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ORIGINAL ARTICLE/ARTICLE ORIGINAL

Template-operated MUP analysis is not accurate in the diagnosis of myopathic or neuropathic changes in the diaphragm

L'analyse quantifiée automatisée des PUM n'est pas appropriée au diagnostic des anomalies myopathiques ou neuropathiques dans le diaphragme

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KEYWORDS
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Diaphragm;
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Summary
Objectives. — The aim of this study was to evaluate the quantitative motor unit potential (MUP) analysis in the diagnosis of myopathy and neuropathy of the diaphragm.
Methods. — Diaphragm template-operated quantitative EMG were performed in 30 patients with myotonic dystrophy type 1 (DM1), 17 with myotonic dystrophy type 2 (DM2) and 40 with amyotrophic lateral sclerosis (ALS).
Results. — Low MUP amplitude precluded MUP analysis in 21% of DM1 patients. Only a single DM1 patient had EMG findings consistent with myopathy. In this patient, and another 4 DM1 and 3 DM2 patients, findings were consistent with neuropathy. Neuropathic MUP changes were found in 92% of ALS patients, but due to motor neuron cell loss in only 60% MUPs analyses could be done. Phrenic nerve conduction studies correlated with respiratory function tests, whereas MUP parameters did not.
Conclusion. — Quantitative MUP analysis was not able to adequately sample diaphragm MUPs in patients with chronic myopathy or motor neuronopathy.

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MOTS CLÉS
Diaphragme ;
Dystrophie myotonique ;
Fonction pulmonaire ;
Potentiel d'unité motrice ;
Sclérose latérale amyotrophique

Résumé
Objectifs. — L'objectif de cette étude était d'évaluer l'intérêt de l'analyse quantifiée automatisée des potentiels d'unité motrice (PUM) dans le diagnostic d'anomalies myopathiques ou neuropathiques au niveau du diaphragme.
Méthodes. — Des enregistrements EMG diaphragmatiques ont été réalisés chez 30 patients atteints de dystrophie myotonique de type 1 (DM1), 17 avec une dystrophie myotonique de type 2 (DM2) et 40 avec une sclérose latérale amyotrophique (SLA).
Résultats. — La faible amplitude des PUM a empêché l'analyse quantifiée dans 21 % des patients DM1. Seul un seul patient DM1 avait des résultats EMG compatibles avec une myopathie. Chez ce patient, ainsi que chez 4 autres patients DM1 et 3 patients DM2, les résultats étaient en revanche compatibles avec une neuropathie. Des anomalies neuropathiques des PUM ont été observées dans 92 % des patients atteints de SLA, mais en raison de la perte neuronale motrice, l'analyse des PUM n'a pu être réalisée que dans 60 % des cas. Les paramètres de conduction du nerf phrénique étaient corrélés avec les tests de la fonction respiratoire, alors que les paramètres des PUM ne l'étaient pas.
Conclusion. — L'analyse quantifiée automatique des PUM n'a pas permis d'échantillonner de manière adéquate les PUM au niveau du diaphragme chez des patients présentant une myopathie chronique ou une neuronopathie motrice.

Introduction

In evaluation of patients with hypercapnic respiratory failure, phrenic nerve conduction studies (NCSs) [11,25] and needle electromyography (EMG) of the diaphragm [5,17,43,45] are able to directly demonstrate a neuromuscular lesion as the possible cause of respiratory dysfunction. We have previously reported reference data and our experience with phrenic NCSs [31] and quantitative concentric needle EMG of the diaphragm muscle [27] in a control population. In a quantitative EMG study, we have shown diaphragmatic motor unit potentials (MUPs) to be much smaller compared to limb muscle MUPs [27]. Furthermore, due to the waxing and waning respiratory EMG pattern, MUP sampling was found to be much more difficult in the diaphragm than in limb muscles. This raised the question of the feasibility and utility of quantitative MUP analysis in the diagnosis of myopathy and neuropathy of the diaphragm. It would, however, be very useful to have a direct and objective test for myopathy or neuropathy in the diaphragm, because in some patients this important muscle may be even the first clinically affected (e.g. adults with Pompes' disease [33] or amyotrophic lateral sclerosis (ALS) [9,12]). Therefore, in the present study we aimed to employ quantitative MUP analysis in two groups of patients: one with myotonic dystrophy (DM), which is the most common inherited myopathy found in the adult population, and one with neuronopathy due to ALS.

Two forms of DM are described: DM type 1 (DM1) (OMIM #160900) and DM type 2 (DM2) (OMIM #602668). Although DM1 and DM2 are genetically different diseases inherited on different chromosomes, they share a similar pathogenetic mechanism. In both diseases, the expression of a mutated gene causes accumulation of aberrant RNA in the cell nucleus that affects the splicing of other common genes. Clinically, both forms of DM are progressive multi-organ disorders characterized by myotonia, muscle weakness, cardiac conduction defects, iridescent posterior subcapsular cataracts, insulin insensitive type 2 diabetes mellitus and testicular failure. ALS is a rapidly progressive neurodegenerative disease that affects the upper and lower motor neurons, which leads to muscle weakness. Chronic respiratory failure is a frequent complication in both diseases and consequently cause of premature death [2,3,35,39].

Diaphragmatic MUPs have only been previously studied qualitatively in DM1 and ALS [10,38,43]. Zifko et al. found qualitative diaphragmatic EMG abnormalities in 64% of DM1 patients: myotonic discharges in 56%, a decreased number of MUPs firing during inspiration in 32% and shorter MUP duration in 28% [43]. Twenty-eight percent of ALS patients without symptoms or signs of respiratory insufficiency had abnormal spontaneous activity in diaphragm EMG at rest [38]. No diaphragmatic needle EMG study has been to date reported in patients with DM2.

In the present study, the feasibility and utility of template-operated quantitative MUP analysis was assessed in DM1, DM2 and ALS patients. The sensitivity of MUP analysis in the diaphragm was calculated. Furthermore, quantitative MUP results were correlated with phrenic NCSs and respiratory function studies.

Methods

An invitation letter was sent to groups of genetically confirmed DM1 and DM2 patients from a Slovenian register of neuromuscular disorders. All responding DM patients willing to participate were included into the study. ALS patients regularly followed by our ALS team in outpatient clinic of the Ljubljana Institute of Clinical Neurophysiology in years 2010—2012, were invited to participate in the study. The

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