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Original Article

Risk factors in cervical spondylosis

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ABSTRACT

Background: Cervical spondylosis is essentially a degenerative disorder common after fourth decade. It has been seen that radiological evidence of cervical spondylosis do not necessarily co-relate with clinical findings. This discrepancy has been attributed to the morphometric dimensions of the vertebrae, age, sex, race, occupation, weight and height of the patients.

Objective: The objective of this study is to co-relate the variables like age, sex, race, occupation, vertebral body diameter, canal diameter, canal body ratio of cervical spine vertebrae with cervical spondylosis cases with normal population.

Methods: In this hospital based, case control, consent based, cross-sectional, clinico-radiological study 200 individuals (controls-100, cases-100) who were subjected to lateral projection radiographs of cervical spine. Their age, sex, race, occupation, height, weight and mid-sagittal canal diameter (CD), sagittal vertebral body diameter (VBD) and the canal-body ratio (CBR) of the cervical vertebrae was recorded and analyzed statistically.

Results: There was no relation between vertebral dimensions and clinical groups. In radiculopathy group, age and height showed significance on univariate analysis. While only age remained significant on multivariate analysis. In neck pain group age, sex, and height showed significance on univariate analysis while in multivariate analysis age, sex and occupation were significant risk factors.

1. Introduction

Cervical spondylosis is essentially a degenerative disorder starting in the intervertebral disc and progressing with advancement in age to involve more than one disc.[1] The term covers the pathology in the spine and the neurological syndrome associated with it.[1] Nearly 50% of people over the age of 50 and 75% of those over the age of 65 have typical radiographic changes of cervical spondylosis.[2] It is important to realize that radiological changes with age only represent structural changes in the vertebrae but such changes do not necessarily cause symptoms.[3]

It is believed that this mismatch between radiographic appearance and clinical symptoms have is not only because of

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age[4–6] but also because of gender,[5,7,8] race,[8,9] ethnic group,[10] height[7] and occupation.[1,11–13] It has also been attributed to various morphological dimensions of the vertebrae like antero-posterior vertebral body diameter (VBD), mid-sagittal vertebral canal diameter (CD) and canal-body ratio (CBR). Morphological dimensions of vertebrae (VBD, CD, CBR) and patient characteristics (age, sex, height, occupation) in adult population in normal healthy persons as controls and in cases of cervical spondylosis were studied. The findings were statistically analyzed and results reported.

2. Aims & objectives

The objective of this study is to co-relate clinically and statistically the variables like age, sex, race, height, weight, occupation, vertebral body diameter, canal diameter, canal body ratio of cervical spine vertebrae and to find which the above variables either singly or as a group are the risk factors in causing cervical spondylosis.

3. Materials and methods

This hospital based, cross-sectional, clinico-radiological study done in department of orthopedics included 200 subjects (males 100 & females 100). The study was done after prior approval from ethical committee of the Institute. All those willing to participate after informed and written consent were included in the study. Individuals aged 20 years or above with complaints of neck pain, stiffness in neck, brachial neuralgia, symptoms of cervical radiculopathy or myelopathy were included. Individuals less than 20 years of age, with history of cervical spine injury, surgically intervened cervical spine or spinal cord, infective pathology of cervical spine, tumors and congenital/developmental cervical anomalies were excluded.

Detailed history, clinical examination for assessing cervical spine dysfunction was performed. The subjects, on the basis of their signs and symptoms, were categorized into symptomatic and asymptomatic group. Symptomatic group was again subdivided into two groups – Group I: patients with Cervical Spondylotic Radiculopathy (CSR)/Cervical Spondylotic Myelopathy (CSM), Group II: Patients with complaints of neck pain, not improved by treatment for other causes of neck pain over 2 weeks period of observation. Group III was the control group comprising of all those who reported to our outpatient department with complaints unrelated with cervical spondylosis and found to be having no signs and symptoms of cervical Spondylosis. Group I and Group II had 50 patients and Group III included 100 individuals.

Race, age, sex, height, weight and occupation of the subjects were noted. The subjects were divided into Mongoloid (0) and non-mongoloid race (1). The occupation was divided as 1) house hold workers (0), 2) Outdoor workers (1), 3) Manual laborers (2) and, 4) Head load carriers (3).

All were subjected to a lateral projection radiograph of cervical spine. Each subject sat erect with his opposite shoulder touching the cassette film holder and his head held in a neutral position with 3 kg sandbags in each hand. The x-ray focus to film distance was kept at a constant distance of 183 cm with central rays focusing over the fourth cervical vertebra 2.5 cm behind the mastoid process.[12] The mid-sagittal canal diameter (MSD), sagittal vertebral body diameter (VBD) and the canal-body ratio (CBR) were recorded. The sagittal diameter of the cervical spinal canal in each subject was measured between two fixed bony landmarks. The anterior point being the middle of the posterior surface of the vertebral body height from C2–C6 and the posterior point being the anterior-most point on the spino-laminar line. Likewise, the sagittal diameter of the vertebral body of the corresponding vertebra was measured from the middle of the anterior surface of the vertebral body height to the middle of the posterior surface of the vertebral body height. The canal–body ratio (Torg–Pavlov ratio) at each vertebral level was calculated by dividing the sagittal diameter of the cervical spinal canal by the sagittal diameter of the vertebral body.[13,14] Measurements were made directly on the radiograph after marking points or lines with a graphite film marker, which provided a very small well-defined point or line necessary for accurate measurement.[15] Measurements were made with a standard metallic ruler (precision ±0.5 mm). Same ruler was used throughout the study. Each measurement of distance was rounded off to the nearest millimeter. All measurements were made independently twice by two observers without reference to prior measurements and the average distance measured was rounded off to the nearest 0.5 mm. Various dimensions thus determined were recorded in a standard proforma. Height, weight, race, age, sex and occupation were also noted. The data was recorded and entered in a Microsoft excel file. The statistical analysis was done in Epi-info 2000 program.

4. Observations & results

This study included 200 individuals (males – 100, females – 100) who attended out-patients clinic of Orthopedics department during the study period. Various vertebral dimensions of cervical vertebrae were measured from lateral projection radiographs of cervical spine as described in methodology. The vertebral dimensions of the three groups are shown in Table 1. K–W test was applied for vertebral body diameter, canal diameter and canal body ratio between all three clinical groups and it was found that the difference was not significant ($p > 0.05$). The mean age, height and weight of the individuals included in the Group I [$n = 50$ (25%)] were 49.76 ± 11.30 years, 156.58 ± 8.84 cm and 55.32 ± 11.04 kg respectively. The mean age, height and weight of the individuals from clinical group II [$n = 50$ (25%)] were 45.82 ± 11.35 years, 156.14 ± 9.22 cm and 55.86 ± 10.78 kg respectively. Similarly, the individuals of clinical group III [$n = 100$ (50%)] had their mean age, height and weight 39.38 ± 14.35 years, 159.54 ± 8.17 cm and 55.60 ± 9.06 kg respectively (Table 2).

5. Univariate analysis

The comparison of clinical group I (radiculopathy) with the control group (clinical group III) for differences in age, height, weight, sex, race and occupation was done and it was found

Table 1 – Vertebral body dimensions among clinical groups.

Description	Group I	Group II	Group III	p-value (ANOVA)
Vertebral body diameter (VBD)	17.86 ± 1.79 mm	17.53 ± 1.88 mm	17.81 ± 1.73 mm	$F = 0.532$ $p = 0.588$
Canal diameter (CD)	17.04 ± 1.56 mm	17.17 ± 1.82 mm	17.18 ± 1.67 mm	$F = 0.124$ $p = 0.883$
Canal-body ratio (CBR)	0.96 ± 0.13	0.98 ± 0.14	0.97 ± 0.13	$F = 0.285$ $p = 0.753$

that the controls were significantly younger (p-value < 0.01) and taller than cases (p-value < 0.05). The difference in weight, sex and race were not significant (Table 3).

Next, comparison between clinical group II (neck pain) and control group (clinical group III) was done. The controls were significantly younger, taller and had a predominance of males. The difference in race, weight and occupation was not significant (Table 4).

6. Multivariate analysis

Multivariable logistic regression analysis comparing controls (Group III) and patients with radiculopathy (Group I) showed that only age remained a significant determinant of group at $p < 0.05$. The model according to likelihood ratio estimates was highly significant p-value = 0.0005 (Table 5).

Multivariable logistic regression analysis comparing controls and patients with neck pain showed that age, sex and occupation were significant determinants of group at $p < 0.05$. The model according to likelihood ratio estimates was highly significant p-value = 0.0000 (Table 6).

7. Discussion

Cervical spondylosis is degenerative disorder characterized clinically by local pain in the neck with or without radiation, numbness, tingling and paresthesia and in later stage spondylotic myelopathy of upper limb and radiologically by reduction in intervertebral disc space and formation of marginal osteophytes. Posteriorly these osteophytes protrude into the spinal canal and laterally into the intervertebral foramina. The spinal cord and nerve root impingement by posterior and lateral osteophytes and bulging intervertebral disc would present as local neck stiffness and radicular pain along the offending nerve root. Long standing compression of the spinal cord can result in irreversible damage including demyelination and necrosis of grey matter.[1] Demonstrating the presence of posterior and postero-lateral osteophytes or reduction in intervertebral disc space by lateral projection plain radiographs, CT scan and MRI forms the basis of radiological confirmation of the disease. But often the presence and severity of clinical symptoms and radiological changes do not occur simultaneously or progress at the same pace. The mismatch in clinical signs and symptoms with radiological findings may cause delay in diagnosis or the condition may remain undiagnosed and lead to much disabling state of cervical spondylotic myelopathy. The identification of risk factors associated with cervical spondylosis would help clinicians to identify the patient at risk and implement appropriate preventive and management steps before the neurological changes appear.

This study was designed and conducted to identify the risk factors pertaining to patient variables and the anatomical variables of the cervical vertebrae of patients and healthy individuals. The morphometric dimensions like VBD, CD & CBR have been measured either with plain lateral projection radiography or by CT scan or by MRI alone or a combination of these techniques. Variations of morphology of the vertebrae in healthy individuals, in patients of cervical spondylosis and also in cadaveric skeletons have been widely studied and reported in literature by many authors. In a study done on normal healthy Indian adult subjects Gupta[7] reported mid sagittal diameter smaller in females than males. Similarly in a Japanese study involving normal healthy subjects, Sasaki[4] also reported smaller sagittal diameter of spinal canal in females and in older persons. He also reported higher incidence of spondylotic changes in population with increasing age and more in males than females even though his study included only normal healthy individuals. Hukuda[16] reported significantly smaller CBR in males and believed it to be an important risk factor for male prevalence of cervical myelopathy even though his study included only healthy normal subjects. Lim JK[17] in his study on 80 healthy men and women reported that women had smaller canal diameter (CD) and men had larger VBD thus resulting in smaller Torg ratios in men. He suggested that Torg ratios should not be used to identify the presence of cervical canal stenosis.

Taitz[18] after his study on 214 cadaveric skeletons reported that whites have a larger CD and Transverse diameter of the cervical canal than blacks emphasizing racial variation in morphometric dimensions. Lee MJ[19] after his study of 469 skeletal specimens did not find any significant difference in values obtained from black and white groups. He suggested that radiographic finding of cervical stenosis should be correlated with the clinical presentation before decision-making regarding treatment. Again in both of these studies the authors did not know regarding the presence or absence of

Table 2 – Age, height, weight among different clinical groups.

Description	Clinical group I	Clinical group II	Clinical group III
Age	49.76 yrs	45.82 yrs	39.38 yrs
Height	156.58 cm	156.14 cm	159.54 cm
Weight	55.32 kg	55.85 kg	55.60 kg

Table 3 – Univariate analysis of clinical group I with III.

Variables	Group I		Group III	Significance values
Age	49.76 ± 11.30 yrs		39.38 ± 14.35 yrs	0.0000
Height	156.58 ± 8.84 cm		159.54 ± 8.17 cm	0.024
Weight	55.32 ± 11.04 kg		55.60 ± 9.06 kg	0.45
Sex	0	25	39	χ^2 $p = 0.26$ (Yates corrected)
	1	25	61	
Race	0	33	56	χ^2 $p = 0.31$ (Yates corrected)
	1	17	44	
Occupation	0	9	24	χ^2 $p = 0.72$ (Yates corrected)
	1	34	67	
	2	4	5	
	3	3	4	

Sex: M – 0, F – 1; Race: Mongoloid – 0, Non-mongoloid – 1; Occupation: 1) house hold workers (0), 2) Outdoor workers (1), 3) Manual laborers (2) and, 4) Head load carriers (3).

Table 4 – Univariate analysis of clinical group II with III.

Variables		Group II	Group III	p-value
Age		45.82 ± 11.35 yrs	39.38 ± 14.35 yrs	0.0013
Height		156.14 ± 9.22 cm	159.54 ± 8.17 cm	0.019
Weight		55.86 ± 10.78 kg	55.60 ± 9.06 kg	0.49
Sex	0	36	39	χ^2 $p = 0.0002$ (Yates corrected)
	1	14	61	
Race	0	31	56	χ^2 $p = 0.59$ (Yates corrected)
	1	19	44	
Occupation	0	15	24	χ^2 $p = 0.73$ (Yates corrected)
	1	32	67	
	2	1	5	
	3	2	4	

Sex: M–0, F–1; Race: Mongoloid–0, Non-mongoloid–1; Occupation-house hold workers 0, Outdoor workers 1, Manual laborers 2 and, Head load carriers 3.

signs and symptoms of cervical spondylosis in the life time of their subjects. Hukuda[20] in his case – control study measured the size of vertebral body, spinal canal and spinal cord and after multivariate analysis concluded that narrow spinal canal and large vertebral body are the risk factors for cervical myelopathy. John[21] in his age and sex matched case – control study reported the importance of both clinical and radiological findings rather than anyone of them alone but did not specify any risk factor. Mahbub et al[12] considered head load carrying porters as a risk group for developing cervical spondylosis but Bista[13] reported his findings contrary to this and concluded that prevalence of cervical spondylosis is significantly lesser in porters than in non-porters.

It is evidently clear from the above discussion that the ambiguity in identifying the definite risk factors in diagnosis of cervical spondylosis still persists. Nearly all of the above studies were designed to find out the anatomical variations and their effects in either different race, gender, age. No study

Table 5 – Multivariate analysis of clinical group I with III.

	Coeff.	St. Er.	Z-stat.	p-value	Odds ratio		
					OR	Lower	Upper
Age	0.0550	0.0143	3.8448	0.0001	1.057	1.027	1.087
Height	−0.0385	0.0270	−1.4275	0.1534	0.962	0.913	1.014
Occupation	0.1994	0.2780	0.7173	0.4732	1.221	0.708	2.105
Race	−0.4627	0.3954	−1.1702	0.2419	0.630	0.290	1.367
Sex	−0.1771	0.4390	−0.4034	0.6866	0.838	0.354	1.981
Weight	0.0212	0.0215	0.9873	0.3235	1.021	0.979	1.065

Test	Statistic	DF	p-value
Score	22.6253	6	0.0009
Likelihood ratio	23.9404	6	0.0005

−2* Maximized log-likelihood: 167.0138.

Table 6 – Multivariate analysis of clinical group II with III.

	Coeff.	St. Er.	Z-stat.	*p*-value	Odds ratio		
					OR	Lower	Upper
Age	0.0397	0.0149	2.6697	0.0076	1.041	1.011	1.071
Height	−0.0273	0.0276	−0.9873	0.3235	0.973	0.922	1.027
Occupation	−0.7430	0.3640	−2.0413	0.0412	0.476	0.233	0.971
Race	−0.3629	0.4114	−0.8820	0.3778	0.696	0.311	1.558
Sex	−1.7353	0.4969	−3.4920	0.0005	0.176	0.067	0.467
Weight	0.0398	0.0231	1.7202	0.0854	0.041	0.994	1.089

Test	Statistic	DF	*p*-value
Score	27.6745	6	0.0001
Likelihood ratio	30.6000	6	0.0000

−2* Maximized log-likelihood: 160.3542.

had taken all of these parameters together. Also many of them have been done in healthy populations or cadavers. Few case control studies are there but none of them were designed to find out the patient variables as well as anatomical variations of cervical vertebrae in patient and as well as in healthy individuals. Recently, Singh[22] in her systemic review on the risk factors for cervical spondylotic myelopathy has reported larger vertebral body and smaller spinal CBR associated with CSM diagnosis while gender was not associated with CSM diagnosis in most of the studies included in the analysis.

We, in our own literature search, did not find any study that has compared the patient variables and their effect as a causative or risk factors in cervical Spondylosis. We had tried to analyze these factors singly (univariate) or together as a group (multivariate) as risk factors of cervical spondylosis. Our result shows that there was no relation between vertebral dimensions and clinical groups (Table 1). The data collected shows that in univariate analysis, radiculopathy patients (Group I) were significantly older and shorter than controls (Group III) i.e. older and shorter subjects had more chances of having features of radiculopathy (Table 3). Comparing clinical group II with controls showed that old age, short height and females being the main sufferers (Table 4). In multi variable analysis only age remained the significant determinant when radiculopathy (Group I) was compared to controls (Group III) (Table 5). Age, sex and occupation were the significant determinants between neck pain (Group II) and controls (Group III) on multivariate analysis (Table 6). Since, no such study has been done earlier we could not compare our results with others.

8. Conclusions

We conclude that variations in canal–body ratio, canal diameter, vertebral body diameter of the cervical vertebrae and race, weight and height of the patients are not the risk factors of cervical spondylosis. Age, gender and occupation are the only risk factors for having cervical spondylosis. The identification of risk factors would help clinicians to identify the patient at risk and implement appropriate preventive and management steps before the neurological changes appear. Moreover assessing various morphological dimensions of the cervical vertebrae by plain radiography or CT or MRI seem to be unnecessary and escalation in treatment cost can be avoided.

Conflicts of interest

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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