Methamphetamine Related Radiculopathy: Case Series and Review of Literature

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Background: Peripheral nervous injury and neuromuscular complications from methamphetamine abuse has not been reported in peer reviewed literature so far. Clinical presentation of this disorder usually consists of flaccid paraparesis or paraplegia with sensory loss in the legs and lower thoracic dermatomes along with urinary sphincter disturbances in some occasions. In this study, we described a series of eight patients who developed lumbosacral radiculopathy following methamphetamine abuse.

INTRODUCTION

Amphetamine-like drugs are potent psychostimulants capable of producing prompt neuropsychiatric effects (1,2). While amphetamine abusers are seeking euphoria, sensual enhancement, greater physical endurance and visual illusions as desired effects; headache, nausea, tachycardia, hyperthermia, agitation, anxiety, insomnia and several neurologic complications may develop as side effects (1-3). Recreational abuse of these drugs has shown an increasing trend during recent decade in Iran (3).

Methamphetamine or N-methyl-O-phenyliso-propylamine is a lipid soluble compound which has been shown to be a powerful neurotoxin (1,4). It is available mostly in tablet form in the illicit drug market in Iran and is commonly called shisheh (/shish/ means “glass” in English). Methamphetamine abusers strive to increase the neurologic effects of the drug and want to experience an upsurge in their euphoria overtime. Therefore, abusers increase their dose either suddenly and subsequently risk acute overdose, or gradually and develop chronic complications (3-26). Expected acute neurologic complications of amphetamine abuse include seizures and ischemic or hemorrhagic cerebral accidents. The most frequent long-term complications include cognitive impairments, psychosis and Parkinsonism (Table 1).

Lumbosacral radiculopathy following methamphetamine abuse has not been reported in peer reviewed literature so far. Clinical presentation of this disorder usually consists of lumbosacral radiculopathy following methamphetamine abuse.

METHODS

During December 2009 to May 2010, 8 methamphetamine abuser who presented with lumbosacral radiculopathy were admitted to Ghaem Hospital, Mashhad Medical University of Medical Sciences. Clinical manifestations, laboratory tests (serum electrolytes, complete blood count, lipid profile, immunologic tests, serum antibodies against herpes simplex virus and varicella zoster virus, and serum B12 level), electromyography (EMG) and nerve conduction velocity (NCV) were collected from all patients. EMG and NCV were performed using Medelec MS92 (Medelec, San-ei, Tokyo, Japan) and Toennies Multiliner E (Jaeger/Toennies, Höchberg, Germany) respectively. Diagnosis was made based on history and clinical findings. All Patients declared that they have abused methamphetamine (shisheh) for at least a period of time and especially prior to admission. All of them admitted that they have abused other types of illicit drugs, especially opioids.

RESULTS

During a 5 month period, 8 methamphetamine abuser subjects who presented with lumbosacral radiculopathy were admitted to Ghaem Hospital, Mashhad Medical University of Medical Sciences. Clinical manifestations, laboratory tests (serum electrolytes, complete blood count, lipid profile, immunologic tests, serum antibodies against herpes simplex virus and varicella zoster virus, and serum B12 level), electromyography (EMG) and nerve conduction velocity (NCV) were collected from all patients. EMG and NCV were performed using Medelec MS92 (Medelec, San-ei, Tokyo, Japan) and Toennies Multiliner E (Jaeger/Toennies, Höchberg, Germany) respectively. Diagnosis was made based on history and clinical findings. All Patients declared that they have abused methamphetamine (shisheh) for at least a period of time and especially prior to admission. All of them admitted that they have abused other types of illicit drugs, especially opioids.
Archival of SID has not been completely identified. Possible causes might be direct neuronal damage or vasoconstriction due to methamphetamine (7,28). There are safety reports of patients who developed radiculopathy following methamphetamine abuse while concomitantly being treated with carboplatin or Advair Diskus 250/50 (18,19). Nevertheless, it is not clearly known whether radiculopathy in these cases was caused by the neurotoxic properties of methamphetamine or caused by deleterious interactions between methamphetamine and carboplatin or Advair Diskus 250/50. Another possible theory would be the adverse effects of the aforementioned medicines. Apart from methamphetamine, neuropathic disorders following abuse and overdose of other illicit drugs including heroin and cocaine were reported in several articles (Table 2). There were many reports regarding heroin associated plexopathy and radiculopathy (29-37). In most of these reports, brachial or lumbosacral plexopathy was accompanied by rhabdomyolysis (29,31-37). In this regard, Diaz Guzman et al. suggested the term rhabdomyolysis-lumbosacral plexopathy (RLPS) to describe lumbosacral plexopathy along with rhabdomyolysis developing shortly after intravenous heroin administration (31). The sensory and motor deficit levels may extend to the cervical region in heroin-induced radiculopathy (42,43). The prognosis is generally poor, with residual spastic paraparesis and sensory deficits, and in some patients, death may occur. Electrodiagnostic studies assist in localizing the lesions and provide a more accurate diagnosis (34,44). Almost all reported cases of neuromuscular complications have occurred following intravenous injections of heroin rather than other methods of abuse. Unsafe non-sterile injections of heroin and the use of a mixture of various substances may also be related to this pathology. Notwithstanding, some studies reported these complications after heroin was taken orally or intranasally (29,32). This suggests a systemic mechanism has not been completely identified. Possible causes might be direct neuronal damage or vasoconstriction due to methamphetamine (7,28). There are safety reports of patients who developed radiculopathy following methamphetamine abuse while concomitantly being treated with carboplatin or Advair Diskus 250/50 (18,19). Nevertheless, it is not clearly known whether radiculopathy in these cases was caused by the neurotoxic properties of methamphetamine or caused by deleterious interactions between methamphetamine and carboplatin or Advair Diskus 250/50. Another possible theory would be the adverse effects of the aforementioned medicines.

Table 1. Neurologic complications following abuse of amphetamine-like drugs

<table>
<thead>
<tr>
<th>Neurologic Complications</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seizure</td>
<td>3,5,7-9</td>
</tr>
<tr>
<td>Cerebral Ischemia (Stroke),</td>
<td>3,5,7-14</td>
</tr>
<tr>
<td>Cerebral hemorrhage (ICH, SAH)</td>
<td>7,9,10,15</td>
</tr>
<tr>
<td>Serotonin Syndrome</td>
<td>16</td>
</tr>
<tr>
<td>Bruxism</td>
<td>3</td>
</tr>
<tr>
<td>Optic nerve atrophy (peripheral neuropathy)</td>
<td>17</td>
</tr>
<tr>
<td>Transient ischemic attack</td>
<td>7</td>
</tr>
<tr>
<td>Spinal cord infarctions</td>
<td>7</td>
</tr>
<tr>
<td>Radiculopathy</td>
<td>Present study,18,19</td>
</tr>
<tr>
<td>Chorea athetoid and Dyskinesia</td>
<td>3,7,8</td>
</tr>
<tr>
<td>Cognitive impairment</td>
<td>6,9, 20-23</td>
</tr>
<tr>
<td>Parkinson’s Disease</td>
<td>5,6,9,24-26</td>
</tr>
<tr>
<td>Psychosis</td>
<td>5-9</td>
</tr>
<tr>
<td>Rhabdomyolysis</td>
<td>7</td>
</tr>
</tbody>
</table>

Admitted. The median age of patients was 26 years and five patients were male. All patients abused methamphetamine via ingestion of tablets in the past 12 months prior to admission to the hospital. No patient had a history of disc herniation or spinal trauma.

Clinical manifestations comprised of distal paresthesia of the lower extremities with progression to proximal portions, with minimal sensory involvement in the distal of the lower extremities. On physical examination, deep and superficial sensory loss was observed. Achilles tendon and patellar tendon stretch reflex were diminished or absent in all patients. Weakness of hip extension, knee flexion and plantar flexion were also evident. Decreased forces of the lower extremities with prominence of distal muscles were observed. Laboratory profiles of all patients were within normal limits. Lumbosacral magnetic resonance imaging was performed for all patients and showed unremarkable findings. EMG/NCV in all patients showed variable degrees of lumbosacral radiculopathy. Sensory nerve conduction studies were normal. Compound motor action potentials were normal except in two patients with severe damage showing diminished amplitude. F waves were normal in all patients.

At a three month follow up after discontinuation of methamphetamine, plexopathy in three patients subsided and they were able to walk. The other 5 patients showed some degrees of disability on follow-up.

**DISCUSSION**

Radiculopathy, as a subset of neuropathic disorders, is a condition in which nerve roots are adversely affected. In a majority of cases, the disorder is caused by nerve root compression as a result of disk herniation or degenerative spondylosis (27). However, radiculopathy in our patients was probably due to the neurotoxic effects of methamphetamine. The exact mechanism of neurotoxicity has not been completely identified. Possible causes might be direct neuronal damage or vasoconstriction due to methamphetamine (7,28). There are safety reports of patients who developed radiculopathy following methamphetamine abuse while concomitantly being treated with carboplatin or Advair Diskus 250/50 (18,19). Nevertheless, it is not clearly known whether radiculopathy in these cases was caused by the neurotoxic properties of methamphetamine or caused by deleterious interactions between methamphetamine and carboplatin or Advair Diskus 250/50. Another possible theory would be the adverse effects of the aforementioned medicines.
as a cause of radiculopathy rather than a local trauma.

The following causes have been proposed for heroin induced radiculopathy: (a) an allergic reaction from an unknown substance used in ‘cutting’ heroin (30,36,37,45); (b) a direct neurotoxic effect of heroin or contaminants (31,32,45); (c) an isolated vasculitis (45); (d) embolism of adulterants (45); (e) systemic hypoxia and hypotension due to border zone infarction or vascular lesion of the spinal cord (45); (f) relative ischemia of spinal column due to hypotension following hypersensitivity reaction to heroin or an adulterant (42); and (g) hyperextension injury of the neck (45). These theories can similarly be proposed for radiculopathy resulting from methamphetamine.

The role of adulterants in causing these idiopathic complications could not be ignored. In Iran, several reports confirmed adulterants in illicit drugs, with lead being the most common culprit (46-48). Lead poisoning has shown to induce radiculopathy in chronic occupational exposure (49).

In this study, patients were treated supportively by reducing pain with analgesics and post discharge physiotherapy. Currently, no specific treatment could be recommended due to the limited information about the mechanism of disease (7,30).

### LIMITATIONS

In this study, urine levels of amphetamine/methamphetamine and morphine were not reported. In addition, serum levels of lead and thallium, which are the most reported adulterants in illicit drug market in Iran, were not screened. Moreover, we could not access any of the ingested substances to chemically analyze the active ingredient. Furthermore, all patients in this study were co-abusers of opioids and methamphetamine. Hence, radiculopathy could not be exclusively attributed to either drug. Correspondingly, Nicholas et al showed that a subset of HIV infected patients with high levels of neuropathy abused significantly higher amount of amphetamines and other illicit drugs in addition to alcohol use and cigarette smoking (50).

### CONCLUSION

For patients with a history of illicit drug abuse and acute neuromuscular weakness, methamphetamine or heroin toxicity should be taken into account. Hence, urine morphine and amphetamine/methamphetamine tests should be performed and serum lead and thallium levels should be evaluated. In addition, rhabdomyolysis and myoglobinuria should be worked up. Furthermore, it seems judicious to add methamphetamine and heroin toxicity to the list of differential diagnoses of lumbosacral radiculopathy.

### ACKNOWLEDGMENT

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### CONFLICT OF INTEREST

None to be declared

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None

### REFERENCES


