Ultrasound For Detecting Carpal Tunnel Syndrome (CTS)

Ethics

This study was a graduation thesis numbered 436 and ethically approved by the review board of Shahid Beheshti University of Medical Sciences. The written consent including all purposes and methods of the study, benefits and disadvantages of techniques and the declaration of financial support to patients involved with our study, were signed by patients and the control group.

Study methods

This was a cross sectional study which assessed the diagnostic values of ultrasound for diagnosing CTS among patients with RA. All patients with Rheumatoid Arthritis (RA) attending to the Rheumatology clinic of Loghman Hakim hospital from April 2017 to January 2018 were considered for this study. Those with medical history of diabetes, hypothyroidism, pregnancy, any types of polyneuropathy, history of injury or prior surgery at wrist, and age> 70 years were excluded. A total of 38 patients were included in our final analysis.

Demographic data including age, sex, height and weight were documented. EDx and nerve sonography were performed in an equipped center by qualified specialists. Nineteen healthy individuals were convinced and considered as the control group. Median nerve ultrasonography was performed for each healthy individual if EDx result was normal.

Electro Diagnostic test (EDx)

EDx was performed by a physical medicine specialist evaluating both motor and sensory median nerve conduction pathways according to the American Association of Neuromascular & Electrodiagnostic Medicine (AANEM). Device settings order included 20 microV/Div sensitivity and 2 ms/Div sweep speed to check the SNAP and 4000 microV/Div sensitivity and 5 ms/Div sweep speed for CMAP. The following were recorded for the upper limb: Sensory Nerve Action Potential, Compound Muscle Action Potential, Distal Motor Latency, and Nerve Conduction Velocity. CTS diagnosis was confirmed if Median peak latency in distance of 14 cm to 3rd finger was more than 3. 5 ms, distal motor onset latency of Median nerve with 8 cm distance with thenar area was above 4. 1 ms, and subtraction of peak latency of SNAP of Median and ulnar nerve to 4th finger was more than 0. 5 ms. According to the EDx findings, patients were divided into 3 groups of mild, moderate and severe CTS.

Ultrasonography

Ultrasonography was performed by the same specialist, using a Philips HD6 scanner (Philips Ultrasound, Bothell, WA) and a 3–12-MHz linear probe. The patients were seated facing the examiner with the forearm in extended supination, the wrist in neutral position and the fingers rested on a hard surface in semi extended position. The sonogram linear probe was put on the wrist longitudinally and in perpendicular position to identify the median nerve and longitudinal, FDP, and FDS views. No pressure was added by the specialist while performing the

examination. The patients were asked to move the fingers, making both the tendons and median nerve to move. Slower movement of median nerve provided a better view of the MNCSA at distal wrist crease level while the probe was rotated 90 degrees. The measurement of the MNCSA in mm2 was calculated by direct method, in which electronic calipers of the ultrasound machine was placed around the margin of the nerve. In this measurement, perineurium between neural fascicles was considered hypoechoic while median nerve sheath was considered hyperechoic. The measurement was performed three times for each patient and average values were calculated and recorded for the final analysis. The MNCSA was evaluated by means of Ultrasonography and linear probe. In each patient, one CTS hand with the longer sensory latency was chosen. If both hands had equal latencies, the dominant hand was chosen for the final analysis.

Statistical Analysis

Data analysis was performed using the SPSS version 22 software (SPSS Inc, Chicago, IL). Mean (± SD) was used to describe the MNCSA. Quantitative data in each group were compared by using independent samples t-test, and differences between the qualitative data in each group were analyzed using Chi-Square test. To evaluate the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of ultrasonography in CTS diagnosis, receiver operating characteristic (ROC) curve was used to find out the cutoff point. The cutoff point accuracies were determined, as well. Cutoff point in ROC curve was chosen based on the optimum point with the most sensitivity and specificity. P value less than 0. 05 was considered significant.

Results

According to the eligibility criteria, 38 patients with RA and 19 healthy individuals as control group were enrolled to this study. EDx and ultrasonography were performed consecutively for all individuals. The study population consisted of 4 men (7%) and 53 women (92. 9%); the mean (±SD) age was 51. 9 (±9. 3) years, and the mean (±SD) body mass index (BMI) was 27. 9 (±4. 9). Of total 57 cases, 17 patients (29. 8%) had RA with CTS, 21 patients (36. 8%) had RA without CTS. Nineteen individuals were considered as healthy control group (33. 3%) had none. The overall mean value (±SD) of the MNCSA was 10. 3 (±1. 5) mm2 ranging from 7. 4 to 14. 9 mm2, and it was 11. 86 (±1. 87) mm2, 10. 16 (±1. 71) mm2, 9. 42 (±1. 46) mm2 in RA patients with CTS, RA without CTS, and the healthy control group respectively. There was a statistically significant association between the mean MNCSA and BMI of all individuals (P=0. 019). There was a statistically significant association between the mean MNCSA and sensory latency in control group (P=0. 04), But no statistically significant association was found between the mean MNCSA and sensory latency in patients with RA and CTS and RA without CTS group (P>0. 1). The mean MNCSA in RA patients with CTS and the control group were not statistically different (P=0. 386). A statistically significant correlation was observed between the MNCSA and sensory latency in RA patients with CTS and control group (P=0. 016). Significant difference in MNCSA was found between RA patients with CTS and RA without CTS group, which was significantly higher in the RA patients with CTS group (P=0. 003). There was no statistically significant association between the MNCSA and severity (mild, moderate, severe) of CTS (P>0. 05). No statistically significant correlation was found between the MNCSA and time duration after RA diagnosis (P=0. 301).

Accuracy of Ultrasonography in CTS DiagnosisThe diagnostic accuracy of the sonographic measurement of the MNCSA was evaluated and presented by applying ROC curve (Figure 1). The area under the ROC curve (accuracy) was 0. 793 (95% CI, 0. 67–0. 91). Cutoff point of the MNCSA was determined as 9. 98 mm2 on the basis of this analysis. Finally, sonographic measurement diagnosed 32 cases with CTS. According to Kappa test, there was statistically significant association between the results of EDx (standard diagnostic test) and sonographic measurement of the MNCSA (P