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Research Article

Evaluation of Anemia among Men and Women with Acute Renal Disease in Jos, Plateau State, Nigeria

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Abstract

Background and Objective: Acute Renal Failure or disease (ARF) is a complicated disorder that causes a fast reduction in kidney function and anemia is a common feature of this disease. This study aimed to evaluate the anemia situation in patients with acute renal failure among men and women. **Materials and Methods:** This case study was conducted on 56 patients with acute renal failure attending DEE Medical Center, Buruku, Jos, Plateau State Nigeria, from January-September, 2019. Initially, two separate blood samples were taken from each patient, 2 mL uncoagulated sample harvest for biochemical assay and EDTA anticoagulated whole blood sample for hematocrit value. Serum was used to determine the level of urea, creatinine and hematocrit value was done with EDTA anticoagulated samples by hematocrit centrifuge. The values obtained in urea and creatinine were divided into three groups: low, moderate and high, data obtained were analyzed by SPSS software. **Results:** Generally, the study revealed the anemic condition of all the acute renal disease patients irrespective of gender ($p < 0.05$). However, it was discovered that the mean hematocrit value of females (22.2 ± 3.3) was higher than of males (19.8 ± 2.5). **Conclusion:** It was discovered that the severity of anemia in acute renal disease in men was as a result of the effect of the disease on testosterone level synthesized in the kidney, therefore, it is recommended that testosterone can be used as alternative or complementary for erythropoietin to boost up hematocrit value in severely anemic patients and management of acute renal failure in men.

Key words: Anemia, acute renal failure, hematocrit value, erythropoietin, testosterone

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

World health organization threshold for sex-based definition of Anemia was defined as a hemoglobin concentration of less than 13 g dL⁻¹ or hematocrit value less than 39% for men and hemoglobin concentration less than 12 g dL⁻¹ or hematocrit value less than 36% for women¹. The inability of the kidney to remove the poisonous substance and metabolic waste from the blood is called renal failure or disease. There are two types of renal failure namely acute and chronic². Acute renal failure is a disorder with a feature of high urea and creatinine level with the outcome of an unexpected decrease in kidney function resulting to a significant decline in glomerulus filtration rate³. The diagnostic yardstick is the laboratory analysis that shows high serum creatinine or Blood Urea Nitrogen (BUN) levels⁴. The risk factors are advanced age, male gender, African American ethnicity and diabetes mellitus^{4,5}. For more understanding, Acute Renal Failure (ARF) is classified into origins of kidney injury namely: pre-renal, intrinsic and post-renal. Pre-renal ARF is the limitation of blood flow to the kidney with frequent symptoms of vomiting, diarrhea, poor fluid intake, fever, use of diuretics and heart failure. Intrinsic ARF occurs by causing destruction to kidney tubules, interstitium and glomeruli. Post renal ARF is due to blockage of one or both urinary tracts. For surgical patients, ARF is a scourging clinical problem with high rate of mortality based on the status of the disease⁶.

One of the frequent intricacies of kidney inadequacy that gives rise to a decrease in renal erythropoietin output is anemia⁷. The connection between hematocrit value and kidney function may be different among males and females because their average value differs. The male has been pointed to the difference in hormones and females on size of the body⁸.

Many studies have observed the relationship of anemia and ARF which is common among inpatients in the hospital with painful result⁹. The impacts of the presence of anemia to ARF are with many factors. The decreased hematocrit level exposes patients to renal hypoxia and oxidative stress¹⁰. Furthermore, many patients with anemia have a subclinical renal disease which increases the susceptibility to renal insults¹¹.

This study aimed to define the relationship between renal function and hematocrit value and to determine whether this relationship differs in men and women and finally, to show if the severity of acute renal disease by creatinine and Urea value is determined by anemia.

MATERIALS AND METHODS

Study area: This case study was conducted on 56 patients with acute renal failure attending DEE Medical Center, Buruku, Jos, Plateau State Nigeria, from January-September, 2019.

Ethical approval: Ethical approval and patient's consent statements were taken from everyone and the study was performed in the Medical Laboratory department of the hospital. At first, all patients with proven acute renal failure were included in study. Patients with specially established disorders such as endocrinopathies, anemia and hepatosplenomegaly as well as patients using certain drugs such as heparin were excluded from the study. During the study, no patient had a blood transfusion or dialysis before blood sample collection.

Research protocol: Patient blood 3 mL was put into EDTA and plain bottles. Serum was used to determine level of urea by kinetic enzymatic estimation method and creatinine by Jaffe method¹² and hematocrit values were done with EDTA blood samples by hematocrit centrifuge by centrifugal force principle.

Statistical analysis: The value obtained in urea and creatinine was divided into three groups: Low, moderate and high and data obtained were analyzed by SPSS software version 22.

RESULTS

In groups of patients with acute renal disease, 70% male, 30% female and mean age was 36.32±13.3 years. The most frequent age in this research work was 34 years. The average levels of creatinine and BUN in patients with acute renal failure were 547.21±165 and 10.955±1.9 mmol L⁻¹, respectively as shown in Table 1.

Table 2 shows the relationship between hematocrit value among men and women with acute renal disease. Hematocrit value significantly low in acute renal disease (p<0.0001) indicating a strong relationship among them. The hematocrit value was significantly low in both men and women (p<0.0001) indicating no difference irrespective of gender. However, it was discovered that the mean value of females (22.1765±3.24491) was higher than that of males (19.7179±2.48097).

Table 3 shows the effect of low, moderate and high values of creatinine and urea of acute renal disease on the hematocrit value. It showed no significant difference (p = 0.112).

Table 1: Demographic and clinical characteristic of acute renal disease

Characteristic	Total of patients	Number of percentage
Number of patients 56		
Ages (years)		
10-30	10	17.9
31-50	25	44.6
51-71	21	37.5
Gender		
Male	39	70
Female	17	30
	Creatinine ($\mu\text{mol L}^{-1}$)	Urea (mmol L^{-1})
(Mean \pm SD)	547.21 \pm 165	10.955 \pm 1.9

Table 2: Relationship between hematocrit value among men and women with acute renal disease

Sex	Mean \pm SD	t-value	p-value
Male	19.7179 \pm 2.48097	-51.053	0.0001
Female	22.1765 \pm 3.24491	-17.565	0.0001

Mean difference is significant at the 0.05 level

Table 3: Different values of creatinine and urea (low, moderate and high) in comparison with hematocrit value in acute renal disease

Values of ARD marker	Sum of squares	df	Mean square	F	p-value
Between groups	44.890	2	22.445	2.283	0.112
Within groups	520.950	53	9.829		
Total	565.839	55			

Mean difference is significant at the 0.05 level, df: Degrees of freedom

Table 4: Multiple comparison of different of ARD marker in hematocrit value

Levels	Mean difference	Std. error	p-value
Low-moderate	-2.020	1.173	0.091
Moderate-high	-0.518	0.928	0.579
High-low	-2.538	1.205	0.040

Mean difference is significant at the 0.05 level

In Table 4, multiple comparisons of the low, moderate and high value of creatinine and urea on hematocrit value, it was only low-high shows the significant difference ($p = 0.040$) while others were not significant ($p = 0.091, 0.579$).

DISCUSSION

Acute Renal Failure or disease (ARF) is a complicated disorder that causes a fast reduction in kidney function with the rapid rise of serum creatinine and urea as a result of various origins¹³. The rate of occurrence of acute renal failure is in the increase more than the period of 10 years ago accounting for 20% of patients in the hospital with majority of them severely sick^{14,15}. The complications of acute renal failure are as follows: advancement into chronic renal disease, cardiovascular disease, long duration of patients and rise in mortality in the hospital¹⁶⁻¹⁸. However, the acknowledgment of clinical investigation of acute renal disease has reduced the mortality rate and mortality can only occur when the situation is critical mostly in dialysis-requiring acute renal failure^{19,20}.

This study revealed generally the anemic condition of all acute renal disease patients ($p < 0.05$). Therefore, anemia was considered in patients with acute renal failure.

Some previous study revealed 91% anemic patients with acute renal failure due to high level of urea and the presence of oliguria. Patients with mild anemia (hematocrit $< 35\%$) were 53 out of the 56 as inpatients and those with hematocrit below 30% were 43²¹. The same finding was observed by another study where majority of patients (87.5%) with acute renal failure had a hematocrit below 35% and only 12.5% of patients had a hematocrit lower than 30%²². These findings are not compatible with present findings where all our patients (100%) with acute renal failure had a severe anemia with a hematocrit below 30% with only 1.8% of patients had a hematocrit of 30%. The severe anemia may be as a result of a complication of renal insufficiency mostly as a result of decreased kidney production of erythropoietin⁷. The anemic condition makes patients susceptible to kidney hypoxia and oxidative stress¹⁰. Furthermore, numerous anemic patients have non-detectable kidney disease which predisposes to renal insults¹¹.

It was also discovered that mean hematocrit of men (19.8 \pm 2.5) was lower than that of women (22.2 \pm 3.3). This is in agreement with a finding that postulates that "At any given level of renal function, men have a larger decrease in hematocrit than women"²³. This may be as a result of the effect of androgens or testosterone (sex hormone) on erythropoiesis. It was known a fact that men have higher levels of hematocrit value than women²³. It was discovered that before boys and girls reach puberty age, they have the same levels of hematocrit value but at puberty, boys hematocrit value become higher which is connected to rapid rise in testosterone levels²⁴. The chronic menstrual blood losses in women are not the determinant factor of lower hematocrit value because this sex variation in hematocrit value continues in women that not menstruating^{25,26}. The synthesis of testosterone and dihydrotestosterone takes place in kidney as a result of the presence of cytochrome P450 enzymes that are essential²⁷.

Testosterone was used as a treatment for anemia in renal disease and bone marrow failure previously until the formulation of recombinant erythropoietin, hence showing its impact on erythropoiesis^{27,28}. The intramuscular testosterone replacement in men is usually linked with polycythemia but when the dose of the therapy is reduced or stopped, it will regress^{29,30}. Furthermore, androgen deficiency drugs for prostate cancer will result to a low Hematocrit value³¹.

Exogenous and endogenous androgens have been connected with an increase in erythropoiesis, thereby causing

an increase in hematocrit and hemoglobin level in men^{32,33}. Reduction in renal production or deficiency of erythropoietin directly decreases testosterone (male sex hormone) level thereby causing severe anemia in males with renal failure in confirmation with the previous studies³⁴. This also can account for the reason of male hematocrit or hemoglobin level is higher than that of a female because females have low testosterone levels.

Furthermore, multiple comparisons of three different levels of creatinine and urea (low, moderate and high) in relationship with hematocrit were not statistically significant (p value = 0.112, p>0.05) showing that the severity of anemia is independent of the value of creatinine and urea. This is in contrast with other findings that showed a significant correlation between maximum serum urea and severity of anemia³⁵. However, there is a slightly significant difference between high and low levels.

CONCLUSION

Conclusively, it was discovered that hematocrit value had a strong association with acute renal failure irrespective of the gender and the severity of the anemia is independent of the maximum or minimum value of the creatinine or urea. It was also discovered that women with acute renal disease had higher hematocrit value than men as a result of a reduced level of testosterone in the male. This study has shown us that any given severe anemia, acute renal failure should be investigated.

Severe anemia in acute renal failure may be associated with other abnormalities such as infertility in men. Another insight is that testosterone is the cause of a high level of hematocrit value in males than females. More additional knowledge is that female hematocrit low value is not associated with their monthly menstruation.

SIGNIFICANCE STATEMENT

This study discovered the severity of anemia in acute renal disease in men was as a result of the effect of the disease on testosterone level synthesized in the kidney. Therefore, it is recommended that testosterone can be beneficial to boost up hematocrit value in severe anemic patients and management of acute renal failure in men. This study will help researchers to uncover the critical areas of renal failure that many researchers were not able to explore.

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