7. SUMMARY

Aquatraining- Effects on selected blood parameters and on the heart-rate variability of horses

The objectives of the present investigation were to investigate the effects of Aquatraining with horses on selected blood parameters and on heart rate variability to determine the degree of burden of this training-method.

Seven horses performed six exercise tests varied by different velocities (walking: $\bar{x}$ = 94 $\pm$ 5 m/min; trotting: $\bar{x}$ = 174 $\pm$ 8 m/min) and different water levels (dry, water above the carpus and water above the elbow). The standardised test-protocol was: 5 min warm up at walk while the water was pumped in, followed by the 20 min exercise period at walk or trot, followed by a 5 min walk while pumping out the water. Blood samples were taken prior to each test at rest in the stable (basic value; 1. blood sample), as well as exactly 5 min after the end of the 20 min exercise period (after pumping out the water, 2. blood sample). Further blood samples were taken 25 minutes (3. blood sample) or 24 hours respectively (4. blood sample) after the 2. blood sample, to determine the removal-rates of the blood parameters. Electrocardiograms were recorded during rest and the 20 min exercise periods.

Lactic acid concentration [mmol/l], pH, hemoglobin content [g/l], packed cell volume, erythrocyte count [T/l], total plasma protein [g/l], creatin-kinase [U/l], aspartate-aminotransferase [U/l], lactate-dehydrogenase [U/l], alanin-aminotransferase [U/l], heart rate [bpm], IBI [ms], SDNN [ms], SDANN [ms], RMSSD [ms], HRV tr Index, TP [ms^2], LF_{NORM} [%], HF_{NORM} [%], LF/HF ratio, %recurrence [%], %determinism [%], $ratio_{KORR}$ and $entropy_{KORR}$ [bits] were determined for characterising how metabolism and heart rate variability are influenced.

The measured concentrations of hemoglobin, packed cell volumes and the erythocyte counts show a marked increase as result of an Aquatraining following our training-protocol. The remaining blood parameters are nearly unchanged compared with the basic values. This indicates that Aquatraining represents a moderate submaximal aerobic training-method for horses.

Regarding the time domain parameters, the chosen workloads lead to a significant increase of heart rate and a significant decrease of IBIs, SDNN, SDANN, RMSSD and HRV tr Index compared to rest. An increase of workload, varied by water level as well as by velocity, partly results in a significant decrease of HRV. The lowest variability appears while trotting in water above the carpus and the elbow.

The analysis of the frequency domain parameters shows that the amplitude of the linear harmonic components of the heart rate always remain in nearly similar limits, independent of the degree of workload. This occurs in spite of the exercise-induced significant increase of heart rate. This amplitude is independent of the degree of workload. As a result of the significant increase of the sympathetic and the significant decrease of parasympathetic influences on the heart the demanded exercises lead to a significant shift of the sympathetic and the parasympathetic ratio.

The recurrence plot parameters indicate an increase of deterministic dynamics in connection with higher stability and complexity of the HRV caused by physical exercise. Furthermore an improvement of workload leads to an increase of stability. Thus the influence of fluctuations by chance on the non-linear dynamics of HRV decreases by rising workload.