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Comparisonof Motor NCS Parameters with MRI in Degenerative Cervical Spondylosis

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Abstract:
Background: *Degeneration of cervical spine involving uncovertebral or facet joints are more often radiological findings in patients with cervical spondylosis. Magnetic Resonance Imaging (MRI) which is the gold standard radiological investigation to diagnose and detect grades of degenerative cervical spondylosis reveals only the anatomical structures and delineates extent of soft tissue involvement around the cervical spine. Functional status of the cervical spine and extent of nerve root compression can be unraveled by Nerve Conduction Studies(NCS).Moreover, NCS helps to guidethe treatment for degenerative cervical spondylosis in a modified and individualized manner.*
Aim: *Our focus was to evaluate, compare and correlate motor NCS parameters in different grades of MRI diagnosed degenerative cervical spondylosis, whether they vary significantly according to the different grades of cervical spine degeneration.*
Setting and Design:*Cross- sectional study performed on 55 subjects of clinically and MRI diagnosed degenerative cervical spondylosis attending orthopedics OPD of R. G. KAR Medical College,Kolkata.*
Materials and Methods:*Symptomatic patients diagnosed having cervical spondylosis underwent NCS procedures in the department of Physiology of the same institution. Thereafter Motor NCS parameters were measured for Distal Motor Latency(DML), Compound Muscle Action Potential (CMAP)along with Motor Nerve Conduction Velocity (MNCV) of Median, Ulnar, Radial and CMAP amplitude of Musculocutaneous and Axillary nerves. Values were compared and correlated with different grades of degeneration assessed with MRI and analyzed by using SPSS version 20.*
Results: *Among Motor Nerve Conduction study parameters of respective motor nerves, CMAP amplitude of Median, Radial and Musculocutaneous nerves varied significantly according to different grades of degenerative cervical spondylosis. There was a strong correlation between CMAP amplitude of Median, Radial, Musculocutaneous and Axillary nerves with different grades of degeneration assessed with MRI.*
Conclusion: *Motor NCS parameters especially CMAP amplitude of Median, Radial and Musculocutaneous nerves vary significantly with different grades of cervical spine degeneration, and all these parameters along with CMAP of Axillary nerve strongly correlate with different grades of MRI.Therefore,NCS can help in guidingtreatment modalities in these patients and maythusreduce the cost of care to patients in developing country like India.*

Key Words: *Cervical spondylosis; NCS; MRI.*

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I. Introduction

Cervical spondylosis, a common degenerative condition affecting the cervical spine,is the most common compressive etiology of cervical radiculopathy apart from disc herniation. Age-related degenerative changes may involve the intervertebral disks, uncovertebral joints and facet joints. Degenerative changes may also result in bone formation in these areas, producing an osteophyte or hard disc.Clinically, several syndromes, both overlapping and distinct, ranging from neck, arm and shoulder pain, sub-occipital pain to headache, numbness, tingling, weakness in the upper extremity and radicular symptoms are seen.

For investigating cervical spondylosis, MRI (Magnetic resonance imaging) is the imaging modality of choice.Cervical degenerative changes can be graded using a very old but reliable classification done by Kellgren

et al[1,2]. It was applied to MRI evaluation of spine.The key parameters were osteophyte formation, intervertebral disc height narrowing and vertebral end-plate sclerosis.

Nerve conduction studies (NCS) are simple noninvasive techniques to diagnose cervical root compression. Different grades of degenerative cervical spondylosis as diagnosed by MRI produce variations of neurophysiological manifestations on NCS. Motor NCS parameters of Median, Ulnar, Radial, Musculocutaneous and Axillary nerves vary significantly according to different grades of cervical spondylosis in MRI.

There were no such available studies for comparison of different motor NCS parameters in different grades of cervical degenerative spondylosis as diagnosed by MRI. In our study, focus was made to find out whether motor NCS parameters vary significantly in different grades of degenerative cervical spondylosis and correlate with MRI findings.

II. Materials and Methods

An observational cross-sectional study was performed after getting permission from the institutional ethics committee on 55 subjects aged between 16 to 69 years attending at orthopedic OPD of R. G. KAR Medical college Kolkata and diagnosed both clinically and radiologically by MRI as degenerative cervical spondylosis. They were referred for NCS study to the department of Physiology of same institutionto compare neurophysiological findings of cervical root compression in different grades of degenerative cervical spondylosis. There were 5 groups of cases according to MRI: Grade 0 (normal)- no degenerative changes; Grade 1 (minimal/early)- minimal anterior osteophyte formation,no reduction of intervertebral disc height, no vertebral endplate sclerosis; Grade 2 (mild)- definite anterior osteophyte formation ,subtle or no reduction in intervertebral disc height (<25%), just recognizable sclerosis of the endplates; Grade 3 (moderate)- definite anterior osteophyte formation,moderate narrowing of the disc space (25-75%), definite sclerosis of the endplates and osteophyte sclerosis; Grade 4 (gross)- large and multiple large osteophyte formation is seen, severe narrowing of the disc space (>75%), sclerosis of the endplates with irregularities. Patients with other causes of polyneuropathy or radiculopathy, radial mononeuropathy, with history of trauma, metastatic disease of spine and related structures, migraine headache, cluster headache, tension headache, multiple sclerosis were excluded from the study.

Nerve conduction study was performed using RMS EMG EP MARK II 2011 computerized machine.The selected motor nerves were stimulated on two points along its course for Median, Ulnar and Radial nerve. Single stimulation was used for Musculocutaneous and Axillary nerves. Maximal stimulation was applied. The surface recording electrodes were placed in belly tendon montage; keeping the active electrode nearer to the motor point and reference to the tendon. Ground electrode was placed between stimulating and recording electrode. Distal motor latency (DML) and Compound muscle action potential (CMAP) amplitude, Motor nerve conduction velocity (MNCV)were noted for Median,Ulnar, Radial nerves and Compound muscle action potential (CMAP) amplitude of Musculocutaneous and Axillary nerves were also measured.

Statistical analysis was done using IBM SPSS version 20. Mean and standard deviation of different NCS parameters of selected motor nerves were calculated and compared in different grades of degenerative cervical spondylosis by ANOVA, Kruskal- wallis and Post –hoc analysis. Pearson correlation coefficient was calculated for Motor NCS parameters to correlate with MRI.

III. Results

There were 32 females and 23 males among 55 patients. The average age groups were as follows(Table 1).

Table1: Average age group of male and female subjects

Sex	Age in years (mean±sd)
Male(n=23)	49.65±11.50
Female(n=32)	43.44±12.90

Table2: Values of different motor NCS parameters in different grades of degenerative cervical spondylosis

NCS Parameters	Grade 0 (n=8) (mean±sd)	Grade 1 (n=8) (mean±sd)	Grade 2 (n=16) (mean±sd)	Grade 3 (n=16) (mean±sd)	Grade 4 (n=7) (mean±sd)	p Value
MedianCMAP	8.10±3.72	8.04±3.11	7.47±3.67	3.56±3.06	3.37±1.95	**0.001***
MedianDML	3.74±1.57	3.32±0.75	3.77±1.13	4.76±3.46	3.85±2.06	0.569
Median MNCV	55.66±7.45	55.69±5.28	55.86±5.19	52.69±9.53	49.23±13.78	0.402
Ulnar CMAP	6.80±3.09	5.75±2.31	8.16±3.98	4.87±4.03	4.85±2.28	0.086
Ulnar DML	2.89±0.44	2.37±0.58	2.47±0.77	2.16±1.11	2.56±0.83	0.381
Ulnar MNCV	61.23±6.88	59.62±5.89	59.03±8.78	59.55±7.24	58.98±4.88	0.968
Radial CMAP	4.79±2.32	2.56±1.08	4.14±2.04	2.66±1.28	3.03±1.83	**0.020***

Radial DML	2.19±1.21	2.57±0.74	1.88±0.62	2.62±1.29	2.81±1.91	0.291
Radial MNCV	57.39±6.75	51.66±5.63	55.05±8.34	54.55±9.32	55.68±6.07	0.691
Musculocutaneous CMAP	5.72±5.19	3.31±1.61	4.36±2.62	1.84±1.13	1.36±1.06	**0.003***
Axillary CMAP	4.82±2.99	4.48±1.82	4.32±2.14	2.97±1.97	2.81±2.03	0.142

From the (Table 2) it has been seen that CMAP amplitude values of Median, Radial and Musculocutaneous nerve vary significantly in different grades of degenerative cervical spondylosis.

Table 3: Post-hoc analysis of significant motor NCS parameters in different grades of degenerative cervical spondylosis

NCS Parameters	MRI grade	MRI grade	Significance(p value)
Median CMAP	0	1	1.000
		2	0.991
		3	**0.018***
		4	**0.053***
	1	0	1.000
		2	0.994
		3	**0.021***
		4	0.058
	2	0	0.991
		1	0.994
		3	**0.011***
		4	0.057
	3	0	**0.018***
		1	**0.021***
		2	**0.011***
		4	1.000
	4	0	**0.053***
		1	0.058
		2	0.057
		3	1.000
Radial CMAP	0	1	0.097
		2	0.912
		3	**0.053***
		4	0.309
	1	0	0.097
		2	0.243
		3	1.000
		4	0.985
	2	0	0.912
		1	0.243
		3	0.133
		4	0.628
	3	0	**0.053***
		1	1.0000
		2	0.133
		4	0.990
	4	0	0.309
		1	0.985
		2	0.628
		3	0.990
Musculocutaneous CMAP	0	1	0.349
		2	0.745
		3	**0.010***
		4	**0.017***
	1	0	0.349
		2	0.878
		3	0.691
		4	0.600
	2	0	0.745
		1	0.878
		3	0.061
		4	0.095
	3	0	**0.010***
		1	0.691
		2	0.061
		4	0.994
		0	**0.017***

	4	1	0.600
		2	0.095
		3	0.994

Table 4 : Correlation between Motor NCS parameters with different grades of MRI

Motor NCS parameters	**Pearson correlation coefficient Sig(2-tailed)**
Median CMAP	**<0.001***
Median DML	0.327
Median MNCV	0.094
Ulnar CMAP	0.169
Ulnar DML	0.221
Ulnar MNCV	0.587
Radial CMAP	**0.057***
Radial DML	0.280
Radial MNCV	0.910
Musculocutaneous CMAP	**<0.001***
Axillary CMAP	**0.015***

From the (Table4), it was seen that CMAP amplitude of Median, Radial, Musculocutaneous and Axillary nerves strongly correlate with different grades of MRI.

IV. Discussion

Cervical nerve root enters the foramen medially at the level of the superior articular facet of the inferior vertebrae. Radiculopathy results if exiting nerve root is impinged mechanically due to hypertrophy of either the uncovertebral joints or the facets joints. Degenerative changes in these joints are called spondylosis[(3)]. Cervical spondylosis resulting neural irritation is one of the causes of shoulder girdle and arm pain [(4)]. Magnetic resonance imaging (MRI) is the imaging modality of choice for cervical radiculopathy [(5)].MRI generally provides superior evaluation of the soft tissues and detailed anatomical structures suggesting degeneration of cervical spine, disc space narrowing and or osteophyte formation. But it cannot indicate the functional status of the diseased spine or the extent of nerve root compression. Nerve Conduction Study is superior in this aspect because it diagnoses the extent of nerve root impingement. In our study,we wanted to compare and correlate whether the values of different motor NCS parameters vary according to different grades of degenerative cervical spondylosis as diagnosed by MRI. In one study done by Arslan Y et al , EMG findings correlated with MRI findings in both cervical and lumbosacral radiculopathy. EMG and MRI findings correlated well for lumbar radiculopathy, but not for cervical radiculopathy in mild to moderate grades[(6)]. Another study done by Pawar S et al to see the diagnostic efficacy of NCS parameters in cervical radiculopathy and found reliable sensitivity and specificity of NCS for diagnosing suspected cervical radiculopathy[(7)].In 1989 ,Khan MR et al took a total of 57 patients of cervical spondylosis who underwent NCV, SSEP, EMG to aid the diagnosis.It was concluded that NCV, SSEP, and concentric needle electromyography were useful tests in distinguishing between root lesions and peripheral entrapment neuropathy [(8)].There are no such available studies for comparing neurophysiological findings in different grades of MRI diagnosed degenerative cervical spondylosis. We have seen among all the NCS parameters we have measured, CMAP amplitude of Median, Radial and Musculocutaneous nerves vary significantly in different grades of degenerative cervical spondylosis. Moreover, CMAP amplitude of Median, Radial, Musculocutaneous and Axillary nerves strongly correlate with different grades of MRI.

V. Conclusion

From the above findings, we can conclude that as the Motor NCS findings vary in different grades of degenerative cervical spondylosis, especially the muscle action potential amplitude of Median, Radial and Musculocutaneous and Axillary nerves, so by doing this noninvasive and cost effective test we can get an idea about not only the diseased status, but also the functional status of the nerve root compression. Therefore, by doing simple NCS evaluation of clinicallydiagnosed cervical radiculopathy patients, treatment modalities can be planned, modified and justified in different groups of patients with degenerative cervical spondylosis.

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