Neurophysiologie Clinique/Clinical Neurophysiology (2008) **38**, 227—233

Disponible en ligne sur www.sciencedirect.com

ScienceDirect

journal homepage: http://france.elsevier.com/direct/neucli

ORIGINAL ARTICLE/ARTICLE ORIGINAL

Soleus H reflex and motor unit number estimation after tibial nerve block and neurotomy in patients with spastic equinus foot☆

Modification du réflexe H et du nombre d'unités motrices du muscle soléaire après bloc du nerf tibial et après neurotomie en cas de pied équin spastique

T. Deltombe[a,*], J. Jamart[b], P. Hanson[a], T. Gustin[c]

[a] *Departments of Physical Medicine and Rehabilitation, université catholique de Louvain, cliniques universitaires de Mont-Godinne, avenue Dr Thérasse, 1, 5530 Yvoir, Belgium*
[b] *Departments of Biostatistics and Medical Documentation, université catholique de Louvain, cliniques universitaires de Mont-Godinne, 5530 Yvoir, Belgium*
[c] *Departments of Neurosurgery, université catholique de Louvain, cliniques universitaires de Mont-Godinne, 5530 Yvoir, Belgium*

Received 24 May 2007; accepted 23 March 2008
Available online 22 April 2008

KEYWORDS
Spasticity;
Equinovarus foot;
Neurotomy;
H reflex;
MUNE

Summary
Objective. — To assess and compare, clinically and electrophysiologically, the effects on muscle innervation and spasticity of selective anaesthetic nerve block and selective neurotomy of the motor-nerve branch to the soleus muscle in patients with spastic equinus foot.
Methods. — Eleven hemiplegic patients were studied before and after anaesthetic tibial-nerve block, and at two months and one year after tibial nerve neurotomy. Triceps surae spasticity and strength, walking speed, gait kinematics of the ankle, maximal amplitude of the H reflex and of the M-response and the Hmax/Mmax ratio of the soleus muscle, and the mean motor unit action potential area and motor unit number estimation (MUNE) of the soleus muscle were calculated on the normal and spastic side.
Results. — Spasticity and equinovarus improved in a similar fashion after tibial nerve block and neurotomy. The soleus Hmax/Mmax ratio decreased by 42% after tibial nerve block and 77% after neurotomy. The soleus MUNE decreased by 52% after tibial nerve block and by 86% after neurotomy.

☆ Supported in part by the ''Fondation Van Goethem-Brichant'' Grant.
* Corresponding author.
E-mail address: thierry.deltombe@uclouvain.be (T. Deltombe).

0987-7053/$ - see front matter
doi:10.1016/j.neucli.2008.03.003

Conclusion. — Diagnostic nerve block predicts the spasticity and gait improvement, which is expected after neurotomy. The clinical improvement was similar after block and neurotomy. Nerve block is associated with a 50% decrease in the soleus Hmax/Mmax ratio and soleus MUNE. The median 80% neurotomy is associated with an 80% decrease in the soleus Hmax/Mmax ratio and soleus MUNE.

MOTS CLÉS
Spasticité ;
Pied équin ;
Neurotomie ;
Réflexe H ;
Nombre d'unités motrices

Résumé
Objectifs. — Évaluer et comparer, cliniquement et électrophysiologiquement, les effets d'un bloc anesthésique sélectif et d'une neurotomie du nerf soléaire sur l'innervation musculaire et la spasticité chez des patients présentant un pied équin spastique.
Méthode. — Onze patients hémiplégiques ont été évalués avant et après bloc anesthésique ainsi que deux mois et un an après neurotomie. La spasticité et la force du triceps sural, la vitesse de marche, la cinématique de cheville, l'amplitude maximale du réflexe H et de la réponse M et le rapport Hmax/Mmax du muscle soléaire ainsi que la taille moyenne de l'aire des unités motrices et le nombre estimé du nombre d'unités motrices du muscle soléaire ont été mesurés sur le côté spastique et sur le côté sain.
Résultats. — La spasticité et le varus équin ont été améliorés de façon similaire après bloc et neurotomie. Le rapport Hmax/Mmax du soléaire est réduit de 42 % après bloc et de 77 % après neurotomie. Le nombre d'unités motrices du muscle soléaire est réduit de 52 % après bloc et de 86 % après neurotomie.
Conclusion. — Le bloc diagnostique aux anesthésiques est prédictif de l'amélioration attendue après neurotomie de la spasticité et de la marche. Le résultat fonctionnel obtenu est identique après bloc et neurotomie. Un bloc anesthésique entraîne une réduction du rapport Hmax/Mmax et du nombre d'unités motrices de 50 %. Une neurotomie de 80 % entraîne une diminution de 80 % du rapport Hmax/Mmax et du nombre d'unités motrices.

Introduction

Spastic equinovarus foot is a common deformity among hemiplegic patients. This deformity is mainly caused by spasticity of the triceps surae and tibialis posterior muscles, sometimes associated with weakness of the peroneus longus, peroneus brevis and tibialis anterior muscles, and Achilles tendon shortening. Treatment of the spastic equinovarus foot includes physical therapy, orthosis, chemical neurolysis with phenol, botulinum toxin injections, tendon transfers, Achilles tendon lengthening, and neurotomy.

In the assessment of the spastic equinovarus foot, especially before neurotomy, a selective diagnostic motor-nerve block with anaesthesia of the motor-nerve branches of the tibial nerve innervating the soleus, gastrocnemius, and tibialis posterior muscles is recommended. The nerve block stops spasticity for a few hours, allowing assessment of the respective contributions to the equinovarus deformity of the different spastic muscles, the degree of Achilles tendon shortening, and the weakness of the antagonistic muscles [1—3]. If weakness results from an excessive treatment of the triceps spasticity, it induces a decrease in the ankle push-off at the end of the stance phase of gait, resulting in poor propulsion. Diagnostic nerve block enables better understanding of the problematic and a more-informed therapeutic decision-making process [4]. It also helps predict the likely functional result of a tibial neurotomy [3].

Neurotomy, also called peripheral selective neurotomy, was reintroduced by a French neurosurgical team in the 1970s. The technique has been enhanced considerably by use of intraoperative electrical stimulation and operating microscopes, making it possible to selectively section motor-nerve branches of the spastic muscles and to preserve sensory nerve branches in order to avoid sensory deficit and neuropathic pain. Neurotomy results in permanent reduction in the spasticity of the selected muscles [5—9]. Partial section of the motor-nerve results in section of both afferent fibers mediating the spastic monosynaptic reflex arc and afferent fibers, the latter being responsible for transient muscle weakness. Several studies demonstrated permanent and selective release of spasticity and disappearance of clonus after neurotomy, correlated with a reduction in the ratio of the maximum amplitude of the H reflex to the maximum amplitude of the M-response (Hmax/Mmax) [8,10,11].

Even though the surgical technique and the resulting functional improvement are well established, several issues remain unanswered. Firstly, although the functional improvement that is obtained after diagnostic nerve block is believed to be predictive of what will be obtained after neurotomy, no study has prospectively, clinically or electrophysiologically, compared both techniques in the same patients. A correlation between a decrease in spasticity and Hmax/Mmax ratio was noted after both anaesthetic nerve block and neurotomy but, once again, not on the same patients [10,11]. After neurotomy, the Hmax/Mmax ratio was permanently reduced while the Mmax amplitude decreased two months after neurotomy and returned to preoperative value eight months after neurotomy [10,11]. However, the part of the nerve fibres involved in the section has not been assessed. Secondly, the percentage of motor nerve that should be sectioned during neurotomy is largely based on clinical experience and constrained by the fear of undertreating spasticity (if the section is insufficient) or of inducing excessive weakness (if the section is too large or