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Comparative gross anatomical study on the branching pattern of bronchial tree in black Bengal goat and Garole sheep

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Abstract

The present study revealed that the apical bronchus originated from right side of the trachea at the level of 35th and 39th tracheal rings in sheep and goat respectively. In goat, left principal bronchus gives off five lateral branches, three ventral branches, five dorsal branches and two medial branches (L5, V3, D5, M2). The right bronchus detached five lateral, five ventral, two medial and six dorsal first order branches. In sheep, the right principal bronchus gave rise to five laterals, four dorsal, two medial and four ventral first order branches whereas the left principal branches gave rise to six lateral, five dorsal, two medial and four ventral branches. It was observed that there was no definite pattern of origin of the first order branches from the principal bronchus both in goat and sheep. With the help of rubber cast (Anabond) prepared during this investigation exhibited second order, third order, fourth order and even fifth order branches of the bronchial tree which represented tertiary bronchus, terminal bronchus, bronchiole and terminal bronchiole respectively.

Keywords: Bronchial tree, branching pattern, black Bengal goat and garole sheep

Introduction

The bronchial tree is the anatomical and functional component of the respiratory system that conducts air from the upper respiratory tract to the lung parenchyma. It is composed of bronchi and bronchioles. The bronchioles divide many more times into smaller branches called intralobular bronchioles, terminal bronchioles and respiratory bronchioles. The respiratory bronchioles end with smallest and final air pathways of the respiratory system called alveoli. The Anatomy of bronchial tree has been described by Ranjan *et al.* (2020) [8] in goat lungs. But comparative structural organization of bronchial tree in sheep and goat was scanty. The present investigation will be helpful in the diagnosis of respiratory diseases. Therefore, the present work undertaken to study the branching pattern of bronchial tree of black Bengal goat and Garole sheep.

Materials and Methods

The study was conducted on the adult black Bengal goat and adult Garole sheep. In each species six lungs were utilized for the preparation of casts of lung and trachea. The casting was done by using Anabond® (Silicone paste-polyflex GR200-10 orthothalic Resin). The Anabond® was infused into the freshly collected sample of lung and trachea through the trachea. For large hollow spaces like trachea and bronchi the anabond was introduced without dilution. Then the infused samples were kept for 2 week in plane water. After that the sample were kept in 10% HCl for 5 days for the digestion of the tissues. Following the digestion of the tissues the casts were collected and washed in tap water and then hot water repeatedly and air-dried.

Result and Discussions

The branching pattern of the bronchial tree was studied from synthetic cast, prepared by anabond. After bifurcation of the trachea each of the principal bronchus gave rise to a number of second branches (lobar) which were directed in different direction in both the lungs. Ananya *et al.*, (2019) [2] reported that the trachea was branched into the right and left primary bronchi. The secondary bronchi are further branched to form the tertiary bronchi which resemble like fine bristles. In the right lung, it is observed that before the branching of primary bronchus from the trachea, it is known as the apical bronchus supplying the apical lobe of the right lung

In goat the right principal bronchus gave rise to 6 dorsal, 5 lateral, 5 ventral and 2 medial branches. The tracheal bronchus (apical) originated from right side of the trachea at the level of 39th tracheal rings in this animal (Fig.1).

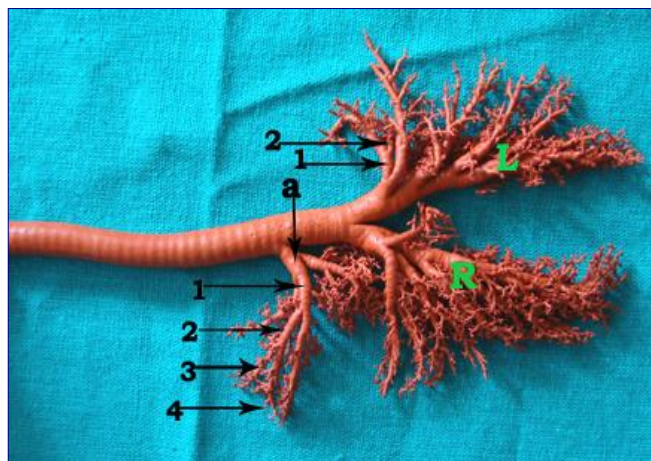


Fig 1: Photograph showing the ventral view of bronchial tree in goat. Right bronchial tree (R), Left bronchial tree (L), Apical bronchial tree (a), 1st order branch (1), 2nd order branch (2), 3rd order branch (3), 4th order branch (4).

In sheep the right principal bronchus gave off 4 dorsal, 5 lateral, 4 ventral and 2 medial bronchus and the left principal bronchus gave off 5 dorsal, 6 lateral, 4 ventral and 2 medial branches (Fig.2). Albert *et al.* (2009)^[1] recorded that the right principal bronchus gave rise to 6 dorsal, 6 lateral, 3 ventral and 1 medial first order branch and the left principal bronchus gave rise to 2 dorsal, 4 lateral, 1 ventral and 5 medial branches in Reeve's muntjac (Taiwanese deer).

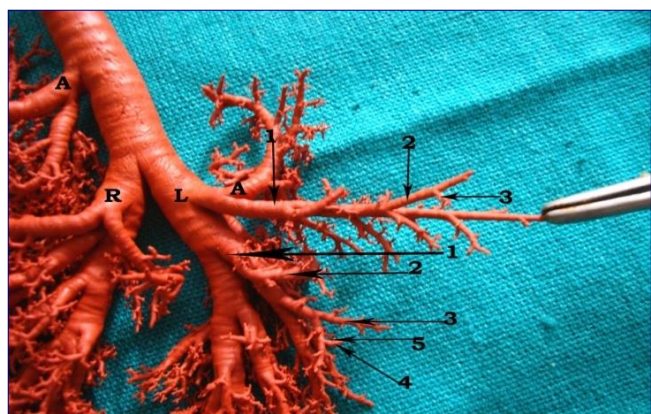


Fig 2: Photograph showing ventral view of bronchial tree in sheep. Right bronchial tree (R), Left bronchial tree (L), Apical bronchial tree (a), 1st order branch (1), 2nd order branch (2), 3rd order branch (3), 4th order branch (4), 5th order branch (5).

In goat the tracheal bronchus just after entering into the apical lobe divided in to one cranial and one caudal branches to ventilate the corresponding aspect of the apical lobe of right lung. The first ventral branch (V1) of the right lung divided immediately after its origin into one medial and a lateral branch to ventilated intermediate lobe and the cardiac lobe of the right lung respectively.

In sheep the tracheal bronchus originated at the level of 35th tracheal ring at the right side. It also divided into one cranial and one caudal branch like that of goat. It was observed that in both the species (goat and sheep) a small branch from first

lateral branch (L1) of right principal bronchus also ventilated the caudal part of right apical lobe. Albert *et al.* (2009)^[1] observed that the tracheal bronchus arose from the right dorsal side of the trachea before its bifurcation and divided immediately into one cranial and one caudal branch. The cranial branch was more developed than caudal one. Hare (1975)^[4] observed that the tracheal bronchus was divided into cranial and caudal branch to ventilate the corresponding aspect of the apical lobe. As mention by him the cardiac lobe and intermediate lobe of right lung were ventilated separately by lobar branches originated from the ventrolateral and venteromedial aspect respectively from the right principal bronchus. However in this investigation it was observed that both these two lobar branches has a common origin from the ventral aspect of the right principal branches in both the species.

Rest of the other of first order branches were distributed within the corresponding aspect of the diaphragmatic lobe. The first lateral branch of left principal bronchus divided into one cranial and one caudal branch to ventilate the apical lobe and cardiac lobe of the left lung respectively. All other branches were distributed in the corresponding aspect of the diaphragmatic lobe in a similar manner to that of right lung.

Nanda *et al.* (1967)^[6] recorded that the bronchial tree and broncho-pulmonary segments in goat with the help of dissection and casting technique. They used wax, as casting medium. They have mentioned that the right lung provided an apical bronchus for the apical lobe, a cardiac lobar bronchus for the cardiac lobe, the intermediate lobar bronchus for the intermediate lobe and diaphragmatic lobar bronchus for the diaphragmatic lobe.

Each of the first three bronchi provided two sub-divisions and the diaphragmatic lobar bronchus gave off six segmental bronchi. In the left lung the apico-cardiac lobe was ventilated by apico-cardiac lobar bronchus and the diaphragmatic lobe was ventilated by the left diaphragmatic lobar bronchus. The diaphragmatic lobar bronchus was disposed in a similar pattern to that of right. Variations found in different specimens were discussed. Nanda and Malik (1968)^[5] reported that in buffalo, the tracheal bronchus originated at the level of second intercostal space. This tube was divided into one anterior and one posterior branch. The right middle lobar bronchus generally did not originate in common with the intermediate lobar bronchus. The diaphragmatic lobar bronchus gave off six segmental bronchi. In the left lung they have recorded that the apico-cardiac lobe was ventilated by two segmental bronchi. The diaphragmatic bronchus gave off six segmental bronchi. They also mentioned about the variations in the distribution pattern within the same animal. The branching pattern of the bronchial tree as have been described by Nickel and Schummer (1973)^[7] in case of ox was in virtual agreement of the present finding.

It was observed that there was no definite pattern of origin of the first order branches from the principal bronchus both in goat and sheep. With the help of rubber cast (Anabond) prepared during this investigation exhibited second order third order fourth order and even fifth order branches of the bronchial tree which represented tertiary bronchus, terminal bronchus, bronchiole and terminal bronchiole respectively. Similar description has also been made by Ghosh (2006)^[3], the trachea give rise off apical bronchus at the level of 3rd rib, bifurcates into right principal and primary bronchi at the base of the heart. Each primary bronchus divides into secondary bronchi, one for each bronchial lobe represented lobar

bronchus. Each lobar bronchus again divided into tertiary bronchi. The bronchopulmonary segment the tertiary bronchus was repeatedly divided, loose their cartilaginous component from the wall and then termed bronchioles.

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