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ORIGINAL ARTICLE

Forensic Implications of Carpal Tunnel Syndrome in Relation to Neurological, Radiological and Orthopedic Assessments

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ABSTRACT

Objective: To determine forensic implications of carpel tunnel syndrome in relation to neurological, radiological and orthopedic assessments.

Study Design: Prospective

Place and Duration of Study: Department of Forensic Medicine in collaboration with Radiology and Orthopaedic Departments, Govt. Khawaja Muhamamd Safdar Medical College Sialkot from 1st March 2020 to 28th February 2021.

Methodology: One hundred and fifty patients of both genders were enrolled and age between 15-70 years. Details demographics age, sex and body mass index of all patients were recorded after taking written consent. Patients were divided into 2 groups. Group I had 75 patients with carpal tunnel syndrome and group II had 75 patients without carpal tunnel syndrome. Patients were undergone for ultrasonography and ultradiagnostic test used to diagnose the carpal tunnel syndrome. The carpal tunnel and proximal levels of the median nerve's CSA were measured, delta cross-sectional area (CSA) was determined for each wrist based on the differences between CSAc and CSAp. Sensitivity and specificity in wrists among both groups were identified.

Results: There were 15 (20%) males and 60 (80%) females in group I with 90 wrists while in group II 17 (22.7%) males and 58 (77.3%) females in group II with 100 wrists. Mean age in group I was 49.68±9.66 years with mean BMI 26.47±9.54 kg/m^2 and in group II mean age was 51.68±9.66 years with mean BMI 25.47±9.54 kg/m^2. Mean CSAc in affected wrists group I was 17.11±6.44 greater than group II 08.17±6.58 mm^2. Mean delta CSA in healthier wrists was lower 1.01±2.11 than group I 8.44±9.55 mm^2. It was shown that the delta-CSA threshold of 2 mm^2 had the maximum sensitivity (98.7%) and specificity (100%) in group I than control group.

Conclusion: As compared to CSAc, the CSA is more accurate in diagnosing carpal tunnel syndrome.

Keywords: Carpel tunnel syndrome (CTS), CSA, Wrists, Specificity, Sensitivity, Ultrasonography

INTRODUCTION

There are roughly 2.7 million doctor's office visits every year in the United States that are connected to patients complaining of finger or hand symptoms. It can be caused by nerve impingement, tendon disease, overuse of muscles or nonspecific pain syndromes.[1] One of the most prevalent types is carpal tunnel syndrome, which accounts for 90 percent of all entrapment neuropathies.[2,3] One in five patients who complain of pain, numbness, and tingling in their hands will be diagnosed with CTS on the basis of clinical examination and electrophysiological testing, according to current expectations.[3] In the general population, CTS is estimated to affect 3.8 percent of people[4-5], with an annual incidence rate of 276:100,000.[6] It affects more women than men, with a prevalence rate of 9.2 percent in women and 6 percent in males.[7] Patients as young as twenty and as old as eighty-seven years old have been diagnosed with it bilaterally.[8]

It's located at the base of the palm. It is partially enclosed by the eight carpal bones, and partially by the transverse carpal ligament, a thick fibrous roof (TCL). Eight digital flexor tendons (two for each of the four middle fingers) flow via this tunnel, as does the thumb's flexor pollicis longus (FPL) tendon, as well as the median nerve (MN).[1] Carpal tunnel syndrome is consequently very densely packed, and any condition that could increase the volume of the structures within it could force MN to compress as a result of that. An ischemia of the nerve, which manifests as pain and paresthesia, may result from this process.[8,9]

A symptomatic compression neuropathy of the median nerve at the wrist is defined by the American Academy of Orthopedic Surgeons (AAOS). Symptoms of CTS can be seen in the fingertip when MN is compressed. In contrast, CTS has no impact on the palm of the hand, which is supplied by the sensory cutaneous branch of the median nerve (PCBMN). These fluctuations in pressure within the CT do not affect the TCL branch, which emerges around 6 cm in front of the TCL.[3]

In addition, idiopathic CTS with a tingling sensation along the MN distribution in the hands is the most common diagnosis in patients with pain and numbness.[10] Even though this syndrome is well-known, its cause is still a mystery. Recently, biomechanical, magnetic resonance imaging (MRI) and histological studies have strongly suggested that CTS is caused by dysfunction of neuronal vessels, synovial tissue, and flexor tendons inside the CTS.[11,12] To generate a tunnel-like groove, the carpal bones articulate to form a backward convex bony arch on the dorsal side and concave on the palmar side. An arched flexor retinaculum (FR) abuts this osseous groove, transforming the sulcus carpi into the carpal tunnel.

It has been attempted by a number of study investigators to identify the optimal median nerve CSA cutoff value.[13,14] The literature is divided on the optimal CSA threshold for diagnosing CTS. An upper limit of 15 millimeters was advocated in one study, while cutoff values of 9 to 12 millimeters have been proposed in the majority of studies.[15] Larger than 9mm2[16] and 10mm2[17,18] CSAs have been reported in patients with CTS at the scaphoid-pisiform level. Using an extra cross-sectional measurement of the median nerve positioned closer to the pronator quadratus muscle, we hoped to improve the accuracy of CTS diagnosis.

MATERIALS AND METHODS

This prospective study was conducted at Department of Forensic Medicine in collaboration with Radiology and Orthopaedic Departments, Govt. Khawaja Muhamamd Safdar Medical College Sialkot from 1st March 2020 to 28th February 2021 and comprised of 150 cases with 190 wrists. Patient's details demographics age sex and BMI index were recorded after taking informed written consent. Patients with severe medical illness and those did not give any written consent were excluded. Patients were aged between 20-70 years age. Patients were divided into 2-groups. Group I had 75 patients with CTS and group II had 75 patients without CTS. Patients were undergone for ultrasonography and ultradiagnostic test used to diagnose the CTS. The carpal tunnel and proximal levels of the median nerve's CSA were measured, delta CSA was determined for each wrist based on the differences between CSAc and CSAp. Sensitivity and specificity in wrists among both groups were identified. Complete data was analyzed by SPSS 24.

RESULTS

There were 15 (20%) males and 60 (80%) females in group I with 90 wrists while in group II, 17 (22.7%) males and 58 (77.3%) females in group II with 100 wrists. Mean age in group I was 49.68±9.66 years with mean BMI 26.47±9.54 kg/m^2 and in group II mean age was 51.68±9.66 years with mean BMI 25.47±9.54 kg/m^2 (Table 1).

Table 1: Baseline details demographics of enrolled cases

Variable	Group I	Group II
Mean age (years)	49.68±9.66	51.68±9.66
Mean BMI (kg/m^2)	26.47±9.54	25.47±9.54
Gender		
Male	15 (20%)	17 (22.7%)
Female	60 (80%)	58 (77.3%)
Wrists		
Left	55	45
Right	35	55

Table 2: Comparison of nerve measurements among both groups

Measurement	Group I	Group II
CSAc	17.11±6.44	08.17±6.58
CSAp	10.1±6.4	7.6±6.8
Delta CSA	8.44±9.55	1.01±2.11

Mean CSAc in affected wrists group I was 17.11±6.44 greater than group II 08.17±6.58 mm^2. Mean delta CSA in healthier wrists was lower 1.01±2.11 than group I 8.44±9.55 mm^2. Mean CSAp in group I was 10.1±6.4 and in group II was 7.6±6.8 mm^2 (Table 2). The delta-CSA threshold of 2 mm^2 had the maximum sensitivity (98.7%) and specificity (100%) in group I than group II in wrists (Table 3).

Table 3: Comparison of sensitivity and specificity of nerve measurements in the diagnosis of CTS among both groups

Delta CSA with 2-mm^2 Threshold	Group I	Group II
Sensitivity	89 (98.7%)	95 (95%)
Specificity	90 (100)	98 (98%)

DISCUSSION

In most situations, electrodiagnostic tests can confirm the diagnosis of CTS based on common clinical indications and symptoms.[19] Mean age in group I was 49.68±9.66 years with mean BMI 26.47±9.54 kg/m^2 and in group II mean age was 51.68±9.66 years with mean BMI 25.47±9.54 kg/m^2. Our findings were comparable to the previous findings.[20] There were 15 (20%) males and 60 (80%) females in group I with 90 wrists while in group II, 17 (22.7%) males and 58 (77.3%) females in group II with 100 wrists.[21,22]

The carpal tunnel comprises the wrist bones and the transverse carpal ligaments at the bottom and the top of the wrist.[23] Wong et al[24] suggested a protocol that included a first US examination for those suspected of having CTS, followed by further electrodiagnostic testing only if the US examination was negative. To detect space-occupying lesions that produce symptoms of CTS, such as ganglia and fibromatous lesions as well as to detect an enlarged median nerve circumferential area in patients with CTS, ultrasound is employed.[25] In our study mean CSAc in affected wrists group I was 17.11±6.44 greater than group II 08.17±6.58 mm^2. Mean delta CSA in healthier wrists was lower 1.01±2.11 than group I 8.44±9.55 mm^2. Mean CSAp in group I was 10.1±6.4 and in group II was 7.6±6.8 mm^2. These were comparable to the previous study.[20] Our investigation found that the US diagnosis of CTS was highly accurate. Considering that ultrasound is less invasive than electrodiagnostic testing, clinical examination combined with ultrasound may be the best strategy in future.

A delta CSA of 2 mm^2 or above is considered an optimal test threshold for the diagnosis of CTS. Our CSA measure has a significant diagnostic advantage over the CSAc when diagnosing CTS. We found that delta-CSA threshold of 2 mm^2 had the maximum sensitivity (98.7%) and specificity (100%) in group I than group II in wrists. As well as the transverse carpal ligament bulge, the median nerve flattening ratio, as well as the median nerve's echogenicity and mobility, are all potentially helpful metrics. In spite of the fact that these characteristics have been extensively studied and provide valuable information in the diagnosis of CTS, this study focused on the evaluation of a recently developed US method for evaluating median nerve size. In addition, we found no evidence of a relationship between median nerve thickness and body mass index or hand physiognomies (small or strong wrists).[26] Drittens, the reliability and repeatability of the US test are reliant on the operator. Inter- or intraobserver variability was not assessed in this study. Our study's design was strengthened by the inclusion of a wide range of disease

severity levels. Both mild and severe CTS patients benefited with the delta CSA, according to the study result.

One of the most commonly reported forms of median nerve compression is CTS. Squeezing or compression of the median nerve as it runs through the wrist is the cause of CTS. The median nerve syndrome is characterized by hand pain, numbness, and tingling. CTS has been described in this literature review in terms of anatomy, epidemiology and risk factors as well as stages of CTS and diagnosis and therapeutic options. In most of cases, trauma to the wrist joint region and ultimate healing of the wounds in this area results into the compression and entrapment of median nerve in this very particular area, giving complete or partial dysfunction of muscles supplying by this nerve leading to decrease in functional capacity of the movements of the fingers and sensational variability. So if this trauma is inflicted by someone else, the injured persue for medico legal case, and medicolegal expert can put these complications under ITLAF E SALAHIYYAT E UDW according to QISAS AND DIYYAT ACT, and hence these types of trauma/injuries as well as their complications can lead to severe litigations on the offenders.

CONCLUSION

When compared to the CSAc, the CSA is more accurate in diagnosing CTS. Ultrasound examination with high-frequency probes and increased power Doppler technology appears to be the most helpful and accurate way to diagnose CTS.

Injuries to wrist joint and complications as a result of trauma to median nerve should be considered regarding their medicolegal aspects and should be handled and reported carefully to forensic medicolegal examiner for proper justifications in the courts of law in future.

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