Fasciculations: clinical, electromyographic, and ultrasonographic assessment

Abstract Widespread fasciculations are an important clinical sign in, for example, degenerative lower motor neuron diseases (LMND). Usually they are detected by clinical inspection and electromyography. Recently myosonography has been proposed for the detection of fasciculations. This prospective study compares the value of these three modes of examination in patients with degenerative LMND. Seventy healthy control persons and 34 patients (11 women, 23 men; aged 43–78 years; median age 60.5) with LMND were included in the study. All participants were subjected to thorough visual screening for the presence of fasciculations. Fourteen muscles were examined bilaterally by myosonography and a median of 8 muscles were screened electromyographically (only in the patients); the investigators were blinded to the other findings. Clinical inspection and ultrasonography exhibited fasciculations in up to 5 and 8 muscles, respectively, in 8 healthy persons. Ultrasonography demonstrated fasciculations in all patients, clinical inspection in all but 2, and electromyography in 26 of 33 patients (1 patient was not examined electromyographically). Comparing the three methods, clinical observation revealed fasciculations in 42%, electromyography in 39%, and ultrasonography in 67% of all muscles. Thus, ultrasonography was significantly more sensitive than the other techniques ($P < 0.001$). The interrater agreement (correlation coefficient $r$ in respect of the presence or absence of fasciculation was 0.71 for the clinical, 0.85 for the electromyographic and 0.84 for the myosonographic examinations. Ultrasonography and electromyography were more reliable than the clinical examination ($P < 0.001$ and $P < 0.01$, respectively). Our study indicates that ultrasonography is more sensitive than clinical and electromyographic examination in visualizing fasciculations in patients with LMND. Additionally, it is more reliable than clinical examination.

Key words Lower motor neuron disease · Fasciculation · Ultrasonography · Electromyography

Introduction

Fasciculations are brief muscle twitches, usually lasting for 0.2–0.5 s [9] or 500 (SD 110) ms [14]. They are commonly found in amyotrophic lateral sclerosis and degenerative lower motor neuron disease (LMND), but can occur in other diseases of the lower motor neuron at any level from the anterior horn cells to the axon terminals [6]. They are detected, for example, in multifocal motor neuropathy, muscular pain-fasciculation syndrome, radiculopathies, sequelae of poliomyelitis, syringomyelia, tetany, myelopathies, following an overdose of anticholinesterase medication, plexopathies, peripheral nerve in-
juries, polyneuropathies, and rarely even in primary muscle disorders [3–6, 13]. In addition, about 70% of healthy subjects occasionally experience muscle twitches [8]. They can be detected by clinical inspection, and sometimes they can be palpated or even heard by auscultation. Furthermore, they can be depicted by conventional needle electromyography or by surface electromyography [5]. Recently, Reimers et al. [9], Rott et al. [10], and Walker et al. [14] described the possibility of visualizing fasciculations by B- or M-mode ultrasonography. A systematic study on the sensitivity and specificity of ultrasonographic screening for fasciculations has not yet been reported.

The purpose of the present study was to compare the sensitivity and specificity of a clinical, electromyographic, and ultrasonographic assessment of fasciculations. We chose patients with degenerative LMND for the study group because of the high incidence of fasciculations in these patients.

Materials and methods

Control group

Seventy voluntary healthy individuals without signs or symptoms of neuromuscular diseases (35 women and 35 men, aged 21–80 years, median age 42 years) were checked clinically and ultrasonographically for the presence of fasciculations in the same way as the patients.

Patients

Thirty-four consecutive patients (11 women, 23 men, aged 43–78 years, median age 60.5 years) with degenerative LMND, seen between January 1994 and August 1995, were included in the study. All had a history of progressive muscle wasting and weakness without sensory changes. Asymmetrical or multifocal electromyographic signs of motor neuron degeneration, i.e. fibrillation potentials and positive sharp waves and/or motor unit action potentials of increased amplitude and duration in muscles, outside the distribution of a single peripheral nerve or nerve root, were visible in at least three limbs or two limbs and the head [6, 11]. Possible differential diagnoses such as syringomyelia, polyradiculopathies or polynuropathies were excluded by radiological examination, motor and sensory neurography, and examination of the cerebrospinal fluid. Ten patients additionally revealed involvement of upper motor neurons, documented by obvious spasticity, abnormally brisk tendon reflexes or reflexes of the Babinski group. Three patients started with a progressive bulbar palsy with gradual generalization of their muscle weakness. Twenty-five patients were examined ultrasonographically for the first time during their initial clinic admission. Nine patients were included in the study during follow-up visits. The study was approved by the local ethical committee.

Methods

Clinical examination

The control subjects and patients were carefully visually screened for the presence and location of fasciculations by a neurologist not involved in the ultrasonographic and electromyographic examinations, first in the sitting, then lying in the supine and finally in the prone position. The duration of the clinical examination was on average 6–8 min.

Electromyography

Electromyography was performed exclusively in order to verify the clinical diagnosis of a degenerative LMND using a Nicolet Viking (Nicolet, Madison, Wis., USA) or Neuropack 2 (Nihon Kohden, Tokyo, Japan) electromyograph. The muscles included in the examination were determined, according to the clinical findings, by an experienced examiner who was not involved in the clinical and ultrasonographic investigations. The muscles were usually examined at only one or two sites with the concentric needle electrode inserted fanwise to register as many motor units as possible. According to our experience, this procedure is sufficiently sensitive for the detection of positive sharp waves and fibrillation potentials and large polyphasic motor unit action potentials, these being electrophysiological hallmarks of degenerative LMND. In each muscle, searching for fasciculations took at least 10 s, that is as long as for ultrasonography (see below). In 1 patient with a diagnosis proven by recent examinations, no follow-up electromyography was performed. In the remaining 33 patients, 3–11 (median: 8) limb muscles were examined. Electromyographic findings in facial, tongue and paravertebral muscles were not considered in the statistical evaluation as relaxation was often not adequate for assessing the presence or absence of fasciculations.

Ultrasonography

A real-time B-mode scanner with a 5-MHz electronic linear array transducer (Philips P700, Philips, Santa Ana, Calif., USA) was employed. The following muscles were regularly investigated bilaterally: when sitting, the deltoid, biceps and triceps brachii muscles; when lying supine the rectus abdominis, rectus femoris, vastus medialis, vastus intermedius, vastus lateralis, sartorius, and tibialis anterior muscles; and while lying prone the lumbar paraspinal, semitendinosus, gastrocnemius and soleus muscles. Undue pressure was not exerted on the imaged tissue. Each muscle was observed for at least 10 s in searching for spontaneous muscle movements. The presence of fasciculations was determined by several irregular movements of small parts of the muscle, lasting for about 0.2–0.5 s [9]. Arterial pulses were easily distinguished by their rhythmic appearance and their close topographical relation to blood vessels [9, 14]. Movements due to poor relaxation could also be differentiated from fasciculations as they – in contrast to fasciculations – result not only in contraction of the small parts of the muscle [14] and have a longer duration. We tried to avoid muscle shivering by ensuring a warm room temperature. If it was nevertheless present, it could be distinguished from fasciculations as it persisted for a longer period, involved several muscles, and was relatively regular. Finally, displacement of the transducer due to the examiner’s movements is also more coarse than fasciculations. This could be avoided by propping up the arms.

Frequency of fasciculations

The time intervals between consecutive fasciculations within a single muscle (935 single fasciculations in 13 patients), i.e. the reciprocal of the number of twitchings per second (not necessarily belonging to a single motor unit), visualized on videotapes were analysed by means of a personal computer program, the occurrence of muscle twitchings being marked by pressing a key on a keyboard.