

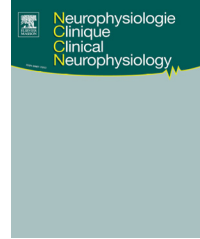


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ORIGINAL ARTICLE/ARTICLE ORIGINAL

Decline of compound muscle action potentials and statistical MUNE during Wallerian degeneration



Mesure de la diminution d'amplitude du potentiel d'action musculaire composite et évaluation statistique du nombre d'unités motrices au cours de la dégénérescence wallérienne

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KEYWORDS

MUNE;
Statistical MUNE;
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Nerve injury;
Nerve degeneration

Summary

Aim of the study. – In two previous studies, we found that the compound muscle action potential (CMAP) amplitude loss was significantly higher than the loss of estimated motor unit numbers in the course of Wallerian degeneration (WD). In order to overcome some drawbacks of the method previously used, we performed a similar CMAP vs MUNE comparison by using the statistical motor unit number estimation (MUNE) method.

Patients and methods. – Initial electrophysiological studies on 6 patients were performed between 22 and 98 hours after the injuries; it was possible to make repeated examinations, four times in 1 nerve, twice in 1 nerve and three times in 4 nerves, before the eventual complete disappearance of the CMAPs.

Results. – The transected/intact (T/I) side CMAP ratios declined steeply as WD evolved. They were significantly lower than the relatively stable MUNE ratios 48 hours after the injury.

Abbreviations: ALS, Amyotrophic lateral sclerosis; CMAP, Compound muscle action potential; MUNE, Motor unit number estimation; WD, Wallerian degeneration; sMUP, Surface recorded motor unit potential; T/I, Transected/intact side; MUP, Motor unit potential.

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MOTS CLÉS

Comptage des unités motrices ;
Méthode statistique de comptage des unités motrices ;
Dégénérescence wallérienne ;
Lésion nerveuse ;
Dégénérescence nerveuse

Conclusion. – This study, performed with the use of statistical MUNE, strengthens our previous observation by the incremental method that might have some relevance to the pathophysiology of early WD. CMAP amplitude loss that is more than expected from the amount of axonal degeneration may indicate a considerable amount of inactive muscle fibers in the motor units innervated by the nerve fibers, which are undergoing degeneration but still retain their excitability. Although technical sources of error cannot be totally excluded, our findings could more likely be explained by the failing of neuromuscular synapses in an asynchronous order before complete unresponsiveness of the motor unit ensues.

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Résumé

But de l'étude. – Nous avons montré dans deux études antérieures que lors d'une dégénérescence wallérienne (DW), la diminution d'amplitude du potentiel d'action musculaire composite (PAMC) était significativement plus marquée que la perte estimée du nombre d'unités motrices. En vue d'exclure tout biais méthodologique, nous avons utilisé une méthode statistique de comptage des unités motrices (CUM)

Patients et méthodes. – Notre étude a porté sur 6 patients présentant une lésion nerveuse aiguë examinés pour la première fois entre 22 et 98 heures après la survenue de la lésion. Ces études ont été répétées à 4 reprises sur un nerf, à 2 reprises sur un nerf et à 3 reprises sur 4 nerfs, avant la disparition complète du PAMC.

Résultats. – On note une diminution rapide du rapport entre les amplitudes des PAMC ipsi- et controlatérales par rapport à la lésion, lequel décroît plus rapidement que celui entre le nombre d'unités motrices ipsi- et controlatérales, qui reste relativement stable 48 heures après la survenue de la lésion.

Conclusions. – Cette étude faisant appel à une méthode statistique de CUM renforce nos observations antérieures, basées sur la méthode incrémentale de CUM, mettant en lumière la physiopathologie de la phase précoce de la DW. Une diminution d'amplitude du PAMC plus marquée que ce à quoi on se serait attendu sur base du degré de dégénérescence axonale, suggère l'existence d'un grand nombre de fibres musculaires inactives au sein des unités motrices dépendant de fibres nerveuses en cours de dégénérescence mais qui gardent leur excitabilité. Même si des biais techniques ne peuvent être totalement exclus, nos observations suggèrent que des défaillances des jonctions neuromusculaires pourraient se succéder de façon asynchrone avant la perte totale des réponses des unités motrices.

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Introduction

In two recent studies, we traced the transected/intact (T/I) side ratios of compound muscle action potential (CMAP) amplitudes and estimated motor unit numbers (MUNE) by performing repeated studies in the early course of acute nerve lesions [28,37]. In both studies, we found significantly steep CMAP amplitude loss as compared to MUNE, and hypothesized that the disparity between the CMAP and MUNE ratios may have relevance for the pathophysiology of Wallerian degeneration (WD). Although axonal degeneration was also shown to be a fast and asynchronous process, we explained our findings by the random and asynchronous dysfunction of neuromuscular synapses due to its earlier occurrence after nerve injury [2,24,28,37]. However, the technical factors inherent to the incremental MUNE method used in these studies should have been eliminated, as far as possible, before concluding that physiological mechanisms were responsible for our findings.

The present study was designed in order to re-evaluate our previous observations by using a MUNE method, which depends on a different principle. Complete

nerve transection seems to represent an ideal condition for pursuing the WD process. However, due to the resulting total paralysis, it requires the use of a stimulation MUNE method and in most patients this stimulation must be performed in a very restricted nerve segment distal to the injury site. Therefore, we chose to perform the study in patients with complete nerve transection by using the statistical MUNE method, which is operated by electrical stimulation at a single site and seems not to possess the major drawbacks of the incremental method [30,34].

Methods**Cases**

Six patients [5 female; 1 male; aged 13–42 years (mean: 29 ± 11.2)] with complete peripheral nerve transection, referred for electrophysiological examination early after urgent microsurgical repair and before the termination of WD, were included in the study. Five nerves (4 ulnar, 1 median) had been transected completely by broken glass

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