

RISK OF CARDIOVASCULAR COMPLICATIONS DURING WALKING WITH ABOVE-KNEE PROSTHESIS IN ELDERLY PERSONS

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Abstract

A decision for above-knee prosthetic fitting in elderly patients suffering from numerous comorbidities is often difficult to make. The study included 40 subjects with above-knee amputation older than 65 amputated due to vascular atherosclerosis or diabetic angiopathy. Before the discharge, the 6-minute walking test was performed with above-knee prosthesis and walking aids used during the training. By means of telemetry,

continuous monitoring of the following was performed: ECG (12 channels), VO₂, VCO₂, BF, VE, RER (Oxicon mobile - Jaeger). In elderly patients with generalized atherosclerosis, the risk of cardiovascular complications during training and walking with prosthesis is very high. For the sake of prevention of the latter, exercise stress testing up to submaximal heart frequency is essential and is one of the important criteria in deciding for above-knee prosthetic fitting.

INTRODUCTION

A decision for above-knee prosthetic fitting in elderly patients suffering from numerous comorbidities is often difficult to make.

From the viewpoint of safety and prevention of sudden cardiac events, it is essential to know the patient's cardiorespiratory response to ambulation effort.

The data on the energy cost of walking with an above-knee prosthesis in elderly persons are very scarce. The measured oxygen uptake (VO₂) in slow, short-distance walking is low. When taking into account the distance walked, the values of the energy cost are very high compared to regular walking (1).

Due to comorbid cardiovascular diseases, the occurrences of clinical symptoms of coronary ischemia or heart failure are frequent (2, 3).

The aim of our study was monitoring of metabolic parameters and heart function with simultaneous ECG in order to determine heart rhythm disorders or coronary ischemia in walking with above-knee prosthesis, defining the energy cost and the required cardiac capacity for walking and confirming the need for exercise stress testing before starting rehabilitation programs.

METHODS AND SUBJECTS

Methods

Before the discharge, the 6-minute walking test was performed with above-knee prosthesis and walking aids used during the training. The subjects walked down a corridor on a level surface. The walking speed was determined individually by each subject. They were allowed to take rests during walking.

By means of telemetry, continuous monitoring of the following was performed: ECG (12 channels), VO₂, VCO₂, BF, VE, RER (Oxicon mobile - Jaeger). The energy cost was calculated in regard to the distance covered.

Before and after walking, blood pressure values were measured in the sitting position with a quicksilver manometer.

The patients were divided into 4 groups according to sex and the type of walking aids used during walking.

Subjects

The study included 40 subjects with above-knee amputation older than 65. The causes of the amputation were vascular atherosclerosis or diabetic angiopathy. The patients were admitted to the Institute for Rehabilitation, Republic of Slovenia, for primary rehabilitation in 2007.

They were included into standard rehabilitation programs.

Prior to starting the programs, submaximal exercise stress testing was performed on a manual bicycle according to the protocol of discontinuous stressing.

The patients were fitted with above-knee prosthesis with plastic sockets and locked knees. They took part in gait training.

RESULTS

The study included 40 subjects over 65 years old, who had been fitted with above-knee prosthesis with a locked-knee mechanism. There were 18 female and 24 male subjects. The average age was 71.5 ± 7.5 years. The women were 73.4 and the men 71.3 years old on average.

All the subjects were included into rehabilitation programs for the first time; the duration of the programs was 32 days on average.

Twenty-five (62.5%) of the patient had been treated for diabetes, 5 patients had ECG criteria for myocardial infarction, 2 patients underwent myocardial revascularization, 1 patient had suffered stroke with good neurological restitution. Twelve (30%) patients took medications for coronary disease.

Twelve (30%) patients used a walker (5 female, 7 male), 28 (71%) used two crutches (11 female, 17 male).

All the subjects performed the 6-minute walking test.

Table 1: Results of 6-minute walking test and energy cost during walking

| | Male | | Female | |
|--|----------|--------|----------|--------|
| | Crutches | Walker | Crutches | Walker |
| Average (years) | 70.8 | 71.3 | 73.3 | 73.6 |
| Distance (m) | 99.9 | 65.7 | 65.7 | 49.9 |
| Oxygen cost VO ₂ ml/kg/min | 11.55 | 10.15 | 10.5 | 9.1 |
| Velocity m/min | 16.6 | 10.9 | 10.8 | 8.3 |
| RER | 0.9 | 0.88 | 0.92 | 0.88 |
| Energy cost ml/kg/m | 0.69 | 0.93 | 0.97 | 1.09 |

Two patients in the group using crutches for walking took medications affecting heart frequency. Among the 26 of the remaining patients, the average increase of the heart frequency was 84.8% of the expected maximal age-related frequency.

In four patients heart rhythm disorders were detected (SVES and VES), three had chronic atrial fibrillation and ischemic changes were shown in one patient.

Among the 12 patients who walked with crutches, 6 took beta blockers due to IBS, in 3 patients heart frequency during walking was over 82.1% of the expected age-related frequency. In three patients, coronary ischemia criteria were observed and heart rhythm disorders were shown in 2 patients (VES).

The differences between the measured values of the systolic blood pressure before and after walking were 29.6 mmHg on average (from 10 to 75 mm Hg). In five patients from the first group blood pressure exceeded 200 mmHg after walking.

In the second group, the average increase in blood pressure was 55 mmHg (from 30 to 80 mmHg). The blood pressure reached over 200 mmHg in as many as 7 patients.

DISCUSSION

Elderly persons with above-knee amputations are mainly able to walk slowly at short distances. In 6 minutes, longer distance was covered by male subjects using either crutches or a walker. In the groups of male and female subjects, those that used walkers were older.

At shorter distances, the oxygen consumption was lower in female subjects.

The energy cost was very high in all the four groups. Walking with a walker demanded the highest energy expenditure. The patient in the group using a walker had the largest number of comorbidities. The walkers had been prescribed since the patients were less secure in walking and had more balance problems. Lower walking economy was therefore understandable.

In the majority of the patients who did not take chronotropic medications, the measured heart frequency during walking was over 80% of the expected age-related frequency. In addition, heart rhythm disorders and/or coronary ischemia were registered in 13 patients.

Significant increase of systolic blood pressure during walking requires good regulation of blood pressure which is sometimes difficult to achieve in patients with multiple comorbidities.

All the measured values confirm the fact that walking with above-knee prosthesis requires adequate heart capacity.

CONCLUSION

In elderly patients with generalized atherosclerosis, the risk of cardiovascular complications during training and walking with prosthesis is very high. For the sake of prevention

of the latter, exercise stress testing up to submaximal heart frequency is essential and is one of the important criteria in deciding for above-knee prosthetic fitting.

References:

1. Otis JC, Lane JM, Kroll MA. Energy cost during gait in osteosarcoma patients after resection and knee replacement and after above-knee amputation. *J Bone Joint Surg* 1985;67:606-11.
2. Hirsch AT, Haskal ZJ, Hertzler NR, Bakal CW, Creager MA, Hiratzka LF et al. ACC/AHA 2005 Guidelines for Management of Patients With Peripheral Arterial Disease. *J of American Coll of Cardiology* 2006;47(6):1239-1312.
3. CAPRIE Steering Committee. A randomised, blinded, trial of clopidogrel versus aspirin in patients at risk of ischaemic events (CAPRIE). *Lancet* 1996;384:1329-39.