DEMOGRAPHIC, ANTHROPOMETRIC, OCCUPATIONAL, AND NEUROGRAPHIC FINDINGS IN ULNAR NEUROPATHY AT THE ELBOW (UNE). PRELIMINARY RESULTS OF A CASE-CONTROL STUDY

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BACKGROUND

The epidemiological studies published so far on risk factors of UNE are few, the inclusion criteria and methods of recruitment of cases and controls vary widely. The known risk factors include trauma, systemic diseases (diabetes, hypothyroidism and renal failure), smoking, and biomechanical work-related factors of the upper limbs, especially of the elbow, tied to particular tasks. Excessive alcohol consumption and BMI show uncertain results [1-11]. By June 2014 we started a prospective multicentre case-control study on risk factors of UNE, the study design was elsewhere reported [12].

Methods

Sample size of 213 cases and 426 controls was sufficient for a case-control study with 1:2 matching, significance level 0.05, power 80%, prevalence 10% and expected odds ratio 2.0. For these preliminary results UNE diagnosis ("case") was based on clinical features. Mandatory symptoms included numbness, tingling, or burning sensation in the fifth digit of the hand or weakness in an ulnar distribution. "Hand diagram protocol" proposed by Werner et al. was also used [12-13]. From June 2014 to April 2015 we consecutively enrolled 98 cases and 178 controls with age >14 and <70 years in 4 EMG labs. For this preliminary report we selected only cases and controls without symptoms and medical conditions affecting peripheral nervous and muscular systems. We considered demographic, anthropometric (BMI, waist-to-hip ratio (WHR), elbow dimensions) and occupational (job titles according to ISCO-2008) findings.

The elbow dimensions were: a) width of the elbow measured between the tips of medial and lateral humeral epicondyles and b) width of the cubital groove (WCG) at the level of the medial epicondyle between the two inner edges. The measurements of the elbow were done with the elbow and wrist flexed at 90°, the arm abducted at 90° and the hand palm leaned against a hard surface using a sliding caliper (accurate to 0.1 mm) (see figure). The length of the upper limb was measured from the acromion of the scapula to the ulnar styloid with a stretch-resistant tape (accurate to 0.5 cm). The ratio between WGC and elbow width and between this ratio divided by the arm length were also calculated. All the examiners underwent a common training to standardize the measurement techniques. The interexaminer agreement of all body, elbow and arm measures of both sides was tested in a single blind measurement session with 16 volunteers of various body sizes (12 women and 5 men, mean age 48.9±10.8 years).

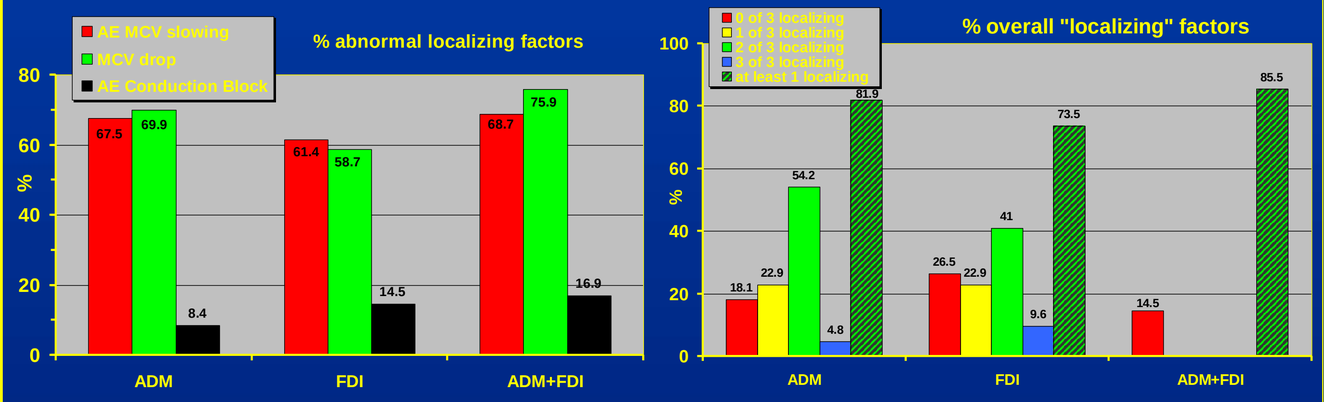
The standardized electrophysiological protocol, inspired to AANEM [14], included: **1) UNE "localizing"** neurographic parameters of the ulnar nerve: a) reduction of MCV in across-elbow segment ("MCV slowing"), b) MCV drop across-elbow vs. forearm ("MCV drop"), c) CMAP amplitude drop across elbow (conduction block-CB-) recording from ADM and FDI muscles and **2) UNE "non-localizing"** neurographic parameters: a) EMG of ulnar nerve intrinsic hand muscles, b) SCV and SAP amplitude of the ulnar nerve in IV and V digit-wrist segments (U4 and U5) and c) SCV and SAP amplitude of cutaneous ulnar dorsal (DUC) nerve (from the ulnar styloid to the dorsum of the hand in the metacarpal interspace between the fourth and fifth rays). We also performed motor and sensory neurography of the median nerve in all cases and controls and of the contralateral ulnar nerve in all cases.

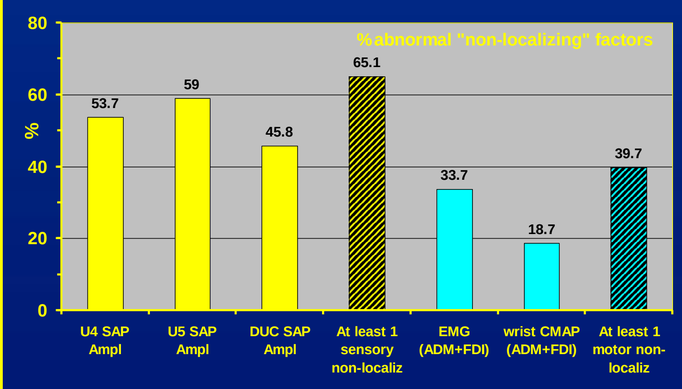
Descriptive statistics, differences between case and controls, and between affected and unaffected sides of unilateral UNE cases were calculated with Mann-Whitney and chi-squared tests. Multivariate logistic regression was carried out to evaluate risk factors associated to UNE.

Results

We enrolled 83 cases (mean age 49.2 years, 45.8% females, 45.8% blue collars) and 160 controls (mean age 47.3 years, 51.3% females, 45% blue collars). Subjects with bilateral UNE were 9/83 (10.8%).

At univariate analysis there were differences between cases and controls in WHR, cubital groove and almost all neurographic parameters. If FDI and ADM localizing measures were considered together UNE cases had at least one abnormal value in 85.5%. Between nonlocalizing parameter U5 SAP amplitudes was abnormal in 59%. At least one abnormal localizing neurographic parameters of contralateral asymptomatic ulnar nerve were recorded in 27.4% of unilateral UNE (see figures).





Independent variables	P	OR(95%CI)
Age (years)	0.011	0.95 (0.92-0.99)
Gender (male)	0.23	0.54 (0.2-1.46)
Occupation (blue collar)	0.5	1.32 (0.59-2.97)
WHR (cm)	0.49	5.32 (0.05-81.1)
Cubital width (mm)	0.014	0.8 (0.67-0.96)
AE MCV slowing (m/s)	<0.0001	0.77 (0.69-0.87)
MCV drop (m/s)	0.89	1.01 (0.91-1.12)
AE CMAP drop (%)	0.3	0.95 (0.87-1.04)
Wrist CMAP (mV)	0.58	0.95 (0.82-1.11)
U5 SAP Amplitude (μV)	0.66	1.01 (0.97-1.06)

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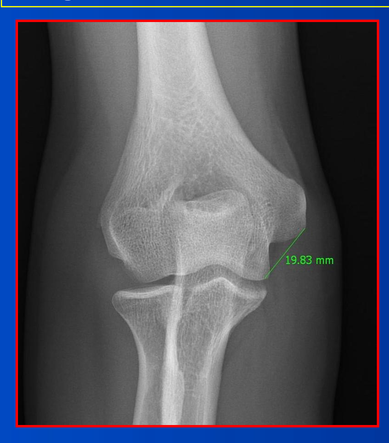
AIM OF THE STUDY

The ultimate goal of the study is to demonstrate the association between UNE and the demographic, anthropometric and lifestyle factors, comorbidities and occupational biomechanical exposures with particular attention to non-neutral postures, forceful and repetitive elbow movements, and vibrations. The aim of actual study is to report preliminary results of anthropometric, demographic, occupational and neurographic findings of subjects enrolled from June 2014 to April 2015.



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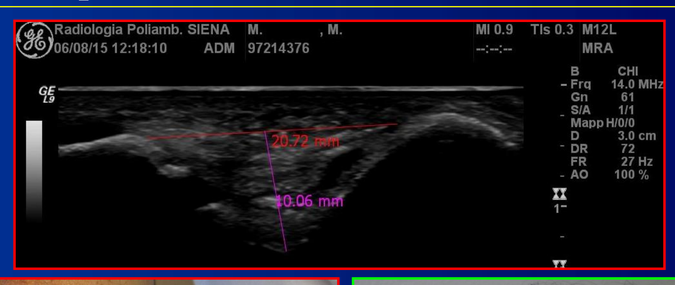

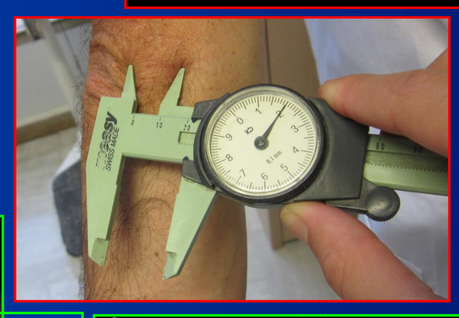

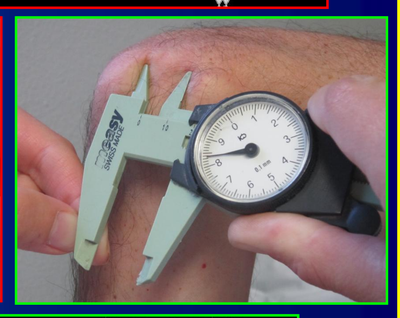

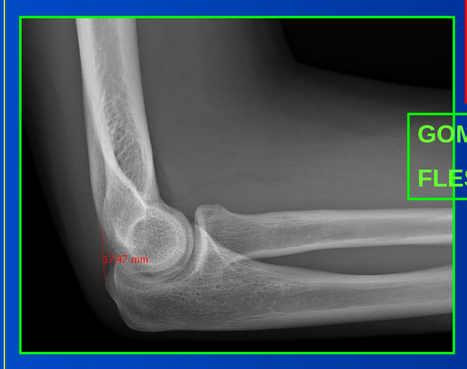

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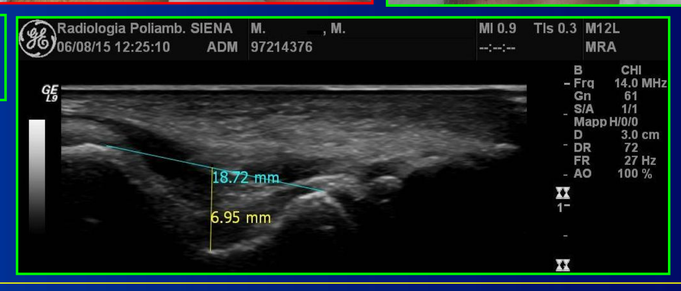

DISCUSSION

In these preliminary results the "gold standard" of UNE diagnosis is based only on clinical diagnosis, the subjects with comorbidities were excluded, and lifestyle and biomechanical work-related risk factors were not statistically evaluated. At the end of the enrollment we will separate the patients with UNE diagnosis according to clinical and electrophysiological findings from the subjects with ulnar nerve symptoms without abnormal electrophysiological results and we will include the comorbidities in the risk factors.

The most original finding of our preliminary report is that **the decreased CGW may be a risk factor of UNE**. For convenience we measured the external CGW at the level of medial epicondyle with the elbow flexed at 90°. The space (width, depth and CSA of cubital tunnel) available for the nerve varies with the degree of the elbow flexion. **During the progressive flexion** the width, depth and cross-sectional area of the cubital tunnel at the level of medial epicondyle decreases, the pressure increases and the ulnar nerve stretches. There are differences in amount of this variation according to radiological (US or MRI) study or anatomical morphological model in cadavers [15-17]. In our preliminary US study of a sample of the same subjects used to assess the agreement of inter-examiner measurements, we observed that the ratio of width and depth of the groove at the level of the medial epicondyle does not vary significantly during the flexion and the external measurement width well matches with the ultrasound measurement (see figures).

Therefore **we think that the measurement of the external CGW at the level of medial epicondyle may be a good surrogate (easy to measure) of the available space of the nerve in the retroepicondylar groove.**

We also preliminary showed that the increased age was a protective factor and we will check if this association is due to lifestyle and work-related factors. Type of occupation was not a risk for UNE. But in this preliminary report we considered only the job title, at the end of enrollment we will examine some job tasks regardless of job title (i.e. the exposure to non-neutral postures, repetitive movements of elbow, hand-arm vibrations and forceful work).

Regarding the electrophysiological findings, 27% of patients with unilateral UNE showed contralateral asymptomatic neurographic anomalies. AE MCV was the most sensitive electrophysiological findings and **ADM and FDI neurography together was more sensitive than neurographic measures recording from the single muscles**. Multiple internally consistent abnormalities are more convincing than isolated abnormalities, which raise the possibility of artifact or technical mishap.

Finally, if the sample size will be sufficient, we will evaluate whether the different location of UNE (just proximal to the medial epicondyle in the retroepicondylar groove and just distal medial epicondyle under the humeroulnar aponeurotic arcade of Osborne i.e. cubital tunnel) identified only through electrophysiological methods have different risk factors as demonstrated by a recent paper [10].