

RESEARCHES REGARDING THE CORRELATION BETWEEN RENAL PARAMETERS AND THE EVOLUTION OF ELECTROLYTES IN RENAL FAILURE IN DOGS

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Abstract

Renal failure is a medical emergency defined as an acute syndrome of partial or total rapid loss and potentially reversible of the renal excretion function, typically on a healthy renal parenchymal and rarely on an old nephropathy untreated on time that can lead to chronic renal failure, or be incompatible with life. The cases studied are canine patients of different ages, belonging to different races and sharing acute or chronic renal insufficiency of different etiology. Determination of renal parameters was performed in all cases and their progress was closely correlated with the electrolyte and sanuguine gas parameters. The purpose of this research is to determine, based on the cases under consideration, the AnGap influence in establishing a vital prognosis and a therapeutic protocol. Determination of blood gases and electrolytes is an important component in determining the degree of dehydration, electrolyte imbalance and the degree of kidney damage. The difference between electrolytes and pH value are important indexes and provide extremely useful data to guide the therapeutic act. The following study was performed in the Faculty of Veterinary Medicine's Clinic and it was based on case studies spontaneously presented in the Clinic. This activity was conducted during 16 months (March 2015 - June 2016). During this period, 30 patients who presented clinical signs of renal impairment and were confirmed by biochemical analysis were introduced into the study. The studied cases are dogs of different ages, belonging to different races and sharing acute or chronic renal impairment of different etiology. Determination of renal parameters was performed in all cases and their progress was closely correlated with the electrolyte and sanguine gas parameters.

Key words: dog, renal failure, electrolyte balance, AnionGap

Introduction

One of the most important functions of the kidneys is to maintain the acid-base balance and to ensure a normal cellular function necessary to maintain blood pH within narrow limits around 7.4. (1)

Maintenance of constant pH involves the optimum operation of various intra- and extracellular buffer systems, of the respiratory and excretory system. The first two have a role in the rapid changes in pH, while the kidney is responsible for the long-term homeostasis. (2)

Disruptions of fluid and electrolyte balance are often emergencies and therapeutic measures depend on the accurate understanding of the pathophysiology of these disturbances. Fluid and electrolyte disorders may be of interest: mostly water, predominantly various electrolytes, water and electrolytes alike. Electrolytes are represented by ions of the main elements: Sodium (Na^+), Chlorine (Cl^-), Hydrogen (H^+), Bicarbonate (HCO_3^-), Potassium (K^+), Sulfate (SO_4^{2-}), phosphate (PO_4^{3-}), calcium (Ca^{2+}), Magnesium (Mg^{2+}). In this matter, it is known that the action of magnesium, calcium, iron and zinc ions is as activators of enzymes, calcium's role in blood clotting and neuro-muscular irritability, the importance of calcium/phosphorus ratio in the process of ossification, the main role of sodium and potassium in osmotic control of water metabolism, regulation of acid-base balance. (1)

The samples were submitted for laboratory investigations for electrolytes, blood gases, acid-base balance, AnGap, tCO_2 and bicarbonate, and played an important role in emergency medicine and in cases of severe hydroelectrolytic deprivation, providing essential information for clinical diagnosis. The laboratory parameters shown above are pre-programmed with limits and benchmarks for veterinary medicine and species-specific. (1)

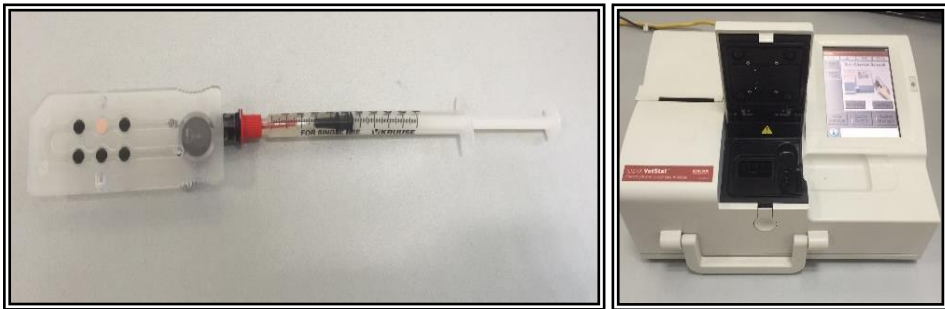
Materials and methods

The study was conducted on 30 canine patients of different ages, belonging to different races and presenting acute or chronic renal failure of different etiology. Determination of renal parameters was performed in all cases and their progress was closely correlated with the electrolyte and blood gas balances.

The principle of the method is based on the quantitative analysis of the presence of molecules of the gas and electrolyte at a point in the venous blood circulating through interaction with fluorescent sensor molecules that give to the final results needed for balancing the canine patient.

The analysis offer fast results of the following parameters: Sodium, Potassium, Chlorine, Hydrogen ion concentration (pH), carbon dioxide partial pressure (PCO₂), total carbon dioxide (tCO₂), bicarbonate (HCO₃), AnionGap.

For the analysis of blood gases and electrolytes the blood is sampled in a 1 ml vial with green cap (Li-heparin anticoagulant). The sample is then analyzed in a very short time (less than 30 min for blood gases), using the VetStat Idexx machine. Urea and creatinine were analyzed using the Idexx Vet Lab Station for blood biochemistry.



Picture 1. Disposable box for electrolytes determination - left, VetStat Idexx for blood gases and electrolytes determination (orig.)



Picture 2. Idexx Vet Lab Station - blood biochemistry analyzer (orig.)

Results and discussions

All data were summarized in tables and analyzed in the context of clinical patient dynamics. The tables were analyzed and the data obtained was introduced in graphs and subsequently analyzed.

Table 1.

Case dynamics and the relationship between AnGap and renal values

	BUN	CREA	pH	AnGap	HCO₃	PCO₂
Case 1	+	+	-	+	-	-
	+	+	-	+	-	-
Case 2	+	+	-	+	-	Normal
Case 3	+	+	Normal	Normal	Normal	Normal
Case 4	+	+	-	+	-	-
Case 5	+	+	Normal	+	-	-
Case 6	+	+	-	+	-	-
	+	+	-	+	-	-
Case 7	+	+	-	+	-	-
	+	+	Normal	Normal	-	Normal
	+	+	Normal	+	Normal	Normal
	+	+	Normal	Normal	-	Normal
	+	+	Normal	+	-	Normal
	Normal	+	+	Normal	Normal	Normal
	+	+	-	+	-	-
	+	+	Normal	Normal	Normal	Normal
Case 8	+	+	+	+	-	-
Case 9	+	+	Normal	+	-	-
Case 10	+	+	-	+	-	Normal
Case 11	+	+	-	+	-	Normal
	+	+	+	Normal	Normal	Normal
	+	+	+	Normal	Normal	Normal
	+	+	+	Normal	+	Normal
	+	+	+	+	Normal	Normal
	Normal	Normal	+	Normal	+	Normal
	+	+	+	Normal	Normal	Normal
	Normal	Normal	+	Normal	Normal	Normal
	+	+	+	Normal	Normal	Normal
Case 12	+	+	Normal	+	-	-
Case 13	+	+	+	+	-	-
Case 14	+	+	-	+	-	Normal
Case 15	+	+	Normal	+	-	-
Case 16	+	+	-	+	-	Normal
Case 17	+	+	Normal	+	-	-
	+	+	+	+	Normal	-
	+	+	+	Normal	+	Normal
	+	+	+	Normal	Normal	-
	Normal	Normal	+	Normal	Normal	Normal
	Normal	Normal	+	Normal	Normal	Normal
	+	Normal	+	Normal	Normal	Normal
	+	+	Normal	Normal	-	Normal
	+	+	+	+	Normal	Normal

Case 18	+	+	-	+	-	-
	+	+	-	+	-	-
	+	+	-	+	-	-
Case 19	+	+	-	+	-	-
Case 20	+	+	Normal	Normal	-	-
Case 21	+	+	-	+	-	-
Case 22	+	+	Normal	+	-	-
Case 23	+	+	Normal	Normal	Normal	Normal
Case 24	+	+	Normal	+	-	-
Case 25	+	+	-	+	-	-
	+	+	+	Normal	Normal	Normal
	+	+	-	+	-	Normal
Case 26	+	+	-	+	-	-
	+	+	-	+	-	-
	+	+	Normal	Normal	Normal	Normal
Case 27	+	+	-	+	-	Normal
	+	+	-	+	-	Normal
	+	+	+	Normal	Normal	Normal
	+	+	+	Normal	Normal	Normal
	+	+	Normal	Normal	Normal	Normal
Case 28	+	+	Normal	+	-	-
	+	+	+	Normal	Normal	Normal
	+	+	Normal	Normal	Normal	Normal
	+	+	+	Normal	Normal	Normal
	+	+	+	Normal	Normal	Normal
	+	+	+	Normal	Normal	Normal
	Normal	+	+	Normal	Normal	Normal
Case 29	+	+	-	+	-	-
Case 30	+	+	Normal	+	-	-

Analyzing the studied cases reveals that the 30 cases generated 71 complete episodes of analysis, diagnosis and treatment.

From the 71 tests, AnGap was determined normal in 31 cases. Direct association of AnGap values with urea, creatinine, pH, bicarbonate and venous carbon dioxide revealed interesting data that corresponds with the actual literature, extremely poor in specific data related to the change AnGap domestic canidae with renal failure.

In 64 cases AnGap was higher than normal associated with high urea and creatinine or when one of these values have been higher than normal. This represents a percentage of 90.14% of the studied cases, which confirms that AnGap is an extremely useful index in evaluating and forecasting the progression of renal failure in dogs.

Out of the 71 tests, in 50 the pH was modified (metabolic acidosis or alkalosis). From the 50 cases, in 29 cases AnGap was higher and in 21 cases AnGap was normal. This demonstrates that the change in blood pH does not influence the variation of AnGap. The correlation between the two values is poor statistically and predictive.

Out of the 71 tests, 26 showed both HCO₃ and pCO₂ within normal limits. In 23 (88.46%) cases AnGap was normal, which demonstrates a clear and direct correlation with the

literature that AnGap is directly influenced by venous blood gas values. Only in 11.54% of cases, AnGap was had higher values than normal.

Certainly, the determination and analysis of the ionogram and the venous blood gases is the right and impetuous way in the diagnosis and treatment of canine kidney diseases.

Once blood gases and electrolytes balance is adjusted, that leads to the adjustment of umoral balance that leads to an improvement of clinical signs of the patient.

Conclusions

The results of the present study lead to several important conclusions.

AnGap is an extremely useful index in evaluating and forecasting the progression of renal failure in dogs, given that in 64 cases, AnGap was higher than normal, when urea and creatinine or one of these values have been higher than normal.

Changes in blood pH does not influence the variation of AnGap. The correlation between the two values is statistically and predictive weak.

AnGap is directly influenced by venous blood gas values.

Determination of ionogram and venous blood gases is the right and impetuous way for the diagnosis and treatment of canine kidney diseases.

Once blood gases and electrolytes balance is adjusted, that leads to the adjustment of umoral balance that leads to an improvement of clinical signs of the patient.

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