MRI RESEARCH OF THE CAUSES OF DYSTROPHIC PROCESSES IN THE SPINE

Cherkasov A.D. 
senior researcher,  
Shchipkova E.S.  
junior researcher

Research Institute of General Pathology and Pathophysiology NIIOPP,  
Moscow, Russia.  
DOI: 10.31618/asi.2707-9864.2021.1.56.141

Abstract. The aim of the study was to search for organic changes in the tissues of the spine, which are the cause of pain syndromes in the back and spine.

Method. MRI was used to diagnose the condition of the muscular corset of the spine and conditions of the identified disorders with the localization of pain syndromes in the back and the localization of dystrophic manifestations in the vertebrae and intervertebral discs.

Results. In 70 patients who underwent MRI of areas with pain syndromes in the back, it was shown that dystrophic manifestations in the spine are preceded by spastic conditions of the intervertebral muscles, leading to disruption of trophism (nutrition and regeneration) of the vertebrae and intervertebral discs, as well as the spine, the development of pain syndromes.

The localization of spastic conditions of the intervertebral muscles coincides with the areas in which people experience pain, caused, according to most neurologists, by osteochondrosis of the spine. Osteochondrosis of the spine as a dystrophic process is a consequence of the spastic conditions of the muscles that cause disturbances in the trophism of the vertebrae and intervertebral discs.

Conclusions: Spinal osteochondrosis is not a disease, but an irreversible dystrophic process in the vertebrae and intervertebral discs. The reasons for the development of dystrophic processes and back pain are spastic conditions in the intervertebral muscles.

Keywords: spine, pain syndromes, MRI, osteochondrosis, muscles, spastic conditions.

Introduction

The problem of osteochondrosis concerns not only doctors trying to treat pain syndromes in the back and joints, but also every person. Dystrophic processes in the spine are a manifestation of premature aging of human bone and cartilage tissues.

Osteochondrosis of the spine according to the theory of Ya. Yu. Popelyansky is credited with many neurological syndromes in the spine and throughout the body [4]. The term "osteochondrosis of the spine" has practically become synonymous with back pain. MRI studies have shown that the term "osteochondrosis" corresponds only to dystrophic changes in the vertebral bodies and intervertebral discs. In 1995 in Vienna at the congress of vertebrologists and orthopedists G. Wolf presented a report. He cited the results of a study of 50,000 patients with lumbosacral radiculopathy. Of these, 40% of patients with changes on radiographs did not have clinical neurological manifestations. On the contrary, 40% of patients had clinical neurological symptoms without radiological symptoms. J. Braceford [6], having analyzed 10,000 X-ray studies for lumbar pain, found osteochondrosis only in 10% of cases. The diagnosis, which until recently did not raise doubts - "discogenic radiculitis", "lumbosacral radiculitis" or "radiculopathy" - was declared untrue [1,2].

From the point of view of anatomy, neither osteochondrosis of the spine, nor herniated discs can cause pain syndromes in the back, spine and extremities. However, neurological syndromes in the back can be caused by "tunnel effects" - compression of the spinal nerves [3]. At the conference - a school for doctors called "Back pain - an interdisciplinary problem", held at the 1st Moscow Medical University in 2015 was presented as the main conclusion on the results of the conference, adopted by all leading experts, the following conclusion: Osteochondrosis of the spine is not involved in the occurrence of pain syndromes in the back. In 80% of cases, the causes of pain in the spine are not known and are not associated


with osteochondrosis of the spine. Now neurologists have suggested calling these pains a nonspecific pain syndrome. Neurologists believe that 20% of back pain is caused by herniated discs.

However, this latter is also questioned. Herniated intervertebral discs cannot cause compression of the nerve roots, since the nerve roots are located at a distance of one third of the thickness of the vertebra [1,2]. These pains should be called specific pain syndrome.

This study is devoted to the search for the physiological causes of pain syndromes in the back and spine and spinal osteochondrosis as a dystrophic process.

**Purpose of the work:** Study of the state of spinal tissues using MRI in order to detect abnormalities in tissue structures, leading to the occurrence of pain syndromes in the spine and to the development of osteochondrosis of the spine.

The contingent of the surveyed and research methods. A comprehensive examination of the condition of the muscular corset of the spine was used: 30 MRI examinations of the spine, 100 manual examinations of the spine with palpation, with the measurement of the mobility of the spine segments during functional tests and with temperature diagnostics of the paravertebral zones were performed and analyzed. The examination of the condition of the muscular corset of the spine involved 70 people aged 6 to 80 years who were undergoing treatment or rehabilitation, and 30 patients who underwent MRI examinations for pain in the back and spine. Statistical data on the study of the patterns of development of osteochondrosis using MRI were obtained from the results of examinations of 600 out-patients.

**Results**

Clinical and statistical analysis of degenerative manifestations in the spine

We analyzed 600 outpatient examinations carried out using the methods of magnetic resonance imaging in persons who applied to the diagnostic department of Clinic № 1 of the Presidential Administration of the Russian Federation for pain in the spine. The analysis was carried out on the basis of expert opinions on the detection and severity of signs of dystrophic changes in the spine (DCS). We analyzed the distribution by the spine and the extent of the areas of dystrophic changes in the intervertebral discs (changes in the quality, density and thickness of discs, herniated discs), vertebral bodies (presence of outgrowths or changes in the shape of the vertebra, Schmorl’s hernia, hemangiomas, compression fractures).

Based on the results of the analysis, diagrams of the frequencies of manifestations of all types of dystrophic changes were constructed for each segment of the spine. These conditions were often interpreted by doctors as osteochondrosis of the spine. An analysis of DCS according to MRI data was carried out for three parts of the spine: lumbar (n = 141), thoracic (n = 294) and cervical (n = 165) for four age groups: 13 - 21 years old, 22 - 35 years old, 36 - 50 years, more than 50 years (Fig. 1).

The general patterns of development of dystrophic changes in the spine were established. Comparison for all age groups showed that the maximum number of detected DCS in all age groups falls on the following areas of the spine: in the cervical spine on the vertebrae C4, C5, in the thoracic spine on the vertebrae Th5, Th6, in the lumbar spine on the vertebrae L4, L5. These areas correspond to areas of maximum curvature for each of the spine sections. Areas of DCS lesion with a width of 2 - 3 segments correspond to the age groups of 18 - 35 years.

With age, the areas of the spine with the dystrophic process expand while maintaining the position of the maxima. More than 50% of the detected DCS s are in the C3 - C6, Th5 - Th11, and L3 - L5 regions. The areas most susceptible to dystrophic processes coincide with the areas of maximum curvature of the spine in each of the 3 sections.

In the same areas, spastic conditions were found in the intervertebral muscles.
Figure: 1. Graphs of the frequency of manifestations of dystrophic manifestations in the cervical (A), lumbar (B) and thoracic (C) spine for 4 age groups.

2. Study of the state of the spine in patients with pain in the spine during MRI examinations of adolescents, we find changes in the image tone of the intervertebral muscles in the area of pain, localized by manual diagnostic methods. We will give three typical examples of examinations of the spine for reasons of back pain. First, let us consider an MRI image of our patient - a 17-year-old girl who had suffered from back pain throughout the thoracic region for three years (Fig. 2).

In the area of pain syndrome from 6 to 9 thoracic vertebrae, we find a change in the intensity of the image of the muscles of the spine towards darkening and thinning of the subcutaneous fat.

Dystrophic changes in the intervertebral discs are in the initial stage.

Functional tests for the mobility of the spine segments show that the thoracic spine is blocked (Fig. 3, Fig. 4).

The curvature of the spinal segments relative to the adjacent segments is less than 1 degree, while there is hypermobility in the thoracolumbar junction, reaching 12 degrees. The hypermobility zone covers a zone of 4 vertebral segments and compensates for the immobility of the upper and middle thoracic regions.

Figure: 2. MRI of the thoracic spine of our 17-year-old patient.
In the area of pain syndrome of a young man of 23 years in the middle thoracic spine, we find the initial stage of osteochondrosis of the spine - three intervertebral discs with reduced thickness and loss of the nucleus pulposus in the region of 4-6 and 8-9 thoracic vertebrae (Fig. 4). In this area there is a local area with a much darker image tone of the muscles of the spine.
Figure: 4. MRI of the thoracic spine of a 23-year-old man with pain in the middle thoracic spine.

In a 60-year-old patient with pain in the lumbar spine, we find multiple dystrophic changes in the spine (Fig. 5). During the examination, the attention of doctors is attracted by 6 discs with a changed structure (there is no light pulposus nucleus) and with a reduced disc thickness. These are three discs between the 9th and 12th thoracic vertebrae and three discs between the 3rd lumbar vertebra and the sacrum. The surfaces of the vertebrae adjacent to the discs (hyaline plates) have significant irregularities caused by dystrophic processes in the vertebral bodies.

The discs between the 12th thoracic vertebra and the first lumbar, as well as between the first and second, second and third lumbar vertebrae are of normal thickness and have a nucleus pulposus (light formation in the middle of the disc). Between the 11th and 12th thoracic vertebrae there is a disc herniation - a protrusion of the disc towards the spinal canal, inside which the spinal cord passes.
This picture can serve a successful teaching material for neurologist and therapist, since it contains all stages of dystrophic processes in the spine.

Formulation of the medical diagnosis: osteochondrosis of the thoracic spine in the region of the 9th - 12th thoracic vertebrae, protrusion of the discs in the regions of 11-12 thoracic vertebrae and 4-5 lumbar vertebrae, disc herniation in the region of the 11th thoracic vertebra, osteochondrosis of the lumbar the region of the third lumbar vertebra - the sacrum, listez - displacement of the 5th lumbar vertebra relative to the sacrum. The condition of the muscles of the spine falls out of the attention of doctors. In the area of the 12th thoracic vertebra - the 4th lumbar vertebra, the muscles of the spine have a dark tone without white layers - the intensity of the response is sharply reduced. It was in this area that the pain in the lower back was localized. Above and below this area, there are muscles with white stripes. These are fatty layers between the bundles of muscle fibers. Their presence is a sign of the passivity of these muscles and the loss of their contractility. There is no pain in these areas.

In the area of the spine with good discs, the intervertebral muscles do not have fat layers, and their structure has a darker texture than normal muscles. This is a sign of high muscle activity, muscle inflammation or swelling. It is in this area that the patient experiences pain, and not where there is osteochondrosis or disc herniation. Recall that the purpose of the MRI examination was to find the cause of back pain.

Two conclusions can be drawn from this study:

1. The area of pain syndromes does not coincide either with areas prone to osteochondrosis of the spine, or with areas where there are disc herniation and protrusion.

2. Localization of the area of pain syndrome corresponds to a dark image tone of the muscles of the spine without fatty layers.

**Discussion**

Osteochondrosis of the spine as a dystrophic process in the vertebrae and intervertebral discs begins to appear already in adolescence and continues to develop throughout life, capturing more and more areas with deepening dystrophy. In all age groups, dystrophic processes develop in areas with the maximum curvature of the spine - lordosis and kyphosis [5].

Comparison of dystrophic changes in the intervertebral muscles in 70 patients who underwent MRI examinations for the presence of pain syndromes and age analysis of the condition of the discs and muscles of the spine allows us to reveal the dynamics of the development of dystrophic changes in these structures. In childhood and adolescence, there are pain syndromes without manifestation of osteochondrosis of the spine. At a young age, in the area of pain, the initial stages of osteochondrosis of the spine are found. In adulthood, areas of pain syndrome coincide with areas of osteochondrosis of the spine.

In old age, areas with dystrophic muscle conditions appear, coinciding with areas of the spine with osteochondrosis, protrusions and disc herniation, but without pain. The conclusion from this analysis is
age-related development of dystrophic changes in the spine. Initially, long-term, several years, spastic conditions develop in the muscles of the spine. They cause back pain.

Spastic conditions of the intervertebral muscles make the spine area not flexible - a blockade of a group of spinal segments occurs. In areas of blockages, manual diagnostics reveals stiff and painful muscles. Then, in the blocked part of the spine, there is a violation of the blood supply to the vertebrae due to squeezing of blood vessels when passing between stiff muscles and a violation of the tropism of the vertebrae. For several years, trophic disturbances lead to the development of osteochondrosis of the spine: there is a thinning of the intervertebral discs, destruction of the nucleus pulposus, and Schmorl's hernias are formed.

In the future, it is in these areas that protrusions, disc hernias and compression fractures of the vertebrae occur (compression of the vertebral bodies due to the destruction of the bone beams) as a result of traumatic injuries of the spinal segments during excessive physical exertion in the conditions of already existing dystrophic disorders. With age, perennial spastic conditions of the muscles lead to dystrophic changes in the structure of the intervertebral muscles.

Muscles lose elasticity and contractility and muscle fibrosis begins. In this case, the muscles no longer contract. The function of ensuring the rigidity of the spine is performed by fibrous fibers - the spine becomes rigid. In this state, the muscles no longer hurt - pain syndromes in areas with osteochondrosis and herniated discs disappear.

Spastic conditions of the intervertebral muscles occur as a result of improper exercise regime or stressful situations. We believe that the physiological cause of the occurrence of spastic conditions of the intervertebral muscles is a violation of the metabolism of muscle fibers, namely: a decrease in the activity of calcium pumps in myocytes. These conditions also often occur in the muscles of the knee, causing severe and prolonged pain.

These functional disorders in muscle work are caused by excessive consumption of starch-containing foods and sugar with a lack of vitamin B1 - thiamine. This condition should be considered as a western variant of the disease “beri” or vitamin B1 hypovitaminosis (from Sinhalese beri - weakness; synonym: alimentary polyneuritis, polyneuritis endemica, B1-avitaminosis). Spastic conditions of the muscles of the spine can exist for many months and years, leading to the development of osteochondrosis as a dystrophic process and to neurological syndromes in the back, lower back and throughout the body.

Conclusions:

1. Osteochondrosis of the spine is not a disease, but an irreversible dystrophic process in the vertebrae and intervertebral discs, which develops over the years and does not cause either pain or neurological syndromes.

2. Osteochondrosis of the spine and back pain have the same source - spastic conditions in the muscles of the spine, which are not a disease, but reversible physiological disorders.

3. Treatment of osteochondrosis by using pain relievers does not eliminate the causes of osteochondrosis, since it does not eliminate the spastic conditions of the muscles and contributes to the further development of dystrophic processes in the spine.

4. To eliminate spastic conditions in the muscles of the spine and in the joints, it is necessary to reduce the consumption of foods containing starch and sugar, periodically carry out vibration massage of the deep muscles of the spine and rubbing with vibration for the knee joints.

5. It is necessary to carry out therapy with vitamin B1 and in the future to consume products containing this vitamin.

References


