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A comparison of traditional and quantitative analysis of acid-base metabolism (Henderson-Hasselbalch equation and Stewart's strong ion model) during fluid therapy in horses

147 pp., 32 figures, 44 tables

The purpose of this study was to compare traditional and quantitative approach to analysing acid-base imbalances in horses. In the quantitative approach (Stewart-Model) the acid-base-status is assessed by looking at three independent variables: the Strong Ion Difference (SID), the total amount of nonvolatile acids (A_{tot}) and the carbon dioxide partial pressure (pCO_2).

The study was divided in two parts. First we obtained preliminary reference values for SID and A_{tot} in healthy horses (n=38) and compared these to recent studies of other authors. We gained for $SID_3(mmol/l) = \bar{x} \pm s = 41{,}84 \pm 1{,}69$ and $SID_4(mmol/l) = \bar{x} \pm s = 40{,}91 \pm 1{,}69$. A_{tot} was arrived at using the simplified model (CONSTABLE, 1997) from total protein as $A_{tot,1} = \bar{x} \pm s = 14{,}5 \pm 1{,}42(mmol/l)$ and from concentration in albumine, inorganic phosphate and globuline as $A_{tot,2} = \bar{x} \pm s = 13{,}5 \pm 0{,}99(mmol/l)$. Looking at the narrow difference of $A_{tot,1} - A_{tot,2} = \bar{x} \pm s = 1{,}02 \pm 1{,}51(mmol/l)$ it can be suggested to use the more expensive determination of $A_{tot,2}$ only when changes in albumin/globulin-ratio or in inorganic phosphate are suspected. The SIG was also calculated using the simplified model: $SIG = \bar{x} \pm s = -4{,}75 \pm 5{,}19(mmol/l)$. Furthermore the venous pH was calculated from the three independent variables and compared to measured pH with Bland-Altman-method: $pH_{ven,measured} - pH_{ven,calculated} = \bar{x} \pm 2 \times s = -0{,}073 \pm 0{,}092$.

In a second part we assessed the changes in acid-base using both approaches during fluid therapy in 6 cases. Venous blood samples were taken several times during fluid application. At some points arterial blood samples were also taken. It can be shown that the Stewart approach is well suitable for showing influences of fluid therapy to acid-base metabolism. It explains that the administration of a solution with a SID=0 mmol/l (NaCl 0.9%, 7,5%; Ringer, HES) leads to mild metabolic acidosis through decreasing SID. This acidosis is partly compensated through a parallel induced hypoproteinaemic alkalosis (decreasing A_{tot}). A

great benefit of the Stewart approach occurs from a possible distinction between different metabolic acidosis. Therefore, a better understanding of the effect of fluid therapy on acid-base-metabolism, through changes in electrolyte and protein imbalances, is achievable. In some cases we were able to state diagnoses, which did not show up when using the traditional approach.