Original Research—CME

Ulnar Neuropathy Among Active Workers Based Upon Hand Diagram Ratings

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Abstract

Background: Limited studies have estimated the prevalence of ulnar neuropathy (UN) in the workplace. Hand diagrams have been demonstrated to have a good sensitivity and specificity when attempting to identify patients with UN.
Objective: To determine the prevalence and associated risk factors for UN among active workers based on results of a hand diagram, and to determine the reliability of hand diagram scoring.
Design: Cross-sectional study.
Setting: Seven different industrial and clerical work sites.
Methods: A total of 501 active workers were screened. Subjects completed a hand diagram and the Job Content Questionnaire, and had ergonomic assessment of their job. Each hand diagram was scored independently by 2 raters.
Main Outcome Measures: Rating of the hand diagram for UN.
Results: Interrater reliability of scoring the hand diagram for UN was very high. The estimated prevalence of UN was 3.6%. Suspected UN was associated with positioning of the elbow but not by contact stress at the elbow or force at the hand. Smokers had a lower prevalence, but smokers with suspected UN had higher-pack year histories. Workers with suspected UN had a greater sense of job insecurity and lower job satisfaction rating.
Conclusions: Hand diagram rating has a high interrater reliability. Suspected UN has a relatively high prevalence among active workers in comparison to prior estimates of the prevalence of UN among the general population and is not strongly associated with ergonomic factors.

Introduction

Ulnar neuropathy (UN) is a common nerve entrapment disorder in the upper extremity. Typical symptoms include numbness, tingling or burning sensation in the fourth and fifth digits of the hand. The most common site of entrapment is the elbow, although entrapment at the wrist is also a possibility. Although UN at the elbow is the second most common compression neuropathy of peripheral nerves, its prevalence in the workplace is not well defined. UN at the elbow has an annual incidence in the general population that is approximately 1 in 13 of that of carpal tunnel syndrome (CTS), or 24.7 per 100,000 population [1]. Another study estimated the prevalence rate as 0.6% to 0.8% [2]. There is little literature regarding the incidence or prevalence of this disorder in the working population, although 1 study of female floor cleaners demonstrated a prevalence of 7% [3].

There are no general population estimates of the prevalence of UN at the wrist.

Repetitive work was considered a risk factor in some studies but depended upon the case definition of UN [4,5]. UN has also been associated with forceful work and use of a tool in the hand [5,6]. UN at the elbow has been demonstrated to be more common in men and among smokers [7-10]. Sustained pressure over the elbow region is also considered a risk factor.

The diagnosis of UN at the elbow or Guyon canal nerve entrapment is typically made by clinical presentation and confirmed by electrodiagnostic testing. Clinically, an affected patient complains of numbness and tingling in an ulnar distribution. In a recent study, Werner et al [11] demonstrated that a hand diagram that shows numbness, tingling, burning, or pain in the ulnar distribution had a 50% sensitivity and 93% specificity with a receiver operating characteristic (ROC) curve of 90% when compared to electrodiagnostic

testing of the ulnar nerve across the elbow. This demonstrated that the rating of a hand diagram for ulnar symptoms can be a valuable tool for estimating the prevalence of UN in the general population and in the workplace. This would also allow evaluation of associated ergonomic risk factors in a cost-effective manner. Hand diagrams have been used reliably for evaluation of CTS [12,13].

It is known that there are other neurologic lesions that can present with a similar sensory distribution and thus a similar hand diagram. A C8 radiculopathy, lower trunk brachial plexopathy, or thoracic outlet syndrome can also present with symptoms in the fourth and fifth digits of the involved hand. The Werner et al study did not find any of these other etiologies in their screening of 117 patients [11]. The most common other neurologic abnormality was CTS or no abnormality at all on nerve conduction testing. Based upon the earlier Werner et al study [11], it is reasonable to assume that half of the subjects who screen positive for an abnormal ulnar hand diagram have UN, and this can be used to estimate the prevalence in the workplace.

Methods

A total of 501 active workers from 7 settings (4 industrial and 3 clerical work sites in southern Michigan and northern Ohio) were recruited for evaluation. This was part of a larger study previously described by Werner et al [14]. All subjects signed a consent form that was approved by the institutional review board at the University of Michigan. All subjects completed a symptom questionnaire, including a hand diagram. The hand diagram was rated for the possibility of an ulnar mononeuropathy using the classification protocol proposed by Werner et al [11] that is described in Table 1. The hand diagram was reviewed independently by 2 of the authors (A.F. and R.A.W.). For the interrater reliability study, all 3 categories of the hand diagram rating were used in the analysis. For the estimate of the prevalence of UN, a participant was considered to have a positive hand

diagram if either the right or left hand (or both) was rated as 1 (possible) or 2 (definite).

All subjects were weighed, and height was also recorded and used to determine their body mass index (BMI; kg/m^2). All jobs were assessed and rated for ergonomic exposures at baseline and whenever a job change took place. The methods used to assess the jobs were described previously by Latko et al [15]. Jobs were videotaped and rated for the degree of repetition, average and peak hand contact stress, average and peak force, and average and peak posture of the shoulder, elbow, forearm, and wrist/hand. The ratings were performed using a 0-10 visual analog scale for each stressor, with verbal anchors on the 10-cm scale. A rating of 0 corresponded to no stress (or neutral posture), and a rating of 10 corresponded to the greatest possible stress (or deviation from neutral). A neutral position for the elbow was defined as a 90° angle. The formal ratings were conducted by a team comprising university faculty and research staff specializing in ergonomic analysis. The 3 team members rated the jobs independently, and then final ratings for the jobs were achieved through consensus. The same ergonomic risk factor measurement techniques have been adopted by the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV) for evaluating hand activity level. The ratings for hand repetition level and the normalized peak force are multiplied and rated (1 = acceptable, 2 = borderline, 3 = unacceptable) [16]. The workers also completed a psychosocial questionnaire evaluating job security and satisfaction, supervisor and co-worker support, job creativity, decision authority, and skill discretion as defined by Karasek et al [17].

Statistical analysis included a *t*-test and χ^2 test to determine which demographic, ergonomic, and psychosocial factors were associated with a higher prevalence of UN. Odds ratios were estimated using logistic regression modeling, with presence of a positive hand diagram as the dependent variable and the ergonomic, demographic, and psychosocial variables as the independent variables. A κ value was determined to evaluate the interrater reliability.

Results

A total of 501 participants were recruited into the study. The mean age was 44.1 ± 9.8 years, with a range of 24-75 years. Of the participants, 71% were female. The mean height was 1.67 m, mean weight was 82.8 kg, and mean BMI was 29.5 kg/m^2. A total of 36 subjects (7.2%) had a classification of a possible or definite UN using the hand diagram criteria. Using the 50% sensitivity of a positive hand diagram for predicting UN, the estimated prevalence of suspected UN in this population was 3.6%. The demographic, ergonomic, and psychosocial risk factors are presented in Table 2,

Table 1
Hand Diagram Protocol for Screening for Ulnar Neuropathy

2	Definite	Palmar symptoms in the fifth digit or symptoms in the fifth digit and ulnar side of hand. Symptoms may also be in the fourth digit, but cannot include digits 1, 2, or 3 or the radial aspect of the palm.
1	Possible	Symptoms in the fifth digit and ulnar side hand. Symptoms may also be noted in the rest of the palm. Symptoms may be in digits: 1 2 4 5, 1 3 4 5, or 1 2 3 5.
0	Unlikely	No evidence of ulnar neuropathy—no symptoms in the fourth or fifth digit; or whole hand symptoms; or 4 contiguous digits involved; or only joint or nondistal phalanx involvement.