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REPEATED VERTEBRAL FRACTURES IN CHILDREN

The main epidemiological indicators of the problem of recurrent uncomplicated vertebral fractures in somatically healthy children have been studied. In the overwhelming majority of clinical observations with repeated trauma, fractures of those thoracic and lumbar vertebrae not initially damaged were diagnosed. The average age of children with primary vertebral fractures was 7 years 7 months, the same children repeatedly injured the spine at average age of 11 years 3 months. In more than half of the clinical observations, the main mechanism of injury is a fall onto the buttocks from height of one's own height. More often than others, the bodies of ThV and ThVI vertebrae were damaged in the primary injury, while the body of ThIV vertebra was observed in the repeated injury. Key words: children, repeated vertebral fractures.

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Relevance. Various aspects of vertebral fractures in children are fairly well presented in the modern medical literature. At the same time, despite a large volume of science research on this topic, we failed to find any publications devoted to cases of repeated vertebral fractures in somatically healthy children. Two scientific articles devoted to the problems of osteoporosis and osteogenesis imperfect provide information on the possibility of receiving repeated vertebral fractures in children with these diseases [10,13]. The lack of modern scientific information on the problem of recurrent vertebral fractures in somatically healthy children motivated this study.

Objective. To study the main epidemiological indicators of the problem of recurrent uncomplicated vertebral fractures in somatically healthy children.

Materials and methods. At the stages of planning and implementation of this study, in order to determine its type and design, we were guided by the recommendations presented in the journal "Traumatology and Orthopedics of Russia" [7]. According to these recommen-

dations, the type of research carried out is defined as "applied", aimed at gaining knowledge for solving a specific practical problem, namely, studying the main epidemiological indicators of repeated vertebral fractures in children. Design-analytical sample cross-sectional study.

We had 9 years of experience in dynamic observation and treatment of 1,000 children and adolescents aged 2 to 17 years inclusive, who received uncomplicated compression fractures of the vertebral bodies of the cervical, thoracic and lumbar localizations. Of this number, 16 (1.6%) children received vertebral fractures twice. These 16 patients constituted the observation group that served as the clinical material for the present study. For the diagnosis of vertebral body fractures in children, both in primary and in repeated injuries, we used the methods of examination traditional for emergency traumatology: collection of complaints and anamnesis, clinical examination, radiation diagnostics (plain radiography, computed tomography (CT), magnetic resonance imaging). tomography (MRI)).

Children who received repeated compression fractures of the vertebral bodies were consulted by an endocrinologist. Anthropometric parameters were determined in patients with the calculation of the body mass index. All patients underwent a blood test (ionogram, ionized calcium, total protein, alkaline phosphatase, bilirubin) and urine (daily excretion of calcium and phosphorus).

To determine the severity of injuries to the vertebral bodies, the AO/ASIF classification was used [12]. In accordance with the criteria of this classification, fractures of all vertebrae in the studied children with primary and repeated injuries were attributed to type A. More detailed detailing of the nature of fractures made it possible to ascertain the A1 subtype in 15 (93.75%) children and in 1 (6.25 %) clinical observation, with repeated trauma, a ThXII vertebral body fracture was attributed to the A3 subtype.

For statistical processing of data, the

Microsoft Excel and Statistica 6.0 software package was used. The specific weight of each of the variants of the studied indicators is presented in the form $P \pm m$, where P is the relative value of the indicator variants in%, m is the error in the representativeness of the relative value.

The study was approved by the Ethics Committee at the Tyumen State Medical University Federal State Budgetary Educational Institution of Higher Education of the Ministry of Health of Russia (protocol No. 59 of June 27, 2014).

Results and discussion. Among 16 children who received vertebral fractures twice, there were 9 (56.25%) boys, and 7 (43.75%) girls. The average age of patients at the time of their primary injury was 7 years 7 months, and the second injury was 11 years 3 months. The average time elapsed between the dates of the spinal injury was initially and again equal to 3 years 8 months. The minimum period between episodes of obtaining vertebral fractures was 8 months, the maximum period was 8 years. In more than half of the cases, the main cause of vertebral fractures in children, both in primary and in repeated injuries, was a fall on the buttocks from their own height - in 75.0% and 56.25% of cases, respectively ($t < 2$). The data published in the literature confirm the fact that more than half of cases of vertebral fractures in the pediatric population arise from falls on the back from a low height [11]. The high incidence of vertebral fractures in children with minor trauma is due to the action of the so-called arc-keyboard mechanism, described by the staff of the Central Institute of Traumatology and Orthopedics [2].

Less often, children injured the spine as a result of an automobile injury and as a result of a fall from a height of 2 floors - (according to one clinical observation with primary and repeated injuries).

The information about the number of vertebrae was broken in the children of the studied cohort is of undoubted interest. Analysis of the clinical material showed that in more than half of the

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cases - 56.25% - patients received fractures of one vertebra, both in primary and in repeated injuries. Fractures of two vertebrae were diagnosed in 37.5% and 25.0% ($t < 2$) clinical cases, respectively. Three vertebrae were fractured in 6.25% of the patients at the time of the primary injury and in 12.5% ($t < 2$) of the patients at the time of the second injury. Four vertebrae were injured only in 1 (6.25%) patient, at the time of receiving a fracture again. A total of 24 vertebrae were broken in children with the primary injury, and 27 vertebrae in the repeated injury.

In primary trauma, the bodies of ThV (16.68%), ThVI (16.68%), ThX (12.5%) and ThXII (12.5%) vertebrae were most often compressed. With repeated trauma, fractures of the bodies of ThIV (14.87%), ThIII (11.11%), ThXII (11.11%) and LII (11.11%) vertebrae were most often diagnosed. In none of the analyzed cases were the vertebrae of the upper thoracic, middle and lower lumbar spine broken.

The predominant localization of the compressed vertebrae in the thoracic spine in children is due to the anatomical and physiological characteristics of the growing child's spine [6].

In the course of the study, in 2 (2.97%) clinical cases, compression of the same vertebra was established twice - the bodies of the ThIII and ThXII vertebrae, respectively. In one of these observations, an 8-year-old girl received a ThXII vertebra body fracture while riding a slide. After 8 years, she repeatedly injured the same vertebra when falling from a height of 2 floors. As a result of this falling from height, the patient required surgical treatment in order to stabilize the fracture and prevent the formation of symptoms of mechanical and (or) neurological instability at the level of the spinal motion segments ThXI-ThXII and ThXII-LI [8]. In the remaining 14 clinical observations, the re-injured vertebrae in 8 (54.17%) cases were located caudally in relation to the already consolidated vertebrae, and in 6 (42.86%) cases - cranially. The clinical picture of vertebral fractures was typical when children received both primary and repeated injuries, and is well and fully described in the literature [6]. There were no clinical features of the course of the acute period of trauma in the studied children.

In order to objectively confirm compression fractures of the vertebral bodies in children, we used radiological diagnostic methods. Objective X-ray diagnosis of the injured spine began with plain X-ray or CT. The choice in favor of one or another research method was determined individually and depended on the characteristics of the child's response to the

injury received, the mechanism of injury, and the severity of clinical symptoms.

Upon confirmation of compression fractures of the vertebral bodies by X-ray or CT, the children were admitted to the traumatology and orthopedic department of the children's hospital, where they were treated. This course consisted of adhering to strict bed rest on a reclinator roller in the projection of the compressed vertebrae, physiotherapy procedures, physical therapy sessions with an instructor. In cases of diagnostics of fractures of the lower thoracic and lumbar vertebrae in 6 patients with primary injury and in 7 patients with repeated injury, traction was performed for the pelvis along an inclined plane. We consider this procedure to be effective not only in terms of treatment, but also in terms of compliance with the orthopedic regime in the department.

On days 2–3 of hospital stay, as the severity of vertebral pain syndrome decreases, all patients underwent MRI of the spine, which is currently the most informative research method in the diagnosis of compression fractures of vertebral bodies in children [1]. It was MRI that made it possible to finally formulate the clinical diagnosis and determine the method of immobilization of the spine, before the patients were discharged from the hospital for outpatient treatment.

For the purpose of immobilization of the spine, plaster corsets, made individually for each injured child, were used more often than others [9]. In total, immobilization with a plaster brace was performed in 12 (75.0%) children with primary injury, and in 7 (43.75%) patients with repeated injury ($p < 0.05$). The use of plaster braces in clinical practice ensures reliable immobilization of the injured spine, creates favorable conditions for the processes of remodeling of compressed vertebrae and, importantly, fully complies with the program of state guarantees of free medical care to victims in case of injuries of the musculoskeletal system. In addition to plaster corsets, such orthopedic products as reinforced posture corrector "Orlett", frame hyperextension corrector by "Otto Bock" company, "Orlett" orthopedic thoracic-lumbar corset were used for therapeutic purposes. The listed products are also widely used in the clinical practice of orthopedists [5].

The analysis of anthropometric indicators of children made it possible to register that all 16 patients with repeated vertebral fractures "were" within their age norms [4]. The average body mass index in the study group of patients was 21.4 ± 1.3 .

Table shows the average biochemi-

cal parameters of blood and urine in the same children.

As the studies have shown, all the studied parameters in patients were within the age norm [4]. Considering the normal blood and urine parameters in the studied patients, a more detailed study of bone mineral density was not carried out in them.

A paraclinical study of blood and urine prescribed by an endocrinologist for all children in cases of repeated spinal injury did not reveal any deviations from the age norm. The average hospital stay for patients with the initial injury was 9.6 days, with the repeated one - 11.7 days.

As our experience in providing emergency vertebral care to children who have received uncomplicated vertebral fractures repeatedly, there are no specific measures to prevent these injuries. Although, as follows from literary sources, recently, on the basis of large medical institutions, whole "services for the prevention of recurrent fractures" are being created, but only patients suffering from osteoporosis are provided with assistance in these units [3].

Conclusion. The relevance of this study is primarily due to the lack of modern scientific medical information on repeated vertebral fractures in children. In the course of the study, several important epidemiological indicators were obtained, which, in our opinion, are of interest to interested medical specialists. Thus, in the course of the study it was found that the frequency of repeated fractures of the vertebral bodies in children is 1.6% of cases. In the overwhelming majority of clinical observations - 87.5% of cases - with repeated trauma, fractures of those thoracic and lumbar vertebrae that were not initially damaged were diagnosed. Only in 2 (12.5%) clinical ob-

Biochemical parameters of blood and urine in children with repeated vertebral fractures

Investigated parameters	Average results
Magnesium	0.95 ± 0.3 ммоль/л
Potassium	4.2 ± 0.9 ммоль/л
Chlorine	98 ± 3.1 ммоль/л
Ionized calcium	1.19 ± 0.5 ммоль/л
Total protein	64 ± 3.7 г/л
Alkaline phosphatase	170 ± 5.3 ед/л
Total bilirubin	9.6 ± 1.6 ммоль/л
Daily urinary calcium excretion	3.2 ± 1.1 ммоль/л
Daily urinary phosphorus excretion	36 ± 3.4 ммоль/л

servations were vertebral fractures that were injured earlier. The average age of children who received vertebral fractures was initially 7 years 7 months, the same children repeatedly injured the spine at an average age of 11 years 3 months. The average time elapsed between the dates of primary and repeated vertebral injury was 3 years 8 months. In more than half of the clinical observations, the main mechanism of injury is a fall on the buttocks from a height of one's own height - 75.0% of cases with primary injury and 56.25% of clinical observations with repeated injury. More often than others, the bodies of the ThV and ThVI vertebrae were damaged during the primary injury - in 16.68% of cases, respectively. In case of repeated trauma, the body of the ThIV vertebra is most often compressed - 14.87% of clinical observations. Therapeutic tactics, both in primary and in repeated spinal injuries, is to conduct a course of conservative therapy aimed at relieving vertebrogenic pain syndrome, creating conditions for a more favorable course of the remodeling processes of compressed vertebrae. Only in 1 (6.25%) clinical observation, with repeated spinal trauma, it was required to perform surgical treatment of the damaged spinal motion segments. In order to immobilize the injured spine, a plaster corset was used more often than others from orthopedic products, made individually, taking into account the physique of each patient. The use of plaster braces in clinical practice has found application in 75.0% of patients with primary injuries and in 43.75% of patients with repeated vertebral fractures. Examination of children with repeated injuries to the spine, carried out by an endocrinologist, did not

reveal any deviations from the age norm in any of the clinical observations.

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