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Hematobiochemical alterations in hypertensive dogs

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Abstract
The current study was conducted to investigate hematobiochemical alterations in hypertensive dogs. Out of a total of 6856 adult (>6 years) dogs, 87 dogs were diagnosed to have hypertension (>150 mm Hg) when measured with Vet Doppler BP machine. Blood samples were obtained from the dogs in the study group to evaluate different hematobiochemical parameters. Haemogram (HB: 9.48±0.67g/dl, PCV: 30.22±2.09%, TEC: 4.56±0.31 million/cumm) of the hypertensive dogs was significantly (p < 0.01) reduced when compared to apparently healthy dogs. There was a significant (p <0.01) increase in mean TLC with significant (p <0.05) neutrophilia in hypertensive dogs as compared to apparently healthy dogs whereas, the eosinophils, lymphocytes, and monocytes showed no significant changes. Biochemical parameters (BUN: 63.13 ± 12.99 mg/dl, Creatinine: 5.54 ±1.14 mg/dl, SDMA: 20.70±3.91 µg/dl, ALP: 223.47±36.77 IU/L, ALT: 77.12±18.94 IU/L, Glucose: 112.50±20.26 mg/dl, Triglycerides: 71.55 ± 4.22 mg/dl, Cholesterol: 203.82 ± 12.22 mg/dl) of the hypertensive dogs were significantly (p < 0.01) elevated when compared to apparently healthy dogs. Whereas, there was a significant (p <0.05) decrease in the serum values of total protein, albumin, and globulin (5.18±0.26 g/dl, 2.21±0.15 g/dl, 3.02±0.14 g/dl) in hypertensive dogs.

Keywords: Hypertension, hematology, biochemical alterations, dog

1. Introduction
Hypertension refers to sustained elevations in systolic blood pressure over 150 mmHg [6]. In general, the diagnosis of hypertension usually occurs after the patient has exhibited symptoms of substantial damage to their end organs. However, improved monitoring of patients at high risk of systemic hypertension results in the diagnosis before the clinical signs develop. Hypertension associated with concurrent clinical disease is the most prevalent type of hypertension in veterinary patients [11]. Diseases/conditions associated with secondary hypertension in dogs are CKD, AKD, hyperadrenocorticism, diabetes mellitus, obesity, primary hyperaldosteronism, pheochromocytoma, and hypothyroidism [1] and these diseases lead to alterations in hematological and biochemical parameters. The present study was undertaken to ascertain hematobiochemical alterations in hypertensive dogs.

2. Materials and methods
All the client-owned dogs presented to the VCC, C.V.Sc., Hyderabad were subjected to blood pressure measurement with the help of Vet doppler BP machine and the dogs that were hypertensive (SBP >150 mmHg) were considered for the study. Samples of Blood were obtained either through cephalic or saphenous venipuncture from all the hypertensive and 10 healthy adult dogs (in order to determine the normal values). 2 ml of blood was aseptically drawn into sterile tubes coated with EDTA for hematological examination. Additionally, 4 ml of blood was collected in sterile serum vials coated with a clot activator. These serum vials were left undisturbed until the serum gets naturally separated. The serum was carefully transferred to a separate test tube with the aid of a sterile Pasteur pipette and centrifuged at 5000 rpm for 5 minutes to get a clear serum. Then the clarified serum was carefully transferred to properly labeled Eppendorf tubes. Serum samples were preserved at -20 °C in a deep freezer for estimation of Canine SDMA.
For the estimation of blood samples, the ABX Micro ESV 60 fully automated veterinary hematology analyzer, manufactured by Horiba Pvt. Ltd., India, was employed. On the other hand, the sera samples underwent analysis using the EM DENSITY 180 fully auto

biochemical analyzer, provided by Erba Mannheim Pvt. Ltd., Germany. Using the SPSS package version 20.00, the data was statistically analysed in accordance with the procedures outlined by Snedecor and Cochran (1994) [25]. The significance of the results was assessed through the application of one-way ANOVA and significance was set at 5 percent (p<0.01).

3. Results

The haematological parameters of the hypertensive dogs were assessed and a comparative analysis of these parameters is provided in Table 1. There was a significant (p<0.01) decrease in mean values of hemoglobin, packed cell volume, and total erythrocyte count and a significant increase (p<0.01) in mean TLC concentration with a significant (p<0.05) increase in neutrophils in hypertensive dogs. However, the eosinophils, lymphocytes, and monocytes of hypertensive dogs showed no significant change when compared to apparently healthy dogs.

Table 1: Mean hematological findings in apparently healthy and hypertensive dogs

Parameters	Apparently healthy dogs (n=10)	Hypertensive dogs (n=87)
Hemoglobin (g/dl)	14.15 ± 0.29	9.48 ± 0.67**
PCV (%)	41.04 ± 0.57	30.22 ± 2.09**
TEC (million/cumm)	6.96 ± 0.15	4.56 ± 0.31**
TLC (X 10^3/µl)	9.24 ± 0.70	25.78 ± 5.43**
Neutrophils (%)	66.53 ± 2.72	71.15 ± 4.84*
Eosinophils (%)	3.15 ± 0.18	2.82 ± 0.67 ^{NS}
Lymphocytes (%)	26.17 ± 1.78	22.96 ± 3.56 ^{NS}
Monocytes (%)	4.15 ± 0.23	3.07 ± 2.60^{NS}

*Significant at (p<0.05), **Significant at (p<0.01)

There was a significant (p<0.01) elevation in blood urea nitrogen, creatinine, SDMA, serum alkaline phosphatase and serum alanine aminotransferase with significant (p<0.05) increase in serum glucose, triglycerides, and cholesterol, but with a significant (p<0.05) decrease in the serum values of total protein, albumin, and globulin in hypertensive dogs when compared to apparently healthy dogs (Table 2).

Table 2: Mean biochemical findings in apparently healthy and hypertensive dogs

Parameters	Apparently healthy dogs (n=10)	Hypertensive dogs (n=87)
BUN (mg/dl)	14.11 ± 0.83	63.13±12.99**
Creatinine(mg/dl)	0.90 ± 0.07	5.54±1.14**
SDMA(µg/dl)	5.95 ± 0.80	20.70±3.91**
ALP (IU/L)	91.60 ± 5.84	223.47±36.77**
ALT(IU/L)	44.75 ± 1.44	77.12±18.94**
Total protein(g/dl)	6.74 ± 0.14	5.18 ± 0.26*
Albumin(g/dl)	2.93 ± 0.11	2.21± 0.15*
Globulin(g/dl)	3.89 ± 0.19	3.02±0.14*
Glucose(mg/dl)	77.57 ± 1.55	112.50±20.26*
Triglycerides(mg/dl)	58.08 ± 3.81	71.55 ± 4.22*
Cholesterol(mg/dl)	175.28 ± 3.41	203.82 ± 12.22*

*Significant at (p<0.05), **Significant at (p<0.01)

4. Discussion

In the present study, the mean hemoglobin, PCV and TEC were significantly (p<0.01) lowered in hypertensive dogs as compared to apparently healthy dogs. Anemia in hypertensive dogs might be due to prevailing chronic kidney disease, which was the primary cause of hypertension in the present investigation. The decrease in hemoglobin, PCV and TEC might be due to factors such as diminished renal erythropoiesis (due to renal parenchymal loss), decreased erythrocyte lifespan, bone marrow fibrosis, gastrointestinal bleeding and nutritional inadequacies and available iron is decreased by substances such as hepcidin [9]. Production of inflammatory cytokines contributes to anemia in renal disease by acute and chronic inflammation as well as by affecting erythropoietin function and red blood cell survival [7]. The decreased levels of PCV may be due to blood loss originating from gastrointestinal hemorrhage [21]. Neutrophilic leukocytosis noticed in the present hypertensive dogs was in agreement with Sansom and Bodey (1997) [22] and Thiruselvame (2002) [28], which might be due to the result of both primary inflammatory conditions within the urinary system and the involvement of other bodily systems and tissues [18]. Leucocytosis with neutrophilia and lymphopenia may develop as a result of varying degrees of stress, as seen in conditions like cystitis and nephritis and also indicates that the body's defense against bacterial infection has been activated [23].

A significant (p<0.01) elevation in blood urea nitrogen, creatinine, and SDMA of the hypertensive dogs might be due to azotemia prevailing in kidney-diseased patients in the hypertensive group. Several workers like McGrotty (2008) [16], Grauer (2009) [13], Lee and Hyun (2009) [15], Priyanka (2010) [20], Acierno *et al.* (2018) [1], Beeston *et al.* (2022) [2], Choi *et al.* (2022) [8] also observed azotemia in renal hypertensive dogs. Increased BUN levels could arise from the accumulation of nitrogenous compounds normally eliminated by kidneys [19], gastrointestinal bleeding resulting in greater absorption of nitrogenous substances within the GI tract [10], and a marked reduction in glomerular filtration rate of kidneys [12]. SDMA concentrations were considerably greater in azotemic dogs compared to apparently healthy dogs and these values increased during disease progression showing a significant correlation with GFR in dogs experiencing advancing kidney disease. SDMA identifies reduced renal function in advance than serum creatinine [14].

The mean values of serum alkaline phosphatase and serum alanine aminotransferase were significantly (p<0.01) elevated among hypertensive dogs as compared to apparently healthy dogs. These findings concurred with Sansom and Bodey (1997) [22] and Priyanka (2010) [20] who opined that this could be due to hypertension-induced hepatic over-perfusion. The mean values of total protein, albumin and globulin exhibited a significant (p<0.05) decrease among hypertensive dogs of the present study as compared to apparently healthy dogs. This might be due to liver and kidney disease associated with hypertension. Decreased total protein levels might be due to increased filtration through glomeruli [3] and also due to renal insufficiency [26]. Decreased albumin levels in dogs with chronic kidney disease were due to enhanced filtration of albumin through the glomeruli occurs due to its molecular size [3], azotemia of renal origin [5] and due to urine protein loss associated with glomerular disease [24]. Decreased protein levels in chronic hepatitis might be resulting from disturbances in the metabolic processes of hepatic proteins [4], a substantial reduction in dietary intake, malabsorption, and disorders like gastroenteritis, chronic gastritis and gastrointestinal ulcerations can lead to protein loss through the intestines [27].

Obesity and hypothyroidism could also be the underlying causes for secondary hypertension among dogs that might significantly elevated serum triglycerides and cholesterol in the present study. This was in accordance with Priyanka

(2010) [20] and Meenu (2020) [17] who observed increased serum triglycerides and serum cholesterol levels in obesity and hypothyroidism-associated hypertension, respectively. Sansom and Bodey (1997) [22] observed hypercholesterolemia in hypertensive dogs and opined that it might be due to hypothyroidism.

5. Conclusion

Hypertension among dogs is mostly a secondary form that is associated with underlying primary disease or organ dysfunction. There is no sufficient data available on the hemato-biochemical aspects of hypertensive dogs in Indian conditions. The hemato-biochemical alterations noticed in the present investigation are reflecting the specific organ dysfunction and underlying disease.

6. References

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