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THE STATE OF THE SPINAL CORD, INFLUENCING FACTORS, AND ITS INJURY

Khaydarova Barno Israiljanovna
Senior Lecturer at the Department of Anatomy, Tashkent State Dental Institute (TSDI), Ministry of Health of the Republic of Uzbekistan, Tashkent

Azizov Ulugbek son of Davronbek
Student, Tashkent State Dental Institute (TSDI),
Ministry of Health of the Republic of Uzbekistan, Tashkent

Abstract
This article examines the peculiarities of the spinal cord and the concept of "spinal cord membranes" in children. It discusses their anatomical development, functional significance, and potential clinical consequences. By analyzing comprehensive literature, the study focuses on understanding the maturation process, methods used to study pediatric spinal cord structures, and the impact of these findings on pediatric neurology.

Keywords: Spinal cord, spinal cord membranes, pediatric neuroanatomy, development, maturation, morphology, functional impact.

Introduction

Materials and Methods of Research:

The musculoskeletal system of the human body consists of the skeleton and the skeletal muscles. Primarily, this system serves as the framework for the entire organism and acts as a protective shell surrounding the internal organs (heart, lungs, gastrointestinal system, kidneys, spleen, etc.). Movement is considered the method of existence for every living organism. This function is carried out by the musculoskeletal system.

Research Results:

All vital processes in the body are maintained within normal limits only when there is continuous movement. In experimental conditions, a model was created for spinal column injury with and without spinal cord injury, and the relationship between the limitations in musculoskeletal system activity and changes in metabolic indicators was established. Objective criteria for assessing the post-traumatic period were studied. The dysfunctions of the body's functions related to spinal column and spinal cord injuries, as well as the associated medical and social issues, remain a critical and relevant problem today [1, 2].

According to the World Health Organization (WHO) statistics, in recent years, 422 million people worldwide suffer from this disease, and the incidence continues to rise each year. According to WHO, the disease is often diagnosed only in cases of complications. Globally, the rate of diabetes among young people under the age of 18 has increased from 4.7 in 1980 to 8.5 today. Doctors

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emphasize that the number of individuals suffering from this disease will nearly double in the next 20 years.

The sharp increase in urbanization, the high development of the construction industry, and the expansion of production are contributing factors to the increasing number of injuries, including spinal column injuries, which continue to rise steadily.

Data suggests that spinal injuries are prevalent in different regions of the world, ranging from 1.7% to 8.3%【4-6】. The distinctive features of such injuries include the complexity of the pathogenesis of complications that arise due to the injury, the long-term limitation of social activity in patients, the high risk of disability, and the significant treatment costs【7, 8】.

From this perspective, developing highly informative and objective criteria that allow for the assessment of spinal column and spinal cord injuries not only helps evaluate the severity of these injuries but also enables an assessment of the scope of related complications. This, in turn, plays an important role in predicting the recovery time and completeness of the impaired functions of organs and tissues following spinal cord injury.

Spinal column and spinal cord injuries primarily involve limitations in the activity of the musculoskeletal system components. The degree of limitation in the musculoskeletal system's function is directly related to the area of spinal injury and the extent of spinal cord damage. Therefore, creating models of spinal column injuries with and without spinal cord injury is crucial for studying the mechanisms of this pathology, which are difficult to investigate in clinical settings.

Spinal cord injuries and damage to the spine lead to the development of hypoxia in the organs and tissues, activating anaerobic glycolysis pathways. This, in turn, significantly increases the concentrations of lactate and pyruvate in the blood plasma. Therefore, monitoring the increase in the concentrations of these intermediates can serve as a reliable criterion for predicting changes and complications associated with the injury【9, 10】.

Taking these facts into account, establishing the relationship between the severity of spinal injuries, the extent of spinal cord dysfunction, limitations in the activity of the musculoskeletal system, and changes in lactate and pyruvate concentrations in the plasma enables a better understanding of the disease progression, treatment efficacy, and strategies for preventing complications. Globally, the frequency of spinal cord injuries varies from 30 to 50 cases per million people. Among the injured, men of working age (20-39 years) dominate, indicating that this issue is not only of medical significance but also of social importance. Spinal cord injury is a disruption of the anatomical and physiological relationships of the spinal cord and the structures of the spinal canal (membranes, substances, spinal cord blood vessels, spinal nerves), leading to the partial or complete loss of their corresponding functions. Open spinal cord injuries may result from gunshots (shrapnel, bullets) or non-gunshot wounds (cuts, lacerations, knives, etc.).

Spinal injuries are classified into the following nosological forms:

1. Contusion of the spinal column,
2. Partial or complete rupture of the capsule-ligament apparatus of the vertebral motion segment,
3. Spontaneous recovery of vertebrae, rupture of intervertebral disc,
4. Partial and complete dislocation of vertebrae,
5. Fractures of vertebrae,
6. Combination of fractures and dislocations (fractures of vertebrae with displacements, affecting two or more adjacent vertebrae or intervertebral discs, known as multi-vertebral

injuries, or damage to two or more non-adjacent vertebrae or discs, termed multi-level spinal injuries).

The following types of injuries can occur:

- Spinal cord concussion,
- Spinal cord contusion (severity is determined retrospectively during the acute phase when spinal shock is present, typically causing complete disruption of spinal cord reflex activity for an average of three weeks),
- Spinal cord compression with the development of myelopathy (acute, early, or late),
- Anatomical rupture of the spinal cord (referred to as "complete damage" in foreign nomenclature),
- Hematomyelia (bleeding into the spinal cord or intraspinal hematoma),
- Hemorrhage in the subarachnoid space,
- Injury to the main blood vessels of the spinal cord (traumatic spinal cord infarction),
- Damage to the nerve roots of the spinal cord (these injuries are classified similarly: concussion, contusion, compression, rupture, circulatory disorders, and bleeding in the roots).

Thus, when there are bruises and deformities in the chest area, rib fractures, lung ruptures, hemothorax, and pneumothorax should be excluded. Spinal deformities in the thoracolumbar region may not only be associated with injuries to the vertebrae at that level but can also be accompanied by damage to internal organs such as the kidneys, spleen, liver, and others. Approximately 37% of individuals with spinal cord injuries die before reaching the hospital, and around 13% die in the hospital. In cases of isolated spinal cord compression, the postoperative mortality rate is 4-5%, while the combination of spinal cord compression and contusion can result in a mortality rate of 15-70%, depending on the severity of the injury, its nature, the quality of medical care, and other factors.

For spinal cord injuries caused by stab or cut wounds, complete recovery with a positive outcome occurs in 8-20% of cases, while with gunshot injuries to the spinal cord, positive recovery is seen in only 2-3% of cases. Complications arising from the treatment of spinal cord injuries worsen the progression of the disease, increase the length of hospital stay, and sometimes lead to death. Often, individuals do not die from the spinal injury itself but may succumb to paralysis (30%), pneumonia (30%), urological complications (30%), thrombembolic events, or other causes. These are approximate statistics.

Conclusions:

Spinal cord injuries refer to damage to the structures that make up the spinal cord. This can include bruising, dislocation, fractures, and torsion of the ligamentous apparatus. It is important to differentiate between vertebral injury and spinal cord injury, as spinal cord damage impacts the musculoskeletal system. A spinal cord injury refers to damage to the nervous system, which is not the same as a vertebral injury, although they are often accompanied by one another due to anatomical proximity.

In conditions of limited supraspinal control, the results of meta-studies on the state of spinal motor centers indicate that, during the early stages following traumatic injury, there is a protective inhibition associated with a decrease in reflex excitability of spinal motor neurons. Spinal shock and the degree of inhibition of reflex responses are more pronounced in severe cases of spinal cord

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injury, during which the motor responses of the lower extremity muscles do not significantly change.

It is known that local injuries that trigger secondary pathological changes lead to widespread dysfunction in large segments of the spinal cord. The apoptosis of neurons increases the loss of active neurons, and the apoptosis of glial cells leads to widespread neurodegeneration, involving both increase and decrease. There is demyelination of nerve fibers and death of some axons. The significant role of muscle tone regulation in spinal cord injury cannot be denied. Severe spinal injuries result in the loss of supportive afferentation, leading to the paralysis of the limbs, and as a result, long-term physical immobility and hypokinesia. This significantly reduces the activity (inhibition) of motor neurons, which causes muscle atonia. Muscle protein synthesis intensity decreases, and their breakdown accelerates, leading to the deterioration of the structural and functional properties of muscle fibers.

In the later stages following traumatic spinal cord injury, there is an increase in the reflex excitability of spinal motor centers against the background of the worsening condition of the peripheral neuromotor apparatus. The exact nature of this increased reflex excitability is not fully clear, but it may be a compensatory reorganization of the nervous apparatus of the spinal cord in response to a limited afferent flow. Our data suggest that changes in the parameters of motor and reflex responses have a universal character, varying in severity depending on the spinal cord injury.

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