Annals of Physical and Rehabilitation Medicine xxx (2017) xxx–xxx

Available online at
ScienceDirect
www.sciencedirect.com

Elsevier Masson France
EM|consulte
www.em-consulte.com

Original article

Nordic walking versus walking without poles for rehabilitation with cardiovascular disease: Randomized controlled trial

Sébastien Girold [a,*], Jérome Rousseau [b], Magalie Le Gal [b], Emmanuel Coudeyre [a,c,d], Jacqueline Le Henaff [b]

[a] Department of Physical and rehabilitation Medicine, Clermont-Ferrand University Hospital, Hospital of Clermont-Ferrand, Cébazat, France
[b] The Moulin Vert Rehabilitation Center, 86340 Nieuil L'Espoir, France
[c] Clermont Auvergne University, 63000 Clermont-Ferrand, France
[d] Human nutrition unit, INRA, 63000 Clermont-Ferrand, France

ARTICLE INFO

Article history:
Received 11 August 2016
Accepted 8 December 2016

Keywords:
Rehabilitation
Cardiovascular disease
Nordic walking
6-min walk test

ABSTRACT

Background: With Nordic walking, or walking with poles, one can travel a greater distance and at a higher rate than with walking without poles, but whether the activity is beneficial for patients with cardiovascular disease is unknown.
Objective: This randomized controlled trial was undertaken to determine whether Nordic walking was more effective than walking without poles on walk distance to support rehabilitation training for patients with acute coronary syndrome (ACS) and peripheral arterial occlusive disease (PAOD).
Methods: Patients were recruited in a private specialized rehabilitation centre for cardiovascular diseases. The entire protocol, including patient recruitment, took place over 2 months, from September to October 2013. We divided patients into 2 groups: Nordic Walking Group (NWG, $n = 21$) and Walking Group without poles (WG, $n = 21$). All patients followed the same program over 4 weeks, except for the walk performed with or without poles. The main outcome was walk distance on the 6-min walk test. Secondary outcomes were maximum heart rate during exercise and walk distance and power output on a treadmill stress test.
Results: We included 42 patients (35 men; mean age 57.2 ± 11 years and BMI 26.5 ± 4.5 kg/m^2). At the end of the training period, both groups showed improved walk distance on the 6-min walk test and treatment stress test as well as power on the treadmill stress test ($P < 0.05$). The NWG showed significantly greater walk distance than the WG ($P < 0.05$). Both ACS and PAOD groups showed improvement, but improvement was significant for only PAOD patients.
Conclusions: After a 4-week training period, Nordic walking training appeared more efficient than training without poles for increasing walk distance on the 6-min walk test for patients with ACS and PAOD.

1. Introduction

Aerobic physical training is effective in the care of patients with cardiovascular diseases [1–3]. Indeed, this type of training allows patients to develop physical abilities, mainly in the cardiovascular and ventilation systems [4,5]. As an endurance exercise, walking is widely recommended for physical reconditioning [1,6,7]. However, this activity used with poles, as with Nordic walking, allows for travelling a greater distance and at a higher rate [8,9] than without poles.

Nordic walking has benefits for physical endurance capacity among healthy people [6,10,11]. The activity has shown benefits for patients with coronary [12] and arteritis diseases [9,13]. Indeed, Bulinska et al. [13] and Oakley et al. [9] showed a direct effect on increased walk distance for patients with arterial disease. Moreover, Kocur et al. [12] reported significant effects on cardiovascular adaptation to effort, mainly with decreased heart rate at a given intensity and a risk of heart attack level equivalent to that with walking without poles.

Compared to walking without poles, despite greater muscle recruitment, Nordic walking produces no significantly greater

* Corresponding author. Médecine Physique et Réadaptation, CHU Clermont-Ferrand, route de Chateaugay, 63118 Cébazat, France. Tel.: +33 4 73 75 09 00; fax: +33 4 73 75 09 01.
E-mail address: sgirold@chu-clermontferrand.fr (S. Girold).

http://dx.doi.org/10.1016/j.rehab.2016.12.004
1877-0657/

stress on the heart [14]. Thus, for use in cardiovascular training, Nordic walking may be similar to walking. We aimed to determine whether Nordic walking in a training program differs from walking without poles in increasing the walk distance for patients with acute coronary syndrome (ACS) and peripheral arterial occlusive disease (PAOD).

2. Methods

2.1. Participants

Patients signed a consent form after receiving complete information about the study and the risks, before the start of the protocol. Patients were recruited in a private specialized rehabilitation centre for cardiovascular diseases, treating 250 patients per year, on average. The entire protocol, including patient recruitment, took place over 2 months from September to October 2013.

The centre's physicians determined the inclusion and exclusion criteria. Inclusion criteria were ACS or occlusive peripheral arterial disease, having undergone one or more transluminal angioplasties with stent(s) placement, and able to follow the reconditionning program and tests. Exclusion criteria were sternotomy less than 3 months before the hospital stay, no revascularization [needing angioplasty with stent(s)], a coordination or learning problem concerning the Nordic walking technique, neuromuscular commorbidities (unable to walk), and unstabilized cardiorespiratory status. The patients' main risk factors and medical treatments are in Appendix 1.

2.2. Procedures

Patients were randomly devided into 2 groups by the centre physicians who used a randomization list. Each group performed a training program with 5 sessions per week lasting an effective duration of 45 min. The Nordic walking group (NWG) used Nordic walking for the training and the control group (WG) used walking without poles.

In addition to these training sessions, each patient performed the same reconditioning program including 5 sessions on an ergometrical bicycle, 5 gym sessions and 5 sessions of Adapted Physical Activity per week (Monday to Friday) (Appendix 2), for an effective duration of 45 min each over a total of 4 weeks.

The walk sessions involved a 900-m outdoor flat walking route around the rehabilitation centre. All other activities were held at the center.

The typical day of a patient is in Appendix 2.

2.3. Interventions

Nordic walking sessions involved use of specific poles composed of a handle and an adjustable gauntlet with markers for adjusting height. The pole was made of carbon fiber to combine flexibility and strength but also to limit the weight between 150 and 200 g depending on the size of the pole. The low weight of the pole also limited the risk of injury to the shoulder girdle, which is strongly affected by the weight of the moving object and movement repetitions [7]. A good pole length was determined by the distance between the hand with the elbow positioned at 90 degrees and the ground (a flat surface) when the person was standing.

For each patient in both groups (NWG and WG), the intensity of the training session was fixed in relation to the training heart rate determined by the maximum heart rate recorded during the exercise test, performed at the patient's admission to the centre and with use of the Karvonen formula [15]. The Karvonen formula aims to determine a work intensity based on a percentage of heart rate reserve (HRR), represented by the difference between maximum heart rate and resting heart rate. To maintain a maximum of aerobic impact, this percentage was set at 50%, corresponding to the first threshold or ventilatory threshold 1 [15]. A margin of $\pm$ 10% was tolerated given that maintaining a heart rate beat close to 50% is difficult.

Before Nordic walking sessions, all NWG patients received individual training for 30 min on the handling of poles and the technique of Nordic walking, to discover the activity and become familiar with the most effective movements.

Walking sessions for both groups started after a 10-min warm-up to stimulate and effectively prepare the cardiorespiratory and muscular system for the effort [2,3]. Then, each patient performed a 45-min session of walking at a pace dictated by the training heart rate. All patients were equipped with a heart rate monitor (Polar® FT1). Before each session, resting heart rate and blood pressure were measured. Any heart rate or blood pressure considered excessively high before the activity ($>$ 90 beats/min for heart rate and 150 mmHg for blood pressure) resulted in a medical opinion, after which the patient was or was not allowed to take part in the activity. None of the patients who participated in this study showed values greater than the cutoffs before the activity. Thus, they could all perform the same number of sessions. During these sessions, the patient regularly monitored the heart rate instantaneously to ensure that it corresponded to the training heart rate. After the session, patients performed an activity recovery at low intensity for 5 min.

For all patients, gym sessions and Adapted Physical Activities followed the recommendations of the Group of Exercise Rehabilitation and Sport and the French Society of Cardiology [16] and are presented in Appendix 2.

2.4. Outcomes

The main outcome was walking distance (m). Secondary outcomes were maximum heart rate during exercise (beats/min) and power output (W). All these criteria were measured before and after the training period. The evaluators were blinded to group assignment.

Before the protocol (W0), patients underwent two 6-min walk tests at a 24-h interval to avoid training effects [17]. The best walk distance from both tests was retained. After 4 weeks of exercise training (W4), patients underwent a third 6-min walk test. The same physiotherapist was in charge of all walk tests. Tests were performed indoors over a distance of 30 m delimited by cones. Patients were instructed to walk as far as possible during 6 min. During the tests, the physiotherapist used only standard phrases of verbal encouragement described in the American Thoracic Society statement [17].

Maximum heart rate achieved during the tests was recorded. The 6-min walk test has been described as the most suitable field test and most relevant for assessing patients with cardiac or respiratory failure and in patients with occlusive arterial disease [17]. Test passage modalities complied with the recommendations by Enright [18].

Walk distance was also measured with stress tests on a treadmill before and after 4 weeks of exercise training. Before the protocol (W0), patients underwent a triangular stress test based on a modified Bruce test [19,20]. This stress test complied with the terms described by Broustet and Monpère [21] and validated in patients with arterial disease. The test was stopped when patients reported too much pain or tiredness to continue.

For the treadmill stress test, a power output in Watts was estimated, with the metabolic equivalent of task (MET) of the final level reached at the end of the test [19,22–24]. The estimated

Please cite this article in press as: Girold S, et al. Nordic walking versus walking without poles for rehabilitation with cardiovascular disease: Randomized controlled trial. Ann Phys Rehabil Med (2017), http://dx.doi.org/10.1016/j.rehab.2016.12.004