Use of Single Limb Exercise Training to Improve Cardiovascular Function in Chronic Stroke

SA Billinger, PT, FAHA[1]; KA Schippers, SPT[1]; JL Nordstrom, SPT[1]; L Guo [2] and PM Kluding, PT, PhD[1]

[1]Dept. of Physical Therapy and Rehabilitation Sciences; School of Medicine; [2]University of Kansas Medical Center, Kansas City, Kansas

INTRODUCTION

Blood flow regulation may be influenced by physical activity levels and metabolic demand. For people post-stroke, a sedentary lifestyle and decreased use of the hemiparetic limb may affect blood flow to the affected lower limb. In our previous work, we found significant differences in resting femoral artery diameter and blood flow velocity in the hemiparetic limb when compared to the less affected side. In an attempt to improve cardiovascular function, a single limb exercise (SLE) protocol that focused on the hemiparetic limb was used for the training intervention.

PURPOSE

The purpose of this study was to determine the effect of a SLE training protocol on oxygen uptake (VO_2), femoral artery blood flow, diameter, and peak velocity in the hemiparetic limb in people post-stroke.

PARTICIPANTS

Ten individuals (5 males, 61.5 $\pm$ 11.7 years of age; 50.8 $\pm$ 59.7 months post-stroke) with mild to moderate stroke (lower extremity Fugl-Meyer score: 26.7/34 $\pm$3.3) participated in this within subjects study.

METHODS

•Doppler ultrasound was used to assess femoral artery diameter and blood flow velocity at three timepoints (baseline, midpoint, post-intervention).

• Blood flow(BF) was calculated from the equation: BF= ((π) * (radius) ^{2} * (mean bf velocity (Vmean)) * (60)).

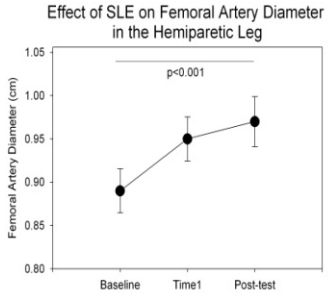
•SLE training with the hemiparetic limb 3 times per week for 4 weeks using a Biodex System knee extension/flexion exercise protocol with a pace of 150º *sec^{-1} at 40 repetitions per set.

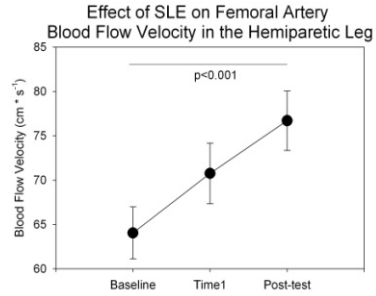
•Metabolic cart was used to assess oxygen uptake (VO_2) during SLE at baseline and post-intervention.

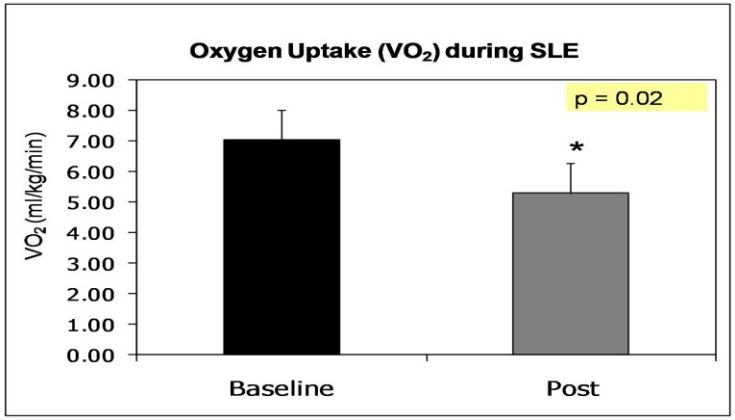
•Statistical significance was set at alpha $\leq$ 0.025.

RESULTS

Using repeated measures ANOVA with a main effect for time, significant improvements for femoral artery BF ($p < 0.001$), diameter (baseline: 0.89 cm $\pm$ 0.03 (SE) vs post SLE: 0.97 cm $\pm$ 0.03; $F= 48.08_{(2, 16)}$; $p < 0.001$) and blood flow velocity (baseline: 67.35cm*sec^{-1} $\pm$ 4.38 (SE) vs post-SLE: 76.7cm*sec^{-1}; $F = 55.45_{(2,16)}$; $p < 0.001$) were found in the hemiparetic limb after SLE training. No significant increases were observed in femoral artery diameter ($p = 0.12$) or blood flow velocity ($p=0.24$) for the untrained limb. During submaximal exercise, VO_2 peak decreased after the intervention by 24.4% (baseline:7.0 $\pm$ 0.6 (SE) to 5.3 $\pm$ 0.5 ml*kg^{-1}*min^{-1}; $p= 0.015$).







CONCLUSION

These data suggest that SLE improves femoral artery adaptations in hemiparetic lower extremity following stroke. SLE training focused on the hemiparetic limb may be considered as an effective intervention for people post-stroke to improve blood flow and oxygen uptake for performing daily functional activities.

Supported by the KUMC General Clinical Research Center grant M01 RR 023940 National Institutes for Research Resources/NIH; Sonosite, Inc for equipment loan