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Visualization and quantitative analysis of skeletal muscle NMES by 18F- FDG PET/CT scan

Hee-won Park[1*], Sora Baek[1†], In Kook Chun[2], Gyuhyun Lee[1]

Kangwon National University Hospital, Kangwon National University School of Medicine, Department of Rehabilitation Medicine[1], Kangwon National University Hospital, Kangwon National University School of Medicine, Department of Nuclear Medicine[2]

Objectives

To visualize the skeletal muscle contractions generated by neuromuscular electric stimulation (NMES) using 2-deoxy-2-[fluorine-18]fluoro- D-glucose integrated with computed tomography (18F-FDG PET/CT) and to evaluate relationship between muscle contraction force and FDG uptake amount.

Methods

18F-FDG PET/CT were scanned after muscle contraction stimulation with NMES on both Vastus Medialis (VM) muscles of 10 healthy males with a mean age of 25.0 ±2.7 years. Before NMES stimulation, maximum isometric knee extension strength was evaluated with dynamometer and then electric stimulation level was determined as intensity generating 5% of the maximum extension peak torque. Subjects were undergone total 40 minutes of electric stimulation before scan. In the middle of stimulation, 15 minutes of break time were given and the FDG were administered intravenously to subjects at the end of the break time. PET/CT images were obtained immediately after the second 20 minutes of electric stimulation. To quantify the FDG uptake of VM, the volume of interest, 18 F-FDG PET / CT images were reconstructed in 3-dimensional voxels and the amount of radioactivity was estimated. The Standard Uptake Value (SUV) was calculated by dividing amount of radioactivity in VM by the FDG units per body weight administered.

Results

Average NMES stimulation intensity was 9.3 ± 6.9 mA and range were 20-45 mA. The torque generated by the NMES stimulus averaged 8.6 ± 2.2 Nm and ranged 5-13 Nm. The SUV value averaged 803.8 ± 279.2 and ranged 477-1441. Throughout the group, the torque and SUV value did not clearly correlate. But the ratios of SUV to torque for same subject showed good consistency in both left and right VM (Intraclass correlation coefficient = 0.7, 95% CI 0.16-0.91).

Conclusion

The effect of skeletal muscle contraction by NMES could be visualized by 18FDG-PET/CT. It was also found that calculated amount of FDG uptake in PET / CT images reflects the strength of contraction.

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Figure 1. NMES stimulation of Vastus Medialis

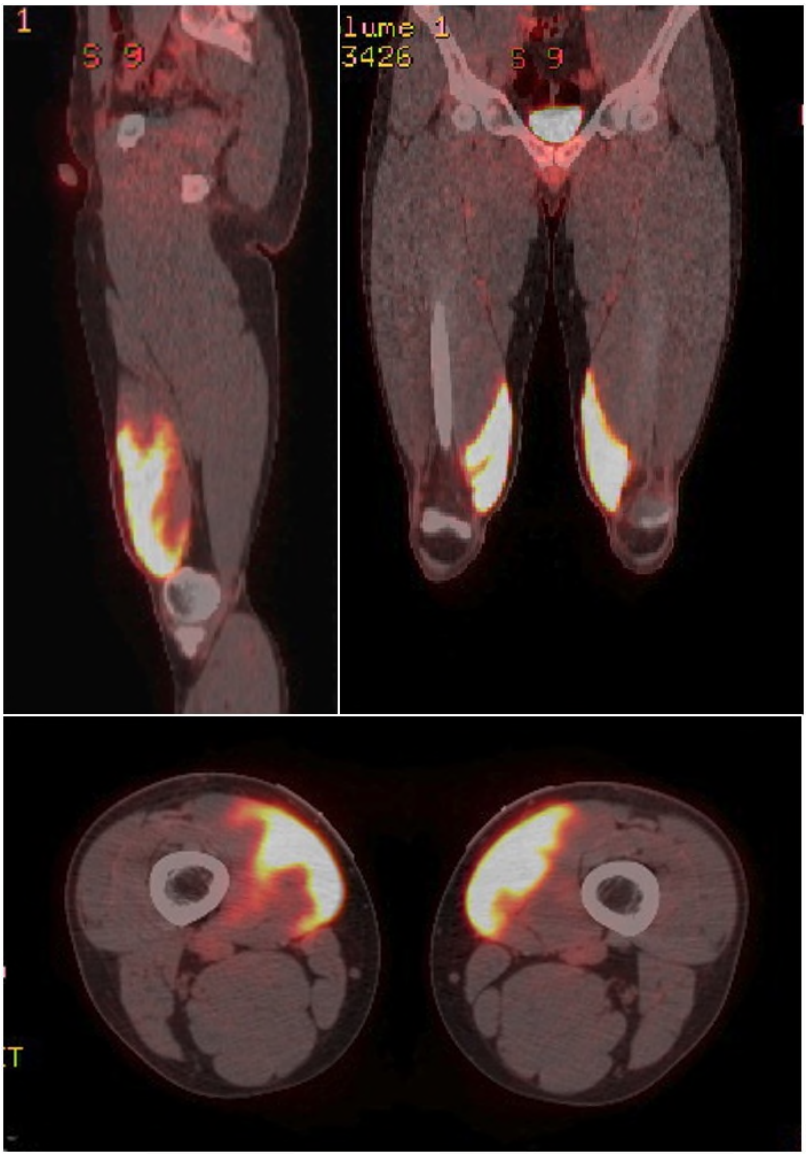

Figure 2. 18F-FDG PET/CT image of Vastus Medialis after NMES