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CLINICAL STUDY

Single parameter wrist ultrasonography as a first-line screening examination in suspected carpal tunnel syndrome patients

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Abstract: Carpal tunnel syndrome (CTS) is the most common form of peripheral nerve entrapment. Electromyography with selected nerve conduction studies (NCS) is an accepted diagnostic tool in CTS patients. Ultrasonography presents a widely available and low cost investigation method and its position in CTS diagnostics needs further clarification with concrete recommendations for clinical practice.
A prospective study of 37 patients with 74 wrists (59 wrists with suspected CTS) was done. Normative data were obtained from a control group of 25 healthy persons (50 wrists) age and sex matched. All persons underwent ultrasonographic examination (median nerve cross-sectional area at carpal tunnel entrance measurement – CSA) and median NCS studies (distal motor and sensory latency measurement – DML and DSL).
Results: CSA has a sensitivity of 93 % (CI 84–97 %) and specificity of 96 % (CI 87–99 %) in our patients group. Conventional first-line NCS studies results in our patients groupare as follows: DML sensitivity 58 % (CI 45–69 %) and specificity 100 % (CI 93–100 %); DSL sensitivity 88 % (CI 78–94 %) and specificity 94 % (CI 84–98 %).
Conclusion: We recommend the use of single-parameter wrist ultrasonography as a first-line screening laboratory method in suspected CTS diagnosis *(Ref. 14).* Full Text (Free, PDF) www.bmj.sk.
Key words: carpal tunnel syndrome, ultrasonography, electromyography, nerve conduction study.

Carpal tunnel syndrome (CTS) is the most common form of peripheral nerve entrapment. The median nerve is affected at the wrist and the underlying etiology varies from processes narrowing the carpal tunnel (e.g. carpal bones arthritis) to processes increasing the nerve vulnerability to compression damage (e.g. diabetes mellitus) or both. In many cases CTS can be readily identified by the examining physician and the clinical picture itself is fully sufficient for the diagnosis. Electromyography with selected nerve conduction studies (NCS) focused on motor and sensory fibres conduction velocity through the carpal tunnel is an accepted diagnostic tool in CTS patients. The usefulness of different imaging methods (e.g. ultrasonography, magnetic resonance imaging) in CTS diagnosis has become a matter of debate especially in the past years. Mainly the position of ultrasonography which presents a widely available and low-cost investigation method needs further clarification with concrete recommendations for clinical practice.

The aim of our simply and clearly designed prospective study was to state the diagnostic value of ultrasonography in relation to standard electromyography in patients with clinically suspected diagnosis of CTS. We compared one single ultrasonographic parameter (the cross-sectional area of the median nerve at the proximal level of the carpal tunnel) to selected NCS.

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Materials and methods

A prospective study of 37 patients with 74 wrists (9 men, age 30–74, mean 50.2; 28 women, age 36–76, mean 58.2) was done. In 59 wrists the diagnosis of carpal tunnel syndrome was suspected. Normative data were obtained from a control group of 25 healthy persons (50 wrists) matched by age and sex (7 men, age 34–66, mean 49.2; 18 women, age 29–70, mean 52.2). The ultrasonographic device Esaote Megas CVX with 10 MHz linear array transducer was used. The ultrasonographic examination was performed with patients seated in a comfortable position facing the sonograph with forearms resting on the table and palms facing up in neutral position. The volar wrist crease was used as an initial external reference point with subsequent modification during scanning using carpal bony landmarks. The median nerve was identified and its cross-sectional area (CSA) at the proximal level of the carpal tunnel was measured. The median nerve borderline was manually defined and its cross-sectional area was calculated by the machine software. Two measurements were made and their mean value represents the definite result. The electromyographic examination (Medtronic Keypoint device) consisted of following NCS: 1 – median nerve

motor conduction with supramaximal stimulation at the wrist and superficial registration from abductor pollicis brevis muscle (segment lenght 80 mm); 2 – median nerve antidromic sensory conduction with supramaximal stimulation at the wrist and ring electrodes registration from the index finger (segment length 140 mm). Skin hand temperature was maintained above 30 °C. Median nerve distal motor latency (DML) with upper limit of normal 4.6 ms and distal sensory latency (DSL) with upper limit of normal set to 3.8 ms according to the Stalberg's reference values were used (1, 2).

Results

The mean CSA value in the control group was calculated to be of 0.0800 cm^2 with SD 0.0096. Statistical analysis was done using the upper limit of mean value±2SD to calculate the cut-off point (and its specificity and sensitivity) for pathological CSA that discriminates between patients with CTS and healthy persons. The upper limit of normal was set to 0.0992 cm^2 and CSA values equal to or greater than 0.1000 cm^2 were considered as pathologic. The single parameter wrist ultrasonography with measurement and calculation of median nerve CSA at the proximal level of the carpal tunnel has a sensitivity of 93 % (CI 84–97 %) and specificity of 96 % (CI 87–99 %) in our patients group. The results of conventional first-line NCS used in CTS diagnosis in our patients group are as follows: DML sensitivity 58 % (CI 45–69 %) and specificity 100 % (CI 93–100%); DSL sensitivity 88 % (CI 78–94 %) and specificity 94 % (CI 84–98 %). We performed also the χ^2 test to establish the correlation between ultrasonography and NCS (CSA and DSL were correlated). The results (sensitivity $p=0.342$ and specificity $p=0.646$) suggest that there is no significant difference between these diagnostic tools.

Discussion

The CTS diagnosis based only on patient's history and clinical picture is common. Suspected CTS cases usually need diagnostic confirmation and NCS is considered to be the first-line diagnostic method. However conventional electrophysiological studies are sometimes not able to detect mild median nerve compression. Electrodiagnostic parameters become pathologic only with marked focal demyelination and/or axonal loss. Normative NCS data cannot have higher sensitivity because of insufficient specificity and false positive diagnosis risk. More precise special conduction analysis (e.g. the inching technique) are not routinely used in clinical practice.

Another approach to CTS diagnosis confirmation present selected imaging methods (ultrasonography and magnetic resonance imaging). Especially ultrasonography and its diagnostic value in CTS has become a matter of discussion in the past years. Only a few prospective studies with different design dealing with this field were done. Some of them investigated only patients with confirmed CTS by NCS (3, 4, 5). This fact in our opinion excluded many CTS patients with only mild median nerve involvement. In our study we investigated patients with clinically suspected CTS. The majority of studies investigated more than one ultrasonographic parameters (3, 4, 5, 6, 7, 8, 9). Such ultrasonographic examination may be in our opinion more time-consuming and complicated when compared to single level CSA measurement. Iannicelli et al (2005) investigated patients and controls only ultrasonographically without confirmation or comparison to NCS (10). Next three studies had a design that was similar to our work. Miedany et al (2004) strongly recommend to consider ultrasonography examination of the median nerve and measurement of its CSA as a new alternative diagnostic modality for the evaluation of CTS. They achieved a sensitivity of 97.9 % and specificity of 100 % in differentiating between patients and controls, which are very similar to our own results (93 % and 96 % respectively) (11). Ziswiler et al (2005) state that different cut-off values for the largest CSA may be used to accurately rule CTS in or out (12). Wiesler et al (2006) state that ultrasonography shows an enlargement of the median nerve at the distal wrist crease in symptomatic CTS patients (13).

The results of our prospective and current clinical practice-oriented study are consistent with those cited above. Several ultrasonographic parameters are used in CTS evaluation (CSA at entrance, middle and exit from the carpal tunnel; the flattening ratio; the swelling ratio; the bowing of the flexor retinaculum etc.). Our results suggest that ultrasonography with the use of a single parameter (CSA at the proximal entrance level of the carpal tunnel) has diagnostic sensitivity and specificity that is comparable to standard NCS. Both methods reflect the median nerve compression resulting in median nerve enlargement (higher CSA) and focal demyelination (segmental conduction slowing). Therefore we recommend using single-parameter wrist ultrasonography as a first-line screening laboratory method in cases of suspected CTS.

In our study we did not sort patients according to severity (clinical and electrophysiological) of CTS. This fact has not influenced the results (the comparison of ultrasonography to NCS) because both tested methods were used in the same patients group. The diagnostic sensitivity and specificity of single-parameter wrist ultrasonography related to CTS severity (e.g. the scale from minimal to extreme involvement by Padua et al (14) was analysed by Mediany et al (2004) and remains to be confirmed in further studies (11). Also the impact of median nerve CSA at the proximal level of the carpal tunnel on therapeutic approach selection and clinical outcome remain unknown and will be subject to testing in the future.

Ultrasonography has several advantages over NCS. The ultrasonographic examination is not painful and it is known that some patients do not tolerate supramaximal electrical peripheral nerve stimulation. Ultrasonographic devices are also generally more accessible than electromyographic devices which can be found mainly at neurologic clinics. The ultrasonographic examination itself is less time-consuming than the standard electromyographic investigation and the cost-benefit ratio favours ultrasonography too. Additionally in some patients also the etiology of CTS may be discovered (e.g. flexor muscles tendosynovitis;

aberrant vessels, muscles and tendons; abundant fat tissue; material deposits; ganglioma). In our patients group one case of ganglioma was found.

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