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Early post-stroke physical conditioning in hemiplegic patients: A preliminary study

Prise en charge précoce des patients hémiplégiques en activités physiques adaptées: étude préliminaire

A. Letombe [a,b,*], C. Cornille [a], H. Delahaye [a], A. Khaled [a], O. Morice [a], A. Tomaszewski [a], N. Olivier [c,d]

[a] *Centre de rééducation « L'Espoir », 25, pavée-du-moulin, 59260 Hellemmes, France*
[b] *Centre de rééducation Orcet/Mangini, rue de l'Orcet, 01110 Hauteville Lompnes, France*
[c] *Université Lille Nord de France, 59 000 Lille, France*
[d] *UDSL, EA4488, 59790 Ronchin, France*

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Abstract

Objective. – To establish the value of an early post-stroke evaluation of cardiorespiratory fitness in hemiparetic patients using a one-leg cycling exercise test and to analyze the impact of an adapted physical activity programme 12 weeks after the stroke.
Protocol. – Eighteen hemiparetic stroke patients participated in the study. The subjects were randomly assigned to one of two groups: the control group (CG) underwent 4 weeks of conventional rehabilitation, whereas the training group (TG) performed additional physical exercises. The initial evaluation (T1) was carried out after 1 week of exercise and the final evaluation (T2) was performed after 28 days. Both evaluations consisted of maximal graded tests performed with the valid leg, followed by completion of a questionnaire on personal autonomy in activities of daily living (ADL).
Results. – In the CG group, we recorded a 4 to 8% increase in peak oxygen uptake (VO_2 peak). There was no significant increase in peak power output (Wpeak). However, the TG displayed significantly ($P < 0.05$) greater peak values than those recorded on study entry (Wpeak: +30%, VO_2 peak: +20%). The TG showed a statistically significant improvement in the Barthel and Katz ADL scale scores, whereas the pre- and post-rehabilitation values did not differ significantly in the CG. However, there was no correlation between the Barthel/Katz scale scores and Wpeak.
Conclusion. – Evaluation of cardiorespiratory fitness by using the valid leg seems to be feasible in hemiplegic patients 1 month post-stroke. Early post-stroke physical training appears to be needed to limit the negative effects of functional hypoactivity.

Keywords: Stroke; Physical fitness; One-leg cycling; Exercise training; Adapted physical activity

Résumé

Objectif. – Montrer l'intérêt de l'évaluation précoce de l'aptitude aérobie chez des personnes hémiplégiques à partir d'un pédalage unilatéral et analyser chez ces patients, l'impact d'un reconditionnement à l'effort réalisé moins de 12 semaines après l'accident vasculaire cérébral (AVC).
Protocole. – Dix-huit patients hémiplégiques, répartis de manière aléatoire en deux groupes de neuf, ont participé à cette étude. Les sujets ont été évalués à quatre semaines d'intervalle. L'évaluation initiale a été effectuée dès l'entrée dans le service soit en moyenne 21 jours après l'AVC. Les évaluations consistaient en une épreuve d'effort maximale réalisée à partir du membre inférieur valide, suivie de questionnaires évaluant l'autonomie. Le groupe témoin a bénéficié d'une rééducation pluridisciplinaire sans reconditionnement à l'effort tandis que le groupe entraîné a bénéficié en supplément d'un programme en activités physiques adaptées (APA).
Résultats. – Une augmentation non significative ($p < 0{,}05$) de la puissance maximale aérobie (PMA) et de la consommation pic d'oxygène (VO_2 pic) de 4 et 8 % est enregistrée chez le groupe témoin. En revanche, le groupe entraîné obtenait des valeurs pics supérieures, comparativement aux

* Corresponding author.
E-mail address: a.letombe@orcet-helios.org (A. Letombe).

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valeurs d'entrée (PMA: +30 %; VO_2 pic: +20 %). Les scores enregistrés avec l'échelle de Barthel et de Katz sont statistiquement inchangés pour le groupe témoin signifiant l'absence d'amélioration de l'autonomie à la différence des scores du groupe entraîné qui ont significativement progressé. Aucune corrélation n'a été trouvée entre les scores de Barthel et Katz et la PMA.

Conclusion. – Une épreuve d'effort effectuée à partir d'un pédalage unilatéral semble tout a fait réalisable chez des patients hémiplégiques à un mois de l'AVC. Un reconditionnement à l'effort précoce semble nécessaire pour limiter les effets de l'hypoactivité fonctionnelle et permettre au patient de participer pleinement à sa rééducation.

Mots clés : AVC ; Réentraînement à l'effort ; Pédalage unilatéral ; Déconditionnement ; Activité physique adaptée

1. English version

1.1. Introduction

Stroke is the third-ranked cause of mortality after myocardial infarction and cancer. It constitutes the leading cause of acquired handicap in adults [7]. After the age of 60, this pathology is the leading cause of death in women and the second-ranked cause in men. The frequency, severity and cost of stroke make it an important public health problem. In 2002, the French National Agency for Accreditation and Evaluation (ANAES) emphasized the importance of functional and cardiovascular deconditioning in stroke patients. The severity of this deconditioning depends on the lesion's location and size [1]. Ramas et al. [26] reported that exercise capacities are 25 to 45% lower in hemiplegic patients than in age-matched, healthy subjects. After a stroke, the maximum oxygen consumption (VO_2) falls to a mean value of between 10 and 20 ml/kg per minute. Given that a value of 15 ml/kg per minute is required to perform most activities of daily living (ADL), improving the VO_2 during rehabilitation becomes a crucial issue. In a study of hemiplegic vascular stroke patients, Courbon et al. [5] found a significant relationship between the maximal effort and walking ability. A certain number of studies have highlighted the importance of post-stroke exercise training [14,21,22, 24,29]. In view of these observations, it is essential that healthcare establishment offer their patients muscle strengthening and cardiovascular training programmes. To counter deconditioning and accelerate recovery, stroke rehabilitation protocols indeed recommend cardiorespiratory training but there is no consensus on training in a broader sense.

In fact, there are significant disparities in the literature concerning the intensity, frequency and duration of exercise and the equipment to be used (treadmills, cycle ergometers, etc.) [5,14,25,10]. There is also heterogeneity in terms of the time interval between the initial stroke and the start of the training programme (generally very long – over a year [20,31]). We believe that this time interval is too long, in view of the average length of a hemiplegic patient's stay in a rehabilitation unit. In fact, the crucial period for rehabilitation is between 3 and 6 months post-stroke [13,27], meaning that rehabilitation should start as soon as possible. The neurological consequences of hemiplegia and improvements in the affected leg may limit the reliability of the effort tests described in the literature. This is why most researchers only perform cardiorespiratory evaluations 6 months after the accident, when neurological symptoms have stabilized. Nevertheless, Tang et al. [29] have demonstrated the feasibility of testing soon after the stroke. Implementation of an early post-stroke evaluation (on a treadmill with bodyweight support) has also been suggested by MacKay-Lyons and Makrides [14]. However, VO_2 measurement is difficult in this type of protocol. To counter this problem, the evaluation could be performed with the valid leg, since the feasibility of this approach has been demonstrated in patients with orthopaedic conditions [3,17]. To the best of our knowledge, the impact of a training programme (based on one-leg cycling) 1 month after stroke has not previously been studied.

Thus, the main objective of the present study was to show that a one-leg cycling evaluation of the aerobic capacity in hemiplegic patients is feasible soon after stroke. Our study also sought to determine the effects of exercise training initiated only a few weeks after the stroke.

1.2. Patients and methods

1.2.1. Population

Eighteen hemiplegic patients participated in the study. The subjects' anthropometric measurements are given in Table 1. At the start of the study, the mean time since stroke was 20 ± 2 days, with uninterrupted hospitalization. The inclusion criteria were as follows: right or left hemiplegia following ischaemic or haemorrhagic hemispheric stroke; a full set of aetiological data (CT and/or MRI scans, Holter ECG, Doppler, cardiac ultrasound); a stable clinical state; well-balanced treatment (particular in terms of antihypertensives and anticoagulants). The exclusion criteria were as follows: existence of disorders associated with hemiplegic motor damage, such as cognitive and memory disorders; hemisensory neglect; the existence of an intercurrent affection or unstable brain lesions.

Table 1
Anthropometric data.

	Control group, $n = 9$	Trained group, $n = 9$
Age (years)	60.6 ± 8.2	59.1 ± 9.4
Time since stroke	20 ± 2	21 ± 3
Number of women	3	4
Number of men	6	5
Ischaemic stroke	5	5
Haemorrhagic stroke	4	4
Left-side stroke	5	5
Right-side stroke	4	4