6 SUMMARY

Heart rate variability in the horse at rest and after stress

Analytic parameters from human medicine were investigated for their applicability for the determination of heart-rate-variability in the horse. This non-invasive investigative procedure, based on data from electrocardiography (ECG), has had significant impact in human medicine. In veterinary medicine, the focus has previously been laid only on the manual and optical analysis of ECG data. Linear and non-linear parameters are used for the analysis of heart-rate-variability. Linear parameters are represented by time-domain and frequency-domain parameters, whereas non-linear parameters include the recurrence-plot method and the calculation of maximum Lyapunow exponents.

Three different groups of horses were used for the study. Group I was used as reference group and consisted of n = 6 horses in healthy condition. Group II consisted of n = 12 horses with chronic obstructive pulmonary disease. They were enrolled in a clinical trial for the use of acetylcysteine (secretolytic drug) in horses. Group III consisted of n = 7 two-year-old trotters monitored from February until November 1997 during training.

The parameters used in this study revealed interesting results after the analysis of various data from inter-beat-intervals.
Results of the parameters in the time-domain suggested that this analytic method alone was not a sufficient source of information. Confounding random factors significantly influenced this method and made results inconsistent and non reproducible.

The usage of the parameters in the frequency-domain gave better results. With the use of normalized units, inter individual differences were suppressed so that the influence of the sympathetic and parasympathetic system on the results could be better interpreted. The results of this study indicated that an analysis of heart-rate data by Fourier-transformation, the separation of the spectra in frequency ranges modified for horses and their presentation in normalized units are suitable methods

for investigations of equine heart rate. However, the time series of inter-beat invervals provided signals that did not allow spectral analysis without transformation. The probability of a heart beat occuring is not the same at every time point (nonstationary) because the sinus rhythm can be interrupted by extrasystoles or the ECG can be disrupted by artefacts. Furthermore, data from RR-intervals are not consistent at each time point. This makes the transformation of the time series neccessary for spectral analysis.

With respect to analysis by non-linear methods, transformation of the time-series is not neccessary for the reccurrence-plot method, as this method is robust for nonstationary data. Furthermore, it is possible to correct the influence of random changes. Indeed, the reccurrence-plot method provided insights into the dynamics of regulation processes in all groups of horses. The calculation of the maximum Lyapunow-exponent also gave readily interpretable results and was a good supplement for the reccurrence-plot method regarding the dynamics of regulation processes. Random changes could also be eliminated by correction.

In summary, the various analytical parameters used in this study have proved to be an effective non-invasive method for the characterization of heart rate variability in the horse.