INCREASES IN VENOUS RETURN DURING THE PRONE POSITION IN WATER.

Onodera Sho1, Nishimura Kazuki2, Ono Kumiko2, Seki Kazutoshi2, Ishida Yasuo2, Takahara Terumasa2, Kremenik Michael3, Takahashi Koki4, Hara Hideki5, Ogita Futoshi6, Toussaint Hubrecht Martin7

(Kawasaki University of Medical Welfare1, Japan, Graduate School Kawasaki University of Medical Welfare2, Japan, Kawasaki University of Medical Welfare3, Japan, Kurashiki University of Science and Arts4, Japan, Kogakuen University5, Japan, National Institute of Fitness and Sports, Kanoya6, Japan, Free University7, Netherlands)

It is well known that, during water immersion, bradycardia and increases in stroke volume are induced by an effect of hydrostatic pressure. We clarified the volume of venous return changes depending upon the water depth while standing in water, which was indicated the changes in the size of the cross sectional area of the inferior vena cava1,2). However, there is still no common agreement on changes in venous return while in the prone position. Therefore, the purpose of the present study was to investigate the changes in the cross sectional area of the inferior vena cava while in the prone and supine position in and out of water.

Seven subjects voluntarily participated in this study (age of 21.4±1.3 years, height of 174.4±5.7 cm, body weight of 66.9±7.4 kg, rate of body fat of 17.5±3.8%). We have informed consent for subjects according to the Declaration of Helsinki. The experiments were performed in four different ways: in the prone and supine positions both in and out of the water. The subjects were in a resting state during those positions. Water temperature was set at 30 degrees Celsius. The cross sectional area of inferior vena cava was measured by using B-mode echocardiography. Data were analyzed by ANOVA and the level was set at p<0.05.

The cross sectional area of inferior vena cava was 2.19±0.74 cm² in the supine position out of water, 3.20±0.65 cm² in the prone position out of water, 3.60±0.43 cm² in the supine position in water and 4.10±0.59 cm² in the prone position in water. The differences among these data were statistically significant (p<0.05). These results indicate that the cross sectional area of the inferior vena cava is enlarged during the prone position both in and out of water when compared with the supine position, and also becomes greater in water than out of water in both supine and prone position.

We suspect that the venous return has no change both in and out of water in the prone position. This is because the water depth of ~20 cm would be so shallow that the effect of water pressure would be negligible. Therefore, the findings of the study indicate that volume of venous return increases during swimming posture, and furthermore, those would imply an important suggestion that the venous return is affected by swimming style.


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