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Long-term outcomes in patients with ulnar neuropathy at the elbow treated according to the presumed aetiology ☆

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Dedication: We dedicate this paper to our recently deceased colleague and friend Dr. Tomaž Žgur.

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HIGHLIGHTS

- We treated patients with ulnar neuropathy at the elbow (UNE) in accordance with lesion aetiology.
- After 2.5 years 83% entrapments (surgery) and 84% external compressions (conservative) improved.
- Our results support a therapeutic approach tailored according to the presumed aetiology of the UNE.

ABSTRACT

Objectives: Ulnar neuropathy at the elbow (UNE) consists mainly of two conditions: entrapment under the humeroulnar aponeurosis (HUA) and extrinsic compression in the retrocondylar (RTC) groove. These in our opinion need different treatment: surgical HUA release and avoidance of inappropriate arm positioning, respectively. We treated our UNE patients accordingly, and studied their long-term outcomes.
Methods: We invited our cohort of UNE patients to a follow-up examination consisting of history, neurological, electrodiagnostic (EDx) and ultrasonographic (US) examinations performed by four blinded investigators.
Results: At a mean follow-up time of 881 days, we performed a complete evaluation in 117 of 165 (65%) patients, with 96 (90%; 35 HUA and 61 RTC) treated according to our recommendations. An improvement was reported by 83% of HUA and 84% of RTC patients. In both groups the ulnar nerve mean compound muscle action potential (CMAP) amplitude, and the minimal motor nerve conduction velocity increased, while the maximal ulnar nerve cross-sectional area (CSA) decreased.
Conclusion: After 2.5 years similar proportions of HUA and RTC patients reported clinical improvement that was supported by improvement in EDx and US findings.
Significance: These results suggest that patients with UNE improve following both surgical decompression and non-operative treatment. A clinical trial comparing treatment approaches in neuropathy localised to the HUA and RTC will be needed to possibly confirm our opinion that the therapeutic approach should be tailored according to the presumed aetiology of UNE.

1. Introduction

In our previous publications (Omejec and Podnar, 2015, 2016b), we presented evidence that idiopathic ulnar neuropathy at the elbow (UNE) mainly consists of two conditions occurring 2–5 cm apart. In the first condition, affecting about 15% of UNE patients (Omejec and Podnar, 2016b), the ulnar nerve is entrapped 2–3 cm distal to the medial epicondyle (ME) under the humeroulnar aponeurosis (HUA), i.e., in the cubital tunnel (Omejec and Podnar, 2015). In the second condition, affecting the majority (about 85%) of patients (Omejec and Podnar, 2016b), the lesion is located at the ME or up to 4 cm proximally in the retrocondylar groove (RTC) (Omejec and Podnar, 2015). As no anatomical structure constricting the ulnar nerve is usually found in that segment, the most probable cause of UNE at this location is extrinsic ulnar

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nerve compression against the underlying bone. For these two groups of UNE patients, previous authors have proposed different therapeutic approaches: surgical release for ulnar nerve entrapment distal to ME and conservative treatment for extrinsic nerve compression in the RTC groove (Stewart, 2006). Therefore, our approach was to first precisely localise UNE in our patients using motor short-segment nerve conduction studies (SSNCSs) and ultrasonography (US) (Omejec and Podnar, 2015). According to the presumed mechanism of UNE, we then recommended to our patients either early surgical release or the avoidance of risky positioning of the affected limb.

To evaluate the efficiency and validity of this therapeutic approach, several years after the initial evaluation and treatment we invited the whole cohort of our UNE patients (Omejec and Podnar, 2016b) to a follow-up examination. At that time, we obtained the history of current UNE symptoms, performed neurological, electrodiagnostic (EDx) and US examinations and compared these with data obtained during the initial diagnostic evaluation (Omejec et al., 2015). We then compared improvements achieved during the follow-up period in surgically treated HUA patients versus improvements in conservatively treated RTC patients.

2. Materials and methods

2.1. Patients and controls

We invited our whole cohort of prospectively recruited consecutive patients with EDx and US confirmed UNE to a follow-up examination (Omejec and Podnar, 2016b). The same four investigators involved in the initial diagnostic evaluation (Omejec et al., 2015) obtained the history and performed the neurological, EDx, and US examinations of the affected arm. They were blinded to the findings of previous diagnostic investigations and also to the other parts of the follow-up evaluation. The study was approved by the National Ethics Committee of Slovenia and, prior to the investigation, all participating patients provided written informed consent.

2.2. History and clinical neurologic examination

The first investigator obtained a short history focused particularly on UNE treatment and current UNE symptoms. The second investigator performed a neurological examination; he graded muscle atrophy, manually tested muscle strength according to the extended Medical Research Council (MRC) scale (O'Brien, 2010) and graded light touch and pinprick sensation in the affected upper limbs.

The third investigator measured the strength of the small hand muscles using the Rotterdam Intrinsic Hand Myometer (RIHM) (Schreuders et al., 2006) and tested light touch using Semmes-Weinstein monofilaments (Weinstein, 1993). Strength measurements were performed three times and their average was obtained for further analyses.

2.3. Electrodiagnostic studies (EDx)

The fourth investigator performed nerve conduction studies (NCSs) and needle electromyography (EMG) using standard EMG equipment (Nicolet Synergy, Natus Medical Incorporated, San Carlos, USA). As during previous diagnostic evaluations, he stimulated the ulnar nerve at the wrist and at six positions separated by 2 cm, from 4 cm distal (D4) to 6 cm proximal (P6) to the medial epicondyle (ME) of the elbow (i.e., SSNCSs) (Omejec and Podnar, 2015; Omejec et al., 2015). This time, compound muscle action potentials (CMAPs) were recorded only from the abductor digiti minimi (ADM) muscle. He also recorded the ulnar sensory nerve action potentials (SNAPs) on stimulation at the wrist and recording from the 5th finger (i.e., antidromic study) and performed concentric needle EMG of the ADM and of the first dorsal interosseous (FDI) muscles (Omejec and Podnar, 2016a).

2.4. Ultrasonography (US)

The third investigator also measured cross-sectional areas (CSAs) of the ulnar nerve at the elbow markers with the most pronounced abnormality (maximal and, for HUA, also minimal CSA) during the diagnostic US study, and 6 cm proximal to the ME (P6). He used standard US equipment (ProSound Alpha 7, Hitachi Aloka Medical, Ltd, Tokyo, Japan) and a 4–13 MHz linear array transducer. For the ulnar nerve CSA measurements, he employed a trace method that excluded the hyperechoic rim (Omejec et al., 2015). In addition, he measured CSA of the FDI by positioning the US probe in the middle of the second metacarpal bone perpendicular to the bone (Mohseny et al., 2015).

2.5. Statistics

We described continuous variables as the median, 5th and 95th percentiles, range, or as the mean and standard deviations (SDs). We compared the two matched groups using the Wilcoxon paired test and the two unmatched groups with the Mann-Whitney *U* test. All tests were performed at a significance level of $\alpha = 0.05$ (two-sided). On comparison of the two matched groups, the effect size > 0.5 and $p < 0.05$ were considered significant.

Due to significant differences between men and women in CSA of the FDI muscle, and strength of the ADM muscle, separate reference limits were calculated and applied. No similar differences were found for other evaluated parameters.

3. Results

We were able to contact 165 of 175 (94%) patients from our original cohort with a clinical UNE diagnosis confirmed by EDx or US examination (Fig. 1). Of these, 117 (67%) patients were fully examined in person. A focused history was obtained by a structured phone interview with an additional 48 (27%) patients (Tables 1 and 2). The remaining 10 (6%) patients either could not be reached or declined to answer our questions.

Of the 107 patients who attended the complete follow-up examination and had a precisely localised UNE lesion (Fig. 1), 41 had UNE distal to the ME (i.e., under the HUA) and the remaining 66 had UNE at or up to 4 cm proximal to the ME (i.e., in the RTC groove). We examined them after a median follow-up period of 630 and 1015 days, respectively (Table 1). The large majority of these patients were treated according to our recommendations; surgical release was performed in 35 (85%) of our HUA patients and conservative treatment was applied in 61 (92%) of our RTC patients (Fig. 1). These 96 UNE patients were further analysed.

On follow-up examination, our conservatively, but not surgically treated patients, reported a significant reduction in activities deemed responsible for external compression of the ulnar nerve in the RTC groove (Table 2 and Fig. 2). Patients in both groups reported a significant reduction in the frequency and severity of all UNE symptoms. At least partial symptom improvement was reported by 83% HUA and 84% RTC patients and marked or complete improvement by 54% of HUA and 61% of RTC patients (Table 1).

HUA patients reported a significant improvement in sensory symptoms, but less marked improvement in motor symptoms (Table 2). The reduction in muscle atrophy and improvement in