MRI Outcomes of Nonsurgical Treatment of Giant Lumbar Disc Herniation: A Prospective Clinical Study

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Research article

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Abstract

Background: The phenomenon of lumbar disc herniation resorption is increasingly being reported, but the occurrence of this phenomenon cannot currently be accurately predicted.

Methods: We acquired magnetic resonance imaging (MRI) of patients with giant lumbar disc herniation from January 2018 to December 2019, and analyzed the prognostic value of measurements performed on the images. The patients underwent conservative treatment according to the doctor's decision. The imaging assessments included Komori points, MSU type, Iwabuchi type, the presence of a "bull's eye" sign on contrast-enhanced MRI, Modic type classification, initial imaging prominence rate, and maximum level projection area. Post-treatment MRI was reviewed to evaluate the outstanding prominence rate and the maximum level projection area, thereby allowing calculation of the intervertebral disc absorption rate after treatment. The rate of patients undergoing later surgery was also recorded.

Results: Seventy-six patients (46 males and 30 females, aged 14–65 years [mean 37.79 ± 10.60]) were included in this study, 12 of whom underwent surgery, giving a surgical rate of 15.79%. All patients were followed up for more than 9 months. The outburst rate was $84.41\% \pm 14.72\%$. The absorptivity rate of the 64 patients under conservative treatment was $38.35\% \pm 40.64\%$, with the absorptivity of the patients with Iwabuchi type 1 and a bull's eye sign being significantly higher than the average rate ($P < 0.01$).

Conclusions: The resorption of giant lumbar disc herniation is a natural process. Imaging findings showed Iwabuchi type 1 and a positive bull's eye sign on contrast-enhanced MRI to be associated with an increased probability of resorption.

Background

In 1984, Guinto et al. reported the resorption of a lumbar disc herniation in a patient after conservative treatment, with this observation being made through computed tomography (CT) examinations. [1]. Since then, many other researchers have reported similar findings of the spontaneous regression of lumbar disc herniation [2–4]. In recent years, with the increasing use of magnetic resonance imaging (MRI), there have been more and more reports of disc lesions shrinking or even disappearing completely [5–7]. There have been many attempts to forecast the occurrence of this 'heavy absorption', with the factors being examined including the degree of intervertebral disc herniation, intervertebral disc protrusion size and location, composition, enhanced MRI vertebral canal morphology, and a protrusion ring around the strengthening point. Japanese scholars Komori and Boda (Komori) [8] depending on the degree of displacement of protrusions on MRI research, clinical observation showed protrusions absorption probability as the outstanding level of larger, with the rising of the displacement of intervertebral disc protrusion, the more likely they are to absorb, the greater the prominence, heavy volume of intervertebral disc tissue is easy to absorb. Autio et al. [9] also reported that disc herniations were more likely to show resorption, and that the mechanism may be related to the degree and size of the area of the ruptured nucleus pulposus in contact with the blood supply. Mochida [10] found that the lateral type of disc

herniation protrusion was more prone to resorption than the central type. It was reported that spinal canal volume size differs among patients with lumbar disc herniation with or without clinical symptoms, and that patients with severe symptoms have a smaller spinal canal volume, which indicates that spinal canal diameter is an important factor determining the severity of patients' symptoms [11]. Yuan et al. [12] studied the spinal canal morphology of 182 patients whose symptoms were significantly relieved after conservative or surgical treatment, and found that the spinal canal volume in the patients in the conservative treatment group was significantly greater than of the patients in the surgery group. On the basis of the different signal characteristics of protrusions on ordinary MRI, Iwabuchi et al. [13] speculated that most type 1 protrusions were composed of nucleus pulposus. A nucleus pulposus with high water content and a small degree of degeneration was more likely to show vascular growth and tissue dehydration, factors realizing the resorption of protrusions. Autio et al. [9] used contrast-enhanced MRI to predict the resorption of herniated discs and found that MRI axial planes allowed visualization of ring enhancement signals around protrusions. They found that the greater the thickness of the edge enhancement and the higher the signal strength, the higher the degree of vascularization around the protrusions and the more likely resorption was to occur. At present, it is generally believed that the main cause of this phenomenon is the growth of new blood vessels into protruding tissues [14, 15]. Contrast-enhanced MRI showed that the appearance of ring enhancement around the protrusion had a positive significance for resorption [16]. In addition, there are also many clinical cases of bull's eye syndrome on contrast-enhanced MRI images, and resorption after conservative treatment has been reported [17]. Kawaji, [18] the 65 cases of enhanced MRI displayed on the "bull's eye" huge type patients with lumbar disc prolapse, 21 cases adopted conservative treatment, 44 cases of surgical treatment, conservative treatment of patients in the period of symptom onset and symptoms, respectively for an enhanced MRI contrast before and after the test, the results found that annular strengthened significantly smaller part, the author thinks that enhanced MRI is an effective forecast to predict lumbar disc after heavy absorption method. The production of granulation tissue and blood vessels around a lumbar disc herniation is the main indicator of whether a lumbar disc herniation is likely to be reabsorbed or not; the production and range of vascularization are closely related to the reduction of herniated tissue, the degree of absorption, and the prognosis [19]. At present, it is believed that PERI-MRI enhancement may be related to vascularization and the formation of inflammatory granulation tissue in lumbar disc herniation [14]. Lumbar disc herniation breaks through the posterior longitudinal ligament from the degenerative annulus fibrosus and enters the epidural membrane as a foreign body, generating an immune inflammatory response and inducing the growth of new blood vessels [20, 21]. According to a method for calculating the disc herniation rate and absorption rate [5], a disc herniation rate of more than 50% is clinically defined as giant lumbar disc herniation [22]. Knowing the appropriate course of action to deal with a patient with giant lumbar disc herniation with surgical indications, but also with the possibility of resorption, is very difficult, and it is necessary to grasp the non-surgical and surgical indications. Therefore, we studied the use of imaging measurement methods for predicting the suitability of conservative treatment for patients with giant lumbar disc herniation. The purpose of this prospective study was to investigate whether imaging data of giant lumbar disc herniation can be used to predict the

incidence of disc resorption and improve the success rate of conservative treatment of giant lumbar disc herniation.

Methods

Study design and population

From January 2018 to December 2019, this prospective clinical study enrolled patients with giant lumbar disc herniation who were initially indicated for conservative treatment as out-patients or inpatients of Suzhou Hospital of Traditional Chinese Medicine. The patients were classified according to the type of herniation on imaging. Giant lumbar disc herniation was defined according to patient physical characteristics: different degrees of lower extremity root pain, the Straight Leg Raise Test (SLRT; also known as the Lasegue sign) with or without corresponding muscle weakness and paresthesia of the lower extremity of the involved nerve root segment [23], and imaging characteristics: whether the protrusion exceeded or left the original vertebra space to move downward or upward, whether it was connected to the mother disc by a narrow neck or appeared to be free, whether it formed a circular or ovoid isolated mass, and whether the rate of herniated disc in the responsible segment was $\geq 50\%$ or the herniated disc exceeded 50% of the sagittal midline of the spinal canal [22].

Inclusion and exclusion criteria

The inclusion criteria included outpatients or inpatients who met the diagnostic criteria for giant/free lumbar disc herniation, conformed to Komori improved types 2 or 3, and MSU types 2 or 3. The patients were required to be free of cauda equina nerve injury and progressive motor nerve injury symptoms and signs. They were required to be willing to truthfully inform the researchers of any health problems and any drugs taken during the treatment, and to attend the hospital for further consultation as required. The patients gave informed consent that they were willing to participate in this clinical study and agreed to provide accurate medical history and current condition information, and that they were willing to take drugs prescribed by the doctor and complete the follow-up as required. The age range was 14–70 years old, and both sexes were included.

The exclusion criteria included patients with severe primary diseases and psychosis complicated with vital organs, pregnant or lactating women, patients who received any lumbar surgery or intraspinal injection before treatment, patients with scoliosis, spinal tumors, spinal tuberculosis, inflammatory diseases, severe degenerative diseases of the spine such as severe spinal stenosis, osteoarthritis, intervertebral disc cyst, subchondral cyst, ganglion cyst, and other lumbar diseases affecting the prognosis, including spondylolisthesis and isthmus.

Treatment protocol

The conservative treatment options involved one or more of the following: 1. Absolute bed rest for 2–6 weeks. 2. Administration of the traditional Chinese medicine (TCM) preparation Xiaosui Huahe (roasted *Astragalus* 20 g, raw *Astragalus* 20 g, *Angelica sinensis* 10 g, *rhizoma Atractylodis macrocephalae* 10 g,

Ligusticum wallichii 10 g, pawpaw 10 g, *radix Stephaniae tetrandrae* 10 g, *Lumbricus* 10 g, *Brassica alba boiss* 6 g, leech 6 g, and *radix Clematidis* 10 g) decocted in water and taken orally for 8–16 weeks. 3. If pain was not relieved after the first 1–2 weeks following an acute episode, patients were permitted to take 0.1 g celecoxib twice daily. The indications for surgical treatment included: non-surgical treatment was ineffective after 3–6 months; symptoms and/or signs of progressive aggravation during treatment; and symptoms of cauda equina compression appearing. Surgical treatment was performed according to the patient's condition and lumbar degeneration, and included laminectomy with decompression and nucleus pulposus, decompression, bone grafting, fusion and internal fixation, and excision of nucleus pulposus under percutaneous intervertebral foramen mirror.

Imaging measurements

Protrusion percentage and absorption percentage The protrusion percentage and absorption percentage were calculated following the methods of Yu et al. [5]. The upper vertebral body wall after the halfway point of the trailing edge to the vertebral canal length was set as a (the spinal canal diameter), the prominence peak to the vertebral canal wall distance was set as b , and the protrusion percentage was calculated as: $[(a - b)/a] \times 100\%$ (Fig. 1). The absorption percentage was calculated as (protrusion percentage before treatment – protrusion percentage after treatment) / protrusion percentage before treatment.

a: Length from the midpoint of the posterior margin of the upper vertebral body to the posterior wall of the spinal canal (diameter of the spinal canal); *b*: The distance from the highest point of the protrusion to the posterior wall of the spinal canal; protrusion percentage = $[(a - b)/a] \times 100\%$

Spinal canal area and protrusion area (Fig. 2) The spinal canal and protrusion areas were calculated on the axial MRI image showing the maximum protrusion. A datum line L maximum level of, behind the wall before the vertebral canal and intervertebral disc as, graphical, area a protrusion on spinal canal area b, use the hospital image system polygon measuring tools graphical directly from the biggest plane area and prominence is the largest area of vertebral canal, protrusion of vertebral canal maximum level area ratio = a/b .

Komori improved typing [8] Type 1, the black line behind the protruded disk is complete; type 2, the black line is interrupted or absent; and type 3, the herniated disc exceeds the height of the mother disk (Fig. 3).

MSU classification types [24] The spinal canal is divided into three and four equal sections in the axial and coronal positions, respectively, and the region and type of the vertebral canal are determined according to the farthest region invaded by protrusions (Fig. 4).

Iwabuchi classification [13] According to the different signal of MRI scan protrusions on the characteristics of the T1 weighted as will highlight the nucleus pulposus and within the same segment disc nucleus pulposus signal strength comparison, will highlight the nucleus pulposus on the T2-weighted images within the same segment disc fiber ring signal strength comparison, according to the comparison results are divided into 5 types (Fig. 5).

Iwabuchi type and its clinical significance

Type 1 shows isosignal on T1-weighted imaging, high signal on T2-weighted imaging, and most of the protrusions are nucleus pulposus with a high possibility of resorption. Type 2 shows equal signal on T1-weighted imaging and equal signal on T2-weighted imaging. Most protrusions are fibrous rings with little possibility of resorption. Type 3 shows high signal on T1-weighted imaging, high signal on T2-weighted imaging, the protrusion has myxoid change, and the possibility of resorption is small. Type 4 shows high signal on T1-weighted imaging and equal signal on T2-weighted imaging, with protrusion granulation tissue hyperplasia and low possibility of resorption. Type 5 shows low signal on T1-weighted imaging, equal signal on T2-weighted imaging, the protrusion part is a fiber ring, and the possibility of resorption is greater.

Type 1 (T1 equal signal, T2 high signal) Type 2 (T1 equal signal, T2 equal signal) Type 3 (T1 high signal, T2 high signal)

Type 4 (T1 high signal, T2 equal signal) Type 5 (T1 low signal, T2 equal signal)

Figure 5. Signal intensity typing of Iwabuchi MRI protrusions

"Bull's eye" sign (the edge of the enhancement of the protrusion on contrast-enhanced MRI)[9]. A herniated disc in the epidural space may cause an autoimmune inflammatory response with the formation of granulation tissue around the disc. This is characterized by annular enhancement and an absence of enhancement in the central free disc. This finding is called a "bull's eye" sign (Fig. 6).

Adjacent vertebral bodies and Modic changes [25] Type I shows a signal change area with low signal on T1-weighted imaging and high signal on T2-weighted imaging. Type II shows a signal change area with high signal on T1-weighted imaging and high or slightly high signal on T2-weighted imaging. Type III shows signal changes that are low signal on T1 and T2-weighted imaging (Fig. 7).

Type I Modic changes (T1 low signal, T2 high signal) Type II Modic changes (T1 high signal, T2 high signal)

Type III Modic changes (T1 low signal, T2 low signal)

Figure 7 Modified Modic typing

Statistical analysis

SPSS 22.0 software was used for statistical analysis. Measurement data are expressed as mean $\pm$ standard deviation and were compared using *t*-tests between two groups. Count data were compared using 2 test. A value of $P < 0.05$ was considered statistically significant.

Results

General data

A total of 76 patients with giant lumbar disc herniation were enrolled in this clinical study, with these including 46 males and 30 females, aged from 14–65 years (mean age of 37.79 ± 10.60). All patients received a contrast-enhanced MRI examination at their first diagnosis. Twelve patients finally received surgical treatment, giving an operative rate of 15.79%. The remaining 64 patients underwent conservative treatment, and received at least 1 MRI examination after treatment, allowing results on first and last MRI examinations to be compared. All patients were followed up for more than 9 months, with a mean follow-up time of 1.05 ± 0.44 years, and none of the patients showed symptoms of cauda equina nerve injury during treatment.

Statistical analysis

Reabsorption of protrusions

For the 64 patients who received non-surgical treatment, the protrusion rates before and after treatment, the percentage of the largest layer of protrusions in the spinal canal area, and the absorption rate are shown in Table 1. To facilitate easier comprehension of the statistics, we defined a resorption rate (RR) $\geq 50\%$ as significant absorption and an RR of 30–50% as partial absorption. Because of measurement errors, an RR of $< 30\%$ was counted as non-significant absorption. The post-treatment MRI examinations of the 64 patients treated conservatively showed significant resorption in some patients, with an average absorption rate of $38.35\% \pm 40.64\%$. The numbers of cases of resorption of giant lumbar disc herniation in each type of image observation are shown in Table 2.

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Table 1
Protrusion rate, maximum surface area of protrusions, and percentage of protrusions in the spinal canal area before and after treatment

	cases	Protrusion percentage(%)	Maximum bedding area of a projection(mm ²)	Percentage of spinal canal area of protrusion(%)	absorptivity(%)
Before treatment	64	84.41 ± 14.72	171.25 ± 49.52	46.04 ± 9.77	-
After treatment	64	51.58 ± 35.41	109.84 ± 74.74	29.96 ± 19.46	38.35 ± 40.64

After treatment, the protrusion rate, maximum surface area of the protrusion, and percentage of the protrusion in the spinal canal area were all significantly different to the pre-treatment values ($P < 0.01$, paired data t-test)

Table 2

The number of cases of resorption of giant lumbar disc herniation in each observation type

Observation index		cases	Obvious resorption RR $\geq$ 50%	Partial resorption 30% $\leq$ RR $\leq$ 50%	No resorption RR $\leq$ 30%
classification of type		64	25	3	36
Komori types	Type 1	0	0	0	0
	Type 2	36	11	2	23
	Type 3	28	14	1	13
MSU types	Type 1	0	0	0	0
	Type 2	26	9	1	16
	Type 3	38	16	2	20
Iwabuchi types	Type 1	35	22	2	11
	Type 2	15	2	0	13
	Type 3	10	0	0	10
	Type 4	0	0	0	0
	Type 5	4	1	1	2
Bull's eye sign	positive	47	22	3	22
	negative	17	3	0	14
Modic types	TypeⅠ	1	1	0	0
	TypeⅡ	13	6	1	6
	TypeⅢ	0	0	0	0
	None	50	18	2	30

Table 3

Comparison of absorption rates of giant lumbar disc herniation between different imaging categories

Imaging type	classification of type	cases	absorptivity(%)	Type of contrast	P values
Komori types	Komori type 2	36	33.01 ± 40.72	Komori type 3	0.236
	Komori type 3	28	45.21 ± 40.22	Komori type 2	
MSU types	MSU type 2	26	35.06 ± 44.20	MSU type 3	0.596
	MSU type 3	38	40.60 ± 38.47	MSU type 2	
Iwabuchi types	Iwabuchi type 1	35	57.76 ± 40.44	Iwabuchi type 2	0.000
				Iwabuchi type 3	0.000
				Iwabuchi type 5	0.160
	Iwabuchi type 2	15	18.01 ± 31.97	Iwabuchi type 3	0.313
				Iwabuchi type 5	0.487
	Iwabuchi type 3	10	3.58 ± 8.35	Iwabuchi type 5	0.176
	Iwabuchi type 5	4	38.35 ± 40.64	-	-
	Enhanced MRI edge enhancement	Bull's eye sign(+)	47	48.14 ± 41.45	Bull's eye sign(-)
Bull's eye sign(-)		17	16.95 ± 28.99	Bull's eye sign(+)	
Modic changes	Modic typeⅡ	13	50.55 ± 42.89	None Modic changes	0.221
	None Modic changes	50	34.85 ± 40.20	Modic typeⅡ	
Note: Komori type 1, MSU type 1, Iwabuchi type 4, and Modic type I and III categories did not contain sufficient patient numbers to allow inclusion in the statistical analysis. P < 0.05 was taken to indicate statistical significance.					

Discussion

The relationships between image type and resorption of giant lumbar disc herniation are shown in Table 3. The associations between resorption of protrusions and Komori typing, MSU typing, Iwabuchi typing, "bull's eye" sign, and Modic changes were evaluated for the study patients. The numbers of Komori type 1, 1, Iwabuchi type 4, and MSU Modic types I and III were insufficient for statistical analysis. Chi-square tests showed non-significant differences ($P > 0.05$) between Komori types 2 and 3, and between MSU types 2 and 3. Apparent absorption was seen in 22/35 (62.86%) Iwabuchi type 1 cases, 2/15 (13.33%) type 2 cases, no type 3 or 4 cases, and 1 (25.00%) type 5 case. Iwabuchi type 2 and type 1 and type 3 by chi-square test $P < 0.01$, significant statistical significance on the difference between the remaining parting compare the chi-square ($P > 0.05$, no significant statistical significance, Iwabuchi classification is illustrated in the projection type 1 component of nucleus pulposus, the more the higher water content, resorption is more likely to occur. Obvious resorption was found in 22/47 (46.81%) cases with a positive bull's eye sign and 3/17 (17.65%) cases with a negative bull's eye sign, with the difference being statistically significant (chi-square test, $P < 0.01$), indicating that a protrusion surrounded by an active inflammatory reaction with new vascular growth and a positive bull's eye sign were more likely to show resorption. Modic type II with Modic changes in patients with absorption by chi-square test, $P > 0.05$ difference is not significant.

A typical case description (Fig. 8) A 30-year-old woman presented at the hospital in January 2018 with lumbago and pain in both lower extremities but no symptoms of cauda equina compression. Physical examination indicated L4/L5 and L5/S1 bilateral paracanth tenderness radiating to both lower limbs. A straight leg elevation test was performed at 50° (+) on the left side and 50° (+) on the right side. The skin sensation and muscle strength of both lower limbs were normal. The first MRI examination showed an L4/L5 giant protrusion of Komori improved type 3, MSU type 3-AB, Iwabuchi type 1, positive bull's eye sign, and no Modic changes, and an L5/S1 herniated disc of Komori modified type 2, MSU type 2-A, Iwabuchi type 2, no bull's eye sign, and no Modic changes. Eight months later, the symptoms of lumbago and leg pain were mostly relieved. The straight leg elevation test showed 80° (-) on the left side and 80° (-) on the right side, and the JOA score was 22 points. The first MRI review shown in Fig. 8B showed partial resorption of the L4/L5 type huge disc herniation. The patient was followed up 18 months later, and the symptoms of lumbago and leg pain were completely resolved, with a straight leg elevation test result of 80° (-) on the left side and 90° (-) on the right side, and a JOA score of 26 points. The second MRI review shown in Fig. 8C showed that the L4/L5 herniated disc had disappeared, the bull's eye sign had disappeared on contrast-enhanced MRI, and the L5/S1 herniated disc was not changed from before.

Possible mechanisms for the resorption of intervertebral discs include the following.

(1) Phagocytosis of inflammatory cells: intervertebral disc herniation after chemical inflammation and vascular proliferation may contribute to mononuclear macrophage inflammatory cell infiltration and prominence and heavy this change more apparent, caused by inflammatory cells phagocytosis of the outstanding intervertebral disc tissue absorption [8]. Kobayashi et al. [26] performed light and electron microscopy observations on disc herniation tissues from 73 patients undergoing lumbar disc herniation surgery, and found that new microvessels grew around the intervertebral disc tissue that entered the

epidural space, with there also being local inflammatory reactions and high infiltration of macrophages at the same time. Tsuru et al. [27] observed human intervertebral disc surgical specimens at the cell level with electron microscopy, and found a large number of infiltrated macrophages in the herniated intervertebral disc tissue. They believed that these infiltrating macrophages were the mechanism for the spontaneous resorption of the herniated disc, with there being fragments of intervertebral disc tissue present. Minamide et al. [28] studied the resorption of intervertebral disc herniation in rabbits, and found that when the nucleus pulposus was free in the spinal canal, peripheral capillary proliferation increased, accompanied by infiltration of macrophages, lymphocytes, and fibroblasts.

(2) The body's own immune function: in free, after longitudinal ligament, protrusions longitudinal ligament into epidural, worn out after exposure to blood circulation of intervertebral disc tissue to become the body of the antigen, which can lead to autoimmune reaction, and the resulting autoantibodies or self-sensitization lymphocyte immune to outstanding intervertebral disc tissue dissolution [8]. Through the immunohistochemical staining of specimens from 49 cases of lumbar disc herniation, Arai et al. [29] found that the inflammatory cell infiltration at the site of disc herniation comes mainly from T lymphocytes and macrophages, which play an important role in the resorption of disc herniation. It is suggested [30] that antigens and antibodies in the medullary nucleus form immune complexes to activate complement, attracting inflammatory cells such as neutrophils that produce inflammatory transmitters, thereby causing local inflammation. Inflammatory transmitters can increase vascular permeability, promote macrophage phagocytosis of antigen and antibody complexes, release lysosomal proteases, break down proteoglycan, break collagen balance, degrade collagen molecules, and make the fiber ring crack and fracture. All these processes have specific effects on lumbar disc resorption. As an immune response develops, the rapid cellular immune response is weakened or even disappears, whereas the delayed humoral immune response is gradually strengthened until the antigens are completely digested and decomposed.

(3) Growth of new blood vessels: vascularization is a very important indicator of resorption of herniated disc tissue, and the presence and progression of vascularization is greatly related to the degree of reduction of the absorption of the protrusion and the prognosis [31]. Grang et al. [32] found that 57% of large and free herniated tissues had capillary infiltration, a rate much higher than that found in other types of herniated disc tissues. In addition, vascular endothelial growth factor, an important vascular growth stimulator, can induce the growth of new capillaries from the edge of the intervertebral disc and promote resorption. Toru et al. [33] analyzed macrophages produced by rat tail discs, studying interleukin 1 (IL 1), vascular endothelial growth factor (VEGF), and expression of matrix metalloproteinases (MMPs) in the role of intervertebral disc heavy absorption, and found they were all positively expressed in the intervertebral disc, under the condition of women within the intervertebral disc tissue to form the new blood vessels, IL - 1, VEGF, MMPs further contribute to the formation of new blood vessels, heavy absorption. It can be seen that herniated intervertebral disc has the possibility of resorption and shrinkage after making contact with tissue with an abundant blood supply, and that the nucleus pulposus tends to shrink or disappear.

(4) Degradation imbalance of matrix metalloproteinases (MMPs): recent studies have shown that disc herniation is closely related to matrix metabolism imbalance, with matrix metalloproteinases (MMPs) and tissue inhibitors of matrixmetalloproteinase (TIMPs) playing important roles [34]. Le Maitre et al. [35] found that the MMP-3-positive cell rate in tissue from human herniated discs was significantly higher than that in a normal control group, and that it was closely related to the degree of herniation. Haro [5] 36 etc by reverse transcription polymerase chain reaction (PT - PCR) technology to find the chondrocytes culture alone makes a small amount of MMP-3, macrophages and cultivate the expression of MMP-3 increased significantly after, MMP-3 in addition to direct degradation of protein, polysaccharide, also induced macrophage chemotactic factor, may be the intervertebral disc cells express monocytes chemical affect protein 1 (MCP 1), make the protein dissolved macrophage infiltration in the activity, lead to highlight the absorption of intervertebral disc tissue. Iwabuchi et al. [38] used low-intensity pulsed ultrasound to stimulate rat intervertebral disc tissue in vitro, and found that it increased the content of MMP-3 and promoted the absorption of intervertebral disc tissue.

(5) The involvement of various cytokines: Interleukin-1 (IL-1) is a common inflammatory factor that shows high activity in herniated disc tissue [39]. Yoshida et al. [40] suggested that at the time of intervertebral disc herniation, intervertebral disc tissue cells begin to produce pre-inflammatory factors such as tumor necrosis factor (TNF-) and IL-1. The transfer of these cytokines from the intracellular to extracellular environment leads to the accumulation of macrophages in the herniated disc, and the material in the disc is gradually absorbed because of the strong phagocytic activity of the aggregated macrophages and the neutral metalloproteinases released by them. Tumor necrosis factor TNF-A can stimulate cytokine secretion, promote macrophage aggregation, play a strong role in phagocytic activity, release a large amount of interleukin, and absorb the herniated intervertebral disc tissue. TNF alpha is an important component of inflammation; it can strengthen the function of neutrophils and eosinophils, directly affect nerves and blood vessels, and stimulate cells to produce other pathogenic substances that also effect inflammatory cells and the organization of the nerve sheath cells, thereby leading to more TNF alpha generation and promoting heavy absorption of outstanding intervertebral disc.

Conclusions

After conservative treatment, the protrusion of a giant lumbar disc herniation can shrink or even disappear. Conservative treatment is preferred for giant disc herniation without progressive motor nerve injury or cauda equina syndrome. Annular enhancement around the herniated disc (the bull's eye sign) on contrast-enhanced MRI and Iwabuchi type 1 were important imaging predictors for resorption.

Abbreviations

MRI = magnetic resonance imaging, CT = computed tomography, SLRT = straight leg raising test, TCM = traditional Chinese medicine, RR = resorption rate, IL = interleukin, VEGF = vascular endothelial growth factor, MMPs = matrix metalloproteinases, TIMPs = tissue inhibitors of matrixmetalloproteinase, PT - PCR

= reverse transcription polymerase chain reaction, MCP = monocytes chemical affect protein, TNF = tumor necrosis factor.

Declarations

Ethics approval and consent to participate

The Ethics Committee of Suzhou Hospital of Traditional Chinese Medicine approved the study under the number 2020-LYP-034. All patients gave written informed consent prior to participation. For those participants who were children (under 16 years old), written informed consent was obtained from their parent or guardian.

Consent for publications

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

PY contributed to the statistical analysis and drafting of the manuscript; QF is responsible for the assessments made, data collection, and data review; YD performed statistical analysis and assisted with writing the manuscript; LW assisted with drafting the manuscript; XS contributed to drafting, editing, and formatting the manuscript; HJ contributed to drafting, editing of the manuscript, and performed the data review. All authors read and approved the final manuscript.

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Figures

Figure 1

MRI measurement of the protrusion percentage

Figure 1

MRI measurement of the protrusion percentage

--- L
L was set as a reference line on the anterior wall of the spinal canal and the back of the disc

a is the area of the projection

b is the spinal canal area

Figure 2

Diagram explaining the calculation of the percentage of the maximum bedding area of the protrusion in respect to the corresponding spinal canal area.

Figure 2

Diagram explaining the calculation of the percentage of the maximum bedding area of the protrusion in respect to the corresponding spinal canal area.

Figure 3

Figure 3

Komori improved typing

Figure 4

MSU is differentiated

Figure 4

MSU is differentiated

Type 1 (T1 equal signal, T2 high signal)

Type 2 (T1 equal signal, T2 equal signal)

Type 3 (T1 high signal, T2 high signal)

Type 4 (T1 high signal, T2 equal signal)

Type 5 (T1 low signal, T2 equal signal)

Figure 5

Signal intensity typing of Iwabuchi MRI protrusions

Type 1 (T1 equal signal, T2 high signal)

Type 2 (T1 equal signal, T2 equal signal)

Type 3 (T1 high signal, T2 high signal)

Type 4 (T1 high signal, T2 equal signal)

Type 5 (T1 low signal, T2 equal signal)

Figure 5

Signal intensity typing of Iwabuchi MRI protrusions

Figure 6

Circumferential enhancement around sagittal, coronal, and axial protrusions ("bull's eye" sign)

Figure 6

Circumferential enhancement around sagittal, coronal, and axial protrusions ("bull's eye" sign)

Type I Modic changes (T1 low signal, T2 high signal)

Type II Modic changes (T1 high signal, T2 high signal)

Type III Modic changes (T1 low signal, T2 low signal)

Figure 7

Modified Modic typing

Type I Modic changes (T1 low signal, T2 high signal)

Type II Modic changes (T1 high signal, T2 high signal)

Type III Modic changes (T1 low signal, T2 low signal)

Figure 7

Modified Modic typing

Figure 8

The L4/L5 herniated disc was reabsorbed, whereas the L5/S1 disc did not change

Figure 8

The L4/L5 herniated disc was reabsorbed, whereas the L5/S1 disc did not change