CASE REPORT

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Congenital absence of right cardiac notch in the lung of a Bunaji calf

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Abstract

The cardiac notch (fissure) is normally present in both right and left lungs of ruminants. The notch is usually smaller on the right lung relative to its left counterpart and distinctly confined to the lower parts of the third and fourth intercostal spaces where the pericardium comes in contact with the thoracic wall. We report a case of congenital absence of right cardiac notch in one out of the five White Fulani calves used for routine dissection in the Department of Veterinary Anatomy, University of Jos, Plateau state, Nigeria. A complete closure of the cardiac notch was observed between the middle and apical lobes of the right lung. Due to this defect, the pericardium was completely obliterated from view of the coastal surface of the middle lung`s lobes which occupied the supposed space for the cardiac notch in the right lung. To the best of our knowledge, congenital absence of cardiac notch has not been reported in literature. Hence, this study would benefit veterinary surgeons operating the thoracic cavity, radiologists examining radiographs and pathologists investigating thoracic cavity and its contents.

Keywords: Bunaji calf, cardiac notch, congenital absence, right lung

Introduction

The lung is a paired asymmetrical organ of respiration occupying the thoracic cavity with prime function of exchanging oxygen for carbon dioxide in the blood (Frandson *et al*., 2009). The bovine lungs are divided by inter lobar fissures into distinct lobes (Budras & Habel, 2003). The right lung has four lobes; cranial (apical), middle (cardiac), caudal (diaphragmatic) and accessory (intermediate or azygos) (König *et al*., 2007). The cranial lobe of the right lung (unlike the left) is solely ventilated by a brochus detached from the trachea just before the main bifurcation (Prohl *et al*., 2014). The left lung possesses only 2 lobes; cranial and caudal lobes (König *et al*., 2007). The former further divides into two parts; a part which extends forward toward the apex of the pleural sac and other part that descends ventrally over the pericardium (Dyce *et al*., 2002). A notch, known as the cardiac notch exist between the cranial and caudal lobes of the left lungs and spans from the third intercostal space to the fifth rib corresponding to the area where the heart is in direct contact with the thoracic wall (Dyce *et al*., 2002). The cardiac notch is smaller on the right lung than on its left counterpart and is markedly restricted to the lower parts of the third and fourth spaces (Dyce *et al*., 2002). Cardiac notch is clinically relevant as the site for directing a needle into the heart (cardiac puncture) without piercing lung tissue (König *et al*., 2007; Frandson *et al*., 2009).

The lung begins to divide into five lobes; two on the left and three on the right very early after conception (5th week in man) in mammals (Roth-Kleiner & Post, 2003). The development of the lungs is an extremely coordinated process governed by

mesenchymal-epithelial interactions that direct the temporal and spatial expression of multiple regulatory factors required for proper lung formation (Roth-Kleiner & Post, 2003). The left and right lungs have an asymmetrical developmental pattern that constitutes an integral part of the body plan and it is crucial for normal formation and localization of intra-thoracic and intra-abdominal organs (Roth-Kleiner & Post, 2003).

Numerous signaling factors recognized to influence the left-right asymmetry include; sonic hedgehog [Shh] (Meyers & Martin, 1999), fibroblast growth factor-8 [FGF-8] (Boettger *et al*., 1999) and HNF-4 (Chen *et al*., 1998). In addition, experimentally derived mutant mice have been shown to contain mis-expressed transcription regulator Pitx-2 on the right side of the lungs thereby promoting left sided appearance of the former as well as altered positioning of the heart (Lin *et al*., 1999).

The absence of cardiac notch on the right side of the bovine lung is a rare anomaly that has not been reported in Nigerian breeds of cattle. Therefore, this case report will fill the literature gap and would be of benefit to veterinary surgeons, radiologists and pathologists to further understand the condition.

Case Report

Case history

During a routine dissection of calves by 200 level (DVM I) students of the Department of Veterinary Anatomy, Faculty of Veterinary Medicine, University of Jos, an embalmed male calf (8 months old) was observed with an absence of cardiac notch (CN) in the right lung. Gross morphometric measurements of the lung with defect; length (apico-caudal dimension; 27cm), width (vertebral-sternal dimension; 12cm) were taken. The anomalous lung was described in detail, photographed (Plate IB) and compared with a normal right lung of calf within the same age group (Plate IA).

Observations

The right lateral thoracic wall of the calf was placed on left lateral recumbency. Thereafter, the ventral margin of serratus ventralis thoracis, superficial and deep pectoralis muscles as well as intercostalis muscles were dissected and reflected to expose the right ribs. The latter were then disarticulated from both the costovertebral and sternocostal joints using scapel blade and rib cutter to expose the costal or parietal surface of the thoracic cavity and subsequently visceral surface. It was observed that the right lung of the calf in question completely lacked cardiac notch (Plate IB). The notch in other three calves was present, comparatively smaller than its left counterparts (Plate II) and was markedly restricted to the lower parts of the third and fourth spaces.

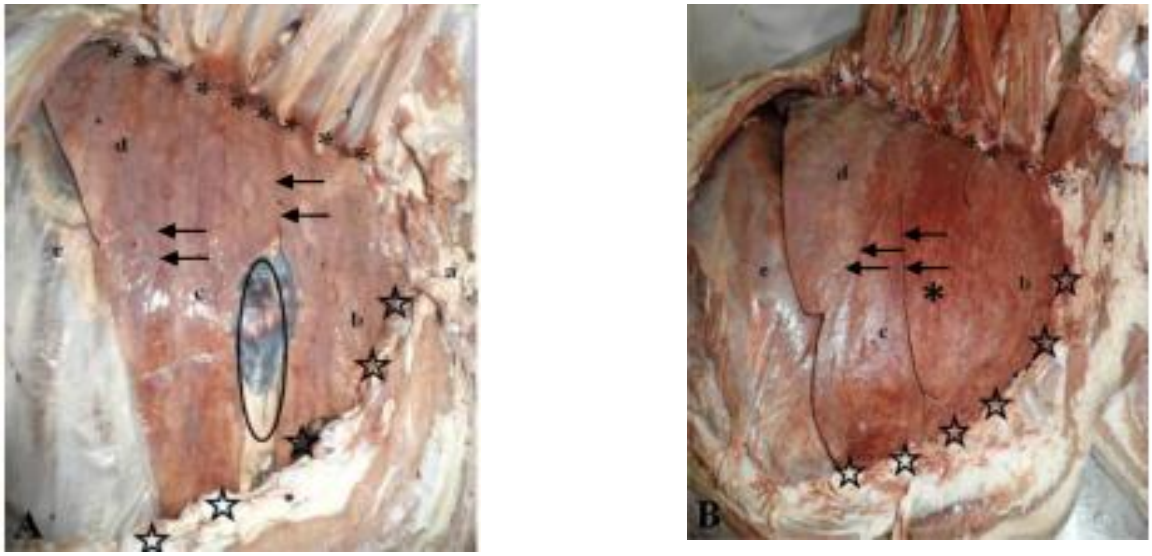

Plate I: Photographs of the costal views of bovine right lungs. A. Right lung with cardiac notch (CN) – area delineated with the ellipsoidal outline. B. Right lung without cardiac notch (the asterick depicts the position of CN in the right lung), a (thoracic inlet), b (cranial lobe), c (middle lobe), d (caudal lobe), e (diaphragm), small stars (vertebral border), big stars (sternal border) and arrows (interlobar fissures)

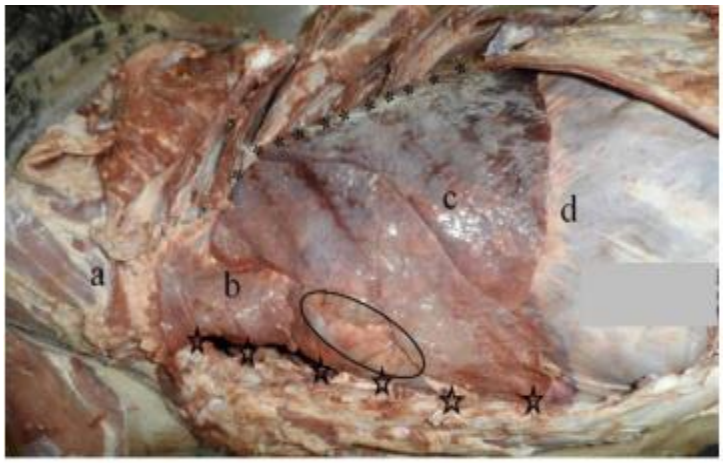

Plate II: Photograph of the costal view of bovine left lung. The cardiac notch (CN) area is delineated with the ellipsoidal outline. a. (thoracic inlet), b (cranial lobe), c (caudal lobe), d (diaphragm), small stars (vertebral border) and big star (sternal border)

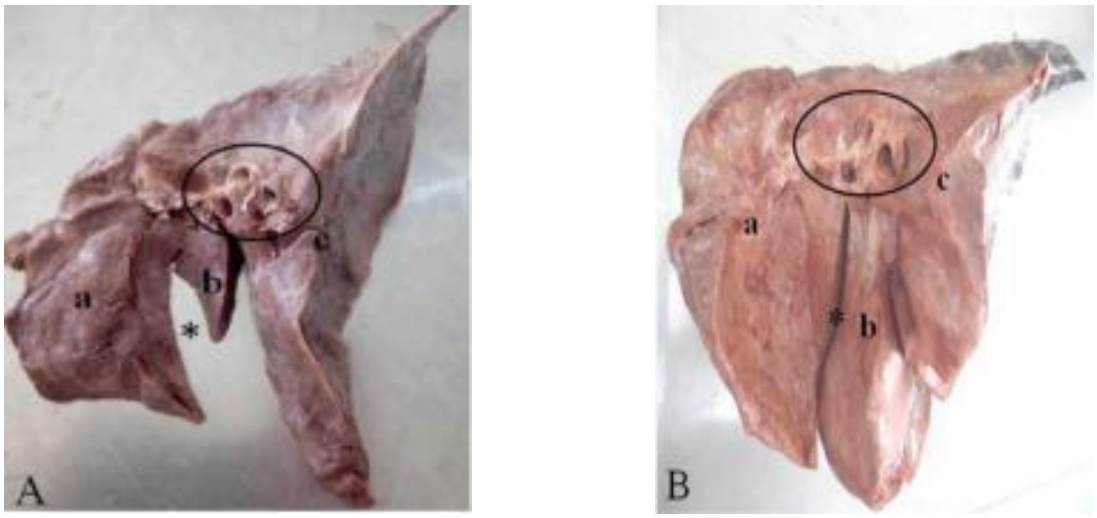

Plate III: Photographs of the mediastinal surface of bovine right lungs. A. Right lung with cardiac notch (CN). B. Right lung without cardiac notch (the asterick depicts the position of CN on the right lung). a. (cranial lobe), b (middle lobe), c (caudal lobe) and pulmonary hilus (oval)

Discussion

The entire right lung of bovine is divided by inter lobar fissure into four lobes; cranial, middle caudal and accessory lobes (Dyce *et al*., 2002). The cranial lobe lies in the thoracic inlet, middle lobe gives impression for contact with heart, caudal lobe forms the base of the lungs and rests on the diaphragm and accessory lobe situates between the right and left lungs as described by König *et al*. (2007). Grossly, normal bovine lungs usually bear notches which are positioned between the cranial and caudal lobes of the left lungs and span from the third intercostals spaces to the fifth rib. On the right, the notch has a reduced coverage and is noticeably confined to the lower parts of the third and fourth spaces between the cranial and middle lobes (Dyce *et al*., 2002).

In the present case, we did not observe any other gross congenital defect in the lung parenchyma except for the complete closure of the wide fissure (cardiac notch) between the middle and apical lobes of the right lung suggesting a disruption in the sequence of normal lung development. Generally, congenital defects encompass both the functional and morphological imperfections and may be compatible or lethal. It could results into neonatal mortality when it has a lethal effect (Smolec *et al*., 2010). It is important to mention that the defect described in this study is compatible with life but clinical manipulation such as (cardiac) puncture into the heart might not be possible through the right side. However, this may not be a major clinical problem as most puncture is usually done through

the cardiac notch on the left lung (König *et al*., 2007). The space provided by the cardiac notch of both sides in clinically healthy animals houses pericardial fluid, gives roomy space for detecting echocardiogram imaging of the heart frictionless movement and contraction against the lungs (Frandson *et al*., 2009) which in the case of this congenital absence might be compromised.

Based on the aforementioned, the condition might remain unnoticed *in situ*. Nevertheless, it is a rare anomaly whose report would benefit veterinary surgeons operating the thoracic cavity, radiologist examining radiographs and pathologist investigating thoracic cavity and its content.

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