Effects of contracting muscle mass on arterial plasma [K^+] and fatigue during exercise

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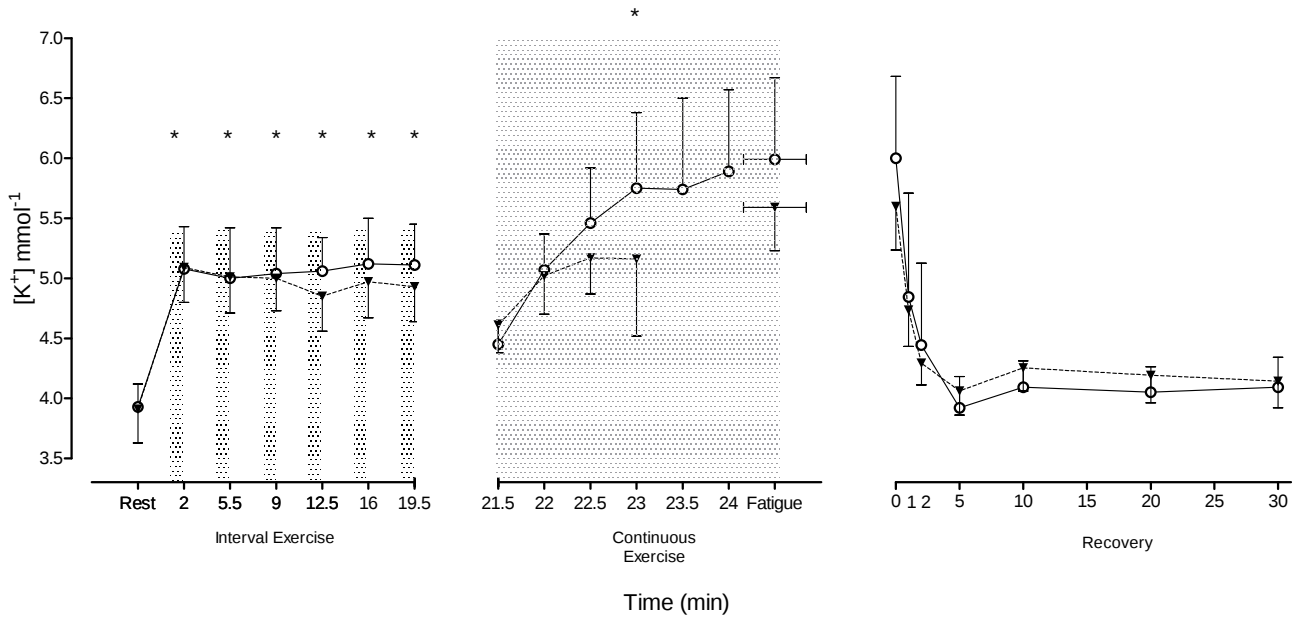
During exercise the mass of contracting muscle should theoretically enhance circulating K^+ concentration ([K^+]) and may also impact on performance and fatigue. In an effort to maintain performance and increase time to fatigue inactive muscles may assist in regulating [K^+] *via* the Na^+, K^+ pumps. We therefore investigated the effects of cycling exercise using two (2L) and one leg (1L) on arterial and venous plasma [K^+] and performance. Nine healthy recreationally active participants (8 males, 1 female) volunteered for the study. Participants physical characteristics (mean ± SD) were 24.0 ± 4.1 yr, 177 ± 8 cm, 76.29 ± 12.88 kg. Participants performed separate 2L and 1L cycle ergometer graded exercise tests to exhaustion, separated by 4-7 d, to determine $\dot{V}O_{2\ peak}$ (2L $\dot{V}O_{2\ peak}$ 44.0 ± 10.5 ml.kg^{-1}.min^{-1} and 1L $\dot{V}O_{2\ peak}$ 32.1 ± 4.0 ml.kg^{-1}.min^{-1}). Participants then performed 2L and 1L cycle exercise trials comprising 6×2 min intervals at 80% of $\dot{V}O_{2\ peak}$ followed by 90% of $\dot{V}O_{2\ peak}$ with 90 s recovery followed by exercise at 90% of $\dot{V}O_{2\ peak}$ until fatigue with trials separated by 7 d. Peak torque during maximal isometric voluntary contraction of the quadriceps muscles was recorded before and after the exercise. Radial artery and antecubital venous blood was sampled at rest, during and after exercise for analysis of [K^+].

Arterial plasma [K^+] increased throughout exercise ($P < 0.05$) and was 35% and 26% greater at fatigue in 2L and 1L respectively (the Figure, 2L open circle, 1L solid triangle, $P < 0.05$).



Venous plasma [K^+] increased during exercise ($P < 0.05$) by 1.37 (26%) and 1.43 mmol^{-1} (27%) for 2L and 1L respectively. The arterial-venous difference in plasma [K^+] increased by 70 - 90% ($P < 0.05$). At fatigue the peak torque decreased ($P < 0.05$) by 19% (28 ± 4 Nm) and 32% (50 ± 8 Nm) for 2L and 1L respectively with no difference between trials ($P < 0.05$).

Arterial and venous plasma [K^+] was higher in the 2L than 1L ($P < 0.05$) possibly due a larger contracting muscle mass. Interestingly, there was no significant difference between 2L and 1L peak torque there was a slightly larger loss of force for the 1L following exercise. This was possibly due to a smaller contracting muscle mass. In conclusion, the results of this study are possibly due to circulating [K^+] not reflecting the venous effluent during exercise.