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Duplex Doppler sonographic measurements of the renal blood flow in horses  
as parameter for the early detection of kidney dysfunction

## 7 Summary

HOFFMANN et al. (1997) demonstrated that an examination of the kidneys with Doppler sonography is generally possible in horses. To date, there are no studies investigating the practical significance and application of this method. The objective of this patient-oriented pilot study was measuring and monitoring various blood flow parameters obtained by non-invasive procedures and serving as early indicators of renal disturbances in horses with gastro-intestinal conditions. For this purpose, 23 horses were divided into three groups and examined. Group 1 (n=8) consisted of horses showing no clinical or diagnostic lab findings. Group 2 (n=9) contained horses sent to the Clinic for Horses of the Freie Universitaet Berlin for gastro-intestinal disturbances that had been treated with conservative therapy. Group 3 (n=6) consisted of horses hospitalised at the Clinic for Horses of the Freie Universitaet Berlin for gastro-intestinal disturbances as well. They were examined within 48 hours of surgery. In addition, ten examinations were described as isolated cases. They were: a follow-up examination of one horse three weeks after the baseline examination; the examination of two horses while they were receiving an infusion; and the examination of seven horses with clear-cut symptoms (acute post-infection kidney failure, chronic kidney failure, primary polydipsia, renal tubular acidosis, multiple lymphosarcoma).

All horses underwent clinical and diagnostic lab tests (urea and creatinin concentrations in the blood, urea concentrations in the urine, fractional sodium excretion, gamma-glutamyl transferase activity in the urine), followed by a conventional B-mode sonography and a Duplex-Doppler sonography performed with a System FiVe apparatus from GE Healthcare and a 2.5 MHz sector probe.

The Duplex-Doppler sonography was performed on defined measuring points in the second-order renal artery. Two sonographic recordings of three cardiac cycles each were made separately from one another, and the following flow velocities were then measured offline: peak systolic velocity (PSV), end-diastolic velocity (EDV), and time-averaged maximum velocity (TAMAX). The results were used to calculate the following resistance indices: resistive index (RI), pulsatility index (PI) and A/B ratio. The obtained values provide a measure for vascular resistance in the sonographically examined area.

Doppler-sonographic imaging and analysis of the equine renal blood flow proved possible. As in human medicine, however, obesity caused some restrictions. In addition, body and breathing movements of the horses could not be prevented. As expected, all blood flow parameters examined in the subjects showed a broad fluctuation range as a consequence of the different diseases and their outcomes.

Compared to Group 1 (n=9) the flow velocities in Group 2 (n=9) were significantly reduced ( $p \leq 0.05$ ). On average, the horses of Group 3 showed lower flow velocities compared to the horses in the control group, although the difference was not statistically significant ( $p > 0.05$ ). None of the patients showed increased resistance indices. This suggests that the reasons for the obtained results lie in the selection of patients, because their renal function impairment was almost exclusively of a primarily pre-renal nature, and it demonstrates that haemodynamic changes as a cause of renal blood flow modifications can be visualised regardless of damage to the renal parenchyma.

No correlations between the data obtained in Doppler sonography and diagnostic lab parameters were found. The visualisation of the renal blood flow velocity profile is a sensitive examination method that can be used to diagnose impaired renal function even before lab parameter changes occur, because it offers additional diagnostic information. Further, it helps to monitor the course of the disease, including the identification of potential renal complications, until kidney function is restored.

In light of the results from this study Doppler-sonographic imaging and analysis of renal blood flow rates in horses can be recommended as a valuable, non-invasive diagnostic procedure. Reduced flow velocities point to existing renal impairment. Using this diagnostic procedure the course of the disease and therapeutic success can be documented.