



Changes in motor and sensory nerve conduction parameters in chronic renal failure (CRF) patients

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Abstract

Chronic renal failure (CRF) is a chronic, progressive, irreversible condition which causes much suffering to the patient. The families, societies and country have to bear a great economic burden to manage patients of CRF. Significant electrophysiological changes may be present in nerve conduction studies (NCS) of peripheral nerves of chronic renal failure patients having no clinical neuropathy. This was a Cross-sectional comparative type of study. The study period extends from January 1, 2007 to December 31, 2007. The study was carried out in the out-patient and indoor patients of Nephrology and Medicine units of Rajshahi Medical College Hospital (RMCH), Bangladesh. The study aimed to evaluate the Status of sensory nerve conduction parameters in patients with CRF. In CRF there is progressive, irreversible loss of renal function, which render the patient permanently dependent upon renal replacement therapy. Peripheral neuropathy adds more to these problem and patients gradually develop weakness. The quality of life deteriorates and finally the patient may become bedridden. The management of these problems are long term and costly. Due to poverty CRF patients become a burden for the family and for the society. Majority of these patients are unable to bear the expenditure of renal replacement therapy. Early detection of neuropathy in CRF patients is one of the management of strategy of these patients because timely intervention may reduce the morbidity related to neuropathy. In CRF patients who have no clinical signs or symptoms of neuropathy, nerve conduction studies can detect early abnormalities. So, this study was designed to find out the subclinical peripheral neuropathy in CRF patients in our country. If subclinical neuropathy can be detected early and appropriate treatment instituted, it reduces further progression of neuropathy and also reduce neuropathy related complications. Such type of study has not been conducted in our country previously so this study will provide some data about the prevailing condition in our country and future researchers can carry out further studies on this subject.

Keywords: chronic renal failure (CRF), nerve conduction studies (NCS), nephrology, electrophysiological neuropathy

1. Introduction

Chronic renal failure is a world-wide threat to public health. In the USA about 11% of the adult population is suffering from chronic renal disease [1]. In the UK 85 to 95 new patients per million of the adult population are accepted for long-term dialysis treatment each year [2]. The exact incidence or prevalence of renal diseases is not known in Bangladesh. National mortality data show that 1.16% of the total mortality in Bangladesh occurs due to renal diseases. 1.40% of the males and 0.88% of the females die due to renal problem (Statistical Yearbook of Bangladesh, 2004). The prevalence of chronic renal failure (CRF) in Bangladesh is increasing silently day by day. Limited studies have done in Bangladesh show that about 18% of the adult population maybe suffering from chronic renal disease. More than 40,000 patients develop chronic renal failure every year in Bangladesh [3]. Peripheral neuropathy is a common complication of CRF which is demonstrated in 60 to 100% of CRF patients [4]. In most patients who receive chronic hemodialysis the neuropathy will either stabilize or improve slowly. Patients with mild neuropathy often recover completely with dialysis, but those who begin dialysis with severe neuropathy rarely recover even after several years. Successful renal transplantation has a clear-

cut, predictable, beneficial effect upon uremic neuropathy. Progressive improvement over six to twelve months generally occurs, often with complete recovery, even in patients with severe neuropathy before transplantation [5]. Slowing of nerve conduction is a frequent occurrence in uremic patients with no other symptoms or signs of neuropathy. In patients with moderate renal failure not requiring dialysis, serum creatinine elevation correlated with decreased velocity of motor-nerve conduction. Clinical neuropathy appeared, generally, in the patients whose renal function deteriorated most markedly and whose conduction velocities slowed the most [5]. The most frequent clinical features reflect large-fiber involvement, with paresthesia's, reduction in deep tendon reflexes, impaired vibration sense, muscle wasting, and weakness. Nerve conduction studies demonstrate findings consistent with a generalized neuropathy of the axonal type. Patients may also develop autonomic features, with postural hypotension, impaired sweating, diarrhea, constipation, and impotence [6]. Electro physiologically, mainly axonal loss and secondary demyelination can be found. The most sensitive parameter in the diagnosis of uremic neuropathy are F-wave parameter in the lower limbs, vibration detection threshold on the foot, the sural nerve sensory action potential amplitude and

decreased nerve conduction velocity [4]. The vibratory threshold on the foot correlates with the clinical grading of neuropathy. The nerves from the upper extremities on the side of the fistula should not be used in the diagnosis due to numerous mild local nerve lesions [4]. In most patients, uremic neuropathy will stabilize or even improve during chronic dialysis. Paresthesia may improve rapidly once hemodialysis is started, but other symptoms mostly persist. Renal transplantation can result in recovery from uremic neuropathy through remyelination. If extended axonal degeneration has developed and large number of axons are lost, results of renal transplantation are disappointing [7]. Mild neuropathies may clinically resolve completely after dialysis is started, although impaired nerve conduction usually persist on neurophysiological testing. Severe cases slowly improve but do not fully recover, even after several years of dialysis. A few patients have been reported to have a paradoxical worsening of their neuropathy on commencing dialysis. Hemodialysis and continuous ambulatory peritoneal dialysis (CAPD) are both effective in preventing the progression of neuropathy, but CAPD may be the treatment of choice for patients with diabetes mellitus and end stage renal failure. In this study the Status of sensory nerve conduction parameters in patients with CRF only thirty patients were included due to lack of investigation facility and also high cost of investigation procedure.

2. Objectives

General objective:

To assess the changes in motor and sensory nerve conduction parameters in patients with CRF.

Specific Objectives:

To assess the status of sensory nerve conduction parameters in patients with CRF.

To assess the status of motor nerve conduction parameters in patients with CRF

3. Methodology and Materials

This was a cross-sectional comparative type of study. The study period extends from January 1, 2007 to December 31, 2007. the study was carried out in the out-patient and indoor patients of Nephrology, Neurology and Medicine units of Rajshahi Medical College Hospital (RMCH), Rajshahi, Bangabandhu Shiekh Mujib Medical University (BSMMU) & Dhaka Medical College Hospital, Dhaka, Bangladesh. A

total number of 60 patients were included in the study. Gender matched 30 patients of chronic renal failure and 30 normal control subjects were included.

4. Results

In the present study, 30 patients suffering from chronic renal failure and 30 control patients were included. The mean age of both the CRF patients and the controls were 38 years with a range of 18 to 60 years. That 80% of patients having serum creatinine values >15 mg% are suffering from subclinical neuropathy while only 33% patients having creatinine values less than 5mg% have subclinical neuropathy. The comparison of motor nerve conduction parameters among the 30 CRF patients (cases) and the 30 control subjects. DML, CMAP and MCV of median nerve were statistically significantly different from that in the control group of patients, but F-wave latency showed no significant variation (P>0.10). In the Ulnar nerve CMAP and MCV were statistically significantly different from that in the control group of patients, but DML and F-latency of the ulnar nerve showed no statistically significant difference. In the tibia nerve only DML was statistically significantly prolonged (P<0.05). CMAP, MCV and F-wave latency did not show statistically significant difference in the two groups (p>0.05) of patients. The comparison of sensory nerve conduction parameters among the two groups of patients. In the Median nerve statistically significant difference was found in SNAP and SCV between the CRF patients and the control group of patients (p<0.05), but no statistically significant difference was found in DSL (p>0.05). Statistically significant difference was found between CRF patients and the control group in SNAP and SCV of ulnar nerve (p<0.05), but no statistically significant difference was found in DSL of ulnar nerve (p>0.05). Table shows that as the serum creatinine level increases, more patients are suffering from subclinical peripheral neuropathy. In the peroneal nerve only CMAP showed statistically significant difference. DML and MCV did not show statistically significant difference in the two groups (p>0.05) of patients. Statistically significant difference (p<0.05) was found in DSL, SNAP, and SCV of sural nerve among the two group of patients. Abnormal finding of sensory nerve conduction parameters among the 30 CRF patients. Table shows the affection of different sensory nerve conduction parameters in the different nerves in the 30 CRF patients.

Table 1: Status of peripheral neuropathy in relation to serum creatinine level among cases (N=30)

Serum Creatinine level	Total No. of cases	No subclinical peripheral neuropathy	Subclinical neuropathy present
Up to 5 mg %	3	2 (66.67 %)	1 (33.33 %)
>5 to 10 mg %	13	8 (68.54 %)	5 (38.46 %)
>10 to 15 mg%	9	2 (22.23 %)	7 (77.77 %)
>15 mg %	5	1 (20.00 %)	4 (80.00 %)
Total	30	13 (43.30 %)	17 (56.70 %)

Table 2: Comparison of motor nerve conduction parameters among 30 CRF patients and the control group of patients. (N=30)

Parameter	Case (n=30) (Mean ± SD)	Control (n=30) (Mean ± SD)	P-value
Median nerve			
DML (msec)	3.37 ± 1.10	3.19 ± 0.48	0.011
CMAP (mv)	11.72 ± 4.32	15.78 ± 4.67	0.001
MCV (m/sec)	53.71 ± 4.30	57.60 ± 4.07	0.001
F-latency (msec)	26.38 ± 5.49	25.20 ± 2.52	0.289
Ulnar nerve			

DML (msec)	2.76 ± 0.61	2.52 ± 0.53	0.112
CMAP (mv)	11.09 ± 4.43	14.58 ± 4.69	0.004
MCV (m/sec)	53.69 ± 6.36	57.08 ± 4.18	0.018
F-latency (msec)	25.58 ± 7.36	25.54 ± 2.11	0.977
Tibial nerve			
DML (msec)	4.35 ± 0.82	3.95 ± 0.65	0.041
CMAP (mv)	12.73 ± 7.79	15.82 ± 5.39	0.079
MCV (m/sec)	48.12 ± 6.55	47.97 ± 6.26	0.928
F-latency (msec)	48.38 ± 10.43	47.07 ± 4.76	0.536
Peroneal nerve			
DML (msec)	4.37 ± 1.16	4.21 ± 0.56	0.523
CMAP (mv)	5.56 ± 3.31	8.23 ± 2.73	0.001
MCV (m/sec)	45.14 ± 10.43	49.13 ± 3.52	0.052

Table 3: Comparison of sensory nerve conduction parameter among 30 CRF patients and the control group of patients. (N=30)

Parameter	Case (No. 30) (Mean ± SD)	Control (n. 30) (Mean ± SD)	P-value
Median nerve			
DSL (msec)	2.33±0.88	2.39±0.44	0.743
SNAP (µv)	16.57±10.50	29.99±11.22	0.00
SCV(m/sec)	51.13±18.99	61.89±6.43	.005
Ulnar nerve			
DSL(msec)	1.83±0.90	2.18±0.47	0.069
SNAP(µv)	12.71±8.95	25.31±11.77	0.000
SCV(m/sec)	47.71±20.23	59.95±4.42	0.002
Sural nerve			
DSL(msec)	1.98±1.36	2.75±0.58	0.006
SNAP(µv)	11.21±9.99	19.71±9.29	0.001
SCV(m/sec)	37.00±23.70	54.43±4.72	0.000

Table 4: Shows the affection of different motor nerve conduction parameters in the different nerves in the 30 CRF patients. (N=30)

	Case (n=30)	
	No.	(%)
Median nerve		
DML (>4.4 msec)	3	10
CMAP (< 4.0 mv)	0	0
MCV (<49 m/sec)	3	10
F-latency (>31 msec)	1	3.3
Ulnar nerve		
DML (>3.3msec)	0	0
CMAP (<6 mv)	2	6.7
MCV (<49 m/sec)	5	16.7
F-latency (>32 msec)	4	13.3
Tibial nerve		
DML (>5.8 msec)	10	33.3
CMAP (<4.0 mv)	3	10
MCV (<41 m/sec)	11	36.7
F-latency (>56 msec)	3	10
Peroneal nerve		
DML (>6.5 msec)	14	46.7
CMAP (<2.0 mv)	11	36.7
MCV (<44 m/sec)	15	50

Table 5: Abnormal finding of sensory nerve conduction parameters among the 30 CRF patients(N=30)

Parameter	Case (n=30)	
	No.	(%)
Median nerve		
DSL (>3.5 msec)	3	10
SNAP (<20 µv)	15	50
SCV (<50 m/sec)	6	20
Ulnar nerve		
DSL (>3.1 msec)	1	3.3
SNAP (<17 µv)	17	56.7
SCV (<50 m/sec)	9	30
Sural nerve		
DSL (>4.4 msec)	5	16.7
SNAP (<6 µv)	17	56.7
SCV (<40 m/sec)	15	50

5. Discussion

This was a cross-sectional comparative type of study undertaken to evaluate subclinical neuropathy in asymptomatic chronic renal failure (CRF) patients of Bangladesh by electro diagnosis and to explore whether there is any correlation between the duration of CRF and the development of subclinical uremic neuropathy and also to find any relation between age and sex of the patient to the development of neuropathy among CRF patients. To evaluate the presence of subclinical neuropathy in CRF patients we conducted nerve conduction studies of one lower and one upper extremity in asymptomatic CRF patient and compared the result with those of normal subjects. The healthy controls and the CRF patients were matched by gender. 53.3% were male and 46.7% were female. All patients were ambulant and apparently in good built. In this study, Table I shows that as the level of serum creatinine level is increasing, more and more patients show presence of subclinical neuropathy.^[8] showed that in patients with moderate renal failure in whom dialysis was not done, serum creatinine elevation correlated with decreased velocity of motor-nerve conduction. But^[5] found that individual serologic biochemical abnormalities (calcium, magnesium, phosphate, urea, creatinine, etc.) do not correlate well with uremic neuropathy or any other neurologic manifestation of uremic state. The chronicity and severity of renal failure appear to be more important to the development of neuropathy. They also state that though slowing of nerve conduction sometimes correlated with height of serum creatinine level, the velocity is not predictable in a given patient. Values in Table II indicate that there is major involvement of the motor segment of the Median nerve. There is statistically significant difference in DML, CMAP and MCV values in the CRF patients in comparison with the control patients. Table III shows that there are statistically significant differences in SNAP and SCV values of median nerve indicating involvement of sensory segments also. The high incidence of involvement of median nerve may result from the fact that because the median nerve evoked potential was obtained from the abductor pollicis muscle and index finger by stimulating the wrist joint, the median nerve DML and MCV might have been affected by median neuropathy because of asymptomatic carpal tunnel syndrome^[8]. The forearm motor nerve conduction velocity, which represents the function of the nerves proximal to the carpal tunnel, also decreased. This decrease may be explained by (1) development of retrograde degeneration of the nerve fibers and (2) selective injury of the thick fibers by the mechanical compression at the entrapment point. Therefore, the effect of entrapment neuropathy on the median nerve impedes evaluation of the severity of uremic neuropathy using the upper extremities. (IV)The lower extremities allow precise evaluation of severity of uremic neuropathy because they rarely develop tarsal tunnel syndrome, which is an entrapment neuropathy^[9]. The most commonly affected parameter in the present study was sural SNAP amplitude, which was abnormal in higher percentage of patient consistent with lower limb predisposition of neuropathy. It is consistent with previous studies which show pronounced involvement of lower limb^[10] Seventeen patients (56.7%) out of 30 showed abnormal sural SNAP value. Fifteen patients (50%) out of 30 patients showed abnormal sural SCV value and five patients (16.7%) out of 30 patients

showed abnormal sural DSL value consistent with lower limb predisposition of neuropathy (Table-V). Previous studies showed the amplitude of sural nerve SNAP was reduced in 75% patient with a less reduction in sural nerve conduction velocity^[10]. The sensory nerve conduction studies showed reduction of the sural nerve conduction velocity, reduction of sural nerve SNAP and prolongation of sural nerve Distal sensory latency compared with normal subjects. Recording was impossible in 16.6% patient for the sural nerve. The cause of this failure may have been the effect of age because small amplitude evoked potentials of a sensory nerve are known to be affected by aging^[9]. On the other hand, Nerve conduction studies of tibia and peroneal nerve were obtained successfully in all the CRF patients. Previous studies have demonstrated that abnormalities in the late responses, namely F-waves and H-reflexes may be a sensitive marker of neuropathy in chronic renal failure. In the present study, although tibia F-wave latency was abnormal in 10% of patients but sural nerve SNAP was abnormal in 56.7% patient suggesting that sural nerve SNAP is a more sensitive parameter in patients with chronic renal failure than lower limb F-wave parameter. This finding is consistent with the finding of previous studies^[11] Electrophysiologically, mainly axonal loss and secondary demyelination can be found. The most sensitive parameters in the diagnosis of uremic neuropathy are F-wave parameters from the lower limbs, vibration detection threshold on the foot, the sural nerve sensory action potential amplitude (SNAP) and decrease nerve conduction velocity^[11]. Our findings of sural nerve conduction abnormality are consistent with the above studies. In our study CMAP value of peroneal nerve was statistically significantly ($p < 0.05$) reduced among CRF subjects then control subjects. 36.7% patient had abnormal peroneal CMAP value (Table- IV). DML value and MCV values of peroneal nerve were not significantly different than in the control groups, but 46.7% patients had abnormal DML value of peroneal nerve and the MCV showed a downward trend (50% patient had abnormal MCV table- IV). Previous studies had indicated that reduction of peroneal motor conduction velocity is reduced in 36% and CMAP was reduced in 21% of patients of CRF^[10]. So from these electrophysiological results we predict a high incidence of subclinical neuropathy in CRF patients. Findings of abnormalities of nerve conduction parameter support the hypothesis that significant electrophysiological changes are present in the peripheral nerves of neurologically asymptomatic CRF patients.

6. Limitations of the study

It was a cross-sectional study with small sample size, which doesn't reflect the scenario of the whole country.

7. Conclusion and recommendations

The results of this study suggest that Abnormalities of nerve conduction parameters are detected early in chronic renal failure patients. Sensory nerve conduction parameters are affected more than motor conduction parameters. SNAP (Sensory nerve action potential) are more frequently involved. Abnormal nerve conduction parameters seem to be related to the duration and severity of CRF. Sensory alteration develops in the feet first. Lower extremities are affected more than upper extremities. As the progress of peripheral neuropathy in chronic renal failure patient can be halted by dialysis treatment or can be reversed by early

transplantation, it should be diagnosed early in the course of chronic renal failure. Accordingly evidence of peripheral neuropathy is a firm indication for the initiation of dialysis or transplantation. In order to assure optimal care for patients with renal failure, both neurologist and nephrologist should be familiar with neurologic complications including peripheral neuropathy that almost invariably will occur in these patients. Interdisciplinary collaboration plays an important role in prevention and/or early diagnosis and adequate treatment.

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