일회성 운동의 강도 변화에 따른 정맥혈과 말초 및 타액의 Nitric Oxide 대사체 농도변화

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Abstract

Kim, Y.J., Park, C.S., Kim, K.H., OH, S.H., Park, D.H. Comparisons of Nitric Oxide Concentration changes in vein, capillary and saliva according to changes of exercise intensity in acute exercise. *Exercise Science*. 17(4): 383-390, 2008. This study is to confirm whether the samples obtained by non-invasive method(saliva) or minimal-invasive method(capillary blood) can be used like vein blood to observe the significant amount of Nitric Oxide(NO) by finding the changes in capillary and saliva when the amount of NO in vein blood changes as the intensity of acute exercise changes. for this 20 volunteers(man:12, woman:8) had done an acute exercise program, which was consisted of two different kind of intensity, one was lactate threshold intensity for 10minute and the other was VO_2 max intensity by exhaustion. The sampling time was before exercise, immediately after Lactate threshold intensity, after VO_2 max intensity, and after 1 hour resting, and the sample was gathered from vein, capillary and saliva at the same time. We measured NO from the three site sample and compared each other. The result was that the changes of NO from vein and capillary was similar($p>.05$) but not same. The changes of salivary NO was different with other two type samples($p<.01$). we could know that salivary NO is capable of announcing of neuronal system especially parasympathetic situation.

초록

김용진, 박창신, 김광희, 오수학, 박동호. 일회성 운동의 강도 변화에 따른 정맥혈과 말초 및 타액의 Nitric Oxide 대사체 농도변화. *운동과학*, 제17권 제4호, 383-390, 2008. 본 연구는 운동강도가 변하는 일회성 운동에 의해 정맥혈의 Nitric Oxide (NO) 값이 변하는 상황에서 채취하기 쉬운 체액인 말초혈액과 타액의 NO값 변화를 관찰함으로써 통증을 최소로 하거나 비 침습적 방법으로 얻은 샘플을 통해 정맥혈의 NO값을 예측할 수 있는지 확인하는데 그 목적이 있었다. 이를 위해 20명(남자 12명, 여자 8명)의 피험자들은 각 개인의 적정강도인 젖산역치(lactate threshold; LT) 강도에서 10분간 운동 한 후 최대산소섭취량(VO_2 max)의 강도에서 힘들어서 포기할 때까지 달리는 두 가지 강도가 포함된 일회성 운동을 실시하였다. 샘플은 안정시(baseline), 젖산역치 운동 직후(LT), 최대강도(VO_2 max) 운동 직후, 한 시간 휴식 후(1h poste-exercise)에 채취되었다. 이때 각 시기마다 정맥혈과 손가락 끝의 말초혈액 및 타액을 채취하였다. 채취된 샘플에서 NO를 측정하였고 세 가지 체액이 각 시기마다 동일한 반응을 나타내는지 확인하였다. 그 결과 정맥혈과 말초혈액의 NO값 변화는 비슷한 경향($p>.05$)을 보였으나 동일하지는 않았고 타액의 NO는 전혀 다른 경향을 나타내었다($p<.01$). 또한 본 연구를 통해 타액의 NO는 신경계, 특히 부교감 신경계를 대변할 가능성이 높음을 알 수 있었다.

Key words : Exercise Intensity, Vein, Capillary, Saliva, Nitric Oxide

주요어 : 운동강도, 정맥, 말초, 타액, Nitric Oxide

참고문헌

- Astaneie, F., Afshari, M., Mojtahedi, A., Mostafalou, S., Zamani, M. J., Larijani, B., & Abdollahi, M. (2005). Total antioxidant capacity and levels of epidermal growth factor and nitric oxide in blood and saliva of insulin-dependent diabetic patients. *Archives of Medical Research*, 36(4): 376-381.
- Al-Waili, N. S., & Boni, N. S.(2004). Honey increased saliva, plasma, and urine content of total nitrite concentrations in normal individuals. *Journal of Medical Food*, 7(3): 377-380.
- Bodis, S., & Haregewoin, A.(1994). Significantly reduced salivary nitric oxide levels in smokers. *Annals of Oncology*, 5(4): 371-372.
- Daniel, J., Andrew, M., Gerry., & Taylor, R.(2004). Effect of exercise training on endothelium-derived nitric oxide function in humans. *The Journal of Physiology*, 561: 1-25.
- Feldman, P. L., Griffith, O. W., & Stuehr, D. J.(1993). The surprising life of Nitric oxide. *C & EN*, 20: 26-38.
- Goto, C., Higashi, Y., Kimura, M., Noma, K., Hara, K., Nakagawa, K., Kawamura, M., Chayama, K., Yoshizumi, M., & Nara, I.(2003). Effect of different intensities of exercise on endothelium-dependent vasodilation in humans: role of endothelium-dependent nitric oxide and oxidative stress. *Circulation*, 108(5): 530-535.
- Goto, C., Nishioka, K., Umemura, T., Jitsuiki, D., Sakaguchi, A., Kawamura, M., Chayama, K., Yoshizumi, M., & Higashi, Y.(2007). Acute moderate-intensity exercise induces vasodilation through an increase in nitric oxide bioavailability in humans. *American Journal of Hypertension*, 20(8): 825-830.
- Heinrich, P., Fischer, Wolfgang. E., & Russell, I. J.(1998). a possible role for saliva as a diagnostic fluid in patients with chronic pain. *Seminars in arthritis and rheumatism*, 27(6): 348-359.
- Ignarro, L., Napoli, C., & Loscalzo, J.(2002). Nitric oxide donors and cardiovascular agents modulating the bioactivity of nitric oxide. *Circulation Research*, 90(1): 21-28.
- Ignarro, L.(2004). Experimental evidences of nitric oxide-dependent vasodilatory activity of nebivolol, a third-generation beta-blocker. *Blood Press. Supplement*, 1: 2-16.
- Imai, K., Sato, H., Hori, M., Kusuoka, H., Ozaki, H., Yokoyama, H., Takeda, H., Inoue, M., & Kamada, T.(1994). Vagally mediated heart rate recovery after exercise is accelerated in athletes but blunted in patients with chronic heart failure. *Journal of American College of Cardiology*, 24(6): 1529-1535.
- Jouni, S., Kyösti, N., & Seppo, S.(2006) Nitric oxide synthase in human salivary glands. *Histochemistry and Cell Biology*, 125(6): 717-723.
- Knowles, R. G., Moncada, S.(1994). Nitric oxide synthases in mammals. *The Biochemical Journal*, 298: 249-258.
- McKnight, G. M., Smith, L. M., Drummond, R. S., Duncan, C.W., Golden, M., & Benjamin, N. (1997). Chemical synthesis of nitric oxide in the stomach from dietary nitrate in humans. *Gut*, 40: 211-214.
- Mahn, K., Borrás, C., Knock, G. A., Taylor, P., Khan, I. Y., Sugden, D., Poston, L., Ward, J. P., Sharpe, R. M., Viña, J., Aaronson, P. I., & Mann, G. E.

- (2005). Dietary soy isoflavone induced increases in antioxidant and eNOS gene expression lead to improved endothelial function and reduced blood pressure in vivo. Official publication of the Federation of the American Societies for Experimental Biology, 19(12): 1755-1757.
- Stoudemire, N. M., Wideman, L., Pass, K. A., McGinnes, C. L., Gaesser, G. A., & Weltman, A.(1996). The validity of regulating blood lactate concentration during running by ratings of perceived exertion. *Medicine and Science and Sports Exercise*, 28(4): 490-495.
- Taubert, D., Roesen, R., Lehmann, C., Jung, N., & Schömig, E.(2007). Effects of low habitual cocoa intake on blood pressure and bioactive nitric oxide: a randomized controlled trial. *The Journal of the America Medical Association*, 298(1): 49-60.
- Tavares, F. N., Goncalves, P. L., Porto, S. A., Pereira, F. E., & Ribeiro-Rodrigues R.(2005). Nitric oxide levels are not changed in saliva of patients infected with hepatitis C virus. *Revista da Sociedade Brasileira Med Trop*, 38(6): 453-455.
- Yamamoto, Y., Hughson, R. L., & Nakamura, Y.(1992). autonomic nervous system response to exercise in relation to ventilatory threshold. *Chest*, 101: 206-210.

논문투고일 : 2008. 09. 02

심사일 : 2008. 10. 13

심사완료일 : 2008. 11. 07