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COMPRESSION-ISCHEMIC NEUROPATHIES OF THE SHOULDER GIRDLE AND UPPER LIMBS AMONG LAW ENFORCEMENT PERSONNEL – CLINICAL PRESENTATION, DIAGNOSIS, TREATMENT

MARKHAMAT YAKUBOVA
PROFESSOR, DEPARTMENT OF NEUROLOGY AND MEDICAL PSYCHOLOGY, TASHKENT STATE MEDICAL UNIVERSITY. TASHKENT, UZBEKISTAN. E-MAIL: marhamatyakubova62@gmail.com, https://orcid.org/0000-0002-0208-8013

SABOKHAT KARIMKHODJAEVA
RESEARCHER, MILITARY MEDICAL ACADEMY OF THE ARMED FORCES OF THE REPUBLIC OF UZBEKISTAN. CENTRAL HOSPITAL OF THE MINISTRY OF INTERNAL AFFAIRS OF THE REPUBLIC OF UZBEKISTAN. TASHKENT, UZBEKISTAN. E-MAIL: sabokhat17@mail.ru, https://orcid.org/0009-0002-7342-4261

NUGMANOVA UMIDA
ASSOCIATE PROFESSOR, DEPARTMENT OF HISTOLOGY AND MEDICAL BIOLOGY, TASHKENT STATE MEDICAL UNIVERSITY. TASHKENT, UZBEKISTAN. E-MAIL: nugmanova.1@mail.ru, https://orcid.org/0000-0002-3012-9812

KUSHAYEVA DILDORA
ASSOCIATE PROFESSOR, DEPARTMENT OF HISTOLOGY AND MEDICAL BIOLOGY, TASHKENT STATE MEDICAL UNIVERSITY. TASHKENT, UZBEKISTAN. E-MAIL: dildora7519@mail.ru, https://orcid.org/0009-0007-2577-3631

RAXIMOVA SHAXZODA
SENIOR LECTURER, DEPARTMENT OF HISTOLOGY AND MEDICAL BIOLOGY, TASHKENT STATE MEDICAL UNIVERSITY. TASHKENT, UZBEKISTAN. E-MAIL: shaxzodare@gmail.com, https://orcid.org/0009-0002-8834-2808

Abstract
Compression-ischemic neuropathies (CIN) are a prevalent cause of peripheral nervous system disorders, particularly in professions involving repetitive strain and physical load. This study investigates the clinical presentation, diagnosis, and treatment of CIN of the shoulder girdle and upper limbs among law enforcement personnel. The research involved 60 patients with CIN and 20 control subjects with cervical osteochondrosis without neurological manifestations. Diagnosis was confirmed through a combination of physical examination, nerve conduction studies (NCS), Doppler ultrasound of upper limb arteries, ultrasound of peripheral nerves, and MRI of the cervical spine. Patient assessments included the Visual Analog Scale (VAS), DN4 questionnaire, Neuropathy Impairment Score (NIS), and Hospital Anxiety and Depression Scale (HADS). The primary etiological factors were identified as prolonged forced positioning and repetitive movements under load, with 40% of cases co-occurring with cervical osteochondrosis. Clinical presentation was characterized by numbness (90%), reduced sensitivity (83.3%), pain (80%), and muscle weakness (75%). Following a comprehensive inpatient treatment course, significant improvements were observed in pain scores (VAS: 5.2 to 0.5), neuropathic symptoms (DN4: 4.8 to 0.7), motor function (NIS: 5.8 to 2.6), and objective parameters from NCS and Doppler ultrasound. Blood levels of insulin-like growth factor 1 (IGF-1) were found to be elevated, suggesting its potential role as a marker for nerve regeneration. The study concludes that a combined pharmacological and physiotherapeutic approach is effective for treating CIN in this high-risk group and highlights the need for optimized diagnostic, preventive, and therapeutic strategies.
Keywords: Compression-ischemic neuropathy, Tunnel neuropathy, Law enforcement personnel, Peripheral nervous system, Nerve conduction studies

INTRODUCTION

Compression-ischemic or tunnel neuropathies rank among the most prevalent disorders of the peripheral nervous system, predominantly affecting young and middle-aged individuals within the most active and productive periods of life. The prevalence of compression-ischemic neuropathies within the overall structure of neurological disorders is

9.5%, while among diseases of the peripheral nervous system it reaches 53% [10]. The literature describes more than 30 forms of tunnel neuropathies, the majority of which (80%) are associated with lesions of the upper limbs [4]. These are clinical syndromes caused by the compression of nerve trunks, blood vessels, or the neurovascular bundle in natural anatomical tunnels, or due to external pressure. Such tunnels are formed by bony structures, ligaments, tendons, fasciae, or spasmodic muscles. Tunnel neuropathies most commonly develop in the upper limbs due to the significant occupational and everyday strain on the muscles of the shoulder girdle and upper extremities [1]. They often occur in individuals whose professional activities involve prolonged repetitive strain on the muscular-ligamentous system, as well as a high risk of injury [5]. This issue is particularly relevant among law enforcement officers and military personnel, whose professional activities involve exposure to a wide range of physical and psychological factors. Prolonged, repetitive strain on the shoulder girdle muscles, as well as compression of the upper limbs during shooting practice, sports training, or carrying heavy loads while performing duty tasks, contribute to microtraumas and microhemorrhages. This, in turn, leads to scarring of muscles, tendons, ligaments, and fasciae, ultimately resulting in the narrowing of natural anatomical tunnels. According to the literature, compression-ischemic neuropathies lead to temporary and, in some cases, permanent loss of working capacity in civilians and military personnel. They are also one of the common reasons for discharge from service and changes in fitness category for military duty [6].

The pathogenesis of compression injury is based on three components: the presence of a tunnel, nerve compression, and ischemia. Each nerve has anatomical weak points that make damage more likely in a certain location, called “trap points”. Compression followed by ischemia of the nerve trunks leads to the development of focal or segmental demyelination, which clinically manifests as dysfunction of the affected fibers – motor, sensory, and autonomic disorders.

Compression-ischemic neuropathies are characterized by a relatively prolonged initial stage, marked predominantly by irritation symptoms such as paresthesia and pain. The first signs of the disease are paresthesia, which is provoked by prolonged rest and a horizontal body position. They are usually localized in the zone of distal cutaneous innervation: with compression of the median nerve - in the I-III fingers, with compression of the ulnar nerve - in the IV-V fingers. Subsequently, pain develops, which intensifies with active movements and subsides at rest. A typical symptom of a nerve tunnel lesion is the occurrence of spontaneous pain, the nature and intensity of which varies widely - from mild to severe, preventing patients from sleeping at night and limiting the range of motion of the limb. In the majority of patients, sensory disturbances of varying severity are detected within the innervation zone of the affected nerve. Motor impairments develop at later stages or in cases of prolonged disease progression, although in some instances they may precede sensory disturbances (for example, in tunnel neuropathy of the radial nerve).

The diagnosis of compression-ischemic neuropathies is based on the complex use of physical and instrumental examination methods. In addition to diagnostic tests aimed at identifying the site of compression, the diagnosis is established using electrodiagnostic and ultrasound studies, X-ray imaging, computed tomography, and magnetic resonance imaging. The treatment of tunnel neuropathies can be either conservative or surgical. An essential aspect of management includes preventive measures aimed at properly organizing work and rest schedules, ensuring functional unloading of the affected limb, and making lifestyle modifications. Patients should be educated on avoiding provoking positions and actions that contribute to nerve trunk compression. Conservative therapy includes a range of medications and physiotherapy treatments aimed at relieving pain, reducing edema and ischemia in the affected area, improving microcirculation, and promoting regenerative processes. Surgical treatment becomes relevant when conservative therapy is ineffective for three months or when patients present with severe forms of neuropathy that significantly reduce both daily and professional work capacity.

Purpose of the research

The purpose of the research was to study the clinical and neurological features and pathogenetic mechanisms of compression-ischemic neuropathies of the shoulder girdle and upper limbs among law enforcement personnel, and to improve diagnostic and therapeutic methods.

Research objective

Study of the clinical and neurological features and pathogenetic mechanisms of compression-ischemic neuropathies of the shoulder girdle and upper limbs among law enforcement personnel, and improvement of diagnostic and therapeutic methods.

METHODS

The research included patients working in law enforcement agencies with clinical manifestations of compression-ischemic neuropathies of the shoulder girdle and upper limbs. The patients were divided into two groups: the main group and the comparison group. The main group consisted of 58 men and 2 women, with an average age of 38.4±1.5 years. The comparison group consisted of 20 patients (19 men and 1 woman) with MRI-diagnosed cervical osteochondrosis without neurological manifestations. The average age of the patients was 34.5±2.5 years.

The diagnosis was established based on patient history (presence of factors leading to nerve trunk compression), their complaints, physical examination, and the results of instrumental diagnostic methods. Physical examination includes sensory and strength screening of specific nerve roots and peripheral nerves, the use of provocative tests to determine

the site of nerve trunk compression. All patients underwent NCSs, Doppler US of the main arteries of the upper extremities, US examination of peripheral nerves, and MRI of the cervical spine. During the NCS the following specific electrodiagnostic patterns were assessed: the compound muscle action potential (CMAP) amplitude, conduction velocity (CV), distal latency (DL), and other measurements. Doppler imaging of the vessels was performed using the classical technique with standard localization points [11]. A qualitative and quantitative evaluation of blood flow was conducted, including the analysis of blood flow velocity (V), resistive index (RI), pulsatility index (PI) and spectral broadening index (SBI). US examination of peripheral nerves was performed to assess the condition of the nerve trunks and surrounding tissues. During the scanning process, the anatomical integrity of the nerve trunk, its structure, and the cross-sectional area (CSA) were evaluated. MRI of the cervical spine was conducted to diagnose the degree of degenerative processes.

The physical and instrumental examination was supplemented with the results of assessment scales. The Visual Analog Scale (VAS) was used to assess the intensity of pain, while the presence of a neuropathic component was identified using the DN4 questionnaire. For the objective assessment of motor impairments, the Neuropathy Impairment Score (NIS) scale was used. The state of the psychoemotional sphere was evaluated using the Hospital Anxiety and Depression Scale (HADS; Zigmond A.S. and Snaith R.P.).

The level of insulin-like growth factor 1 (IGF-1) in the blood was determined using the immunochemiluminescent assay (ICLA). The results were interpreted according to age-specific reference values, expressed in nanograms per milliliter (ng/ml), as shown in Table 1.

Table 1 Reference values for IGF-1 in patients depending on age and gender

Name of the analysis	Normative values	Unit of measurement
Insulin-like growth factor 1	Men: 12-25 years – 231.1-406.7 26-50 years – 105.4-400.1 51-90 years – 68.0-325.0 Women: 12-25 years – 118.7-822.1 26-50 years – 48.7-407.3 51-90 years – 46.2-317.1	ng/ml

RESULTS AND DISCUSSION

As a result of the research, the main causative factors for the development of compression-ischemic neuropathies of the shoulder girdle and upper limbs among law enforcement personnel were identified. According to the analysis, in about 70% of cases, the cause of compression was prolonged forced positioning or repetitive movements under excessive physical load, which is associated with the specific demands of service in law enforcement officers. Among these cases, 40% of tunnel neuropathies developed against the background of cervical osteochondrosis. 18 patients had a history of upper limb trauma, which subsequently led to upper limb mononeuropathies in 9 cases, brachial plexus involvement in 2 cases, and combined damage to the nerves in 7 cases. According to the time of hospitalization following peripheral nerve injury, the patients were distributed as follows: acute period – 2 patients, early period – 5 patients, subacute period – 4 patients, late period – 5 patients, and long-term period – 2 patients.

Upon analysing the clinical presentation prior to the initiation of therapy, the main complaints reported by patients were numbness (in 90% of cases) and reduced sensitivity (in 83.3% of cases) in limb areas corresponding to the innervation zones of the compressed nerves. In 80% of cases, these symptoms were accompanied by pain of varying intensity. 75% of patients reported complaints of muscle weakness and fatigue. Clinically identified muscle hypotrophy was observed in 38 patients, all of whom also exhibited muscle weakness (ranging from 1 to 4 points), which showed a direct correlation with the degree of noted hypotrophy. The average pain intensity, according to the VAS score, was 5.2 points. The average score on the DN4 questionnaire was 4.8 points, indicating the presence of a neuropathic component of pain. The average score on the NIS was 5.8 points. According to the HADS, subclinical levels of anxiety and depression (8–10 points) were observed in 60% of cases.

NCSs revealed a decrease in amplitude and CV along motor fibers, as well as an increase in DL at the site of nerve compression and distally. Analysis of hemodynamic parameters based on Doppler US data of the main arteries of the upper extremities, in all cases, a decrease in blood flow velocity, along with an increase in the RI, PI and SBI. US examination of peripheral nerves assessed the dynamics of the CSA. According to MRI data of the cervical spine, 65% of patients showed degenerative changes of varying degrees with signs of compression of the spinal nerve roots, which could contribute to an increase in the susceptibility of nerve fibers to additional compression in the distal region due to impaired axonal transport.

The dynamics of the patients' condition were assessed after completing the inpatient treatment course and three months after the start of therapy. Against the background of the conducted therapy, physical examination data and the results of evaluation scales showed a reduction in the intensity of pain syndrome and the severity of sensory and motor disorders (Table 2).

Table 2 Dynamics of pain indicators and neuropathic disorders in patients during treatment

Evaluation method	Before treatment	After treatment	
VAS, points	5.2±0.2	1.8±0.2	0.5±0.2
DN4 questionnaire, points	4.8±0.2	1.2±0.1	0.7±0.1
NIS, points	5.8±0.2	3.2±0.1	2.6±0.1

During NCSs, an increase in amplitude and CV along motor fibers, and a decrease in DL values was recorded; on Doppler US, an increase in blood flow velocity was observed, as well as a decrease in RI, PI, and SBI (Tables 3 and 4).

Table 3 ynamics of nerve conduction study parameters

CMAP	Median nerve			Ulnar nerve			Radial nerve		
	before	after therapy		before	after therapy		before	after therapy	
amplitude, mV	3.8±0.2	4.0±0.2	6.0±0.1	5.3±0.2	5.78±0.1	7.2±0.2	0.9±0.2	1.1±0.2	1.5±0.3
CV, m/s	34.7±0.3	45.8±0.2	52.4±0.2	36.2±0.2	40.7±0.3	48.1±0.2	29.9±0.2	37.8±0.3	46.3±0.2
DL, ms	6.9±0.2	5.8±0.2	4.2±0.3	5.7±0.1	5.12±0.2	3.2±0.2	4.6±0.1	4.2±0.2	2.9±0.2

Table 4 Dynamics of hemodynamic parameters according to Doppler ultrasound of the main arteries of the upper limbs

Indicators	Subclavian artery			Brachial artery			Radial artery			Ulnar artery		
	before	after therapy		before	after therapy		before	after therapy		before	after therapy	
V, cm/s	51.7	58.2	62.5	40.2	45.6	50.0	16.3	18.2	20.1	15.9	17.8	19.8
RI	1.21	1.1	0.9	0.98	0.9	0.86	1.12	1.0	0.91	1.29	0.92	0.88
PI	8.2	7.81	6.5	7.68	6.9	5.97	7.1	6.88	5.21	6.4	5.62	4.97
SBI	89.1	88.2	86.5	81.7	79.6	77.4	68.5	67.1	66.7	79.3	78.1	77.2

At the end of the therapy course, US examination revealed a reduction in the CSA of the nerve compared to the baseline values. The level of IGF-1 in the blood of the examined patients was close to the upper limit of normal or above the normal age-related values, which may indicate enhanced metabolic and reparative processes.

CONCLUSIONS

Thus, compression-ischemic neuropathies of the shoulder girdle and upper limbs are the most common socially significant pathology of the peripheral nervous system, both among the civilian population and military personnel. Prolonged, monotonous load during the performance of duties and frequent injuries increase the risk of developing tunnel neuropathies among military personnel and law enforcement officers. In this regard, it is important to develop and implement into clinical practice recommendations for improving diagnostic, preventive and therapeutic measures aimed at the prevention and early recovery of compression-ischemic neuropathies. The combined use of pharmacological and physiotherapeutic interventions promotes accelerated regenerative processes and, consequently, facilitates earlier recovery. The optimization of complex conservative therapy, as well as the search for specific blood markers, is a priority area. IGF-1 may be considered as one of the potential markers in the diagnostics of peripheral nerve regeneration processes, which requires further study.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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REFEsRENCES

[1] A.A. Skoromets, “Tunnel compression-ischemic mono- and multineuropathy”. 5rd ed., revised and expanded. M.: GEOTAR-Media, 2022, p. 464.

[2] A.G. Gennadinik, A.A. Nelaeva, “The role of insulin-like growth factor-I in metabolism, regulation of cellular renewal and aging processes”. Obesity and metabolism, 2010, 7(2), pp. 10-15.

[3] A.N. Barinov, Yu.A. Merkulov, D.M. Merkulova, “Multiple axoplasmic compression syndrome: features of diagnosis and treatment of compression-ischemic neuropathies in pathology of the cervical spine”. Farmateka, 2013, №20 (273), pp. 31-41.
[4] A.V. Moskvitin et al., “Tunnel syndromes: aspects of pathogenesis, manual and drug therapy: a textbook for doctors”. State Budgetary Educational Institution of Higher Professional Education IGMU of the Ministry of Health of Russia, Department of Nervous Diseases. – Irkutsk: IGMU, 2013, p. 28.
[5] G.A. Akimov and M.M. Odinak, “Differential diagnosis of nervous diseases”. 3rd ed., revised and expanded. “Gippokrat+”, 2004, p.744.
[6] I.V. Litvinenko, S.A. Zhivolupov, A.R. Bulatov, E.E. Kuzina, E.A. Provotorov “Multilevel lesions of the peripheral nervous systems in military and naval clinical practice medicine”. Marine medicine, 2018, 4(3), pp. 26-35.
[7] M.R. Sapin, G.L. Bilich, “Human Anatomy”. Textbook for Students, vol. 2., 5rd ed., revised and expanded, 2006, p. 512.
[8] Pico Caroni and Pedro Grandes, “Nerve Sprouting in Innervated Adult Skeletal Muscle Induced by Exposure to Elevated Levels of Insulin-like Growth Factors”. The Journal of Cell Biology, vol. 110, April 1990, pp. 1307-1317.
[9] V.I. Kozlov, “Anatomy of the Nervous System”. Textbook for Students. – M.: Mir, 2006, p. 208.
[10] V. Khodulev, N. Nechipurenko. “Compression neuropathies: anatomical and physiological features, pathophysiological patterns, clinic”. Meditsinskie novosti. – 2018. – N1. – P. 27–32.
[11] Ye.B. Kuperberg, “Ultrasound Dopplerography in the diagnosis of occlusive lesions of the arteries of the brain and limbs”. Educational and methodological manual. – M.; 1996, p. 73.