Whole-body energy consumption map constructed by PET during some movements in daily life

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Introduction

Positron emission tomography (PET) can be used to visualize tissue metabolism in vivo in humans. [¹]¹⁸Fluorine-fluoro-deoxy-glucose (FDG) is commonly used to measure, with anatomical precision, regional metabolic levels which closely reflect the functional activity of organs. [¹] We proposed the use of the 3D-FDG-PET technique in sports medicine for mapping the working strength of muscles in the body. The purpose of this study was to obtain the skeletal muscle activity during running, cycling and going up stairs. Muscle activities during these movements were well unknown.

Methods

Regional brain activity was measured with PET and FDG. Young male subjects took part in this study. All subjects fasted at least 6 hours before experiment. They run, cycled, went up for 50 minutes at intensity correspond to 55% VO₂max using ergometer. FDG was injected 20 minutes after the beginning of exercise. PET emission scan started approximately 45 min after FDG injection using an SET2400W whole-body tomography system, (Shimadzu Co, Japan), with an intrinsic spatial resolution of 3.9 mm. The tomography system has 32 rings of BGO crystals separated by axial intervals of 3.15 mm covering an axial field of 20 cm. Transmission scan followed the emission scan, using a ⁶⁸Ge/⁶⁸Ga rotating external line source for correction of tissue attenuation. The tomographic images were obtained from the regions of the foot, 10 cm up the medial malleolus, to the maximal girth of the leg and thigh, the greater trochanter, the 4th lumbar vertebra and the 7th thoracic vertebra. We measured the FDG uptake of 39 muscles present in these regions. The localization of individual muscles were verified by comparison with the tomographic images with magnetic resonance imaging (MRI).

Results and Discussion

During running, more than two times FDG accumulated in foot and leg, and slightly more FDG accumulated in the quadriceps femoris and gluteal muscles than in the thoracic, back, abdomen and arm muscles. During cycling, FDG accumulated in quadriceps femoris and iliopsoas muscles were markedly increased. During going up stairs, FDG uptake in gluteus medius muscle was greater than that of other active muscles such as gastrocnemius, iliopsoas and quadriceps femoris muscles. These results would provide data useful not only in sports medicine but also in rehabilitation medicine.

References