Portable, Noninvasive and Wireless Near Infrared Spectroscopy Device to Monitor Skeletal Muscle Metabolism during Exercise

Authors : Adkham Paiziev, Fikrat Kerimov

Abstract : Near Infrared Spectroscopy (NIRS) is one of the biophotonic techniques which can be used to monitor oxygenation and hemodynamics in a variety of human tissues, including skeletal muscle. In the present work, we are offering tissue oximetry (OxyPrem) to measure hemodynamic parameters of skeletal muscles in rest and exercise. Purpose: - To elaborate the new wireless, portable, noninvasive, wearable NIRS device to measure skeletal muscle oxygenation during exercise. - To test this device on brachioradialis muscle of wrestler volunteers by using combined method of arterial occlusion (AO) and NIRS (AO+NIRS). Methods: Oxyprem NIRS device has been used together with AO test. AO test and Isometric brachioradialis muscle contraction experiments have been performed on one group of wrestler volunteers. 'Accu- Measure' caliper (USA) to measure skinfold thickness (SFT) has been used. Results: Elaborated device consists on power supply box, a sensor head and installed 'Tubis' software for data acquisition and to compute deoxyhemoglobin ([HHb), oxyhemoglobin ([O2Hb]), tissue oxygenation (StO2) and muscle tissue oxygen consumption (mVO2). Sensor head consists on four light sources with three light emitting diodes with nominal wavelengths of 760 nm, 805 nm, and 870 nm, and two detectors. AO and isometric voluntary forearm muscle contraction (IVFMC) on five healthy male subjects (23,2±0.84 in age, 0.43±0.05cm of SFT) and four female subjects (22.0±1.0 in age and 0.24±0.04 cm SFT) has been measured. mVO2 for control group has been calculated (-0.65%/sec±0.07) for male and -0.69%/±0.19 for female subjects). Tissue oxygenation index for wrestlers in average about 75% whereas for control group StO2 =63%. Second experiment was connected with quality monitoring muscle activity during IVFMC at 10%,30% and 50% of MVC. It has been shown, that the concentration changes of HbO2 and HHb positively correlated to the contraction intensity. Conclusion: We have presented a portable multi-channel wireless NIRS device for real-time monitoring of muscle activity. The miniaturized NIRS sensor and the usage of wireless communication make the whole device have a compact-size, thus can be used in muscle monitoring.

Keywords : skeletal muscle, oxygenation, instrumentation, near infrared spectroscopy
Conference Title : ICPESS 2016 : International Conference on Physical Education and Sport Science
Conference Location : Bangkok, Thailand
Conference Dates : December 12-13, 2016