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Clinical and pathological considerations in lumbar herniated disc associated with inflammatory lesions

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Abstract

Lumbar herniated disc is the most frequent cause for lumbar pain. It is caused by degenerative, macroscopic and microscopic changes of the intervertebral discs. It is a chronic disease, with periods of exacerbation and remission under drug and physiotherapeutic treatment. When the disc lesions are large, with intense symptoms, reduced or impossible movements, with pain radiating to the sciatic nerve trajectory, a surgical treatment is required, to remove the herniated *nucleus pulposus* and decompress the nerve roots. Patients who present high inflammatory signs, high inflammatory serous markers, may have a longer postoperative recovery period, while the motor recovery may be late and incomplete. We analyzed a group of 24 patients with lumbar herniated disc that required discectomy, with clear inflammatory signs, together with histopathological and immunohistochemical changes present in the herniated disc.

Keywords: disc hernia, *nucleus pulposus*, inflammatory tests, immunohistochemistry.

Introduction

Lumbar pain represents one of the most frequent symptoms affecting people all over the world, regardless of age and occupation. It is thought that up to 84% of people present at least one episode of lumbar pain during their life span [1, 2]. At present, back pain became a problem of public healthcare, being the fifth most frequent cause of hospital admission and the third most frequent cause for undergoing surgery [3–6]. The negative economic effects of back pain result from the fact that these appear mainly in individuals aged between 50 and 70 years old (and also in young adults, even less than 30 years old) generate the reduction of productivity in the workplace and a higher number of medical leave period [5]. Only in the US, the annual expenses for back pain are estimated at about 91 billion dollars [7].

The most common cause for lumbar pain is represented by intervertebral disc disease and its associated conditions. Lumbar herniated disc affects approx. 1–3% of all people around the world, thus requiring medical, physiotherapeutic or surgical treatment [8]. The disease presents a tendency of incidence increase as the population gets older [9]. The medical imagistic studies showed that disc hernias are mainly symptoms free, being identified in about 30–40% of the adult population [10] who, from other reasons, performed a medical imagistic investigation [X-ray, computed tomography (CT) scan or magnetic resonance angiography (MRA)] of the lumbar spine.

Lumbar herniated disc is the result of the lumbar intervertebral disc degeneration, which is morphologically characterized through the partial damage of the fibrous ring in the intervertebral disc, followed by the displacement and herniation of the *nucleus pulposus* towards the vertebral canal or intervertebral hole, compressing the spinal nerve root [11, 12]. The compression of the spinal nerve root also causes lumbar pain on the posterior side of the lower limbs, also known as sciatica.

Lumbar herniated disc with symptoms requires a non-surgical or surgical treatment. The surgical treatment has the result of a rapid and more efficient remission of symptoms, and it is required in more advanced stages of the disease, when there is no response to other treatment ways [13, 14].

Aim

In this study, we proposed to present the cases of lumbar herniated disc who showed positive inflammation serological tests, had a difficult progression due to the long-term persistence of a sensitive syndrome characterized by

prolonged pain, paresthesia, motor deficit and a long recovery period. In these patients, there was performed a histopathological (HP) and immunohistochemical (IHC) study for highlighting the microscopic changes of the intervertebral disc.

Patients, Materials and Methods

Of 1792 patients clinically and imagistically diagnosed with lumbar herniated disc and surgically treated between January 1, 2016–December 31, 2019, in the Department of Neurosurgery, Emergency County Hospital, Pitești, Argeș County, Romania, there were selected 24 patients who presented positive inflammation serological tests and had a less favorable postoperative recovery. All the patients gave their consent for the surgery and for the use of the biological material resulted from discectomy for the HP study. Also, there was obtained the agreement from the Ethics Committee within the Emergency County Hospital of Pitești for performing the study and publishing the results.

There were excluded the patients with chronic paresthesia, motor or sphincter problems caused by intra-operative incidents or accidents, like nervous root lesions, dural rupture, hematoma or postoperative infection, surgical wound rupture, suture material intolerance.

Histopathological study

The harvested intervertebral disc fragments were immediately passed into 10% neutral buffered formalin containers for 24 hours and sent to the Laboratory of Histopathology for microscopic study. After formalin fixation, the biological material was included into paraffin, according to the classical HP protocol, followed by a microtome sectioning, with 4-μm thick pieces. The histological sections were stained with Hematoxylin–Eosin (HE) for the study of HP changes and with the green light trichrome, the Goldner–Szekely (GS) technique, for highlighting the collagen fiber changes in the intervertebral disc.

Immunohistochemical study

For completing the HP study, we performed an IHC study, for a specific highlighting of the inflammatory cells, and also of the changes caused by the secretion of some matrix metalloproteinases (MMPs). For this, we used the following antibodies: anti-cluster of differentiation (CD)3 (monoclonal mouse anti-human CD3, clone F7.2.38, 1/25 dilution, Dako) for highlighting T-lymphocytes; anti-CD20 (monoclonal mouse anti-human CD20cy, clone L26, 1/50 dilution, Dako) for highlighting B-cells; anti-CD68 (monoclonal mouse anti-human CD68, clone KP1, 1/100 dilution, Dako) for the macrophage study; anti-CD34 (monoclonal mouse anti-human CD34 Class II) for highlighting possible blood vessels in the damaged intervertebral disc; anti-tryptase (monoclonal mouse anti-human mast cell tryptase, clone AA1, 1/500 dilution, Dako) for highlighting the presence of mastocytes; anti-MMP-1 (monoclonal mouse anti-human MMP-1, clone VT7, 1/50 dilution, Dako); anti-MMP-2 (monoclonal mouse anti-human MMP-2, clone NB200-114, 1/50 dilution, Novus); anti-MMP-8 [purified anti-mouse monoclonal immunoglobulin G2a (IgG2a), clone 100608, 1/50 dilution, R&D Systems]; anti-MMP-13 (polyclonal rabbit anti-human MMP-13, clone NB110-5919, 1/50 dilution, Novus).

Results

Clinical examination

All the patients included in the study group presented pain in the lumbar area of the spine for at least 3–6 months, associated with the reduction of lumbar spine mobility, sometimes up to the rigidity stage, together with changes of the physiological curves of the spine, with onset of scoliosis and more or less intense contracture of the paravertebral muscles. Lumbar pain was sometimes associated with migration of pain onto the dorsal side of the thigh alongside the sciatic nerve trajectory, paresthesia, hypoesthesia or even anesthesia in some skin areas, innervated by the sciatic nerve. Some patients presented motor deficit in the innervated area by the crural or sciatic nerve.

Quite rarely, there was observed the "ponytail syndrome", characterized by paresthesia or hypoesthesia and sphincter disorders.

The mean age of the patients in our group was 61 years old and the sex distribution was equal.

The paraclinical examinations highlighted the presence of a non-specific inflammatory syndrome, characterized by the presence of moderate leukocytosis in the blood, with a high number of neutrophils, a moderately high erythrocyte sedimentation rate (ESR), together with high values of C-reactive protein (CRP) and fibrinogen.

The X-ray investigation highlighted the change in the height reduction of some lumbar intervertebral discs, with the formation of some marginal osteophytes in the adjacent vertebral surfaces. Conclusive imagistic information was also obtained by using the CT scan or MRA images. These imagistic investigations highlighted the changes of the disc hernia subtypes (median, paramedian, lateral), compression of the dural sac, damage of the nervous trajectories, changes of the disc surfaces (bone edema), damage of vertebral ligaments and presence of inflammatory changes on the interapohysis joints.

Imagistic investigations showed that the most affected intervertebral discs were L3–L4, L4–L5 and L5–S1 (Figures 1–3).

The differential diagnosis was mainly represented by the usual pathology of the spine: lumbar stenosis, foraminal stenosis, vertebral fracture, vertebral tumor, vertebral metastasis, vertebral damage in malignant blood diseases, vertebral tuberculosis (TB), primitive osteodiscitis, epidural or paravertebral abscess and other neighboring pathologies, such as arachnoiditis, retroperitoneal inflammations (renal, ureteral, vascular), etc.

The associated pathology was represented by obesity and type 2 diabetes mellitus (DM) – five cases, cardiac ischemia – seven cases, high blood pressure (HBP) – six cases, chronic atrial fibrillation (AF) – two cases, chronic bronchopneumopathy – three cases, pulmonary TB sequelae – one case.

The microbiological examination, performed after surgery from the intervertebral disc fragments, both through direct microscopy using Gram staining, and through culture environment inoculation, did not highlight the presence of any microbial pathogenic agent.

The postoperative treatment of the patients in the study group included anti-inflammatory, neurotropic, myorelaxant

drugs, as well as physiotherapy, hydrotherapy, electrotherapy, massage, kinesiotherapy. Nevertheless, the serum inflammatory tests maintained over the normal values for a longer time, in comparison to other patients, the motor deficit recovery was incomplete (reduced to about 50%) and required a longer recovery time period.

From our observations, the association between disc hernia and local inflammatory processes is rare, but it offers a poorer postoperative prognosis, due to the persistence of paresthesia symptoms over a longer period of time. In our study, this association represented 1.34%.

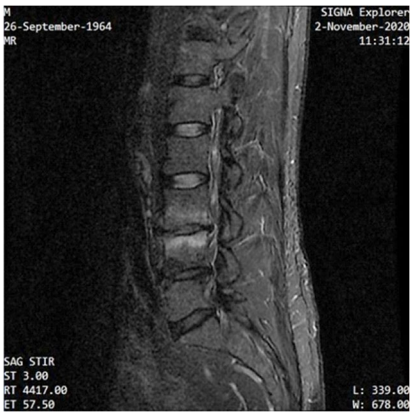

Figure 1 – ***Isolated and linear hyper T2 signal, hyper or hypo T1. STIR: changes within the vertebral plateau of L3 and L4 vertebrae with mixed Modic type I and Modic type II changes, edema and lipomatous transformation of bone marrow. STIR: Short tau inversion recovery.***

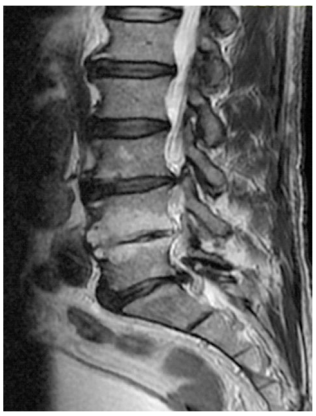

Figure 2 – ***T2 MRI sagittal section, lumbar spine. Lumbar disc herniation at L5–S1; disc protrusion L3–L4 and marked degenerative changes, with chronic inflammatory changes, Modic type II within L4 and L5 vertebrae. MRI: Magnetic resonance imaging.***

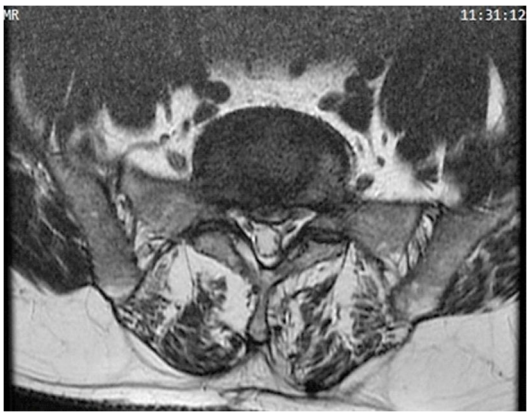

Figure 3 – ***Circumferential herniated disc, contained by the posterior longitudinal ligament, predominantly median, with compressive effect onto the dural sac, disc–nerve root conflict bilaterally L4–L5, L5–S1; linear zones of T2 hypersignal.***

Histopathological study

HP study performed on the harvested intervertebral disc fragments during discectomy showed major, mainly degenerative changes. The collagen fibers in the intervertebral disc structure appeared dissociated and fragmented, most probably because of the mechanic overload on the disc, associated with the local fibroblast proliferations in some areas, an aspect interpreted as a local reparatory reaction (Figures 4 and 5).

In the *nucleus pulposus*, there were observed areas with chronic degenerative changes, with a heterogenous distribution of glycosaminoglycans, edema and even cellular necrosis (Figures 6 and 7).

In some patients, there were identified deposits of calcium salts, both in the fibrous ring and in the *nucleus pulposus* (Figures 8 and 9).

Local inflammatory processes had various intensity from one patient to another. Most often, they presented as chronic, more or less abundant, inflammatory infiltrates, mainly formed of lymphocytes, plasmocytes, macrophages, rare mastocytes and quite rare granulocytes (Figures 10 and 11). Frequently, in the areas with a chronic infiltrate, there were also identified capillaries of angiogenesis, thus explaining, on the one side, the number of inflammatory cells in some areas of the intervertebral disc, as well as the formation of some local reparatory areas through the presence and multiplication of fibroblasts. These cells are the main conjunctive cells that synthesize collagen fibers, as well as the intercellular and interfibrillar matrix present in the intervertebral disc structure (Figures 12 and 13). In some areas, there were identified abnormal processes of local tissue repair through the presence of bone tissue islands in the structure of the intervertebral disc, like a process of ectopic bone metaplasia (Figure 14). Regarding the cartilaginous tissue from the intervertebral disc, we found frequent empty chondroblast cavities, a sign for apoptosis or chondrocyte necrosis (Figure 15), thus showing an important reduction of the capacity of cartilaginous tissue remake in the intervertebral disc.

Immunohistochemical study

IHC study proposed to highlight the inflammatory cells present in the intervertebral disc through specific antibodies, as well as the synthesis and excretion of MMPs, enzymes that may contribute to the amplification of disc lesions, through the destruction of some elements of the extracellular matrix (ECM). Normally, the intervertebral disc does not contain blood vessels or inflammatory infiltrates. In our study, we identified the presence of various types of inflammatory cells: T-, B-lymphocytes, macrophages, mastocytes (Figures 16–19). Of these, the most numerous ones were the macrophages and T-lymphocytes. The presence of a high number of macrophages, of large sizes, with a foamy cytoplasm, indicates the presence of some intense processes of cellular and tissular necrosis in the affected disc.

Another important aspect of our study was the highlighting of blood vessels in the lesioned intervertebral disc, through the specific highlighting of the endothelial cells' marker. The use of anti-CD34 antibody showed that, in the damaged disc, there appear new angiogenesis blood vessels (Figure 20), correlated with the intensity of the local inflammatory reaction and the processes of tissue remodeling.

Regarding the IHC expression of MMPs, our study allowed us to observe that both inflammatory cells and local fibroblasts synthesize more types of de MMPs, higher

quantities being expressed for MMP-8 and MMP-13 (Figures 21–24). MMPs are traditionally considered enzymes that degrade the ECM components. MMP-8 and MMP-13 are hydrolytic enzymes acting upon collagen type I, II and III found in the ECM whom they deform into smaller, non-functional molecules.

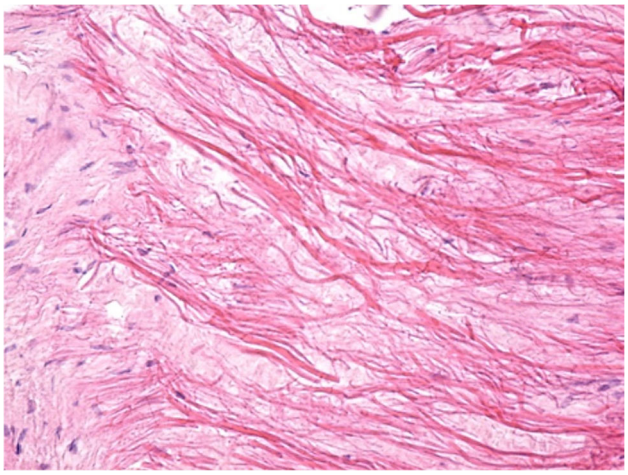

Figure 4 – ***Dissociated and fragmented collagen fibers in the structure of the intervertebral disc, most probably because of the mechanical overload of the disc, associated with the fibroblast proliferation, as a sign of local tissular repair. Hematoxylin–Eosin (HE) staining, ×200.***

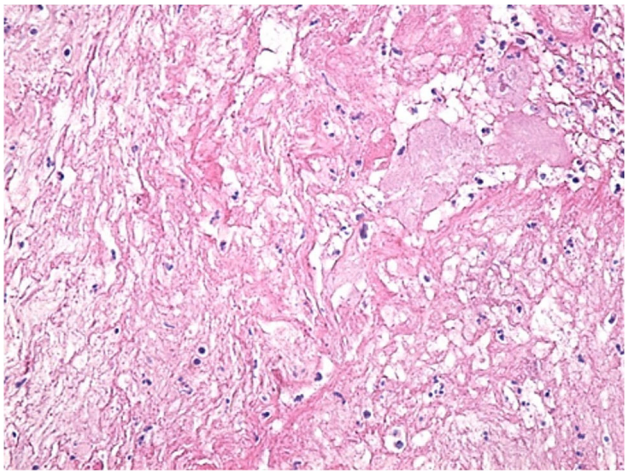

Figure 5 – ***Intervertebral disc with degenerative changes, with fragmentation and disorganization of collagen fibers. Cellular necrosis. HE staining, ×100.***

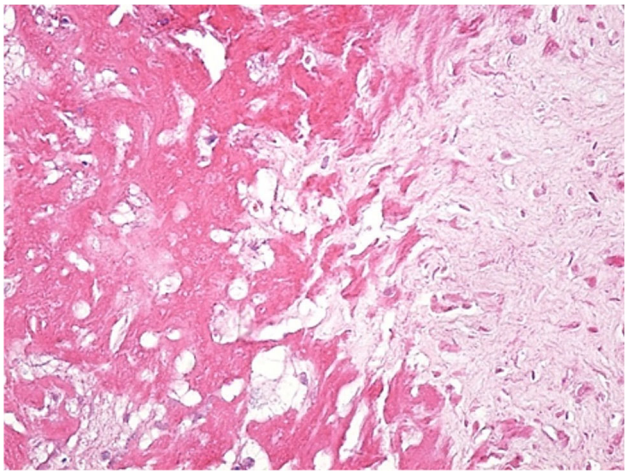

Figure 6 – ***Glycosaminoglycans in the nucleus pulposus, intensely acidophilic, with a heterogenous distribution, associated with cellular apoptosis. HE staining, ×100.***

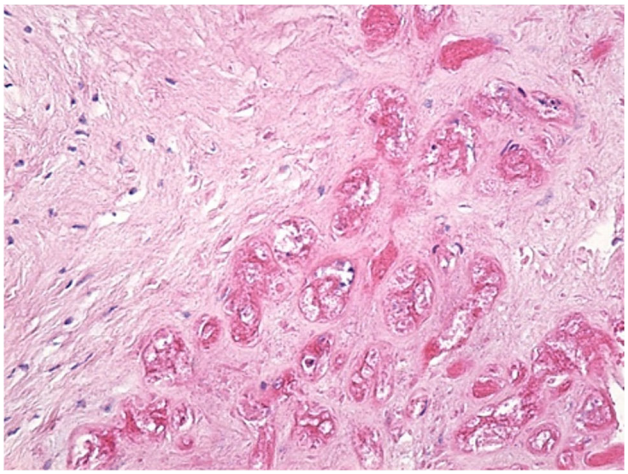

Figure 7 – ***Intervertebral disc area with necrosis and chondrocyte apoptosis. HE staining, ×100.***

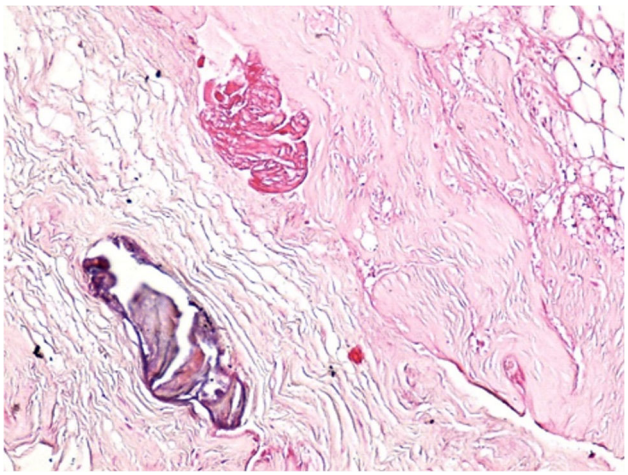

Figure 8 – ***Intervertebral disc with deposits of calcium salts among the collagen fibers. HE staining, ×100.***

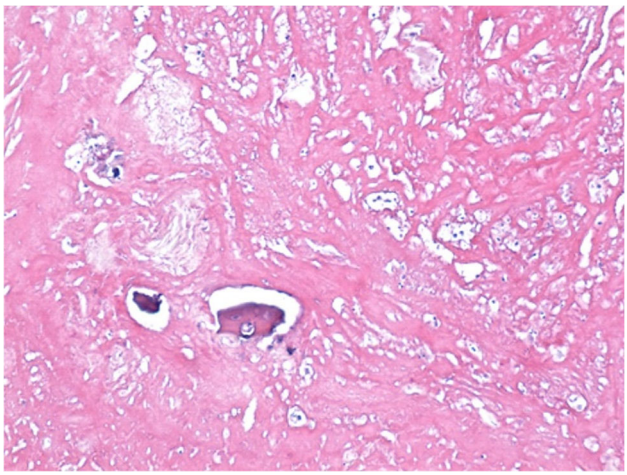

Figure 9 – ***Image of nucleus pulposus with intense degenerative processes and deposits of calcium salts. HE staining, ×100.***

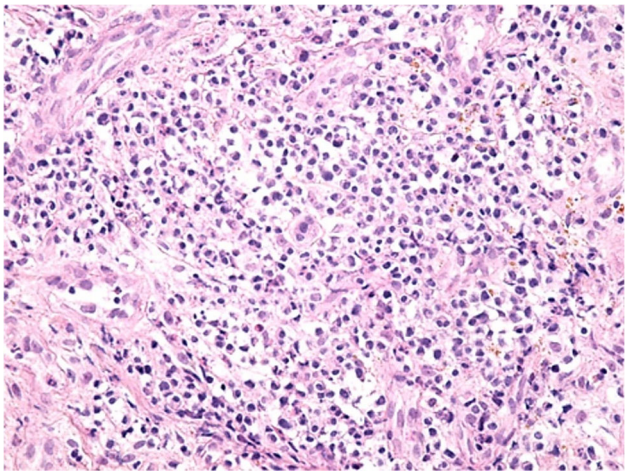

Figure 10 – *Abundant inflammatory infiltrate, mainly formed of lymphocytes, plasmocytes, macrophages and mastocytes. HE staining, ×200.*

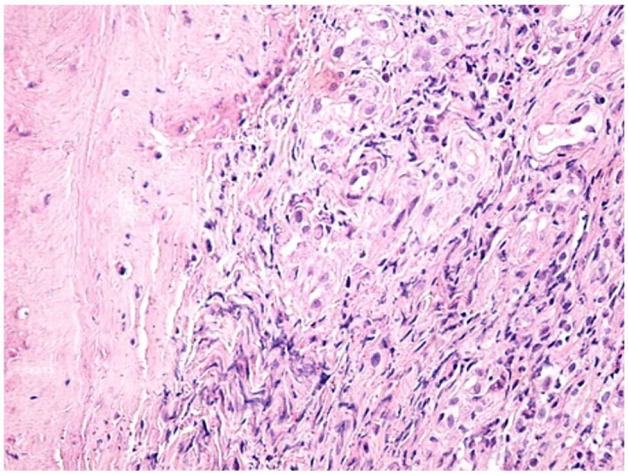

Figure 11 – *Intervertebral disc area with moderate, parceled inflammatory infiltrate, associated with fibroblast proliferation. HE staining, ×200.*

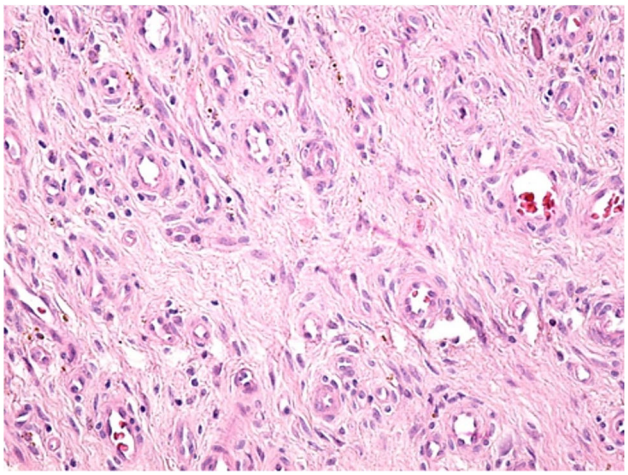

Figure 12 – *Intervertebral disc area with moderate inflammatory reaction and presence of numerous angiogenesis vessels. HE staining, ×200.*

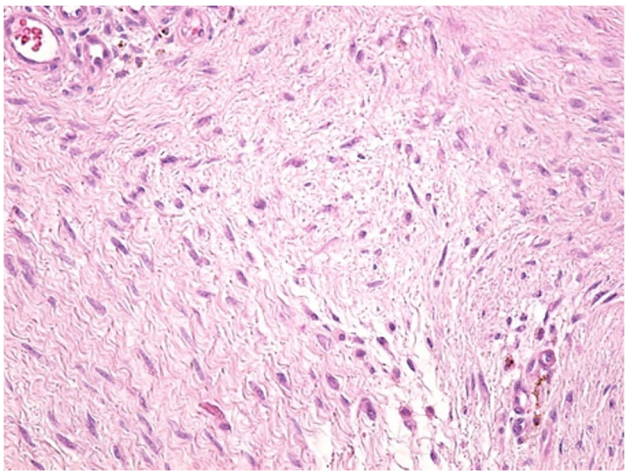

Figure 13 – *Area of intense fibroblast proliferation, associated with a high synthesis of fibrillary collagen, because of local reparatory reaction. HE staining, ×200.*

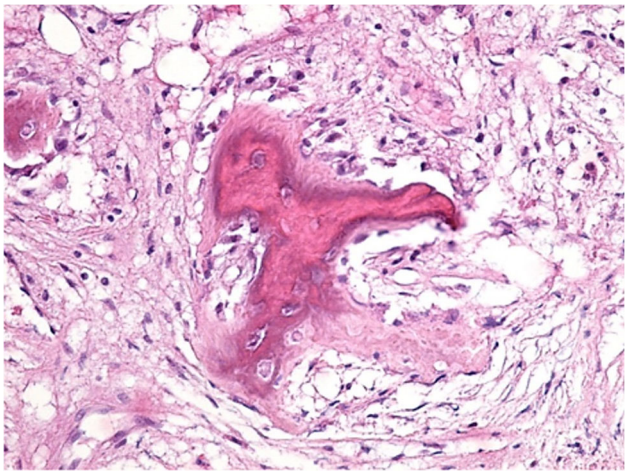

Figure 14 – *Intervertebral disc with islands of anarchic bone proliferation (ectopic osteogenesis). HE staining, ×200.*

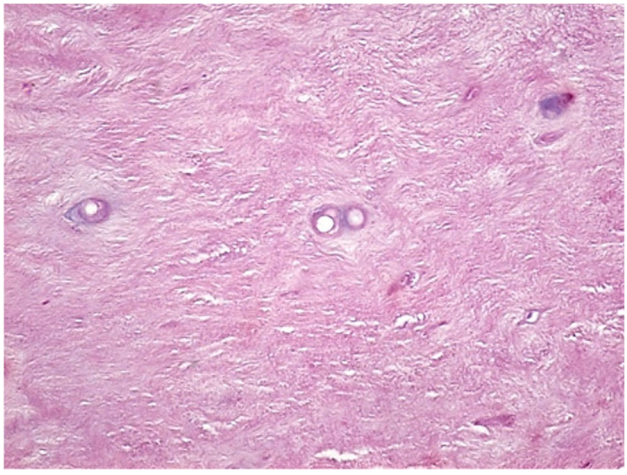

Figure 15 – *Area of disc cartilage with rare empty chondroblasts because of the apoptosis of cartilaginous cells inside. HE staining, ×100.*

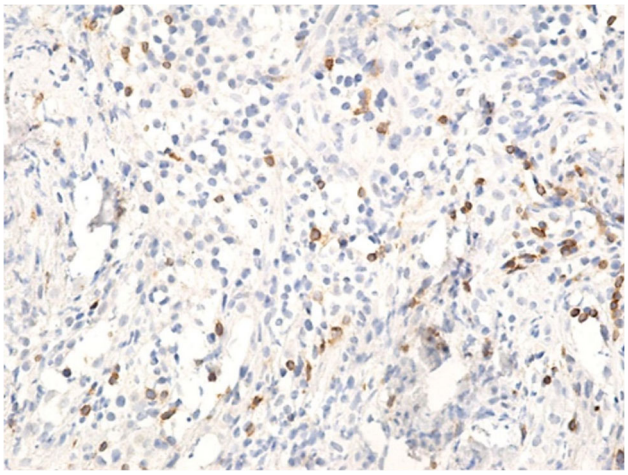

Figure 16 – ***T-lymphocytes present in a high number in an intervertebral disc area with abundant chronic inflammatory infiltrate. Immunomarking with anti-CD3 antibody, ×200. CD3: Cluster of differentiation 3.***

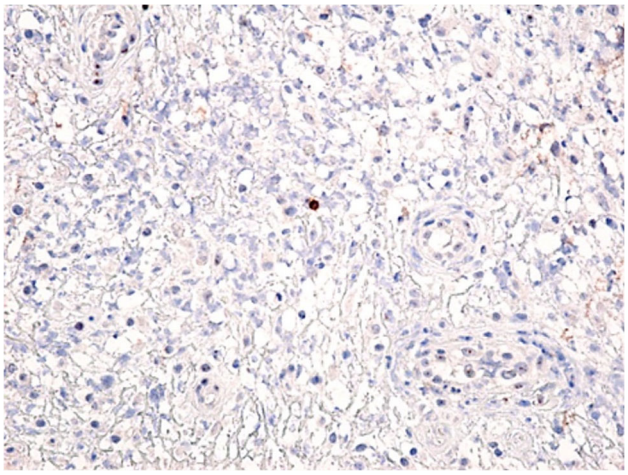

Figure 17 – ***Rare B-lymphocytes identified in the structure of the inflammatory infiltrate in the intervertebral disc. Immunomarking with anti-CD20 antibody, ×200. CD20: Cluster of differentiation 20.***

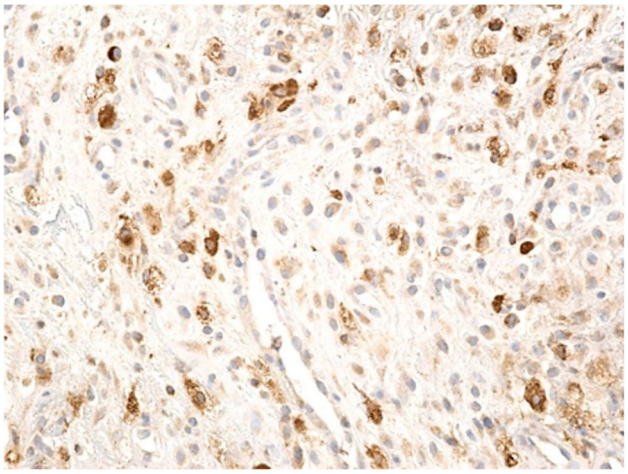

Figure 18 – ***Image of abundant chronic infiltrate, mostly formed of macrophages. Immunomarking with anti-CD68 antibody, ×200. CD68: Cluster of differentiation 68.***

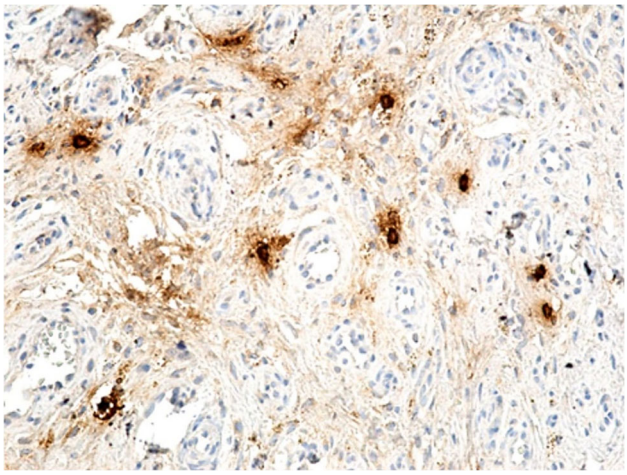

Figure 19 – ***Image with rare, hypertrophied mast cells, with a high synthesis and secretion of tryptase. Immunomarking with anti-tryptase antibody, ×200.***

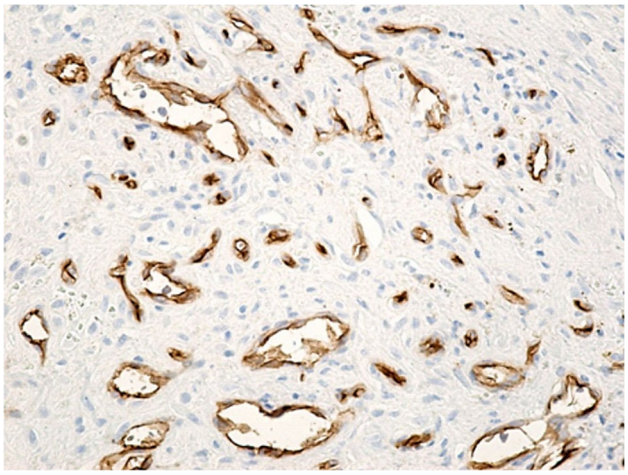

Figure 20 – ***Highly-developed network of new blood, angiogenesis vessels, developed during the local inflammatory reaction in the damaged intervertebral disc. Immunomarking with anti-CD34 antibody, ×200. CD34: Cluster of differentiation 34.***

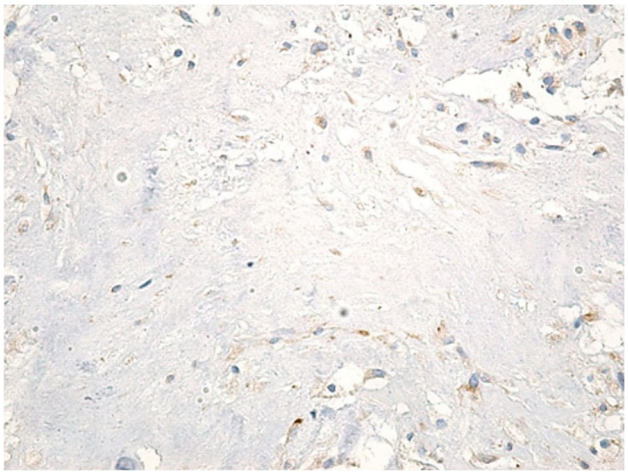

Figure 21 – ***Low immunohistochemical reaction of MMP-1 in the inflammatory and stromal cells in the intervertebral disc. Immunomarking with anti-MMP-1 antibody, ×100. MMP-1: Matrix metalloproteinase-1.***

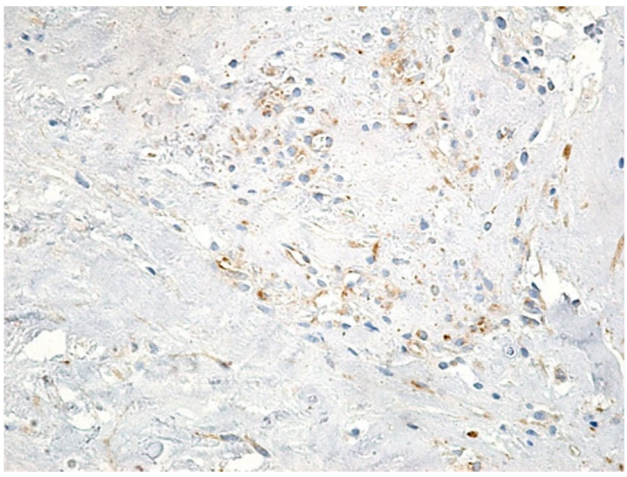

Figure 22 – ***Immunohistochemical reaction of MMP-2 present in the leukocytes from the inflammatory infiltrate. Immunomarking with anti-MMP-2 antibody, ×100. MMP-2: Matrix metalloproteinase-2.***

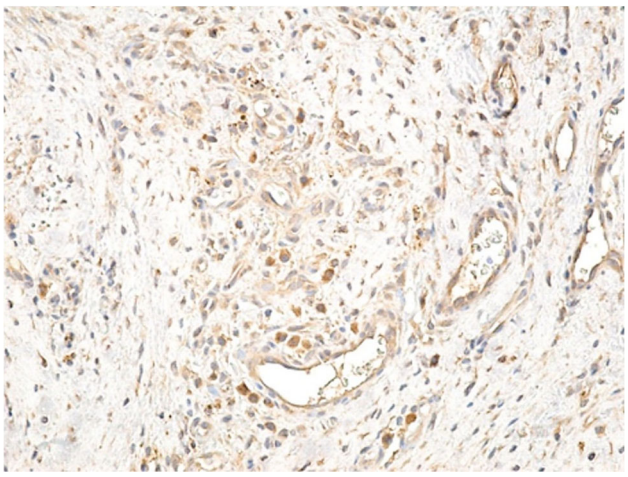

Figure 23 – ***Intense immunohistochemical reaction for MMP-8 present in the inflammatory cells, endothelial cells and stromal cells. Immunomarking with anti-MMP-8 antibody, ×200. MMP-8: Matrix metalloproteinase-8.***

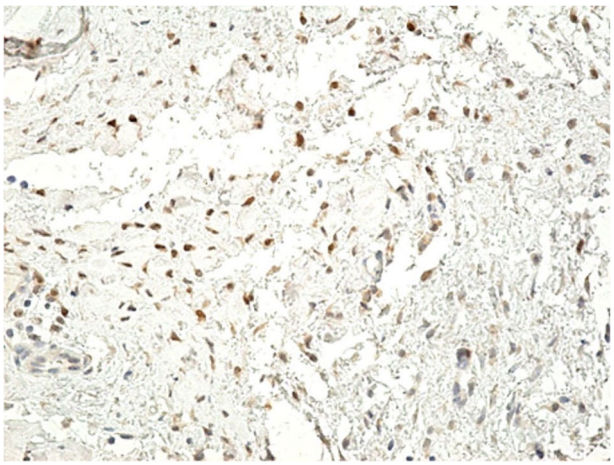

Figure 24 – ***Intense immunohistochemical reaction for MMP-13 present especially in the macrophages and lymphocytes. Immunomarking with anti-MMP-13 antibody, ×200. MMP-13: Matrix metalloproteinase-13.***

Discussions

Lumbar herniated disc is a condition that may start during adolescence until the older age. Still, it is more common in the elderly, because, with age, there occur more degenerative lesions of the lumbar spine [15, 16]. Lumbar herniated disc is defined as a pathological condition caused by the displacement of the *nucleus pulposus*, of the ring or terminal plate that exceeds the normal line of the intervertebral disc, thus compressing the corresponding segment of the dural sac or the nervous root [17]. Most often, disc hernia is the result of the posterior migration of the *nucleus pulposus*, with the rupture of the fibrous ring, herniation into the vertebral canal and compression of the dural sac, of a nervous root or the roots composing the "ponytail" [18–20].

Lumbar pain caused by the compression of the spinal nervous root and the dural sac is accompanied by radiant pain and paresthesia in the lower limbs, progressive loss of muscular force in the lower limbs or even the presence of some sphincter dysfunctions. Because a long duration of the disease, the recurrence and associated complications, lumbar herniated disc seriously affects the life and work of patients.

The diagnosis of disc hernia is established through anamnesis, physical examination, and imagistic investigations. The imagistic diagnosis in patients with back pain and/ or lower limbs pain is required in order to evaluate the compression of the nervous root caused by disc hernia or lower spine stenosis and the "ponytail" syndrome [21–24]. For the imagistic diagnosis, at present, there is used simple X-ray for lumbar spine in two instances (front and profile), CT scan and magnetic resonance imaging (MRI). For now, MRI represents the selection imagistic method due to its advantage of not using ionizing radiations and its good visualization characteristics, especially for the soft tissues [25–28].

In our study, we selected a group of 24 patients with clinical signs of lumbar discopathy, who presented high serological values for the inflammatory markers (leukocytosis with neutrophils, CRP, fibrinogen, ESR over the normal values). The clinical examination highlighted the presence of lumbar pain, most often radiating onto the sciatic nerve trajectory of a lower limb, with the reduction of the spine mobility, muscle contraction and even vicious positions of the spine. The MRI examination confirmed the presence of discopathy, highlighted the migration of the *nucleus pulposus* and the compression on the nervous roots or the dural sac. Moreover, medical imagistic allowed the establishment of adequate therapeutical measures. In our study, the most affected intervertebral discs were L4–L5 and L5–S1. It is well-known the fact that the most affected intervertebral discs are the ones localized in the lower lumbar area, because they have quite a large area of movements and bear almost all the head, trunk and upper limbs weight. Due to this fact, they are among the first discs undergoing degenerative changes [29–31].

The causes for lumbar herniated disc are quite numerous, including degenerative changes of the lumbar intervertebral disc, genetic factors, lumbar-sacral congenital anomalies, and predisposing factors [32]. At present, it is thought that the degenerative changes of the lumbar intervertebral disc represent an irreversible pathological process that intensifies with age. This process is caused by the reduction of the water content on the *nucleus pulposus* because of the reduction of proteoglycans synthesized by the discal cartilage cells during the biological aging process.

Proteoglycans are hydrophilic macromolecules that maintain the hydration of the *nucleus pulposus*, its elasticity, essential conditions for the portant characteristic of the intervertebral disc [30]. Some lumbar-sacral congenital anomalies, like the sacralization of the L5 lumbar vertebra, hemivertebra deformation, asymmetry of joint processes, change the stress on the lower lumbar spine and accelerate the onset of degenerative lesions. The inducing factors are represented by high abdominal pressure, posture changes, obesity, pregnancy, intense physical effort, etc., factors that may induce a sudden pressure upon the vertebral disc and may cause the rupture of the fibrous ring and the *nucleus pulposus* hernia onto the vertebral canal.

HP and IHC studies performed highlighted the presence of degenerative changes in the herniated disc, together with some local inflammatory and regenerative processes. There should be said that the intervertebral disc is a complex structure, made of two terminal cartilaginous plaques that insert into the vertebral bodies, a fibrous ring and a *nucleus pulposus* [33, 34]. The fibrous ring is thick, dense structure, divided into two structurally distinct parts: an external part (external ring) and an internal part (internal ring). The external ring is composed of organized concentric blades, of collagen fibers and of cells similar to fibroblasts that mainly produce type I collagen; the internal ring is more fibrocartilaginous, and it is composed both of type I and type II collagen. In its central area, the fibrous ring closes the *nucleus pulposus*, a gelatinous structure mainly made of proteoglycans in a free network of type II collagen. In their turn, proteoglycans are made of a basic protein to which there are bound various chains of glycosaminoglycans of keratan sulphate and chondroitin sulphate, structures that give the *nucleus pulposus* hydrostatic properties capable of counterpart the compressive overload of the spine [5]. The *nucleus pulposus* contains a variable number of notochordal cells, similar to chondrocytes, playing an important role in the stimulation of glycosaminoglycans and proteoglycans synthesis, being used as progenitor cells for preserving and controlling the number of cells in the *nucleus pulposus*. As a result, the loss of notochordal cells because of aging or disease has negative effects on the structure and function of the intervertebral disc [35, 36].

Regarding the relationship between the inflammatory and degenerative processes of the disc, both the clinical signs and symptoms and various studies showed that in individuals with intense back pain, associated with radiculopathy, there is an increase of the serum biomarkers for inflammation, with the presence of a chronic inflammatory process associated with degenerative lesions of the disc [37–42].

In our study, there were identified numerous inflammatory cells in the intervertebral disc: T-, B-lymphocytes, plasmocytes, mastocytes and macrophages. Of all these cells, through IHC studies there was observed that the most numerous were the macrophages, cells involved in the phagocytosis of tissular debris resulted from the degenerative lesions of the intervertebral disc. It is well-known that when tissues are damaged by various pathogenic mechanisms, a local inflammatory response occurs, characterized by the recruiting, proliferation, and activation of various hematopoietic and non-hematopoietic cells, including neutrophils, macrophages, B-lymphocytes, T-lymphocytes, natural killer (NK) cells, fibroblasts, epithelial cells, endothelial cells and stem cells forming together the cellular response that orchestrates the tissue repair [43, 44]. As such, in the damaged intervertebral disc occur degenerative and inflammatory, proliferative processes, respectively, that seek to restore the structural and functional integrity of the disc [45]. Within these local reparatory processes, we identified numerous activated fibroblasts, with a high synthesis of collagen fibers and a non-fibrillary conjunctive matrix, as well as the presence of ectopic osteogenesis foci, because of the fibroblast metaplasia in the osteoblasts. Another microscopic aspect highlighted both in classical stainings and through immunohistochemistry was that of the herniated disc neovascularization. Thus, we identified a network of small-sized blood vessels (arterioles, metarterioles, capillaries, venules), with hypertrophied endothelial cells, with large, ovalary, hypochromic nuclei and abundant cytoplasm, morphological aspects typical for the neoangiogenesis processes. This process is extremely interesting, because the normal intervertebral disc is a mainly avascular structure, with blood vessels present only in the longitudinal ligaments and in the external layers of the fibrous ring. In the case of the herniated disc, more authors described the presence of blood vessels caused by neoangiogenesis, which seem to have an important role in the spontaneous resorption of intervertebral disc hernia [46, 47]. Other studies show that neovascularization brings a high quantity of inflammatory cells in the herniated disc, it activates the reaction of tissue restoration with the formation of a granulation tissue, also activating the proteolytic cells that leads to a volume increase of the herniated disc, to the increase of radicular compression and, of course, to symptoms intensification [48–50]. It seems that at hernia level appears a vicious circle where the vascular growth determines the decomposition of the conjunctive matrix in the *nucleus pulposus*, of proteoglycans and glycosaminoglycans, by the inflammatory cells accumulated and the enzyme release, proliferation of the tissue granulation, accumulation of cytokines and growth factors with unpredictable clinical effects [51, 52].

In our opinion, the patients with lumbar vertebral hernia and high values of the serum biomarkers for inflammation need to be carefully monitored, because the postoperative recovery is late and requires a complex treatment.

Conclusions

In our study, the patients with lumbar herniated disc, with high values of the serological markers for inflammation, who required a surgical intervention as a selective treatment method, represented only 1.34% of the total of patients admitted and surgically treated in the Department of Neurosurgery within the Emergency County Hospital of Piteşti. The mean age was 61 years old and a third of the patients had type 2 DM. HP and IHC examinations highlighted the presence of degenerative lesions of the disc, associated with inflammatory infiltrates and neovascularization. The recovery of the motor deficit was slowed down by 50% and required a longer recovery period. We consider that the postoperative monitorization of the inflammatory syndrome is a positive prognosis factor; in our study group, this attitude had a major clinical echo for the improvement of the residual pain–paresthesia syndrome.

Conflict of interests

The authors declare that they have no conflict of interests.

Authors' contribution

George Sorinel Diaconu and George Popescu equally contributed to the manuscript.

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