The Essence of Clinical Practice Guidelines for Lumbar Disc Herniation, 2021: 2. Pathological Condition

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Pathogenic Mechanism of Lumbar Disc Herniation

Summary

- Lumbar disc herniation occurs relatively less frequently in childhood and in elderly people.
- Upper lumbar discs are often affected in elderly people, while lower lumbar discs are often affected in children, as in adults.
- Various patient background factors have been reported as onset risks for herniation, but it remains to be clarified whether these factors are directly involved in the pathogenic mechanism.

Commentary

The pathogenic mechanism of lumbar disc herniation largely remains unclear, and there may be differences in the pathogenic mechanism and affected intervertebral level particularly between children and elderly people. Here, we discuss differences in the pathogenic mechanism depending on age and patient background.

a. Age-associated differences

Studies have shown that the incidence and affected level differ depending on patient age, suggesting age-associated variations in the pathogenic mechanism. The incidence of upper lumbar disc herniation increases with age. A study investigating histological differences between removed herniated discs reported that the number of cases of hernias containing cartilage endplates increased with age; cartilage endplates were found in 70% of patients in their 60s and 80% of patients over 70 years of age[1].

b. Onset risk associated with different patient background factors

Abnormally large lumbar intervertebral disc mobility has been reported to be a risk for the development of herniation because general joint laxity was observed in 13.2% of hernia patients and this rate was significantly higher than 5.1% in the control group[2]. Lumbar facet joint asymmetry has been reported to be[3] and not to be[4] a risk factor.

Size and Clinical Symptoms of Lumbar Disc Herniation

Summary

- The size and shape of lumbar disc herniation often correlate with leg pain and neurological symptoms. However, this is not always the case.

Commentary

Advances in diagnostic imaging have brought about improved understanding of the morphology of lumbar disc herniation compared with earlier. Here, we review the relationship between morphology and clinical symptoms of herniation based on the relationship with spinal canal occupation ratio and classification of herniation.

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a. Relationship between spinal canal occupation ratio and clinical symptoms

Three methods are available to measure the ratio of the lumbar disc herniation size to the spinal canal size: area ratio, product ratio of lateral diameter × anterior-posterior diameter, and anterior-posterior diameter ratio using CT. Regardless of the method used, the measured ratios have been shown to have tight positive correlations with the intensity of buttock/leg pain[5]. The results of a survey of 298 lumbar disc herniation patients aged ≤60 years have shown that the severity of lower limb muscle weakness increased with the spinal canal occupation ratio of herniation, and the incidence reached 80% when the occupation ratio was greater than 50%[6].

b. Relationship between hernia classification and clinical symptoms

Among different types of lumbar disc herniation, the extrusion and sequestration types have been reported to be associated with a higher SLRT-positive rate and an increased severity of motor/sensory disturbance in the damaged nerve root region compared with the protrusion type[7].

Environmental Factors That Affect the Development of Lumbar Disc Herniation

Summary

- There are some reports on occupations posing a risk.
- Regarding the effects of smoking, smokers have been reported to be at an increased risk for herniation.
- Many environmental factors associated with hernia patients have been reported; however, no factors other than smoking have been demonstrated to have a clear association.

Commentary

Lumbar disc herniation is a multifactorial illness, and environmental factors are among the important ones. Here, we review related occupations, effects of smoking, and other factors.

a. Effects of occupations

Reported risk factors include helicopter pilot[8], astronaut[9], medical doctors and other healthcare professionals[10], and occupational exposure to whole-body vibration[11] as well as a time-constraint work environment[12].

b. Effects of smoking

Regarding the relationship between smoking and the development of lumbar disc herniation, a systematic review has shown that the relative risk of smokers was 1.27; both male and female smokers have a significantly increased risk for lumbar disc herniation.

Genetic Factors That Affect the Development of Lumbar Disc Herniation

Summary

- Familial aggregation has been detected to be associated with the occurrence of lumbar disc herniation, and differences in disease susceptibility genes among races have been reported recently.
- The involvement of genes of type IX and XI collagen, cartilage intermediate layer protein, thrombospondin, and matrix metalloproteinase (MMP)-9 has been reported previously; various disease susceptibility genes have been reported recently.
- Recently, genetic polymorphisms associated with hernia pain have also been reported.

Commentary

Young patients with lumbar disc herniation are known to show particularly high familial aggregation, and studies in twins have shown frequent simultaneous onset. Here, we review the results of studies on genetic background factors in patients with lumbar disc herniation (excluding intervertebral disc degeneration and stenosis).

a. Hereditability of hernias

Previous studies have reported familial occurrence of lumbar disc herniation[13-15], and familial aggregation is considered particularly clear for intervertebral disc herniation in young patients. A twin study reported that the onset of intervertebral disc herniation in a twin is associated with a 10-fold increase in the onset risk in the other twin[16]. A recent study that surveyed 1,264 cases of lumbar disc herniation in Utah, U.S.A., suggested familial aggregation[17].

b. Disease susceptibility genes of herniation

Many disease susceptibility genes have been reported from multiple races, such as South Korean, Chinese, and Caucasians, and differences and homologies among races have been shown. While these genes are not directly involved in the onset of herniation, they are mentioned here because they can cause persisting pain and thus interfere with daily life.

In the present revision, we focused on reports on disease susceptibility genes of lumbar disc herniation; however, other factors such as intervertebral disc degeneration[18], spinal stenosis, abnormal spinal curvature, and environmental factors are likely to be involved in the pathogenesis of intervertebral disc herniation. Future studies are expected to identify genes that have clear effects on the development of lumbar disc herniation and reveal the pathogenic mechanisms.

Resorption Mechanism of Lumbar Disc Herniation

Summary

・Cytokines released from macrophages, such as TNF-α, and factors, such as MMP and vascular endothelial growth factor (VEGF), are considered to play a role in the mechanism of hernia regression.

Commentary

We reviewed the resorption mechanism of lumbar disc herniation.

A systematic review of reports on the regression mechanism of herniation suggested the following regression mechanism. First, MMP-7 induces the release of the inflammation cytokine TNF-α from macrophages. TNF-α, via nuclear factor-kappa B (NF-κB), tumor necrosis factor-like weak inducer of apoptosis (TWEAK)[19], and thymic stromal lymphopoietin, increases the expression levels of the matrix degrading enzyme MMP-3 and the macrophage migration enhancer monocyte chemotactic protein 1 (MCP-1). Macrophages migrate toward the extruded herniated mass; matrix degrading enzymes, such as MMP-3, and VEGF promote neovascularization; and spontaneous resorption of herniation occurs[20].

Conflicts of Interest: The author declares that there are no relevant conflicts of interest.

The original version of these clinical practice guidelines appeared in Japanese as Yotsui Tsuikanban Hernia Shinryo Guidelines 2021, and its translated version in English was published in the Journal of Orthopaedic Science: Japanese Orthopaedic Association (JOA) clinical practice guidelines on the management of lumbar disc herniation, third edition. 2022;27(1): 31-78.

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