Auditory and visual reaction time changes in chronic renal failure patients

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ABSTRACT

Objective: Chronic renal failure involves progressive and irreversible loss of renal function. This ultimately leads to uremia in which there is loss of excretory functions .Reaction time is the interval between application of stimulus and onset of response. The patients of chronic renal failure show many central nervous system function disturbances which lead to peripheral neuropathy, loss of memory and errors of judgement. The present study assesses these reaction times in uremic patients and compares them with reaction times of controls. **Methods:** This study was conducted on 25 patients with chronic renal failure on hemodialysis presenting to Dialysis unit, Dayanand medical college and hospital, Ludhiana.25 healthy controls were included for comparison. Auditory and Visual reaction time was recorded using digital display response time apparatus (model no; RTM608 Medicaid: Ambala) equipped with three light stimuli(red, green, yellow) and three auditory stimuli (low, medium, high pitched sounds). **Results:** The mean and standard deviation was computed. The comparison of means was done using the unpaired t-test. A significant number of patients demonstrated increase in auditory and visual reaction time values. **Conclusion:** The rate of chronic renal failure is rising worldwide and there has been an outgrowth of research exploring the neuropsychological sequelae of chronic kidney disease. Our study found a relationship between renal and neurophysiological functions especially immediate recall and memory.

Keywords: Chronic renal failure; reaction time; hemodialysis; uremia.

Introduction

Chronic renal failure refers to the clinical syndrome which results from progressive and irreversible loss of renal function.[1] This progression of renal failure would ultimately lead to uremia. In uremia, there is not only a loss of the excretory functions of the kidney, but also the metabolic and the endocrine functions are affected involving virtually every organ in the body.[2]

Disturbances in central nervous system functions were also seen including inability to concentrate, drowsiness and insomnia. Mild behavioral changes, loss of memory, peripheral neuropathy and errors of judgment soon follow and maybe associated with neuromuscular irritability,fasciculations and muscle twitchings. Recent reports present conflicting findings concerning possible contribution of hemodialysis to hearing loss and the incidence is higher in children. Different studies have reported the presence of visual evoked potential abnormalities also. Reaction time experiments give information on alertness and speed of activation of the processing system. However, there have been very few studies to assess these complications. Therefore, we planned this study to observe changes in reaction times in patients of chronic renal failure and compare these with controls. The study was conducted under the indian council of medical research and approved by the institutional ethics committee.

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Materials and methods

The study was conducted on patients with chronic renal failure presenting to dialysis unit of a tertiary care teaching hospital. Twenty five patients of chronic renal failure of varying etiologies undergoing dialysis were the prospective candidates for this study. Twenty five healthy controls were included in the study. The controls were not from the same batch and the same department as the research student as per the guidelines laid by the institutional ethical committee Subjects

suffering from any clinical disease likely to affect retina, visual pathway, auditory pathway (this was done by getting patients examined from the ENT and eye department) disorders that could alter the results of the tests were excluded from the study. .A written informed consent was taken from all the subjects. Then the subjects were thoroughly acquainted with the apparatus and three practice sessions were given to every subject before taking the reading. Auditory reaction time and visual reaction time were recorded using digital display response time apparatus (model No RTM 608 Medicaid: Ambala) equipped with three light stimuli (red, green and yellow) and three auditory stimuli (low, medium and high pitched sounds)Auditory Reaction Time-The patients and volunteers were presented randomly one of the three sound stimuli by the observer and the subjects responded by pressing the knob of the digital display apparatus to switch off the produced sound. The reaction time displayed on the apparatus in milliseconds was recorded and lowest of the three recordings was considered for each stimulus. Visual Reaction Time-The patients and volunteers were presented randomly one of the three stimuli for light i.e. Red, green and yellow light and the subjects responded by pressing the knob of the digital display apparatus to switch off the produced light, the reaction time displayed on the apparatus in milliseconds was recorded and lowest of the three recordings were considered for each stimulus.The mean and the standard deviation were computed. The comparison of means was done by using the unpaired t-test.

Results

This study was carried out on twenty five patients of chronic renal disease with end stage renal failure who were undergoing hemodialysis. These patients were evaluated for reaction time, both auditory and visual, and then the results were compared with reaction time of controls. Out of twenty five patients included in the study, twelve were males and thirteen were females. The sex distribution of these twenty five cases is shown in table I

Table 1: Sex distribution

Sex	Number of Patients
Male	12(48%)
Female	13(52%)

Auditory Reaction Time measurements were done and three readings were recorded for each sound stimulus and the lowest of all readings was considered. Comparison between the values of the control group and the study group are shown in table II and figure I. There is a significant increase (P=.000) in the reaction time of Chronic renal failure patients

Table2: Comparison of Auditory Reaction Time values in cases and controls

Reading	Control Group	Study Group	T value	P value
Sound 1	0.394693	0.620747	13.826	.000*
Sound 2	0.39452	0.613547	18.102	.000*
Sound 3	0.383333	0.605827	18.451	.000*

***P=.000 Significant**

Visual Reaction time was measured in both cases and controls. Three readings were recorded for different light wavelengths that is red, yellow and green and the lowest of all three was considered .Comparison between the values of control and the study group is shown in table III and figure II. There is a significant increase (P=.000) in the reaction time of Chronic renal failure patients

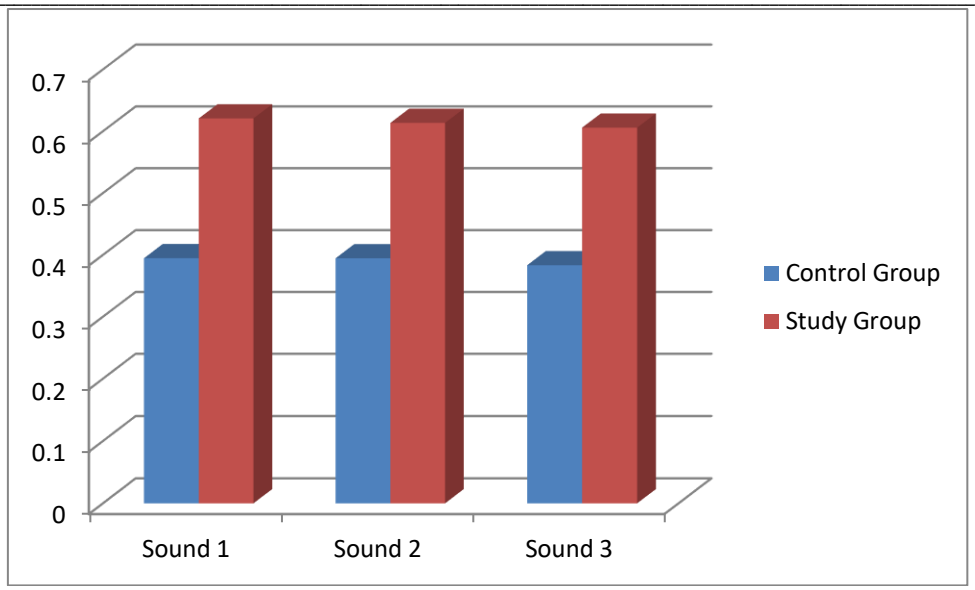

Figure 1: Comparison of auditory reaction times in cases and controls

Table 3: Chronic renal failure patient

Reading	Control Group	Study Group	T value	P value
Red	0.48984	0.763053	22.351	.000*
Yellow	0.496493	0.8568	6.622	.000*
Green	0.493467	0.811453	31.545	.000*

***P=.000 Significant**

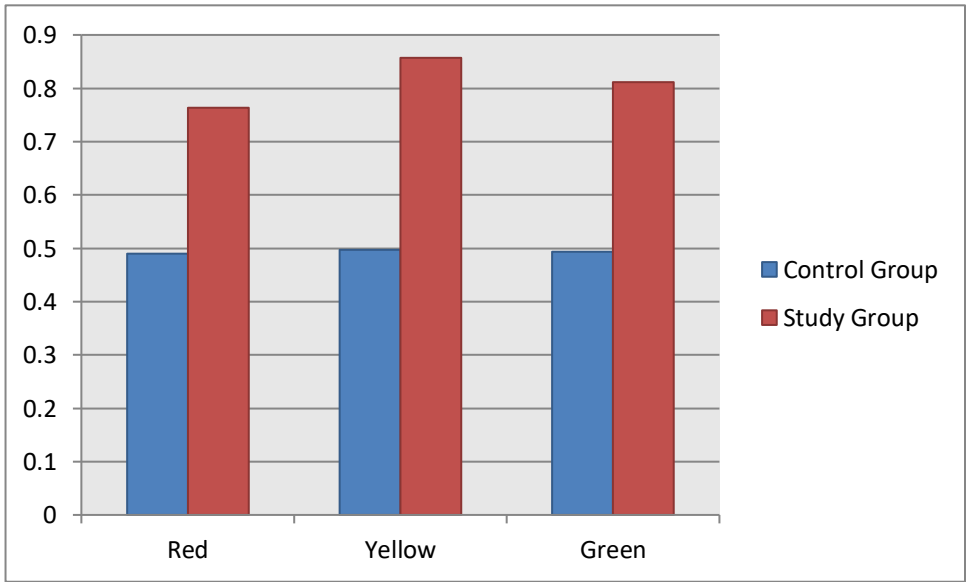

Figure 2: Comparison of visual reaction times in cases and controls

Discussion

Chronic renal failure is the substantial and usually long standing loss of renal functions developing insidiously

over years. The progression of renal failure ultimately leads to uremia. Ion transport mechanisms become defective , ability of the kidney to handle even a normal sodium load may decrease leading to excessive salt water retention ,edema ,hypertension, congestive cardiac failure and a volume overloaded state results[3]. Neurological abnormalities are also seen in patients with uremia , many of which resolve with hemodialysis.[4]Reaction time is the interval between application of stimulus and onset of response. These experiments give information on alertness, functions and speed of activation of information processing system. It involves receptors that receive input, afferents that transmit information to central nervous system and efferents that send impulses to effectors with setting up of response. The major reaction time experiments carried out were auditory and visual reaction time experiments.The incidence of sensorineural hearing loss among patients with chronic renal failure is higher than in general population. One study found an incidence of 77% hearing loss in chronic renal failure patients.[5] Another study reported hearing loss in 40% of the chronic renal failure patients on hemodialysis.[6]Some researchers found 60% of patients had hearing loss , 36% had vestibular dysfunction and 26% had a combination of both.[7]Another study documented high frequency hearing loss early in course of hemodialysis[8]Some authors reported patients with progressive hearing loss parallel to progression of chronic renal failure , peritoneal dialysis and hemodialysis .They found anatomic changes in labyrinth which they attributed to osmotic disequilibrium caused by hemodialysis. Another study investigated sensorineural hearing loss in three groups of children with chronic renal failure, 14 on conservative treatment, 18 on hemodialysis and 36 with renal transplant. [9]They found sensorineural hearing loss in 29% of the children on conservative treatment, hemodialysis and 47% of children with renal transplants. The results of our study showed increased values for auditory and visuals reaction times. Our patients showed a significant increase (p= .000) in both parameters. The increase was seen for all sound stimuli. The above results can be explained on the hypothesis that renal failure may have affected the peripheral nervous system resulting in neuropathy which shows a predilection for large diameter axons. Hearing loss amongst patients with chronic renal failure has been a common finding in studies investigating the effects of renal failure on auditory functions [10]One study found a significant higher incidence of cochlear dysfunction in children on conservative treatment.[11]Some workers reported an improvement of 20 db in the hearing of patients following hemodialysis.[12]Uremia may affect both central nervous system and peripheral nervous system. Uremic encephalopathy is associated with problems in cognition and memory. Visual reaction time values also were significantly (p=.000) increased in the study group as compared to the control group.In summary, patients with chronic renal failure show changes in reaction times both auditory and visual reaction times . Hemodialysis tends to correct a number of these abnormalities although some patients are left with residual defects due to irreversible changes. Further research is warranted to study the neuropsychological deficits produced by renal failure.

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