Research Journal of Recent Sciences _____ ISSN 2277-2502
Vol. 3**(ISC-2013),** 327-331 **(2014)** *Res. J. Recent. Sci.*

Evaluation of Renal Status among Hypertensive Postmenopausal Women with and without Renal Insufficiency

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Available online at: www.isca.in, www.isca.me
Received 20th November 2013, revised 3rd April 2014, accepted 29th April 2014

Abstract

Menopause is accompanied by increased risk of chronic diseases. Hypertension is mostly asymptomatic and if left untreated may progress to renal damage. In the present study, an attempt was made to assess the renal function among hypertensive postmenopausal women with and without renal insufficiency. Forty five postmenopausal women were selected and categorized into three groups - normotensive postmenopausal, hypertensive postmenopausal and hypertensive postmenopausal with renal insufficiency. Serum sodium, potassium, chloride, creatinine and estimated glomerular filtration rate were assessed in the selected groups. One way ANOVA and Kruskal-Wallis test were performed using SPSS 16.0 statistical software. Sodium levels were significantly elevated in hypertensive postmenopausal women compared to those with renal insufficiency. Whereas potassium levels were significantly decreased in hypertensive postmenopausal women compared to normotensives. No significant difference was observed in chloride levels. Serum creatinine levels were significantly increased in hypertensive postmenopausal with renal insufficiency compared to normotensive and hypertensive postmenopausal women. A significant decline in estimated glomerular filtration rate was found in experimental groups compared to normotensive control. Elevated levels of creatinine and drop in estimated glomerular filtration rate reflected impaired renal function. Elevated sodium and decreased potassium levels in hypertensives might indicate the intake of high sodium and low potassium diet as contributing factor for the development of hypertension.

Keywords: Menopause, hypertension, renal insufficiency, creatinine, estimated glomerular filtration rate.

Introduction

The continual aging of world population is accompanied by a dramatic rise in the incidence of non-communicable diseases. Unhealthy dietary practice and sedentary lifestyle influence the susceptibility to various lifestyle diseases.

Women in premenopausal state have reduced blood pressure compared to age-matched men. Hypertension is more prevalent in postmenopausal women[1]. It was reported that in India, the number of hypertensives will rise from 118.2 million in 2000 to 213.5 million by 2025. The prevalence of hypertension is 25 per cent in urban and 10 per cent in rural population[2].

Aging leads to increased rigidity of arterial walls thereby resulting in narrowing of arteries. As blood flows through these arteries, fluid pressure increases due to the resistance offered by the reduced lumen space. This consistently high blood pressure even at resting state is the characteristic feature of hypertension (high blood pressure)[3].

Aging, physical inactivity, obesity and dietary salt consumption are the predisposing factors responsible for exacerbating postmenopausal hypertension. In postmenopausal state, the lack of endogenous estrogens that mediate vasodilation contributes to hypertension. The incidence of cardiovascular outcome increases after menopause[4].

Once women attain menopause, they are prone to various non-communicable diseases. Hypertension and renal diseases are a few among them that need special attention. This is because a vast majority of the postmenopausal women suffer from these non-communicable diseases. These diseases are mostly asymptomatic and may result in co-morbid conditions or end organ damage if left untreated. Studies on postmenopausal women with clinical complications are scarce. In the present study, an attempt was made to assess the renal function among hypertensive postmenopausal women with and without renal insufficiency.

Material and Methods

The study was conducted on 52 postmenopausal women who visited KTVR Hospital, Coimbatore, Tamil Nadu. A written informed consent was obtained from the participants. Questionnaire was distributed to elicit personal details, family history, medical history and personal habits of the participants. Institutional Human Ethics Committee clearance (HEC.2011.25) was obtained for the study. Subjects with blood pressure ≥140/90 or those taking antihypertensive medications

were categorized as hypertensive. Menopause was confirmed by the absence of menstruation for more than two years. Those having thyroid abnormalities, congenital heart disease, cancer, jaundice, infectious diseases, who received/receiving hormone replacement therapy and undergone hysterectomy were excluded from the study. Thus out of 52 subjects considered, 45 subjects were selected and categorized into three groups - normotensive postmenopausal, hypertensive postmenopausal and hypertensive postmenopausal with renal insufficiency. Normotensive postmenopausal group served as the control.

Height and weight of the subjects were measured. Blood pressure was recorded using mercury sphygmomanometer in sitting position. Body mass index (BMI) was calculated from the formula: BMI = Weight in kg / (Height in meter)^2

2ml blood was drawn from each of the subjects through venipuncture and collected in serum separator tubes. Serum was separated for the analysis of selected biochemical parameters namely sodium, potassium, chloride and creatinine. Sodium and potassium levels were estimated by flame photometry by the method of Wooton[5]. Chloride was assessed by the method of Van Slyke and Hiller with slight modification[6]. The content was digested for only 1-2 minutes and was indicated by the pale yellow colour of the solution. Serum creatinine was assessed by the method of Bonsnes and Taussky[7]. Estimated glomerular filtration rate (eGFR) was calculated using the Modification of Diet in Renal Disease (MDRD) study equation:

$GFR = 186 \times (SCr)^{-1.154} \times (age)^{-0.203} \times 0.742$ (if the subject is female)

GFR is expressed in ml/min/1.73 m^2, SCr is serum creatinine expressed in mg/dl, and age is expressed in years[8].

One way ANOVA and Kruskal-Wallis test were performed using SPSS 16.0 statistical software.

Result and Discussion

Systolic blood pressure (SBP) was significantly increased in experimental groups compared to the control group. Diastolic blood pressure (DBP) was significantly increased in hypertensive postmenopausal women compared to normotensive postmenopausal women and hypertensive postmenopausal women with renal insufficiency. No significant difference was observed in age, height, weight and BMI as shown in table-1.

Ong *et al* recorded elevated SBP and reduced DBP in women than in men[9]. The study conducted in National Health and Nutrition Examination Survey 1999–2006 participants with hypertension, with and without chronic kidney disease, revealed high SBP rather than high DBP in participants with uncontrolled blood pressure regardless of chronic kidney disease (CKD) status[10]. In the present study also there was a significant increase in SBP and a significantly reduced DBP among hypertensive postmenopausal women with renal insufficiency.

In the present study, no significant difference was observed in age, height, weight and BMI in any of the groups. A follow-up study on men and women revealed that majority of the patients with incidence of hypertension were women, who were older and had higher prevalence of kidney disease and blood pressure compared to age matched men. Older women in the study population revealed poor hypertension control compared to age matched control[11]. Another study reported that in normotensive subjects there was no striking change in SBP between the BMI groups namely thin, normal, overweight and obese groups whereas in the hypertensive subjects SBP was highest in the overweight group and lowest in the obese group[12]. In contrast to the present study, subjects with chronic kidney disease (CKD) were older and had higher BMI compared to those without CKD[13].

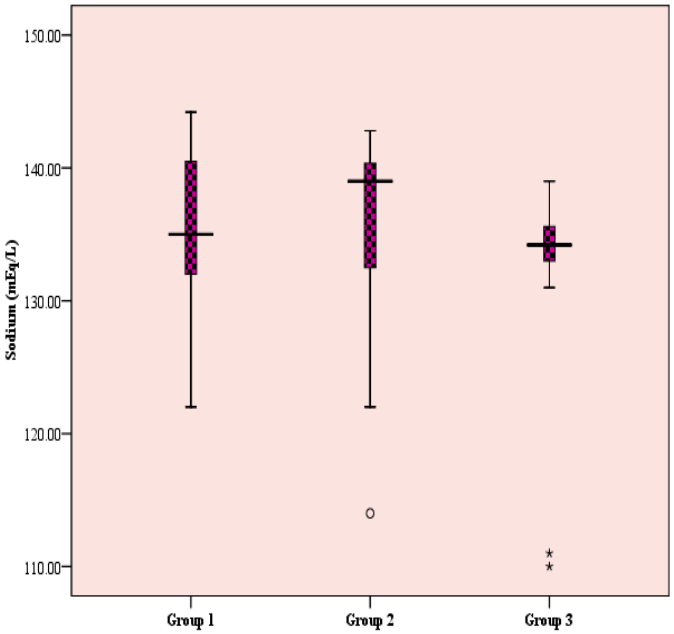
Table-1
Anthropometric profile of the participants of the study

Parameters	Control Group 1 (n=15) (a)	Experimental groups	
		Group 2 (n=15) (b)	Group 3 (n=15) (c)
Age (yrs)	58.7±12.7	66.7±13.1	63.6±13.5
Systolic Blood Pressure (mmHg)	124.0±5.1	136.2±15.5[a]	139.3±18.3[a]
Diastolic Blood Pressure (mmHg)	81.3±6.4	88.6±9.2[a]	82.7±7.9[b]
Weight (kg)	62.6±8.8	60.0±10.1	55.5±10.6
Height (cm)	159.5±7.4	156.7±6.4	154.5±10.2
Body Mass Index (kg.m^{-2})	24.5±2.7	24.3±3.0	23.1±2.5

Values are Mean ± SD
The superscript alphabets of a specific group mean denote the statistically significant difference of that group at 5% level. Group 1 - normotensive postmenopausal women as control. Group 2 - hypertensive postmenopausal women. Group 3 – hypertensive postmenopausal women with renal abnormalities

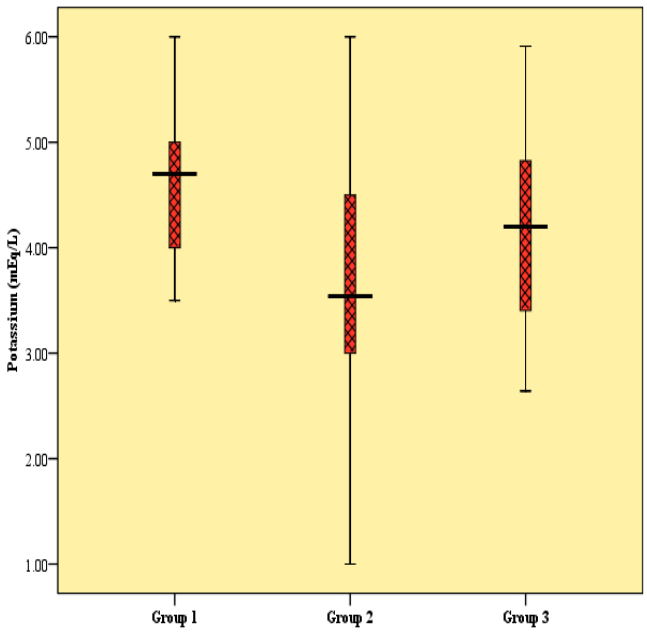
Sodium levels were significantly elevated in hypertensive postmenopausal women compared to those with renal insufficiency as given in figure-1. Whereas in figure-2, potassium levels were significantly decreased in hypertensive postmenopausal women compared to normotensives. No significant difference was observed in chloride levels in figure-3 Studies on hypertensive subjects revealed that serum sodium and chloride levels were higher while serum potassium was lower in hypertensive patients than in normotensive subjects. This substantiates the importance of these ions in the pathogenesis and advancement of hypertension in individuals with routine salt consumption[14]. Similar findings were reported on hypertensive patients and considered elevated sodium, reduced potassium levels as an indication of very high dietary intake of sodium and low dietary potassium intake, as contributing factors for hypertension[15]. Low serum chloride was associated with greater risk of mortality in hypertensive individuals [16]. Hence the present study reports are in partial agreement with these statements.

Figure-4 shows significantly increased serum creatinine levels in hypertensive postmenopausal with renal insufficiency compared to normotensive and hypertensive postmenopausal women. A significant decline in estimated glomerular filtration rate was found in experimental groups compared to normotensive control and is depicted in figure-5.



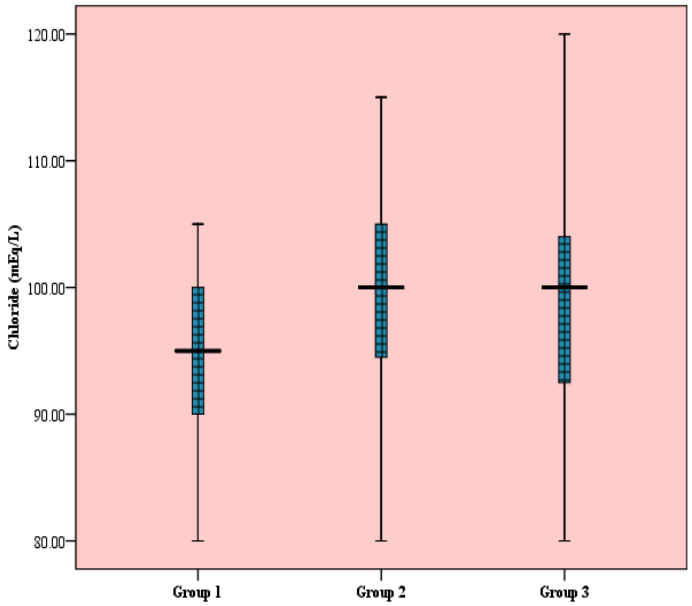
Group 1 - normotensive postmenopausal women as control (n=15). Group 2 - hypertensive postmenopausal women (n=15). Group 3 - hypertensive postmenopausal women with renal abnormalities (n=15)

Figure-1
Sodium levels in normotensive and hypertensive postmenopausal women with and without renal abnormalities



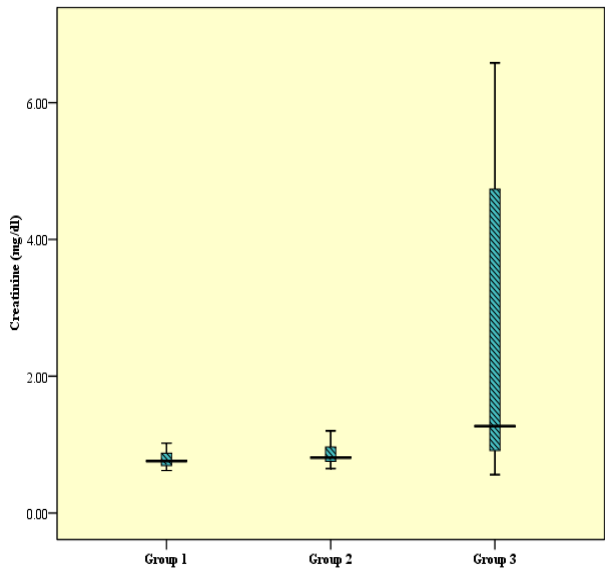
Group 1 - normotensive postmenopausal women as control (n=15). Group 2 - hypertensive postmenopausal women (n=15). Group 3 - hypertensive postmenopausal women with renal abnormalities (n=15)

Figure-2
Potassium levels in normotensive and hypertensive postmenopausal women with and without renal abnormalities



Group 1 - normotensive postmenopausal women as control (n=15). Group 2 - hypertensive postmenopausal women (n=15). Group 3 - hypertensive postmenopausal women with renal abnormalities (n=15)

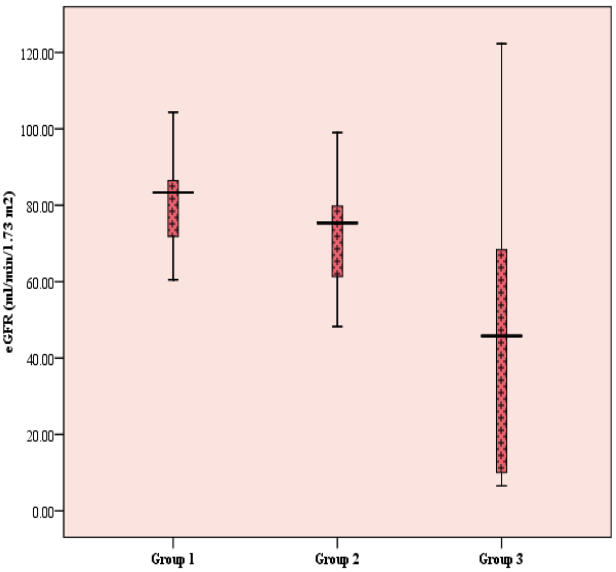
Figure-3
Chloride levels in normotensive and hypertensive postmenopausal women with and without renal abnormalities



Group 1 - normotensive postmenopausal women as control (n=15). Group 2 - hypertensive postmenopausal women (n=15). Group 3 - hypertensive postmenopausal women with renal abnormalities (n=15)

Figure-4

Serum creatinine levels in normotensive and hypertensive postmenopausal women with and without renal abnormalities



Group 1 - normotensive postmenopausal women as control (n=15). Group 2 - hypertensive postmenopausal women (n=15). Group 3 - hypertensive postmenopausal women with renal abnormalities (n=15)

Figure-5

Estimated glomerular filtration rate in normotensive and hypertensive postmenopausal women with and without renal abnormalities

Creatinine is the breakdown product of muscle creatine and is secreted by the proximal tubule of the kidney. As the level of creatinine increases glomerular filtration rate (GFR) decreases, ensuing in the accumulation of nitrogenous waste products[17]. A crude measure of renal function is serum creatinine (SCr), which is a readily available parameter and can be easily entered into equations that estimate glomerular filtration rate at the bedside and is known as estimated glomerular filtration rate (eGFR)[18]. The most commonly advocated estimating equation for calculating the glomerular filtration rate (GFR) is the one that was developed by the Modification of Diet in Renal Disease (MDRD) Study Group. The MDRD study equation was developed in 1999, utilizing the data from 1628 patients with chronic kidney disease with a mean measured GFR of 40 ml/min/1.73 m^2. The formula estimates GFR adjusted for body-surface area[8].

Creatinine level was significantly elevated whereas estimated glomerular filtration rate (eGFR) was significantly decreased in hypertensive postmenopausal women with renal insufficiency compared to the other groups. Elevated serum creatinine levels were observed in peritoneal dialysis and hemodialysis patients compared to those in healthy controls[19]. Similar findings were also observed in chronic kidney disease patients[20]. In an overview of 10 Japanese cohort studies the incidence of cardiovascular disease increased significantly in subjects with GFR 60 to 89 ml. min^{-1}.1.73 m^{-2} and in subjects with GFR <60 ml. min^{-1}.1.73 m^{-2} compared to those with GFR >90 ml. min^{-1}.1.73 m^{-2} [21]. A retrospective cohort study on hypertensive patients reported old age and female sex to be associated with reduced eGFR at baseline. Their study revealed that in hypertensive patients with normal or near normal kidney function, diabetes was the strongest predictor of incident CKD leading to drastic decline in renal function[22].

Conclusion

Elevated sodium and decreased potassium levels in hypertensives might indicate the intake of high sodium and low potassium diet as contributing factor for the development of hypertension. Hence dietary sodium restriction can be considered as the preferred choice for controlling blood pressure.

Elevated levels of creatinine and drop in estimated glomerular filtration rate reflected impaired renal function. Reduced glomerular filtration rate might escalate the risk for cardiovascular morbidity and mortality.

Studies on postmenopausal women with clinical complications are scarce hence, more studies with larger sample size is warranted.

Most of the postmenopausal women subjects were unaware of the complications related to hypertension. Screening strategies and awareness programmes to identify individuals at increased risk for developing hypertension and associated complications in the postmenopausal stage need to be formulated.

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