An Anatomical and Clinical Investigation of Spinal Meningeal Nerves

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Summary

Anatomical studies on nerve roots obtained from autopsied subjects indicated that meningeal innervations of the dura surrounding spinal nerves are more numerous in the lumbar and cervical regions. They are most abundant near the surface of the dura, and on the ventral, lateral and ventro-lateral aspects of the spinal nerve root dura.

A denervation procedure was conceived and carried out on 28 patients, 8 of which were failed discs. The results indicated that these nerves subserve the function of pain and their denervation may ameliorate such pain.

Introduction

The existence of spinal nerve root dural meningeal nerves as anatomical entities, was first described by Luschka. The term sinu-vertebral nerve was used. Further elucidation and confirmation were made by others. These nerves were found to have dual origins: from the dorsal root ganglia and the sympathetic chain via the gray rami communicantes. They then form twigs numbering anywhere from 2 to 6, re-enter the spine through the intervertebral foramen, coursing along either the ventral or ventro-lateral aspects of the dural coverings of the nerve roots to supply the epidural tissues including blood vessels, annulus fibrosus, posterior longitudinal ligaments, the bony components of the vertebrae, facet joints and also the spinal dura. Though discounted by some, others including ourselves, have demonstrated that these nerves pierce the dural sheath of the spinal nerves to supply them. The controversy about denervation of the facet joints for back pain, though it failed to establish a cure, definitely indicates that the nerves to these joints have a pain function. Our interest as to the function of these meningeal nerves supplying the dural coverings of the spinal nerves was aroused when we observed the complete absence of pain in patients who had an accidental tear of the spinal nerve dura following difficult disc operations. In launching the current study we were surprised that Mahdi et al. had the same idea and concept. Based on clinical investigations, they demonstrated that irritation of these nerves with hypertonic saline caused not only back pain and stiffness, but also radicular pain, an exact reproduction of the sciatic pain that the patient had preoperatively. Instillation of a topical anesthetic agent would alleviate the pain and stiffness. They also postulated that epidural blocks merely act on these meningeal nerves and not the intra-dural spinal nerves. The following studies were launched to establish two sets of facts:

1. The anatomy of these meningeal nerves to and in the spinal nerve dura. germane to this would be the location of these nerve endings across the dural sheath, whether superficial or deep-lying, the number of these nerves with special reference to the specific nerve roots, for example cervical and lumbar roots, versus other roots, and the question of quantitative innervation on the dorsal, ventral, lateral or medial aspects of the roots.

2. The physiology and function of these nerves. Along this line a denervation procedure was conceived and executed as the best approach for both a testing and therapeutic modality. By doing this procedure we simultaneously determine the functional status with respect to pain and the efficacy of such a procedure.
Materials and Methods

Anatomical Studies

To avoid repetition of anatomical studies exhaustively done by others and described under Introduction, we elected to concentrate on those meningeal nerve strands on the surface and in the dura of spinal nerves. 61 nerve roots were obtained from 8 autopsied subjects. These patients had diseases unrelated to nerve root abnormalities. The nerve roots were obtained with their intact dural sheaths. They measured approximately 3 cm in length. They were sectioned from the attachment of the thecal sac and actually included part of the thecal sac, to just past the dorsal root ganglion. They were fixed in formalin solution and were stained with H & E and supplemented with Bielschowsky's stain. Longitudinal and cross sections were made at the center and the proximal and distal portions. Meningeal nerves intradurally and also at the immediate epidural regions were identified and counted quantitatively. The spinal nerves removed were from C5 to C7, most of the thoracic nerves and L1 to S1. Figs. 2 and 3 are photomicrographs of such postmortem sections with the arrows pointing to the neural structures. These were seen at a magnification of ×100, confirming the fact that these are extremely small nerves. Hence at a surgical magnification of ×24, it is difficult to differentiate nerve strands from fibrous tissue strands. The average counts are shown on Table 1. Three surgical biopsied samples were also obtained to confirm that they were in fact meningeal nerves.

Thus, there seem to be more such nerves in the lumbar and