

Current status of treatment and rehabilitation of lumbar disc herniation

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Abstract. Lumbar disc herniation (LDH) is now a widespread and common disease with a large number of patients. Chronic pain caused by LDH has now become an important problem affecting the broad masses of the people, causing a serious impact on the people's daily life and economy, and even the production and economy of the society. In the treatment of chronic pain for LDH has a long history, in recent years also has many new treatment methods, but because of its complex pathogenesis, there is still few treatments, can achieve better effect in LDH chronic pain, makes it has become a worldwide problem. This paper will conduct the latest review of modern medicine and traditional Chinese medicine for the treatment of LDH chronic pain, in-depth research and explore the treatment of LDH chronic pain, in order to provide scientific research ideas and scientific basis for clinical treatment and research of this disease.

Keywords: Lumbar Disc Herniation, Pathogenesis, Treatment.

1. Introduction

Lumbar disc herniation (LDH) is a common spinal disease, where the disc of the spine (the cushion structure between the vertebrae) protrudes into the spinal canal and may compress the surrounding nerve root or spinal cord, leading to pain, numbness, muscle weakness and other symptoms [1]. Widely worldwide and attracted widespread clinical and social attention. The age of onset of the disease is mostly concentrated in the age of 25-55 years [2]. In addition, with the change of modern lifestyle and the influence of electronic products such as mobile phones and computers, the high incidence age of patients with this disease is becoming more and more younger, and the incidence and disability rate are also increasing year by year [3].

Currently, the diagnosis of the disease usually includes clinical symptoms evaluation, physical examination by a doctor, and imaging examination, such as X-rays, nuclear magnetic resonance resonance (MRI), to confirm whether the intervertebral disc is protruding and determine its location and impact on the surrounding structures. In the past few decades, therapeutic approaches targeting LDH have been continuously developed and innovated. Doctors may also determine treatment options based on symptoms and images. Traditional conservative treatment includes rest, physical therapy, medical therapy, and so on, which have achieved some effectiveness in relieving pain and improving functional

recovery. Surgical treatment also plays an important role in the management of LDH. The introduction of minimally invasive surgical techniques reduces the risk of surgery and shortens the postoperative recovery time, providing more treatment options for patients. However, there may be some postoperative complications, and the cost is relatively high. At the same time, some emerging clinical treatment methods have gradually attracted attention, such as physical therapy, traditional Chinese medicine (TCM) treatment and rehabilitation exercise, in order to provide more treatment options for patients. However, no matter what kind of treatment, the importance of individualized treatment should be considered, that is, according to the condition and characteristics of patients, to achieve the best effect.

This paper aims to provide a comprehensive review of the treatment methods of LDH, explore the application of different treatment options in patients with LDH deeply, and analyze their efficacy, indications and risks. So that to help medical staff and patients to better understand and cope with the disease.

2. The pathogenesis of LDH

2.1. Machine compression mechanism

This mechanism was proposed in the 1930s, in order to eliminate the compression of the nerve in the diseased disc, and to remove the diseased space in patients with lumbar disc herniation, which made a significant improvement in chronic low back pain in patients with LDH. The chronic low back pain in LDH was caused by the compression relationship between the lumbar disc and the nerve.

2.2. Mechanism of the chemical stimulation of inflammation

During the surgical treatment, the scholars found that the diseased lumbar disc did not cause compression or slight compression of the nerve root and the removal of the nerve root compression after surgical resection, the patient's chronic pain still existed and did not relieve. Make scholars guess whether there are other factors lead to chronic pain of lumbar disc, and then through the anatomy, found that the diseased lumbar disc attachment nerve root adhesion, congestion, edema, consistent with inflammatory symptoms, so guess whether the chronic pain cause by LDH disease is associated with the existence of inflammatory factors. After the treatment of Non-steroidal Anti-inflammatory Drugs (NSAID), it was found that the chronic pain has been significantly relieved, which confirmed that the scholars' speculation is correct that anti-inflammatory factors are also one of the pain-causing mechanisms of chronic pain in patients with lumbar disc herniation.

2.3. Mechanism of the autoimmune response

The nucleus pulposus, a hidden antigen not recognized by the autoimmune system, is the largest avascular tissue in the body and relies mainly on the penetration of the cartilage endplate to provide nutrients. When the nucleus pulposus is in a pathological state, its own immune response will be activated, resulting in the interaction between T lymphocytes and B lymphocytes in peripheral blood with specific nucleus pulposus tissue antigen, and then the autoimmune response will activate local inflammatory effects, making the nerve root is induced to produce pain [4].

3. The effect of TCM

TCM treatment for LDH is effective, which is considered as one of the good clinical treatment options of LDH, and the long-term development history of TCM is also the innate advantage. TCM mainly including Chinese medicine, acupuncture, massage, ion introduction, needle injection, needle knife, acupoint injection, etc.

3.1. Traditional Chinese medicine

3.1.1. Oral administration. Oral administration of TCM has a certain clinical effect, which may reduce inflammatory factors, promote the absorption of the nucleus pulposus, reduce the internal pressure of

the nucleus pulposus, and then relieving the pain caused by stimulating nerve roots. Clinically, patients tend to see doctors for lumbar pain, so the analgesic effect is particularly important in the treatment of LDH. Zhou Hua et al randomly dividing 80 New Zealand white rabbits into different dose groups, model groups and normal groups (16 each) to study the treatment mechanism of the solitary parasitic soup for pain caused by LDH, the content of IL- β and PGE-2 was significantly reduced in the high dose group, suggesting that the mechanism of the treatment of LDH may be related to the downregulation of IL- β and PGE-2 levels in disc nucleus pulposus tissue [1]. A clinical observation, 78 patients with LDH (39 each of control group and observation group) were used to observe the clinical efficacy of Angelica soup for LDH. The results indicated that the VAS score of the observation group was significantly lower than the control group, and the recovery rate (58.97%) and the total response rate (94.87%) were significantly higher than that of the control group (30.77%) and the total response rate (82.05%) ($P < 0.05$) [2]. Several studies have found that internal Chinese medicine has a positive therapeutic effect in relieving pain and restoring the biomechanical properties and motor function of the lumbar spine.

3.1.2. External application. Chinese medicine external application is also an important means of TCM treatment, the main role of the method is to make the effective ingredients of Chinese medicine through the skin penetration to the affected, promote the blood circulation, speed up the local metabolism, promote the absorption and fade, speed up the local damage repair, make local tissue inflammation and congestion edema reduce even disappear, improve the symptoms of local low back pain. A randomized controlled trial, 80 patients with LDH were selected and randomly divided into control group and observation group to observe the effectiveness of TCM external application [3]. The results indicated that the total effective rate of TCM external application (94.1%) was significantly higher than that of the control group (80.6%). After treatment, the VAS, score and ODI scores in the observation group were significantly lower than the control group ($P < 0.05$). In clinical observation, 84 LDH patients (42 each of control group and observation group) were selected, and the results suggested that the total effective rate of TCM external application observation group was 98%, which was significantly higher than that of 87% of the control group [4].

3.1.3. Ion import. Oral administration of TCM has a certain clinical effect, which may reduce inflammatory factors, promote the absorption of the nucleus pulposus, reduce the internal pressure of the nucleus pulposus, and then relieving the pain caused by stimulating nerve roots. Clinically, patients tend to see doctors for lumbar pain, so the analgesic effect is particularly important in the treatment of LDH. The ion introduction of traditional Chinese medicine is to soak the medicine pad after the Chinese medicine and shock the corresponding acupoints on the electric plate to ensure that the Chinese medicine can penetrate into the skin to the affected area, and play a local therapeutic effect. By combining acupoints, traditional Chinese medicine and electrical stimulation, this method accelerates the metabolism of the affected areas and accelerates the elimination of inflammatory factors to achieve a good therapeutic effect.

A clinical study, 96 patients with acute phase of LDH were selected (48 each in control group and observation group). The control group adopted conventional treatment methods such as bracing, medication and injection, and the observation group used TCM ion infusion on the basis of the treatment of the control group. The results indicated that the total response rate of the observation group was 95.83%, significantly higher than control group (81.25%, $P < 0.05$) [5]. JOA, ODI, and SF-36 scores in the observation group improved significantly better than control group. Both electrophysiological measures improved significantly compared with before treatment, such as the MCV (46.87m/s vs 40.36m/s), tibial nerve MCV (45.34m/s vs 39.27 m/s) and the tibial nerve H reflex latency (21.96ms vs 27.32ms). In a randomized controlled trial, 84 LDH patients were included. The control group ($n=42$) adopted conventional western medicine treatment and nursing, and the observation group ($n=42$) gave TCM ion introduction treatment on the basis of the treatment of the control group. Both groups lasted two weeks and were observed for 12 weeks after two weeks. Results The control group had the highest VAS score on admission (7.40) and the lowest two weeks after treatment (3.19), but increased at 12

weeks after treatment (3.90); the observation group (7.34), which decreased (2.17) and remained stable 12 weeks after treatment (1.98) [6]. The efficacy and safety of TCM for LDH has been fully demonstrated, so the choice of TCM for LDH can be widely promoted and used. However, in the actual clinical treatment, TCM is mostly combined with other treatment methods, and for patients with no significant improvement after long-term treatment, the replacement of treatment methods should be considered.

3.2. *Acupuncture therapy*

Acupuncture has treated pain for thousands of years, using special needles to puncture specific acupoints in the human body. The therapists transmit the needle sense to the local area through various techniques, so that the body can achieve the steady state and eliminate the sub-health state, so as to achieve the effect of treating and relieving the symptoms. Clinically, acupuncture treatment can be divided into electric acupuncture, fire acupuncture, warm acupuncture, etc., according to the treatment methods.

In the clinical observation, 40 patients with LDH were selected (control/observation group=20). The control group adopted conventional drug therapy, the observation group adopted acupuncture therapy, and the acupoint taking method refers to the acupoint name and Positioning [7]. 4 mL of elbow ita blood and ABC-ELISA was used to detect SP (Substance P) concentration in plasma samples. The results indicate that the plasma SP content in the observation group was significantly lower (20.732ng/m L) compared with the patients before treatment (46.454ng/m L) and significantly better than the control group (26.597ng/m L). Feng Yingshuai et al randomly divided forty healthy New Zealand rabbits into blank control group, model group, electroacupuncture group, and 10 animals in each group. Results showed that the serum expression levels of IgM (7.44) and IgG (9.01) in the electroacupuncture group were significantly lower than those in the model group (IM:10.33;IgG:12.37) and the electroacupuncture group (IgM:9.98;IgG:11.89). It suggests that electroacupuncture point treatment for LDH may be related to the inhibition of IgM and IgG expression in serum [8].

3.3. *Massage therapy*

Massage therapy is an important means of conservative treatment, which has the advantages of rapid relief of symptoms, less pain, less complications and low cost.

A clinical trial, with 110 LDH patients (55 each in the control and observation group) [9]. The control group adopted conventional conservative treatment, and the observation group took massage pressing on specific acupoints such as Xiaochangshu point, Guanyuanshu point, Dachangshu point, Qihai point, Shenshu point, Ciliao point, etc., so as to reduce the pain to the minimum. Results proved that compared with the observation group, the control group was better than the control group, like total response rate (74.55%vs90.91%); serum NO(185.12vs160.33);PGE2(48.92vs35.87);IL-1 β (10.04vs8.95);IL-6(38.29vs29.01);IL-8(45.50vs34.02); anti-inflammatory factor IL-4(34.19vs47.55); IL-10(37.66vs42.39). A clinical observation, 63 LDH patients were divided into control(n=30, oral large active capsule combined with lumbar traction) and observation group(n=33, combined with massage therapy based on the control group). After the treatment, the effective rate (93.9%vs73.3%) and JOA score (21.88vs13.83) of the observation group is significantly better than the control group indicators [10].

3.4. *Knife therapy*

Acupuncture and knife therapy is one of the conservative therapies, which is a kind of closed release between surgery and non-surgery. It has the advantages of minimally invasive, and can directly peel and release the muscle. By inhibiting the expression and release of IL-6, IL 10, TNF- α , TGF- β and other inflammatory factors in the muscle tissue, it improves the local microcirculation, reduces the congestion and edema in the diseased site, and promotes the damage repair of the diseased tissue and the absorption of the nucleus pulposus edema. Wang Meiqin et al randomly divided 32 SD rats into blank control group, model group, needle knife group and electroacupuncture group of 8 each. 2mL of cardiac blood collection and centrifugation for TXB2 and 6-K-PGF1 α [11]. The results showed that in the acupotomy group compared to the model group, there was a decrease in TXB2 (thromboxane B2) levels (200.01 vs.

242.70pg/mL) and an increase in 6-K-PGF1 α (6-keto-prostaglandin F1 α) levels (193.26 vs. 132.59pg/mL). Under normal physiological conditions, TXB2 and 6-K-PGF1 α have opposing effects, but both have strong biological activity. These two substances form a dynamic balance regulatory system “TXB2/6-K-PGF1 α ” in the body, which is an important indicator of microvascular constriction status [12]. These experimental results suggest that acupotomy intervention improves the local microcirculation in the dorsal root ganglia of rats.

3.5. Acupoint injection

Acupoint therapy, also known as water acupuncture therapy, is to stimulate specific acupoints through acupuncture, and inject drugs around the acupoints, so that the efficacy can achieve full play, and then achieve the therapeutic effect. Drugs commonly used for acupoint injection include methylcobalamin, lidocaine, normal saline, traditional Chinese medicine compound injection, etc. Studies have shown, acupoint injection organically combines acupuncture with the action of drugs, which can reduce the level of IL-6 and NO, promote the absorption of inflammatory factors, and help improve the clinical symptoms of LDH [13]. It is a common treatment method in clinical practice. In the clinical observation, 92 LDH patients were selected and randomly divided into the control group and observation group with sacral canal injection (0.9% sodium chloride injection 15 mL + 2% lidocaine hydrochloride injection 2mL + vitamin B 12 injection 1mg + triamcinolone acetate injection 40mg); the observation group used the control group, the injection was 20 mL, based on the clinical symptoms and imaging data of the lesion. Results showed that total response rate was higher (73.91% vs 93.48%); lower VAS score (4.64 vs 2.32) and higher JOA score (18.44 vs 24.63) ($P < 0.05$) in the observation group [14].

4. Western medicine treatment

4.1. Drug therapy

4.1.1. NSAIDs. NSAIDs are a class of drugs with analgesic, anti-inflammatory and platelet inhibitory effects that reduce inflammatory cytokines (IL-1 β , IL-6 and TNF-A), thereby reducing the expression of iNOS, COX-2, IL-1 B and TNF-A. Wang Changlin et al evaluated the preoperative and 3,7d after six months of self-care ability (ADL), lumbar function score (JOA), patients waist pain degree (VAS) on the treatment group (taking aceclofenac slow-release tablets, $n=50$) and the control group (no intervention, $n=50$), the results shows that ADL scores increased over time after treatment, and ADL and JOA scores increased significantly compared with preoperative levels (both $P < 0.05$); and waist VAS scores decreased significantly after treatment ($P < 0.05$). which further prove that the postoperative acetolofenac sustained-release tablets can restore the patients' daily living ability and lumbar function in a short time and may effectively relieve the lumbar pain of patients with obvious effect, which may reduce the incidence of postoperative lumbar discomfort to a certain extent [15].

4.1.2. Muscle relaxants. LDH is accompanied by long-term chronic lumbar muscle strain, and chronic fasciitis in the back of the waist. The use of muscle relaxation drugs can relieve the muscle spasm, relieve the stiffness of the back. ethperasone hydrochloride can act on central nervous system and vascular smooth muscle, relieve skeletal muscle tension and improve blood circulation by dilating blood vessels; achieve analgesic effect by combination of drugs, make full use of the interaction between drugs, enhance the efficacy and reduce the occurrence of adverse reactions [16]. Fu Hongwei and others found that whether it was 2 weeks of treatment or 6 months of follow-up, the total effective rates (95.56%, 84.4%) of the treatment group (taking eperisone hydrochloride and methylcobalamin injection, $n=45$) were higher than Control group (no intervention, $n=45$) [17]. The results proved that in the non-surgical treatment of vertebral LDH patients, methylcobalamin and ethperasone hydrochloride had good efficacy and short course and high clinical cure rate.

4.1.3. Dehydration drugs. In LDH patients, due to the prominent nucleus pulposus, repeated compression and stimulation of the cauda equina nerve, nerve root and other tissues, which will lead to edema of the cauda equina nerve, nerve root and other tissues, thus producing inflammatory reaction, causing the symptoms of low back pain and leg pain. Mannitol is a dehydration drug, after the intravenous injection can quickly increase the osmotic pressure of plasma, transfer the interstitial fluid to plasma, and produce the dehydration effect of tissue. Through intravenous infusion of mannitol, dehydration, can effectively relieve the edema of nerve root, cauda equina, but may not directly play an anti-inflammatory effect, so it can not directly relieve pain. Zhuo Yuegeng et al found that no significant changes in VAS and JOA in both groups (the control group (no intervention, n=21), experimental group (20% mannitol (250ml), n=22)), the mannitol injection did not reduce postoperative pain, improve the treatment effect [18]. Research by Gao Xinfeng et al. demonstrated that there was also no significant difference between VAS and JOA in the mannitol (n=30) and control groups (n=27), Higher incidence of sublimb rebound pain (33.3%) than the control group (29.6%), indicating that mannitol eliminates neurologic edema but has no analgesic effect, And may lead to a hydroelectrolysis disorder, Increasing the cardiac load, etc., people should use it with caution [19].

4.1.4. Glucocorticoid. Glucocorticoid have anti-inflammatory effects. Inflammatory response secreting inflammatory mediators include TNF- α , IL-1 β , IL-6, IL-8 and other pain factors. Dexamethasone, as a glucocorticoid, is well lipid-soluble and can bind to the phospholipid bilayer on the cell membrane to inhibit pain signaling and play an analgesic effect. In the control group (no intervention, n=27), with dexamethasone (20mg, n=25), the incidence of dexamethasone (24%) was significantly lower than that in the control group (29.6%), indicating that glucocorticoids had an anti-inflammatory effect and alleviated pain.

4.2. Surgical treatment

4.2.1. Intervertebral body fusion procedure. Minimally invasive transforaminal approach lumbar intervertebral body fusion (MIS-TLIF) has been widely used in clinical practice due to its small trauma, quick postoperative recovery and relatively short learning cycle, and unilateral double-channel endoscopic lumbar interbody fusion (ULIF) has also achieved good results in clinical treatment. Zhu Yihao et al. scored 62 ULIF surgery patients and 58 MIS-TLIF surgery patients on VAS, JOA, LL (lumbar lordosis angle) and IDH (intervertebral disc height) one month after surgery [20]. The results showed that in the comparison of the two groups, the preoperative VAS and JOA decreased significantly, and the LL and IDH increased significantly. indicating that the two groups before the two groups of postoperative fusion rate and lumbar curvature recovery can achieve better results.

4.2.2. Laminectomy. Laminectomy is a longitudinal incision in the rear, cutting part of the lamina, exposing the disc after the nerve root, and the fiber tube is open, the intervertebral space is cleaned, and some of the deformed disc tissue will be peeled off. Xu Jie et al. conducted postoperative follow-up visits on 56 patients with severe LDH (12 patients who underwent hemilaminectomy and 10 patients who underwent total laminectomy) [21]. Three patients who underwent hemilaminectomy still had mild low back pain and lower limb pain. The numbing effect was poor, and the symptoms of the remaining 9 patients disappeared completely, with an excellent and good rate of 75.0%; after total laminectomy, 2 patients had no obvious improvement in postoperative low back and leg pain symptoms, and there was no improvement in the straight leg raising test, and the remaining 8 patients had symptoms. The symptoms completely disappeared, and the excellent and good rate was 80.0%. Patients who prove that conservative treatment can be effectively treated by hemilaminectomy and total laminectomy.

4.2.3. Interforaminal oscopy. Percutaneous foraminal surgery is a posterior percutaneous puncture of the lumbar spine under local anesthesia, with a diameter of about 7.5mm, the working casing, endoscopic approach into the intervertebral foramen (intervertebral space), into the intervertebral disc

or spinal canal, and remove the protrusion or protruding disc compression tissue under the visual endoscope, and the nerve root release. A retrospective study, included 60 patients who underwent percutaneous transforaminal endoscopic surgery and compared the postoperative efficacy of VAS, ODI (Oswestry Disability Index score), JOA and Macnab [22]. The results showed that postoperative lumbar spine and lower limbs The VAS score was lower than before surgery ($P<0.05$); there was no statistically significant difference in VAS scores of lumbar spine and lower limbs ($P>0.05$); the ODI score was lower than before surgery, and the JOA score was higher than before surgery ($P<0.05$); The excellent and good rate 6 months after operation was 91.67%, and the excellent and good rate 5 years after operation was 83.33%. It shows that percutaneous foraminal mirror technique in LDH is not only effective in the near term, but also worthy of long-term efficacy. Meanwhile, it has the advantages of mild trauma, high response rate, quick recovery and less complications, and has good application prospects.

4.2.4. Artificial intervertebral disc replacement. Clinically, artificial disc replacement is an advanced treatment for LDH. Through the implantation of artificial intervertebral disc, the normal height of the vertebral body can be maintained, and the normal vertebral space can be maintained, so that the waist after the force, can balance the decomposition of external force stimulation, reduce the occurrence of lumbar lesions, but also can effectively protect the dural sac and bilateral nerve roots. Kangnan et al. evaluated the VAS and ODI of 20 patients after surgery, and both decreased steadily, the total satisfaction rate reached 96% [23]. This indicates that artificial disc replacement is one of the effective methods for recurrent LDH, but the long-term efficacy should be further observed.

5. Rehabilitation exercise

5.1. Bed rest

Bed rest may play a certain auxiliary role in the LDH treatment, but attention should be paid to the moderate and correct methods. First of all, people should maintain a correct posture when in bed rest. Only the correct posture can reduce the burden on the waist. In addition, maintaining the same position for a long time will increase the extra pressure on the waist, so you should be slightly active.

5.2. How to reduce or avoid lumbar movement

In the treatment and rehabilitation stage of LDH, it is very important to reduce or avoid lumbar weight bearing. If avoid lifting heavy objects, ensure the correct lifting posture if required. Use a support pillow or cushion to maintain lumbar integrity. And be sure to avoid strenuous physical activities, especially those that may cause additional stress on the lower back.

5.3. Exercise

LDH rehabilitation exercise should be performed carefully to avoid further injury. Here are some suitable rehabilitation exercises: Core muscle exercises to strengthen the abdominal and back muscles to provide better spine stability. Recommended exercises include abdominal plank, bridge movement, and abdominal roll. Also performing some mild aerobic exercises, such as brisk walking, swimming or cycling, can promote blood circulation and help with recovery. After exercise, you should also remember to stretch to help relieve muscle tension and reduce stress, but take care to avoid overstretching to avoid strain. During exercise, must maintain stability during any movement and avoid sudden twisting or movements, which may increase the burden on your waist. And should start with light exercise and gradually increase the intensity and duration. If pain or discomfort occurs, patients should stop exercising immediately and consult a doctor. It is best to perform rehabilitation exercises under the guidance of a physical therapist. They can design an appropriate exercise plan according to the condition to ensure correct movements.

6. Conclusion

After a long period of development, modern medicine and traditional Chinese medicine have their own unique methods and methods for the treatment of LDH disease. In the chronic pain caused by the complex physiopathological mechanisms targeting LDH, although both can effectively relieve the chronic pain caused by LDH disease, there is no way to completely solve the chronic pain caused by LDH. Most of the related studies are small sample sizes and the evidence-based evidence is not strong enough. However, modern medicine has gained a deeper understanding of the pathology of LDH. In the aspect of TCM, TCM realized that the pathophysiology of TCM is closely related to kidney, bone and brain. It is expected that in the future, more new and effective treatment methods will emerge in both TCM and modern medicine, which can more effectively treat the chronic pain caused by LDH, increase the research sample size, provide patients with more optimized individualized treatment plans, and overcome this problem that disturbs people's long-term health.

Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

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