The Diagnostic Accuracy of Phalen Test and Prayer Test in Carpal Tunnel Syndrome

Suroso Agus Widodo[1], Fatchur Rochman[1], Ratna D. Haryadi[1], Patricia Maria K[1]

[1]Department of Physical Medicine and Rehabilitation, Faculty of Medicine, Universitas Airlangga, Dr. Soetomo Teaching Hospital, Surabaya 60285, Indonesia

Abstract

Background of Study: Carpal Tunnel Syndrome is a series of symptoms and signs because of pressure on the median nerve in a small space in the wrist called carpal tunnel. In diagnosing CTS, it is required anamnesis and thorough physical examination which includes CTS provocation test, for instance Phalen test, Prayer test, and Tinel sign. The aim of this study is to reveal the diagnostic accuracy of Phalen test and Prayer test in diagnosing CTS.

Methods: The samples that fulfilled inclusion criteria were 19 subjects went through Phalen test, Prayer test, and nerve conduction study using CSI in Department of Physical Medicine and Rehabilitation Dr. Soetomo General Hospital Surabaya, Indonesia. The nerve conduction study using CSI was conducted by EMG Cadwell equipment. The data analysis was conducted by using SPSS software.

Result of the Study: The sensitivity of the Phalen test and Prayer test combination in diagnosing CTS was 94.1 %. The specificity of Phalen test and Prayer test combination in diagnosing CTS was 100%. The positive predictive value was 100% while the negative predictive value was 66.7%. The result of person chi-square examination was obtained asymp. Sig value of $0.001 < \alpha\ 0.05$.

Conclusion: There was a correlation between the combination of Phalen test and Prayer test with CTS.

Keywords: *Carpal Tunnel Syndrome, Combined Sensory Index, Phalen test, Prayer test,*

Introduction

Carpal Tunnel Syndrome is a series of symptoms and signs because of pressure on the median nerve in a small space in the wrist called carpal tunnel. The common symptoms include numbness, paresthesia, or the pain in distributed median nerve in the hand [1,2].

CTS has been encountered by 3% of the entire population [3]. CTS is considered the most frequent cases than other entrapment neuropathy[4,5]. There has been no specific data which specifies the number of CTS patients in Indonesia. However, there were 173 cases of CTS in Dr. Soetomo General Hospital Surabaya on October 2011 until September 2012.Only 55% of them (95 cases) visited the Medical Rehabilitation Unit. In addition, CTS is mostly encountered by females aged 40-60 years old (70%) as from 173 cases in Dr. Soetomo General Hospital Surabaya, 151 cases (87%) of the entire cases were females. CTS usually strikes both hands, however it is more severe in the dominant side of hand [6]. The increase of carpal tunnel compression of 30 mmHg can cause venous congestion in nerve and interruptaxonal transport [7]. Without adequate therapy, the nerve compression can cause median nerve damage with; consequently, the function of hands will be less or lost [1].

The electro-diagnosis examination is the only method to find out the media nerve physiology caused by CTS and eliminate other diagnosis [7]. Electrodiagnosis examination is considered as the golden standard to diagnose CTS. In fact, there are several electro-diagnosis methods in diagnosing CTS [5,8,9].One of the electro-diagnosis methods is CSI (Combined Sensory Index) that compare the median sensory nerve conduction to

Corespondence:
Fatchur Rochman
fatchurrochmanf@gmail.com

ulnar and radial nerve. This CSI method has the highest sensitivity and specificity than other electro-diagnosis methods [5]. However, most hospitals in Indonesia still cannot conduct such examination method due to the unavailability of EMG machine. In diagnosing CTS, it is required anamnesis and thorough physical examination which includes CTS provocation test [7]. The CTS provocation tests that are usually conducted in the Medical Rehabilitation Unit Dr. Soetomo General Hospital Surabaya, Indonesia are Phalen test, Prayer test, and Tinel sign. The aim of this study is to reveal the diagnostic accuracy of Phalen test and Prayer test in diagnosing CTS.

Method

This study was an observational analytic study conducted using Cross Sectional [10] approach in Department of Physical Medicine and Rehabilitation Dr. Soetomo General Hospital Surabaya, Indonesia since November 2012 until January 2013. The sample was collected on the basis of consecutive sampling [11]. The samples of this study were CTS patients who fulfilled inclusion criteria (patients with CTS symptoms aged 20-60 years old, no movement limitations in upper limb joins, understood and followed the test rules, and fulfilled the requirements in following nerve conduction examination) and signed the informed consent forms. Ninetine subjects who fulfilled the inclusion criteria encountered Phalen test, Prayer test, and nerve conduction study using CSI on the same day. The nerve conduction study using CSI was conducted by using EMG Cadwell equipment (xx,yy, zz). The study protocol was approved by the Ethical Commission to conduct basic science/clinical research in Dr. Soetomo General Hospital Surabaya. The analysis of data was conducted by using SPSS software (SPSS, Inc,. Chicago, IL).

Result

Table 1 The characteristic of research sample

	Minimum	**Maximum**	**Average**
Age (years)	45	59	51.7
Height(cm)	145	155	151
Weight(kg)	47	75	58.1
BMI	20.89	32.04	25.4

BMI : .....

Table 2 The result of Phalen test in CSI

Positive		**CSI**		**Total**
		Negative		
Phalen test	Positive	14	0	14
	Negative	3	2	5
Total		17	2	19

CSI: .....

Table 3 The result of Prayer test in CTS

Positive		**CSI**		**Total**
		Negative		
Prayer test	Positive	15	0	15
	Negative	2	2	4
Total		17	2	19

Table 4 The combination of Phalen test and Prayer test in CSI

Positive		**CSI**		**Total**
		Negative		
The combination of Phalen test and Prayer test	Positive	16	0	16
	Negative	1	2	3
Total		17	2	19

The samples were all females with the average age of 51.7, with the age range of 45–59 years old. The average BMI was 25.4, with the BMI range of 20.89-32.24.30% of samples worked as employees in particular cigarette factory in Surabaya, 20% of them worked as housemaids, 20% of them worked as housewives, and 10% of them worked as private practice midwives (Table 5.1). On the average, the subjects have encountered CTS symptoms for 19.3 months.

From 19 hands, 17 hands of them (89.5%) suffered from CTS while 2 other hands (10.5%) did not encountered CTS From 17 hands that suffered from CTS, 14 (82.4%) obtained positive Phalen test and 3 (17.6%) obtained negative Phalen test. The correct positive predictive value was 14 while the false positive value was 0. Moreover, the false negative was 3 (table 5.2).

We obtained the sensitivity value of Phalen test in CTS was 82%. The specificity value of Phalen test in CTS was 100%. The positive predictive value was 100% while the negative predictive value was 40%. The AUC value of Phalen test was 0.912 (Figure 5.1). From 17 hands that suffered from CTS, 15 (88.2%) of them were with positive Prayer test result and 2 (11.8%) of them were with negative Prayer test result. The correct positive value was 15 while the correct negative was 2. The false positive was 0 while the false negative was 2 (table 3).We obtained the sensitivity value of Prayer test in CTS was 80% while the specificity was 88%. The specificity of Prayer test in CTS was 100%. The positive predictive value was 100% while the negative predictive value was 50%. The value of AUC in Prayer test was 0.941 (Figure 5.2).

From 17 hands that suffered from CTS, 16 (94.1%) were the combination of positive Phalen test and Prayer test result and 1 (5.9%) were negative. The correct positive value was 16 and the correct negative was 2. The false positive was 0 and false negative was 1 (Table 5.4). We obtained the sensitivity value of the Phalen test and Prayer test combination in CTS 94.1 %. On the other hand, the specificity of the Phalen and Prayer test combination in CTS was 100%. The positive predictive value was 100% while the negative predictive value was 66.7%.

To examine the correlation between Phalentestand CTS was conducted through Pearson Chi Square examination. The result of person chi-square examination was obtained asymp. Sig value of 0.012< α 0.05. It meant that there was a correlation between Phalen test and CTS.

To examine the correlation between Prayer test and CTS was conducted through Pearson Chi Square examination. The data analysis was conducted by using SPSS software version 20. The result of person chi-square examination was obtained asymp. Sig value of 0.004< α 0.05. It meant that there was a correlation between Prayer test and CTS. To examine the correlation between Phalen and Prayer test with CTS was conducted through Pearson chi-square examination. The data analysis was conducted by using SPSS software version 20. The result of person chi-square examination was obtained asymp. Sig value of 0.001< α 0.05. It meant that there was a correlation between the combination of Phalen test and Prayer test with CTS.

Discussion

All the samples were females with average age of 51.7 and with the age range between 45 – 59 years old. This demographic data was based on the result of Craig and Richardson's study in 2011 [6] which asserted that women are more likely to have carpal tunnel syndrome than men. They further stated that carpal tunnel syndrome is most frequently diagnosed between the ages of 40 and 60. Women are more likely to have carpal tunnel syndrome than men because the size of carpal tunnel is smaller than men's [6].

The average BMI in this study was 25.4, between the ranges of BMI 20.89–32.24. Obesity is one of the factors for carpal tunnel syndrome. The risk of having CTS will increase in obesity patients.In individuals with BMI >29, the CTS risk increases 2.5 time compared to individuals with BMI <20 [9].

All the subjects had works that required them to do repetitive motions in their wrists. 30% of the research samples worked as employees in particular cigarette factory in Surabaya. Employees of cigarette factory are much related to repetitive motions to all directions using their wrists. 20% of the samples worked as housemaids that were also related to repetitive motions. 20% of them worked as housewives and 10% worked as private practice midwives. The number of CTS risks will increase in the workers that require them repetitive and excessive hand movements [12,13]

The diagnostic test with sensitivity and specificity value of > 50 % is considered high and proved to diagnose a particular disease [14].The diagnostic accuracy of Phalen test and Prayer test in this study was reported in ROC (Receiver Operating Curve). The most important section in ROC is the measurement result in Area Under Curve (AUC). The vast of AUC was used to assess how accurate a diagnostic test was. A diagnostic accuracy of a test was considered high if it had the AUC value of 1 [14].

The sensitivity value of Phalen test in CTS was 82% whereas the specificity was 100%. The value of AUC in Phalen test was 0.912 (near 1). The sensitivity in Prayer test in this study was 88% while the specificity was 100%.The AUC value of Prayer test in CTS was 0.941. It meant that Phalen test and Prayer test had high accuracy to detect the occurrence of CTS due to the value of sensitivity and specificity was each > 50% and the value of AUC was nearly 1.

The hypothesis of this study stated that Phalen test and Prayer test had high diagnostic accuracy sensitivity, and specificity in diagnosing CTS. The result of this study supported the previous study that was conducted by J. Bruske et al. about the sensitivity and specificity of Phalen and Tinel test in CTS. These samples of their study were 147 hands of 112 patients who underwent CTS operation in General and Hand Surgery, Pomeranian, Polandia from 1993 -1998. The CTS diagnosis was on the basis of electro-diagnosis with the nerve conduction study (the median sensory nerve conduction speed < 40 m/s and distal motor latency > 0.6 ms/cm).The sensitivity in Phalen test in J. Bruske et al.'s study was 85% while the specificity was 89% [8]. In this study, in sensitivity and specificity in Phalen test was higher than the result of J. Bruske et al. [8]. It was because, in our study, we applied electro-diagnosis examination using CSI that had higher diagnostic accuracy, sensitivity, and specificity than J. Bruske et al.'s study [8].

Sayeeda Bilkis, et al. in 2012 conducted a study in 66 hands of 37 patients aged more than 18 years old which found the sensitivity Phalen test of 50 %, while the specificity was 100%. Electro-diagnosis examination was considered as the golden standard. The electro-diagnosis method that was used in this study applied CSI method, in which it was the difference in peak latency between the ulnar nerve and the median nerve from the

palm of the hand to the wrist. The electro-diagnosis was considered positive if the difference in peak latency between the ulnar nerve and the median nerve from the palm of the hand to the wristwith 8 cm showing the difference of >0.3 ms[15].

We found that the sensitivity in Phalen test was 82 % which was higher than the study conducted by SayeedaBilkis et al.[15]. It was because we added up the comparison of the ulnar nerve and the median nerve from the palm of the hand to the forth finger, the comparison of the radialis nerve and the median nerve from the palm of the hand to the thumb, the comparison of the ulnar nerve and the median nerve from the palm of the hand to the wristwith the distance of 8 cm.

Filip Georgiew, et al. [16] conducted a study in 215 hands from 163 CTS patients, who were confirmed by electro-diagnosis examination, stated that the sensitivity of Phalen test depends on the severity of CTS. The more severe the CTS is, it will be more sensitive.In the very mild CTS, the sensitivityin Phalen test was 63%.In the mild CTS, the sensitivity in Phalen test was78.7%. In the medium CTS, the sensitivity in Phalen test was 97.3%, while in the heavy and very heavy CTS, the sensitivity in Phalen test was 100% (14). Because of sample limitations in our study, we did not calculate the sensitivity of Phalen and Prayer test with the CTS severity.

The result of the study stated that the sensitivity of Prayer test (88%) was higher that Phalen test (82%). It was in accordance with Denis Cerimegic et al. from Departemen Neurology of Dubrofnik, Croasia in 2010) [17]. They conducted a nerve conduction study in CTS patients in three positions: neutral position, maximum extension and maximum flexibility from the wrist. It was examined the motorist nerve conduction and sensory in median nerve in the wrist area. The electro-diagnosis result in the extension position of the wrist (Prayer position) was worse than other two positions [17].

This study was expected in giving the benefits from scientific knowledge and enriching the information about the diagnostic accuracy, sensitivity, and specificity in Phalen and Prayer test in diagnosing CTS. In addition, it provides the contribution in the development of diagnosis management and therapy towards CTS patients. Phalen test and Prayer test had sensitivity, specificity, and diagnostic accuracy in diagnosing CTS. In the hospitals that have not provided electro-diagnosis equipments, CTS diagnosis can be conducted with thorough anamnesis, and the right combination of Phalen test and Ptayer test.

Conflict of Interest : There is no conflict interest

Source of Funding : This study is self-funded

Ethical of Cleareance : This study was approved by Ethical Commision of Health Research Faculty of Medicine University of Airlangga

Conclusion

1. The sensitivity of Phalen test in diagnosing CTS was 82%.
2. The specificity of Phalen test in diagnosing CTS was 100%.
3. The sensitivity of Prayer test in diagnosing CTS was 88%.
4. The specificity of Prayer test in diagnosing CTS was 100%.
5. The sensitivity of the Phalen test and Prayer test combination in diagnosing CTS was 94.1 %.
6. Prayer test was more sensitive in diagnosing CTS than Phalen test was.
7. The combination of Phalen test and Prayer test in diagnosing CTS had higher sensitivity value than Phalen test itself or Prayer test itself.

References

1. Marshall SC, Tardif G, Ashworth NL. Local corticosteroid injection for carpal tunnel syndrome. Cochrane Database Syst Rev. 2007;(2).
2. Mohammadi A, Afshar AR, Etemadi A, Masoudi S, Baghizadeh A. Diagnostic value of cross-sectional area of median nerve in grading severity of carpal tunnel syndrome. Arch Iran Med. 2010;13(6):516–21.
3. Rempel D, Evanoff B, Amadio PC, De Krom M, Franklin G, Franzblau A, et al. Consensus criteria for the classification of carpal tunnel syndrome in epidemiologic studies. Am J Public Health. 1998;88(10):1447–51.
4. Kimura J. Electrodiagnosis in disease of nerve and muscle. 2nd edi. Philadelphia, FA Davis Co. 1981;
5. Robinson LR. Electrodiagnostic Evaluation of the Peripheral Nervous System. Fifth ed ed. In: Frontera WD, JA (eds.) editor. Philadelphia: Lippincott Williams & Wilkins, Wolter Kluwer; 2010.

6. Craig A, Richardson JK. Rehabilitation of Patients with Neuropathies. Physical Medicine and Rehabilitation (Braddom R.). Elsevier. Philedelphia; 2011.
7. Weiss L, Weiss J, Pobre T. Oxford American Handbook of Physical Medicine & Rehabilitation. Oxford University Press, USA; 2010.
8. Bruske J, Bednarski M, Grzelec H, Zyluk A. The usefulness of the Phalen test and the Hoffmann-Tinel sign in the diagnosis of carpal tunnel syndrome. Acta Orthop Belg. 2002;68(2):141–5.
9. Werner RA, Andary M. Electrodiagnostic evaluation of carpal tunnel syndrome. Muscle Nerve. 2011;44(4):597–607.
10. Wabula H, Rochmah TN, Chalidyanto D, Robby HD. Impact of organizational climate and job involvement on leprosy surveillance performance in Sampang District, Indonesia. J Public Health Africa [Internet]. 2019;10(S1). Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85074434354&doi=10.4081%2Fjphia.2019.1171&partnerID=40&md5=1e207c275557efac4b619f1b7bd58105
11. Rhatomy S, Tanzil H, Setyawan R, Amanda C, Phatama KY, Andrianus J, et al. Influence of anthropometric features on peroneus longus graft diameter in Anterior Cruciate Ligament reconstruction: A cohort study. Ann Med Surg [Internet]. 2019;48:77–80. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0 -85074417989&doi=10.1016%2Fj.amsu.2019.10.023 &partnerID=40&md5=837229348eed8d88321bd9110497248a
12. Qiyunshi J CMD. Is Surgical Intervention More Effective than NonSurgical Treatment for Carpal Tunnel Syndrome? J Orthop Surg Res. 2011;2011;6(17).
13. Ibrahim I, Khan WS, Goddard N, Smitham P. Suppl 1: carpal tunnel syndrome: a review of the recent literature. Open Orthop J. 2012;6:69.
14. Kotwal PP, Varshney MK. Carpal tunnel syndrome: current concepts. JIMSA. 2011;24(1):21–5.
15. Bilkis S, Loveman DM, Eldridge JA, Ali SA, Kadir A, McConathy W. Modified Phalen's test as an aid in diagnosing carpal tunnel syndrome. Arthritis Care Res (Hoboken). 2012;64(2):287–9.
16. Filip G, Oftinoswska E, Adamczyk T. An Evaluation of Sensitifity of Provocative Tests Used in The Carpal Tunnel Syndrome Diagnosis Depending on Clinical Severity of The Syndrome. Med Rehabil. 2009;2009;13(2).
17. Cerimagic D, Bilic E. CARPAL TUNNEL SYNDROME reverse Phalen's versus Phalen's maneuver. Transl Neurosci. 2010;1(1):59–61.