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ORIGINAL ARTICLE

Contribution of ultrasonography to the evaluation of peripheral nerve disorders

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Electrodiagnosis;
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Ulnar neuropathy at the elbow;
Ultrasonography

Summary
Objective. — Although ultrasonographic (US) visualization of peripheral nerves is becoming more and more frequently used, there are few studies on its actual contribution to the diagnosis and management of patients with peripheral nerve disorders.
Methods. — The electronic records of consecutive patients referred to our US laboratory over an eight-month period were retrospectively analyzed. The contribution of US examination to patient management was evaluated.
Results. — Two hundred and thirty one consecutive patients (43% men) were analyzed. The US result was pathologic in 71% of patients. US provided a new diagnosis in 3% of patients (including 4 with tumors), contributed other additional information in 60%, and only confirmed the referral diagnosis in 11%. In 26% of patients, US was neither confirmatory nor contributive, nor did it provide a new diagnosis. US sensitivity in electrodiagnostically (EDx) confirmed ulnar neuropathy at the elbow (UNE) was 77% and median neuropathy at the wrist 84%. In EDx negative patients, US sensitivities were 47% and 40%, respectively.
Discussion. — The study demonstrated the ability of peripheral nerve US to provide useful diagnostic information in the majority of adequately referred patients.

Introduction

Traditionally, peripheral nerve disorders have been diagnosed by clinical and electrodiagnostic (EDx) examinations. However, with advancements in medical technology, particularly in the last two decades, visualization of peripheral nerves has also become possible by both magnetic resonance imaging (i.e., magnetic resonance neurography (MRN)) [1] and ultrasonography (US) [12,14]. The latter has a number of practical advantages [12,14], and is therefore more widely used in clinical practice. Most experience with US has been reported in focal neuropathies, mainly compression or entrapment mononeuropathies, particularly median neuropathy at the wrist and ulnar neuropathy at the elbow (UNE) [6,9]. More recently, the role of US has also been explored in the diagnostic confirmation of polyneuropathies with distinctive US findings, particularly in patients with disorders

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of myelin and less consistently axon [3]. Regarding etiologies, immune-mediated [4], hereditary [16], and infectious polyneuropathies [5] can be diagnosed by US.

However, the actual contribution of US methods to the routine confirmation of diagnosis and management of patients with peripheral nerve disorders has rarely been studied [10]. Likewise, the optimal position of US studies in the routine evaluation protocols is not clear. In order to obtain information on these issues, retrospective analysis was performed of a series of consecutive patients referred to our US laboratory due to disorders of the peripheral nerves.

Materials and methods

The electronic records of all patients referred to the US laboratory at the Institute of clinical neurophysiology, University medical center, Ljubljana, Slovenia from January to August 2015 were retrospectively analyzed. Our unit is the only one dedicated to peripheral nerve US in Slovenia, a country with a population of two million. In our laboratory, we mainly examine patients referred by EDx physicians from the whole country, usually following EDx examination. We do not routinely examine patients concomitantly by EDx and US. Due to the retrospective analysis with no direct involvement of patients, the National Ethics Committee of Slovenia waived the necessity of obtaining written informed consent from patients. All analyses were performed by the author, who was cautious to protect all personal information.

All patients were US examined by the author or a neurophysiologic technician, both with > 7 years' experience in performing US studies of peripheral nerves during the studied period. Most of the patients were examined in the presence of both the author and a neurophysiologic technician. We used a standard US equipment (ProSound Alpha 7, Hitachi Aloka Medical, Ltd, Tokyo, Japan), and a 4—13 MHz linear array transducer. To declare an US study ''pathologic'' (i.e. establish US diagnosis), we used nerve cross-sectional area (CSA) with our set of previously reported normative data [11]. In a few patients we also described pathologic structures outside of the peripheral nerves. The US examiner was not blinded to findings of clinical and EDx examinations.

In this group of patients, data were collected on gender, age, referral diagnosis (i.e. diagnostic question) on referral form, EDx findings and diagnosis, and US findings (i.e. diagnosis). From these data, the contribution of US examination was established as one of the 3 following categories:

- new diagnosis not established by neurologic examination and EDx testing;
- contributive—providing relevant additional information about the nerve lesion that was unclear before US (e.g. precise localization of the ulnar neuropathy at the elbow (UNE), etc.);
- confirmative—confirmation of the referral (most of the time EDx-confirmed) diagnosis;
- Sensitivity of US was also calculated in patients with clinical features of CTS and UNE confirmed by EDx.

Results

In the analyzed period, 231 patients were examined (100 men, 43%), aged 14—94 years (mean [SD]: 53.4 [16] years). The most common indication was UNE (in 92 patients, 42% of referrals), followed by suspected carpal tunnel syndrome in 57 patients, 25%, 17 of them after surgical release of the carpal ligament, (Fig. 1) (Table 1). EDx studies were abnormal in 173 (74%), and normal in 29 (13%) included patients. In the remaining 29 (13%) patients, the report of the EDx study was not available at the time of the US study.

The US result was pathologic in 165 (71%) patients. The most common US diagnosis was UNE in the retroepicondylar (RTC) groove, which was diagnosed in 55 (24%) of patients, followed by median neuropathy at the wrist in 50 (22%), and UNE under the humeroulnar aponeurotic arcade (HUA) in 17 (7%, Table 2). US was positive in 60 of 78 UNE (sensitivity, 77%) and in 38 of 45 CTS both confirmed by EDx (sensitivity, 84%). US provided a new diagnosis in eight (3%) patients. In four of them US revealed expansive lesions (i.e., tumors) of the median, ulnar (Fig. 2), fibular and sciatic nerves. In remaining four patients US established a diagnosis of tendinitis (referral diagnosis: carpal tunnel syndrome), median nerve entrapment at the wrist (referral diagnosis: radial neuropathy), median neuropathy elsewhere (referral diagnosis: familial amyloid polyneuropathy), and superficial radial neuropathy (referral diagnosis: carpal tunnel syndrome) in one patient each. US was regarded as contributive in 132 (57%) patients, and as confirmative in 25 (11%) patients (Fig. 3). In 123 of 132 patients (93%) with contributive US, US was also regarded confirmative. In 66 (29%) patients, US was neither confirmatory nor contributive, nor did it provide a new diagnosis. In 17 of them EDx studies were negative, and in 13 they were unavailable. EDx diagnoses in remaining 33 patients were: ulnar neuropathies of unknown localization in 16, fibular neuropathy at the fibular head in 5, median entrapment at the wrist in 4, median neuropathies of unknown localization in 3, tibial neuropathy in 2, polyneuropathy in 2 and femoral neuropathy in 1 patient.

Twenty-nine patients with negative EDx findings were also examined with US: 17 with suspected UNE (US was pathologic in eight = 47%), five with suspected CTS (US was pathologic in two = 40%), four with suspected fibular neuropathy at the fibular head (US only demonstrated a Baker's cyst in a single patient with no US signs of fibular neuropathy = 0%), two with suspected radial neuropathy (US was negative in both), and one with suspected meralgia paresthetica (US was negative).

Discussion

In the present series, the most common referral diagnosis was UNE (42%). This was partly due to our center's research interest in this condition [8,9], but it was also in accordance with our experience that UNE is a focal neuropathy in which US is most useful. We have indeed demonstrated previously that US is more useful than EDx in achieving precise localization of UNE [7]. In the author's opinion, precise localization of UNE is essential for decision making on the most appropriate treatment; i.e., surgical release of the humeroulnar aponeurosis (HUA) in UNE localized distal to

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