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Nerve Conduction Study (NCS) in Patients with Cervical Radiculopathy at Arifin Achmad General Hospital, Riau Province

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Abstract

Background: Radiculopathy is one of the most common causes of neck pain in everyday clinical practice. Radiculopathy can occur in the cervical segment. The prevalence of cervical radiculopathy is lower than lumbar radiculopathy. NCS is an attempt to confirm the diagnosis of radiculopathy. This study aims to describe the NCS findings in cervical radiculopathy patients at RSUD Arifin Achmad, Riau Province.
Methods: This descriptive quantitative study was conducted from January to September 2024 at RSUD Arifin Achmad, Riau Province, using total sampling. Data from NCS tests, including latency, amplitude, nerve conduction velocity (NCV), and F-wave parameters for motor and sensory nerves, were analyzed using descriptive statistics.
Result: The majority of the results were ≥40 years old (69.2%), female (61.5%), and predominance of one extremity testing in cervical radiculopathy (60%). NCS of cervical radiculopathy motor, n.medianus latency was elongated (5.13 ± 2.22 ms), amplitude was normal (4.42 ± 3.03 mV), and KHS was decreased (46.50 ± 11.79 m/s). The n.ulnaris latency lengthened (4.49 ± 5.53 ms), amplitude shortened (5.02 ± 2.70 mV), and KHS decreased (46.44 ± 16.51 m/s). The n.radialis latency (2.34 ± 0.98 ms), amplitude (3.25 ± 0.98 mV), and KHS (78.91 ± 27.47 m/s) were normal. Cervical radiculopathy sensory NCS, n.medianus latency was normal (2.86 ± 0.51 ms), amplitude shortened (19.37 ± 19.38 µV), and KHS decreased (43.82 ± 20.27 m/s). In n.ulnaris, latency lengthened (3.30 ± 1.78 ms), amplitude was normal (17.13 ± 13.98 µV), and KHS decreased (42.62 ± 16.63 m/s). The n.medianus (26.47 ± 2.74 ms) and ulnar (24.83 ± 1.63 ms) F-waves were normal.
Conclusion: NCS findings in cervical radiculopathy patients at RSUD Arifin Achmad reveal prolonged distal latency, decreased nerve conduction velocity, and reduced amplitude, suggesting demyelination and axonal loss. These results reinforce the role of NCS as a key diagnostic tool for cervical radiculopathy. Further research is needed to evaluate its correlation with clinical severity.

Keywords: *cervical radiculopathy, nerve conduction studies*

Introduction

Neck pain is one of the most common diseases encountered in daily clinical practice. Radiculopathy is one of several causes of neck pain. Radiculopathy is a peripheral nervous system disorder that occurs due to compression, degenerative, and inflammatory processes in the nerve roots around the spine.[1] About 83 out of 100,000 people in the world suffer from radiculopathy. The incidence of cervical radiculopathy is lower than lumbar radiculopathy with an incidence rate of about 85 people per 100,000.[2] The C7 segment is the most common lesion site in cervical radiculopathy (70%) and followed by C6 (19-25%).[1] In the period January-June 2024, there were 19 cases of cervical radiculopathy in RSUD Arifin Achmad Riau Province.

Magnetic resonance imaging (MRI) is the modality of choice for evaluating radiculopathy.[2] When clinical findings and imaging diagnosis show little correlation, electrodiagnostic testing can be performed. Electrodiagnostics is an examination that tests neurologic function and is an alternative to reduce the pain caused by other

examination methods.[3] Electrodiagnostics consisting of Electromyography (EMG) and Nerve Conduction Studies (NCS) can help distinguish between radiculopathy and more diffuse disorders of the peripheral nervous system.[4] The progressive sequence of abnormalities that appear on NCS and EMG examinations can distinguish hyperacute, acute, subacute, and chronic lesions. In addition to helping confirm the diagnosis, electrodiagnostic examinations can also help locate the lesion, differentiate myelin or axon lesions, and determine the prognosis of radiculopathy.[5] One of the electrodiagnostics that can be performed is a nerve conduction study that includes examining motor and sensory nerve conduction in the form of distal latency, amplitude, and nerve conductance velocity (KHS), as well as F-wave slow response.[6,7]

This study aims to determine the description of nerve conduction study (NCS) in cervical radiculopathy cases at RSUD Arifin Achmad Riau Province. The absence of research on NCS of cervical radiculopathy at RSUD Arifin Achmad Riau Province encouraged researchers to conduct this study.

Methods

Study Design

This study employs a descriptive quantitative design to analyze nerve conduction study (NCS) results in cervical radiculopathy patients. The study was conducted at RSUD Arifin Achmad, Riau Province, from January to September 2024.

Population and Sampling

The study population consists of cervical radiculopathy patients who underwent NCS tests at RSUD Arifin Achmad, Riau Province. A total sampling technique was used to select participants. Data were collected secondarily from NCS test results, including latency, amplitude, KHS, and F-wave of motor and sensory nerves.

Variables and Operational Definitions

The dependent variable in this study is extremity involvement, which is defined as the number of extremity sides tested in the NCS examination. Based on the NCS test results, extremity involvement was categorized into one extremity and two extremities. Several NCS parameters were analyzed to assess nerve conduction characteristics. Distal latency refers to the latency value of motor and sensory nerves tested in the NCS examination, with results presented as the mean ± standard deviation. Amplitude represents the amplitude value of motor and sensory nerves tested, also described using the mean ± standard deviation. Nerve Conduction Velocity (KHS) measures the conduction velocity of motor and sensory nerves, and its results are reported as the mean ± standard deviation. Lastly, F-wave latency refers to the latency value of the F-wave tested in the NCS examination, with findings expressed as the mean ± standard deviation.

Data collection technique

Data were collected secondarily through NCS test results, including parameters such as distal latency, amplitude, KHS, and F-wave.

Data Analysis

Descriptive statistics were used to summarize the findings, with results presented as the mean ± standard deviation for each NCS parameter.

Ethical Considerations

This study received ethical approval from the Medical and Health Research Ethics Unit, Faculty of Medicine, Riau University, under approval number B/123/UN19.5.1.1.8/UEPKK/2024

Results

Based on the results listed in table 1, it was found that the majority of cervical radiculopathy patients who performed the NCS test were in the age range ≥ 40 years, as many as 4 people (80%). The next age group is patients aged more than 40 years as many as 1 person (20%).

Based on gender, it was found that most of the cervical radiculopathy patients who performed the NCS test were female with a total of 4 people (80%), and 1 patient (20%) was male.

Based on limb involvement, it is known that the majority of cervical radiculopathy patients who perform the NCS test perform an examination on one extremity with the highest percentage of 60% with a total of 3 patients. Meanwhile, the examination of two extremities amounted to 2 patients with a percentage of 40%.

Table 1. Characteristics of Cervical Radiculopathy Patients who Performed NCS Test

Characteristics	Frequency (n)	Persentage (%)
Age		
< 40 year	1	20
≥ 40 year	4	80
Total	5	100
Gender		
Man	1	20
Woman	4	80
Total	5	100
Extremity Involvement		
One Extremity	3	60
Two Extremity	2	40
Total	5	100

Table 2. NCS Overview of Cervical Radiculopathy Cases

Variable	Distal Latency (ms)	Amplitude (µV)	NCV (m/s)
Motoric			
N. Medianus	5,13 ± 2,22	4,42 ± 3,03	46,50 ± 11,79
N. Ulnaris	4,49 ± 5,53	5,02 ± 2,70	46,44 ± 16,51
N. Radialis	2,34 ± 0,98	3,25 ± 0,98	78,91 ± 27,47
Sensoric			
N. Medianus	2,86 ± 0,51	19,37 ± 19,38	43,82 ± 20,27
N. Ulnaris	3,30 ± 1,78	17,13 ± 13,98	42,62 ± 16,63

From table 2 NCS motor cases of cervical radiculopathy obtained, the mean ± SD distal latency value is elongated, the amplitude is normal, and the KHS decreases in the median nerve. In the ulnar nerve, the mean ± SD distal latency value lengthens, the amplitude shortens, and the KHS decreases. In the radial nerve, the mean ± SD values of distal latency, amplitude, and KHS were normal.

Based on the sensory NCS results of cervical radiculopathy cases, the mean ± SD distal latency value is normal, the amplitude shortens, and the KHS decreases in the median nerve. In the ulnar nerve, the mean ± SD distal latency value is elongated, the amplitude is normal, and the KHS decreases.

Table 3. F-Wave Overview of Cervical Radiculopathy Cases

Variable	F-Wave (ms)
N. Medianus	26,47 ± 2,74
N. Ulnaris	24,83 ± 1,63

From table 3 f-waves of cervical radiculopathy cases, normal values are obtained in the median nerve and ulnar nerve.

Discussions

Based on the results of the research conducted, it was found that the majority of cervical radiculopathy patients who performed the NCS test were in the age range ≥ 40 years, as many as 4 people (80%). A similar thing was also found in a study in India in 2019, male cervical radiculopathy patients had an average age of 43.94 ± 7.12 years and women had an average age of 44.26 ± 5.76 years.[8] The degenerative process that runs with age is the underlying cause of this.[9] Secondary causes that arise due to chronic vertebral degenerative processes can increase the risk of disc herniation. Herniations or osteophytes that occur along the vertebral area will affect the entire vertebral cord and nerve roots.[10]

From the results of this study it can be concluded that most of the cervical radiculopathy patients who performed the NCS test were female with a total of 4 people (80%). This is also supported by the results of research related to pain profiles at Prof. Dr. RD Kandou Manado Hospital in 2014, it was found that the dominance of women experiencing pain was 58.7%, while men were 41.3%.[11] The dominance that occurs in women is related to many factors, one of which is hormonal.[12] The role of hormones in pain modulation causes women to be more likely to experience pain.[11] The process and menopause will result in changes in the body's estrogen hormone. A decrease in estrogen levels will affect bone density and increase the risk of pain.[13]

Based on limb involvement, it is known that the majority of cervical radiculopathy patients who perform the NCS test perform the examination on one extremity with the highest percentage of 60% with a total of 3 patients. Patients with cervical radiculopathy tend to cause unilateral symptoms, although in rare cases at a certain level will affect both nerves.[2]

From the results of this study, NCS motor cases of cervical radiculopathy were obtained, on average ± SD distal latency values were elongated, normal amplitude, and decreased KHS in the median nerve. The meaning of each parameter is compared with the normal value recommended by Chen et al.[14] Comparison with the value of a healthy group in a study conducted at Sanglah Denpasar Hospital also shows the same meaning.[15] The results of distal latency and KHS are in line with research conducted in India in 2019 which found that there was a lengthening of distal latency and a decrease in KHS on the symptomatic side compared to the asymptomatic side.[8]

In the ulnar nerve, the mean ± SD value of distal latency lengthened, amplitude shortened, and KHS decreased. The meaning of each parameter is compared with the normal values recommended by Chen et al.[14] These results are in line with research conducted in India in 2019 which found that there was a lengthening of distal latency, a decrease in amplitude, and a decrease in KHS on the symptomatic side compared to the asymptomatic side.[8]

In the radial nerve, the mean ± SD values of distal latency, amplitude, and KHS were normal. This meaning was obtained from comparing with the values of the healthy group in a study conducted at Sanglah General Hospital, Denpasar.[15]

Significant nerve root compression will cause axon loss. Motor amplitude will be reduced if more than 50% of motor axons are damaged.[16] Increased motor distal latency, decreased KHS, conduction block, and increased dispersion are criteria for demyelination.[17]

Based on the results of sensory NCS cervical radiculopathy cases obtained, the mean ± SD distal latency value is normal, the amplitude shortens, and the KHS decreases in the median nerve. Hal in India in 2019, the symptomatic side and the asymptomatic side showed these latency results in line with the research conducted distally in the normal category, shortened amplitude on the symptomatic side compared to the asymptomatic side. However, the KHS results are not in line with the study conducted in India in 2019 because the results were found to increase on the symptomatic side compared to the asymptomatic side.[8]

In the ulnar nerve, the mean ± SD distal latency value lengthens, the amplitude is normal, and the KHS decreases. These results are in line with research conducted in India in 2019, obtained the results of an increase in distal latency values, amplitude in the normal category, decreased KHS on the symptomatic side compared to the asymptomatic side.[8]

In most radicular processes, the Sensory Nerve Action Potential (SNAP) tends to be normal in amplitude and latency, which may result from compression on the nerve root occurring proximal to the sensory dorsal root ganglion.[16] In sensory nerve examinations, decreased KHS test results are always related to demyelination. However, the decrease in amplitude in SNAP tends to be caused by axon loss and lesions affecting the dorsal ganglion. The decrease that occurs is influenced by the extent of axon damage.[17,18]

F-waves in cases of cervical radiculopathy are obtained, normal values in the median nerve and ulnar nerve. F-wave is a small picture of Compound Muscle Action Potential (CMAP) which represents 1%-5% of muscle fibers. Therefore, the series of f-waves is purely motor. When there are conditions that selectively affect sensory nerves, the f-wave response will show normal results.[19-21]

Conclusions

The characteristics of cervical radiculopathy patients who performed NCS testing at RSUD Arifin Achmad Riau Province were mostly ≥40 years old, female, and involved one extremity in NCS testing. In the median nerve, the mean ± SD distal latency value was elongated (5.13 ± 2.22 ms), the amplitude was normal (4.42 ± 3.03 mV), and the KHS decreased (46.50 ± 11.79 m/s). In the ulnar nerve, the mean ± SD distal latency value lengthened (4.49 ± 5.53 ms), the amplitude shortened (5.02 ± 2.70 mV), and the KHS decreased (46.44 ± 16.51 m/s). In the radial nerve, the mean ± SD values of distal latency (2.34 ± 0.98 ms), amplitude (3.25 ± 0.98 mV), and KHS (78.91 ± 27.47 m/s) were normal. The sensory NCS picture of cervical radiculopathy was obtained, in the median nerve, the average ± SD distal latency value was normal (2.86 ± 0.51 ms), the amplitude shortened (19.37 ± 19.38 µV), and the KHS decreased (43.82 ± 20.27 m/s). In the ulnar nerve, the mean ± SD distal latency value lengthened (3.30 ± 1.78 ms), the amplitude was normal (17.13 ± 13.98 µV), and the KHS decreased (42.62 ± 16.63 m/s). The f-wave picture of cervical radiculopathy cases was obtained, normal values in the median nerve (26.47 ± 2.74 ms) and ulnar nerve (24.83 ± 1.63 ms).

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Declarations of competing interest

No potential competing interest was reported by the authors.

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