

THORACIC RADIOGRAPHIC ANATOMY AS A DIAGNOSTIC TOOL FOR PNEUMONIA IN WEST AFRICAN DWARF GOATS

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ABSTRACT

West African Dwarf (WAD) goats are native to Nigeria and are mostly kept under a semi-intensive management and remain susceptible to pneumonia which is one of main causes of death. Normal anatomy of WAD goats using radiographic modality will serve as reference for clinical use. Six WAD male goats aged nine months to one year five months, weighing 6 – 11 kg and temperatures within normal limits of 38.5 – 39.7°C were used. Four view radiographs (DV, VD, RL and LL) taken with a Radiography Machine, AMX 700, using standard exposure factors after sedation with xylazine (0.02 mg/kg). The visibility, location, number, shape and size of thoracic organs and structures were recorded. The number of thoracic vertebrae was constantly 13 and sternabrae were 5. The VHS value ranged from 8.5 to 10 on the right lateral view and 7 to 9 on the left lateral view. The angle of divergence of the trachea from the thoracic vertebrae ranged from 14 to 25 degrees and there was no depression of the trachea at the thoracic inlet. The heart shape was consistently oval and visibility of caudal vena cava and aorta was inconsistent. The depth and width of the thorax did not differ significantly and visibility of all lung lobes was recorded in all the animals. The species-specific differences observed in other species of goats do not appear to occur in prepubertal WAD goats. Normal thoracic radiographic anatomy of WAD goats will serve an important role in interpretation and diagnosis of thoracic diseases.

Keywords: WAD goats, Thoracic radiograph, Pneumonia, Diagnosis

INTRODUCTION

West African Dwarf (WAD) goat is the commonest indigenous breed of goat in the 15 countries of West and Central Africa (Abu *et al.*, 2013). They play a vital role exclusively for animal protein to the ever growing population in Nigeria and financial reserve especially for rural dwellers (Peacock, 2005; Ames, 2014). Nigeria has a current population of 34.5 million goats and livestock contributes 6 – 8 % of the GDP (Lawal-Adebowale, 2012; Oredipe, 2017).

Despite their small body size, they are hardy, highly prolific and often require small

space and capital for rearing. They are well suited for browsing of fresh forage, with little supplements from their caregivers (Chiejina *et al.*, 2015). These and more important reasons why they are popular among the peri-urban and rural dwellers and also why policy makers are getting more interested in increasing their production to meet the demand of growing population in Nigeria (Lawal-Adebowale, 2012). Therefore, the most common management system of WAD goats in Nigeria especially the southern (humid) part of Nigeria is semi-intensive management system (Lawal-Adebowale, 2012).

Small ruminant production has been limited by myriads of infectious diseases of which respiratory infections are of paramount importance. Young WAD goats, less than a year, remain susceptible to pneumonia and diagnosis is usually done at post-mortem (Emikpe *et al.*, 2013). There is a strong relationship between mortality in small ruminants and occurrence of pneumonia and clinical diagnosis of respiratory conditions in goats has been limited. Scanty reports of use of imaging in clinical diagnosis are available.

Radiography is a non-invasive diagnostic imaging technique, which has been used for the diagnosis of thoracic diseases in goat (Makungu and Paulo, 2014). Use of imaging would help to improve ante-mortem diagnosis which will lead to less mortality of goats from respiratory conditions. Vertebral heart score (VHS) is a reliable indicator of cardiac size changes (Olatunji-Akioye and Alabi, 2015). VHS is taken as cardiac silhouette long axis (taken from left main stem bronchus ventral border to the cardiac apex with a measuring scale) and short axis (taken from central third region of heart perpendicular to the longitudinal axis with a measuring scale) on a lateral radiograph and compared with the thoracic vertebra beginning at the fourth thoracic vertebra. Pneumonia in goats is an inflammatory condition of the pulmonary parenchyma usually characterized by respiratory embarrassment (Kusiluka and Kamarage, 1996). This study is therefore an attempt to assess how thoracic radiographic anatomy and visualization of thoracic cavity features may enable ante mortem diagnosis of pneumonia by visualization of pertinent features of the cavity that may be affected by disease.

MATERIALS AND METHODS

Six WAD goats aged between nine months to one year and five months and mean weight of 9 ± 2.5 kg were acquired and medically examined to be free of any physiological abnormality. They were acclimatized and four (DV, VD, RL and LL) view radiographs were taken using a Radiography Machine, AMX 700 (General Electric, USA) using exposure factors 68 – 76

kvp and 8 – 16 mAs. The radiographs were assessed by a Radiologist and parameters evaluated included, number of thoracic vertebrae, sternabrae, vertebral heart score from both left and right lateral views, angle of trachea with thoracic vertebrae, shape of cardiac silhouette, lung patterns and visibility of lung lobes. Vertebral heart score and cardiothoracic ratios were calculated and mean values were determined.

Vertebral Heart Score is used to determine if cardiac enlargement exists in conditions where cardiac involvement occurs with pneumonia in goats. The shape of the cardiac silhouette may be altered when congestive heart failure coexists with pneumonia and the shape is altered from oval to ovoid to what is known as a reverse D shape. There may be elevation of the trachea at the thoracic inlet when there is cardiac enlargement causing a decrease in the angle the trachea makes with the ventral border of the thoracic vertebrae. The lung patterns may change from interstitial to alveolar and the lung lobes which are most affected are the right lung lobes (Emikpe *et al.*, 2013; Asare *et al.*, 2016) which are easily visible on lateral radiographs. The cranial part of the right lung which is reportedly most commonly affected can be better assessed on the dorsoventral or ventrodorsal views.

Data Analysis: The vertebral heart score from both left and right lateral views and the cardiothoracic ratios were summed and Microsoft Excel used to calculate the means and results were displayed as a range.

RESULTS AND DISCUSSION

There were consistently 13 (6/6) thoracic vertebrae and six (5/6) sternabrae with one goat having 5, the VHS from left and right lateral views were 7 – 9 and 8.5 – 10 (Table 1). The angle of divergence of the trachea was 14 – 25 degrees but there was no depression of trachea at thoracic inlet. The heart was oval in shape and visibility of the aorta and caudal vena cava was inconsistent (Table 2). There was clear visibility of all lung lobes and Figures 1 – 4 demonstrates different parameters that may be assessed in the thorax via radiography.

Table 1: Thoracic cavity quantitative parameters that may be useful in diagnosis of pneumonia in WAD goats

Goat ID	Weight	Number of thoracic Vertebrae	Number of Sternabrae	VHS (Left Lateral)	VHS (Right Lateral)	Cardiothoracic ratio
Black	11	13	6	9	9.5	0.67
Black and white	9	13	6	7	9.5	0.62
Brown Black Big	9	13	6	7.5	8.5	0.57
Brown Black Small	6	13	6	8	10.0	0.56
Brown	8	13	5	8.5	9.0	0.69
Black with Brown Head	8	13	6	8	10.0	0.50

Vertebral Heart Score-VHS

Table 2: Thoracic cavity parameters that may be assessed from a thoracic radiograph of WAD goats

Thoracic cavity parameters	Black	Black and white	Brown Black Big	Brown Black Small	Brown	Black with Brown Head
Angle of divergence of Trachea	18	16	20	18	25	16
Depression of trachea at thoracic inlet	None	None	None	None	None	None
Shape of the heart	Oval	Oval	Round	Round	Oval	Oval
Visibility of aorta	Visible	Not Visible	Visible	Not Visible	Visible	Visible
Visibility of CVC	Visible	Visible	Visible	Not Visible	Not Visible	Visible

CVC - Caudal Vena Cava



Figure 1: Dorsoventral thoracic view showing inspiratory radiograph demonstrating the cardiac silhouette, and visibility of the right and left lung lobes. Mag x100



Figure 2: Ventrodorsal thoracic view showing the lungs and cardiac silhouette. Mag x100

Figures 1 and 2 shows inspiratory thoracic radiographs that demonstrate the visibility of the divisions of the right and left lung lobes and the accessory lobe in the dorsoventral and ventrodorsal positioning of the WAD goat. Figure 3 shows on a right lateral radiograph, the bony structure of the thoracic vertebrae and the

sternabrae, the visibility of the trachea, its angle of divergence from the ventral border of the thoracic vertebrae. Figure 4 is used to demonstrate the measurement of the vertebral heart score which is used to determine cardiac enlargement by comparing the long and short axis of the cardiac silhouette with the number of thoracic vertebrae from the fourth thoracic vertebra.

clinical diagnosis and could be deployed in diagnosis of pneumonia in this species to preclude the high rate of mortality that is associated with the condition.

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