Optimization of exercise therapy in type 2 diabetes mellitus

Published: 30-08-2012
Last updated: 26-04-2024

1. Measurement of the 24-hour glycemic profile in response to acute submaximal hypoxic and hyperoxic exercise in order to determine its effectiveness and select the most efficient method in reducing post-exercise hyperglycemia prevalence in...

Ethical review	Approved WMO
Status	Pending
Health condition type	Glucose metabolism disorders (incl diabetes mellitus)
Study type	Interventional

Summary

ID

NL-OMON39148

Source
ToetsingOnline

Brief title
Hypo- and hyperoxic exercise & glycemic profile in DM2

Condition

- Glucose metabolism disorders (incl diabetes mellitus)

Synonym
adult onset diabetes, Diabetes type 2

Research involving
Human

Sponsors and support

Primary sponsor: Erasmus MC, Universitair Medisch Centrum Rotterdam
Source(s) of monetary or material Support: Ministerie van OC&W

Intervention

Keyword: Exercise, hyperglycemia, oxygen, type 2 diabetes

Outcome measures

Primary outcome

Average values of glucose concentrations computed during the 24 h - continuous subcutaneous glycemia monitoring (CGMS) (GlucoDay®, A. Menarini) following exercise under various oxygen conditions.

Secondary outcome

• Workload in watts and VO2max during maximal exercise test.

• Performance on an sub-maximal exercise test (50% VO2max - relative workload to oxygen conditions).

• Muscle blood flow (NIRS Portamon®)

• Cardiac output (noninvasive thoracic bio-impedance method using Haemoseis 256®)

• Lung diffusing capacity (Master Screen PFT® (Viasys/Jaeger)

• Sublingual microcirculation imaging (Sidestream Dark Field Imaging®)

• Measurements of the mitoPO2 and mitoVO2 by the PpIX triplet state lifetime technique during every sub-maximal test.

• Adrenaline and noradrenaline concentrations (plasma).

• HbA1c (blood), plasma glucose

Study description

Background summary

DM2 is considered a growing pandemic problem. In accordance, DM related complications, like retinopathy, neuropathy, myocardial infarction and stroke will be experienced more frequently in the future. Vastly enlarging diabetes population will impose an enormous burden on our healthcare system and the quality of life of the diabetes patients. Therefore, besides pharmacological and nutritional strategies, other therapeutic options are required. The latter would amplify the efficacy of complex prevention and treatment programs in DM2.
Regular physical activity is considered an important cornerstone in the prevention and treatment of DM2 patients. In particular, it has been documented that regular physical activity improves lipid profile, cardiovascular fitness, quality of life and glycemic control. The latter is a direct and independent risk factor for the development of DM2 complications.
On the other hand, it has been shown that an acute bout of exercise immediately reduces the level of hyperglycemia in DM2 subjects, along with diet and medication.
This research aims to improve our understanding on effectiveness of a single bout of exercise in more physiologically challenging oxygen conditions in DM2 patients. Obtained results will help us selecting the most beneficial method in order to further improve treatment strategies/interventions in DM2.

Study objective

1. Measurement of the 24-hour glycemic profile in response to acute submaximal hypoxic and hyperoxic exercise in order to determine its effectiveness and select the most efficient method in reducing post-exercise hyperglycemia prevalence in comparison with normoxic conditions.

2. Comparison and selection of oxygen conditions which amplify stimulation of muscle blood flow/ improve exercise tolerance during exertion. Moreover, obtained peripheral and central hemodynamic/respiratory responses will demonstrate the net result of acute exercise in various oxygen conditions.

The latter will contribute to optimize exercise therapy in DM2 patients with impaired exercise tolerance and diabetes complications.

Study design

SIngle-blinded, case-control, observational study.

Intervention

Patients will undergo 1 maximal exercise test. Subaequently, they will be randimized and blinded to 3 steady-state sub-maximal tests (30 min each) in various oxygen conditions (21%O2-79%N2 / 14%O2-86%N2 / 35%O2-65%N2, 4-8L/min) on separate days. Additionally, subjects will be monitored by noninvasive equipment for hemodynamic and cardiorespiratory measurements. During the

experimental trial blood glucose profiles of subjects will be monitored by portable CGMS devices for 2 days. Total time of participation in the study equals 12 weeks.

Study burden and risks

The subjects will follow 1 normoxic maximal exercise test (screening and pre-testing) on a bicycle using spiro-ergometry, ECG and non-invasive blood pressure monitoring. Subsequently, 3 submaximal steady-state exercise tests will be performed (30 minutes each) under hypoxic, hyperoxic and normoxic conditions. 7-day breaks will be preserved between each test. Blood samples will obtained once during screening, pre-testing (9ml). During submaximal testing blood will be withdrawn every 15 minutes (0,15,30 min) from venous punction (3ml each sample).
During the submaximal trials(3 days each) the subjects will be monitored by continuous glycemia monitoring system (CGMS) (GlucoDay®, A. Menarini) for 48 hours.
Measurements of a hemodynamic response will be performed by the noninvasive Haemoseis 256®, PortaMon®, Sidestream Dark Field imaging devices during every sub-maximal test. Respiratory manouvers (prior and post every sub-maximal test) will be performed using a noninvasive PFT Master Screen
The subjects will be provided with standardized diet during the trial (3x2days) matched for their body mass (6 meals and 6 snacks). The patients will be asked to report consumed nutrition products prior each submaximal testing period (2 days).
During exercise testing the risk of a hypoglycemic event is low considering moderate-intensity exercise trial. If necessary carbohydrate solutions or in case of loss of consciousness, Glucagon (Glycagen®, 1 mg dissolved in 1 ml) are available.
Besides the direct therapeutic effects, both interventions are expected to improve general health and well-being.

Contacts

Public
Erasmus MC, Universitair Medisch Centrum Rotterdam

's-Gravendijkwal 230
Rotterdam 3015 CE
NL
Scientific
Erasmus MC, Universitair Medisch Centrum Rotterdam

's-Gravendijkwal 230

Rotterdam 3015 CE
NL

Trial sites

Listed location countries

Netherlands

Eligibility criteria

Age
Adults (18-64 years)
Elderly (65 years and older)

Inclusion criteria

Diabetes patients(n=12):
• Type 2 Diabetes Mellitus >3 months.
• Age: 40-65 years.
• BMI between 27 and 35 kg/m2.
• Formal permission to participate in the study by signing an informed consent form.
Healthy subjects(n=20):
• Age:18-40 years.
• BMI:23-26 kg/m2
• Formal permission to participate in the study by signing an informed consent form.
Overweight /Obese subjects - glucosetolerant(n=12):
Age: 40-65 years;
BMI >27 kg/m2;
HbA1c <6.0%;
Formal permission to participate in the study by signing an informed consent form.
Overweight /Obese subjects - glucoseintolerant(n=12):
Age: 40-65 jaar;
BMI > 27 kg/m2;
HbA1c >=6.0%;
Formal permission to participate in the study by signing an informed consent form.

Exclusion criteria

• Cardiovascular disease: objective heart failure (ejection fraction <35%), electrocardiographically diagnosed cardiac ischemia or symptomatic peripheral vascular

disease diagnosed by Doppler ultrasound investigation
• Serious orthopedic of neurological conditions precluding an exercise test.
Healthy subjects:
• Positive signs of cardiac ischaemia on the ECG (ST>2mm) during the incremental exercise test;
• Orthopaedic impairments that would limit participation in the study.
Obese volunteers - glucose tolerant:
• Positive signs of cardiac ischaemia on the ECG (ST>2mm) during the incremental. exercise test;
• Orthopaedic impairments that would limit participation in the study.
• Use of β-blockers, α-blockers, calcium antagonists.
Obese volunteers - glucose intolerant:
• Positive signs of cardiac ischaemia on the ECG (ST>2mm) during the incremental. exercise test;
• Orthopaedic impairments that would limit participation in the study.
• Use of β-blockers, α-blockers, calcium antagonists.

Study design

Design

Study type:	Interventional
Intervention model:	Parallel
Allocation:	Randomized controlled trial
Masking:	Single blinded (masking used)
Control:	Active
Primary purpose:	Prevention

Recruitment

NL

Recruitment status:	Pending
Start date (anticipated):	01-03-2012
Enrollment:	56
Type:	Anticipated

Medical products/devices used

Product type:	Medicine
Brand name:	Medicinal oxygen 14%

Generic name:	Medicinal oxygen 14%
Product type:	Medicine
Brand name:	Medicinal oxygen 21.5%
Generic name:	Medicinal oxygen 21.5%
Registration:	Yes - NL outside intended use
Product type:	Medicine
Brand name:	Medicinal oxygen 35%
Generic name:	Medicinal oxygen 35%

Ethics review

Approved WMO Date:	30-08-2012
Application type:	First submission
Review commission:	METC Erasmus MC, Universitair Medisch Centrum Rotterdam (Rotterdam)
Approved WMO Date:	12-12-2012
Application type:	First submission
Review commission:	METC Erasmus MC, Universitair Medisch Centrum Rotterdam (Rotterdam)
Approved WMO Date:	29-05-2013
Application type:	Amendment
Review commission:	METC Erasmus MC, Universitair Medisch Centrum Rotterdam (Rotterdam)
Approved WMO Date:	07-08-2013
Application type:	Amendment
Review commission:	METC Erasmus MC, Universitair Medisch Centrum Rotterdam (Rotterdam)
Approved WMO Date:	10-12-2013
Application type:	Amendment
Review commission:	METC Erasmus MC, Universitair Medisch Centrum Rotterdam (Rotterdam)

Study registrations

Followed up by the following (possibly more current) registration

No registrations found.

Other (possibly less up-to-date) registrations in this register

No registrations found.

In other registers

Register	ID
EudraCT	EUCTR2011-006237-42-NL
CCMO	NL39085.078.12