The role of radioisotopic methods in imaging of intervertebral disc inflammation in children

Stanisław Pilecki¹, Marcin Gierach¹, Przemysław Drobik¹, Andrzej Kurylak², Iwona Trzcinska³, Wojciech Hagner⁴, Olgierd Pilecki⁵, Sebastian Watek¹, Roman Junik¹

¹Laboratory of Nuclear Medicine, Department of Endocrinology and Diabetology Nicolaus Copernicus University in Torun, Collegium Medicum in Bydgoszcz
²Department of Paediatrics, Haematology and Oncology Nicolaus Copernicus University in Torun, Collegium Medicum in Bydgoszcz
³Department of Radiology and Diagnostic Imaging Nicolaus Copernicus University in Torun, Collegium Medicum in Bydgoszcz
⁴Department of Orthopaedic Rehabilitation, Nicolaus Copernicus University in Torun, Collegium Medicum in Bydgoszcz
⁵Department of Paediatrics and Endocrinology, County Children’s Hospital in Bydgoszcz

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Abstract
The authors present the case of a 17-year-old girl, with pain over lumbar spine area, treated by paediatricians and rehabilitation specialists, discussing diagnostic imaging and laboratory examinations together with clinical observations. Spondylodiscitis was diagnosed after bone scintigraphy with ⁹⁹mTc-MDP, the course of disease was monitored by immunoscintigraphy amongst other techniques.

Key words: spondylodiscitis, scintigraphy, children

Introduction
Persistent back pain in children, however infrequent, is a serious diagnostic issue. Spondylodiscitis should be taken under consideration, among other causes, in differentiation.

Most frequently ultrasonographic and radiological methods are used in diagnostic imaging, rarely scintigraphy. However, radionuclide imaging is inevitable to establish the diagnosis in some cases.

Case description
A 17-year-old girl was admitted to Hospital due to elevated body temperature and pain in the lumbar-sacral spine area. The pain caused limitation of movement in the lumbar spine area, the difficulties with getting up from horizontal position and enabled crouching according to subject examination.

Increased level of C-reactive protein (CRP) was detected. Infection of urinary system, borreliosis, yersiniosis, tuberculosis and rheumatoidal background were excluded on the basis of laboratory findings. Ultrasonography of the abdominal cavity was without change. X-ray scan of spine was normal. Increased bone metabolism at area of L₂–L₃ was observed after three-phase bone scintigraphy and emission tomography (SPECT) of lumbar-sacral part of spine utilising ⁹⁹mTc-MDP. Scintigraphic image suggested an inflammation in intervertebral space and two adjacent vertebral bodies L₂ and L₃ (Figure 1). Inflammatory changes at the aforementioned area were confirmed by Magnetic Resonance Imaging (MR) (Figure 2). Fusion of MR and SPECT images was carried out due to detail location changes (Figure 3).

Lumbar spine was fixed in a Jevett jacket. Antibiotic-therapy together with adjunctive anti-inflammation therapy were used. Improvement of clinical status was attained; blood sedimentation rate and CRP were back to normal. SPECT by means of monoclonal antibodies against surface antigens of granulocytes was performed after antibiotic-therapy. Pathologic gathering of radiotracer was not observed during aforementioned examination. However, a clearly decreased accumulation of radiotracer in vertebrae L₂ and L₃ was noticed (Figure 4). Fixation was left with patient due to occasional pains while getting up and during morning hours. Control examinations in a 3 month period were prescribed and the girl was referred to Departments of Neurosurgery and Rehabilitation for further care.

After two months, the patient was admitted to the Hospital again, due to sudden pain, radiating to the left lower limb. Protru-
Figure 1. SPECT of lumbar spine. Intensive accumulation of $^{99m}$Tc-MDP in bodies and intervertebral spaces of L2–L3 vertebrae of spine is seen.

Figure 2. Magnetic resonance examination — peroneal cross-section of lumbar spine in sequence FSE, $T_2$-dependent. Increase of intensification of signal in vertebral bodies L2–L3 with unequal outlining of border plates together with narrowing of intervertebral disc.

Figure 3. Fusion of SPECT/MR images after $^{99m}$Tc-MDP administration. Sufficient increased accumulation of radiotracer in L2–L3 of vertebral column is observed.
Compression coming into vertebral canal and intervertebral foramens at around 4 mm with pressure on dural sac together with bilateral stenosis of intervertebral foramens at aforementioned level was noted by MR (Figure 5). Fusion of MR images together with earlier scintigrams after using monoclonal antibodies was carried out to show almost complete lack of radiotracer accumulation connected with L2–L3 vertebral bodies (Figure 6). Analgesic and muscle loosening medication was administered and again, the spine was fixed by a Jevett jacket.

Kinesis-therapeutic and physiotherapeutic exercises were applied, reaching strengthening of muscular brace, after pain regression. The hospitalization period went without complications. The patient was discharged home in a generally good state, after planned therapeutic rehabilitation.

Methods

Scintigraphic examinations were performed utilising a single-head gamma camera. Technical parameters of equipment were: rectangular crystal, spectrum of detector: 31 × 41 mm, axis of detector: 51 cm, number of photomultipliers: 76, capability of object shape evaluation, FWHM of detector < 3.8 cm.

First, scanning of the skeleton was carried out after administration of 500 MBq of 99mTc-MDP. Three-phase procedure was performed. During 1 min., a series of acquisitions every 2 seconds was carried out in vascular phase. Three planar projections...
Back-pain in children may have different causes, and its likelihood during childhood and youth is estimated to be as much as 30% [1]. Most frequently, ailments last for a short time, but 4-week pain indicates serious disease and requires detailed and complex diagnosis [1, 2]. Either changes at area of spine and para-spinal tissues, or organs located in the abdominal cavity and chest, and even mental causes should be taken into consideration in discussed case. Scintigraphic image showed classical pattern of spine changes: inflammation of two adjacent vertebrae and intervertebral disc L₂–L₃, but extra examinations and phthisiologic consultation excluded suspicion of tuberculosis.

Imaging diagnostics is emphasized by many authors as most efficient in monitoring and diagnosing spondylodiscitis [8–16]. Generally it is believed that diagnostics should be started with conventional X-ray imaging, in two projections. Unfortunately, radiological symptoms as stenosis of intervertebral space and osteolytic focuses or erosions of adjacent surfaces of vertebral bodies occur relatively late (after 2–8 weeks since disease started) and not in all patients [9, 14]. Also in our case there were no changes visible on X-ray images.

Some authors believe that the next examination should be MR to confirm clinical differentiation and specify the exact range of inflammation process [11, 13–16]. However, the others emphasize the role of scintigraphic examinations for the location of changes and evaluation of their features [1, 8, 17–20]. The advantage of bone scintigraphy, according to Królicki, is high sensitivity; therefore it should be included as one of first methods in the diagnostic algorithm [4]. Three phase scintigraphy with the use of ⁹⁹ᵐTc-MDP SPECT in 3rd phase was carried out to differentiate changes in the spine according to the discussed case. Gallowitsch performed two-phase scintigraphy in 3 cases of spondylodiscitis getting moderate uptake in vascular phase, which strongly correlated with inflammation focuses [17]. Immunoscintigraphy with ⁹⁹ᵐTc monoclonal antibodies against granulocytes was proposed to monitor changes after decreasing of inflammation of clinical symptoms. Gratz used immunoscintigraphy with antibodies against granulocytes labelled with ⁹⁹ᵐTc, in order to visualize inflammation changes in children and infants, showing inflammation focuses in 36% of cases [8]. MR and PET, and scintigraphy with ⁹⁹ᵐTc-MDP
or $^{67}$Ga was performed in 16 adults, also by the aforementioned author, who concluded PET to be more sensitive than MR together with other scintigraphic examinations in detecting spondylodiscitis, which was confirmed by a number of operations [19]. Chun emphasizes that only scintigraphy with $^{99m}$Tc-MDP enabled diagnosis of spondylodiscitis in a 12-year-old boy during hospitalization. Nijhof used $^{111}$In-IgG for scintigraphic evaluation of inflammation changes. He obtained high sensitivity in detecting inflammation changes in knee and hip joints; however, in one case of spondylodiscitis, the result was negative [19].

Heindel considers MR to have the same sensitivity as bone scintigraphy, to locate changes, but showing details, inflammation range, intracanal changes is much better depicted by MR. MR also enables monitoring of the treatment course, evaluation of bone marrow oedema and return of adipose bone marrow [8]. Plasschaert thinks that MR is the most sensitive and specific method to image changes in spondylodiscitis [11]. Also, MR examination is highly sensitive and specific according to Królicki [4]. According to Staffen, MR and scintigraphy $^{99m}$Tc-MDP are similarly sensitive (92%); however MR is more specific than scintigraphy (83% and 50% respectively) during the preliminary phase of spondylodiscitis [20].

Computed tomography (CT) is not so important in differentiation of inflammation changes in the spine, although it can be sufficient to evaluate infection changes and osseous processes [12]. CT could be necessary in doubtful cases, during the late phase of disease, showing not only erosions of vertebral body surfaces and reconstruction of bone structure, but also changes in paraspinal tissues [4]. CT could be also used in case of problems in differentiating spondylodiscitis and proliferation processes, which, as a rule, do not transmit through the intervertebral disc to the adjacent vertebral body. According to Heidel, the main advantage of CT is the possibility to perform a biopsy under control of CT to evaluate microbiological samples and apply drainage [8].

## Conclusions

Early diagnosis in the case of spondylodiscitis is possible throughout the application of diagnostic algorithm, including detailed subject examination and case examination, together with laboratory and imaging findings examinations, including scintigraphy.

Three-phase scintigraphy and SPECT of lumbar spine utilising $^{99m}$Tc-MDP and monoclonal antibodies enabled the detection and monitoring of spondylodiscitis in the discussed case.

## References