Methods in Diagnosing Chronic Anterior Compartment Syndrome
A Clinical Study in Patients with Exercise-Induced Leg Pain

Akademisk Avhandling

Som för avläggande av medicine doktorsexamen vid Sahlgrenska Akademin vid Göteborgs Universitet kommer att offentligen försvaras i Hörsal Arvid Carlsson, Medicinaregatan 3, onsdagen den 13 maj 2015, kl.09.00

av

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Avhandlingen baseras på följande delarbeten:

I. The magnitude of intramuscular deoxygenation during exercise is an unreliable method to diagnose the cause of leg pain.
Zhang Q, Rennerfelt K, Styf J
Scand J Med Sci Sports. 2012;22(5):690-694.

II. Detection of changes in muscle oxygen saturation in the human leg: a comparison of two near-infrared spectroscopy devices.
Nygren A, Rennerfelt K, Zhang Q
J Clin Monit Comput. 2014:28 (1):57-62.

III. Changes in muscle oxygen saturation have low sensitivity in diagnosing chronic anterior compartment syndrome of the leg.
Rennerfelt K, Zhang Q, Karlsson J, Styf J
J Bone Joint Surg, conditionally accepted

IV. Patient pain drawing (PPD) is a valuable instrument for assessing the causes of exercise-induced leg pain.
Rennerfelt K, Zhang Q, Karlsson J, Styf J
In manuscript

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ABSTRACT

Chronic anterior compartment syndrome (CACS) is a painful condition within one or more muscle compartment(s) in the lower leg. It impedes blood flow and muscular function due to elevated intramuscular pressure. The diagnostic criteria are the subject of debate. At present, the measurement of intramuscular pressure (IMP) is the accepted method for establishing the diagnosis. The limitation is that it is invasive. This thesis evaluates the ability of near infrared spectroscopy (NIRS), using three different devices, to diagnose CACS by monitoring changes in muscular oxygen saturation during and after exercise. The aspect of experimentally induced muscle ischemia was also analysed by NIRS. In addition, a new method, i.e. patient pain drawing (PPD), was assessed to support the diagnosis of CACS.

One hundred and seventy-six patients were included in Study I, median age 32 years. One hundred and fifty-nine patients (median age 29 years) and 31 healthy subjects (median age 36 years) were included in Study III. The use of NIRS as a method for diagnosing CACS, by analysing the changes in muscular oxygen saturation during and after exercise, was evaluated. Twenty healthy subjects (10 women and 10 men), median age 43 years, were recruited for Study II. Two NIRS devices were used to measure muscle oxygen saturation in healthy human skeletal muscle of the lower leg. The capability of the two NIRS devices to detect experimentally induced skeletal muscle ischaemia in the leg was compared. Study IV comprised 477 consecutive patients with exercise-induced leg pain, median age 31 years. The study determined the sensitivity, specificity and predictive value of patient pain drawing (PPD) in identifying CACS patients. Intra-observer agreement was assessed.

In Studies I and III, the magnitude of intramuscular deoxygenation was shown to be a non-reliable method for diagnosing CACS. In Study I, the mean level of oxygenation (relative values) decreased to 33% in patients with CACS and to 34% in patients without CACS (p=0.107). In Study III, the deoxygenation at peak exercise was 1% in the CACS patients and 3% in the non-CACS patients (p=0.003). In Study II, both devices were able to detect experimentally induced skeletal muscle ischaemia in the leg. Moreover, the INVOS device was shown to be less affected by the skin and subcutaneous tissue thickness than the InSpectra device. Study IV showed that PPD can be used to support the diagnosis of CACS. The sensitivity of PPD to identify CACS ranged between 67-75%. When assessing the agreement between the PPD and the gold standard, the correct diagnoses were established in 79% (Observer 1) and 82% (Observer 2) of the CACS patients (n=79).

Patients with CACS cannot be distinguished from patients with other causes of exercise-induced leg pain using NIRS during an exercise test and at rest after an exercise test. The NIRS device, INVOS, is able to detect experimentally induced skeletal muscle ischaemia in the human leg. The use of NIRS may be helpful in detecting leg muscle ischaemia in clinical situations with reduced blood circulation. PPD is useful to support the diagnosis of CACS.

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