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Editor-in-Chief of *World Journal of Clinical Cases*, Bao-Gan Peng, MD, PhD, is Professor and Director of the Department of Orthopedics at The Third Medical Center of PLA General Hospital. Professor Peng's research interest is spinal surgery. His career work has generated a multitude of new academic viewpoints and theories, and more than 200 academic papers, published both at home and abroad. In practice, he has systematically elucidated the pathogenesis of discogenic low back pain and established a new minimally invasive treatment method: The intradiscal methylene blue injection. He also revealed and characterized a new pathogenesis of Schmorl's nodes, which is a now a famous concept. Finally, he was the first to discover that ingrowth of Ruffini corpuscles into degenerative cervical disc is related to dizziness of cervical origin. (L-Editor: Filipodia)

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Chinese Association for the Study of Pain: Expert consensus on diagnosis and treatment for lumbar disc herniation

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Abstract

Lumbar disc herniation is a common disease in the clinical context and does great harm to either the physical or mental health of patients suffering from this disease. Many guidelines and consensus for the diagnosis and treatment of lumbar disc herniation have been published domestically and internationally. According to the expert consensus, clinicians could adopt tailored and personalized diagnosis and treatment management strategies for lumbar disc herniation patients.

Key Words: Lumbar disc herniation; Diagnosis and treatment; Disc degeneration; Radiofrequency thermocoagulation; Percutaneous disc ablation; Expert consensus

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Core Tip: Lumbar disc herniation is a common disease in the clinical context and does great harm to either the physical or mental health of patients suffering from this disease. Therefore, a team containing experts in relevant fields was organized by the Spinal Pain Research Group of the Chinese Association for the Study Pain and compiled the Chinese pain expert consensus on the diagnosis and treatment for lumbar disc herniation through reviewing literature, soliciting opinion and engaging in

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INTRODUCTION

Lumbar disc herniation (LDH) is a common disease in the clinical context and does great harm to either the physical or mental health of patients suffering from this disease. Many guidelines and consensus for the diagnosis and treatment of LDH have been published domestically and internationally^[1-4], but the one that makes a general summary for these publications in clinical practice has not yet been written. Therefore, a team containing experts in relevant fields was organized by the Spinal Pain Research Group of the Chinese Association for the Study Pain and compiled the Chinese pain expert consensus on diagnosis and treatment for LDH through reviewing literature, soliciting opinion and engaging in discussion repeatedly. According to the expert consensus, clinicians could adopt tailored and personalized diagnosis and treatment management strategies for LDH patients.

The databases used for building the consensus included PubMed, Web of Science, Embase, China National Knowledge Internet, Wanfang Data, The Cochrane Library and Up To Date. Medical terms including “lumbar disc herniation” and “lumbosacral radiculopathy” were used as the main keywords, and “low back pain” and “sciatica” were set as the secondary keywords for searching. Only randomized controlled trial research papers, cohort research papers and meta-analyses were included while papers describing non-disc-related causes of pain (such as spinal stenosis, inflammation, tumors, etc.) were excluded from the search result. The classification and evaluation of the research evidence in this consensus was based on the Oxford Centre for Evidence Based Medicine's Levels of Evidence.

DEFINITION

As the lumbar disc experiences degenerative changes, the annulus fibrosus is partially or completely ruptured. Then the nucleus pulposus alone or together with the annulus fibrosus and cartilage endplate protrudes outwards, and these structures stimulate or compress the sinus spinal nerves and nerve roots. LDH manifestations like low back pain, which is caused by the forgoing pathological process, is the major symptom.

EPIDEMIOLOGY

LDH is a frequent and common disease that majorly affected adults in the clinical context. At least 95% of LDH occurs in L₄₋₅ and L₅-S₁^[5,6]. Relevant foreign studies indicate that the incidence of LDH is around 2%-3%, while the incidence in men over 35 is about 4.8% and that in women is about 2.5%^[7].

CAUSE OF DISEASE

Disc degeneration

Lumbar disc degeneration is the fundamental factor suggesting the pathogenic basis for LDH. The pathophysiological alternation of degeneration includes the reduction of water content or moisture content in the fibrous annulus and nucleus pulposus, loss of the nucleus pulposus elasticity and occurrence of concentric annulus fissures.

Injuries

Cumulative trauma injuries caused by physical repetition and labor, sedentary lifestyle, squatting, driving and sports are important factors in the initiation of LDH.

Congenital lumbosacral anomalies

Congenital anomalies such as lumbar sacralization, sacral lumbarization, hemivertebra deformities, facet joint deformities and asymmetry of the articular process would change the stress borne on the lower lumbar spine. Then this leads to increased intervertebral disc pressure, making the individual susceptibility to degeneration and injury.

Genetic factors

The incidence of LDH in populations of color is low. Factors including encoding structural proteins, matrix metalloproteinases, apoptosis factors, growth factors and vitamin D receptors are associated with the increased risk of LDH^[6-10].

Others

Pregnancy, obesity, diabetes, hyperlipidemia, smoking, infection, *etc.* are also risk factors for LDH.

PATHOGENESIS

Intervertebral disc degeneration

The intervertebral disc is mainly composed of the nucleus pulposus, annulus fibrosus and cartilage plate. Type II collagen decreases while type I collagen increases as the disc degenerates owing to factors such as aging. The alteration in the container of the disc results in the loss of disc elasticity and thus reduces its buffer function in the confront of external forces and finally makes the body more vulnerable to trauma and injury. Once the disc is denatured or damaged, it is difficult for this structure to realize self-repair as its congenital feature characterizes insufficient blood supply^[11,12].

Mechanical stress injury

When the spine is under excessive load due to prolonged sedentary conditions, squatting, long-term bending or physical labor, the pressure inside increases. Degenerative changes in the disc are accelerated by cell apoptosis or immune response and eventually develop into LDH.

Immune inflammation

A herniated disc could cause a variety of inflammatory immune responses leading to changes of itself and thus aggravates herniation with corresponding clinical symptoms. The nucleus pulposus can act as an autoantigen to induce an autoimmune reaction and promote the occurrence and development of LDH.

Imbalance of extracellular matrix metabolism

In normal intervertebral discs, the expression of matrix metalloproteinase and metalloproteinase tissue inhibitors maintain a dynamic equilibrium. When the balance is disrupted, the process of extracellular matrix degradation is affected, and the result is reduced disc elasticity and accelerated disc degeneration.

In short, the pathogenesis and mechanism of LDH are considerably complicated, and each stage of the disease may be the result of merely a single factor or the joint action of several factors. Of note, different factors may also deteriorate in different stages and as a result would aggravate LDH.

CLINICAL MANIFESTATIONS

Symptoms

Low back pain: Low back pain is often the initial symptom of LDH. The pain is generally in the lumbosacral region, mostly soreness and pain, which can radiate to the buttocks with repeated episode occurrence. The symptoms are aggravated by sedentary conditions, squatting or exertion after labor, and relieved after rest.

Lower limb pain: Radiation pain may occur in the lower extremities, and symptoms worsen after standing, walking, sneezing or coughing and are relieved during bed rest. Patients with severe disorders may even feel paresthesia or numbness in the corresponding nerve distribution area. Most LDH occurs in L₄₋₅ and L₅-S₁, which can lead to sciatica and radiation pain in the posterolateral lower extremities. A small number of LDH cases involving the high level of spine often affects the L₂₋₄ nerve roots causing femoral neuralgia and pain in the groin area or anteromedial part of the lower limbs. Radiating pain usually affects only one side, and only a few patients may show symptoms of both lower limbs (Table 1)^[13].

Cauda equina nerve symptoms: Large central disc herniation, prolapse or free intervertebral disc tissue can compress the cauda equina nerve causing pain in the lower extremities and perineum, hypoesthesia or numbness and even dysfunction of urine and bowel.

Signs

General signs: Lumbar scoliosis and lameness may occur. Lumbar movement, mainly forward bending, is limited. Tenderness near the vertebrae is often discovered on the affected side of the intervertebral disc, and pressing the point will result in distal radiological discomfort when compressed.

Special signs: (1) The straight leg raise test (SLRT) or Lasegue's sign and its strengthening test: L₄₋₅ and L₅-S₁ herniated discs compress the sciatic nerve, and the SLRT is often positive. A positive result for the SLRT and its enhancement test can usually further rule out causes outside the spine. If SLRT is positive on the healthy side, this usually indicates a serious manifestation of spinal canal herniation; and (2) Femoral nerve traction test: When femoral nerve traction test is positive, it often indicates that L₂₋₄ nerves are involved.

Nervous system performance: (1) Sensory impairment: The affected spinal nerve roots will have paresthesia in the corresponding innervated areas. The original syndrome has hyperesthesia in the early stage followed by numbness, tingling and sensory loss; (2) Decreased muscle strength: The muscles innervated by the affected nerve roots may have varying degrees of muscle weakness, and muscle atrophy may occur in the patients suffering long duration of disease. When the L₅ spinal nerve roots are involved, the ankle and toe dorsiflexion will decrease. When the S₁ spinal nerve roots are involved, toe and plantar flexion will decrease; and (3) Abnormal reflexes: Reflexes of the affected tendon are weakened or disappear. Abnormal knee tendon reflex abnormalities are more common in L₄ spinal nerve root compression, and weakness or missing of Achilles tendon reflex is commonly associated with S₁ spinal nerve root compression. Impaired cremaster and anal reflexes and weakened anal sphincter tone are widely seen in cauda equina involvement.

Imaging

X-ray: When the physiological curvatures of the lumbar spine are broken, lateral radiograph shows that the intervertebral space narrows or narrows in anterior and widens in the posterior. Orthotopic radiograph can show scoliosis, and the height of the affected side of the intervertebral space is often lower than that of the healthy side.

Computed tomography: When intervertebral disc tissues protrude into the spinal canal, they will compress the nerve root or dural sac. Based on this point, the diagnosis of local calcification or osteogenesis using computed tomography (CT) scan can be better than the result from magnetic resonance imaging (MRI).

MRI: Sagittal, coronal and transverse positions can visually display the shape, location and size of the protrusion and the relationship with nerve root compression, which show great value in the initial diagnosis and differential diagnosis of lesions^[14]. CT and MRI show no significant differences in the diagnosis of LDH in terms of sensitivity and specificity, but MRI is better than CT for soft tissue imaging. The level of intervertebral disc signal can reflect the degree of degeneration. Therefore, it is recommended to give priority to MRI examination for patients with LDH. If patients were not able to take MRI, CT examination could be also taken into consideration^[15] (recommendation grade B, evidence level 2a).

Table 1 Clinical manifestations of different lumbar disc herniation segments^[13] (recommendation level B, evidence level 2a)

Protruding segment	Affected nerve	Pain area	Superficial hypoesthesia	Muscle strength decline	Hyporeflexia
L ₁₋₄ , L ₄₋₅ lateral	L ₄	Lower waist, buttocks, anterolateral thighs, medial calves	Anterolateral thigh, knee joint, medial leg	Quadriceps dorsal extensor	Knee jerk
L ₄₋₅ , L ₅ -S ₁ lateral	L ₅	Sacroiliac, buttocks, lateral thighs, lateral calves, dorsal feet	Lateral leg, dorsal foot, great toe (hallux)	First toe back extension, foot back extension	No
L ₅ -S ₁	S ₁	Sacroiliac, waist, buttocks, posterolateral thigh, posterolateral calf, posterolateral foot	Back of calf, lateral ankle, outside of foot	First toe plantar flexion, toe flexion	Ankle reflex

DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

Diagnosis

The final diagnosis of LDH must be combined with clinical symptoms, signs and imaging results to make a comprehensive judgment. The symptoms and signs of the affected segmental nerves should be consistent with the area of the nerve innervated by the protrusions on MRI or CT.

Criteria: (1) Radiation pain in the lower extremities, the location of pain associated with the corresponding innervation area involved; (2) Paresthesia in the lower limbs and reduced superficial sensation in the affected innervated area; (3) SLRT, strengthened SLRT, healthy side SLRT or femoral nerve pull tests positive; (4) Tendon reflexes weaker than the healthy side; (5) Reduction of muscle strength; (6) Selective nerve root block can attenuate pain or paresthesia in the lower limbs; and (7) Lumbar MRI or CT shows disc herniation, and nerve compression is consistent with the symptoms and signs caused by the affected nerve. If three of the first six criteria are met, combined with the seventh, the patients should be diagnosed as LDH^[13-15] (recommended level A, level of evidence 1a).

Attention: (1) Low back pain is not a necessary condition for the diagnosis of LDH, but patients often have a history of low back pain; (2) Diagnostic imaging such as MRI or CT alone should not be used as the basis for diagnosing LDH (recommended level A, level of evidence 1a); (3) Myelography is invasive and not recommended for routine practice^[15] (recommended level B, level of evidence 2a); (4) Neuro-electrophysiological examination and infrared thermography examination are not recommended for routine practice due to limited diagnostic value for LDH^[16,17] (recommended level B, level of evidence 2a); and (5) Discography and selective nerve root block surgery should be used to figure out the responsible segment in cases of multisegmented LDH that is difficult to clarify the main responsible segments.

Differential diagnosis

LDH should be differentiated from diseases including piriformis syndrome, lumbar spinal stenosis syndrome, lumbar tumor, spinal infections, cauda equina neuroma, spondylolisthesis, ankylosing spondylitis and herpes zoster.

TREATMENT

Most patients with LDH will relieve their symptoms over time. Therefore, an individualized treatment regimen should be taken according to the course, clinical manifestations, the location of the disc herniation and the severity of the corresponding nerve root compression. The routine strategies used for LDH treatment include general treatment, drug treatment, minimally invasive treatment, surgery and rehabilitation.

Nonsurgical treatment should be taken as the first-line treatment for most patients with LDH (recommended level A). Generally, conservative treatment should last for at least 4-6 wk (recommended level A), including rest, physical therapy, traction, acupuncture and medication. Although most patients with LDH benefit from conservative treatment, evidence suggests that patients receiving minimally invasive interventional therapy at the early stage can achieve superior outcomes compared with those who undergo long-term conservative treatment in pain relief and functional recovery^[18,19] (recommended level B, level of evidence 2b).

General treatment

Bed rest is required during the acute episode, but long-term bed rest is not recommended. Patients should be encouraged to carry out appropriate and regular daily activities and to wear a back support belt during activities. General treatments such as traction and massage may be suggested according to the condition. In addition, proper health education can help in preventing recurrence and relieving symptoms.

Drug treatment

Acetaminophen, nonsteroidal anti-inflammatory drugs (ibuprofen, celecoxib, etoricoxib, *etc.*, recommended level A, level of evidence 1b), ion channel modulators (gabapentin, pregabalin, *etc.*), tramadol, opioids (oxycodone, fentanyl, buprenorphine, *etc.*^[2,20-22] recommended level B, level of evidence 2), dehydration drugs (mannitol), glucocorticoids, central muscle relaxants (eperisone, chlorzoxazone, *etc.*), neurotrophic agents, microcirculation improvement and traditional Chinese medicines all have an effect on LDH to a certain degree and should be used according to the clinical situation.

Minimally invasive surgery and treatment

Soft tissue lysis surgery: The needle-knife can loosen adhesive tissues, improve the blood supply of the soft tissue and reduce nerve compression. Internal heat needle and silver needle can improve LDH symptoms to varying degrees and should be performed clinically if appropriate^[23,24].

Injection treatment: Including epidural injection, selective nerve root injection, sacral canal injection, lumbar sympathetic ganglion injection, *etc.* (1) Epidural injection: Drugs can be administrated around the root of the affected nerve by approaches like anatomic localization or image-guided operations *via* foramina, an interlaminar approach (including lateral recess approach) or sacral hiatus puncture. Epidural steroid injection, which can relieve the symptoms of low back pain in patients with sciatica in the short term, should be taken into consideration^[25,26] (recommendation level A, evidence level 1b). During epidural steroid injection treatment, glucocorticoids should be administrated in small doses at the beginning. A higher dose is not equal to a better clinical efficacy, and epidural steroid injection is associated with serious complications, especially spinal cord injury and cerebral infarction caused by granular glucocorticoids. The incidence of complications in the waist region is lower than that of the neck area^[27] (recommended level B, level of evidence 2b). Local injections of hyaluronic acid and cytokine inhibitors in patients with LDH and radicular pain require more high-quality randomized controlled trial research evidence; (2) Selective nerve root injection: LDH patients receive selective root injection of glucocorticoids that can reduce the inflammation of compressed nerve roots and surrounding tissues and attenuate pain on most clinical occasions. Long-term pain control can be achieved in some patients, providing support that this method should be considered as the preferred treatment^[28] (recommended level A, evidence level 1a); (3) Sacral canal injection: Sacral injection (which can also be performed under ultrasound guidance) can help to relieve the pain of lumbosacral root compression in patients with LDH; (4) Lumbar sympathetic ganglia injection: Lumbar sympathetic nerve injections are usually L₂ and L₃ sympathetic nerve injections, which can treat sympathetic nerve-related pain in the lower limbs caused by LDH^[29] (recommended level B, evidence level 2a); and (5) Injection of the posterior branch of the lumbar spinal nerve: When lumbar and sacral areas are affected by LDH, chronic strain, edema of the intervertebral foramina or spinal canal tissue, narrowing of the intervertebral aperture, inflammation of the tendon and ligament and facet joint disorder can cause the stimulation of the posterior branch of the spinal nerve in the corresponding segment. It causes symptoms such as soreness, stiffness, pain and limitation of activity in the local or adjacent tissues. Injection of the posterior branch of the spinal nerve is an effective treatment method, and it should be performed under the guidance of images such as ultrasound.

Radiofrequency thermocoagulation: Radiofrequency thermocoagulation can be safely and effectively used in the treatment of LDH. Clinical applications should strictly adhere to the indications.

Percutaneous disc trioxide ablation: Percutaneous intervertebral disc trioxide injection is an effective and safe method with a complication rate of around 0.1%. A cumulative effect induced by ganglion and epidural injections of glucocorticoids/local

anesthetics may improve the overall treatment effect^[20] (recommended level C, level of evidence 4).

Percutaneous disc ablation: As a safe and effective LDH treatment technique, low-temperature plasma percutaneous discectomy should be taken into consideration^[30] (recommended level A, level of evidence 1a). It can significantly relieve pain and improve mobility. Clinical applications must strictly follow the indications. Low-temperature plasma radiofrequency can also be used in combination with ozone to treat LDH^[31] (recommended level B, level of evidence 2c).

Percutaneous low-energy laser disc repair: Percutaneous low-energy laser disc repair is an upgrading version of technology based on percutaneous laser disc decompression. A semiconductor laser with a wavelength of 970 nm is used to inject a small amount of isotonic or hypertonic saline into the disc during treatment^[32].

Percutaneous disc collagenase chemical lysis: For patients whose diagnosis is accurate and conservative treatment is ineffective, collagenase injection treatment can be considered. It is easy to administer and has a remarkable effect^[33] (recommended level B, level of evidence 2b). Methods of collagenase injection can be divided into the intra-disc, extra-disc and combined method. Collagenase injection should avoid entering the subarachnoid space.

Percutaneous discectomy: Percutaneous discectomy is effective and can be used as a treatment for LDH with radiculopathy^[34-36] (recommended level B, level of evidence 2b), but the application is strictly limited to the indications^[37].

Percutaneous spinal endoscopic lumbar discectomy: Compared with open surgery, percutaneous endoscopic lumbar discectomy has a shorter length of stay and shows better results in terms of pain relief and functional recovery^[38-41] (recommendation level B, level of evidence 2b). Percutaneous endoscopic lumbar discectomy contains two types of techniques: Percutaneous endoscopic transforaminal discectomy and percutaneous endoscopic interlaminar discectomy. Generally, percutaneous endoscopic transforaminal discectomy is suitable for scapular, central and recurrent LDH, whereas percutaneous endoscopic interlaminar discectomy is preferred for axillary and displaced intervertebral discs (recommended level A). Compared with open discectomy, percutaneous endoscopic lumbar discectomy has less bleeding and shorter in-hospital stays^[40] (recommended level A, level of evidence 1a).

Surgical treatment

Surgical treatment should be considered if conservative treatment following a rigorous and strict protocol fails to achieve clinical efficacy. The aim of minimally invasive surgery is to relieve pain and/or symptoms of nerve damage instead of a curative effect on disc degeneration and reversing disc herniation.

Rehabilitation treatment

Traction therapy: Lumbar traction is one of the commonly used conservative treatments for patients with LDH that can release intervertebral disc pressure, loosen adhesion tissues, relax ligaments, relieve muscle spasm, improve local blood circulation and address facet joint disorders.

Extracorporeal shock wave: Extracorporeal shock wave treatment can effectively reduce pain in patients with low back pain and improve their functional status and quality of life^[42-44].

Medium- and low-frequency electrotherapy: Commonly used in clinical settings, low-frequency electrotherapy causes percutaneous nerve electrical stimulation (transcutaneous electrical nerve stimulation) and can interfere with electrotherapy. Transcutaneous electrical nerve stimulation can relieve pain, improve dysfunction, and uplift the grade of muscle activation in LDH patients^[45]. Of note, its curative effect has not been recognized^[45,46].

High-intensity laser therapy: High-intensity laser therapy with anti-inflammatory, antitumor and analgesic effects can be used to reach lesions where low-power laser stimulation cannot, such as the deep areas of large and/or small joints^[47,48].

PREVENTION

The prevention of LDH can be carried out with reference to the three-level prevention system for chronic diseases, including steps following the order of the prevention of the initial of LDH, the prevention of the recurrence of LDH radiculopathy symptoms and the prevention of the recurrence after LDH surgery.

Prevention of LDH

Enhancement of self-awareness of professional protection, correct weight-bearing postures at the waist and proper back muscle function training may have a certain preventive effect on acute LDH^[49,50] (recommended level C, level of evidence 4).

Prevention of recurrence of LDH radiculopathy

Weight control, regular back muscle function exercise and correction of poor posture may help to prevent recurrence^[51,52] (recommended level C, level of evidence 4).

Prevention of symptomatic recurrence after LDH

Postoperative recurrence can be prevented by wearing a back support belt and performing exercises to strengthen back muscle function.

CONCLUSION

According to the expert consensus, clinicians should adopt tailored and personalized diagnosis and treatment management strategies for LDH patients.

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