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Estimation of Sodium and Potassium in Dogs with Diarrhoea and Vomition

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Abstract

The study was conducted to estimate the sodium and potassium level in dogs with diarrhea and vomition. Total 150 blood samples were collected and processed in the laboratory of Vet clinic, Krishnagalli as per the protocol of Elyte 2 test kit using colorimeter. Of the total blood samples, 8% showed normonatremia with normokalemia, 76% showed hyponatremia with hypokalemia and 16% showed hyponatremia with hyperkalemia. Diarrhoea and vomition were more prevalent in age group 0-1 years followed by more than 8 years and 1-8 years. The age group 0-1 and 1-8 years showed normonatremia with normokalemia and hyponatremia with hypokalemia but more than 8 years showed hyponatremia with hyperkalemia. Males were found more vulnerable for diarrhoea and vomition than the females. The estimated value of sodium and potassium in both sexes were obtained within normal to lower limits of normal range. German Shepherd had the higher prevalence of diarrhea and vomition among different breeds. The estimated value of sodium and potassium in different breeds showed modest difference and obtained within normal to lower limit of normal range. Na:K ratio was found less than 27:1 in 18% samples, between 27:1 to 40:1 in 26% samples and more than 40:1 in 56% samples.

Key words: hyperkalemia, hypokalemia, hyponatremia, normokalemia, normonatremia.

Introduction

Electrolytes (sodium, potassium, chloride, calcium, magnesium & phosphorus) play a vital role in maintaining the homeostasis within the body. They help to regulate myocardial and neurological function, fluid balance, oxygen delivery and acid-base balance (Perez *et al.* 1977). Electrolytes are dissolved in different compartments of body fluid including the serum of the blood, inside the cells (intracellular), and out-side the cells (extracellular) (Morais & Dibartola 2008). The concentration of these electrolytes varies considerably from one area to the other. However, there is a narrow concentration limit of these electrolytes that the body must maintain within each of these compartments. The most serious electrolyte disturbances involve abnormalities in levels of sodium and potassium. Sodium is the predominant cation in the extracellular fluid and potassium is an anion present in the intracellular fluid. The normal concentration of sodium and potassium in serum is 140-155mEq/l and 3.5-5mEq/l respectively (Nelson *et al.* 1992). The extracellular and intracellular ratio of sodium and potassium is required to maintain normal homeostasis in the body. The normal Sodium: Potassium (Na:K) ratio is 27:1 to 40:1 in dogs (Pak 2000).

Vomition and diarrhoea are a common complaint in canine clinical practice (Duggal *et al.* 2006). A wide variety of disease processes and conditions can cause these signs, and the underlying condition may be mild and self-limiting or severe and even life threatening. Failure to maintain normal homeostasis of fluid and electrolytes in such condition can lead to severe clinical consequences for the animal and change a diagnostic triumph into a therapeutic failure (Roth & Tyler 1999). Careless prescription of parenteral fluid without laboratory diagnosis and infrequent checking of electrolytes level may lead to life threatening conditions in pets resulting in huge economic and sentimental loss to the owners. It is therefore, essential to monitor the serum sodium and potassium concentration to prevent treatment related complications (Dibartola 2006). The choice of the fluid and the amount to be supplemented through parentral route can be estimated by estimating the level of these ions in the serum. So this study was undertaken to estimate the level of sodium and potassium and its ratio in dogs with diarrhea and vomition.

Methodology

A total of 150 blood samples were collected from the dogs showing diarrhoea and vomition. The test was carried out in serum using colorimeter as per the protocol of Elyte 2 test kit (Coral Company, India) in the laboratory of Vet Clinic, Krishnagalli, Lalitpur.

Results and Discussion

Overall Representation of Sample

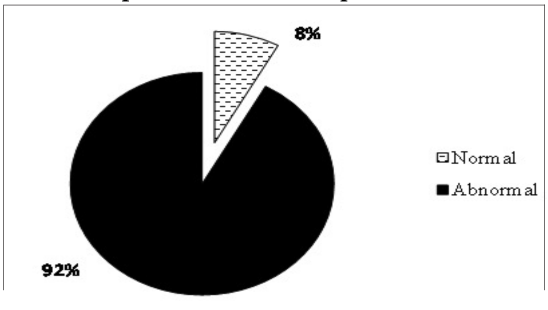

Fig. 1. Overall representation of sample

Out of 150 samples, 138 (92%) samples showed deviation of the values from normal range due to the loss of electrolytes along with fluid. Remaining 12 (8%) samples showed value within normal range which may be due to the less severity of diarrhea and vomition to alter the electrolytes' homeostasis or the feeding of Oral rehydration solution (ORS) before taking to the Veterinarian.

Types of sodium and potassium disorders obtained in laboratory analysis

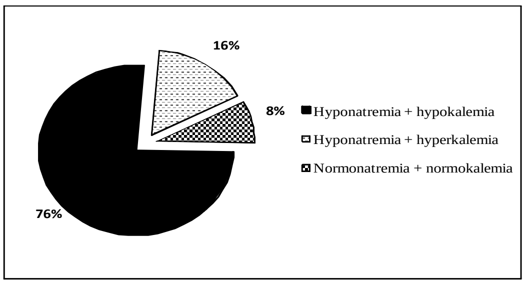

Fig.2. Types of sodium and potassium disorders in dogs with diarrhea and vomition

Of the total, 114 (76%) samples showed hyponatremia with hypokalemia, 24 (16%) samples showed hyponatremia with hyperkalemia and 12 (8%) samples showed normonatremia with normokalemia. The pathogenesis of hyponatremia in diarrhoea is due to the combined loss of sodium and water and the retention of water to compensate the volume depletion. Hyperkalemia may be due to the other secondary causes like: renal failure, hypoadrenocorticism, diabetes mellitus or the pseudohyperkalemia (Schaer 1994). Pseudohyperkalemia may be due to the hemolysis which may occur due to the use of syringe with excessive thrust applied to the plunger. Extreme leukocytosis (probably >100,000/mm^3) and extreme thrombocytosis (>1,000,000/ mm^3) may allow significant amount of potassium to be released into the serum during clotting process. There is linear relationship between the number of platelets and the degree to which the measured serum K^+ is increased (Chakrabarty 2005). The storage of whole blood at refrigerator causes hyponatremia with hyperkalemia due to entering of the sodium in erythrocytes under the influence of concentration gradients (19:1 for Sodium) and cold temperatures disable the membrane ATPase, leading to rise in potassium level (Sharma *et al.* 2011).

Agewise representation of samples

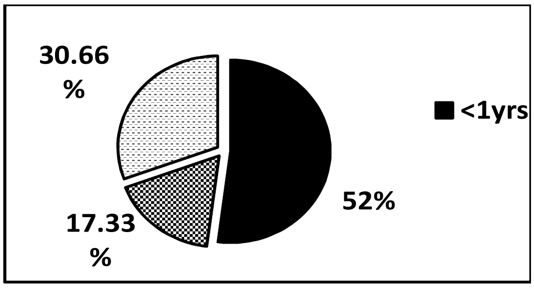

Fig. 3. Agewise representation of samples

Dogs were divided into three age groups: <1 year, 1-8 years and >8 years. The prevalence of diarrhea and vomition was seen more in age group less than 1 year (52%) followed by more than 8 years (30.66%) and 1 to 8 years (17.33%). Wells and Hepper (1999) reported that the frequencies of both vomition and diarrhea were highest in puppies which declined with increasing age. Saevik *et al.* (2012) reported the occurrence of diarrhea and vomition with much higher frequency during the first months of life. Puppies are immunologically immature and by 12 weeks of age the majority of them lose most of their maternally derived antibodies rendering them more prone to infections.

Additionally, the stress of weaning, transportation and re-homing could lead to an increase in gastrointestinal infections due to increased susceptibility. In this study, majority of samples were taken from the dogs of less than 1 year age with parvo virus infection. In the 1 to 8 years age group, the cause of diarrhoea and vomition may be dietary causes, parasitic causes or toxicity. In the more than 8 years age group, the causes of diarrhoea and vomition may be due to the other secondary causes like renal failure, metabolic causes, etc.

Agewise estimation of sodium and potassium concentration

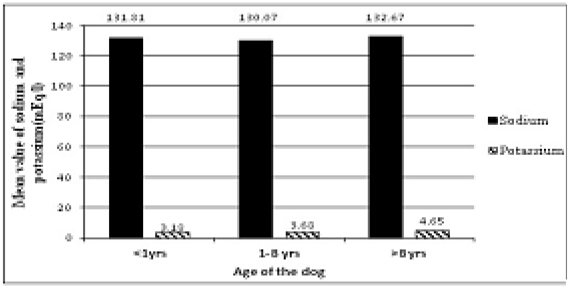

Fig. 4. Agewise estimation of sodium and potassium concentration

The estimated value of sodium and potassium concentration in diffeent age groups were found to be decreased or within lower limit of normal range due to the loss of ions along with the fluid. The reason for obtaining value within normal range may be due to the less severity of diarrhoea and vomition since the amount of ion lost is related to frequency, fluidity and volume of the fluid lost. In more than 8 years age, the potassium value was found at the upper limit of normal range which may be due to the other secondary causes like; *diabetes mellitus*, addison's disease, renal failure or pseudohyperkalemia.

Sexwise representation of samples

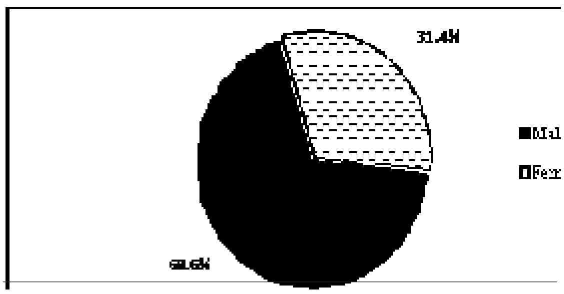

Fig. 5. Sexwise representations of samples

The prevalence of diarrhea and vomition was found more in male dogs (68.6%) than the female dogs (31.4%). Hubbard *et al.* (2007) did not find any association between vomiting and gender, but diarrhea was more common in males. Saevik *et al.* (2012) reported more occurrence of diarrhoea in males compared to the females. This may be due to the differences in behavior between the genders. In a study of dog to dog interaction the frequency of dog sniffing at another dog differed significantly between genders, with males more often exhibiting this behavior (Westgarth *et al.* 2008). Furthermore, the most common inspection areas when two dogs meet are the head and anogenital area, with males inspecting the anogenital area more often than females (Bradshaw & Lea 1992). Male dogs may show increased roaming behavior (Hubbard *et al.* 2007). This difference in behavior between the genders might render males at a higher risk for developing gastrointestinal disorders.

Sexwise estimation of sodium & Potassium concentration

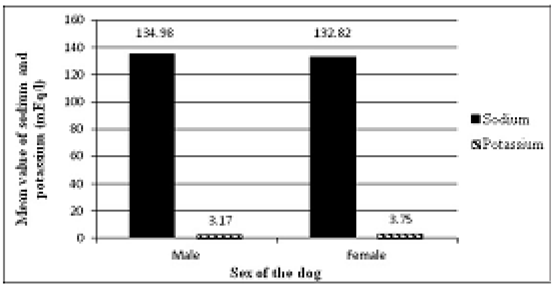

Fig. 6 Sexwise estimation of sodium and potassium concentration

The estimated value of sodium and potassium was found to be decreased or within lower limit of normal range due to loss of electrolytes and fluid in diarrhoea and vomition.

Breedwise representation of samples

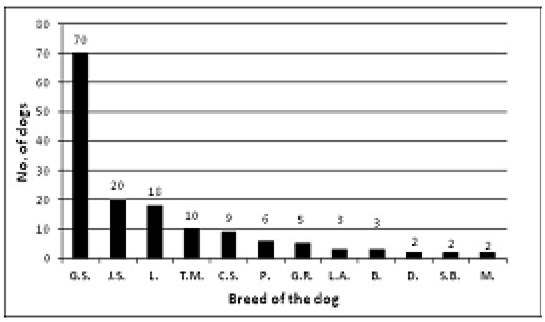

Fig. 7. Breedwise representations of samples

Results from previous studies regarding a possible breed influence on the occurrence of diarrhea and vomition in the dog, are conflicting. Saevik *et al.* (2012)

reported the difference in the epidemiology of diarrhoea and vomition in different breeds, which may be due to the genetic susceptibility of particular breed to increased gastrointestinal infection or difference in the both husbandry and behavior between different breeds (Houston *et al*. 1996). Such differences could be related to feeding regimens including the type of diet, frequency of receiving titbits, frequency of scavenging, frequency and length of walks, length of time off leash, dog to dog interactions, etc. This study showed the more prevalence of diarrhoea and vomition in German Shepherd followed by Japanese Spitz, Labradors, Tibetan Mastiff, Golden Retriever, Cocker Spaniel and other miscellaneous breeds. The information about the nutrition and husbandry were not sufficient enough in this study to rule out the cause for high prevalence in particular breed but genetic susceptibility and the owner's preference for the particular breed may be the most important cause.

Breedwise estimation of sodium and potassium concentration

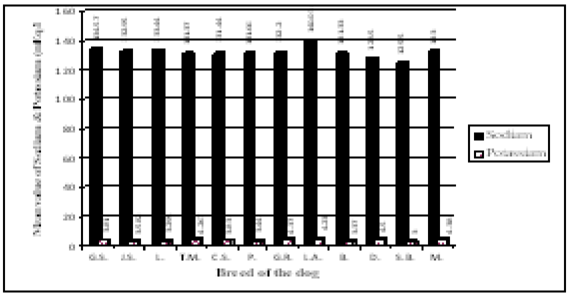

Fig. 8. Breedwise estimation of sodium and potassium concentration

The estimated values of sodium and potassium were found to be decreased or within lower limit of normal reference range. Thus the obtained values showed modest difference in various breeds which may be due to the difference in the frequency or severity of diarrhoea and vomition in different breeds.

Sodium: Potassium (Na: K) ratio in the dogs with diarrhea and vomition

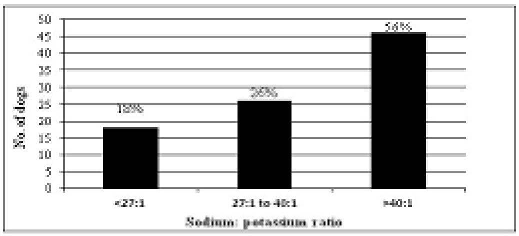

Fig. 9. Sodium: Potassium (Na: K) ratio in the dogs with diarrhea and vomition

Of the total, 27 (18%) sample showed Na:K ratio less than 27:1, 39 (26%) samplse showed ratio between 27:1 to 40:1, and 84 (56%) sample showed more than 40:1. The less severity of diarrhea and vomition may be the professed cause for obtaining the Na:K ratio within normal range. Roth and Tyler (1999) evaluated the low Na:K ratio in 34 serum sample of dogs and in all samples potassium concentration was above the laboratory's reference range but sodium was below the laboratory's reference range in only 18 (53%) samples. Although numerous conditions like hypoadrenocorticism, pancreatic disease, pyometra, etc. were associated with a low Na:K ratio, renal disease was the most common. In this study, may be the animals with diarrhoea or vomition were also presented with other metabolic or systemic diseases that had remained undiagnosed altering electrolyte status in the body consequently altering Na:K ratio than the normal range.

The findings of this study conclude that gastro-intestinal disorders like diarrhoea and vomition causes not only the decrease in the concentration of these ions in the body but sometimes they may be increased or remained within the normal range. The clinical manifestations seen in diarrhoea and vomition are not merely due to the loss of fluid only; the alteration of sodium and potassium concentration is the major cause of cardiac, respiratory, neurological and muscular disorders. The variety of electrolytes measured in the serum can reflect imbalances in water and electrolyte values. They provide the basis for further assessment and the diagnosis of the condition and for the types of fluid needed during management to re-establish the balance. So, it is hoped that in the future the results of this study will contribute a lot to the clinicians while prescribing electrolyte preparations to the dogs exhibiting diarrhoea and vomiting signs.

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