The Role of Hyperlipidemia on Nerve Conduction

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Background: Previous reports suggested a relationship between hyperlipidemia and neuropathy as a cause of focal neuropathy or generalized poly-neuropathy. Only few cases were reported and they are often involved individuals with other illnesses which cause neuropathy, such as diabetes mellitus, hypertension, hyperuricemia and fatty liver.

Objective: To study the association of peripheral neuropathy with hyperlipidemia and to detect the type of peripheral neuropathy and its distribution.

Design: Prospective study.

Setting: Neurophysiology unit in Basra teaching hospital and the department of physiological chemistry, College of Medicine, University of Baghdad.

Method: Sixty-eight patients (38 males and 30 females) aged 25-77 years with a mean age of (48.9±13.5) years. Forty-two healthy subjects (24 males and 18 females) of matching age were enrolled as control. Biochemical investigations included lipid profile, post parandial blood glucose, blood urea, serum creatinin and uric acid.

Electrophysiological investigations included:

١. **Sensory nerve conduction study: measurement of sensory latency, amplitude and conduction velocity of median, ulnar, common peroneal and posterior tibial nerves bilaterally.**
٢. **Motor nerve conduction study: measurement of latency amplitude and conduction velocity of the CMAP of median, ulnar, common peroneal and posterior tibial bilaterally.**
٣. **F-wave conduction study: measurement of minimal f-wave latency and conduction velocity of median and common peroneal nerves bilaterally.**

Result: The result of the sensory nerve conduction study revealed variable levels of significance between measured parameters of the same nerve and between different nerves. As for the motor nerve conduction study and f-wave conduction study, they were all normal and with no abnormality that could be elicited.

Conclusion: Hyperlipidemia could be associated with subclinical peripheral neuropathy which may occur more frequently in patients with very high levels of TG, TC and LDL. The type of peripheral neuropathy that occurs is mainly a sensory type, although motor neuropathy cannot be excluded.

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Hyperlipidemia is a common metabolic disease characterized by abnormal lipid metabolism in which one of the major plasma lipids-cholesterol (free esterified form) and triglycerides is/are elevated[1]. Recently the incidence and the prevalence of hyperlipidemia increased greatly which increases the risk of coronary heart disease.

Metabolic disease affect all systems in the body including the peripheral nervous system but there is a controversy whether to consider hyperlipidemia as a cause of peripheral neuropathy or not[2]. Many reports had suggested that hyperlipidemia can cause focal mono-neuropathy or generalized ploy- neuropathy. However only few cases were reported and they are often involved individuals with other illnesses that may cause neuropathy such as diabetes mellitus, hypertension, hyperuricemia and fatty liver[3].

The proportion of hyperlipidemic patients with poly-neuropathy is unknown[4,5]. Therefore, this study was performed to asses the relationship of peripheral neuropathy with hyperlipidemia and to detect its distribution.

METHOD

This is a prospective study, performed between July 2005 to April 2006. Sixty-eight patients are included in the study (38 males and 30 females), age range 25-77 years with a mean age of (48.9±13.5) years. No one had any medical condition to be associated with poly-neuropathy, unusual dietary habits, family history of peripheral nerve disease, or consumed alcohol or drugs with potential neurotoxic effects. No one received any lipid lowering agents before the electrophysiological examination. They were carefully examined by a senior physician and showed no neurological or dysautonomic symptoms or signs. Forty-two healthy subjects (24 males and 18 females) of matching age were enrolled in this study as control. Biochemical investigations included lipid profile post parandial blood glucose, blood urea, serum creatinin and uric acid.

Computerized Micromed EMG system plus myoquick was used in all the electrophysiological analyses using surface stimulating and recording electrodes.

The electrophysiological study included:

١. Sensory nerve conduction study (SNCS): measurement of sensory latency, amplitude and conduction velocity for median, ulnar, common peroneal and posterior tibial nerves bilaterally.
٢. Motor nerve conduction study (MNCS): measurement of latency amplitude and conduction velocity of the compound muscle action potential (CMAP) for median, ulnar, common peroneal and posterior tibial nerves of both sides bilaterally.
٣. F-wave conduction: measurement of minimal f-wave latency and conduction velocity of median, and common peroneal nerves bilaterally.

RESULT

Twenty one patients (31%) had abnormal electrophysiological results as seen in table 1.

Table 1: Percentage of Patient with Abnormal NCS Results in Each Age Group

Age group	Male		Female		Total	
	No	%	No	%	No	%
15-34	2	9.52	1	4.76	3	14.28
35-65	9	42.58	5	23.8	14	66.66
> 65	2	9.52	2	9.52	4	19.04
Total	13	61.9	8	38.09	21	100

A comparison is made between the data obtained from the right side of the body with those of the left side; no significant difference can be noticed in all the parameters measured and for all tested nerves.

The results of SNCS revealed variable levels of significance between measured parameters of the same nerve and between different nerves. Variation from the normal evoked response is due either to prolongation of distal sensory latency, reduction in amplitude, decrease in conduction velocity or combination of all in comparison with the same measured parameters of control group (Table 2).

Table2: Results of SNC Study of Patients and Controls with their Level of Significance

	subject	no	Rt. Median N mean±SD	Rt. Ulnar N mean±SD	Rt. Com. P.N. mean±SD	Rt Post T.N. mean±SD
DSL (m/sec)	Patients	68	2.65 ± 0.58	2.44 ± 0.5	3.52 ± 0.88	3.6 ± 0.69
	Control	42	2.44 ± 0.17	2.29 ± 0.16	3.05 ± 0.22	3.12 ± 0.27
	P value		S	NS	HS	HS
Amplitude(μv)	Patients	68	22.63 ± 5.5	20.75 ± 3.6	9.65 ± 2.97	9.92 ±3.75
	Control	42	25.25 ± 2.2	22.04 ±1.7	11.07 ± 1.37	11.66 ± 1.81
	P value		HS	S	HS	HS
C.V. (m/sec)	Patients	68	57.34 ± 7.1	57.55 ± 6.7	47.7 ± 8.19	47.88± 8.01
	Control	42	59.67 ± 3	59.41 ± 3.4	51.48 ± 4.55	51.61 ± 3.97
	P value		S	NS	HS	HS

Fifteen patients had abnormal posterior tibial nerve, result, 14 patients had abnormal common peroneal nerve result, 8 patients with abnormal median and 5 patients with abnormal ulnar nerve result, (Table 3).

Table 3: SNCS of Each Tested Nerve

Nerve	DSL		Amplitude		C.V.	
	No	%	No	%	No	%
Rt Median N	8	11.76	8	11.76	8	11.76
Rt. Ulnar N	5	7.35	5	7.35	5	7.35
Rt.Com. P.N.	14	20.58	14	20.58	14	20.58
Rt Post T.N.	15	22.05	15	22.05	15	22.05

MNCS and F-wave conduction study were normal and no abnormality could be elicited.

The results of the biochemical assay revealed highly significant differences in mean values of lipid profile for the two patients' subgroups as compared with the control group, (Table 4).

Table 4: Comparison of Lipid Profile between Patients' Subgroups and Control Group

	Control mean±SD (no.=41)	Patients with normal sensory NCS mean±SD (no.=47)	Patients with abnormal sensory mean±SD (no.=21)
TC	109.85 ± 15.01	243.27 ± 23.58**	251.09±16.32**
TG	93.26 ± 17.88	323.25 ± 40.35**	329.42±35.87**
LDL	17.55 ± 12.9	137.117 ± 24.13**	145.60±16.53**
HDL	73.64 ± 7.43	41.51 ± 7.153**	39.61±7.01**
LDL/HDL	0.24 ± 0.18	3.46 ± 1.09**	3.83±1.02**
VLDL	18.65 ± 3.57	64.64 ± 8.04**	65.87±7.17**

** Highly significant differences in comparison with control group $p<0.01$.

DISCUSSION

The data from the studied series clearly demonstrate that sensory neuropathy may occur in patients with Hyperlipidemia but usually of subclinical type, which can be presented more frequently in patients with very high mean serum level of TG, TC and LDL. However, although motor neuropathy could not be traced in the patients included in this study, but this can not be ruled out completely especially at very high triglycerides and cholesterol levels.

Meanwhile duration of the disease process might affect the results because the turnover rate of lipids in the myelin is slow. The amplitude of the sensory nerve action potential was affected more than the distal sensory latency and conduction velocity which was the first parameter to be affected; the underlying mechanism of that is mixed axonal degeneration and segmental demyelination[6,7,8]. However, segmental demyelination is thought to be secondary to the axonal degeneration[9]. The electrophysiological abnormalities were found to affect both sides of the body equally, which indicate that the peripheral neuropathy associated with hyperlipidemia is of symmetrical type[10]. Median nerve was affected more frequently than ulnar nerve, while the common peroneal and posterior tibial nerves are affected to a certain degree equally. Beside that, the affection of nerve of lower extremities was more than that of the upper extremities, indicating that the effect of hyperlipidemia on the long nerves is more than that of the short nerves[11].

At the same time, the effect was found to be distal while the proximal segment is usually spared as its function was assesed by measurement of F-wave latency and conduction velocity which were normal. Many theories had been postulated to explain the possible relationship between lipid disorders and peripheral neuropathy; one of them assumes that the structure of lipids is involved because of the abnormal serum lipid as in Bassen-Korzweing syndrome[7]. Since the turn over of lipids in the outer layers of the myelin sheath is considered to be rapid than the inner layers, there is a great possibility that serum lipid abnormality have a direct effect on cell membrane and might influence the structure of outer layers of myelin sheath[12]. Another study suggests that the function and structure of the nerve could be affected by abnormal serum lipids by two mechanisms: one of them is by the action of lipoproteins as enzyme cofactors and as bound intermediate in the biosynthesis of polysaccharide and proteins, or because abnormal serum lipids could mediate nerve infarction via fat embolism or lipid induced platelet aggregation[13].

CONCLUSION

Hyperlipidemia could be associated with subclinical peripheral neuropathy which may occur more frequently in patients with very high levels of TG, TC and LDL. The type of peripheral neuropathy that occurs is mainly a sensory type, although motor neuropathy cannot be excluded.

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