WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.084
Volume 9, Issue 5, 75-84. Research Article ISSN 2277– 7105

RENAL FUNCTION STATUS IN THE ELDERLY

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Article Received on
01 March 2020,

Revised on 22 March 2020,
Accepted on 12 April 2020

DOI: 10.20959/wjpr20205-17219

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ABSTRACT

This study was designed to assess the renal function status in the elderly. A total number of One Hundred (100) Subjects were recruited for this study which consists of 50 elderly subjects between 65-100 years old and 50 young adults between 18-30 years which served as the control. Five (5) milliliters of venous blood samples were taken from all the subjects to estimate the levels of creatinine, urea, bicarbonate, chloride, potassium and sodium. There was significant difference (P< 0.05) in the serum creatinine levels when the elderly subjects (0.41 ± 0.29 mg/dl) were compared with the control (0.54 ± 0.21 mg/dl). Similarly, there was significant difference (P< 0.05) when the levels of serum urea in the elderly (25.22 ± 11.11 mg/dl) were compared with that of the control (33.15 ± 6.72 mg/dl). Similarly, there was significant difference (P< 0.05) when the levels of serum bicarbonate in the elderly (22.23 ± 2.39 mmol/L) were compared with that of the control (23.12 ± 1.82 mmol/L). Also, there was no significant difference (P> 0.05) when the levels of serum chloride in the elderly (98.60 ± 3.43 mmol/L) were compared with that of the control (97.11 ± 4.12 mmol/L). There was no significant difference (P>0.05) when the levels of serum potassium in the elderly (4.72 ± 3.59 mmol/l) were compared with that of the control (4.30 ± 0.53 mmol/l). Also, there was significant difference (P< 0.05) when the levels of serum sodium in the elderly (137.22 ± 11.34 mmol/l) were compared with that of the control (142.44 ± 3.01 mmol/l). The result of this study showed that serum creatinine, urea and electrolytes in the elderly were altered and hence supports the fact that renal function status

could depreciate as one gets older. This calls for more critical attention on the care and support of the elderly.

KEYWORDS: Aging, Kidney, Renal function, Renal diseases.

INTRODUCTION

The prevalence of renal disease is increasing worldwide especially in developing countries (Dirks *et al.*, 2005). Worldwide estimates have it that chronic kidney disease affects over 50 million people including 1 million currently receiving renal replacement therapy such as peritoneal dialysis, hemodialysis or renal transplant (Dirks *et al.*, 2005). In the United States (US) the prevalence of renal disease is disproportionately high in African American and Hispanic population groups, and countries around the world are struggling to find cost effective interventions to slow the progression of chronic kidney disease (CKD) and reduce the incidence of end stage renal disease requiring dialysis and/or renal transplant therapy (Chiapella and Feldman, 1995). It is a fact of life— we are getting older, as a result of that; nephrologists need to ready themselves for the implications of this "coming of age." The projected numbers of elderly individuals (defined here as age >65 years) over the next few decades is potentially overwhelming for the health care system. In most of the world, longevity continues to increase. Life expectancy is globally estimated at 67.2 years, averaging 76.5 years in developed countries and 65.4 years in developing countries (Chiapella and Feldman, 1995). As a result, with every passing month, another 870,000 people turn 65 years, and this figure is projected to grow to almost 2 million a month over the next 10 years. Globally, the number of elderly is expected almost to triple, from 743 million in 2009 to 2 billion in 2050. By that date, the number of older persons (age >65 years) will exceed the number of children under the age of 15 (Chiapella and Feldman, 1995).

According to Coresh *et al.*, (2003), the process of aging results in profound anatomic and functional changes in a number of human body systems. Changes in kidney function with normal aging are the most dramatic of any human organ or organ system (Coresh *et al.*, 2003). These include anatomical, physiological, hemodynamic and immunological changes. Increased propensities of systemic diseases and exposure to poly-pharmacy of the aged group have an additive deleterious effect. The aforementioned changes have its implications on clinical presentations, management and prognosis of all renal diseases in the elderly. Atypical presentation, more frequent and longer course are the characteristics of acute renal failure in this age group. Changing in demographics of the global population predict that the number of

people aged 65 years or greater will triple over the coming decades (Coresh *et al.*, 2003). Because the incidence and prevalence of kidney disease increase with advancing age, nephrologists will be increasingly confronted with a population of patients who are elderly and have a large number of comorbid conditions requiring ongoing care (Coresh *et al.*, 2003). Furthermore, it is increasingly understood that aging leads to its own unique aspects of nephrologic diagnosis and treatment. Although it is known that elderly patients constitute a group with special needs and present unique challenges to the nephrologist, traditional nephrology fellowship training has not included a focus on the geriatric population. In response to this need for greater education and awareness, the American Society of Nephrology has initiated a program of educational activities in geriatric nephrology and has chartered a specific advisory council. The priority being given to geriatric nephrology is a hopeful sign that issues such as treatment options, the efficacy of treatments, and their effect on quality of life for the elderly patient with kidney disease will be improved in the coming years (Coresh *et al.*, 2003).

Furthermore, aging is a biological process accompanied by gradual deterioration of the physiological functions and metabolic processes. This multifactorial process which is affected by the sum of genetic and environmental factors, differently encompasses various organs and tissues (Clark, 2000). There is increasing evidence for an age-related decline in renal function, both in animal models and in humans (Hirokawa, 1975; Davies *et al*., 1989; Epstein, 1996; Clark, 2000). Several studies show this function decline to be associated with both structural (glomerulosclerosis, tubular atrophy and interstitial fibrosis) and functional (decreases in glomerular filtration rate (GFR), proteinuria, reduced ability to concentrate or dilute urine, impairment of electrolyte and ion transport, alteration in hormonal functions, reduced drug excretion) changes in the kidney (Martin and Sheaff, 2007; Zhou *et al*., 2008).

However, chronic kidney disease (CKD) is recognized as a significant problem in public health for several reasons and the pathology has a high prevalence worldwide. The prevalence of impaired renal function increases with advancing age. Knowledge about an individual's renal function is an important piece of information for clinicians who medically manage elderly patients (Levey, 1999). Nevertheless, decline in renal function is a phenomenon of the ageing process (Luckey and Parsa, 2005; Anderson *et al*., 2009). There are few published studies exploring renal function status in the elderly and hence this study is undertaken to provide information on the renal function status of the elderly.

MATERIALS AND METHODS

Study Area

This Study was conducted at Ekpoma, Esan West Local Government area of Edo State. The geographical co-ordinates are between latitude 6^{o} 45^{I}N and longitude 6^{o} 08^{I}E. The town has an average population where their major occupation includes marketing and farming. The University is situated in this region and has made the area more lively and habitable. The topography is somewhat undulating (World Gazetter, 2007).

Study Population

A total of one hundred subjects were recruited for this study which consist of fifty (50) elderly subjects and fifty (50) apparently healthy young subjects which served as control. Subject's data such as name, age and gender were obtained. The age ranges of the subjects were from of 65-100 years while that of the control (young adult) were from 18-30 years. The research was designed to evaluate the serum creatinine, urea, bicarbonate, chloride, potassium and sodium in the elderly subjects and make comparison with apparently young healthy individuals (The control). The samples obtained were taken to the laboratory for analysis. The results generated were further used to make comparisons. Also, only elderly men and women between sixty five (65) years to one hundred (100) years without any underlying sickness or disease were included in this study while apparently young adults were also included as the control. Furthermore, subjects with any underlying sickness or disease were excluded in this study.

Sample Collection

Blood samples (5mls) were collected by vene-puncture into an accurately labelled plain container for both subjects and control. The blood samples were centrifuged with a laboratory centrifuge at 4000rpm for 10minutes at room temperature within two hours of collection and the serum separated into a clean plain containers which are labelled corresponding to the initial blood samples containers. Analysis was carried out for creatinine, urea, potassium, sodium, bicarbonate and chloride

Laboratory Analysis

Creatinine was analyzed using the Jaffe'smethod described by Fabiny and Ertingshausen, (1971) while Urea was analyzed using the urease-berthelot method. Potassium and sodium was analyzed using Flame emission photometry. Bicarbonate was estimated using the titration method while chloride was estimated using the Schales and Schales method.

Statistical Analysis

The results obtained from this study were analyzed using SPSS statistical package version 21 to determine the mean, standard deviation as well as the comparison of the control with the test using Student's t test at 95% confidence limit.

RESULTS

The results revealed that serum levels of creatinine, urea and sodium of the elderly were significantly different ($p<0.05$) when compared to the control; while the serum levels of potassium, bicarbonate and chloride were not significantly different ($p>0.05$) when compared to the controls. (Table 1).

There was no significant difference ($P> 0.05$) when the levels of serum creatinine, urea, sodium, potassium, bicarbonate and chloride of the male elderly were compared with that of the male control (Table 2).

There was significant difference ($P< 0.05$) when the levels of serum creatinine, sodium and bicarbonate in the female elderly were compared with that of the female control. The serum levels of urea, potassium and chloride of the female elderly were not significantly different when compared with the female control (Table 3).

There was significant difference ($P< 0.05$) when the levels of serum creatinine, urea, sodium and potassium in the male elderly were compared with that of the female elderly's while there was no significant difference ($P> 0.05$) when the levels of serum bicarbonate and chloride of the male elderly were compared with that of the female elderly (Table 4).

Table 1: Levels of Serum Creatinine, Urea and Electrolytes of the elderly with the control.

Parameters	Control (n=50)	Elderly (n=50)	t-value	P-value	Remark
Creatinine (mg/dl)	0.54±0.21	0.41±0.29	3.010	0.002	S
Urea(mg/dl)	33.15±6.72	25.22±11.11	2.511	0.039	S
Bicarbonate(mmol/L)	23.12±1.82	22.23±2.39	0.221	0.875	NS
Chloride (mmol/L)	97.11±4.12	98.60±3.43	0.429	0.902	NS
Potassium(mmol/L)	4.30±0.53	4.72±3.59	0.799	0.521	NS
Sodium(mmol/L)	142.44±3.01	137.22±11.34	2.412	0.037	S

Key: n=Sample Size; S: Significant; NS: Not significant; P<0.05-Significant; P>0.05-Not significant

Table 2: Levels of Serum Creatinine, Urea and Electrolytes of the male elderly with the control.

Parameters	Male Control (n=25)	Male Elderly (n=30)	t-value	P-value	Remark
Creatinine (mg/dl)	0.63±0.25	0.59±0.33	0.628	0.534	NS
Urea (mg/dl)	35.61±9.59	31.97±16.14	1.353	0.185	NS
Bicarbonate(mmol/L)	25.83±3.79	24.94±3.88	1.371	0.179	NS
Chloride (mmol/L)	96.00±7.08	97.31±5.30	1.478	0.148	NS
Potassium (mmol/L)	4.07±0.47	4.98±6.01	0.908	0.370	NS
Sodium (mmol/L)	140.28±2.19	134.89±22.66	1.427	0.162	NS

Key: n=Sample Size; S: Significant; NS: Not significant; P<0.05-Significant; P>0.05-Not significant

Table 3: Levels of Serum Creatinine, Urea and Electrolytes of the female elderly with the control.

Parameters	Female Control (n=25)	Female Elderly (n=20)	t-value	P-value	Remark
Creatinine (mg/dL)	0.58±0.28	0.38±0.29	3.898	0.000	S
Urea(mg/dL)	29.33±9.84	24.76±13.39	1.962	1.962	NS
Bicarbonate(mmol/L)	23.08±3.82	24.39±2.90	2.599	0.014	S
Chloride (mmol/L)	98.08±5.45	96.78±5.88	1.262	0.216	NS
Potassium(mmol/L)	4.28±0.32	4.13±0.52	1.639	0.111	NS
Sodium(mmol/L)	142.25±2.86	138.36±3.95	5.650	0.000	S

Key: n=Sample Size; S: Significant; NS: Not significant; P<0.05-Significant; P>0.05-Not significant

Table 4: Levels of Serum Creatinine, Urea and Electrolytes of the male and female elderly.

Parameters	Male Elderly (n=30)	Female Elderly (n=20)	t-value	P-value	Remark
Creatinine (mg/dl)	0.59±0.33	0.38±0.29	4.095	0.000	S
Urea(mg/dl)	31.97±16.14	24.76±13.39	3.095	0.004	S
Bicarbonate(mmol/L)	24.94±3.88	24.39±2.90	1.080	0.288	NS
Chloride (mmol/L)	97.31±5.30	96.78±5.88	0.510	0.614	NS
Potassium(mmol/L)	4.98±6.01	4.13±0.52	9.303	0.000	S
Sodium(mmol/L)	134.89±22.66	138.36±3.95	5.050	0.000	S

Key: n=Sample Size; S: Significant; NS: Not significant; P<0.05-Significant; P>0.05-Not significant

DISCUSSION

The decline in the overall physiological functions as one grows older is suggested to have effect on the renal function. The decline in renal with advancing age predisposes older people to abnormalities in renal function and electrolyte disturbances. The widespread availability of the renal function has highlighted the high incidence of chronic kidney disease in the elderly, which is supported by data demonstrating that the elderly are the largest cohort undergoing kidney dialysis in the general population (Hsieh and Power, 2009). Hence, this study was carried out to determine the renal function status in the elderly.

In general, the theories of cellular senescence include genomic instability and telomere loss, oxidative damage, genetic programming and cell death (Johnson *et al.,* 1999). Among these, the oxidative stress theory of aging states that declines in organism function, that characterize the aging process, result from a progressive accrual of oxidative damage to cellular constituents (Harman, 1956; Harman, 1998). These damages associated with old age could have resulted in the alterations observed in the serum electrolytes, creatinine and urea levels in the elderly.

This study showed that serum bicarbonate levels were not significantly altered in the elderly. Also, serum chloride and potassium levels were slightly increased, though this increase is not statistically significantly. Serum sodium, creatinine and urea levels were all decreased significantly in the elderly when compared with the control. There was no significant difference in the all the parameters when the male elderly were compared with male control. Serum levels of bicarbonate, chloride and potassium did not differ significantly when the female elderly were compared with female control; though significant reductions was observed in serum sodium, creatinine and urea in the same group. The comparison between male and female elderly showed that bicarbonate and chloride levels did not differ significantly, while serum potassium sodium, creatinine and urea varied significantly.

This is in line with the reports of Hsieh ad Power, (2009) who reported similar trend of the results. The decrease in serum creatinine levels could be due to loss of muscle mass that usually result with advancing age. The reduction in serum creatinine is also in line with the report of Luckey and Parasa, (2003); Helmmelgarn *et al*., (2006) and Anderson *et al*., (2009) which reported that the elderly are prone to a decline in glomerular filtration rate (GFR). This GFR decline is consistent across numerous studies of GFR and creatinine (Lindeman *et al*., 1985). Also, this is in line with the study of Odonkor *et al*., (1984) which reported a decrease

in creatinine and urea levels and attributed this decrease to small physical stature of the subjects. This assertion is in concordance with a study investigating the effect of dietary nitrogen on urinary excretion of non-protein nitrogen. Since diet and muscle mass were not controlled during this study, further investigations are necessary to study the possible contribution of these variables on the level of biochemical parameters.

Furthermore, the changes in renal function, especially in handling of salt and water excretion, are important in the genesis of electrolyte abnormalities in the elderly (Hsieh and Power, 2009). The observed low sodium level is in line with the reports of Sunderam and Mankikar, (1983). This could be attributed mainly to intravenous fluids and diuretic use in the elderly (Sunderam and Mankikar, 1983). Although potassium is the most abundant cation within cells, the level of potassium in the serum is an important determinant of its biological effects. Hyperkalaemia or hypokalaemia can arise from true excess or deficiency, or an imbalance in the distribution between the potassium inside and outside of cells. The observed increased potassium could be as a result of renal tubular acidosis and the use of drugs that increase serum potassium, such as the angiotensin converting enzyme inhibitors, angiotensin II receptor blockers, beta-blockers, potassium-sparing diuretics and spironolactone (Hsieh and Power, 2009).

This study showed that serum bicarbonate, chloride and potassium levels were not significantly altered while sodium, creatinine and urea levels were reduced significantly in the elderly. Changes in renal function in the elderly make them prone to chronic kidney disease and electrolyte abnormalities. Management is often complex, especially in view of the numerous drugs and co-morbidities often present in this patient group. However, a realistic approach to treatment and careful monitoring are required to optimize outcomes and avoid complications of therapy. There should be appropriate follow up among the elderly to monitor the use of drugs that could affect the kidney. And further investigations should be performed to determine proper ways and novel approaches to be used in monitoring the progress of disease outcomes in the elderly.

REFERENCES

1. Anderson, S., Halter, J.B., Hazzard, W.R., Himmelfarb, J., Horne, F.M. and Kaysen, G.A. Prediction, progression, and outcomes of chronic kidney disease in older adults. *J Am Soc Nephrol*, 2009; 20: 1199-2209.

2. Chiapella A, P. and Feldman, H.I. Renal failure among male Hispanics in the United States. *American Journal of Public Health*, 1995; 85: 1001-1004.
3. Clark, Biology of renal aging in humans. *Adv Ren Replace Ther*., 2000; 7: 11-21.
4. Coresh, J., Astor, B.C., Greene, T., Eknoyan, G. and Levey, A, S. Prevalence of chronic kidney disease and decreased kidney function in the adult US population. Third National Health and Nutrition Examination Survey. *Am J Kidney Dis.*, 2003; 41: 1–12.
5. Davies, I., Fotheringham, A.P. and Faragher, B.E. Age-associated changes in the kidney of the laboratory mouse. *Age Ageing*, 1989; 18: 127-133.
6. Dirks, J.H., de Zeeuw. D., Agarwal, S.K., Atkins, R.C., Correa-Rotter, R., D'Amico, G., Bennett, P.H., El Nahas, M., Valdes, R.H., Kaseje, D., Katz, I.J., Naicker, S., Rodriguez-Iturbe, B., Schieppati, A., Shaheen, F., Sitthi-Amorn, C., Solez, K., Viberti, G., Remuzzi, G. and Weening, J.J. Prevention of chronic kidney and vascular disease: toward global health equity--the Bellagio Declaration. Kidney Int, 2005; 98: S1-6.
7. Epstein, M. (1996): Aging and the kidney. *J Am Soc Nephrol*., 2004; 7: 1106-1122.
8. Fabiny, D.L. and Ertingshausen, G. Automation reation-rate method for determination serum creatinine with centrifichem. *Clin. Chem.*, 1971; 17: 696-700.
9. Harman, D. Aging: A theory based on free radical and radiation chemistry. *J Gerontol.* 1956; 11: 298-300.
10. Harman, D. Aging and oxidative stress. *J Int Fed Clin Chem.*, 1998; 10: 24-27.
11. Hemmelgarn, B.R., Zhang, J., Manns, B.J., Tonelli, M., Larsen, E. and Ghali, W.A. Progression of kidney dysfunction in the community-dwelling elderly. *Kidney Int*., 2006; 69: 2155-2161.
12. Hirokawa, K. Characterization of age-associated kidney disease in Wistar rats. *Mech Ageing Dev*., 1975; 4: 301-316.
13. Hsieh, M. and Power, D. Abnormal Renal Function and Electrolyte Disturbances in Older People. *Journal of Pharmacy Practice and Research*, 2009; 230 39(3): 230-234.
14. Johnson, F.B., Sinclair, D.A. and Guarente, L. Molecular biology of aging, *Cell*; 1999; 96: 291-302.
15. Levey, A.S., Stevens, L.A., Schmid, C.H., Zhang, Y.L., Castro, A.F., Feldman, H.I. and Kusek, J.W. CKD-EPI (Chronic Kidney Disease Epidemiology Collaboration). A new equation to estimate glomerular filtration rate. *Ann Intern Med.*, 2009; *150:* 604– 61.
16. Lindeman, R.D., Tobin, J. and Shock, N.W. Longitudinal studies on the rate of decline in renal function with age. *J Am Geriatr Soc.*, 1985; 33: 278-285.

17. Luckey, A.E. and Parsa, C.J. Fluid and electrolytes in the aged. *Arch Surg*., 2003; 138: 1055-1060.
18. Martin, J.E. and Sheaff, M.T. Renal ageing. *J Pathol*., 2007; 211: 198-205.
19. Odonkor, P.O., Addae, S.K. and Yamamoto, S. Effect of dietary nitrogen on urinary excretion of nonprotein nitrogen in adolescent sickle cell patients. Hum. *Nutr. Clin. Nutr*., 1984; 38: 23-29.
20. Sunderam, S.G. and Mankikar, G.D. (1983): Hyponatraemia in the elderly. *Age Ageing*, 1983; 12: 77-80.
21. World Gazetteer (2007): Population of Cities, news, divisions. http://world gazetteer.com/ng.php. Retrieved on 23/05/2008.
22. Zhou, X.J., Rakheja, D., Yu, X., Saxena, R., Vaziri, N.D. and Silva, F.G. The aging kidney, 2008; 74: 710-720.