Case report **Physiology**

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A CASE STUDY ON LEAD POISONING AND PERIPHERAL NEUROPATHY.

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ABSTRACT

Lead poisoning has been recognized as a major public health risk, particularly in developing countries. The exposure to lead has as special consequence on neurotoxicity. A 49 year old man had been working in a printing press, 10-12 hours daily for 15 years. He got admitted to hospital for nausea and vomiting. He also complained of numbness and tingling sensation on both sides of both lower limb Haematological and clinical findings were indicative of lead toxicity. His lead levels were investigated which showed abnormally high levels (4.20 mmol /L (75.6 µg /100 ml). The nerve conduction studies revealed decrease motor nerve conduction (MNCV) common peroneal and tibial nerves of both lower limb, all other peripheral nerves had normal activity. This case was finally treated as lead toxicity with peripheral neuropathy. The important and interesting fact about this case study is that toxicity of lead was accidentally discovered in a patient who was admitted to hospital with vague complaints. We recommend frequent lead testing in workers of printing press before they become symptomatic.

KEY WORDS: Neuropathy, Nerve conduction, Common peroneal nerve, Tibial nerve.

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INTRODUCTION

Lead poisoning has long been recognized as an occupational hazard. The neurotoxicity of long-term exposure to low levels of lead has a special consequence on public health. Lead is regarded as a potent occupational toxin and its toxicological manifestations are well known. The non-biodegradable nature of lead is the prime reason for its prolonged persistence in the environment. The danger to public health from lead in the environment continues to be a matter of concern due to its indirect effects on the human system. Lead intoxication occurs intermittently and when it does, the source of lead is commonly in the household. Lead may act as a chemical stressor and cause breakdown of homeostatic cellular mechanisms. Exposure to lead interferes with a number of body functions primarily affecting the central and peripheral nervous, systems [1]. Nerve conduction studies (NCS) are used to assess peripheral nerve function. These procedures are performed to aid in the diagnosis of injuries of the peripheral nervous system [2].

METHODOLOGY

Nerve conduction study (NCS) was carried out in a quiet room in a neurophysiology laboratory at a temperature of 26^0 to 30^0C by using Neuroperfect-2000. The nerves (median and radial for motor and sensory) in upper limb and the nerves (common peroneal, tibial for motor and sural for sensory) in lower limb were stimulated subcutaneously along their course where they are relatively superficial. The skin resistance was reduced by rubbing with spirit swab; The nerve conduction examination was done by stimulating these nerves at specific sites, The intensity of stimulus was increased gradually until the muscle action potential is viewed The time it takes for the stimulus to be sensed by the recording electrodes was recorded. E-1 is placed over the mid-portion of a muscle belly to record the distal motor latency (DML). The motor nerve action potential (MNAP) was recorded at their respective places. To record the sensory nerve action potential (SNAP) the recording electrode was placed directly over the nerve. The nerve conduction velocity (NCV) is calculated by measuring the distance between stimulation and recording sites and then dividing by the latency difference.

TABLE 1
MNCV (Upper and Lower limb)

NERVE	Rec – Stim Site	Distance (mm)	Latency difference(ms)	NCV(m/s)
Rt. CPN	EDB- ANKLE	80	2.5	32.00
	EDB-FIB.HEAD	430	14.25	30.45
Lt. CPN	EDB- ANKLE	80	4.38	18.26
	EDB-FIB.HEAD	430	12.37	34.76
Rt. PTN	Abd. Halls- ANKLE	110	4.88	22.54
	Abd. Halls- POP. FOSSA	430	15.62	27.53
Lt. PTN	Abd. Halls- ANKLE	100	5.00	22.00
	Abd. Halls- POP. FOSSA	430	11.25	38.22
Rt. Median	APB-WRIST	83	2.40	34.58
	APB-ELBOW	240	4.12	58.25
Lt. Median	APB-WRIST	72	2.70	26.66
	APB-ELBOW	245	4.22	58.53
Rt. ULNAR	ADM-WRIST	80	2.99	26.75
	ADM-ELBOW	250	4.87	51.33
Lt. ULNAR	ADM-WRIST	80	2.75	25.45
	ADM-ELBOW	240	4.40	54.54

TABLE 2
SNCV (Upper and Lower limb)

NERVE	Rec – Stim Site	Distance (mm)	Latency difference (ms)	NCV (m/s)
Rt. SURAL	Laterals Malls-MID CALF	180	2.88	62.50
Lt. SURAL	Laterals Malls-MID CALF	170	2.70	62.96
Rt. Median	2nd Digit -WRIST	135	1.70	79.41
Lt. Median	2nd Digit- WRIST	140	1.60	87.50
Rt. ULNAR	5th Digit - WRIST	145	1.75	82.85
Lt. ULNAR	5th Digit - WRIST	120	1.55	77.41

Figure 1
Blue lining at the dental margin of the gums.

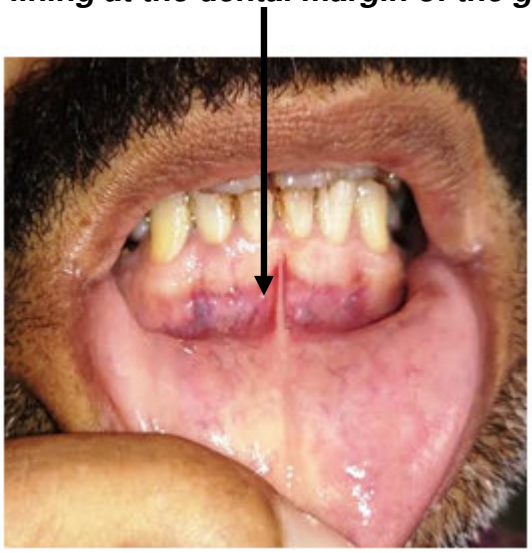
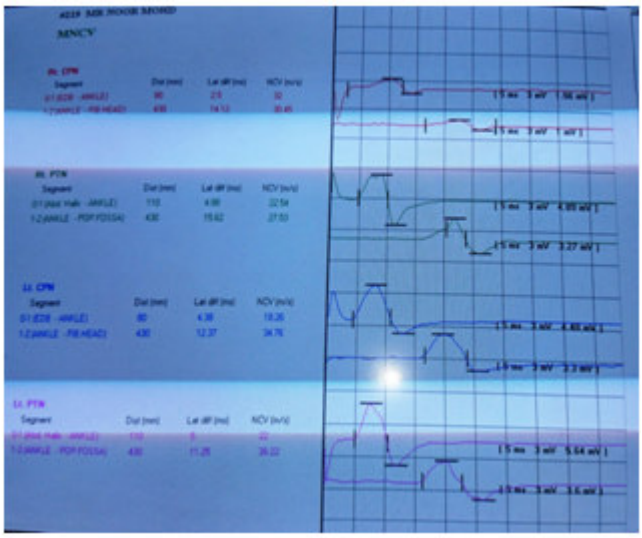


Figure 2
MNCV and SNCV recording of Lower Limb.



Case report

We reported one case of lead poisoning caused by leaded printer cartridge. A man of 49 years old was working in a printing press for 10-12 hrs daily since past 15 years. He complained of head ache and vomiting as well as feeling of numbness and tingling sensations in both lower limbs. He was referred to the hospital for treatment where he got admitted. He gave the history of muscle and joint aches with fatigue, constipation and occasional abdominal colic. Physical examination showed mild abdominal tenderness and abnormal neurological examination. Investigation by the patient's general practitioner showed a blood lead level 4.20 mmol /L (75.6 µg /100 ml), Patient also had a blue line at the dental margin of the gums (Figure: 1) due to deposition of lead sulphide. Blood results were as follows: haemoglobin (Hb) 9.8 g/100 ml, mean corpuscular volume (MCV) 72.0 fL, white cell count (WCC) 12.5 X 10^9/L, Platelet count 225X10^9/L. Serum electrolytes and liver function tests were normal. On examination of blood film, hypochromic microcytic anaemia with basophilic stippling of erythrocytes was noted. Nerve conduction studies showed, sensory nerve conduction (SNCV) to be normal in median (right and left) and ulnar nerve (right and left) of upper limb (Table 1 & 2) Whereas there was decrease in motor nerve conduction (MNCV) in common peroneal (right and left), tibial nerve (right and left) of lower limb. However, sensory nerve conduction (SNCV) of sural nerve (right and left) was normal in lower limb (Table 1 & 2).

DISCUSSION

Lead poisoning has long been recognized as an occupational hazard[3] The Control of Lead at Work Regulations[4,5] prescribes safety limits. Blood lead values <1.45 mmol/L (30 mg µg / 100 ml) represent reasonably well controlled occupational exposure. The blood–brain barrier is highly vulnerable to the toxic action of lead[6]. The earliest lead-induced morphological changes are observed in the endothelium of the micro vessels, which form the main structural component of the blood–brain barrier[7]. Electrophysiological studies showed that neurosensory processing may be affected by lead and provided a direct link between lead exposure and deficits in the neurobehavioral–performance. Lead disrupts the main structural components of the blood–brain barrier. The endothelial cells are exposed to lead during its passage into the brain [8]. The nervous system appears to be the most sensitive and chief target for lead induced toxicity[9]. Both the central nervous system and the peripheral nervous system become affected on lead exposure. The effects on the peripheral nervous system are more pronounced in adults while the central nervous system is more prominently affected in children[10]. Encephalopathy (a progressive degeneration of certain parts of the brain) is a direct consequence of lead exposure and the major symptoms include dullness, irritability, poor attention span, headache, muscular tremor, loss of memory and hallucinations. More severe manifestations occur at very high exposures and include delirium, lack of coordination, convulsions, paralysis, coma and ataxia[11].Consequences of lead exposure on the peripheral nervous system have been observed in the form of peripheral neuropathy, involving reduced motor activity due to loss of myelin sheath which insulates the nerves, thus seriously impairing the transduction of nerve impulses, causing muscular weakness, especially of the muscles, fatigue and lack of muscular coordination[12].The most commonly documented neurological symptom of lead exposure in adults is peripheral neuropathy, typically involving extensor muscle groups. One of the major reasons for lead neurotoxic effects is that it competes with or mimics the action of calcium[14]. This process affects calcium entry into cells and alters mitochondrial structure, leading to inhibited cellular respiration and altered calcium-based reactions and neuronal signalling[15]. Lead also appears to be capable of acting either as a developmental toxin in the central nervous system or as a direct toxicant on neurotransmission[16]. Lead exposure has been shown to affect all neurotransmitters in the brain, the dopaminergic, cholinergic and glutaminergic systems[17]. Previous electrophysiological studies showed that neurosensory processing may be affected by lead with decreased nerve conduction velocities in lead workers with blood lead concentrations of 1.9 mmol/ L(40 µg /100 ml), this may be the reason of observed peripheral

neuropathy of lower limb[18]. Lead directly affects the hematopoietic system through restraining the synthesis of haemoglobin by inhibiting various key enzymes involved in the heme synthesis pathway. It also reduces the life span of circulating erythrocytes by increasing the fragility of cell membranes. The combined consequences of these two processes leads to anaemia [19,20].

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CONCLUSION

It is concluded from the present study; the patient presented with symptoms consistent with, and blood lead concentrations indicative of acute poisoning, this may reason of observed peripheral neuropathy of lower limb. Insufficient observations are unable to find out exact cause about this possible diagnosis. Limitation of this finding can be overcome by further diagnosis. The important and interesting fact about this case study is that toxicity of lead was accidentally discovered in a patient who was admitted to hospital with vague complaints. Hence we recommend lead testing in the workers of printing press before they become symptomatic. So exposure of leaded cartridge represents an established source of danger.

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CONFLICT OF INTEREST

The author declared no conflict of interest.

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