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Original Research Article

CLINICAL AND ELECTROPHYSIOLOGICAL STUDY OF PERIPHERAL NERVOUS SYSTEM IN ELDERLY PEOPLE

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Abstract

Background: To study of clinical and electrophysiological study of peripheral nervous system of the people of geriatric age group. **Materials and Methods:** An observational study of Case control design was conducted at the in Dept. of Physiology, RDJM Medical College and Hospital, Turki, Muzffarpur, collaboration with Dept. of Medicine, RDJM Medical College and Hospital from July 2023 to December 2023. 60 elderly subjects of 60 yrs of age and above (40 Male subjects and 20 Female subjects were taken). Each case was also underwent detailed clinical examination of somatosensory (fine touch by wisp of cotton, crude touch by end of hammer, pain by pin, temperature by test tubes containing warm and cold water), proprioceptive by tuning fork, Motor system (Manual Muscle Test testing Muscle Power Grade) involving all major muscles of both sided upper and lower limbs and Reflexes (superficial & Deep) by hammer. **Result:** No significance was obtained regarding any neurological symptom of normal aged people. Out of all clinical examination parameters only reduced vibration sense and absent ankle reflex were significant (P value <0.05) findings in elderly cases in comparison to control. But no significant P value was found to be occurring between cases of Normal Glucose Tolerance and cases of Impaired Glucose Tolerance. **Conclusion:** Treating metabolic impairment like glucose intolerance should not be the therapeutic target to prevent or cure the age related peripheral nerve dysfunction.

INTRODUCTION

Life span is an idealised, species specific biologic parameter that quantifies maximum attainable age under optimal environmental conditions. Historical anecdote suggests that human life span has remained constant for past 20 centuries. In contrast life expectancy describes an empirical estimate of typical longevity under prevailing or predicted circumstances. Advancement in medical science and health care has improved dramatically life expectancy in industrialised societies. Invasive medical and surgical procedure will continue to require a large share of social and institutional healthcare resources.[1]

In the recent decades, studies of aging theories have expanded rapidly as stimulated by increasing percentage of elderly in the population and ultimate desire of lengthening of human life span. Empirical observation and lab experiments on aging have accumulated numerous and abundant that, a special encyclopedia, The Macmillan Encyclopedia of Aging, might not have the full coverage to every single fact. To summarize and transform those facts to a comprehensive body of knowledge, a framework of aging theories is required. Currently, none of aging theories is able to explain completely all aspects of aging; instead, all theories remain as hypotheses in the scientific method of inquiries, which require further verification and complement from new information. Studying aging theories is valuable in giving broad logical perspectives to diverse bits of information; giving direction to additional research; and helping to develop practical application of knowledge.[2,3,4]

Peripheral nervous system (PNS) develops and ages in much similar ways as does the central nervous system.[9,10] It is presently difficult to ascertain whether age related PNS changes are actual primary

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age related changes of PNS or represent the consequences of more general aging features and metabolic disturbances.[5,6] Exact etiology of PNS changes in elderly has not been completely established.[7]

Nerve conduction studies, primarily nerve conduction velocities are considered one of the most sensitive indices of the severity of neuropathy. Nerve conduction tests are used to localize lesions and to describe the type and severity of the pathophysiologic process, including alterations in function that are not recognized clinically.[8]

So in the present study impaired glucose tolerance has been considered as one age related metabolic event which will be taken into account to compare the findings of clinical and electrophysiological examination between two groups of elderly people.

Aims and Objectives: To study of clinical and electrophysiological study of peripheral nervous system of the people of geriatric age group.

MATERIALS AND METHODS

An observational study of Case control design was conducted at the in Dept. of Physiology, RDJM Medical College and Hospital, Turki, Muzaffarpur, collaboration with Dept. of Medicine, RDJM Medical College and Hospital from July 2023 to December 2023. 60 elderly subjects of 60 yrs of age and above (40 Male subjects and 20 Female subjects were taken).32 subjects belonged to 7th decade, 22 subjects belonged to 8th decade, 6 cases were of 9th decade. 30 apparently healthy normal subjects of less than 40 yrs of age were taken as "control group". (20 male and 10 female subjects were taken). Before the inception of the study an application was submitted to the Institutional Ethics Committee. Cases were randomly selected from Geriatric Medicine clinic OPD Dept. of Medicine. Patients attending Geriatric Medicine clinic were screened for the presence of any potential cause of Peripheral neuropathy by history, clinical examination and relevant laboratory examination.

Study of neurophysiologic parameters on cases:

Each case was also underwent detailed clinical examination of somatosensory (fine touch by wisp of cotton, crude touch by end of hammer, pain by pin, temperature by test tubes containing warm and cold water), proprioceptive by tuning fork, Motor system (Manual Muscle Test testing Muscle Power Grade) involving all major muscles of both sided upper and lower limbs and Reflexes (superficial & Deep) by hammer.

Presence of sensory signs, their extension and their site of distribution were noted.

A. Neurological Symptoms:

(a) Sensory symptoms:

1. Presence of:

Paresthesia (tingling), numbness, neuropathic pain (aching, burning, stabbing), myalgia or cramps.

2. Distribution of symptoms:

Symptoms limited to the tips of fingers or toes/
Symptoms extended to ankle or wrist/
Symptoms extended to above ankle or above wrist to the level of knee or elbow/ Symptoms extended above knee or elbow.

(b) Motor symptoms:

Difficulty in hand dexterity (buttoning, writing, tying shoe laces, opening tight jars, inserting key in lock), Difficulty in walking (unsteady on feet, walking on tip of toes, operating pedals in car),
Difficulty in climbing upstairs,
Difficulty in combing hair or reaching up to a high shelf.

Degree of difficulty: Mild, Moderate, Requiring assistance, Loss of function.

B. Neurological examination:

Clinical examination of Peripheral nervous system:

(a) Sensory system:

(1) Somatosensory:

(i) Decreased or absence of fine touch sensation-
in index finger or great toe/
up to ankle or wrist/
up to elbow or knee/
above the level of knee or elbow
Distribution of signs Symmetrical or Asymmetrical.

(ii) Decreased or absence of crude touch sensation-
in index finger or great toe/
up to ankle or wrist/
up to elbow or knee/
above the level of knee or elbow.
Distribution of signs Symmetrical or Asymmetrical.

(iii) Decreased or absence of pain sensation-
in index finger or great toe/
up to ankle or wrist/
up to elbow or knee/
above the level of knee or elbow.
Distribution of signs Symmetrical or Asymmetrical.

(iv) Decreased or absence of temperature sensation-
in index finger or great toe/
up to ankle or wrist/
up to elbow or knee/
above the level of knee or elbow.
Distribution of signs Symmetrical or Asymmetrical.

(2) Proprioceptive:

(i) Decreased or absence vibration sensation-
in index finger or great toe,
up to ankle or wrist,
up to elbow or knee,
above the level of knee or elbow.
Distribution of signs Symmetrical or Asymmetrical.

(ii) Presence or absence of joint position sense.
Distribution of signs Symmetrical or Asymmetrical.

(b) Motor system:

Inspection:
Presence of muscle atrophy,
Abnormal movement like tremor.
Palpation:

(i) Test of muscle tone.

(ii) Manual Muscle Test to test Muscle Power:

Grade 0: Complete paralysis,
Grade 1: Flicker of contractions,

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Grade 2: Contraction after the effect of gravity is excluded.
Grade 3: Contraction against the force of gravity but not against the resistance.
Grade 4: Contraction against the resistance but of moderate degree,
Grade 5: Normal Contraction of full strength.
(c)Reflexes:
(1) Superficial Reflexes:
Abdominal reflex: Present or absent on each side,
Plantar reflex: Present or absent on each side.
(2) Deep reflexes:
Left side Right side
Biceps jerk:
Triceps jerk:
Knee jerk:
Ankle jerk:
Degrees or status of tendon jerks:
++++: Clonus,
+++: Exaggerated,
++: Normal,
+: Hyporeflexive,
_: Absent.
Each case underwent neuroelectrophysiological examination of the peripheral nervous system using Instrument for Neuroelectrophysiology tests "RMS Aleron 201 Electromiograph"
Nerve conduction velocity (NCV), Compound Motor Action Potential (CMAP) determination of motor components of Median and Ulnar nerve of upper limbs and Tibial & Deep Peroneal nerves of lower limbs and NCV and Sensory Nerve Action Potential (SNAP) determination of sensory component of median, ulnar nerves of upper limbs and sural nerve of lower limbs were determined.
For nerve conduction studies surface electrode, electrolyte jelly, electrical stimulator was used. Motor Nerve Conduction or MNC studies were done on right sided upper and lower limb, Sensory Nerve Conduction or SNC studies were done on left sided upper and lower limb. The unilateral side of the limb has been chosen arbitrarily to simplify the electrophysiological tests for easy execution, better patient compliance and to avoid time consumption.
For upper limb motor nerve conduction wrist (S1) and elbow (S2) stimulation and lower limb motor nerve conduction ankle (S1) and knee (S2) stimulation were applied. To determine Conduction Velocity measuring tape was used to measure the distance in mm between S1 and S2. Conduction velocity was determined dividing the measured distance by the difference of latencies of S1 and S2 stimulation.
In sensory nerve conduction studies, ring electrode was used on upper limb but surface electrode for sural nerve and single site stimulation was given. Distance between recording electrode and point of stimulation was measured to determine Conduction Velocity.

Studies on Control

Controls were selected randomly from students attending classes under Dept. of Physiology, RDJM Medical College and Hospital, Turki, Muzaffarpur. Total 30 controls were recruited in the study comprising male subjects (n=20) and female subjects (n=10).
At the end of the period of the study, results were statistically analysed using suitable statistical tests. Reference from books,[7,8] help of Biostatistics computation website,[9] application of Statistical Softwares like 'epiInfo' and 'Statistica version 6',[10,] were taken.

RESULTS

The study was performed taking 30 normal healthy subjects of <40 yrs of age as control and 60 healthy elderly subjects of more than 60 yrs of age as cases. [Table 1]
Methodology involved a case control study to include normal healthy elderly subjects of more than 60 yrs of age (Geriatric age group) not being suffering from any potential cause of peripheral neuropathy as 'cases' and <40 yr old normal healthy young subjects as 'control'.
Only normotensive and normolipidemic subjects were included in both 'control' and 'case' group. Total 60 elderly subjects (male: n=40, female: n=20) were taken as 'cases' and total 30 (male: n=20, female: n=10) normal healthy young subjects were taken as 'control'.
Neuroelectrophysiological examination involving determination of Nerve Conduction Velocity (NCV), Compound Motor Action Potential (CMAP) was done for motor component of median and ulnar nerve of right upper limb and tibial and deep peroneal nerve of right lower limb and NCV and Sensory Nerve Action Potential (SNAP) determination was done for median and ulnar sensory nerve of left upper limb and sural nerve of left lower limb. Above mentioned neuroelectrophysiological examination was done by- 'Aleron 201 RMS Electromiograph' machine.
No significance was obtained regarding any neurological symptom of normal aged people. Out of all clinical examination parameters only reduced vibration sense and absent ankle reflex were significant (P value <0.05) findings in elderly cases in comparison to control. But no significant P value was found to be occurring between cases of Normal Glucose Tolerance and cases of Impaired Glucose Tolerance.
Regarding electrophysiological parameters statistically significant (<0.05) P value was found between observed result of each of the parameter of NCV, CMAP and SNAP of cases and control; Mean values of Conduction Velocity and Amplitude of nerve action potential of elderly subjects were in lower range than those of the control. But no P value was found to be significant between NGT cases and IGT cases.

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Table 1: Genderwise distribution of the study group

Age group (yrs)	Male	Female
<40	N=20 (66.67%)	N=10 (33.33%)
60 - <70	N=20 (62.5%)	N=12 (37.5%)
70 - <80	N=14 (63.33%)	N=8 (36.67%)
≥ 80	N=6 (100%)	N=0

DISCUSSION

It is obvious that to explore the age related physiological changes a comparison should be made of the finding between elderly subjects and young healthy normal subjects.

So, 60 elderly subjects of Geriatric age group i.e. more than 60 yrs of age were taken as 'cases'; and 30 young healthy normal subjects of less than 40 yrs of age were taken as 'control'.

Although utmost effort has been made to make the span of age of the cases to extremes of age of Geriatric age group but unfortunately some practical considerations have been faced during subject recruitment at Geriatric Medicine clinic. The most of the patients attending the Geriatric Medicine OPD were Diabetic so falling in the zone of exclusion criteria. There was also scarcity to get very old normal subjects of 9th decade. So after exhaustive trial over the study period only 60 elderly subjects were available to include in the Cases. Mean age of them being 68 yrs. Male and Female subjects were randomly selected from study population and ratio of Male: Female in both Case and Control group was kept equal i.e. 2:1

The Peripheral nervous system includes 12 pairs of cranial nerves and 31 pairs of spinal nerves as well as Autonomic Nervous System.

Thorough clinical examination of the Somatosensory, Proprioceptive, Motor function and Reflexes of both control and cases as well as detailed Electrophysiological examination of relevant peripheral nervous system were done.

Comparing the clinical result of neurological symptoms with the control and analysing by Fisher's exact test P value of each of the clinical parameter was found to lie above 0.05. So no significant P value was found in statistical analysis of the parameters of neurological symptoms comparing the cases with the control.

Muravchick Stanley,[11] commented that overall aging produces generalised deafferentation due to progressive increase in mechanical and neuronal activation threshold needed for sensations like touch, pain and temperature.

Dani Su, Hori A, Valter GF et al,[12] in their book wrote as people age, peripheral nerves may conduct signals more slowly. Usually, this effect is so minimal that no change in function is noticeable. As nerves degenerate, the senses may be affected.

Boss GR, Seegmiller JE in their study,[8] said that the rate of aging is the same for a 45-year-old man as it is for an 85-year-old man; the difference is that by 85 years of age more age related changes have accumulated. An important concept not widely appreciated is the distinction that must be made between the normal attrition of function occurring in all persons with advancing age and the loss of function that marks the onset of pathological changes from one or more of the diseases encountered with increased prevalence in the older age group. So in the present study although presence of neurological symptoms were not usual occurrence among 60 elderly subjects; but taking a large number of elderly subjects particularly cases of more than 80 yrs of age as good sample size it would be more easier to conclude whether people of geriatric age group are neurologically silent or not.

Reduced Pain sensation upto the level of ankle was observed only in 80yr old 1 Male subject with normal glucose tolerance. Only 1.6% cases complained of reduced pain sensation.

Somatosensory findings among the other elderly subjects of 7th and 8th decade were within normal limit.

Table 5A of the 'Result' section proves that abnormalities in perception of somatic sensations were not noticeable findings among the elderly people except in very few of the small sample of very elderlies of 9th decade.

Table 5A suggests that reduced vibration sense was the significant finding in total 15.39 % cases.

Mold et al said in their study,[13] that peripheral neurologic deficits are commonly found during physical examination of older patients. In fact, losses of vibratory sensation and ankle reflexes are so common that they are often listed in geriatric textbooks as normal physical findings in very old people.

Bouche P, F Cattelin, O Saint Jean in their study,[14] expressed their result of clinical study stating that impairment of vibration sense was found in 37% subjects and 41% subjects of less than and more than 80 yrs of age respectively.

In the present study reduced vibration sense was significant finding among total 15.39% of elderly people; although no abnormality was found regarding joint position sense.

Analysing the result of cases and control in table 5A only P value of reduced vibration sense was found to be 0.048 i.e. <0.05 or statistically significant. That stands for reduced vibration sense was significant finding among the elderly subjects which obeys the findings of previous studies. No abnormalities of joint position sense was observed.

Motor weakness of grade 4 muscle power was noted in only 1 80 yr old elderly male with normal glucose tolerance i.e. only 1.67% cases in the table 5B of

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'Result' section had motor sign leaving no clue of motor function abnormalities in the geriatric age group because no statistically significant result was obtained regarding this parameter.

In the present study in the table 5B reduced (+) ankle jerk was observed in only 2 cases i.e. 3.33% cases but no significant P value was found of this parameter.

Absent ankle jerk was observed in 19% of cases of below 80 yrs in the study of Bouche P et al,[15] and 50% of cases of more than 80 yrs of age shown the absence of ankle jerk in their study.

In the present study absent ankle jerk was significant finding being 43.33% among elderly people as a whole; but superficial reflexes and other deep tendon jerks were not found to be affected. Result of statistical analysis regarding absence of ankle jerk between cases and control in table 5B shown significant P

Regarding the analysis of electrophysiological data between cases and control P value of each and every parameter of nerve conduction velocities (NCV) and amplitude (CMAP and SNAP) of nerve action potential (i.e. motor component of median and ulnar nerve of upper limb and sensory component of median and ulnar nerve of upper limb as well as motor component of tibial and peroneal nerve of lower limb and sensory component of sural nerve of the lower limb) was found to be statistically significant. From the descriptive result of electrophysiological study it was obvious that mean values of the NCV data of each of the sensory and motor nerves of the elderly cases were 2-3 m/s lower than the mean of the control group. NCV values were also found to be gradually declining with advancement of age from the age group of 7th decade to age group of 9th decade. An overview of such findings can be obtained from the grand charts of the result of cases given in the appendices.

Mean values of Amplitude of Nerve action potential (Compound Motor Action Potential or CMAP and Sensory Nerve Action Potential or SNAP) were also found to be reduced in the elderly cases than young controls. Amplitude was also found to be gradually declining with age.

So the above analysis imparts a positive inference to reject the null hypothesis concluding the finding of significant alteration of nerve conduction parameters among the elderly people.

Authors Dani Su, Hori A in their book had written that "Peripherally aging is associated with loss of motor, sensory and autonomic nerve fibers. Afferent and efferent nerve conduction velocities and the rate of signal processing within brain stem and spinal cord decline progressively."[16] Muravchick Stanley said that "as people age, peripheral nerves may conduct signals more slowly. Usually, this effect is so minimal that no change in function is noticeable."[11]

Bouche P, F Cattelin, O Saint Jean in their study also commented in their result that "We found a decrease in motor and sensory NCV in our group of cases less than 80 yrs of age close to the result obtained in other studies. However, all studies showed a clear decline in amplitude with age and our study confirms the importance of this decrease in very old subjects."[4,5]

Although elderly subjects were found to be neurologically asymptomatic, but significant alteration of values of electrophysiological parameters of peripheral nervous system of elderly people was found in the present study. This way the findings of the present study consolidates the fact that electro physiologically peripheral nerve dysfunction is the significant finding of aged people although neurological symptoms and signs are less obvious.

CONCLUSION

It is established that peripherally aging is associated with loss of motor, sensory and autonomic nerve fibres. The rate of signal processing within brain stem and spinal cord decline progressively. This structural change of peripheral nerves with aging may be the cause of impairment of peripheral nerve conduction and impairment of sensation and loss of reflex as found in the present study. Treating metabolic impairment like glucose intolerance should not be the therapeutic target to prevent or cure the age related peripheral nerve dysfunction because no significant association between two geriatric pathophysiology changes could be established from the present study.

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