Analysis of the Efficacy of Ozone Therapy on Lumbar Disc Herniation

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SUMMARY - *This study assessed the efficacy of ozone therapy on lumbar disc herniation. One hundred and four patients with the main symptom of low back and lower limb pain or numbness were diagnosed with lumbar disc herniation by CT or MRI, including 144 diseased lumbar discs. Under X-ray guidance, a 21G needle was punctured into the disc. Then 4-40 ml ozone of 50ug/ml and 40 mg prednisolone acetate were injected into the intradiscal and paravertebral space. All patients were followed up for three to 84 months (average 38 months) and the last follow-up was in March 2009. The total effective rate was 77.1%, without any serious complications. Percutaneous intradiscal and paravertebral medical ozone injection is an effective and safe method for treating lumbar disc herniation.*

Introduction

Lumbar disc herniation is the most common lumbar degenerative disease, which often does not attract enough attention from patients, because the onset is slow and the symptoms are not obvious and relieved quickly. An American cross-sectional study showed that the incidence of chronic (over three months) back and leg pain jumped from 3.9% in 1992 to 10.2% in 2006 [1]. Lumbar disc herniation is a common and frequent disease which mainly occurs in young and middle-aged people. The percutaneous intradiscal and paravertebral medical ozone injection is a minimally invasive treatment which has developed rapidly with good efficacy. Our hospital treated 104 patients with lumbar disc herniation by this treatment from June of 2002 to February of 2009 and received satisfactory efficacy.

Materials and Methods

Patients

This study selected 104 patients, including 44 men and 60 women, with the age ranging from 27 to 84 years old (average 52.4 years) and the disease course ranged from three days to 20 years (average 14 months). There were 144 diseased discs in all with 2 to 7 mm herniation level, an average of 4.5 mm. All cases met the following conditions: 1. Obvious symptoms of nerve root compression like low back pain and/or lower limbs numbness. 2. Disc bulge and herniation, without disc calcification and adhesion, serious spinal stenosis, bony stenosis of intervertebral foramen, lumbar instability, spondylolisthesis, tumors, etc. 3. Definite evidence of imaging diagnosis like CT or MRI. 4. Voluntary reception of ozone therapy, without any blood system disease or obstruction of spirit and consciousness. 5. Patients could not be selected in this study if the disease was not improved after invasive treatment or recurred after surgery.

Facilities

C-Arm X-ray medical equipment, Ozone generator from Italy MULTIOSSYGEN-99IR, 21G needle, Medical ozone.

Methods

The patients lay in position on the healthy side, putting a soft pillow under the back and bending the knee joint of the healthy side. The drape was disinfected routinely. Then the diseased disc was positioned through the guidance of C-Arm X-ray equipment, and the point on the unhealthy side 7-10 cm away from the midline was taken as the puncture point, where the skin and subcutaneous tissue should be anaesthetized first by injecting 5ml 2% lidocaine, then a 21G needle was inserted at a 35~45° angle to the sagittal plane of the body. The puncture path in discs of L3/4 and L4/5 was as follows: skin--subcutaneous fat-- deep fascia-- lumbar muscle--the inferior nerve root-- security triangle--diseased disc. It was more difficult to puncture into the disc of L5S1, and the angle of puncture

was 8~15° between the needle and the lateral body to the foot. The puncture path was as follows: skin--position of needle tip. When the needle tip was positioned at the third of the of L5S1 diseased disc, ozone generator should be turned on to work and adjust the concentration to meet the requirements. First, 5 ml medical ozone was injected into the diseased disc. By asking the patients whether the symptom of nerve root was induced or aggravated, the researchers confirmed the accountable disc. Then 4~10 ml medical ozone at 50 ug/ml was injected into every disc and 10 ml was injected into every paravertebral space, where, at the same time, 40 mg prednisolone acetate was injected. Lastly, the needle was removed and the skin of the point of puncture was medicated and covered.

Evaluation

The efficacy was evaluated by Macnab: excellent-pain disappeared; patients had no limitation on motor function and could work normally; good-patients would feel pain at some time but could do easy work; fair-the symptom had improved a little but the patients still felt pain and could not work; poor-the patients had the symptom of nerve root compression, requiring further treatment. The patients were examined again by CT or MRI, and the measurement and statistics of related data recorded as follows: AB was assumed as the longest sagittal diameter of disc herniation, CD as the longest sagittal diameter of the vertebral canal, R as the ratio of AB and CD (the ratio was beneficial to decreasing deviation). There were 94 cases with complete imaging data pre- and post operation. Then the researchers measured all the R values and observed whether the size of disc herniation changed after medical ozone treatment. The study adopted the self-control study, and the data of pre- and post operation was compared by rank-sum test.

Follow-up

The patients were followed up at one month later and three months later after treatment mainly by reexamination in the outpatients department. The content of follow-up included: evaluating the efficacy according to evaluation criteria and observing the conditions of diseased disc after treatment by performing CT or MRI. The last follow-up was in March 2009, with 100% follow-up rate. The follow-up time was three to 84 months with an average of 38 months.

Results

Fifty-five patients were punctured successfully and followed up the first time one month later after medical ozone treatment, and all 104 patients were evaluated, including excellent efficacy in 42 cases (40.1%), good in 38 (36.5%), fair in 20 (19.2%) and poor in four (3.8%). The last follow-up was in March 2009. Out of all 104 patients, 50 (48.1%) had excellent efficacy, 30 (29%) good efficacy, 18 (17.3%) fair efficacy, and six (5.8%) poor efficacy. Out of the six patients with poor efficacy, four opted for surgical discectomy and two chose continued conservative treatment. In this study, the total effective rate was 77.1% (excellent and good).

Discussion

Lumbar disc herniation is the most common degenerative lumbar disease and the leading cause of low back pain. At the same time, degenerative lumbar change and abnormal stress function are the main pathological basis of low back pain. Since 1950s, massotherapy has been adopted in China and achieved a certain efficacy in treatment of disc herniation. But for some patients, massotherapy increased the incidence of nerve root adhesion. From 1940s to 1960s, disc herniation was treated by hemilaminectomy or total laminectomy as well as fenestration which were unsuitable to use widely, because less than 10% patients demanded surgery and there were relatively more complications. Recently, physical therapy combined with anti-inflammatory drugs is the most effective treatment for low back pain caused by degenerative lumbar disease. The symptoms in most patients could be relieved in six weeks, thus surgery was not recommended as the first treatment method [2]. However, in a clinical setting, we found the recurrence rate was very high when adopting physical therapy combined with anti-inflammatory drugs. Minimally invasive treatment was more ideal for the recurrent cases. In 1980s, in America and some European countries, selective injection of fibrous histolysis into herniated discs was adopted and achieved a certain efficacy. In 1990s, domestic scholars adopted percutaneous lumbar discectomy which also received good clinical efficacy. In this study, lumbar disc herniation was treated by percutaneous ozone injection which was a new treatment as the combination of minimal mechanism and an anti-inflammatory mechanism. Compared to physical therapy combined with anti-inflammatory drugs, ozone injection obviously had lower recurrence rates. The data showed that the total efficacy reached 77.1%. The efficacy reached 68%-79% according to both domestic and foreign reports. According to He et Al and other reports, the efficacy reached 82.25%, which accorded with the result of this study [5].

Water accounted for about 80% in nucleus pulposus of lumbar disc, and the strong oxidizability could lead to nucleus pulposus dehydration and the water in disc diminished as to decrease the volume of disc. The traditional concept held that mechanical compression on the nerve root was the main cause of back and leg pain, and the degree of pain was related to the degree of nucleus pulposus prolapse and/or nerve root compression. This study showed that the rate of disc retraction was very low according to the contrasting observation of imaging pre- and post surgery ($P>0.05$), which did not have statistical significance but the clinical symptoms were relieved quickly. Although intradiscal and paravertebral medical ozone injection were thought to induce the rapid dehydration and retraction of the nucleus pulposus (such as new young patients), it could not obviously decrease the hyperosteogeny and hypertrophic joint capsule, and the mechanical compression still existed. However, the strong oxidizability, anti-inflammatory effects and analgesic effect of medical ozone combined with non-steroidal drugs could decrease the release of immunological factor and attenuate the edema and adhesion of the nerve root by inhibiting the inflammatory mediators of inflammatory reaction, which would achieve the final purpose of relieving pain. This result showed that mechanical compression could not completely explain the causes of discogenic back and leg pain, thus relieving pain could not only depend on relieving pressure. We should broaden our medical ideas to reach the purpose of eliminating clinical symptoms by multitarget coordination.

The antagonistic action of medical ozone on inflammatory mediators around the nerve root was the key to relieving pain. Clinically, many cases with compression could not be explained by mechanical compression: the nerve compression was not severe in some patients but the clinical symptoms were extremely obvious. Some cases were the opposite: after receiving conservative treatment, the disc herniation had no changes but clinical symptoms had obviously improved. Although some patients had surgery to remove the oppression structure, clinical symptoms had still not improved. Therefore, discogenic back and leg pain was caused by multiple factors, which should be analyzed from anatomy and pathology. There are rich soft tissue of sensory fibers in vertebral canal wall and spinal canal, including the spinal dura mater, posterior longitudinal ligament and anulus fibrosus. Stimulating the three soft tissues is the nosogenesis of low back pain [9,10], and all those tissues are controlled by the sinuvertebral nerve [10,11]. Saal et Al discovered that the action of PLA2 in the nucleus pulposus of the disc was significantly higher than that in blood and other tissues [12]. PLA2 is an important inflammatory mediator and pain-producing substance as well as the marker of tissue inflammation. Animal experiments showed that the PLA2 extracted from the intervertebral disc had an inflammation-causing effect [13-15]. The inflammatory mediators are thought increase in the nucleus pulposus and anulus fibrosus of those degenerative discs. The inflammatory mediators would then induce inflammation by acting on the sinuvertebral nerve, which, at the same time, would induce pain when it was stimulated by certain mechanical pressure. Besides, like the antigen substance, the glycoprotein and β-protein released by rupture of the anulus fibrosus induced the immune response of the organism, which caused aseptic inflammation and even adhesion. These series of actions were the main cause of back and leg pain [3,4]. Hou Shuxun and etc. proposed that the degree of back and leg pain in patients with lumbar disc herniation was unrelated with the types of nucleus pulposus prolapse and the nerve root inflammation induced by inflammatory mediators of nucleus pulposus was an important cause of pain [15]. The study showed that medical ozone could stimulate the overexpression of antioxidase, neutralize excessive reactive oxide and stimulate the cytokines like IL released for antagonizing the inflammatory mediators. At the same time, ozone could inhibit receptor fibers injury and activate the organism's anti-injury system, as well kill pain by stimulating inhibitory interneuron to release enkephalin [7,8]. The result of this study suggested that medical ozone injection into the disc and paravertebral space differed from other chemical dissolution in treating disc herniation, because it not only rapidly antagonized the inflammatory mediators to relieve pain, but also ensured that the local anatomical relationship would not be damaged. Therefore, ozone therapy had the features of high repeatability and security.

Accurate positioning of the " accountable" disc inducing symptoms is the key to guaranteeing the curative effect. We observed that most patients had multidisc herniation, mainly including L3/4, L4/5 and L5/S1 disc herniation, but clinical symptoms and physical signs were usually caused by the disc herniation in L4/5 and L5/S1. Whether the low back pain was induced by the intervertebral disc or whether the accountable disc was positioned should be the indications of choosing medical ozone treatment. We concluded that the diseased disc could be diagnosed according to clinical symptoms, physical signs and careful examination of nerves orientated, and if combined with discography, the "accountable" disc could be accurately positioned. The International Association for the Study of Pain

suggested that when identifying whether back and leg pain was induced by intervertebral discs, the discography should meet the following conditions: 1) Discography should show disc degeneration. 2) Discography should induce the equivalent pain with chief complaints. 3) There should be at least one negative disc for control. In clinical practice, we found that discography was the most reliable diagnostic method. However, the relevant treatment could not be performed immediately after discography, thus intradiscal ozone injection was done to induce equivalent symptoms with chief complaints. Accordingly, we could identify whether the disc we treated was the "accountable" disc. Intradiscal ozone injection had the following advantages: 1) Pain was aggravated by decreasing the chemical irritation of discography. 2) Ozone gas is extremely unstable and would be decomposed quickly after the short-term pressure caused by injection inducing clinical symptoms. Ozone would not increase chemical irritation and could have an effect without having to be absorbed. 3) The anti-inflammatory effects of ozone itself could carry out both diagnosis and treatment, which means it could not only accurately identify the "accountable" disc but also decrease the blindness of multidisc treatment. Therefore, identification of the "accountable" disc had direct significance for treatment: accurately identifying the "accountable" disc and puncturing it successfully was the main factor effecting the prognosis. The concept of "accountable disc" merits diffusion. However, the identification of accountable disc must obey the principle of combining "clinical symptoms", and "discography" with "induction trial"[6].

Analysing the causes for treatment failure in this study, we had two patients with poor efficacy, including the two cases who had good efficacy at the time just after the medical ozone treatment. The two patients opted for microendoscopic discectomy. However, we found that the efficacy was still not satisfactory by follow-up. Through a systematic review of the clinical data of the two patients, we discovered that the main causes for treatment failure included the activity time, intensity of labour and other diseases combined with mental factors. In general, back and leg pain occurred in workers with heavy jobs or people with the inducements like injury and long-standing fixed position. Disease recovery required a combination of clinical treatment, rehabilitation and enough rest. Four patients moved too early after treatment and even demanded to leave hospital, thus the anti-infective drug and anti-dehydration drug were not used for enough time. Doctors and patients did not estimate clearly the long- term effect due to the obvious curative effect just after treatment. Therefore, the lack of systemic follow-up treatment and too early movement were the main causes. Two patients still did not have satisfactory efficacy in spite of receiving systemic follow-up treatment and microendoscopic discectomy. According to our analysis, the failure was related to other diseases and mental factors. Adequate preoperative preparation, careful history-taking, careful medical examination and complete laboratory examination would decrease the failure rate, while improved surgical techniques and scientific adjuvant therapy would guarantee the curative effect. Reinforced psychological intervention would lighten the depression induced by long-term pain, which had an adjuvant therapy effect on disease recovery.

In a word, some aspects of back and leg pain induced by intervertebral disc remain unclear and need further study from the standpoints of pathogenesis, diagnostic method, treatment, etc. Percutaneous intradiscal and paravertebral medical ozone injection for treating lumbar disc herniation is a new treatment method which could identify and treat the " accountable" disc, not only attenuating patients' pain but also decreasing the blindness of treating the healthy disc. Therefore, the hospital stay will be shorter and the cost will be reduced. The total effective rate and safety are high. Medical ozone therapy is an ideal choice for those patients in whom the conservative treatment has no effect and should be spread and applied widely in a clinical setting.

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