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Relationship between the small cervical vertebral body and the morbidity of cervical spondylosis

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Abstract

This study aimed to determine the relationship between the size of the cervical vertebral body and the morbidity of cervical spondylosis, and to examine the characteristics of spondylosis patients with small cervical vertebral bodies.

The clinical data and the sagittal reconstructions of computed tomography images of 182 patients with cervical spondylosis were collected retrospectively. Patients included 74 males and 108 females, with a mean age of 31.8 years (range 20–40 years). The Torg–Pavlov ratio and the sagittal diameter of the vertebral body were measured. A Torg–Pavlov ratio above 1.2 was regarded as a small cervical vertebral body (SCVB), and below 1.2 as a nonsmall vertebral body (NSCVB).

The NSCVB group was more prone to neurological symptoms than was the SCVB group ($P < .05$). There was no significant difference in neck pain between the 2 groups ($P > .05$). Conservative treatment achieved similar recovery rates in the SCVB group and the NSCVB group (81.8% vs 93.6%; $P > .05$). The rate of symptom (eg, axial neck pain) recurrence and persistence in the SCVB group was significantly higher than in the NSCVB group ($P < .05$).

Our study found that smaller size of the cervical vertebral body is an attributing factor for cervical spondylosis. Patients with smaller cervical vertebral bodies are prone to persistent axial neck pain, but not neurological symptoms.

Abbreviations: CT = computed tomography, NSCVB = nonsmall vertebral body, SCVB = small cervical vertebral body, SDVB = sagittal diameter of the vertebral body, VAS = visual analogue scale.

Keywords: cervical spondylosis, cervical vertebral body, Torg–Pavlov ratio

1. Introduction

Cervical spondylosis is a very common arthritic disease. Patients with cervical spondylosis accompanied by spinal stenosis usually obtain more attention because they are more prone to neurological symptoms.[1] However, we have noticed that many patients with larger spinal canals (or larger Torg–Pavlov ratios) also are affected by cervical spondylosis. The relationship between the size of the cervical vertebral body and cervical spondylosis has not been examined previously. Therefore, our study aimed to determine the relationship between the size of the cervical vertebral body and the morbidity of cervical spondylosis, and to examine the characteristics of spondylosis patients with small cervical vertebral bodies.

2. Materials and methods

The study was approved by the Ethical Committee of Peking Union Medical College Hospital, Chinese Academy of Medical Sciences, and Peking Union Medical College (S-K295). The clinical data and the sagittal reconstructions of computed tomography (CT) images of 182 patients with cervical spondylosis were collected retrospectively. These patients were treated in the Outpatient Department of Peking Union Medical College Hospital, Chinese Academy of Medical Sciences, and Peking Union Medical College from January 2014 to September 2016. The patients included 74 males and 108 females, with a mean age of 31.8 years (range 20–40 years) (Table 1).

Diagnosis of cervical spondylosis was made based on the clinical symptoms of the patients (Table 2).[2] All symptoms of the patients lasted at least a month. Patients were divided into 3 main categories based on symptoms: neck pain only, neurological symptoms only, and both neck pain and neurological symptoms. The visual analog scale (VAS) was used to measure the severity of neck pain, which was classified as mild (VAS $\leq$3) or moderate to severe (VAS $>$3).

We carefully measured the Torg–Pavlov ratio and the sagittal diameter of the vertebral body (SDVB) on the sagittal reconstructions of the cervical spine CT images (PACs software, General Electric).[1] A Torg–Pavlov ratio above 1.2 was considered to indicate a small cervical vertebral body (SCVB), and a Torg–Pavlov ratio below 1.2 was considered to indicate a nonsmall vertebral body (NSCVB). Patients were excluded from our study if the vertebral body and the canal were too large (Torg–Pavlov ratio $\geq$1.2, SDVB: male $>$23.7 mm; female $>$21.2

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The authors report no conflicts of interest.

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Table 1

Demographical data of our patients.

	SCVB	NSCVB
Sex (M/F)	1/21	73/87*
Mean age	31.9±5.1	30.6±5.3
HTN	24	0
DM	9	0
HL	36	1
Smoking	36	3
Drinking	31	1
BMI, kg/m^2	22.7±2.6	22.8±2.1

BMI=body mass index, DM=diabetes mellitus, HL=hyperlipidemia, HTN=hypertension, NSCVB=nonsmall vertebral body, SCVB=small cervical vertebral body.
* $P<.05$.

mm) or too small (Torg–Pavlov ratio ≤0.8, SDVB: male <15.8 mm; female <14.1 mm).[1]

All patients received conservative treatments and were followed up for at least 3 months. The extent of patient recovery and recovery time were recorded. Three months after the first visit, the symptom recurrence or persistence also was observed. The Torg–Pavlov ratio (the sagittal diameter) was compared in patients with just neck pain and patients with just neurological symptoms.

Comparison of the continuous data was made using the Student *t* test, and that of the categorical data employed the Fisher exact test. All statistical analyses were accomplished using the IBM SPSS Statistics software (SPSS Statistics 23.0, SPSS Science). A *P* value less than .05 was regarded as statistically significant.

3. Results

There were no significant differences in age and sex between the SCVB and the NSCVB groups. Twenty-two patients (12.1%) had smaller cervical vertebral bodies and larger Torg–Pavlov ratios. No significant difference in neck pain between the 2 groups ($P>.05$) was observed.

Neurological symptoms were noticed in 29.7% of the patients (Table 3). The NSCVB group was more prone to neurological symptoms than was the SCVB group ($P<.05$).

Conservative treatment achieved similar recovery rates in the SCVB group and the NSCVB group (81.8% vs 93.6; $P>.05$). There also was no significant difference in recovery time in the 2 groups ($P>.05$). However, the symptoms recurred in some patients at 3 months after the first visit. The rate of symptom recurrence and persistence in the SCVB group was significantly higher than in the NSCVB group ($P<.05$; Table 4).

The Torg–Pavlov ratio and the SDVB differed significantly between the patients with neck pain only and patients with neurological symptoms only ($P<.05$; Table 5).

Table 2

Clinical features of cervical spondylosis.

Symptoms
- Cervical pain aggravated by movement
- Referred pain (occiput, between the shoulder blades, upper limbs)
- Retro-orbital or temporal pain (from C1 to C2)
- Cervical stiffness—reversible or irreversible
- Vague numbness, tingling, or weakness in upper limbs
- Dizziness or vertigo
- Poor balance
- Rarely, syncope, triggers migraine, "pseudo-angina

Signs
- Poorly localized tenderness
- Limited range of movement (forward flexion, backward, extension, lateral flexion, and rotation to both sides)
- Minor neurological changes like inverted supinator jerks (unless complicated by myelopathy or radiculopathy)

Table 3

The symptoms' distribution between the SCVB and the NSCVB groups.

Group	Total number (Neuro+)	Neck pain solo	Neuropathy solo	Combined
NSCVB	160 (53)*	107	19	34
SCVB	22 (1)	21	0	1

NSCVB=nonsmall vertebral body, SCVB=small cervical vertebral body.
* $P<.05$.

4. Discussion

Patients with cervical spinal stenosis are prone to suffering from spinal cord injury and cervical spondylosis [3,4]. However, many patients with the opposite cervical spinal characteristics tend to be affected by persistent symptomatic cervical spondylosis with axial neck pain. Understanding the general patterns of the small cervical vertebral body and its relationship with axial neck pain may help to elucidate the pathology of cervical spondylosis.

Our study found that cervical spondylosis patients with narrow spinal canals are prone to neurological symptoms, which is consistent with previous studies.[3–7] At the start of our study, the severity of neck pain was similar in the SCVB group and the NSCVB group. However, during the follow-up, the patients with smaller cervical vertebral bodies tended to experience persistent axial neck pain. We speculate that smaller cervical vertebral bodies may cause symptomatic spinal instability.

Hyperostosis or protrusion of the intervertebral discs may cause spinal instability, which can further aggravate congenital cervical spinal stenosis. Smaller vertebral bodies can result in spinal instability and vulnerability to axial neck pain, rather than radiculopathy or myelopathy.

The Torg–Pavlov ratio has been utilized to predict neurological morbidity in patients with degenerative cervical spondylosis and cervical spinal injury.[1] For diagnosis of cervical spinal stenosis, it was suggested that calculation of the spinal canal/vertebral body ratio has superior sensitivity and specificity than does direct measurement of the sagittal diameter of the canal. A ratio of 0.82 as the cut-off line has been used to indicate cervical spinal stenosis.[3,4]

Hukuda et al[8] found that, in addition to cervical spinal stenosis, a large vertebral body also is a risk factor for cervical myelopathy. Although it was not explained why patients with myelopathy had large vertebral bodies, Hukuda et al believed that a large vertebral body might be associated with a large

Table 4

The rate of symptom recurrence and persistence.

Group	Symptom recurrence	Symptom persistence	Total
NSCVB	14	13	27
SCVB	3	5	8*

NSCVB=nonsmall vertebral body, SCVB=small cervical vertebral body.
* $P<.05$.

Table 5

Comparison of the Torg–Pavlov ratio and the SDVB (mean ± SD).

Group	Torg–Pavlov ratio	SDVB, mm
Neck pain alone	1.080 ± 0.130*	16.3 ± 1.7*
Neurological symptoms alone	0.960 ± 0.122	17.3 ± 1.9

SDVB = sagittal diameter of the vertebral body.
* $P < .05$.

osteophyte and large disc protrusion. Our study demonstrated that smaller SDVB (larger Torg–Pavlov ratio) was associated with persistent axial neck pain.

Neck pain syndrome is highly prevalent and a common source of disability in the working-age population.[9,10] However, the exact mechanisms of neck pain are not fully understood yet. Many factors, such as degenerative changes of the cervical discs or facet joints, poor posture or ergonomics, muscle fatigue, and physical or mental stress, can contribute to neck pain syndrome.[11,12] We speculate that smaller vertebral bodies can lead to instability of the cervical spine column. Disk degeneration may give rise to neck pain symptoms.[12–14] This hypothesis still needs to be tested by biomechanical experiments.

There are limitations in our study. First, both SDVB and Torg–Pavlov ratio are indirect measurement of the vertebral body dimension. Second, a relatively younger population was chosen because their CT images were much easier to measure due to the minor bony degenerative changes. Third, the investigators were not blinded to the patient symptom groups when measuring the images.

In conclusion, our study found that smaller size of the cervical vertebral body is an attributing factor for cervical spondylosis. Patients with smaller cervical vertebral bodies are prone to persistent axial neck pain, but not neurological symptoms.

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