

The value of provocative tests in diagnosis of cervical radiculopathy

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Background: This study was aimed at assessing the accuracy of provocative tests in diagnosis of acute or chronic Cervical Radiculopathy (CR) based on an electrodiagnostic reference criterion. **Materials and Methods:** Shoulder Abduction Test (SAT), Spurling Test (ST), Upper Limb Tension Test (ULTT), and electromyography were done on 97 patients who referred to Electrodiagnostic center in the university hospital from January 2010 to March 2011. All of the participants had neck and radicular pain for at least 3 weeks. They were classified according to electrodiagnostic findings. Then diagnostic values of provocative tests were assessed in diagnosis of acute or chronic CR on the basis of reference criterion. **Results:** SAT and ST were more specific (85%) compared to ULTT, while ULTT was more sensitive (60.46% in acute and 35.29% in chronic) than the other two. SAT and ST had a significant accuracy for comparison between acute and chronic CR ($P < 0.05$). **Conclusion:** ULTT is suitable for screening of CR, while SAT and ST can support diagnosis. SAT and ST are good diagnostic tests for comparison between acute and chronic CR.

Key words: Cervical radiculopathy, electrodiagnostic study, shoulder abduction test, spurling test, upper limb tension test

INTRODUCTION

Cervical radiculopathy (CR) is a common condition occurring with an annual incidence rate of 63.5 to 107.3 per 100,000 for women and men, respectively.^[1,2] CR is defined as dysfunction of cervical spinal nerves and/or cervical spinal roots caused by compression and inflammation of the nerve roots by degenerative changes near cervical foraminal space (spondylosis) or as a result of disc herniation. The patients usually complain about neck and upper extremity pain with paresthesia, motor function loss, and/or reflex changes in dermatomal or myotomal distribution of the affected nerve root.^[1-5] Other causes of CR, like tumors or spinal infections, are less common.^[1,6,7] Degenerative changes at the C6-C7 level are the most frequent cause of CR that lead to C7 radiculopathy.^[1,2,4,5,8] It is suggested that smoking might be a risk factor of CR.^[5]

Prolapse of the nucleus pulposus from tear annulus fibroses usually occurs in young patients and causes acute CR while subacute CR mainly in patients with cervical spondylosis. Chronic CR is different from acute or subacute CR, having a persistent, diminished pain with poor response to conservative treatment.^[4] There is no generally accepted diagnostic criterion for CR diagnosis. Most recommendations for diagnosis are based on clinical impression of radiculopathy and using other diagnostic tests, such as diagnostic imaging or Electro Diagnostic Studies (EDX).^[1,5,9,10] However, EDX is considered to be

the most suitable reference standard in the absence of gold standard.^[9,11] On the other hand, there are some provocative tests such as Shoulder Abduction relief Test (SAT), Spurling Test (ST), and Upper Limb Tension Test (ULTT) that can reduce or aggravate radicular symptoms in the affected extremity are well defined. These tests can be performed easily in clinic by family physician and there are not aggressive, but the exact accuracy of these tests is not clear. So, using these tests as screening tests is recommended due to their time and cost benefits.

The purpose of this study was to assess the accuracy of SAT, ST, and ULTT in the diagnosis of acute or chronic cervical radiculopathy based on an electrophysiologic reference criterion.

MATERIALS AND METHODS

Our cross-sectional study was conducted on a number of individuals who were referred from neurology, orthopedic, or neurosurgery clinics, because of neck and arm pain with sensory and/or motor impairment or reflex changes of the upper extremity. This study was done in our Electrodiagnostic center in the Kashani hospital of Isfahan from January 2010 to March 2011. All of the participants had neck and radicular pain for at least 3 weeks and they had to be older than 20 years old. Those with any history of neck trauma, prior surgery on cervical spine, tumors or congenital abnormality

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of cervical spine, any systemic situation known to cause peripheral neuropathies and known cases of rheumatoid arthritis were not included in the study. Informed consent was taken of all participants. Individuals who met inclusion criteria were involved in the study and the provocative tests (SAT, ST, ULTT), as described below, were performed on all participants by two trained examiners in equal situations. Positive and negative responses to these tests were recorded by both examiners [Figure 1]. Then the individuals were divided into CR patients and healthy ones on the basis of EDX by a neurologist. Diagnosis of CR in EDX was made by the presence of normal nerve conduction study of all sensory and motor nerves in upper extremities (with or without late response abnormalities), with spontaneous muscle activity and/or neurogenic motor unit action potential (MUAP) and decreased recruitment in myotomal distribution.

The acute CR patients were diagnosed by the presence of decreased recruitment with or without spontaneous muscle activity and normal MUAP in myotomal distribution.

Patients with neurogenic MUAP with or without spontaneous muscle activity were classified as chronic CR patients [Figure 1].

Exclusion criteria were: 1—no tolerance to EMG procedure, 2—Any peripheral neuropathy diagnosed by EMG.

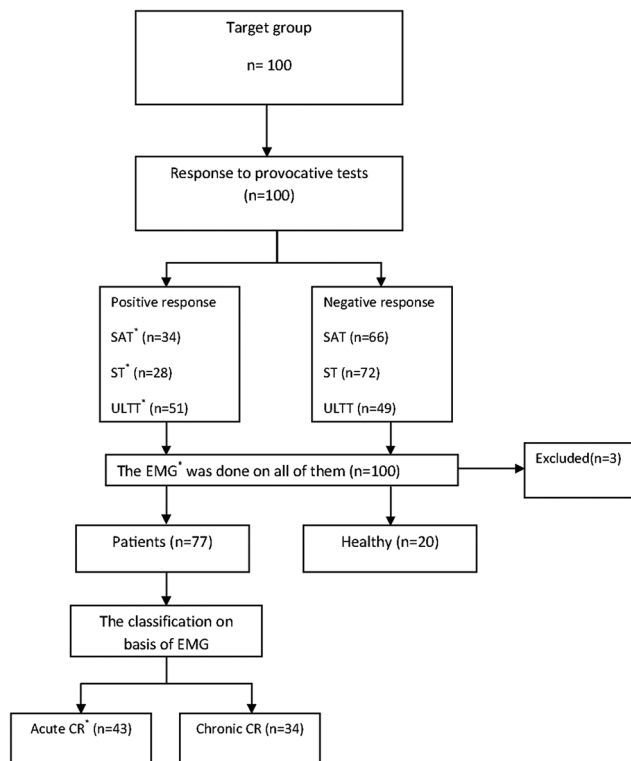


Figure 1: Design of the study

Shoulder abduction test

The participant in the seated position actively placed the palm of the affected extremity on top of the head. Positive signs were achieved when this position could relieve radicular pain.^[1,4,12]

Spurling test

While the participant was seated, the examiner pushed participant's head downward while the head was laterally flexed on the affected side. A reproduction of symptoms was considered as a positive test.^[1,4,13,14]

Upper limb tension test

In this multi-step test, the participant was asked to lie in a supine position, while the affected arm was placed on his/her body. In the first step, the arm was abducted passively by the examiner whereas the participant's forearm was in pronation and flexion situation, then the forearm was extended and supinated. Finally, the participant's hand was extended from the wrist. Reproduction of the pain in any step was considered as a positive sign.^[7]

Statistical analysis

Specificity, sensitivity, positive and negative predictive values of each test were calculated in acute and chronic CR. We used the SPSS software version 16.0 for statistical analysis and results were considered statistically significant with a level of $P < 0.05$. The Chi-square was used for comparison between the accuracy of the tests in acute and chronic CR.

RESULTS

One hundred individuals met the inclusion criteria and three of them were excluded because of failure to tolerate EMG procedure. The stages of the study have been shown in Figure 1. There were 25 males (25.80%) with mean age of 46.32 ± 13.97 years old and 72 females (74.20%) with an average of 46.14 ± 11.45 years old. There was no significant correlation between the mean of age and sex ($P > 0.05$). Twenty of them (20.60%) had no CR and among CR patients diagnosed by EMG (77 cases), 43 patients had acute CR (44.30%) with an average of 47.60 ± 12.03 years old and 34 patients had chronic CR (35.10%) with an average of 44.65 ± 12.61 years old. There was no significant relationship between the duration of disease and age either ($P > 0.05$). The most frequent nerve root involvement detected by EMG belonged to 7th cervical nerve root (49.35%) and C8 radiculopathy was the last item in the list (1.29%) [Table 1].

There was no significant relationship between the duration of disease and the level of nerve root involvement ($P = 0.59$).

Thirty-seven and 40 individuals had right and left radiculopathy, respectively.

The SAT and ST had higher specificity (85%) among provocative tests. The upper most sensitivity was 60.46% and 35.29% for ULTT in acute and chronic CR patients respectively and the highest positive and negative predictive values belonged to SAT [Table 2]. The provocative tests had lower accuracy for diagnosis of chronic CR than acute CR.

The Chi-square test showed a significant comparison in the diagnostic value of SAT and ST between acute and chronic CR with P values $P = 0.001$ and $P = 0.003$, respectively.

The ULTT had no significant relationship in discrimination of acute and chronic CR ($P = 0.063$).

DISCUSSION

The aim of the study was to evaluate the accuracy of shoulder abduction test, Spurling test, and Upper limb tension test in the diagnosis of acute and chronic cervical radiculopathy on the basis of EDX as the reference standard. According to our results, ST and SAT had moderate to high specificity and positive predictive values whether in acute or chronic CR diagnosis. The ULTT had moderate to high sensitivity in the diagnosis of acute CR and low to moderate sensitivity in the chronic form of CR, but other tests had lower sensitivity compared to ULTT. The negative predictive values in all tests were between 30% and 50% with predominance in SAT and ST. Only ULTT was not suitable for discrimination between acute and chronic radiculopathy.

Table 1: The distribution of nerve root involvement detected by EMG in attention to sex and course of disease

Course of disease	Root of involvement				Total
	C ₅	C ₆	C ₇	C ₈	
Acute CR*					
Male	4	3	10	0	17
Female	5	9	11	0	25
Chronic CR					
Male	0	1	5	0	6
Female	9	7	12	1	29
Total	18	20	38	1	77

*CR=Cervical radiculopathy; EMG=Electromyography

Table 2: The accuracy of provocative test for acute and chronic cervical radiculopathy on basis EMG reference criterion

Diagnostic value	Upper limb tension test		Shoulder abduction test		Spurling test	
	Acute CR* (%)	Chronic CR (%)	Acute CR (%)	Chronic CR (%)	Acute CR (%)	Chronic CR (%)
Sensitivity	60.46	35.29	55.81	20.85	46.51	14.70
Specificity	40.00	40.00	85.00	85.00	85.00	85.00
Positive predictive value	68.42	50.00	88.88	70.00	86.95	62.50
Negative predictive value	32.00	26.55	47.22	38.63	42.50	36.95

*CR=Cervical radiculopathy; EMG=Electromyography

The tests with high sensitivity are suitable for the general and family physicians to rule out the CR, if the tests have shown negative results and they can only refer suspected subjects with positive high specificity and PPV tests. As chronic CR patients are resistant to conservative therapy, the discrimination between acute and chronic CR can help the general practitioner to predict the prognosis of the patient. There is a discrepancy in the accuracy of diagnostic tests in different studies for diagnosis of CR which may be related to different reference standards in the absence of gold standard. For example, Shah *et al.*, reported a sensitivity of 90% and a specificity of 100% for ST in basis of operation,^[15] while in the studies with a reference standard of EMG or myelography, the sensitivity was between 30% and 50% and the specificity was between 74% and 93%.^[7,13,14] Another habit study by Shabat *et al.*, in 2011 showed the sensitivity of Spurling test to nerve root pathology to be 95% and a specificity of 94%.^[16] Our findings for ST are consistent with other similar studies with a lower sensitivity in the chronic form. One possible reason is that generally the chronic CR patients showed lower response to the tests.

The sensitivity and specificity of SAT in the study of Wainner *et al.*, was 17% and 92%, respectively.^[7] There are similarities between our results and Wikari-Juntura study for SAT, except that they have used myelography instead of EMG.^[13]

There were more less studies about diagnostic value of ULTT compared with the two others. Quintner *et al.*, found the sensitivity and specificity of 83% and 11% respectively for ULTT when plain film radiography findings of the cervical spine were considered as the reference standard on a population of 45 patients.^[17] These results were similar to Wainner's study findings, while they used needle EMG/NCS as the reference standard with a sample size of 82 patients.^[7] We found much lower sensitivity, one simple guess is that our sample size was larger than other studies; another possible reason is due to quality of the test performance, because these tests are operator dependent.

As described above, the most significant problem appears to be the unavailability of any gold-standard criterion for the diagnosis of CR, because of the false positive rate of the imaging that decrease the specificity of the tests and

false negative rate of the EDX that leads to a decrease of the sensitivity.^[9] Use of multiple tests can help establish the diagnosis in the suspected patients especially when the tests with high sensitivity and those with high specificity and high PPV are used together.

According to our findings, all diagnostic values of the tests except specificity were lower in chronic CR in comparison with acute CR due to the false negative rate of chronic CR, but only the positive SAT and ST can be suggestive of acute CR because of higher sensitivity in acute CR compared to chronic and *P* value of less than 0.05 is recommended for discrimination of acute and chronic CR in these tests.

We recommend that a combined study of imaging studies and EDX should be considered as to determine the optimal gold standard. Also, the assessment of the impact of other peripheral neuropathies, such as Carpal Tunnel Syndrome (CTS), in the accuracy of the provocative tests is recommended.

CONCLUSION

This study suggests using ULTT for screening purposes in patients with neck and arm pains to diagnose CR, so the negative test can minimize further workups. In contrast, physicians can use SAT and ST for confirmation of CR especially the acute form in suspected patients, because of the high specificity, PPV and the discrepancy of diagnostic value among acute and chronic patients. Regarding the lower accuracy of the provocative tests in chronic CR, especially SAT and ST, we can conclude that in the patients with prolonged symptoms, these tests can be negative and lead to no diagnosis of CR.

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