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PROVEN BASICS OF DIAGNOSIS IN ACUTE DOUBLE NECK AREA INJURIES IN CHILDREN



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БОЛАЛАРДА ЎТКИР ҚЎШАЛОҚ БЎЙИН СОҲАСИ ШИКАСТЛАНИШЛАРИДА ТАШХИСЛАШНИНГ ИСБОТЛИ АСОСЛАРИ

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ДОКАЗАТЕЛЬНЫЕ ОСНОВЫ ДИАГНОСТИКИ ОСТРЫХ ДВОЙНЫХ ПОРАЖЕНИЙ ОБЛАСТИ ШЕИ У ДЕТЕЙ

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Резюме. *Ушбу мақола Педиатрик беморларда орқа мия ва орқа мия шикастланишларини ўрганиб, уларнинг таркибий ва биомеханик заифликларини таъкидлайди. Тадқиқот ўмуртқа устуннинг анатомик мураккаблигини ўрганиб, ўзига хос умуртқаларнинг ҳаракатчан ва камроқ ҳаракатчан орқа мия сегментлари орасидаги ўтиш нуқталарида жойлашиши туфайли синишларга мойиллигини таъкидлайди. Тадқиқотда ўмуртқа шикастланишнинг асосий механизмлари, шу жумладан тўғридан-тўғри ва билвосита шикастланишлар, сиқилиш ва ёрилиш ёриқларининг тарқалиши кўрсатилган. Бундан ташқари, у орқа мия шикастланишларини функционал ва анатомик турларга ажратади, уларнинг клиник кўринишлари ва диагностика мезонларини тавсифлайди.*

Калит сўзлар: *Педиатрик ўмуртқа травма, орқа мия шикастланиши, умуртқали ёриқлар, бачадон бўйни беқарорлиги.*

Abstract. *This article examines spinal and spinal cord injuries in pediatric patients, emphasizing their structural and biomechanical vulnerabilities. The study explores the anatomical complexity of the spinal column, highlighting the susceptibility of specific vertebrae to fractures due to their positioning at transition points between mobile and less mobile spinal segments. The research outlines the primary mechanisms of spinal trauma, including direct and indirect injuries, and the prevalence of compression and burst fractures. Additionally, it categorizes spinal cord injuries into functional and anatomical types, describing their clinical manifestations and diagnostic criteria.*

Keywords: *pediatric spinal trauma, spinal cord injuries, vertebral fractures, cervical instability.*

Introduction. The spinal column is composed of both bony and soft tissue structures, including ligaments, cartilage, and muscles. The bony framework consists of 32-34 vertebrae, which are categorized into four main regions with specific numbers: cervical (7 vertebrae), thoracic (12), lumbar (5), sacral (5), and coccygeal (3-5). Vertebrae are classified as either true or false. The sacral and coccygeal vertebrae, which fuse together to form the sacrum and coccyx, belong to the category of false vertebrae. In contrast, true vertebrae, except for the first and second cervical vertebrae, consist of a vertebral body, an arch, and seven processes: three paired (superior and inferior articular processes, transverse processes) and one unpaired (spinous process) [1].

Each vertebral region has distinct characteristics in terms of size, shape, and orientation of the spinous processes. However, despite these differences, the structural organization of the spine follows specific patterns. Notably, the size of each vertebral body increases progressively from the upper to the lower segments, with the lumbar vertebrae being the largest.

The orientation of the spinous processes also varies by region. In the upper cervical vertebrae, they are nearly horizontal with a slight downward inclination, which gradually increases in the thoracic region, where they are so steeply angled that they overlap like roof shingles. However, starting from the first lumbar vertebra, the spinous processes revert to a horizontal position. Among all vertebrae, the sixth cervical vertebra has the longest spinous process, which can be palpated as a small protrusion under the skin. Similarly, though less prominent, the spinous process of the twelfth thoracic vertebra also extends outward [2].

Materials and methods. Spinal fractures account for approximately 1.5% to 17% of all musculoskeletal injuries, according to various sources. The most common causes of such injuries are falls from heights and motor vehicle accidents. Among individuals involved in car crashes, around 30% sustain spinal fractures. These injuries typically result from mechanical impact and can involve compression fractures of the vertebral bodies, fractures of the vertebral arches, or fractures of the spinous and transverse processes.

The distal portion of the spine is structurally integrated into the pelvic ring, where the distinction between individual vertebrae becomes less defined. Due to this anatomical complexity, injuries to these segments have unique characteristics in terms of both mechanism and clinical presentation, warranting their separate consideration. Vertebral body fractures resulting from direct trauma are relatively rare and are typically associated with penetrating injuries caused by bladed or firearm weapons.

The vast majority of vertebral body fractures occur due to indirect trauma mechanisms, such as falls from heights landing on the head, pelvis, or feet, excessive spinal flexion or hyperextension, or a combination of axial loading, flexion, and torsion forces acting simultaneously on the spine.

Under extreme vertical loading, vertebrae undergo compression up to their structural limit. Once this threshold is exceeded, the weakest vertebra fails, leading to a fracture characterized by cracking and compression. Given that excessive force also affects the intervertebral discs, the soft inner core of the disc (nucleus pulposus) is forced into the fracture lines of the bone. Since fluid is nearly incompressible, this pressure is exerted forcefully into the newly formed spaces, causing a violent expansion of the vertebral body—an injury known as a "burst fracture."

However, such a mechanism is relatively rare due to several factors. One of the most significant protective factors is the presence of the spine's natural physiological curvatures, which help distribute mechanical forces. Additionally, during trauma, the human body instinctively attempts to adopt a more stable position—such as landing on four points of support (hands and knees)—which reduces the likelihood of direct axial compression along the spine [3].

Results and discussion. We are once again addressing vertebrae that are structurally vulnerable and therefore more prone to fractures. Certain vertebrae are particularly susceptible to damage due to their anatomical positioning and biomechanical stress. These include the C6-C7, T1-T2, T5-T12, and L1-L2 vertebrae. These segments are located at the transition points between the mobile and less mobile regions of the spine, where flexibility decreases, but the vertebral bodies have not yet developed sufficient strength to withstand critical loads.

Additionally, the biomechanical disadvantage of these vertebrae stems from the evolutionary shift of humans to bipedal locomotion. This transition has placed the greatest mechanical stress on vertebrae situated at the junctions of the spine's physiological curvatures—specifically, the transition points between lordosis and kyphosis, as well as between kyphosis and lordosis. These regions experience a concentration of forces that makes them structurally weaker and more susceptible to injury under excessive load or trauma [4].

Complicated spinal fractures refer to those associated with spinal cord injuries, which can be classified into functional (spinal cord concussion) and anatomical (contusion, compression, partial or complete spinal cord transection).

Diagnosing a complicated spinal fracture is generally straightforward due to the presence of pronounced neurological symptoms, including loss of sensation and motor function in areas below the injury level. The localization of spinal cord damage is determined based on the extent of sensory and motor impairment.

For instance, injuries at the C1-C2 vertebrae typically result in immediate fatality due to paralysis of the respiratory centers and complete failure of the respiratory muscles. Damage to the C3-C4 segments leads to a survival window of 3 to 4 hours due to progressive respiratory failure. A C5 spinal cord transection allows for several days of survival, though the patient experiences complete paralysis of the trunk, upper, and lower limbs.

A C6 spinal cord injury preserves function in the deltoid muscles, leading to the characteristic "praying position" or "surrendering pose", where the hands are raised with bent elbows. In cases of C6-C7 injuries, the patient's arms rest crossed over the chest. This level of injury is also associated with Horner's syndrome, which manifests as ptosis (drooping eyelid), miosis (pupil constriction), enophthalmos (sunken eye), and vascular changes such as facial flushing and increased local temperature on the affected side. Paralysis affects all areas below the lesion.

Such severe neurological deficits, along with dysfunction of vital organs below the injury site, are clinically evident and require no additional diagnostic tests, except for X-ray imaging to confirm the structural damage [5].

Rotational subluxation of the atlas is not only defined by the mechanism of injury but also by the unique anatomical characteristics of the atlantoaxial joint.

Clinical Presentation

The clinical symptoms of rotational subluxation of the atlas are highly characteristic. The condition typically develops after a sudden, forceful rotation and tilting of the head, leading to sharp pain in the cervical spine. The patient's head assumes a fixed tilted position, leaning toward the opposite side of the subluxation. Any attempt to move the head in the opposite direction is significantly restricted or completely impossible.

From a posterior view, paravertebral asymmetry is observed, characterized by the formation of a muscle bulge on the side of the subluxation. This paravertebral asymmetry disappears after successful reduction, which is why a control X-ray should only be performed once the asymmetry is resolved.

On anteroposterior (AP) X-rays taken through an open mouth, several key findings help confirm the diagnosis:

Asymmetry of the lateral atlantoaxial joints, with one joint appearing wider than the other.

Misalignment of the odontoid process (dens) within its fossa.

Disruption of the perpendicular alignment between the axis of the odontoid process and the line connecting the bases of the atlas' transverse processes.

Normally, the vertical axis of the odontoid process aligns with a line passing through the midpoints of the spinous processes of the lower cervical vertebrae, forming a straight cervical spine axis. However, in rotational subluxation, these lines do not align.

On lateral X-rays, cervical lordosis is flattened, which further supports the diagnosis [6].

Treatment

The preferred treatment for rotational subluxation of the atlas is immediate manual reduction using the Riche-Güth method, which is considered safe and effective. The procedure is performed as follows:

The patient is administered promedol (analgesic injection).

In a seated or supine position, the physician firmly grasps the patient's head and applies gentle traction along the axis of the head's tilt.

After sufficient traction, the head is carefully returned to a vertical position, eliminating both the tilt and rotational displacement.

For gradual reduction, Glisson's loop traction can be used to gently realign the atlas over time.

Following a traumatic subluxation, stabilization is achieved by applying a thoracocranial plaster cast for 1 to 1.5 months, followed by additional stabilization with a Schanz collar for up to one month or a polymer-based head support.

Bilateral Subluxations and Dislocations

Bilateral subluxations and dislocations typically occur anteriorly. In these cases:

The head is displaced forward and tilted downward.

Neck movements become impossible.

On examination, a prominent spinous process of the affected vertebra can be palpated on the posterior aspect of the neck.

Diagnosis Confirmation

To accurately diagnose bilateral subluxations or dislocations, spondylography (detailed spinal imaging) is required.

One of the most commonly used methods for treating cervical vertebral body fractures is traction therapy. The patient is positioned on a firm bed with the head end elevated by at least 30 cm. Traction is applied using Glisson's loop, which is first covered with a cotton fabric sleeve, and cotton-gauze pads are placed under the chin and occipital area to prevent soft tissue compression. The straps of Glisson's loop are separated and tied to ropes that hold weights ranging from 1 to 2 kg. These ropes are either passed over pulleys or secured to the headboard of the bed [7].

Conclusion. The use of traction therapy is considered particularly effective in cases of fracture-dislocations with significant displacement, as it enables the restoration of proper anatomical relationships. However, despite the gradual hyperextension of the spine, numerous complications may arise, such as pain syndrome, sleep disturbances, swelling of the lower extremities, and others. Therefore, before proceeding with the extension process, it is essential to perform anesthesia of the fracture area using Schneck's technique. As with one-time reclination, continuous radiographic monitoring is mandatory to ensure the proper realignment of the vertebral body. Once immobilization is removed, a prolonged rehabilitation program is necessary to restore spinal muscle function and strength. This includes targeted physiotherapy aimed at strengthening the back muscles, therapeutic exercises to improve posture and mobility, and pain management techniques to alleviate residual discomfort. The integration of proper pain control, imaging supervision, and structured rehabilitation significantly reduces the risk of chronic spinal instability and functional impairment, ultimately ensuring a successful long-term recovery.

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ДОКАЗАТЕЛЬНЫЕ ОСНОВЫ ДИАГНОСТИКИ ОСТРЫХ ДВОЙНЫХ ПОРАЖЕНИЙ ОБЛАСТИ ШЕИ У ДЕТЕЙ

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Резюме. *В этой статье рассматриваются травмы позвоночника и спинного мозга у детей, подчеркивается их структурная и биомеханическая уязвимость. В исследовании рассматривается анатомическая сложность позвоночного столба, подчеркивается подверженность переломам отдельных позвонков из-за их расположения в точках перехода между подвижными и менее подвижными сегментами позвоночника. В исследовании описываются основные механизмы травмы позвоночника, включая прямые и непрямые повреждения, а также распространенность компрессионных и разрывных переломов. Кроме того, в нем повреждения спинного мозга подразделяются на функциональные и анатомические типы, описываются их клинические проявления и диагностические критерии.*

Ключевые слова: *детская травма позвоночника, повреждения спинного мозга, переломы позвонков, нестабильность шейного отдела позвоночника.*