



COMPARATIVE STUDY OF THE HOFFMANN'S SIGN AND INVERTED RADIAL REFLEX IN THE DIAGNOSIS OF PATIENTS WITH COMPRESSIVE CERVICAL MYELOPATHY

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ABSTRACT

Background: Cervical cord compressive myelopathy (CCCM) is characterized by spinal cord compression due to physiologic narrowing of the sagittal diameter of the spinal canal secondary to congenital and degenerative changes in the cervical spine. Its clinical diagnosis is based largely on initial examination findings during a clinical screening, followed by imaging verification of cord injury or compression. There are contradictory reports regarding the clinical significance of Hoffmann's sign and Inverted Radial Reflex (IRR) with the MRI findings consistent with compressive cervical myelopathy. The present study endeavored to produce the significance and association of the Hoffmann's sign and Inverted Radial Reflex for a sample of patients using a clinical diagnosis and Imaging confirmation as the reference standard for compressive cervical myelopathy. **Objectives:** The objective of this study was to determine the significance and association of Hoffmann's Sign and Inverted Radial Reflex for the diagnosis of compressive Cervical Myelopathy. **Methods:** A total of 50 (Mean age: 44.74, range 10-80 years) patients were recruited with the clinical diagnosis of compressive cervical myelopathy irrespective of age, sex and occupation admitted for surgery in Department of Neurosurgery, Bangabandhu Sheikh Mujib Medical University. **Results:** The Sensitivity and accuracy of Hoffmann's Test reported from our study was 75.6% and 76% respectively whereas, Sensitivity and accuracy of IRR was 68.9% and 70%, respectively. There was a significant association between the Hoffmann's sign and the MRI findings of compressive cervical myelopathy seen in MRI of cervical spine ($P = 0.010$). Similar, association was also found between Inverted Radial Reflex and the MRI findings of cervical spine, $P = 0.031$. The strength of agreement between the Hoffmann's sign and the MRI findings showed fair correlation with kappa value of 0.294. The Kappa test also revealed the fair agreement between the inverted radial reflex and MRI findings of compressive cervical myelopathy with K-value 0.227. **Conclusion:** This study reported Hoffmann's sign and inverted radial reflex as an essential diagnostic tool to rule in and rule out compressive cervical myelopathy. In comparison of two tests, Hoffmann's sign was more sensitive, efficacious and strongly associated with MRI findings compared to IRR. MRI may not be essential for clinical diagnosis, however, MRI have major contribution during planning of surgery.

KEYWORDS: Hoffmann's sign, Inverted Radial Reflex, Compressive Cervical Myelopathy, Magnetic Resonance Imaging.

INTRODUCTION

Cervical cord compressive myelopathy (CCCM) is a syndrome characterized by progressive narrowing of the spinal canal in the cervical spine (Benzel and Ghogawala, 2013). The narrowing of the spinal canal causes compression of the spinal cord. The Hoffmann's sign has been in clinical use for approximately a hundred years. The test is performed by supporting the patient's hand so that it is completely relaxed and the fingers are partially flexed. The middle finger is firmly grasped, partially extended, and the nail snapped by the

examiner's thumbnail. The snapping should be done with considerable force, even to the point of causing pain. The sign is present if quick flexion of both the thumb and index finger results.

The inverted radial reflex (IRR) is done by tapping the brachioradialis tendon by the reflex hammer at the distal end of the radius, with patient forearm supported by examiner with forearm in slight pronation and flexion. The test is said positive if diminished response is noted in the brachioradialis muscle along with the reflex

contraction of the spastic fingers (Estanol and Marin, 1976). Flexion of the fingers in response to eliciting the brachioradialis reflex said to be pathognomonic of cervical spine myelopathy (Wiggins and Shaffrey, 2007).

The objectives of this study were twofold first to assess the significance and association of the Hoffmann's sign and inverted radial reflex for the diagnosis of compressive cervical myelopathy, and to find out whether inverted radial reflex alone is sufficient for the diagnosis of compressive cervical myelopathy.

MATERIALS AND METHODS

A total of 50 (mean age: 44.74, Range: 10-80 years) patients were recruited with the clinical diagnosis of compressive cervical myelopathy irrespective of age, sex and occupation admitted for surgery in Department of Neurosurgery, Bangabandhu Sheikh Mujib Medical University.

This was an observational prospective study carried out between March 2015 to September 2016 in Department of Neurosurgery, Bangabandhu Sheikh Mujib Medical University, Shahbag, Dhaka. The written informed consent was obtained from each individual and the ethical committee approved the study.

SAMPLING TECHNIQUE

Non probability convenient sampling was done. The Demographic and clinical variables include age, gender and occupation of the patients, Hoffmann's sign Inverted Radial Reflex. MRI related Variables include disc herniation, spinal tumors, atlantoaxial dislocation, subluxation of cervical spine, Ossification of the posterior longitudinal ligament (OPLL).

STATISTICS ANALYSIS

Analysis was done to know the comparison between clinical variables i.e. the Hoffmann's sign and Inverted Radial reflex and the MRI findings along with the significance of the above mentioned test in diagnosing the case of compressive cervical myelopathy. For statistical analysis, software SPSS (statistical package for social science), version 23 was used. A P-value of 0.05 was considered significant. Statistical test used to analyses the data were chi square test, sensitivity, specificity, accuracy, positive predictive value, negative predictive value, likelihood ratios, p-value and phi Cramer V test. The strength of agreement between Hoffmann's sign, Inverted Radial Reflex and MRI findings consistent of compressive cervical myelopathy was calculated using Kappa statistics.

RESULTS

In a total of 50 subject population study, 28% belongs between 40-49 years, followed by 24% were in between 50-59 years, 20% were in between 30-39 years, 16% were above 60 years of age, 6% were in between 10-19 years of age and 6% between 20-29 years. About 76% of

the patients were males and 24% were females with a male to female ratio of 3:1.

35 (70%) of the patients had Hoffmann's sign positive 15 (30%) patients had Hoffmann's sign negative 33 (66%) of the patients had inverted radial reflex positive, 17 (34%) patients had inverted radial reflex negative. Sensitivity of Hoffmann's Test was found to be 75.6% which states 75.6% probability, the positive likelihood ratio of Hoffmann's sign was 3.78, negative likelihood ratio of 0.31, Positive predictive value of 97.14%, Negative predictive value of 26.67%, with accuracy of Hoffmann's test was 76%. The Sensitivity of IRR was 68.9% which states, 68.9% probability, Specificity of IRR was 80.0%, the positive likelihood ratio of 3.44 and negative likelihood ratio of 0.39, Positive predictive value of the test was 96.88%, Negative predictive value of 22.22%, diagnostic accuracy of the test was 70%. Pearson chi-square test for association between the Hoffmann's sign and the MRI findings showed that there was the significant association between the compressive cervical myelopathy seen in MRI of cervical spine along with the Hoffmann's sign with $P= 0.010$. Pearson chi-square test for association between Inverted Radial Reflex and the MRI findings showed that there was association between the MRI findings of cervical spine with the Inverted Radial Reflex with $P= 0.031$. The strength of agreement between the Hoffmann's sign and the MRI findings was calculated using kappa statistics (k-value). The test revealed the fair agreement between the Hoffmann's sign and MRI findings consistent of compressive cervical myelopathy with K-value 0.294. Further, it was also seen fair agreement between the inverted radial reflex and MRI findings consistent of compressive cervical myelopathy with K-value of 0.227.

DISCUSSION

Cervical cord compressive myelopathy is characterized by spinal cord compression due to physiologic narrowing of the sagittal diameter of the spinal canal secondary to congenital and degenerative changes in the cervical spine (Cook et al., 2009). The clinical examination for myelopathy includes the use of Hoffmann's sign, deep tendon reflex testing, inverted radial reflex, suprapatellar quadriceps reflex testing, hand withdrawal reflex testing, planter response and clonus. Consequently, the purpose of this study was to assess the inter-rater reliability and diagnostic accuracy of Hoffmann's sign and Inverted Radial Reflex and subjective findings associated with a MRI confirmed diagnosis of cervical spine myelopathy.

The present study showed that the mean age of the compressive cervical myelopathy patient was 44.74 years with lowest and highest ages were 10 and 80, respectively which is lower in comparison with the findings of two other studies where mean ages of the study patients were 49 years and 48 years, respectively (Brain et al., 1952 and Bradshaw et al., 1957).

The predominance of male population with CCM had been frequently confirmed, was presumably related to occupational trauma (Wenzel, 1984 and Lane, 1986). In our study, day laborer about 36% more commonly presented with compressive cervical myelopathy.

In a study conducted by Cook *et al.* (2010) the sensitivity to the Hoffmann's sign was found to be in 61% and specificity 72 %. With positive likelihood ratio of 3.9 and negative likelihood ratio of 0.33, the positive predictive value was found to be 86% and negative predictive value was 24.8%. The efficacy they found for the Hoffmann's test was about 65%. In our present study we found 70% of patient out of 50 patients had Hoffmann's sign positive with sensitivity of 75.6% and specificity of 80% which was higher than the above mentioned study. The positive likelihood ratio of Hoffmann's sign was found to be 3.78 and negative likelihood ratio of Hoffmann's sign was found 0.31. The positive predictive value was 97.14% and the negative predictive value was 26.67%. The efficacy of the test was found 76%. The sensitivity, specificity, positive predictive value, efficacy of Hoffmann's sign was found higher in our studies compared to other studies.

In another study conducted by Cook *et al.* (2009), 60% patient had inverted radial reflex positive with sensitivity 61% and specificity 78% with positive likelihood ratio of 2.8 and negative likelihood ratio of 0.5, the positive predictive value was found to be 82% and negative predictive value was 33.6%. The efficacy they found for the inverted radial reflex was about 64%. In our present study we found 66% of patient out of 50 patients had inverted radial reflex positive with sensitivity of 68.9% and specificity of 80% which was higher than the above mentioned study. The positive likelihood ratio of inverted radial reflex was found to be 3.44 and negative likelihood ratio of inverted radial reflex was found 0.39. The positive predictive value was 96.88% and the negative predictive value was 22.22%. The efficacy of the test was found 70%. The sensitivity, specificity, positive predictive value, efficacy of inverted radial reflex was found higher in our study compared to other studies.

The study conducted by Houten and Nose (2008) showed there was strong association between Hoffmann's sign and MRI findings of compressive cervical myelopathy. In our present study, we found there was significant association between Hoffmann's sign and MRI findings of compressive cervical myelopathy, where p-value was 0.010.

A study by Cook *et al.* (2010) showed there was strong association between inverted radial reflex and MRI findings of compressive cervical myelopathy. In our present study we also found there was significant association between Inverted radial reflex and MRI findings of compressive cervical myelopathy, where p-value was 0.031 (p-value <0.05).

In our study 50 (100%) patients had sign and symptoms of compressive cervical myelopathy out of which 35(70%) had positive Hoffmann's sign and 33(66%) had positive Inverted radial reflex which on MRI was found to be 45(90%), showing fair agreement between two modalities of diagnosing the compressive cervical myelopathy (k-value 0.294 and 0.227, respectively). So, for evaluation of compressive cervical myelopathy MRI is very essential tool.

CONCLUSION

Positive Hoffmann's sign and Positive Inverted Radial Reflex associate well with the MRI findings consistent with the compressive cervical myelopathy but all the positive Hoffmann's Sign and the Inverted Radial Reflex may not have the compressive cervical myelopathy in MRI. The presence of positive Hoffmann's sign and Inverted Radial Reflex act as valuable diagnostic tool clinically but further other clinical signs and symptoms must be taken into considerations. MRI may not be essential for clinical diagnosis however, MRI plays a crucial role in surgery planning.

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