Original Article

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SENSORY NERVE CONDUCTION STUDIES IN PATIENTS WITH CHRONIC RENAL FAILURE

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ABSTRACT

Objective: Evaluation of sensory neuropathy in patients with end stage renal failure by utilizing nerve conduction studies (NCS)

Place and duration: Medical Unit II, Sir Ganga Ram Hospital, Lahore from Mar to Oct 2006.

Study design: Cross sectional comparative study.

Patients and Methods: Chronic renal failure is an irreversible decline of glomerular filtration rate (GFR) below 15 ml/min. Thirty patients who had serum creatinine above 5mg/dl for at least three months duration were included by purposive sampling. Patients with diabetes mellitus, paraplegia, systemic lupus eryethmatosis, polyarteritis nodosa, alcoholism and drug induced neuropathies were excluded. Patients were further segregated into two groups on the basis of either receiving hemodialysis or not. In group C-I twenty patients on regular hemodialysis were included. In group C-II ten patients were included with end stage renal failure waiting for hemodialysis or have refused dialysis. Thirty age and gender matched controls were also included. Sensory nerve conduction studies in upper limb were done by testing median nerve and in lower limb by testing the sural nerve. Parameters of sensory conduction studies checked were latencies, amplitudes and conduction velocities.

Results: Median nerve latency was significantly higher, amplitude and velocity were significantly lower in C-I and C-II groups as compared to controls ($p< 0.05$) but the difference in C-I and C-II group was insignificant ($p > 0.05$). Sural nerve latency was significantly higher, amplitude and velocity were significantly lower in C-I and C-II groups as compared to controls ($p< 0.05$) but the difference in C-I and C-II group was insignificant ($p > 0.05$).

Conclusions: Evaluation of sensory neuropathy by utilizing sensory nerve conduction studies can be used as a reliable test for initial diagnosis or monitoring the patients with chronic renal failure.

Keywords: Chronic renal failure, Nerve conduction studies, peripheral neuropathy,

INTRODUCTION

Chronic kidney disease (CKD) is a rapidly growing global health problem, with a prevalence of 15% in developed nations. CKD can occur as a result of primary renal disorder or as a complication of multisystem disease. Diabetes is now the most common cause of CKD in developed countries, whereas in the developing world, inflammatory diseases of the kidney, particularly glomerulonephritis and interstitial nephritis, remain the most common causes.[1,2]. Peripheral neuropathy has been recognized as one of the major complication of chronic renal failure and is considered a limiting factor in the treatment of patients with this disorder. The pathophysiology of chronic renal disease involves initiating mechanisms specific to the underlying etiology as well as a set of progressive mechanisms that are a common consequence. Following long term reduction of renal mass, irrespective of etiology, there is structural and functional hypertrophy of surviving neurons. This compensatory hypertrophy is mediated by vasoactive molecules, cytokines, growth factors and hyper filtration.[3]

Ureamic patients usually pass through four phases. In phase of decreased renal reserve the creatinine clearance is 60 to 120ml/min and it is sub clinical. In mild renal insufficiency the creatinine clearance is between 30- 60 ml/min. In overt renal failure creatinine clearance is 10-20ml/min. In this stage patient has most of the manifestations of renal failure like hypertension, acidosis and hyper

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phosphatemia. In end stage renal failure creatinine clearance is less than 5ml /min. Once serum creatinine in adults reaches above 3mg/dl the disease is likely to progress to end stage renal disease (ESRD). Nervous symptoms of uremia are intense itching of skin, numbness and tingling of the fingers and cramps in the calf muscles particularly at night. In end stage renal failure there is weakness and wasting of muscles and deep tendon reflexes are absent.[4]

A clinician faces two problems while managing patients with peripheral neuropathy. These are establishing the existence of disease of peripheral nervous system and ascertaining its nature. It is necessary to perform a number of procedures such as biochemical tests, CSF examination, needle examination of muscles, nerve muscle biopsy and electrophysiological studies. Out of all the above mentioned investigations, sensory nerve conduction studies have been found to be the most sensitive detector of neuropathy.[5]

Conduction velocity has remained one of the best measurements of peripheral nerve function. Amplitude of sensory action potential depends upon number of active firing axons. When toxin enters at endoneural space and causes axonal damage, this results in considerable reduction of amplitude.[6]

Nerve conduction studies are simple, non invasive tests which helps the physicians in managing their patients. These studies are helpful to plan the schedule of dialysis. It has been reported that regular hemodialysis improves electrophysiological parameters.[7]

Nerve conduction studies are useful in such patients because successful transplantation results in improvement of all parameters of these studies.[8]

No electrophysiological studies in patients with chronic renal failure have been conducted in Pakistan. The objective of this study was to determine the characteristics of uremic polyneuropathy in a group of CRF patients in our population.

PATIENTS AND METHODS

This cross-sectional study was conducted in the medical unit II, Sir Ganga Ram hospital, Lahore from 1-3-2006 to 30-10-2006. Sixty subjects were included in this study. A total of 30 cases who had serum creatinine above 5 mg/dl for at least three months duration were included through non-probability purposive sampling. None of our patients had disease associated with peripheral neuropathy other than uremia. Patients with diabetes mellitus, paraplegia, drug induced neuropathies, alcoholism, systemic lupus erythematosis, other collagen disorders and heavy metal poisoning were excluded. Thirty age and gender matched controls were also included in the study. Written informed consent was obtained from all the subjects and controls. Patients were further segregated in two groups on the basis of receiving hemodialysis or not. In group C-I twenty patients receiving regular hemodialysis were included. In Group C-II ten patients with end stage renal failure not dialyzed yet or have refused dialysis were included.

Sensory Nerve Conduction Studies

Three parameters of sensory nerve conduction studies, latency, amplitude and conduction velocity were measured by electromyographic(EMG) machine. Principle of this tests was that electric stimulation of a nerve initiates an impulse that travels along motor , sensory or mixed nerves. Conduction characteristics of sensory nerves were evaluated by recording of evoked potentials proximal to the site of stimulation. This allows precise lesion localization and accurate characterization of peripheral sensory nerve functions.[9]

Sensory nerve conduction parameters of median nerve in upper limb and sural nerve in lower limb were assessed. Duration of stimulation was 0.5 to 1.0 ms. Rate of stimulation was 30 to 50/sec. Intensity was gradually increased to get maximum response. Then 20-30% further increase in intensity of stimulus was done. This supramaximal stimulation ensures activation of all the nerve fibers. Orthodromic response is usually triphasic along the course of sensory nerve.

Following parameters of sensory conduction study were measured.

Latency(ms)

Amplitude peak to peak(mv)

Conduction velocity (m/s) = Conduction distance (mm) / sensory latency (ms)

Statistical analysis

Data was analyzed using SPSS version 10. Descriptive statistics were used to describe the data. The significance of difference in average values of NCS parameters between the groups was determined through analysis of variance (ANOVA). *p*-value<0.05 was considered as significant.

RESULTS

Detail of age and weight of three groups is given in table-1. All the three groups were comparable with respect to age (p=0.332) and weight (p=0.233). Males were 57% in control group, 50% in C-I group and 30% in C-II group (p=0.344).

Nerve conduction parameters were significantly different in cases as compared to controls. Median nerve latency was significantly higher, amplitude and velocity were significantly lower in C-I and C-II groups as compared to controls (p<0.05) but the difference in C-I and C-II group was insignificant (p>0.05). Sural nerve latency was significantly higher, amplitude and velocity were significantly lower in C-I and C-II groups as compared to controls (p<0.05) but the difference in C-I and C-II group was insignificant (p>0.05). (Table-1)

Table-1: Comparison of age and weight in three groups

Groups	Age	Weight
Control (n = 30)	39.97 ± 1.83	59.70 ± 1.32
C-I (n = 20)	43.15 ± 2.79	58.45 ± 1.39
C-II (n – 10)	36.50 ± 4.66	63 ± 2.10
p-value	0.332	0.233

Table-2: Comparison of NCS parameters of all the three groups

NCS parameters		Control(n = 30)	C-I (n = 20)	C-II (n – 10)	p-value
Median Nerve	Latency (ms)	2.8±0.007	5.0±0.02	4.9±0.1	< 0.05
	Amplitude (mv)	20.7±1.02	8.2±0.02	8.3±0.1	< 0.05
	Velocity (m/s)	50.8±1.06	23.8±2.0	22.6±3.8	< 0.05
Sural Nerve	Latency (ms)	3.6±0.1	5.3±0.1	5.3±0.1	< 0.05
	Amplitude (mv)	11.7±0.4	3.7±0.7	3.2±0.6	< 0.05
	Velocity (m/s)	40.0±0.1	26.6±0.8	26.6±1.0	< 0.05

DISCUSSION

Sensory neuropathy is a common complication of end stage renal failure (ESRF). It is usually distal, symmetrical, mixed polyneuropathy. Nerve conduction studies (NCS) remain gold standard in diagnosis and management of uremic neuropathy.[10] Our present study investigated excitability properties of sensory axons in upper and lower limbs in a group of our population. Previous nerve conduction studies have demonstrated prevalence rates of neuropathy from 60 – 90%. This difference of rates in different studies depends on choice of nerve segment, the indices measured and number of nerves studied.[11]

In this study 16 patients in group I and six patients in group II demonstrated abnormality of either of the parameter of sensory nerve conduction studies i.e increased latency, decreased amplitude or decreased conduction velocity. Mean values of conduction parameters were nearly same as shown by Makkar in India and Krishnan in Australia.[6,12] These electro-physiological findings are in partial agreement with those obtained by Arum and Mansuri[13,14]. These findings also confirm the results of previous studies that sensory nerves are more severely affected in lower limbs than in upper limbs[15,16].

Data of this study showed abnormalities of sural nerve conduction parameters in 22 patients although 12 patients were without signs and symptoms of sensory neuropathy in

lower limbs. This confirms that sural sensory action potencial (SAP) is a sensitive detector of subclinical neuropathy. Nerve conduction studies can be utilized to watch the adequacy of dialysis. If patients are receiving adequate dialysis sensory nerve conduction parameters do not deteriorate. In patients with successful transplantation sensory nerve function improvement can be detected quantitatively by such studies[17,18].

CONCLUSION

NCS parameters were significantly different in cases and controls therefore we concluded that evaluation of sensory neuropathy by utilizing sensory nerve conduction studies can be used as a reliable test for initial diagnosis or monitoring the patients with chronic renal failure.

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