ABSTRACT The etiology and underlying mechanisms of essential hypertension remain unclear. A neurological theory of hypertension has previously been published and recent reports have demonstrated that the sympathetic nervous system plays an important role in the pathophysiology of essential hypertension. In our clinical practice, we have found that patients with cervical spondylotic myelopathy (CSM) often suffer from uncontrolled hypertension. The authors have also observed that previously hypertensive patients with CSM may become normotensive following decompressive cervical surgery, with some patients no longer requiring antihypertensive medications. We hypothesize that there is a relationship between CSM and hypertension, probably a cause/effect relationship, and we term this type of hypertension “cervicogenic hypertension”.

INTRODUCTION Cervical spondylotic myelopathy (CSM) and hypertension are both very common diseases in the general population. This paper derives from the clinical observation made by us that patients with CSM often have uncontrolled hypertension. We have also observed previously hypertensive patients with CSM become normotensive following decompressive cervical surgery and no longer need antihypertensive medications. Both observations are difficult to explain according to current theories of the two diseases.

A neurological theory of hypertension has previously been published, the idea being that abnormally functioning serotonergic pacemaker cells in the dorsal raphe nucleus inaccurately activate and inhibit parts of the central and autonomic nervous systems as part of a chronic stress response, which causes hypertension and migraine. This theory is now being expanded to encompass both CSM and essential hypertension, the idea being that these two conditions are intimately related. The theory will be stated and its various features discussed.

HYPOTHESIS There is a relationship between CSM and hypertension, probably a cause/effect relationship, and we term this type of hypertension “cervicogenic hypertension”.

Evaluation of the Hypothesis

The Etiology of Essential Hypertension

Although several theories exist regarding the pathogenesis of essential hypertension, the etiology and underlying mechanisms of essential hypertension still remain unclear. Arteriosclerosis has long been regarded as the main factor of essential hypertension. Recently, some reports have demonstrated that the sympathetic nervous system plays an important role in the pathophysiology of essential hypertension. Grassi stated that the increase in circulating norepinephrine in hypertension mainly originates from a “true” increase in central sympathetic neural outflow. In our clinical practice and our study, we found that following decompressive cervical surgery, the blood pressure of 15 hypertensive patients out of 35 (43%) decreased to normal (average preoperative blood pressure: 162/94 mmHg; average postoperative blood pressure: 132/85 mmHg) and anti-hypertensive medications were no longer needed. Furthermore, the blood pressure of another 12 patients with uncontrolled hypertension preoperatively became stable and controlled after decompressive cervical surgery (average preoperative blood pressure: 171/97 mmHg; postoperative blood pressure: 144/86 mmHg). The blood pressure data are presented as average early morning values within a week before or after surgery. At each time, the blood pressure was measured twice by the nursing staff of our department and the mean value was documented.
If there was more than a 10% difference between the two measurements at each time, then a third measurement was performed by the head nurse of our department. A similar phenomenon of blood pressure changes was reported by Pan and colleagues following chiropractic maneuvers for the treatment of cervical spondylosis, although this was not accompanied by statistical data. This phenomenon suggests that a relationship exists between CSM and hypertension. We believe this phenomenon is not coincidental and can be attributed to activation of the sympathetic nervous system. Pan et al. reported 860 cases of essential hypertension that were confirmed to be accompanied by cervical spondylosis by plain radiographs, CT scans and MRIs. Hyperactivity of the sympathetic nervous system has been implicated in the pathogenesis of both essential hypertension and white-coat hypertension. In addition, autonomic dysreflexia is a compound clinical syndrome in patients with spinal cord injuries with lesions at the cervical spine or upper thoracic spine (above 6th thoracic level) and involves hypertension as a result of abnormal sympathetic initiation. 

**Pathogenesis of Essential Hypertension**

As already known, cervical pain may increase blood pressure; however, the current hypothesis refers to hypertension that is independent of cervical pain. Neurologic signs from the upper and lower extremities rather than pain in the cervical region or shoulder area are the main characteristics of CSM. A possible explanation of cervicogenic hypertension is the increase of sympathetic activity due to the chronic irritation of the dura or the posterior longitudinal ligament by osteoarthritic spurs or herniated intervertebral discs. It is well known that cervical spinal tissues are rich in sympathetic fibers. Yamada et al. reported that the cervical dura mater and the posterior longitudinal ligament have distinct sympathetic innervation patterns. Kiray et al. and Saylam et al. found that the cervical sympathetic trunk consists of a main trunk and 2-4 ganglia, which are located anterior to the transverse processes. These ganglia included superior, middle, inferior and vertebral ganglion. The vertebral ganglion and its fibers surround the vertebral artery. The cardiac sympathetic preganglionic neurons exit the spinal cord from T-1 to T-6 to form a synapse with cardiac sympathetic postganglionic neurons in the middle cervical ganglion and stellate ganglion. The postganglionic neurons of the sympathetic nervous system also form visceral nerves (e.g. cardiac nerves) and innervate blood vessels.
The incidence of cardiovascular abnormalities, including hypotension, is very common following acute spinal cord injuries, particularly after cervical injuries due to a sudden loss of sympathetic outflow. Therefore, we speculate that the compression or irritation of the dura mater and the posterior longitudinal ligament of the cervical spine may increase the sympathetic nervous activation. This discharge may pass through the ganglia and the sympathetic trunk to the postganglia fibers arriving at the target organ, such as the vertebral artery and the blood vessels, and subsequently induce hypertension (Fig 2). Decompressive cervical surgery, either anterior cervical discectomy and fusion or posterior laminoplasty, may withdraw any compression of the dura and the posterior longitudinal ligament and thus the sympathetic irritation will be relieved, leading to a decrease in blood pressure.

**THERAPEUTIC IMPLICATION OF THIS HYPOTHESIS**

The prediction can be made that treatment of CSM, including conservative therapy and decompressive surgery, will be effective in treating essential hypertension. We suggest that hypertensive patients in whom there is a suspicion of a cervical spine problem or a past injury involving the cervical spine should undergo routine radiological examinations of the cervical spine, including plain radiographs and MR and/or CT imaging to explore the causes of essential hypertension. If the diagnosis of CSM is confirmed, then conservative intervention of the cervical spine such as decompressive physical therapy (including neck muscle strengthening and cervical traction) will be the first choice while the patient is on antihypertensive medications. Stenosis of the cervical canal by disc bulging or ligament (posterior longitudinal, interlaminar) infolding could be decreased by intrinsic (cervical muscle strengthening) or extrinsic (cervical traction) cervical spine support methods. If hypertension remains uncontrolled, then the patient should be referred to the spine surgeon to decide if decompressive cervical surgery is necessary in treating hypertension and/or neurological symptoms.

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