REVIEW

Innervation of the Thoracolumbar Fascia and its Relationship to Lower Back Pain

Kiyrie Simons[1], Aaron Rapp[1,2], Emre Yilmaz[1], Dia Radi Halalmeh[4], Marc D. Moisi[1,3]

[1]Seattle Science Foundation Seattle, WA
[2]St Joseph Mercy Oakland Department of Surgery, Pontiac, MI
[3]Wayne State University, Department of Neurological Surgery, Detroit, MI
[4]University of Jordan, Department of Neurological Surgery Amman, Jordan

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ABSTRACT

Low back pain is a common disorder treated by physicians on a daily basis. The cause of this pain is often difficult to diagnose specifically when radiological and clinical findings are negative. The thoracolumbar fascia has been proposed as a potential source of the chronic pain these patients experience (Wilkes et al., 2017). Herein we review the literature on the innervation of the thoracolumbar fascia. Using both Web of Science and PubMed, 300 articles were initially identified, a final five being chosen for inclusion. We found this fascia to be a possible source of the pain experienced by these patients. Further research into the thoracolumbar fascia could help to establish superior treatment modalities and improve the quality of life for patients with chronic lower back pain. The Spine Scholar 1:19-21, 2018

INTRODUCTION

Chronic lower back pain can be defined as intense pain, inflammation, swelling and loss of function over an extended period of time in the area surrounding the L1-L5 vertebrae (the lumbar region of the spine). Current speculations about the etiology of chronic lower back pain place it in the thoracolumbar fascia. More specifically, the etiology points to the histological innervations of this particular fascia. There is significant data supporting the attribution of lower back pain to microinjuries in the innervations of the thoracolumbar fascia, and to the nerve structure and physiology of said innervations (Wilkes et al., 2017).

A fascia is defined as “connective tissue composed of irregularly arranged collagen fibers” (Willard et al., 2012). The manner in which the fascia is packaged enables it to resist tension and succumb to pressure forces. The thoracolumbar fascia is unique in that it is built from aponeurotic and fascial planes united around the paraspinal muscles (Willard et al., 2012). The primary role of the lumbosacral spine in the human body is to maintain posture, which aids in activities such as sitting, standing, walking, etc. However, regardless of the strength of the lumbosacral spine, it is improbable that the spine alone could accomplish this task (Willard et al., 2012). Considering the established definition of fascia, the thoracolumbar fascia is packaged so as to help in stabilizing the components of the lower spine.

The aim of this review is to examine the types of innervation of this particular fascia explored in primary and secondary research, and to speculate about the cause (on a histological level) of back pain. It is proposed on the basis of evidence concerning the thoracolumbar fascia in the recent literature that the innervation and its biomechanical pathways induced by chemical and electrical stimuli are responsible for chronic lower back pain.

MATERIALS AND METHODS

Using both the *Web of Science* search engine and *PubMed* and the keywords ‘*innveration fascia*’ and ‘*thoracolumbar fascia innervation*’, over 300 published documents were found. Exclusion criteria included publications

relating to the anatomy of non-human species, innervations of sections of the body other than the lumbar spine, and papers focusing on the fascia of other muscles. Article abstracts were reviewed for relevance and potential inclusion.

RESULTS

Of the 300 publications initially identified, five were chosen for inclusion based on thoroughness of etiological research of lower back pain. These comprised anatomical reviews relating directly to the innervations of the thoracolumbar fascia, experiments performed using chemical and electric stimulation, and anatomical comparisons between human and other mammalian (rat) innervations in the thoracolumbar spine.

DISCUSSION

There are many known causes of low back pain such as spinal deformities, ruptured intervertebral disks, and degenerative and arthritic changes in the spine. Treatment for patients with low back pain becomes difficult when there are few clinical or radiological findings to aid in the diagnosis. The thoracolumbar fascia is a likely source of the pain these patients experience (Wilkes et al., 2017). Consideration of this fascia as the source of the pain provides potential answers for the patient and opens the possibility of devising new solutions for treatment (Wilkes et al., 2017). This hypothesis could also provide further explanations for the effectiveness of some current treatments. For example, physical therapy, massage and heating pads could derive their benefits by treating the pain originating from the thoracolumbar fascia.

The chronic pain from the thoracolumbar fascia can be idiopathic, from micro-injuries, or inflammation (Wilkes et al., 2017); however, the fascia could also be the source of persistent back pain after spine surgery. Some patients will have persistent back pain after fully recovering from such surgery. This pain is often different in nature from the symptoms prior to surgery, possibly arising from scar tissue or persistent inflammation in the thoracolumbar fascia (Wilkes et al., 2017). This consideration further promotes the use of minimally invasive spine surgery in place of the more traditional approaches requiring extensive muscle and fascia dissection. The approach to surgery can have other potential implications. Patients who undergo extreme lateral and anterior spine surgeries do not have the same chronic back pain as those who undergo traditional posterior spine surgery. The difference in the characteristics of pain in these patients provides further support for the hypothesis.

Innervation of the Thoracolumbar Fascia: Embryonic Development and Nociception

The thoracolumbar fascia (TLF) is innervated from both the dorsal and ventral rami, part of the dorsal horn (posterior grey column). The dorsal ramus innervates the expaxial muscles posterior to the vertebral septum, and the ventral ramus innervates the hypaxial muscles anterior to it. The thoracolumbar fascia is divided into three layers: anterior, middle and posterior (Willard et al., 2012). During embryonic development, the hypaxial compartment develops into the posterior abdominal muscles and related structures, and the epaxial compartment into the posterior muscles such as the erector spinae. As seen in the article by Willard et al., the thoracolumbar fascia begins to be innervated during embryonic development from the rami.

The TLF contains CGRP-producing sensory nerve fibers (Tesarz et al., 2011). These fibers are nociceptive and could be the primary factor in generating lower back pain. The thoracolumbar fascia is innervated with these fibers, but they are less concentrated than the PGP 9.5-ir fibers and TH-ir fibers. The TH-ir fibers undergo vasomotor processes because of the proximity of vascular structures, which in turn can lead to pain (Tesarz et al., 2011). It can be speculated that simultaneous activation of these nerves over a long period can contribute to or lead to chronic lower back pain.

Electrical and Chemical Stimulation of the Thoracolumbar Fascia

The nociceptive potential of the thoracolumbar fascia can be deduced from the observations. Other nociceptive nerves were also found. A- and C-nociceptive fibers were found after a hypertonic saline stimulus was applied (Schilder et al., 2014). An experiment by Schilder et al. in which volunteers were subjected to saline injections and reported degrees of pain implicates these fibers and the importance of the thoracolumbar fascia's contribution to lower back pain. According to Schilder et al., the overlying fascia in the thoracolumbar spine was more susceptible to the stimulation than the underlying muscles of the hypaxial compartment of the back such as the erector spinae.
To confirm the nociceptive potential of the thoracolumbar fascia, another experiment was performed by Schilder et al. (2016). This experiment revolved around high frequency stimulation (HFS) using electrical instead of chemical stimuli. It revealed that patients experienced lower pain thresholds for the fascia than the underlying muscle tissue (Schilder et al., 2016). This is probably due to the heavy innervation by nociceptive nerve fibers. In other words, it seems the fascia can evoke pain to a higher degree than the underlying muscles; although in view of their sheer volume, as

mentioned by Schilder et al. (2016), pain from those muscles should not be completely excluded as a contributor to lower back pain.

CONCLUSION

It is evident on the basis of the data obtained from these publications that the thoracolumbar spine is a dense aponeurosis receiving large amounts of nerve reception from the dorsal horn neurons, from which the dorsal and ventral rami are formed. All the publications confirm the heavily nociceptive nature of the thoracolumbar fascia, implying that it is more sensitive to different kinds of stimulation than the underlying muscle. In conclusion, the thoracolumbar fascia is most relevant to chronic lower back pain, although the underlying muscles such as the erector spinae should not be excluded as contributors to this condition. Understanding this component of the lower spine is critical for treating patients with chronic lower back pain. Future research will be concerned with understanding the different patterns of innervation of the thoracolumbar spine, pressure pain in the lumbar spine, and pain allocation.

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Corresponding author: Aaron Rapp, aarapp@gmail.com