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Study of the Features of the Clinical Course of Spondylodiscitis, Problems of Diagnosis and Treatment (Literature Review)

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Abstract Spondylodiscitis is an inflammatory disease of an infectious nature, manifested by damage to various structures of the spine. According to some authors, this includes spondylitis, osteomyelitis and discitis. These states are considered as different manifestations of the same inflammatory process. One of the manifestations of nonspecific spondylitis leads to the destruction of the colloidal structure and disruption of the supporting function of the spine. This article is devoted to current problems in the diagnosis and treatment of spondylodiscitis.

Keywords Spondylodiscitis, Osteomyelitis, Inflammatory process, Diagnosis, Neurosurgical removal

1. Introduction

Back pain is one of the most common complaints for which patients seek medical attention. Most often, back pain is caused by degenerative-dystrophic changes in the spine, but in 5% of cases it is a harbinger of more serious diseases, among which spondylodiscitis (SD) can be distinguished [5,7,12].

Spondylodiscitis is an infection of the spinal structures. According to some authors, this includes spondylitis, osteomyelitis and discitis. These states are considered as different manifestations of the same inflammatory process [7].

Spondylodiscitis is rare, with an average of 0.5–2.5 per 100,000 population [9,13]. Recently, an increase in the incidence of spondylodiscitis has been noted. This is due to the improvement of diagnostic methods, an increase in the frequency of nosocomial infection, an increase in the number of immunocompromised patients, and an increase in the number of the elderly population [1,13].

The initial symptoms of spondylodiscitis practically do not differ from the symptoms of degenerative lesions of the spine, being in essence an inflammatory purulent process. The disease threatens with deformation of bone formations and destruction of neural structures, it is dangerous for the development of generalized sepsis. Accordingly, early diagnosis is important for the further prognosis of spondylodiscitis, and it is precisely this that presents a difficulty for the practitioner due to the nonspecific clinical picture.

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2. Materials and Methods

In this article, we presented our own experience in the diagnosis and treatment of spondylodiscitis. The purpose of the analysis was to highlight diagnostic reference points to facilitate early diagnosis of the disease. of spondylodiscitis was carried out in the Department of Emergency Neurology of the City Clinical Hospital No. 7 of Kazan from May 2014 to September 2016. During the specified period of time, 7 patients with an established diagnosis of spondylodiscitis were registered: 5 women and 2 men. Their average age was 59.4 years (the youngest patient is 29 years old, the oldest patient is 80 years old).

The main symptom that forced patients to seek medical help was severe pain in the affected area, which in most cases (85.7%) bothered them constantly and intensified with movement. Pain intensity on a visual analogue scale ranged from 8 to 10 points. Only in 1 case the pain had a dull aching character and corresponded to 7 points on the visual analogue scale. Such a characteristic of pain was in the youngest patient, 29 years old, who had suffered an injury to the lumbar spine 3 years before the development of spondylodiscitis.

It should be noted that in all observed cases, the use of non-steroidal anti- inflammatory drugs (NSAIDs) in relation to pain was ineffective.

The lumbar spine was predominantly involved in the pathological process - 71.4% (n=5), in the remaining 2 cases, the thoracic spine was affected.

85.7% of patients in the past suffered from -

degenerative-dystrophic changes in the structures of the spine, which was expressed in pain and limitation of movement in the affected area even before the onset of the infectious process. This masked the manifestations of spondylodiscitis and made diagnosis much more difficult.

In 1 case, spondylodiscitis developed as a complication of neurosurgical removal of a disc herniation, in another case, the development of an inflammatory process in the intervertebral disc and vertebral body was preceded by a lumbar injury with fractures of the transverse processes.

1 patient, 62 years old, developed spondylodiscitis after hernia surgery disk Th_7 - Th_8 had a neurological deficit in the form of gross lower paraparesis, pelvic disorders such as retention of urine and feces. In the rest of the patients, an objective examination revealed pain on palpation in the affected area, tension of the paravertebral muscles, and limited range of motion. In 42.9% of cases, the Lasegue tension symptom was recorded. 1 patient had a fever.

In 42.9% of patients, moderate leukocytosis was registered upon admission to the hospital - an average of $13.2*10^9$/l (reference values $4.0\text{-}9.0*10^9$/l). In 57.1% of cases, the erythrocyte sedimentation rate (ESR) was significantly increased - 62.5 mm/h on average (reference values 0.0-15.0 mm/h). C-reactive protein (CRP) was determined only in 1 patient, its content was 17 mg/l (reference values 0.00-5.00 mg/l).

In all cases, the diagnosis was confirmed by the results of neuroimaging. 6 (85.7%) of 7 patients underwent X-ray computed tomography (CT) and magnetic resonance imaging (MRI). Routine X- ray examination was performed in 28.6% of cases and did not reveal changes that would allow suspicion of spondylodiscitis.

Microbiological and serological evaluation of the pathogen was not carried out in any of the cases. All patients were consulted by a phthisio-orthopedist, the presence of a tuberculous lesion was excluded.

Drug treatment of patients with spondylodiscitis was carried out with broad-spectrum antibiotics intravenously, followed by continuation of oral antibiotics on an outpatient basis. The average duration of the course of conservative therapy was 21 days (from 2 to 7 weeks).

In all cases, the patients were consulted by a neurosurgeon, and 1 of the patients received surgical treatment for L-L2 disc herniation due to the stability of the pain syndrome. Interligamentectomy L1-L2 on the left, decompression of the left spinal root $L_{2,}$ removal of a herniated disc L1-L2 were performed.

Spondylodiscitis is a term for an inflammatory process in the intervertebral disc, body and joints of a vertebra. Symptoms of the disease are not particularly specific, develop gradually and subacutely, which makes it difficult to diagnose pathology. Timely detection of spondylodiscitis is of great importance for the prognosis. The disease mainly affects people older than 50 years [5,7,9,13]. In our observation, only 1 patient was younger (29 years old). Men are more likely to get DM and, according to the literature, the ratio of men and women is 1.5–2:1, respectively [1,2,13]. The observation group was dominated by women - 5 people, which may be due to a small number of patients.

The diagnosis of spondylodiscitis is usually delayed. The delay from the onset of the disease to the diagnosis can range from 1–3 months to 1–2 years [5,9]. In the patients we observed, the diagnosis of spondylodiscitis was made on average 86.2 days (from 11 days to 6 months) from the onset of symptoms of the disease.

According to the literature, the pathological process in spondylodiscitis predominantly involves the lumbar spine (in 39-55% of cases), in contrast to the thoracic (20-27%) and cervical (9-10%) regions. The authors attribute this ratio of damage to different parts of the spine to the distribution of blood flow in the structures of the spine [5,7,9,10,14]. Most of our patients had lumbar involvement.

There are purulent, granulomatous and parasitic spondylodiscitis [7]. The most common causative agent of purulent spondylodiscitis is *Staphylococcus aureus*, which is isolated in more than half of the cases of spondylodiscitis. Gram-negative microorganisms *(Escherichia coli, Pseudomonas, Proteus)* [1,4,5,7,13]. Approximately in 34% of cases, the authors fail to identify the specific pathogen that caused the disease. Such cases are considered noninfectious - spondylodiscitis [12].

Granulomatous spondylodiscitis can be caused by Mycobacterium tuberculosis, be a complication of brucellosis, and sometimes be of fungal origin, especially in patients with immunodeficiency [7]. Unfortunately, in none of the cases described by us, the pathogen was identified. However, given the effectiveness of the antibiotic therapy used, we can conclude that we were dealing with purulent spondylodiscitis, granulomatous forms were excluded at the diagnostic stage.

Infection in spondylodiscitis can occur in three ways: hematogenously from distant foci of infection, by direct contact, for example, after surgical interventions, and by contact from neighboring foci of infection [5,13,14].

3. Result and Discussion

Clinically significant for the development of spondylodiscitis are primarily infections of the genitourinary system (17%), skin and mucous membranes (11%), installed intravascular devices (5%), infections of the gastrointestinal tract and respiratory tract (5 and 2%, respectively), foci of infection in the oral cavity and dental procedures (2%). Often, bacterial endocarditis can cause hematogenous spondylodiscitis (12% of cases) [2,5,13].

Risk factors for the development of spondylodiscitis are age over 50 years, the presence of diabetes mellitus, the use of intravenous drugs, systemic diseases, a history of cancer, immunosuppression, and immunodeficiency states [1,9,16]. The risk of developing spondylodiscitis after surgical interventions on the structures of the spine is 0.2-3.6% [2,8,15].

In the study group, 2 patients had diabetes mellitus. At the same time, both manipulations - one of them underwent -

aortofemoral prosthesis, and the other patient received an intravascular device - a cava filter. In addition, the last patient underwent surgery for a Th7-Th8 disc herniation. Of course, all this increased the risk of developing an infectious process in the spine.

In 1 of the patients in the study group, chronic pyelonephritis was registered in the active stage at the time of admission to the hospital. In 2 cases, patients had a history of duodenal ulcers in remission. Only 1 patient (29 years old) out of 7 had no concomitant somatic diseases. However, in her case, manifestations of spondylodiscitis preceded by - trauma to the lumbar spine with closed marginal fractures of vertebrae L L5 and transverse processes L2-L4 on the left.

At admission, all patients had absolutely nonspecific symptoms that can occur in people with degenerative-dystrophic changes in the spine. These are pronounced pains in the affected area, aggravated by movement. According to the literature data, the leading symptom in spondylodiscitis is back pain, but it may be absent in 15% of cases [5,7,9].

Fever was observed in only 1 patient, which could suggest an infectious process. One patient had an acute onset of symptoms, while the pain gradually increased in the rest. Clinically, spondylodiscitis could be suspected only in connection with the persistence of these pains and the ineffectiveness of the use of NSAIDs.

An objective examination also showed no specific symptoms, which is consistent with the literature data. Pain on palpation, tension of a pair of vertebral muscles, and limited range of motion were observed [5,7,9], except for the case of postoperative spondylodiscitis, where severe lower paraparesis and pelvic disorders were recorded. In this patient, the infectious process was localized in the thoracic spine.

Literature analysis shows that neurological symptoms most often develop in lesions of the cervical region (4068.4% of cases), followed by the thoracic spine and only then the lumbar and sacral regions [9,17].

The inflammatory nature of the process may reflect laboratory studies. ESR is considered a fairly sensitive marker of the infectious process, albeit nonspecific. With spondylodiscitis, it increases in more than 90% of cases and reaches values from 43 to 87 mm/h. Correlation of this indicator with the severity of infection or the age of patients was not found [9,15]. However, ESR can serve as a prognostic factor: it was noted that during treatment in most patients with spondylodiscitis, clinical improvement was combined with a decrease in ESR [5,7].

In our study, an increase in ESR was recorded in most patients, in 1 of these cases the indicator returned to normal. Clinical improvement in the study group occurred to varying degrees in all patients, it did not correlate with the dynamics of ESR changes.

The next rather sensitive marker of inflammation is CRP, the content of which is increased in most cases of spondylodiscitis, according to the description in the literature. In addition, 3 months after the start of treatment (subject to its effectiveness), CRP returns to normal, so some authors recommend using the definition of CRP to assess the effectiveness of treatment [5,7,9,15]. Unfortunately, this indicator was not determined in our group.

Leukocytosis is the least sensitive marker of inflammation in spondylodiscitis, the number of leukocytes may increase in only half or even a third of patients. In adults older than 60 years and/or immunocompromised patients with diabetes, the level of leukocytes may remain within the normal range [5,7,9]. In the observed group, less than half of the patients had leukocytosis.

Routine x-rays are often one of the first investigations for back pain. Unfortunately, the method is not sensitive for the early diagnosis of spondylodiscitis, since the manifestations of the disease on an x-ray can be seen only 2–8 weeks after the onset of the disease [4,16]. Changes depend on how long the infectious agent has been in contact with the affected area. Only with destruction of more than 30% of bone structures can spondylodiscitis be diagnosed [1,7]. In the observed group, in 2 patients, the first study was radiography, but no specific changes were detected.

Blood and persistent pain syndrome prompted further examinations.

CT can help in the early diagnosis of spondylodiscitis, since changes can be registered as early as the 2nd week of the disease. In this case, the disc is first of all involved in the pathological process, only then a decrease in the intensity of the signal from the bones is recorded [5,7,16].

In our observation, 6 patients underwent CT, and in 3 studies, changes characteristic of spondylodiscitis were recorded: destruction of the vertebral bodies, usuration and destruction of the endplates, a decrease in disc density, an increase in the volume of paravertebral tissues, and local thickening of the posterior longitudinal ligament. In the remaining 3 patients, specific CT changes were not detected.

MRI is the most sensitive method for diagnosing spondylodiscitis and is considered the method of choice for this pathology. The sensitivity of MRI is 96%, the specificity is 93%, and the accuracy is 94% [1,5,7-9,12-14,16]. characteristic for spondylodiscitis, changes are considered to be a decrease in signal intensity on T1-weighted images and an increase in its intensity on T2-weighted images due to edema from the disc and adjacent vertebral body, as well as a decrease in the clarity of the endplate on T1-weighted images. Contrast enhances the accuracy of MRI results, helps to detect disorders at early stages of the disease and differentiate it from degenerative and oncological pathology [5,7,8,10,12-14].

In our observation, the following changes were found that helped in the diagnosis of spondylodiscitis: trabecular edema of the vertebral bodies, changes in the MRI signal in the area of adjacent vertebrae, deformity of the endplates, a decrease in the height of the affected disc, thickening of the posterior longitudinal ligament, a decrease in signal intensity on T1-weighted image, structural changes in the vertebral bodies.

In suppurative spondylodiscitis, some MRI changes may

persist for a long time despite clinical improvement. R. Brown et al. assessed the state of the structures of the spine after suffering spondylodiscitis in children. The authors - noted that 23 months after treatment, hypointense changes in the vertebral bodies resolved, but still persisted in the disc. Only 34 months later, the disc fully recovered according to MRI results. Fisher suggests assessing the degree of spinal recovery based on MRI results no earlier than 1–2 years after therapy [4,6,10].

Treatment for spondylodiscitis is aimed at stopping the infection and preserving the structure and functions of the spine. Initial antibiotic therapy is always administered parenterally, for at least 10 days, and then continued orally [1,7,9]. Insufficient duration of therapy creates a risk for the recurrence of the infectious process, so the recommended duration of treatment for spondylodiscitis is 6-12 weeks [5,7].

Considering that spondylodiscitis in most cases is caused by *Staphylococcus aureus* and gram -negative flora, empiric therapy should be directed specifically at these pathogens. The criterion for the abolition of antibiotic therapy is the improvement of the patient's condition and the normalization of ESR and CRP.

In addition to antibiotic therapy, it is necessary to use NSAIDs and analgesics, as well as immobilization of the affected area [5,9].

Indications for surgical intervention in spondylodiscitis are symptoms of compression of neural structures, instability of the spine due to bone destruction, severe kyphosis, lack of effect from conservative therapy, and sometimes persistent pain [7,15].

A minimally invasive technique is transcutaneous discectomy followed by drainage. However, most often the foci of spondylodiscitis are located in the anterior sections of the spinal column. For this reason, during surgical intervention, an out-of-cavitary anterior or anterolateral approach is used (depending on the level of spinal lesion), which makes it possible to perform adequate sanitation of the inflammation focus, fixation of the spine, and decompression of neural structures, if necessary. In order to form level rigidity, transpedicular fixation of the spine is performed in some cases [7,11].

In our observation, all patients were discharged from the hospital with an improvement in their condition: in 28.6% of cases, a complete regression of the pain syndrome with restoration of range of motion was noted, in the remaining 71.4%, the pain intensity decreased significantly. As for the laboratory assessment of the regression of the disease, the level of leukocytes returned to normal in 2 patients upon discharge from the hospital, the ESR decreased to normal values in 1 patient, in the rest, changes in blood tests persisted at discharge. Unfortunately, dynamic monitoring of patients after the course of outpatient treatment was not performed.

With the development of antimicrobial therapy, mortality from spondylodiscitis decreased from 25-56% to less than 5-11% [5,7]. The greatest concern in surviving patients is their disability due to the possible development of a severe neurological deficit or severe pain syndrome, which may persist in a third of patients. The return of the infectious process is likely in 14% of cases after treatment. Exacerbations are possible in most cases within 1 year after treatment. A return of the infection can be suspected if the patient has renewed pain in the spine, an unexplained fever has appeared, body weight has decreased, ESR and CRP concentration have increased [5,9].

Thus, based on our own experience in monitoring patients with spondylodiscitis and a literature review, we can highlight the key points that contribute to the correct diagnosis and management of patients [3-7,10,13].

For early diagnosis:

- prolonged back pain in patients over 50 years of age, which cannot be corrected by taking NSAIDs;
- comorbidities, risk factors for spondylodiscitis: diabetes mellitus, urinary tract infections, bacterial endocarditis, endovascular devices, spinal surgery, intravenous drug use, immunosuppression, steroid use, trauma;
- increased ESR and CRP in blood tests in combination with back pain;
- MRI as the method of choice for spondylodiscitis.

Patient management tactics:

performing microbiological tests of blood or the contents of the affected area (biopsy of material from the surgical wound) to identify the pathogen;

- exclusion of tuberculosis, brucellosis and fungal etiology of spondylodiscitis;
- long-term empirical prescription of broad-spectrum antibiotics - at least 10 days of parenteral administration, at least 6-12 weeks of oral administration;
- in order to monitor the effectiveness of therapy after a course of treatment, an assessment of ESR and CRP;
- MRI monitoring of treatment efficacy is not appropriate due to the discrepancy between clinical improvement and neuroimaging pattern (difference of 1-2 years).

The use of MRI over time is recommended in case of treatment failure and continued progression of laboratory parameters.

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