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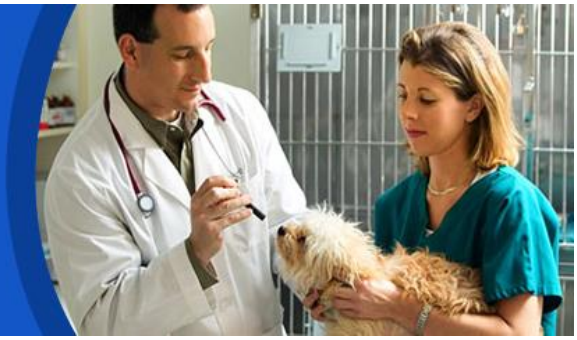

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Epidemiological and Clinco-Pathological studies on megaoesophagus in dogs

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Abstract
Megaoesophagus is a condition characterized by dilatation and decreased motility of the oesophagus, leading to difficulty in swallowing and regurgitation of food. This study aimed to investigate prevalence, clinical features and haemato-biochemical changes associated with megaoesophagus in dogs. During the study period, 33 dogs were diagnosed with megaoesophagus through history, clinical findings, and radiography. Clinical signs included regurgitation, weight loss, skin lesions, muscle wasting, cough, respiratory distress, and eye lesions. Labrador Retrievers were the most affected breed, with males being more commonly affected than females. Haematological examination revealed significant leukocytosis, neutrophilia, and eosinophilia, with a decrease in lymphocyte and monocyte count. Serum T4 values were found to be decreased in affected animals, with 77.8 percent having serum T4 values below 2µg/dL. This study highlights the importance of early diagnosis and management of megaoesophagus in dogs to prevent potential complications.

Keywords: Megaoesophagus, haematology, serum biochemistry, dogs

Introduction
Megaoesophagus is a disorder of oesophagus manifested by dilatation of oesophagus resulting from decreased peristalsis secondary to neuromuscular disorder (Charles, 2015) [1]. It may be congenital or acquired. Congenital megaoesophagus is attributed to vagal dysfunction (Holland *et al*., 2002) [2]. Acquired megaoesophagus depending upon etiology is classified as primary megaoesophagus which is idiopathic and secondary megaoesophagus which occurs in combination with other conditions like myasthenia gravis, hypoadrenocorticism, dysautonomia, polyradiculoneuritis, hypothyroidism, polymyopathies and oesophageal cancer (Arnell *et al*., 2013) [3]. However, myasthenia gravis was suggested main cause of secondary megaoesophagus in 26 percent of dogs being positive for anti-acetylcholine receptor antibody titres (McBrearty *et al*., 2011) [4]. A case control study showed strong correlation between disease and consumption of dry dog food (Lusis *et al*., 2017) [5]. The most common sign of megaoesophagus is regurgitation of food (Manning *et al*., 2016) [6]. Other clinical signs include weight loss, excessive salivation and gagging. Aspiration pneumonia is the most common complication of megaoesophagus (Boudrieau and Rogers, 1985; McBrearty *et al*., 2011) [7, 4]. Cervical and thoracic radiography (plain and contrast) including fluoroscopy in non-anaesthetised patients is used to diagnose oesophageal diverticulum and megaoesophagus (Washabau, 2003) [8].
Recently, large number of cases of megaoseophagus have been presenting in veterinary hospitals in Kerala. Therefore, the present study was aimed at epidemiological and haemato-biochemical changes associated with the condition.

Materials and Methods
Dogs presented to Teaching Veterinary Clinical Complex, Pookode with history of regurgitation, weight loss and rough hair coat was subjected to clinical examination during period from June 2021 to December 2022. Signalment and vital parameters of the affected animals were recorded.

Those cases tentatively diagnosed as megaoesophagus based on history and clinical examination findings were subjected to radiography for confirmatory diagnosis. A contrast oesophagography was performed using barium swallow @ 2 ml/kg orally through the cheek pouch over a period of 15 minutes. Radiographs were exposed immediately after completion of barium swallow and subsequent at 15-60 minutes intervals to confirm the diagnosis of megaesophagus.
Around five millilitres of blood samples were collected from 18 radiographically confirmed cases of megaoesophagus and also from 10 apparently healthy controls. Blood samples were used for estimation of complete blood count and serum samples were used for estimation of serum thyroid hormone (T_4), serum creatinine, and alanine aminotransaminase (ALT). The data obtained were analyzed by using SPSS version 24.0. Comparison between diseased and control group was done by independent sample t-test.

Results and Discussion

A diagnosis of megaoesophagus was made in 33 dogs during the study period. Diagnosis was made by history, clinical findings and radiography. Lateral neck and thoracic radiography showed oesophageal dilatation and then confirmed by contrast radiography (Fig. 1, 2, 3).

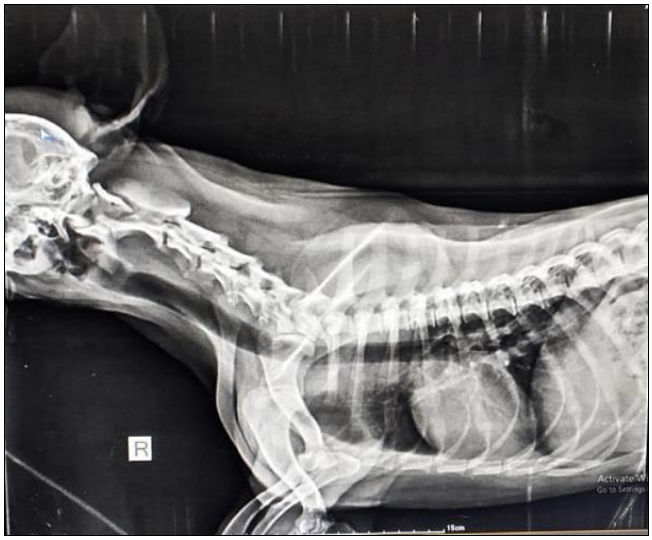

Fig 1: Right lateral thorax showing dilatation of oesopahgus

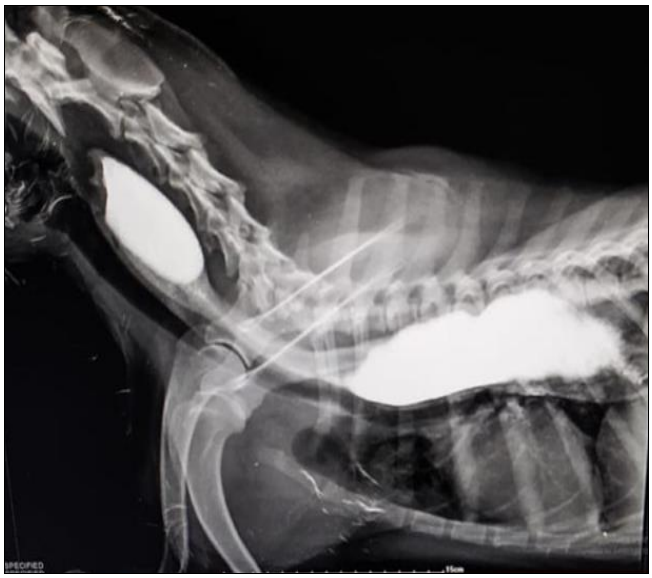

Fig 2: Contrast oesophagography confirming dilated cervical and thoracic oesophagus

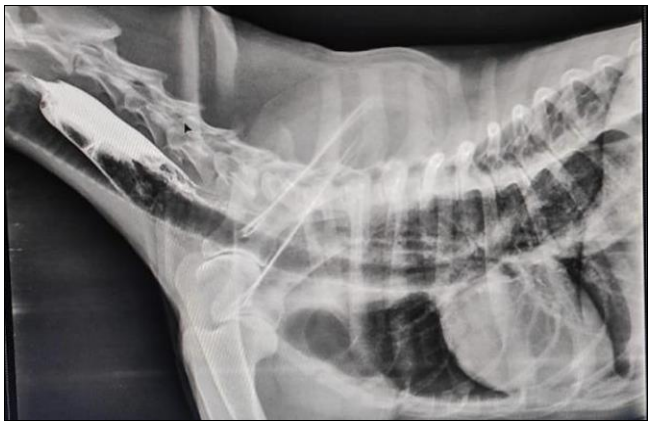

Fig 3: Right lateral thorax showing interstitial pulmonary pattern indicative of pneumonia

The clinical findings exhibited by the affected animals were regurgitation (100%), weight loss (100%), skin lesions including rough hair coat, alopecia, scaling and crusting (50%), muscle wasting (30.3%), cough, respiratory distress (44.4%) and eye lesions including cataract, corneal opacity etc. (23.3%).
In uncomplicated cases of megaoesophagus, dogs might present with only regurgitation and weight loss (Washabau, 2003) [8]. The affected dogs might present with additional clinical signs that hint at underlying cause of megaoesophagus and the most common complication is aspiration pneumonia in which case affected animals exhibit moist cough, dysponea and pyrexia (Washabau, 2003) [8]. Weight loss due to megaoesophagus results from regurgitant loss of caloric intake (Washabau, 2003) [8].
The disease was mostly reported in dogs between two to four years of age (48.5%) followed by in dogs below two years (36.4%) and least in animals above five years of age (15.1%). In contrary, Washabau (2003) [8] found that dogs aged between 7 to 15 years were mostly affected with acquired megaoesophagus whereas Lipsitz *et al. (*1999) [9] observed that acquired megaoesophagus and myasthenia gravis occurred in dogs at a much younger age (≤ 2 years). Miller *et al. (*1983) [10] also noticed megaoesophagus in dogs secondary to congenital myasthenia gravis between four to nine weeks of age. In the present study, Labrador retriever was the mostly affected breed (78.8%), followed by crossbred (9.1%) and Doberman pinscher (6%) and Pitbull (6%) respectively (Table 1).

Table 1: Breed wise distribution of animals affected with megaoesophagus

Breed	Number of animals affected (n=33)	Percentage (%)
Labrador	26	78.8
Doberman	2	6
Pitbull	2	6
crossbred	3	9.1

Congenital megaoesophagus was documented in Newfoundlands, Rusell Terriers, Samoyeds, Spaniels and Shar-peis (Washabau, 2003; Wray and Sparkers, 2006) [8]. Breeds like Irish setters, Great Danes, German Shepherds, Labrador Retriever and Newfound lands were found to have increased prevalence for acquired megaoesophagus (Washabau, 2003) [8]. In the present study, male dogs were found to have higher prevalence (69.7%) compared to females (30.3%) (Table 2). Whereas Batmaz *et al. (*1998) [11] reported no sex predilection for this disease condition. The high

occurrence in male dogs in the present study may be attributed to their higher representation compared to females.

Table 2: Sex wise distribution of animals affected with megaoesophagus

Sex	Number of animals affected(n=33)	Percentage (%)
Male	23	69.7
Female	10	30.3

In the present study, significant leukocytosis, neutrophilia and eosinophilia ($p \leq 0.01$) is observed on haematological examination (table 3). There is statistically significant decrease in lymphocyte and monocyte count ($p \leq 0.01$). There is no significant difference noticed in total erythrocyte count, VPRC and total thrombocyte count. This leukogram might be attributed to secondary aspiration pneumonia in 44.4 percent cases.

Table 3: Comparison of haematological parameters between control and diseased cases

Variables	Control(n=10)	Diseased(n=18)	P-value
WBC($x10^3$/uL)	12.76±1.45	22.2± 2.37	0.003**
Lymphocytes($x10^3$/uL)	3.68±1.1	2.03± 0.91	0.03*
Monocytes($x10^3$/uL)	0.86±0.32	0.64±0.21	0.42^{ns}
Granulocytes($x10^3$/uL)	12.06±1.02	19.42±2.3	0.01**
Total erythrocyte count($x10^6$/uL)	6.14±0.26	7.14± 0.57	0.131^{ns}
Haemoglobin (gm %)	15.75±0.68	12.92±1.09	0.02*
VPRC (%)	0.397±0.029	0.411±0.037	0.777^{ns}
MCV (fl)	64.31±2.96	57.14±1.43	0.053*
MCH (pg)	25.79±0.85	18.06±0.58	0.001**
MCHC (gm/dL))	40.763±2.926	31.75±1.069	0.018**
RDW	30.225±4.24	17.908±0.483	0.023*
PLT($x10^5$/uL)	299.625±41.552	313±81.934	0.902^{ns}

** Significant at 0.01 level; * Significant at 0.05 level; ns non-significant

Serum biochemical estimation showed non-significant difference in serum creatinine and ALT.

Table 4: Comparison of serum parameters between control and diseased cases

Variables	Control(n=10)	Diseased(n=18)	P-value
SerumT4	2.05 ± 0.11	1.43 ± 0.41	0.325
Serum Creatinine	1 ± 0.07	1.13 ± 0.22	0.567^{ns}
ALT	26.75 ± 4.56	30.02 ± 4.69	0.629^{ns}

ns non-significant

There is no significant difference noticed in serum thyroid hormone (T_4) level between affected dogs and controls. Eventhough the serum T4 values were found to be decreased in affected animals when compared to control animals the values did not differs significantly. Serum T4 values are found to be below 2 µg/dL in 14 out of 18 (77.8%) affected dogs (Table 5).

Table 5: Serum Thyroid hormone level in animals affected with megaoesophagus

Serum T_4 value	< 2 µg/dl	> 2 µg/dl
Number of animals affected (n)	14	4
Percentage (%)	77.8	22.2

The remaining four affected dogs (22.2%) had serum thyroid hormone level above 2 µg/dL and these dogs were fed with dry pellet food before disease occurrence. Hypothyroidism is one of the most common endocrine diseases observed in dogs (Miller *et al*., 2015) [10]. Megaoesophagus is characterised by oesophageal hypomotility and dilatation, progressive regurgitation and loss of body condition (Ettinger and Feldman, 2005) [12]. Megaoesophagus is one of the peripheral nervous system syndromes that have been reported in canine hypothyroidism. Even though the pathphysiology underlying hypothyroidism leading to the development of megaoesophagus is unclear, it is hypothesized to occur owing to impaired axonal transport due to decreased metabolism in neurons. Another hypothesis is that the deposition of mucopolysaccharides in the cytoplasm of Schwann cells and connective tissue of the nerves causes demyelination and leads to peripheral neuropathy (Ko *et al*., 2018) [13]. Hurley *et al.* (2021) [14] reported outbreaks of acquired idiopathic megaoesophagus in dogs that fed two brands of commercial dry food.

Conclusion

Megaoesophagus is a disorder of the oesophagus characterised by diffused dilation and decreased peristalsis. Based on the findings of this study, it can be concluded that megaoesophagus is a serious disease that affects dogs of various ages and breeds, but is particularly prevalent in Labrador Retrievers. Clinical signs include regurgitation, weight loss, skin lesions, muscle wasting, cough, respiratory distress and eye lesions. Diagnosis is based on a combination of history, clinical findings and radiographic imaging. Leukocytosis, neutrophilia and eosinophilia are observed on haematological examination, which might be attributed to secondary aspiration pneumonia. Serum T4 values are found to be decreased in affected animals compared to controls, with 77.8% of affected dogs having serum T4 values below 2µg/dL. Further research is needed to investigate the causes and potential treatments of this disease. Owners of affected dogs should seek veterinary advice promptly to ensure appropriate management of the disease and prevent potential complications.

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