The Degenerated Lumbar Intervertebral Disc is Innervated Primarily by Peptide-Containing Sensory Nerve Fibers in Humans

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FROM ABSTRACT

Study Design. Immunohistochemical study of the sensory innervation of the human lumbar intervertebral disc.

Objective. To determine the type of sensory fibers innervating human degenerated lumbar intervertebral discs.

Summary of Background Data.
The character of sensory neurons in human discs has not been clarified.

Methods.
A degenerated, painful lumbar intervertebral disc was harvested from each of 8 patients during surgery.

Sections were immunostained for [neuro-filament proteins].

Results.
Pain neurons fibers were observed in all discs.

Conclusions.
Almost all of the nociceptive nerve fibers in the human intervertebral disc are related to inflammation and transmit pain originating from human degenerated intervertebral discs. **[Very Important]**

THESE AUTHORS ALSO NOTE:

"The lumbar intervertebral disc is a possible source of low back pain."

"Many investigators have reported the existence of sensory nerve fibers in the intervertebral discs of animals and humans, suggesting that the intervertebral disc can be a source of low back pain." **[Important]**

"The L4-L5 and L5-S1 intervertebral discs are the most common sources of discogenic low back pain."

Pain can be transmitted by sensory neurons related to inflammation. These sensory neurons are small-sized, peptide-containing neurons immunoreactive for substance P (SP) and calcitonin gene-related peptide (CGRP).

In this study, an intervertebral disc was obtained from each of 8 patients, 21 to 45 years of age during anterior discectomy for discogenic low back pain.

The authors defined the one-third portion from the outside of the anulus of the intervertebral disc to the outer layer and the two-thirds portion from the inside of the anulus to the inner layer.

DISCUSSION

Half of the nerve fibers documented in this human study "are involved in sympathetic function or proprioception from the intervertebral disc." **[Important]**

[The other half apparently have a nociceptive function].

"Sympathetic nerve fibers have been reported in association with vessels of intervertebral discs" **[Very Important]**

The nerve fibers in the disc, found in this study, "indicates that the disc can be a source of pain sensation." **[Very Important]**

"Sensory nerve fibers have been reported to exist only in the superficial and outer layers of the normal anulus in animals and humans. However, in the present study, nerve fibers were observed in both the inner and outer layers of the anulus."

"The mechanism of nerve ingrowth has not been clarified, although it is reported that nerve fibers accompanying granulation tissue were observed in the inner layers of degenerated discs from patients with chronic low back pain."

Inflammatory mediators are expressed in degenerated intervertebral discs, and intervertebral disc inflammation promotes neuronal axonal ingrowth into inner layers of the disc. **[Very Important]**

The pain sensory nerve fibers found in the disc in this study are dependent on nerve-growth-factor (NGF), "which is synthesized in inflamed tissue." **[Important]**

Therefore, the inflammatory mediators in the disc may promote pain neuronal axonal ingrowth and explain the mechanism of nerve ingrowth into the inner anulus.

"Considering previous reports and our present study, ingrowth of sensory nerve fibers could be closely related to the pathogenesis of discogenic low back pain."

These authors propose that the nociceptive information from the lumbar disc may be transmitted mainly by small sensory neurons associated with inflammation.

Chronic pain derived from tissue inflammation has been associated with NGF-dependent neurons.

CONCLUSIONS

The human intervertebral disc is innervated by pain nerve fibers that depend on NGF and tissue inflammation.

KEY POINTS FROM AUTHORS:

1) Both inner and outer layers of the degenerated lumbar intervertebral disc are innervated by pain sensory nerve fibers in humans.

2) Nociceptive information from the human intervertebral disc is transmitted primarily by small sensory neurons associated with inflammatory pain.

KEY POINTS FROM DAN MURPHY

1) Immunohistochemical analysis is the best method to identify the presence of neuro-filament proteins.

2) "Many investigators have reported the existence of sensory nerve fibers in the intervertebral discs of animals and humans, suggesting that the intervertebral disc can be a source of low back pain." **[Important]**

3) Pain neuron fibers are found in all human discs that have been removed because they are the source of a patient's chronic low back pain.

4) The nerve fibers in the disc, found in this study, "indicates that the disc can be a source of pain sensation." **[Very Important]**

5) "In the present study, nerve fibers were observed in both the inner and outer layers of the anulus."

6) "The L4-L5 and L5-S1 intervertebral discs are the most common sources of discogenic low back pain."

7) Human discs are also innervated with nerve fibers that "are involved in sympathetic function." **[Very Important]**

8) Human discs are also innervated with nerve fibers that "are involved in proprioception." **[Very Important]**

9) Disc nerve ingrowth accompanies granulation tissue.

10) Degenerated intervertebral discs express inflammatory mediators.

11) Intervertebral disc inflammation promotes neuronal axonal ingrowth into inner layers of the disc. **[Very Important]**

12) Inflammatory mediators in the disc may promote pain neuronal axonal ingrowth and explain the mechanism of nerve ingrowth into the inner anulus.

13) "Considering previous reports and our present study, ingrowth of sensory nerve fibers could be closely related to the pathogenesis of discogenic low back pain."

14) Pain from the lumbar disc is transmitted mainly by sensory neurons associated with inflammation.

15) Both inner and outer layers of the degenerated lumbar intervertebral disc are innervated by pain sensory nerve fibers in humans.

16) Nociceptive information from the human intervertebral disc is transmitted primarily by small sensory neurons associated with inflammatory pain.

THIS ARTICLE SUGGESTS THE FOLLOWING MODEL FOR CHRONIC LOW BACK PAIN:

1) The intervertebral disc degenerates.

2) Disc degeneration initiates an inflammatory cascade. This inflammation does the following:

A)) Inflammatory mediators promote the ingrowth of nerve fibers into deeper regions of the annulus.

B)) Inflammation sensitizes and fires local disc nociceptors.

COMMENTS BT DAN MURPHY

1) It is chiropractically clinically relevant that the disc is innervated with nociceptors, because they cause chronic pain.

2) It is chiropractically clinically relevant that the disc is innervated by proprioceptors, as this is an important aspect of the chiropractic complex.

3) It is clinically relevant that the disc is innervated by the sympathetic nervous system, as it helps explain how the subluxation can have visceral manifestations and how the spinal adjustment can influence visceral function.

4) This article underscores the importance in treating inflammation in those suffering from chronic low back pain, i.e. omega-3 essential fatty acids.