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Original Research Article

Electrocardiogram changes in patients with end stage renal disease on chronic haemodialysis

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ABSTRACT

Background: End stage renal disease (ESRD) is irreversible loss of renal function which is physiologically defined by a GFR of less than 15 ml / minute. ESRD is associated with a higher incidence of coronary artery disease and serious arrhythmia especially ventricular arrhythmia. The goal of study is to determine whether ESRD and haemodialysis (HD)are associated with occurrence of significant electrocardiogram (ECG) changes or not.
Methods: This is a cross-sectional study design which involved 22 patients with ESRD on regular HD in Al Sadre teaching hospital / Al Najaf. Both sexes was included in this study. All patients underwent full medical history and examination which included the following aspects: Age, Sex, Occupation, BP, HR, RBS, B.urea, S.creatinine , Serum electrolyte (Na+, K+, Cl-, Ca++), Lipid profile (Cholesterol , Triglyceride, HDL, LDL), Duration of CRF, Duration of dialysis, Social history including (smoking, alcohol) and Drug used by the patient. Resting EGC and Hotler ECG.
Results: Eighteen patients exhibited emergence of simple ectopic activity premature atrial complex (PAC) and premature ventricular complex (PVC) events and four patients exhibited (ST,T changes). Potentially lethal arrhythmias and other serious ECG changes are not detected in our patient's sample.
Conclusion: In this study, neither ESRD nor haemodialysis were associated with development of serious ECG changes or emergence of significant arrhythmia.

Keywords: Electrocardiogram, End stag, Haemodialysis, Renal disease

INTRODUCTION

Patients with end-stage renal disease (ESRD) on long-term dialysis therapy have very high mortality due to predominantly cardiovascular causes.[1,2] Sudden cardiac death (SCD) is the single most common form of death in dialysis patients, accounting for 20% to 30% of all deaths.[3,4]

Epidemiological and observational studies have reported that the overall incidence of SCD in this population is much greater than the incidence of coronary events, and the risk of SCD persists even after coronary revascularization.[5,7] These findings suggest a possibility of a primary increase in the risk of fatal ventricular arrhythmias, which is the most common cause of SCD. Dialysis patients with ESRD have several factors that could predispose them to a high risk of ventricular arrhythmias.

A large number of dialysis patients have diabetes, and thus, autonomic neuropathy as a consequence of both chronic uremia and coexisting diabetes is very common, resulting in alterations in autonomic control with a sustained increase in the sympathetic tone reported to be proarrhythmic.[8]

Similarly, hypertension is very common, and uremia leads to secondary hyperparathyroidism, both of which lead to considerable left ventricular hypertrophy (LVH).[9] In addition, chronic uremia leads to endothelial dysfunction, and the combination of endothelial dysfunction and LVH compromises perfusion reserve and makes the individual susceptible to arrhythmias precipitated by ischemia.

Long-standing uremia leads to uremic cardiomyopathy, with typical changes of diffuse myocardial fibrosis, which could lead to slowing of conduction and increased dispersion of repolarization, both of which have been shown to be proarrhythmic.[10,11]

ECG markers such as QRS duration, corrected QT interval have been suggested as potential predictors of ventricular arrhythmia in dialysis patients.[12-14] Significant sudden shifts in electrolytes and fluid volume that surrounds a dialysis session acts as a trigger and can initiate life-threatening arrhythmias in patients with a susceptible substrate.[15] High-grade ventricular ectopic activity and nonsustained ventricular tachycardia are commonly seen in dialysis patients, particularly around a dialysis session.[16] The cause and significance of these arrhythmias are still not clear. Silent myocardial ischemia and sudden changes in electrolytes have been reported to be associated with higher risk of such arrhythmias.[17,18]

The predictive value of such unsustained arrhythmia recorded during routine hemodialysis sessions in the risk assessment of SCD has not been explored adequately and a proper assessment of such risk is conceivably important, thus physicians can adopt appropriate measures like implantable cardioverter defibrillators (ICD) in patients at a high cardiovascular risk to reduce CV mortality. Indeed, insertion of ICD in properly selected patients have been shown to reduce SCD in patients with ESRD on chronic haemodialysis.[19-23] Hence, it is conceivable that risk assessment tests using resting ECG that evaluate these important variables (ST, T-changes, ventricular arrhythmia, QTC and QRS duration) could be used to identify dialysis patients at risk of CV morbidity and mortality. Thus indicating a need for specific risk assessment to address the unique features that predispose dialysis patients to SCD and enable appropriate intervention, such as an ICD, to be tested in those found to be at highest risk.[24]

Several therapeutic interventions have the potential of reducing the risk of SCD in a high-risk population of which the most effective is an ICD. In fact retrospective analyses from major ICD trails confirmed that dialysis patients have a higher incidence of appropriate ICD therapy.[20-23]

Alterations in the balance between the sympathetic and parasympathetic control of the heart with higher sympathetic tone, parasympathetic (vagal) withdrawal, or both have been reported to increase the risk of SCD.[25] ESRD is characterized by high sympathetic output, which has been reported to be a result of increased chemo sensitive reflex from the failing kidney.[26] This is supported by studies reporting association between high circulating levels of norepinephrine in ESRD and cardiac events, including SCD.[27] Heart rate variability (HRV) is a measure of physiological variation in the beat-to-beat interval of heart rate, is frequently reported in dialysis patients.[28,29]

METHODS

This is a cross-sectional study design which involved 22 patients with ESRD on regular HD in Al Sadre teaching hospital / Al Najaf. The study was conducted from January 2012 to July 2012. Patients with renal failure who were on dialysis were targeted in this study. Patients who fulfill inclusion criteria were included in this study.

Inclusion criteria

Adult who are diagnosed with renal failure and on regular hemodialysis.

Exclusion criteria

Any patient with prior history (before diagnosis of chronic renal failure) of any the following conditions were excluded:

IHD, Hypertension, Rhythm disorder, Conduction defect include BBB.

Both sex was included in this study.

In order to obtain valid results, all patients underwent full medical history and examination which included the following aspects: Age, Sex, Occupation, Blood pressure(BP), Heart Rate(HR),Random Blood Sugar (RBS), blood urea, Serum creatinine, Serum electrolyte (Na^+, K^+, Cl^-, Ca^{++}), Lipid profile (Cholesterol, Triglyceride, HDL, LDL), Duration of CRF, Duration of dialysis, Social history including (smoking, alcohol) and Drug used by the patient.

Resting ECG

Standard 12 leads ECG (nihon) was performed for each patient with analysis for ST, T changes, QTc interval, PR interval, QRS duration.

Holter ECG

Continuous ECG monitoring (schiller mt101) was performed. Monitoring commenced immediately after HD and continued 24 hours. Patients were encouraged not to change their activities of daily living for the duration of the study.

Informed consent was obtained from all patients who participated in this study.

Statistical analysis

Statistical analysis was done by using SPSS (statistical package for social science) version 17. Chi-square (X^2) used to compare categorical data. Authors set p value < 0.05 as significant.

RESULTS

The study involved 22 patients; their age range from 15 years to 71 years. There was16 males and 6 females. Majority of respondent fell in 40-50 year group followed by 51-60 year of age, Table 1.

Table 1: Sociodemographic distribution of the study sample.

Variable	n	%
Gender		
Male	16	72.7
Female	6	27.3
Age		
<20	1	4.5
21-30	2	9.1
31-40	1	4.5
41-50	8	36.4
51-60	6	27.3
>60	4	18.2
Total	22	100.0

Standard 12 leads ECG were examined for QTc interval, QRS duration and ST changes were measured against age groups. The ECG data shows mean QTc was (417 millisecond) and this mean increased with the age. Measurement of QRS for different age groups reveal no patient had QRS duration of 0.12 sec or more. The QRS mean was 10150 second.

Table 2: QTC interval and QRS duration in different age group.

Age group	N	Mean QTc	SD	P	Mean QRS	SD	P value
<20	1	0.377	.	0.109	0.110	.	0.604
21-30	2	0.372	0.000		0.099	0.003	
31-40	1	0.372	.		0.100	.	
41-50	8	0.403	0.022		0.094	0.008	
51-60	6	0.397	0.023		0.098	0.005	
>60	4	0.440	0.049		0.099	0.011	
Total	22	0.403	0.032	0.007	0.097	0.008	

P value is not significant

Table 3: The frequency of dysrhythmia according to age group.

Age group	PVC	PAC	SVT	VT	Total	p value
<20	0	33	1	0	34	<0.001
21-30	9	53	0	0	62	
31-40	0	5	0	0	5	
41-50	9	390	0	0	399	
51-60	149	244	1	0	394	
>60	172	220	2	0	394	
Total	339	945	4	0	1288	

P value is significant

In regard to ST changes, only one patient of the age group 50-60 years old and another three patients who were over age of 60 year showed St elevation, (Table 2).

Table 4: Relation between type of dysrhythmia, St changes and duration of chronic renal failure.

Duration of CRF	PVC	PAC	SVT	VT	Total	ST changes	P value
<1 Y	24	91	0	0	115	0	<0.001
1-2 Y	188	621	3	0	812	3	
>2-3 Y	6	13	1	0	20	0	
>3-4 Y	6	59	0	0	65	0	
>4 Y	115	161	0	0	276	1	
Total	339	945	4	0	1288	4	

P value is significant

The number of arrhythmic events displayed on the ambulatory ECG were searched and recorded. The highest reported dysrhythmias were reported with increasing age beyond 41. They are counted in each age group as in table 3. A further classification was based on the patients who had short runs of tachycardia (more than 3 complexes at a rate of >100/min) of ventricular or supraventricular complexes, PVC and PAC according to duration of CRF.

Considering studying ST, T waves changes according to duration of CRF, three patients (1-2 years' renal failure) had ST depression, one patient (>4 years' renal failure) had ST depression, T inversion, Table 4.

DISCUSSION

The aim of this study was to examine the development of electrocardiographic abnormalities in patients with CRF, in a cross-sectional study. Many studies suggested that cardiovascular mortality is greatly increased in patients on dialysis therapy and, to a lesser extent, in patients with functioning transplants.[30,31] The CV risk often begins to increase during progressive renal impairment, although recent studies suggest that even in the earliest stages of renal failure (when serum creatinine is less than twice normal) CV risk is increased.[32,33]

In our study, the Holter ECG recordings showed only minor abnormalities. There was a higher occurrence of ectopic cardiac activities mainly of atrial type and ventricular ectopic activities came next. But no patient exhibited potentially lethal ventricular arrhythmias or significant conduction disorder. Some previous studies on hemodialysis patients have identified a high prevalence of ventricular dysrhythmias, often complex rhythms likely to be associated with a poor prognosis. It was largely believed that arrhythmias after dialysis occur at a time when there are major changes in serum electrolytes and QT interval and dispersal.[34-36]

The prevalence of such arrhythmias was much lower in the present study, perhaps this finding is a reflection of the asymptomatic population included in this study, where patients with diabetes and prior ischemic heart disease were specifically excluded. Moreover our patients were studied on the post dialysis days rather than per dialysis.

The analysis therefore shows relatively minor abnormalities (frequency of atrial and ventricular ectopic and short runs of SVT) that are not, by themselves, likely to be responsible for a major cardiac event.[12]

Patients with ESRD on long-term dialysis therapy have a very high risk of SCD. Recent studies have suggested that the subdivision of patients into those with eccentric and concentric LVH may be of importance. Patients with ESRD on long term dialysis therapy have a very high risk of SCD in the presence of major CV risk factors (IHD, Hypertension, Rhythm disorder, Conduction defect include BBB). Therefore, extended clinical study concentrating on major CV risk factors notably active IHD, hypertension, LVH, LVSD, HR variation to determine their influence on CV mortality in ESRD patients on chronic haemo dialysis so that a therapeutic intervention like prophylactic ICD insertion to prevent SCD can be reliably adopted.

In our study these major risk factors excluded. There was neither significant difference in the findings from 24 hours ECG recording nor resting ECG. Authors found no significant association between the electrocardiographic abnormalities or arrhythmia and duration of chronic renal diseases and this might be explained by the limited number of patients studied, the duration of dialysis.

Despite Authors have made all necessary steps to ensure valid results, authors faced some inevitable constrains. The laboratory results were variable in term of reliability, so that correlation with electrolytes and lipid profile was not made. Lacking Holter devices in our hospitals to cover a large number of patients and to be studied for appropriate period.

CONCLUSION

In conclusion, our study failed to demonstrate occurrence of serious arrhythmias, significant conduction problems or important cardiac ischemic events.

Authors recommend an extended prospective clinical study involving a large number of patients, taking in consideration all major CV risk factors, so that their negative impact on CV mortality or morbidity can be more clearly and reliably defined enabling caring physician to early implement appropriate therapeutic and or preventive measures.

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