Available online at www.sciencedirect.com
ScienceDirect
Journal of Electromyography and Kinesiology 19 (2009) 500–508
JOURNAL OF ELECTROMYOGRAPHY AND KINESIOLOGY
www.elsevier.com/locate/jelekin

Clinical and electrophysiologic findings in dialysis patients

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Received 18 April 2007; received in revised form 28 October 2007; accepted 29 October 2007

Abstract

The aim of this study was to quantitatively determine the electrophysiologic changes occurring in the peripheral nerves and muscles in patients with chronic renal failure (CRF) treated with haemodialysis (HD) or continuous ambulatory peritoneal dialysis (CAPD), and to determine which electrophysiologic parameters are most commonly abnormal in uraemic patients. We investigated the relationship between the parameters of neurography and quantitative electromyography (QEMG) and clinical findings.

The study included 42 patients with CRF (30 on HD and 12 on CAPD). Nerve conduction studies (NCSs) of the median, ulnar, tibial, peroneal, and sural nerves, and QEMG of the tibialis anterior and biceps brachii muscles were performed.

We found axonal and/or demyelinating polyneuropathies in 97.6% of the patients (100% of HD and 91.7% of CAPD patients), but were not able to verify any significant differences between the HD and CAPD patients using NCS or QEMG. Median, ulnar, sural sensory nerve action potential (SNAP) amplitudes, peroneal CV and F-latency were the most common abnormal parameters in sensory and motor NCSs, respectively. The clinical findings only correlated with the parameters of neurography, and not with the parameters of QEMG. Sural SNAP amplitudes, peroneal and tibial CVs, F-latencies also correlated with the severity of the clinical findings in these patients, suggesting that these parameters can be used in follow up studies in these patients.

In this study, most of the uraemic patients were found to have already mild or moderate neuropathies in which the objective clinical signs might be absent, even if they have some clinical symptoms. NCS showed abnormality indicating polyneuropathy in 24 out of 25 patients with clinical neuropathy signs and in 17 out of 17 patients with no clinical signs. Thus, in subclinical conditions NCS is useful to detect the abnormalities in peripheral nerves of the ureamic patients under chronic dialysis.

Keywords: Uraemic polyneuropathy; Nerve conduction study; Quantitative electromyography; Haemodialysis; Peritoneal dialysis

1. Introduction

Peripheral neuropathy is a well-known complication of chronic renal failure (CRF) (Raskin and Fishman, 1976; Tyler, 1978) and occurs in approximately 60–80% of patients suffering end-stage CRF (Nielsen, 1971; Bolton et al., 1997; Pirzada and Morgenlander, 1997). The frequency of peripheral neuropathy in patients with CRF has declined owing to improvements in the modalities and techniques of dialysis (Goulon-Goeau and Said, 1990). Thus, uraemic neuropathy can be considered to be an indicator of inadequate treatment by dialysis (Laaksonen et al., 2002). It has been pointed out that uraemic neuropathy often remains mild or subclinical, and detectable only by electrophysiologic studies (Bolton et al., 1997; Hassan et al., 2003). Patients with uraemic myopathy generally have a normal physical examination and normal laboratory

Abbreviations: CAPD, continuous ambulatory peritoneal dialysis; CMAP, compound muscle action potential; CRF, chronic renal failure; CV, conduction velocity; DL, distal latency; HD, haemodialysis; MUP, motor unit potential; NCS, nerve conduction study; QEMG, quantitative electromyography; SNAP, sensory nerve action potential

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doi:10.1016/j.jelekin.2007.10.011

findings, including electromyography studies and muscle enzyme activities (Campistol, 2002); uraemic myopathy is thus diagnosed based on abnormal muscle biopsy findings.

There are several reports on nerve conduction studies (NCSs) in CRF patients (Nielsen, 1971; Di Paolo et al., 1988; Bazzi et al., 1991; Bolton et al., 1997; Van den Neucker et al., 1998; Mansouri et al., 2001; Ogura et al., 2001; Laaksonen et al., 2002); however, there is only one report pertaining to the findings of quantitative electromyography (QEMG) in CRF patients (Wanic-Kossowska and Koczocik-Przedpelska, 1996). In that study, NCS and QEMG were performed in 33 patients with CRF, 21 of whom were treated with haemodialysis (HD) and 12 with intermittent peritoneal dialysis. Neurogenic atrophy was found in all patients and primary myopathy was demonstrated in only one patient. There were no differences in the electrophysiologic parameters between the two groups of patients.

The aim of this study was to quantitatively determine the frequency, type, and severity of electrophysiologic changes occurring in peripheral nerves and muscles of CRF patients treated with HD and continuous ambulatory peritoneal dialysis (CAPD), and to compare the findings between these two groups. We also investigated the relationship between the clinical findings and the electrophysiologic parameters.

2. Materials and methods

2.1. Patients

Forty-two patients with CRF who were on a dialysis programme during time this research was conducted were included in the study. The patients were provided HD or CAPD treatment on a random basis, unrelated to the symptoms or signs they exhibited. Due to our inclusion criteria, the study sample consisted of 30 patients on HD, 15 males and 15 females with a mean age of 40.20 ± 15.78 years (range, 17–69 years) and 12 patients on CAPD, 5 males and 7 females with a mean age of 35.50 ± 10.48 years (range, 21–53 years). Patients with diabetes mellitus, alcoholism, amyloidosis, and other metabolic diseases resulting in myopathies or neuropathies were excluded, along with those patients <18 years of age. Primary renal diseases were known in 13 HD patients (nephritis [4], autosomal dominant polycystic kidney disease [3], hypertension [3], and urolithiasis [3]) and in 5 CAPD patients (nephritis [4] and hypertension [1]). The mean duration of dialysis was slightly longer among CAPD patients compared to HD patients (53 versus 50 months, $p > 0.05$). The target KT/V was 1.3 for HD patients and 2.0 for CAPD patients.

2.2. Controls

The standard reference values for NCS of the testing laboratory were used. These values were obtained from published studies (Stålberg and Falck, 1993; Falck et al., 1994). The controls (including 130–381 nerves) were healthy subjects aged 20–80 years called in for the study, or patients with focal lesions. They did not take drugs that were known to give neuropathy. Multiple linear regression analysis was performed with age and height as independent variables. 95% confidence limits were defined. For motor neurography, the technique is standardised, but for sensory studies, particularly for the sural nerve, technical differences may exist. To validate the technique in the testing laboratory for the present study in relation to the larger reference material for the sural nerve ($n = 62$), we collected separate test reference materials from 24 volunteer subjects, 13 males and 11 females with a mean age of 33.92 ± 11.30 years (range, 21–54 years). Informed consent was obtained from all patients and normal subjects. Since two patients did not permit us to complete the examination, their median and peroneal nerves were not examined, but the remainder of data obtained from them were evaluated.

2.3. Clinical evaluation

The patients were questioned about their peripheral neuropathic and myopathic symptoms, and examined carefully for these conditions. The patients were evaluated for the following symptoms: autonomic (orthostatic hypotension, orthostatic dizziness, sweating, sphincter dysfunction, and impotence), positive sensory (pain and paresthesias), negative sensory (numbness), positive motor (fasciculations, restless leg syndrome, and cramps), and negative motor (atrophy and weakness). Forty of 42 patients exhibited at least one of these symptoms.

The patients were also quantitatively evaluated for signs obtained from their neurologic examinations. A score of 1 point was given for each of the following abnormal signs: vibratory sensation, joint position, sense of touch and pain, weakness, atrophy, and deep tendon reflexes in the lower and upper limbs. Thus, the maximal sum of sign scores was 7.

2.4. Neurophysiologic investigation

2.4.1. Nerve conduction studies

Nerve conduction studies were performed with Keypoint EMG-equipment (Medtronic, Skovlunde, Denmark). The nerves on the other side of the fistula were investigated because of the possibility of local nerve lesions on the fistula side. The median, ulnar, peroneal, and tibial motor NCSs, including F-waves, were performed unilaterally. Sensory NCSs included the median, ulnar, and sural nerves unilaterally. All studies were performed using standard techniques of supramaximal percutaneous stimulation with a constant current stimulator and surface electrode recording.

Motor conduction studies

The median and ulnar nerve compound muscle action potentials (CMAPs) were evoked with a 1-cm-diameter cathode, 2 cm distal to the 1-cm-diameter anode, and recorded with 1-cm-diameter stainless steel disc electrodes. For median nerve motor conduction studies, the recording electrode was placed over the motor point of the abductor pollicis brevis muscle, at the midpoint of a line drawn from the first metacarpophalangeal joint to the insertion of the tendon of the flexor carpi radialis muscle, and with the reference electrode over the distal interphalangeal joint. The median nerve was stimulated at the wrist 80 mm proximal to the recording electrode and at the antecubital fossa. For ulnar nerve motor conduction studies, the recording electrode was placed over the motor point of the abductor digiti minimi muscle, at the midpoint of a line between the fifth metacarpophalangeal joint and the piriform bone, with the reference electrode over the middle phalanx of digit V. The ulnar nerve was stimulated at the wrist 80 mm proximal to the recording electrode and the elbow.