DOI: 10.23934/2223-9022-2019-8-2-175-185

Nonspecific Pyoinflammatory Lesions of the Spine: Spondylodiscitis, Epiduritis

A.V. Yarikov[1, 2]*, A.P. Fraerman[1], O.A. Perlmutter[1, 3], A.A. Denisov[4], S.V. Masevnin[4], I.I. Smirnov[1], A.N. Lavrenyuk[1]

Neurosurgical Department № 1
[1] City Clinical Hospital № 39
144 Moskovskoye Highway, Nizhny Novgorod 603028, Russian Federation
[2] Privolzhsky District Medical Center, of the Federal Biomedical Agency
2 Nizhne-Volzhskaya Embankment, Nizhny Novgorod 603001, Russian Federation
[3] City Clinical Hospital № 40
71 Hero Yuri Smirnov Street, Nizhny Novgorod 603083, Russian Federation
[4] R.R. Vreden Russian Research Institute of Traumatology and Orthopedics
8 Akademika Baykova St., St. Petersburg 195427, Russian Federation

*** Contacts:** Anton V. Yarikov, Cand. Med. Sci., Neurosurgeon, City Clinical Hospital No. 39. Email: anton-yarikov@mail.ru

ABSTRACT Nonspecific infectious lesions of the spine are relatively rare, difficult to diagnose and severe diseases of the spine. The urgency of treating nonspecific infectious spinal diseases is explained by an increase in the frequency of these diseases, new antibiotic-resistant strains of microorganisms, and the severity of the course and unsatisfactory treatment outcomes. In this review, we describe spondylodiscitis and epiduritis in detail. On the basis of literature data, we thoroughly studied and described etiology, clinical pattern and diagnosis of these diseases. We thoroughly covered modern laboratory and radiologic methods for the diagnosis of spondylodiscitis and epiduritis, such as spondylography, computed tomography, magnetic resonance imaging, scintigraphy, positron emission tomography of the spine and biopsy and described modern methods of conservative and surgical treatment. The particular attention is paid to the technique of surgical treatment of spondylodiscitis and epiduritis.

Keywords: spondylodiscitis, epiduritis, spinal epidural abscess, spondylitis, biopsy

For citation Yarikov A.V., Fraerman A.P., Perlmutter O.A., et al. Nonspecific pyoinflammatory lesions of the spine: spondylodiscitis, epiduritis. *Russian Sklifosovsky Journal of Emergency Medical Care.* 2019; 8(2): 175–185. DOI: 10.23934/2223-9022-2019-8-2-175-185 (In Russian)

Conflict of interest Authors declare lack of the conflicts of interests

Acknowledgments The study had no sponsorship

Affiliations

Anton V. Yarikov	Cand. Med. Sci., Neurosurgeon, City Clinical Hospital No. 39, ORCID: 0000-0002-4437-4480.
Igor I. Smirnov	Neurosurgeon, City Clinical Hospital No. 39, ORCID: 0000-0002-1766-9515.
Olga A. Perlmutter	Dr. Med. Sci., Professor, Neurosurgeon, City Clinical Hospital № 39.
Aleksandr P. Fraerman	Dr. Med. Sci., Professor, Neurosurgeon, City Clinical Hospital № 39.
Sergey V. Masevnin	Cand. Med. Sci., Traumatologist, R.R. Vreden Russian Research Institute of Traumatology and Orthopedics, ORCID: 0000-0002-9853-7089.
Anton A. Denisov	Traumatologist, R.R. Vreden Russian Research Institute of Traumatology and Orthopedics, ORCID: 0000-0002-1766-9515.
Aleksandr N. Lavrenyuk	Head of the Neurosurgical Department № 1 of City Clinical Hospital № 39.

AT – antibiotic therapy
CNS – central nervous system
CRP – c-reactive protein
CS – cervical spine
CT – computed tomography
ESR – erythrocyte sedimentation rate
HR – heart rate
IVD – intervertebral disc
LS – lumbar spine
MRI – magnetic resonance imaging
NSAIDs – non-steroid anti-inflammatory drugs
NSPSIs – non-specific pyogenic spinal infections
PCR – polymerase chain reaction
RR – respiratory rate
SC – spinal canal
SIRS – systemic inflammatory response syndrome
TS – thoracic spine
VB – vertebral bodies

BACKGROUND

Non-specific pyogenic spinal infections (NSPSIs) are quite rare, difficult to diagnose and serious diseases [1]. The increase in the number of patients with this diagnosis is influenced by a growing proportion of the elderly population, wider use of immunosuppressants, improved diagnostic methods, and the growing number of invasive procedures [2–5]. Another important predisposing factor for the occurrence of NSPSIs is the presence of a number of diseases and

conditions, such as diabetes, alcoholism, drug addiction, hemodialysis, smoking, urinary infections, cancer, rheumatoid arthritis, chronic pulmonary diseases, HIV, hematological diseases, organ donation, overweight, and chronic inflammatory diseases [1, 6-11]. Spinal infections are often preceded by infections of a different location: urinary and genital tract, urological and gynecological operations, the presence of a permanent intravenous catheter [2, 12]. The urgency of the problems of diagnosing and treating NSPSIs is explained by the increase in the incidence of this pathology, the emergence of new antibiotic-resistant strains of microorganisms, the severity of the course of the disease and unsatisfactory treatment outcomes.

TERMINOLOGY

Any parts of the spine and adjacent tissue may potentially be involved in the infectious process. The clinical terms used in the NSPSIs (*R.R. Calderony, M. Larsen, D.A. Capen*, 1996) [12–14] are presented in Table 1.

Table 1

Clinical terms for inflammatory processes of the spine

Departments of the spine	Structures	Applicable names of diseases
Anterior part	Vertebral bodies (VB)	Spine Osteomyelitis Spondylodiscitis Spondylitis Tuberculous spondylitis
	Intervertebral discs (IVD)	Discitis Paravertebral abscess
	Paravertebral spaces	Psoas abscess Retropharyngeal abscess Mediastinitis, empyema
Posterior part	Subcutaneous area	Superficial wound infection Infected seroma Deep wound infection
	Subfascial area	Paraspinal abscess Osteomyelitis, spondylitis
	Posterior vertebral elements	Deep wound infection
Spinal canal (SC)	Epidural space	Epidurit
	Spinal cord sheaths	Meningitis
	Subdural space	Subdural abscess, arachnoiditis
	Spinal cord	Myelitis, intramedullary abscess

NSPSI is an inflammatory and destructive pathology of the spine and its structural elements (vertebral bodies (VB), intervertebral discs (IVD), muscular-ligamentous apparatus, intervertebral joints) caused by any infectious agent [15]. NSPSIs and inflammatory diseases of the central nervous system (CNS) (myelitis, meningitis, epidural abscesses) are classified in blocks M45, M46, M48, M49, M86, G00 – G09 according to the international classification of diseases (ICD-10). When identifying an infectious agent, codes B95 – B98 are used.

The lumbar spine (LS) is most often involved in the NSPSIs (50–55%), the thoracic (TS) is damaged in 20–35%, and the sacral and cervical (CS) spine is involved in 10–15% [14–18].

CLASSIFICATION OF NSPSIs

The newest classification of *Enrico Pola et al*. (2017) *(Catholic University of the Sacred Heart, Milan)* makes it possible to determine the treatment tactics of patients with spondylodiscitis in accordance with the clinical and radiological picture. This classification has already established itself in the global medical community [19]. The classification criteria were chosen among clinical and radiological factors with a known prognostic value.

Three main types (*A*, *B,* and *C*) were determined depending on the following main criteria: the presence of bone destruction or segmental instability, epiduritis and neurological symptoms. Secondary signs: involvement of paravertebral soft tissues and the presence of intramuscular abscesses. Biomechanical instability is a more than 25-percent-change in segmental kyphosis at the level of the infectious-inflammatory process. A physical examination, including assessment of deep tendon reflexes, sensitivity, muscle strength, and central pathological signs, should be performed to assess neurological status.

Type *A.* All cases with the absence of biomechanical instability, acute neurological disorders, and epiduritis. Depending on the secondary criteria, the subclasses were defined as follows:

- *A*.1: Simple spondylodiscitis without involvement of VB.
- *A*.2: spondylodiscitis involving IVD and adjacent VB.
- *A*.3: spondylodiscitis with limited involvement of paravertebral soft tissues.
- *A*.4: spondylodiscitis with unilateral (*A*.4.1) or bilateral (*A*.4.2) intramuscular abscess.

TREATMENT

Immobilization in a hard corset (orthosis) is often used untill the complete remission of NSPSIs. Patients with a higher functional need may be subjected to minimally invasive posterior percutaneous stabilization.

Type *B.* All cases with radiological evidence of significant bone destruction or biomechanical instability without neurological symptoms or epiduritis.

- *B*.1: destructive spondylodiscitis without segmental instability.
- *B*.2: destructive spondylodiscitis that extends to paravertebral soft tissue without segmental instability.
- *B*.3: destructive spondylodiscitis with biomechanical instability and segmental kyphosis (*B*.3.1 to 25°; *B*.3.2 more than 25°) (Fig. 1).

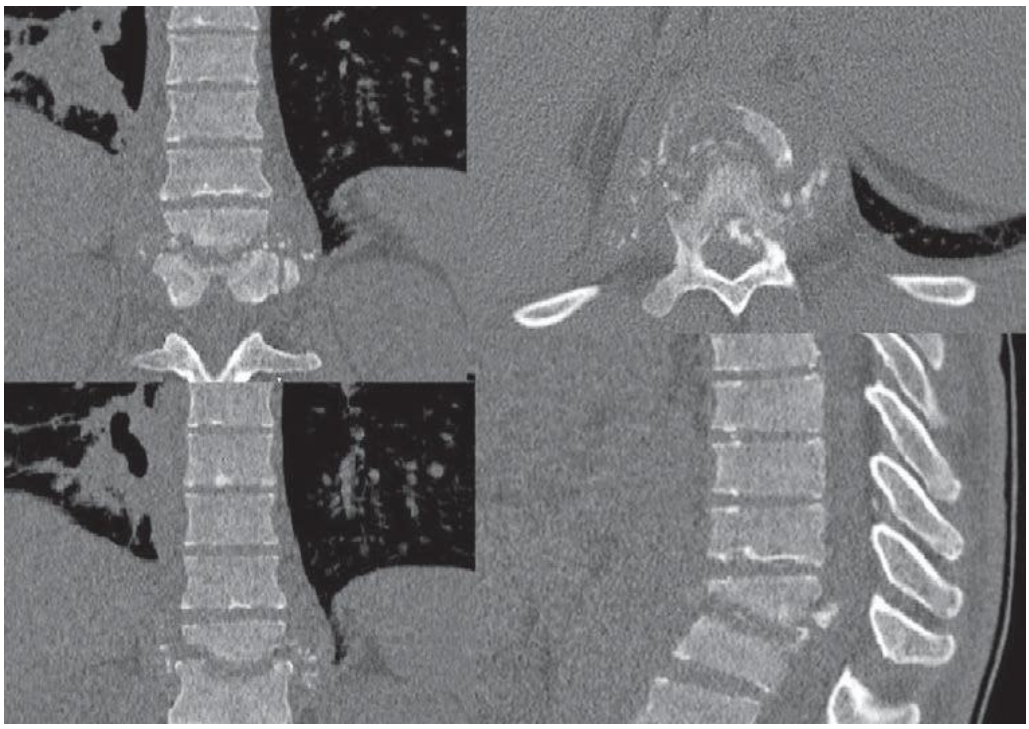

Fig. 1. Spondulodiscitis B.3.2 in a 30-year-old male patient with HIV, Hepatitis C and intravenous drug addiction in history. Spondylodiscitis of Th12-L1 with the development of L1 vertebral body distruction and kyphotic deformations (>25°) of the thoracolumbar passage

The conservative treatment or percutaneous stabilization has been indicated for destructive purulent spondylodiscitis with preserved spinal stability (*B*.1 and *B*.2).

When patients had segmental kyphosis or instability (*B*.3), surgical stabilization was performed without fail. Minimally invasive posterior percutaneous access was considered as a treatment option for people with mild kyphosis (*B*.3.1).

Type *C.* All cases with epiduritis or neurologic syptomatics were included.

- *C*.1: epiduritis without neurological symptoms and segmental instability.
- *C*.2: epiduritis and segmental instability without neurological symptoms.
- *C*.3: epiduritis and neurological symptoms without segmental instability.
- *C*.4: epiduritis and neurological symptoms with segmental instability.

Patients without neurologic symptoms and segmental instability *(C*.1) were on conservative treatment and their neurological status was examined.

Type *C*.2 epiduritis may be stabilized with the drainage of abscess in order to avoid the occurrence of further neurological disorders.

The observations with the threat of the biomechanical stability of the spinal column *(C* and *C*.3.4), surgical decompression of neural structures are always performed in combination with stabilization.

This classification allows the treatment of pyogenic spondylodiscitis on the basis of clinical and X-ray genological classification to be standardized. The suggested scheme includes all available orthopedic treatment methods and helps spinal surgeons significantly reduce the incidence of complications and avoid excessive treatment volume.

SPONDYLODISCITIS

Spondylodiscitis is quite rare, about 0.5–7.6 cases per 100,000 population [20-24]. Among all NSPSIs 80% accounts for spondylodiscitis, and at the moment there is a progressive increase in its incidence [24]. Despite the widespread use of antibacterial therapy (AT), the mortality due to spondylodiscitis remains unacceptably high and reaches 2–20% [3, 25]. In 90%, the route of infection in spondylodiscitis is hematogenous [26, 27]. The following ways of spreading the infection are also possible: secondary post-traumatic, contact, iatrogenic and idiopathic. At present, the most frequent is pyogenic spondylodiscitis, caused by gram-positive flora, in particular, *Staphylococcus aureus* [18, 28–30]. Gram-negative microorganisms, such as *Escherichia coli*, cause up to 25% of all NSPSIs [31].

CLINICAL PICTURE

In the initial stages of the disease, the symptoms of spondylodiscitis are little different from the symptoms of other degenerative and dystrophic diseases of the spine [32]. There is a tension of the paravertebral muscles, pain in TS similarly as in pleurisy or pneumonia, and pain in the lower part of the TS and LS which may mimic pain in acute abdomen, intestinal obstruction, pyelonephritis, paraproctitis, etc. [16]. The pain increases in the ortho-position of the body with axial load and movement [3, 28]. During palpation and percussion of the spinous processes of the vertebrae, their sharp pain at the lesion level is noted [3, 16, 26]. A symptom of axial load (Thompson symptom) is positive, which manifests itself in the patient's tendency to sit leaning forward with support on the knees. Mediastinitis, purulent pleurisy, purulent lymphadenitis, bronchial fistula, infectious aortic aneurysms may develop as complications of spondylodiscitis. [4, 16, 26, 33]. Spondylodiscitis threatens to deform the spine and destroy the structures of the SC and generalized sepsis. Neurological symptoms also develop when the SC and its contents are involved in the purulent process, which is most typical for CS and TS spondylodiscitis [3, 28]. The temperature rarely increases with spondylodiscitis caused by mycobacteria, brucella, fungi, and may not be detected in patients taking analgesics with antipyretic effect [34]. It is known that from the initial manifestations of complaints to the diagnosis of spondylodiscitis takes from 1 to 3 months.

Consequently, early diagnosis is valuable for the subsequent prognosis of spondylodiscitis, but it is precisely this that is difficult for the physician because of the non-specific clinical picture [29, 32, 35]. When spondylodiscitis lasts less than 2 months, it is set as acute, 2 to 6 months — subacute; more than 6 months — chronic non-specific [15].

DIAGNOSIS OF SPONDYLODISCITIS

The percentage of diagnostic errors in the detection of spondylodiscitis is currently very high and totals from 30 to 85%, and the average time for diagnosis of spondylodiscitis is more than 2–4 months [29, 35]. Blood tests reveal abnormalities specific to the inflammatory process: leukocytosis, increased erythrocyte sedimentation rate (ESR), *C*-reactive protein (CRP), dysproteinaemia, and increased levels of procalcitonin and fibrinogen [16, 34, 36]. Leukocytosis may be observed in 50% of patients with acute pyogenic spondylodiscitis. ESR is the most sensitive test, which increases in more than 90% of patients against the background of inflammation. CRP is an acute phase protein, more quickly normalized in time than ESR [16, 27]. An increase in CRP in spondylodiscitis is observed in 90% of individuals (Table 2). A rapid decrease in the level of CRP shows the right choice of therapy and contributes to the change of AT from intravenous injections to oral administration.

Table 2

Interpretation of the CRP test results

CRP level, mcg/l	Interpretation of results
0-5	Normal
6-10	Chronic infections, rheumatic diseases
30-200	Acute Disease
> 200	Sepsis

The study of procalcitonin is a reliable indicator of the syndrome of systemic inflammatory response (SIRS) and sepsis [15]. This study allows the differential diagnosis of bacterial and non-bacterial inflammation to be performed, as well as the severity of the patient's condition and the efficacy of treatment to be assessed (Table 3).

Table 3

Interpretation of the procalcitonin test results

The level of procalcitonin, ng/ml	Interpretation of results
<0.5	Normal. Chronic processes. Local inflammation.
0.5-2.0	SIRS
> 2.0	Sepsis

The above indicators are possible within the normal range in individuals with subclinical or chronic infections. At least two blood cultures for hemoculture should be sampled (two sets, in each bottles for aerobes and anaerobes) in each patient with suspected spondylodiscitis [16, 37, 38]. Hemoculture may be negative in 75% of individuals, especially if the process is caused by low-virulent microorganisms. Hemocultures obtained at a height of fever, provide a more reliable result. To diagnose SIRS (R. Bone), arterial blood pressure, body temperature, heart rate (HR) and respiration rate (RR), a clinical blood test to determine the number of leukocytes, the size of the stab shift, ESR, and CRP should be measured [9]. The main signs of SIRS are the growth of acute phase proteins, leukocytosis ≥12000/μl, in severe cases, leukopenia ≤4000/μl, an increase in the number of immature forms of leukocytes more than 10%, an increase in the temperature reaction to 38°C and more or hypothermia no more than 36°C, heart rate over 90 beats/min, RR more than 20 breaths/min, hypocapnia pCO_2 under 32 mm Hg. [7]. The septic course of SIRS in patients with NSPSIs significantly complicates the course of the disease and may be fatal due to the development of septic polyorgan failure [7, 29].

Several decades ago, radiography was a key method in the diagnosis of spondylodiscitis. The destruction of the bone tissue of the VB begins with visual X-ray imaging 3–6 weeks after the beginning of the process [3, 16, 34]. Computed tomography (CT) is a more sensitive and specific method for diagnosing spondylodiscitis, which makes it possible to see the destruction of VB much earlier than radiography [1, 3]. Characteristic findings are the erosion of the anterior plates, sclerosis of the VB, a decrease in the height and density of the IVD, laterodislocation of the VB, ante- and retrolisthesis of the VB, edema of the paravertebral tissues and/or the formation of the paravertebral abscess, the presence of gas in the abscess [1, 3, 11]. In patients with suspected spondylodiscitis, magnetic resonance imaging (MRI) of the spine should be performed first, if there is a technical possibility. The sensitivity of this method is 97%, the specificity is 93%, and the diagnostic accuracy is 94% [34]. When conducting MRI in T1-mode, a decrease in the intensity of the signal from the VB and IVD of the affected segment is visualized, in T2 and STIR modes the signal from these formations is enhanced. Inflammatory changes have a hypointense or isointensive signal at T1 and isointensive or hyperintense signal on T2 and STIR [16]. MRI reveals changes characteristic of spondylodiscitis: trabecular edema of the TP, change in the MR signal in the area of the adjacent VB, decrease in the height of the affected IVD, thickening of the posterior longitudinal ligament [1]. Combining CT and MRI makes it possible to visualize VB, spinal cord, ligaments, tendons. The MRI with contrast became widely adopted in the diagnosis of spondylodiscitis [39]. Contrast enhancement makes it possible to visualize and separate the demarcation line of the area of necrosis of tissues that do not accumulate a contrast agent, carry out differential diagnostics with tumor diseases and reveal the spread of the inflammatory process beyond the spine with the formation of paravertebral abscesses and epiduritis [3, 34, 40]. If it is impossible to perform MRI (metal implants, claustrophobia, lack of technical capability), a combined scintigraphy of the spine and bones with gallium/Tc^{99} or positron emission tomography of the spine are recommended [34, 41]. The ultrasound remains the method of visualization of paravertebral abscesses [15]. The biopsy of the infected area makes it possible to select the optimal AT, and this method is mainly used in patients with negative blood culture [28, 29, 34]. The biopsy leads to the establishment of a microbiological diagnosis and eliminates the need for open surgery in at least 50–70% of cases [16, 34]. It may be performed percutaneously. CT or X-ray are performed to identify the center

of infection. Histological examination of aspiration material allows to differentiate the infectious process from degenerative and neoplastic changes. This material possible to investigate using PCR analysis (polymerase chain reaction). This is a highly effective method which identifies microorganisms in a minimal amount, even after the onset of AT [15, 23, 40]. There are closed (percutaneous) and open methods for biopsy. The accuracy of results with closed biopsy is 30–74% [26, 34]. The puncture biopsy is performed under ultrasound, X-ray, CT or MRI guidance [13, 25]. It is necessary to obtain the following fragments of various tissues: 2 from VB adjacent to IVD, 2 from the affected IVD, and one should be separated from the liquid after washing the lesion. Ultrasound monitoring is ineffective in the diagnosis of spine diseases. X-ray biopsy is the simplest, most inexpensive, time-consuming method, which makes it possible to follow the procedure in real time. The disadvantage of this method is the inability to visualize the surrounding soft tissue. Visualization of the procedure using CT is a standard in many industrialized countries [43]. The CT allows to design the needle trajectory, avoid damage to organs, and also reach hard-to-reach foci [44, 45]. Disadvantages are the duration of the procedure and exposure to ionizing radiation. The advantage of CT over X-ray is the ability to visualize soft tissues together with bones, as well as a clearer visualization of the needle, in particular, with small pathological foci [25, 43]. An open biopsy is performed during the surgery. At present, knowledge of the factors influencing the diagnostic value of a biopsy is extremely small. In a retrospective study that included 800 patients who underwent bone biopsy under visual control, the highest percentage of positive results was observed when receiving more than 2 ml of fluid. The diameter of the needle used (11–18G), as well as the previous AT, did not have a significant effect on the result [30]. In patients with typical clinical and radiological signs of spondylodiscitis, but with negative biopsy results, a second attempt should be made.

Therefore, the early diagnosis of spondylodiscitis may be performed if the following factors are present [17, 39]:

- long-term pain in the back in patients over 50 years, not arrested with NSAIDs;
- associated diseases and risk factors for spondylodiscitis: diabetes mellitus, infections of the urogenital system, bacterial endocarditis, endovascular devices, spinal surgery, the use of steroids and narcotic drugs, immunosuppression;
- an increase in ESR and CRP in blood tests in combination with pain in the spine;
- MRI as the main method of choice.

TREATMENT OF SPONDYLODISCITIS

Early diagnosis, verification of the causative agent, correct AT are the keys to preventing complications and reducing the need for surgical intervention [16]. Currently, AT, magnetic stimulation, immunocorrective and restorative drugs are recognized as productive [46].

ANTIBACTERIAL THERAPY

Identification of the etiological microorganism is the main stage of adequate AT [34, 29]. In hemodynamically stable patients without neurological deficit, it is possible to keep away from empirical AT until the microorganism is verified. In patients with unstable hemodynamics, sepsis, SIRS, or progressive or severe neurological deficiency, it is necessary to begin empirical AT simultaneously with attempts to establish a microbiological diagnosis [34]. For most patients with spondylodiscitis, parenteral or oral AT with high bioavailability for 6 weeks is necessary. AT is prescribed in maximum therapeutic doses intravenously, in some cases intra-aortic administration of antibiotics is suggested [31]. The low effectiveness of conservative treatment with typical ways of administering AT is associated with an insufficient supply of drugs to the infectious focus through a powerful scar capsule and necrotic areas of bone tissue [38]. In empiric AT, it is necessary to use drugs which eliminate Staphylococci, including methicillin-resistant *S. aureus (MRSA)*, Streptococci, and gram-negative bacteria. Such AT may include a combination of Vancomycin and cephalosporins of III or IV generations. In case of allergies or intolerances, a combination of Daptomycin and Fluoroquinolone may be used. The empirical use of antifungal and antibacterial therapy in most cases is not justified [34].

Factors associated with the lack of effect of conservative treatment are not precisely verified at the moment, but may include damage to several IVDs, concomitant epiduritis, errors in surgical treatment, infections caused by *S. aureus*, old age and severe comorbidities [34].

Immobilization is of particular importance. The combination of bed rest, external corsets, limiting the mobility of the segment and facilitating the formation of bone block is indicated [1, 18, 23]. Evaluating the clinical response to therapy and further monitoring for systemic inflammation markers may help verify patients with a greater risk of therapeutic failure. In patients with spondylodiscitis and a 50% decrease in ESR after 4 weeks, the therapy is ineffective. In one study, it was found that after 4 weeks of treatment, ESR>50 mm/h and the level of CRP>2.75 mg/dl may confirm a significantly higher risk of therapeutic ineffectiveness [34]. Timely selected and interpreted MRI over time makes it possible to provide prognostic information regarding therapeutic ineffectiveness in people with spondylodiscitis with an unfavorable response to therapy. Improvements in the paravertebral and epidural soft tissues on subsequent MRI are best correlated with improved clinical status and outcomes. Compared to baseline MRI, subsequent examinations often show similar or worsening inflammatory characteristics of bone and IVD structures, despite the patient's clinical improvement and, ultimately, successful treatment. MRI changes in soft tissue, such as paravertebral and epidural inflammatory changes and abscesses, may be better correlated with treatment outcomes [34]. Patients with persistent, recurrent or progressive back pain, systemic symptoms of infection, not drained or partially drained considerable epiduritis, or constantly elevated markers of SIRS may have a high risk of treatment failure. Additional clinical criteria associated with treatment failure include diabetes mellitus, intravenous drug use, recurrent blood flow infection, newly appeared neurological deficit, and fistula [34].

Indications for surgical treatment of spondylodiscitis are presented in Table 4 [1, 26, 31, 34, 38, 47–50].

Table 4

Absolute and relative indications for surgical treatment of spondylodiscitis

Absolute indications	Relative indications
1. Severe neurological deficit and/or compression of vertebral canal structures 2. The threat of sepsis 3. Significant involvement of the bone with the development of spinal instability 4. Existing or threatening spinal deformity 5. Epiduritis, fistula	1. Unmanaged pain syndrome 2. Ineffective conservative treatment

Contraindications to surgical treatment are SIRS, generalized purulent process (multiple abscesses), uncorrected coagulopathy, severe comorbidities where the outcome of surgery is associated with a high risk of death [16, 31]. In these cases, a comprehensive conservative treatment is performed [46].

The objectives of surgical intervention are elimination of the infectious focus, performing a biopsy for microbiological and histological examination, SC decompression, ensuring adequate blood supply for tissue healing and maintaining or restoring the stability of the spine [31, 34, 49, 51]. The basic principle in the surgical treatment of NSPSIs is the adequate and complete removal of infected tissues [33, 36]. All infected and necrotic tissues should be removed, exposing normal bleeding bone, and sent for pathological histo- logical and microbiological examination [23, 30, 51–53]. The sanitated cavity must be fully treated with antiseptic and antibiotic solutions [31, 33, 53]. In order to replace the defect after the rehabilitation and stabilization of the spine, autotransplants are applied (ileal wing or rib) [1, 16, 48, 54]. However, only 1/3 of free grafts form a true bone block in the long-term period after transplantation of autograft, keeping their size, and in almost 40% of cases, the results worsen due to the absence of coossification, resorption and transplant fractures leading to pseudoarthrosis [4, 33]. Frequently, free bone grafts larger than 3 cm are resorbed, as they do not have close contact with the maternal bone bed. At the moment, non-resorbable implants made of nickel-titanium, carbon-carbon, ceramics, and their combination with autograft, are increasingly used to replace defects, which is the most promising in the surgical treatment of spondylodiscitis [20, 27, 36, 41, 50]. The use of the posterior access for sanitation and fixation in some cases is preferable because it allows to perform radical sanitation of the focus, reliable extrafocal fixation, eliminate kyphotic deformity, perform decompression of the spinal cord, install a tidal drainage system [1, 30].

EPIDURITIS

The causes of epiduritis are infections from other purulent foci: furuncles, subcutaneous abscesses, cellulitis, panaritiums, sepsis or purulent complications of surgical interventions on the spine and spinal cord, microbes introduced by the hematogenous or lymphogenous route [15, 46, 56, 61]. Quite often, the primary focus cannot be detected. Pyogenic epiduritis occurs relatively rarely and makes up 0.22–2.0% of the pathologies of the spine and spinal cord [13, 46, 53, 56]. The infection mainly involves the posterior parts of the SC, into the anterior sections at the level of CS [5, 15, 25, 48, 57, 58]. The most frequent location is TS (about 50%), then LS (35%) and CS (15%); in 82% — posterior location, in 18% — anterior location [11, 48]. The causative agents of the disease are *Staphylococcus aureus* (70%), gram-negative E. coli and aerobic Streptococci [5, 6]. In loose SC fiber, the process is often generalized along the longitudinal axis. Epiduritis compresses the spinal cord, nevertheless the inflammatory lesion of the spinal cord vessels also plays a role in the onset of symptoms [57].

CLINICAL PICTURE

When describing the clinical picture of epiduritis, most authors divide the course of the disease into 4 stages [1, 13, 53, 56, 57]:

- local back/neck pain;
- radicular pain;
- paresis of muscles, sphincters, sensitivity disorders;
- paraplegia.

The body temperature rises to 39–40 °C with ranges. The pain aggravates by tension, coughing [58–60].

DIAGNOSIS OF EP

Additional research methods are of great importance: CT scan in combination with myelography, MRI [27]. MRI is the only reliable method to determine the location of epiduritis or granuloma in SC and the degree of spinal cord compression [1, 15, 40]. According to the literature, the sensitivity and specificity of MRI in the diagnosis of epiduritis is more than 90% [15, 39]. Also, this diagnostic method allows to differentiate epiduritis and subdural abscess or myelitis [5, 59, 61]. Lumbar punctures at the location of the epiduritis are strictly prohibited due to the danger of meningitis, myelitis, subdural abscess, etc. [59].

TREATMENT

Some experts believe that the indication for surgery is the very establishment of a diagnosis of pyogenic epiduritis [27]. Others make the choice of treatment tactics depending on the size of the epiduritis, the neurological status (I – II stage of the disease) and the general condition of a patient [3, 29, 39, 53]. For small epiduritis, which is an accidental find and do not cause compression of the spinal cord and its roots, surgical treatment is not iindicated, in other cases, surgical treatment is the main treatment [3]. The objectives for the surgical treatment of epiduritis are maintaining the function of the spinal cord, eliminating the toxic effect on the spinal cord, preventing the development of circulatory disorders in the spinal cord, determining the infectious agent and its sensitivity to AT, managing the septic process in the body and preventing the development of metastatic ulcers in other organs [1, 6 , 25]. The sooner the patient is operated, the greater the chances of saving his life and reducing the severity of the neurological deficit are [41, 59]. The operation is urgently performed. A temporary delay of surgical intervention is possible only if it is necessary to manage the activity of the cardiovascular system and SIRS (27). Laminectomy is performed over the entire area of the purulent process in the SC [29, 60]. All affected tissues, including granulation tissue, must be removed, exposing epidural tissue [1, 52]. The necrotic tissue should be carefully removed, so as not to open the dura mater. The operation ends with drainage of the SC space with two perforated tubes with a diameter of 5–6 mm, followed by lavage with an

antiseptic solution and stitching [1, 27]. Other methods of drainage of the cavity epiduritis (rubber strips, vacuum aspiration, irrigation with antibiotics in the tissue around the postoperative wound, with open maintenance) lead to a large number of complications such as osteomyelitis of the archs and contact abscesses of soft tissues [27]. When pyogenic epiduritis extends over several parts of the spine, it is possible to perform a “fenestrated” laminectomy on several levels, but with the indispensable drainage of the entire space of the SC with tubes installed under the vertebral arches. Paravertebral soft tissue abscesses are opened and drained through separate incisions above the area of maximum tissue destruction. If an abscess is located in the anterior TS, an operation is performed from the anterior access [29]. The IVD, which is the source of epiduritis, is removed, the pus is aspirated and the VC space is washed with an antiseptic, the tidal system is installed, and anterior spondylosynthesis is performed [3]. In the postoperative period, intensive AT is performed in accordance with the sensitivity of microflora, and antibiotics of a broad spectrum of activity are used before obtaining the results of bacteriological tests [57, 59]. In the treatment of epiduritis, it is necessary to use extracorporeal detoxification methods. Adverse outcomes in the late postoperative epiduritis period are associated with a lack of dynamics of neurological symptoms, late surgical treatment of epiduritis for more than 7 days from the onset of the disease, myelopathy detected by MRI, kyphotic deformity of the affected spine [3, 35]. Consequently, one of the options for improving the outcomes of surgical treatment of pyogenic epiduritis of the posterior location is the use of transpedicular osteosynthesis after posterior decompression [24].

CONCLUSION

The cause of pain in the back and neck may be associated not only with degenerative and dystrophic diseases of the spine. Nonspecific pyogenic spine infections appear to be a separate nosological form, and their treatment is a complex and far from resolved problem. Despite the relative rarity, these diseases deserve special attention due to the severity and outcomes, as various specialties (neurosurgeons, orthopedic traumatologists, surgeons, therapists, infectious disease specialists, phthisiologists, general practitioners and neurologists) may set the primary diagnosis, and the outcome of treatment depends on its proper time. Nonspecific pyogenic spine infections reduce the quality of life, lead to the disability of patients, neurological deficit, or even death in case of SIRS development. The use of computed and magnetic resonance imaging in the systemic inflammatory response syndrome makes it possible to identify the foci of destruction in the vertebral body, the extent of the process and its connection with the spinal cord, surrounding tissues and organs, and helps set the diagnosis earlier, as well as justify the tactics and treatment plan.

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Received on 04.01.2019

Accepted on 04.03.2019