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Influence of age on blood biochemical profile of obese dogs

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Abstract
Fifteen obese Labrador dogs of more than 3 years age of either sex, brought to Madras Veterinary College Teaching Hospital are selected and are grouped according to their age groups, *viz.,* 3-5 years, 5-8 years and above 8 years. After physical examination, blood samples were collected and analysed for the biochemical parameters including glucose, cholesterol, alanine aminotransferase, BUN, creatinine, total protein, albumin and globulin. Compared with the established reference range, the results of the study revealed that the normal concentration of biochemical parameters including glucose, BUN, creatinine, albumin and ALT within the normal range. But the concentrations of cholesterol and globulin were gradually increased in obese animals as age advances. Aging had also increased serum total protein and decreased serum albumin gradually. The other parameters were not affected due to aging in obese dogs.

Keywords: Obesity, canine, biochemistry, age, cholesterol, globulin, glucose, creatinine

1. Introduction
Obesity is the most common nutritional disorder affecting dogs and cats, and is usually the result of either excessive energy intake or reduced energy utilization. Gossellin *et al*. (2007) [7] reported the incidence of obesity about 20 to 40% of the population of dogs. There are many factors which predispose the animal to obesity including genetic, metabolic and endocrine factors, also the age, sex and breed-specific factors (Lewis *et al.,* 1994) [11]. Accordingly, obesity is also associated with numerous health problems, such as insulin resistance, cardio-respiratory diseases, orthopaedic disorders, uro-genital dysfunctions, neoplasia and several other functional alterations (German, 2006) [6]. The adipose tissue also said to be continuously secreting adipokinins, which are proinflammatory cytokinins responsible for chronic low-grade inflammation (Chmelar *et al.,* 2013) [3]. Hematological and biochemical parameters assess the health status of the animals and interpreting them requires consideration of various number of factors. Each parameter have their own reference value which is again influenced by factors like age, breed, sex, species, environment, disease condition and method of analysis (Lowseth *et al.,* 1990) [12]. Among them the most important key factor which influences the blood profile is the age of the animal. Moreover, obesity in the animals, is also related with dysregulation of glucose and lipid metabolism (Rand *et al.,* 2004) [21] and disturbs the normal biochemical profile. Thus, the objective of the present study is to evaluate the changes in the biochemical parameters of obese dogs according to its age.

2. Materials and Methods
A total of 15 obese Labrador dogs were included in this prospective study. The obese animals were selected among the animals brought to Madras Veterinary College Teaching Hospital, Chennai and were group according to their age i.e., 3-5 years, 5-8 years and above 8 years. There were 10 females and 5 males in that group. The detailed diet history of the animals was collected. The obesity of the animals was assessed by its Body Condition Score (BCS), using a 5-point scale. Visual assessment and palpation of ribs, waist and abdominal tucking were used for determining BCS. The selected animals were given complete physical examination and blood samples were collected to compare the serum biochemistry of the obese animals based on their age groups with normal reference values.

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2.1 Serum Biochemical Analysis

About 3 ml of blood was collected in a plain vacuutainer and serum was separated by centrifuging 10,000 rpm for 3 minutes for estimating Blood Urea Nitrogen (BUN), Creatinine (CRE), Glucose (GLUC), Cholesterol (CHOL), Total Protein (TP), Albumin, Globulin, and Alanine Aminotransferase (ALT) using a fully automated biochemical analyzer (A-15 Biosystem Random Access Analyzer, Biosystems, Barcelona, Spain). The results obtained were analysed using IBM SPSS software 20.

3. Results

The obtained biochemical results of different age groups of the obese animals are presented in Table 1. The established reference interval was obtained from Kaneko (1989) [9], Lumsden (1998) [13], Rizzi et al. (2010) [22].

Table 1: The Biochemical profile of obese dogs based on their age (Mean ± SE)

S. No.	Parameters	Group 1 (3-5 yrs)	Group 2 (5-8 yrs)	Group 3 (>8 yrs)	Reference Range
1.	Glucose (mg/dl)	82.20±2.49	85.00±2.16	87.80±2.05	80-100
2.	Cholesterol (mg/dl)	160.00^a±4.51	189.00^{ab}±5.66	202.00^b±15.37	135-270
3.	Blood Urea Nitrogen (mg/dl)	22.40±3.73	17.77±2.28	20.08±3.07	10-28
4.	Creatinine (mg/dl)	1.21±0.85	1.03±0.93	1.14±0.59	0.5-1.5
5.	Total Protein (g/dl)	7.42^a±0.08	7.60^{ab}±0.10	7.82^b±0.41	6-7.8
6.	Albumin (g/dl)	2.57±0.07	2.50±0.09	2.47±0.16	3.4-4.4
7.	Globulin (g/dl)	4.85^a±0.11	5.10^{ab}±0.15	5.35^b±0.15	2.7-3.2
8.	Alanine aminotransferase (U/L)	52.60±9.98	50.00±11.61	40.20±3.00	21-102

Each value is a mean of five observations. The values bearing different superscripts within the rows differ significantly (p≤0.05).

This study reported no significant difference in the concentration of biochemical parameters like glucose, Blood Urea Nitrogen (BUN), creatinine, and Alanine aminotransferase (ALT) between the groups and was within the normal reference range. The values of BUN and creatinine show variable results and were within the normal range.

The values of Alanine aminotransferase (ALT) tend to be decreasing with age, but reveled no significant difference between the age groups.

The concentrations of glucose increases as age advances (p≤0.05), but they were within the reference range.

Significant difference results in cholesterol concentration of obese dogs and found to be within the normal range. As the age advances, the cholesterol levels also increases.

The concentrations of total protein, albumin and globulin were altered in the obese dogs due to aging. The values of total protein and globulin were progressively increasing and the concentrations of albumin were gradually decreasing with age. The results showed statistical significant increase in globulin concentration and increase in the levels of total protein levels in aged dogs.

4. Discussion

Many studies suggested the association between obesity and hematological disturbances as variable and not consistent.

The level of glucose in serum affects the voluntary feed intake of the animal. De Godoy and Swanson (2013) noticed hyperglycemia and hyperlipidemia as the common metabolic disorders in obese animals. In contrast, the present study showed no significant difference in the concentration of serum glucose between the age groups and was within the reference range. Our results were in agreement with Pickrell et al. (1974) [18], who noted no changes in glucose.

Pena et al. (2008) [16] reported increased concentration of serum glucose, cholesterol, triglycerides and alanine aminotransferase activity in obese dogs. In agreement with his study, the serum cholesterol concentration tend be increasing with age and showed significant difference between the age groups statistically. Also demonstrated higher serum cholesterol concentration in obese dogs, which results in increased concentration of circulating lipoprotein metabolites. The results showed normal levels of serum glucose and cholesterol, which suggested that the obese animals provided no signs of diabetes. However, Zoran et al. (2010) [27] claimed that insulin resistance, which is common in obese animals could be present without the signs of diabetes.

Creatinine concentration served as an indicator of muscle mass (Hjelmesath et al., 2010) [8]. The lowered muscle mass in relation to the highly proliferated adipose tissue explained the lower levels of creatinine in obese animals (Wickman and Kramer et al., 2013) [26]. In contrast to the previous reports, which suggested lowered BUN and Creatinine concentrations in obese animals compared to lean groups (Rafaj et al., 2016) [20], the present study showed serum BUN and Creatinine concentrations remained within the reference range. These results indicated normal kidney functions in obese dogs. But the values were slightly decreasing with increasing age without any significance, which could be due to decreased muscle mass due to aging (Mosier, 1979) [15].

The analysis of blood samples revealed the altered concentrations of total protein (TP), albumin and globulin. Though within the reference range, the serum total protein were gradually increasing with aging. The results revealed low concentration of serum albumin and elevated concentration of serum globulin in the obese dogs due to aging. Kaspar and Norris (1977) [10] and McKelvie (1970) [14] also showed albumin slowly decreasing with age. The decreased albumin concentration might be due to decreased production by the liver resulting in a relative hyperglobulinemia to maintain plasma osmotic pressure Lowseth et al. (1990) [12] agreed that the increasing concentration of total protein could be due to an increase in the gamma globulin fraction. Our result was also in compliance with Piantedosi et al. (2016) [17] and Radokovich et al. (2017) [19], where a state of inflammatory condition in obese dogs had increased specific acute phase proteins and thus raised the serum globulin concentrations (Piantedosi et al., 2016) [17].

The most commonly used enzyme in evaluating canine liver function is Alanine aminotransferase (ALT). The increased level of this enzyme was frequently observed in obese patients with fatty liver condition (Choi, 2003) [4]. According to Tribuddharatana et al. (2011) [25], the obese dogs were frequently found to have abnormal level of serum liver enzymes, such as ALT. Piantedosi et al. (2016) [17] also expressed the values of ALT above the upper limit of the

reference range in obese dogs. Contrastingly, the present study found no difference in the concentration of ALT enzymes between the obese dogs and was within the reference range. But the values were slightly increasing with decreasing age, which was in agreement with Kaspar and Norris (1977) [10]. The results were also in agreement with Rafaj et al. (2016) [20], which indicated no evidence of liver damage in the selected obese dogs.

Thus, the parameters which were found to have statistical significant difference between the age groups were cholesterol, total protein and globulin. No distinct age related changes were observed in other parameters. The obese dogs also showed elevated globulin concentrations and low concentration of serum albumin as age advances. The changes in biochemical parameters have been documented and it seems that increasing age is the critical factor in influencing its concentrations.

5. Conclusion

The biochemical profile of the obese dogs was studied and found that the concentrations of cholesterol and globulin increases, as the age advances.

6. References

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