roles in the Development of Normal Prostate, Benign Prostate Hyperplasia, and Prostate. *Cancer American Journal on Pathology*,185:293-301
- 10) Yuvaraja B, Gopal R. (2014): A clinical study of serum albumin and prostate cancer. *Journal of Clinical Diagnostic Response*. 8(5):CC11-1