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Electrocardiographic abnormalities among dialysis naïve chronic kidney disease patients in Ilorin Nigeria

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Abstract

Background: Chronic kidney disease (CKD) has an increased risk of not only end-stage renal disease (ESRD), but majority of moderate CKD patients do die from cardiovascular disease (CVD) before reaching ESRD. The prognosis of these patients is very poor in most developing countries because of late presentation, inadequate diagnostic facilities, and inability to pay for treatment. Knowledge about CVD in CKD is crucial because of unpredictable progressive nature of the disease and increased risk of premature death from cardiovascular events. We sought to determine prevalence and pattern of electrocardiographic abnormalities in dialysis naïve CKD patients.
Materials and Methods: This is a 10-year prospective cross-sectional study carried out at the University of Ilorin Teaching Hospital, Ilorin. Patients were recruited from the nephrology clinic and renal wards and all who met diagnostic criteria for stages 4 and 5 CKD were included. All had their standard 12–lead electrocardiogram (ECG) recorded and various findings were critically studied and interpreted independently by two consultant physician including a cardiologist. Data analysis was done using SPSS version 16.
Results: Overall, 86% of the patients had at least one form of ECG abnormality, with hypertension (HTN) and anemia being the main contributory factors. These include left ventricular hypertrophy (LVH) (27.6%), left atrial enlargement (LAE) (21.6%), combination of LVH and LAE (17.2%), and ventricular premature contractions (6%). Etiology of CKD appears to have influence on ECG changes as prevalence of LVH and LAE were high among hypertensive renal disease, chronic glomerulonephritis (CGN), and diabetic nephropathy patients.
Conclusion: LVH and LAE were very common ECG abnormalities in our dialysis naïve CKD patients. HTN, CGN, anemia, late presentation, and male gender appear to be the main risk factors for the ECG abnormalities. There is need for gender-specific intervention strategies directed at early detection and treatment of HTN, anemia, and underlying kidney disease, especially in resource poor nations where the burden of CKD is assuming epidemic proportion.

Keywords: Chronic kidney disease, Electrocardiogram abnormalities, Ilorin, Nigeria

Résumé

Fond: Insuffisance rénale chronique (IRC) a un risque accru de non seulement fin-insuffisance rénale terminale (IRT), mais la majorité des patients de PFC modérés meurent de maladies cardiovasculaires (MCV) avant d'atteindre l'insuffisance rénale terminale. Le pronostic de ces patients est très faible dans la plupart des pays en développement en raison de la présentation tardive, des établissements de diagnostic inadéquats et incapacité de payer pour le traitement. Connaissances sur les maladies cardiovasculaires dans les PFC est crucial en raison de la nature progressive imprévisible de la maladie et un risque accru de décès prématuré d'accidents cardiovasculaires. Nous avons tenté de déterminer la prévalence et patron d'électrocardiographie anomalies en dialyse naïve patients CKD.
Des matériaux et des procédés: C'est une étude transversale prospective réalisée à l'hôpital universitaire de l'Université d'Ilorin, Ilorin en 10 ans. Les patients ont été recrutés dans la clinique de la néphrologie et pupilles rénales et tous ceux qui satisfait les critères diagnostiques pour les étapes 4 et 5 CKD ont été inclus. Tous avaient leur standard 12–lead

a enregistré un électrocardiogramme (ECG) de et diverses conclusions ont été gravement étudiées et interprétées indépendamment par le médecin consultant deux, y compris un cardiologue. Analyse des données a été réalisée à l'aide de SPSS version 16.

Résultats: Ensemble, 86 % des patients avaient au moins une forme d'anomalie de l'ECG, d'hypertension (HTN) et l'anémie étant les principaux facteurs contributifs. Il s'agit d'hypertrophie ventriculaire gauche (HVG) (27,6%), l'élargissement auriculaire gauche (LAE) (21,6%), combinaison de HVG et LAE (17,2%) et les contractions prématurées ventriculaires (6%). Étiologie de PFC semble avoir une influence sur les changements de l'ECG comme prévalence de HVG et LAE étaient élevés parmi les maladies rénales hypertendus, glomérulonéphrite chronique (CGN) et les patients de la néphropathie diabétique.

Conclusion: HVG et LAE étaient les anomalies d'ECG très communes dans nos patients CKD de dialyse naïf. HTN, CGN, l'anémie, présentation tardive et sexe masculin semblent être les principaux facteurs de risque pour les anomalies de l'ECG. Il n'est nécessaire pour l'égalité entre les sexes -des stratégies d'intervention spécifiques visés la détection précoce et le traitement des HTN, l'anémie et sous-jacent de la maladie rénale, surtout dans les pays pauvres de ressources où le fardeau de PFC est en supposant que proportion épidémique.

Mots clés: PFC, anomalies ECG

Introduction

The occurrence of electrocardiographic (ECG) changes in uremic patients has been recognized for decades. Cardiovascular disease (CVD) is the commonest cause of morbidity and morbidity in end-stage renal disease (ESRD) patients with or without dialysis therapy.[1-4] Patients with ESRD have an exceeding high risk for CVD and majority of deaths in chronic kidney disease (CKD) patients are due to cardiovascular events.[5-7] Mortality risk from CVD is increased five times in dialysis patients older than 75 years.[6] The factors contributory to cardiac abnormalities include anemia, hypertension (HTN), volume overload, ischemic heart disease, uremic cardiomyopathy, electrolyte imbalance, hyperlipidemia, and arteriovenous fistula.[7-9] CKD has an increased risk of not only ESRD, but majority of moderate CKD patients do die from CVD before reaching ESRD.[10-12] In most of sub-Saharan Africa, prognosis of patients with advanced CKD is very poor because of late referral and inability to pay for treatment.[13] It is envisaged that majority of these patients would have died from cardiovascular events in the earlier stages of CKD without access to any health facility. Electrocardiographic abnormalities like Q-T interval prolongation and dispersal which often occur with left ventricular hypertrophy (LVH) may predispose renal failure patients to varied forms of arrhythmias and sudden death.[14-16] Knowledge about CVD in CKD is crucial because of unpredictable progressive nature of the disease with associated increased risk of death, cardiovascular events, and hospitalization. This study aims to determine prevalence and pattern of electrocardiographic abnormalities among dialysis naïve CKD patients in Ilorin, Nigeria.

Materials and Methods

It was a prospective 10-year (January, 1999-December, 2009) cross-sectional study done in the Renal Care Centre of the University of Ilorin Teaching Hospital, Ilorin, Nigeria. The Hospital is a tertiary health institution, strategically located in the North central zone of the country. The Renal Care Centre offers both hemodialysis and peritoneal dialysis with plans at advanced stage to commence live related kidney transplantation. Patients for the study were recruited from the nephrology clinic and renal wards. All patients who met criteria for diagnosis of CKD[17,18] in stages 4 and 5 and had given informed consent were included in the study. We also carried out detailed clinical assessment, blood chemistry, complete blood count, and ultrasonography of the kidneys from which the demographic data and severity of renal disease were obtained. We excluded from the study, patients who had commenced dialysis or did not give consent. Also excluded were patients with valvular heart disease, cardiomyopathy in the preceding six months prior to diagnosis of CKD, known alcoholics, cigarette smokers, and dyslipidemic patients with established cardiac disease. The etiological diagnosis of CKD followed the pattern of a previous study in our environment.[19] Anemia was defined for the purpose of this study by a packed cell volume of less than 33%, while HTN was taken as systolic blood pressure greater than 130 mmHg and diastolic blood pressure greater than 80 mmHg or previous history of HTN. All consecutive patients had their standard 12–lead ECG recorded. The various findings were critically studied and interpreted independently by two consultant physician including a cardiologist. Data analysis was done using SPSS version 16.

Results

Overall, 116 patients with CKD were evaluated and analyzed. There were 71 (61.2%) males and 45 females with mean age of 50.89 ± 13.43 and 48.22 ± 14.70 years, respectively. The range and mean of systolic and diastolic blood pressure were 100-230; 153.41 ± 27.12 and 60-140; 93.92 ±

17.19 mmHg, respectively. Overall prevalence of anemia was 75% with male and female rates of 61% and 39%, respectively. Etiology of CKD [Figure 1] were systemic HTN (52.58%), chronic glomerulonephritis (CGN) (17.2%), combination of diabetes and HTN (14.7%), diabetes alone (2.6%), polycystic kidney disease (4.3%), chronic pyelonephritis (2.6%), and obstructive uropathy (1.7%).

The electrocardiographic abnormalities [Figure 2] were LVH (27.6%), left atrial enlargement (LAE) (21.6%), combination of LVH and LAE (17.2%), ventricular premature contractions (6%), sinus bradycardia (4%), premature atrial contractions (3.5%), sinus tachycardia (2.6%), while bilateral atrial enlargement and right ventricular hypertrophy were each responsible for 1.7%. Overall, 86% of the patients had at least one form of ECG abnormality.

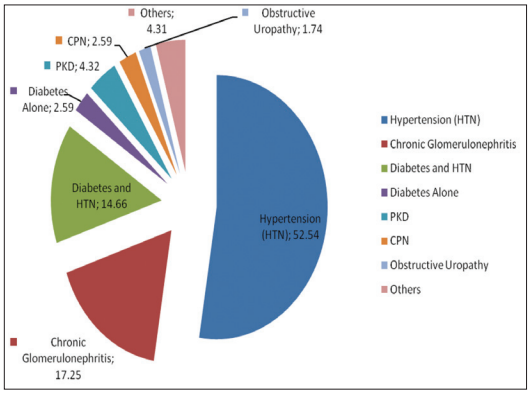

Figure 1: Etiology of CKD
HTN = Hypertension, CGN = Chronic Glomerulonephritis, DM = Diabetes Mellitus, PKD = Polycystic Kidney Disease, CPN = Chronic Pyelonephritis, OU = Obstructive Nephropathy

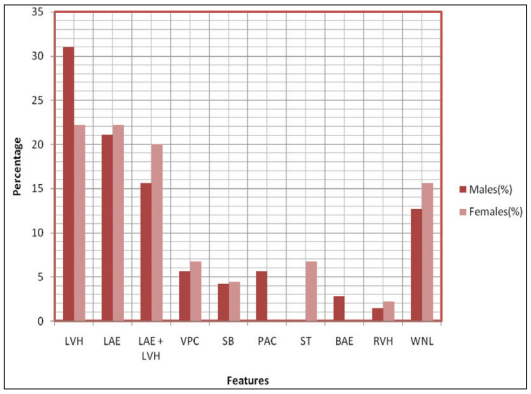

Figure 2: Gender distribution of ECG abnormalities
LVH = Left Ventricular Hypertrophy, LAE = Left Atrial Enlargement, VPC = Ventricular Premature Contractions, SB = Sinus Bradycardia, PAC = Premature Atrial Contractions, ST = Sinus Tachycardia, BAE = Bilateral Atrial Enlargement, RVH = Right Ventricular Hypertrophy, WNL = Within Normal Limits

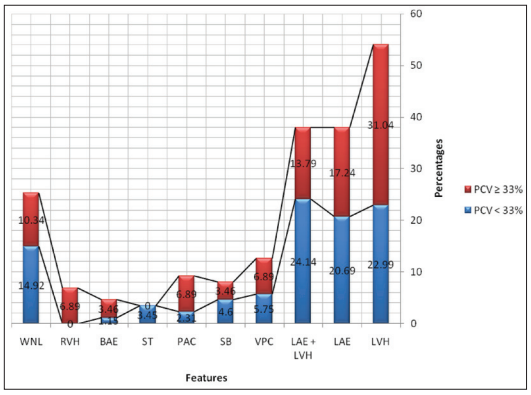

Figure 3: ECG and anemia

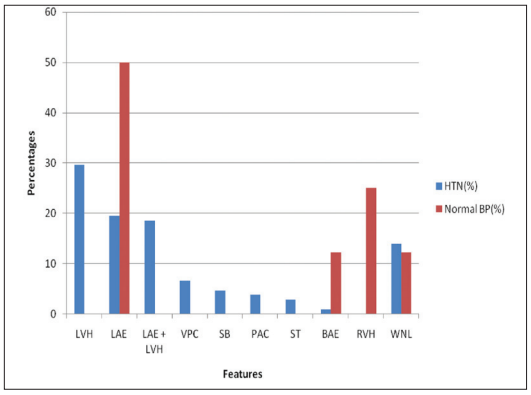

Figure 4: ECG and HTN

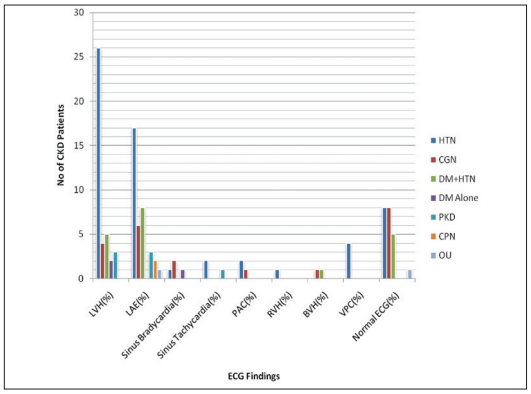

Figure 5: Etiology of CKD and ECG findings

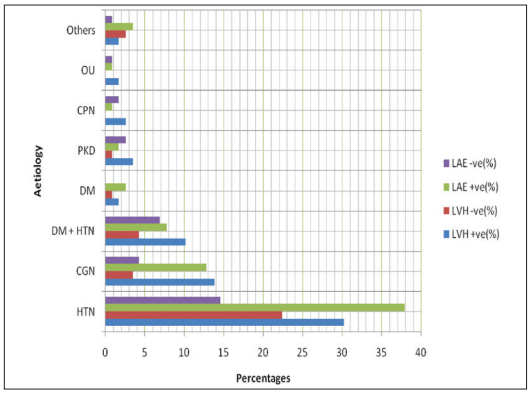

Figure 6: Etiology of CKD in relation with LVH and LAE

Patients with combined LVH and LAE [Figure 3] formed majority of those with anemia followed by LVH and LAE alone. The difference in prevalence of these leading ECG abnormalities between those with and without anemia was statistically significant ($x^2 = 19.64$, $P = 0.018$). Figure 4 depicts the relationship between ECG changes and HTN. It showed that all patients with LVH alone and those with combined LVH and LAE had associated HTN, while only 16% of patients with LAE were normotensive. A patient had combination of BAE and RVH in which the blood pressure was normal. The overall ECG findings in relation to etiology of CKD are shown in Figure 5. Etiology of CKD [Figure 6] appear to have influence on ECG changes as prevalence of LVH and LAE were high (54% *vs* 59%) among hypertensive renal disease, CGN, and diabetic nephropathy in contrast to low values observed in CKD of other etiologies.

Discussion

CKD is associated with increased risk of cardiovascular outcomes and mortality.[20] Adequate preventive measures against CVD should commence early during the natural history of kidney dysfunction as cardiovascular damage start from early stages of well-defined CKD.[21] Unfortunately, the application of preventive strategies is hampered by inaccurate interpretation of renal function parameters, delay in diagnosis of renal failure, and late referral to nephrologists.[22,23] The mean age of our patients was 49.85 ± 13.94 years. This is in agreement with findings of earlier studies which showed highest incidence between third and fifth decade of life.[24-26] It contrast with reports from industrialized countries in which more than 50% of CKD patients are above 65 years.[3,4,27]

The very high mean systolic and diastolic blood pressure of 153 ± 27.12 mmHg and 93.92 ± 17.19 mmHg observed among our patients is a cause for concern as there is evidence that blood pressure control reduces the rate of CVD and attenuates rate of GFR decline in those with proteinuria.[28-31] Guidelines for HTN treatment in CKD patients recommend pharmacological therapy and lifestyle modification that will achieve a blood pressure goal of less than 130/80 mmHg.[32,33] This blood pressure target is difficult to achieve even in developed countries. An American study of blood pressure control among CKD patients revealed that only 37% met the advocated target blood pressure.[34] Adequate blood pressure control in Blacks is crucial as they have a 5-fold risk of progression from CKD to ESRD when compared with Whites.[35]

Overall prevalence of anemia of 75% in our patients is in accord with other studies.[13,15,36] Anemia contributes significantly to cardiovascular morbidity and mortality in CKD as reduced hemoglobin values are associated with LVH, increased frequency and duration of hospitalization, and reduction in quality of life.[37,38] It has been shown consistently to be a risk factor for cardiac abnormalities seen in ESRD patients. The observation that ECG abnormalities were highest in patients with hematocrit below 33% shows that anemia is a major contributor to ECG changes. Some large studies have shown association between anemia and mortality in CKD patients, with the mortality risk increasing as hematocrit falls below 33%.[39-41] A study by Cannella *et al.*,[42] has also demonstrated renormalization of high cardiac output and left ventricular size following long-term recombinant human erythropoietin treatment of anemia in dialyzed uremic patients.

The leading electrocardiographic abnormalities among our CKD patients were LVH followed by LAE, LVH and LAE combination, and ventricular premature contractions. Overall, 45% prevalence of LVH in this study is in agreement with 40% observed in CKD patients by Stewart *et al.*,[43] but contrasts with 83% reported by Nwankwo *et al*.[15] Although there is general agreement that LVH is highly prevalent in dialysis patients, it does vary depending on composition of study population, age, gender, blood pressure, heart rate, and ethnicity.[44] There was gender disparity in the prevalence of LVH as the majority was males and is in accord with findings from other studies.[15,43] This may be due to gender differences in body size as left ventricular mass is a function of body size. The very high prevalence of LVH among our patients appear to be related to late presentation and poor control of blood pressure as LVH is a recognized evidence of end organ damage from uncontrolled HTN. Our observation that all patients with only LVH and those with combined LVH and LAE had associated HTN suggests that hemodynamic changes due to HTN may be responsible for the LVH. It underscores the need for increased utilization of antihypertensive agents that can result in regression or even prevent development of LVH.[45,46]

Recent studies support desirability of achieving LVH regression as it is expected to reduce cardiovascular events, considering its adverse outcome of being risk factor for cardiac arrhythmias and sudden death.[30,47] In another related study, it was found that regression of LVH and systolic dysfunction between baseline and one-year dialysis was associated with a lower risk of new-onset cardiac failure.[48] Therefore, intervention strategies on early detection of HTN and prompt treatment should be vigorously pursued, especially in resource

poor nations, where CKD is assuming epidemic proportions in order to reduce the incidence of cardiovascular mortality. The etiology of CKD seems to have influence on ECG changes as prevalence of LVH and LAE were highest among hypertensive renal disease, CGN, and diabetic nephropathy. This is not surprising as majority of patients with advanced CKD due to either primary or secondary glomerular disease do have associated systemic HTN.[4-7] HTN, CGN, and diabetic nephropathy are leading causes of advanced CKD from earlier studies in Nigeria.[19,26] HTN is the foremost risk factor for CKD and contributes significantly to cardiovascular events in these patients. A prompt application of preventive strategy against CVD in CKD is hampered by incorrect interpretation of renal function parameters, delays in diagnosis of renal failure, and late referral to nephrologist.[23] These abnormalities of the left cardiac chambers are expected as HTN is the implicated major cause of CVD in CKD and albuminuria from primary and secondary glomerular diseases are associated with increased risk of CVD, even after controlling for other risk factors.[29-31,37] In conclusion, LVH and LAE are very common electrocardiographic abnormalities in our dialysis naïve CKD patients. HTN, CGN, diabetic nephropathy, anemia, late presentation, and male gender appear to be the main risk factors for these ECG abnormalities. There is need for gender-specific intervention strategies directed at early detection and treatment of HTN, anemia, and underlying kidney disease, especially in resource poor nations where the burden of CKD is assuming epidemic proportion. This will ameliorate mortality from cardiovascular complications and delay progression of CKD to ESRD.

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