IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 11, Issue 4 Ver. I (April 2018), PP 78-85
www.iosrjournals.org

Analysis of The Tracheobronchi of Hedge Hog: Histomophometric Studies

C Yakubu[1], A. Yahaya[1], H. S Gumi[1], H. P Mana[2], M Chiroma[3]
1Departments of Veterinary Anatomy, Faculty of Veterinary Medicine, University of Maiduguri, P.M.B 1069, Borno State, Nigeria
2Veterinary Teaching hospital, University of Maiduguri, P.M.B 1069, Borno State, Nigeria
3Departments of Veterinary Physiology and Biochemistry, Faculty of Veterinary Medicine, University of Maiduguri, P.M.B 1069, Borno State, Nigeria
**Corresponding Author: C Yakubu*

Abstract : *This study was carried out on six apparently healthy adult hedgehogs of both sexes, to elucidate the normal morphology and architecture in the conducting region of respiratory system of hedgehog and distinguish the normal lobulation of lungs. The animals were used for anatomical study. The mean length, number of tracheal rings, bronchi length and also the number of lung lobes are recorded. The trachea was observed to be cartilaginous tube extending from the larynx to the lung, at thorax it terminates by bifurcating in to the right and left principle bronchi above the base of the heart at the 4th thoracic vertebra. The right primary bronchus branched into three secondary lobar bronchi which provide each lobe of right lung (cranial, caudal, and middle) while the bronchus of the accessory lobe arises from the middle secondary bronchi. The left primary bronchus is branched directly into several tertiary bronchioles. The lungs were observed to be pink coloured organ, occupying most of the thoracic cavity, consisting of five portions. The right lung has four lobes cranial, middle, caudal and accessory lobes. The caudal lobe is largest one, while the smallest one is the accessory lobe. The left lung has only one lobe occupied most the left side of thoracic cavity.*

Date of Submission: 16-04-2018 Date of acceptance: 04-05-2018

I. Introduction

Hedgehog is small nocturnal old world mammal with a spiny coat and short legs, able to roll its self into a ball for defense. It belongs to the subfamily Erinaceinae, in the order Eulipotyphla (Hutter, 2005).There are seventeen species of hedgehog in five genera found in parts of Europe, Asia, Africa and Newzealand. No hedgehogs native to Australia and there are no living species native to America, but the extinct genus in America was Amphechinus which was once presented in North America (Reiter, 1998).

Hedgehogs are easily recognized by their spines which hollow hairs are made stiff with keratin. These spines are not poisonous or barbed and cannot easily be removed from the animal. However, spines normally come out when a hedgehog sheds baby spines and replaces them with adult spines by a process called quilling (David, 2014).

Hedgehogs have similar respiratory system with other vertebrate animals, and has a blunt nose similar to that of the pigs called snouts. The respiratory system is a biological system consisting of various organs and structures used for the process of respiration in an organism (Lahart, 2010). It is essential for gaseous exchange between air and blood the lower respiratory system is consist of trachea, two bronchi, bronchioles and two lungs. Trachea: was flexible mathematical model tube extended from cricoids cartilage of the larynx to the tracheal bifurcation within thorax. It is kept permanently open by a series of in complete cartilaginous rings embedded in its wall. (Konig and Liebich, 2009). The passage of air in to the lungs to supply the body with oxygen is known as inhalation and the passage of air out of the lungs to exhale carbon dioxide is called exhalation: this process is collectively called breathing (Lahart, 2010). The anatomy of the respiratory system is described as a muscular funnel that extends from the caudal end of the nasal cavity to the cranial end of the larynx and oesophagus (Lahart, 2010). Pharynx is however divided in to three sections which include nasapharynx, oropharynx and laryngopharynx. The Nasopharynx is the cranial region of the pharynx found in the posterior end of the nasal cavity. It extends from the base of the skull to the upper surface of the soft palate, it include space between the internal naves and the soft palate and lies above the oral cavity (Moore, 1999).Furthermore, the Pharyngeal tonsils also referred to as called adenoids are lymphoid tissue structures located in the posterior wall of the nasopharynx. The auditory tubes which connect the middle ear to the pharynx open in to the nasopharynx at the pharyngeal opening of the auditory tube (Paulina, 2015). Oropharynxit lies behind the oral cavity extending from uvula to the level of the hyoid bone. Cranially, it is connected to the

nasopharynx and caudally to the laryngopharynx. Its anterior wall consists of the base of the tongue and the epiglottis (Paulina, 2015). Epiglotis is a flap of elastic cartilage that acts as a "switch" between the trachea and esophagus. It ensures that air passes in to the trachea by covering the opening to the esophagus, and during the process of swallowing it moves to cover the trachea to ensure that food enters the esophagus and to prevent aspiration (Paulina, 2015). Laryngopharynx; is also known as hypopharynx, it is the caudal part of the pharynx, it lies caudal to the epiglottis and extends to the location were this common pathway diverges in to the larynx and esophagus (Paulina, 2015).Furthermore, the Tracheais also known as windpipe. It is a long tube made of "C-shape" hyaline cartilage rings, lined with pseudostratified ciliated columnar epithelium. It connects the larynx to the bronchi and allows air to pass through the neck and in to the thorax, the rings of cartilage that make up the trachea allow it to remain open to air all times (Paulina, 2015). The Bronchi are divided into primary and secondary bronchi. The primary bronchi splits into the left and right branches each of which move in to the respective lung before branching in to secondary bronchi. These secondary bronchi carry air into the lobes of the lungs (Paulina, 2015).The secondary bronchi in turn splits in to many smaller tertiary bronchi within each lobe, the tertiary bronchi splits in to many smaller bronchioles that spread throughout the lungs. Each bronchiole further split into many smaller branches less than a millimeter in diameter called terminal bronchioles, and then finally millions of tiny terminal bronchioles conduct air to the alveoli of the lungs (Paulina, 2015).

The primary bronchi contain "C-shape" cartilage ring that firmly hold air-way open and give the bronchi a cross sectional shape like a flattened circle. As bronchi branch in to tertiary bronchi the cartilage becomes more widely spaced and more smooth muscles and elastin protein is found in the wall (Lahart, 2010). Bronchioles do not contain any cartilage at all, the presence of smooth muscles and elastin allows the smaller bronchi and bronchioles to be more flexible and contractile (Lahart, 2010). The Lungsis a pair of large spongy organ found in the thorax, lateral to the heart and cranial to the diaphragm. They are conical in shape with a narrow rounded apex at the top and a broad base that rest on the diaphragm (Adam, 2014).The apex of the lungs extends in to the root of the neck reaching shortly above the level of the sternal end of the first rib (Adam, 2014).The lungs are surrounded by the pulmonary pleurae, the pleurae are two serous membrane; the outer parietal pleura which lines the inner wall of the rib cage and the inner visceral pleura which directly lines the surface of the lungs, between the pleurae is a potential surface called pleural cavity containing pleural fluid (Henry, 2016).

The right lung is bigger than the left lung, and consists of four lobes which include cranial, middle, caudal and accessory lobe. This division is made by invaginations of pleura as fissures, the fissures are double folds of pleura that section the lungs and help in their expansion (Henry, 2016). The left has only one lobe in hedgehog but two lobes in other vertebrates (Henry, 2016). Lung is part of respiratory system and contains the majority of the lower respiratory tract after the trachea. Trachea receives air from pharynx and travels down to a place where it splits into right and left bronchus which supply air in to right and left lungs respectively. The bronchi splits progressively until they become respiratory bronchioles which in turn supply air to the alveolar ducts in to the alveoli where the exchange of gasses take place (Bruce, 2008). Oxygen diffuses through the wall of alveoli into the enveloping capillaries and carbondioxide is diffuse from the capillaries in to the alveoli in exchange of oxygen (Christopher, 2006).The alveolar is a structure in the lungs where gaseous exchange takes place. It consists of two types of cells; alveolar cells and alveolar macrophages (Bruce, 2008).The alveolar cells consists of type I and type II cells. They are called pneumocytes, they make up the walls of the septa of the alveoli. Type I provide 95% of the surface area of each alveoli, they are flat and have a thin wall that enable an easy exchange of gases, Type II cells generally cluster in the corner of the alveoli and have cuboidal shape (Bruce, 2008). Type I cells make alveolar septa which separates each alveolus; they are unable to divide and consequently rely on differentiation from type II cells (Paulina, 2015). Alveolar macrophages; are cells that removes waste substances deposited in the alveoli including dead red blood cells (Bruce, 2008). Additionally, the diaphragm is a sheet of internal skeletal muscle that extends across the bottom of the thoracic cavity. It is dome shaped consisting of muscular and tendinous part (Jean, 2010). The diaphragm has peripheral attachment to structures that make up the abdominal and thoracic cavities; the muscle fibers from those attachments converge in a central tendon which forms the crest of the dome (Jean, 2010). The central tendon of the diaphragm is a thin but strong aponeurosis near the center of the vault formed by the muscle closer to the front than to the back of the thorax (Jean, 2010). Diaphragm separates the thoracic cavity containing the heart and lungs from abdominal cavity. It contracts during inspiration so that the volume of thoracic cavity increases and air is drawn in to the lungs and relaxes during expiration so that air will move out of the lungs (Jean, 2010). There are three major openings of diaphragm which include; aortic hiatus, oesophageal hiatus and caval foramen. Blood supply to the diaphragm is through branches of the intercoastal thoracic arteries such as pericardiophrenic artery and musculophrenic artery which arises directly from the thoracic aorta and from the lower intercostal arteries. It drains blood in to the brachiocephalic veins and azygos vein (Jean, 2010).

The intercostals muscles are located between the ribs; they play a major role in breathing. Beneath the diaphragm are abdominal muscles which help breath out when hedgehog is breathing fast (Heart, lung and blood

institute). Muscles in the neck help to breathe in when other muscles involved in breathing don't work properly, or when lung disease Impairs breathing (Heart, lung and blood institute) (Jean, 2010).

II. Materials And Method

Study Area

The study was conducted in Maiduguri the capital city of Borno State, Nigeria. Maiduguri has an area of about 69,436 km2 and lies between latitude $11^0$32 North and $11^0$42 North and longitude $13^0$20′ east and $13^0$25′ East, temperature of 40-45^{o}C and rainy season of about 3-4 months (June- September) (Udoh, 1981; Mbaya *et. al.,* 2006).

Sample Collection

Six healthy adult of local hedgehogs of both sex, were collected from fields for anatomical study. They were obtained and kept in a cage for seven days before the procedure. Feed and water were provided ad libidum, cage was kept clean, hiding places were also provided where the hedgehogs would hide and sleep during the day time.

On the seventh day, they were transported to Veterinary Anatomy laboratory in a well-ventilated transporting box for the procedure. Hand towel was used to pick the hedgehogs from the transporting box on to the dissection table; this is to protect our gloved hands from direct contact with the sharp edges of the spines.

The hedgehog rolled in to a ball after placing it on the dissection table. Five to ten minutes was given to allow it to unwind to prevent it from rolling back in to a ball. The hedgehog is then picked from the table by exposing its head, neck and ventral surface where there are no spines. The animals were sacrificed by quick decapitation.

During dissection, skin was reflected completely together with the spines, abdominal muscles were incised and abdominal contents were removed. Diaphragm was observed grossly through the abdominal cavity after which thoracic cavity was opened by cutting the costosternal cartilage to reflect the ribs and expose the thoracic content.

Thoracic organs were observed in situ, and respiratory system was harvested from the thoracic cavity to the pharynx.

During this procedure, "rat tooth" forceps was used to hold the skin, scalpel blade with its holder was used for making incisions, thumb forceps was used for holding the soft tissues and towel was used to clean the sprinkled blood on the dissection table.

Measurement

Length of trachea, left and right bronchi was taken and recorded using thread and meter rule.Trachea was carefully examined from the point where it connects with the larynx cranially to the point where it bifurcates into left and right primary bronchi caudally. Thread was carefully adjusted to the length of trachea and the extreme end was marked after which the length of the trachea was recorded by placing the thread on a meter rule in centimetre. The same procedure was applied when taking the length of the left and right bronchi as well as that of left and right lungs.

After taking the length of the trachea, the trachea ring was carefully counted and recorded.

Weighing

Weight of left and right lungs were taking and recorded using digital weighing balance.

After the procedure, trachea, bronchi and lungs was preserved in 10% formalin.

Histological Analysis

The samples of liver, kidney, heart, lung, gizzard, ovary, testes and oviduct collected were fixed in Bouins fluid for 24 hours. The tissues were then dehydrated through grade concentrations of ethanol (70%, 95% and absolute), cleared in xylene. Tissue were infiltrated in xylene paraffin in the oven at 620 C for 3hours and embedded in paraffin wax. The embedded tissues were sectioned at 7μm thickness and stained with Haematoxylin and Eosin (H&E) for light microscope examination (Drury et al., 1976; Carlton, 1980). The features observed under the microscope were photograph using digital camera power shot

Statistical Analysis

The parameters were measured with the help of electrical digital weighing balance. All data were analyzed using SPSS version 17 for Windows. One sample T-test analysis was used. The results are expressed as means ± SEM. The results were regarded as significant when $P < 0.05$

III. Result

Generally the hedgehogs were alert active and apparently healthy, the parameters of the tracheobronchus and the lung were observed to be similar to that of mammals with the trachea having cartilaginous C-shape incomplete ring which is completed by trachealis muscle. The mean total length of tracheal ring of male is 1.53 $\pm$ 0.19cm and that of female is 1.33 $\pm$ 0.12cm (table 1). The trachea bifurcate at the thorax into left and right primary bronchus which is also made up of C-shape incomplete cartilage ring with mean total length of left bronchi of male is 0.70 $\pm$ 0.58cm and that of female is 0.63 $\pm$ 0.09cm (table 1).The mean total length of right bronchi of male is 0.73 $\pm$ 0.12cm and that of female is 0.53 $\pm$ 0.09cm (table 1). The lungs were observed to be pinkish in colour, it is divided into left and right lobes, and the left lobe is not divided while the right have four divisions; cranial, middle, caudal and accessory. The mean total length of left lung of male is 2.37 $\pm$ 0.12cm and that of female is 2.10 $\pm$ 0.26cm (table 1).The mean total length of right lung is 2.33 $\pm$ 0.23cm and that of female is 2.17$\pm$0.09cm. The mean weight of the lung of male is 1.39 $\pm$0.18g and that of female is 1.01 $\pm$0.14g (table 2).The mean weight of right lung of male is 0.88 $\pm$ 0.12g and that of female is 0.64 $\pm$ 0.08g (table 2), mean weight of left lung of male is 0.51 $\pm$ 0.06g and that of female is 1.01 $\pm$ 0.14g (table 2). The mean total number of lungs lobes of male is 5.00 $\pm$ 0.00 and that of female is 5.00 $\pm$ 0.00 (table 2). The mean total number of tracheal rings of male is 16.00 $\pm$ 0.00 and that of female is 16.00 $\pm$ 0.00 (table 2).

IV. Discussion

The conducting air ways of respiratory system in hedgehog consist of trachea bronchial tree and two lungs. The trachea is a flexible cartilaginous cylindrical tube extends from the caudal border of ring shape cricoid cartilage of the larynx at the level of atlanto-occipital through the ventral aspect of the neck in to the lung at thorax. It terminates by bifurcating in to the right and left principle bronchi above the base of the heart at the 4th thoracic vertebra Fig (1). (Ibe *et al.*, 2011) and disagree with result of (Al-anbki and Atya 2013) who stated that the number of tracheal ring in the rabbit is about (45-47). This difference in numbers of tracheal ring may be due to the different in activity of the animal also, the hedgehog is considered as a nocturnal animal that led to having a little ventilation (Al-anbki and Atya 2013).

The lung of local hedgehog is a sponge-like pink coloured organ; it occupied most of the thoracic cavity from 3rd to 8th ribs. The lung consists of two portion right and left. The right lung extended from 3rd rib to the 8th rib. It is divided anatomically by fissures into four lobes cranial (apical), middle (intermediate), caudal (diaphragmatic) and accessory lobes. The caudal lobe is the largest; while the smallest one is the accessory lobe, this result coincide with most research studies on most domestic animals having four right lobes. The left lung has only one lobe occupying most of the left side of thoracic cavity with the heart extending from the 3rd to the 8th intercostal space between 8th and 9th rib, These observations are similar to that in giant pouched Rat, and giant Rat, (Al-anbki and Atya 2013) but different from other rodents like the guinea pig which has lung with seven lobes (Ramchandi *etal*., 2001).

V. Conclusion

The current study has provided a baseline data on the morphology and histology of tracheobronchial and lung of hedgehog in this region.

Recommendation

It is therefore recommended that further studies should be carried out on the histology of other respiratory organs so as to determine the general histology of the respiratory system.

Table 1: mean ±SE, parameters of tracheobronchial and lung of hedgehog

Parameters	Male	Female
Length of trachea	1.53 ± 0.19	1.33 ± 0.12
Length of left bronchi	0.70 ± 0.58	0.63 ± 0.09
Length of right bronchi	0.73 ± 0.12	0.53 ± 0.09
Length of left lung	2.37 ± 0.12	2.10 ± 0.06
Length of right lung	2.33 ± 0.23	2.17 ± 0.09

Table 2: mean ±SE, weight of lungs and number of tracheal ring of hedgehog

Parameters	Male	Female
Weight of the lung	1.39 ± 0.18	1.01 ± 0.14
Weight of right lung	0.88 ± 0.12	0.64 ± 0.08
Weight of left lung	0.51 ± 0.06	1.01 ± 0.14
Number of tracheal ring	16.00 ± 0.00	16.00 ± 0.00
Number of lung lobes	5.00 ± 0.00	5.00 ±0.00

Fig. 1 Photograph of mature long ear hedgehog before dissection

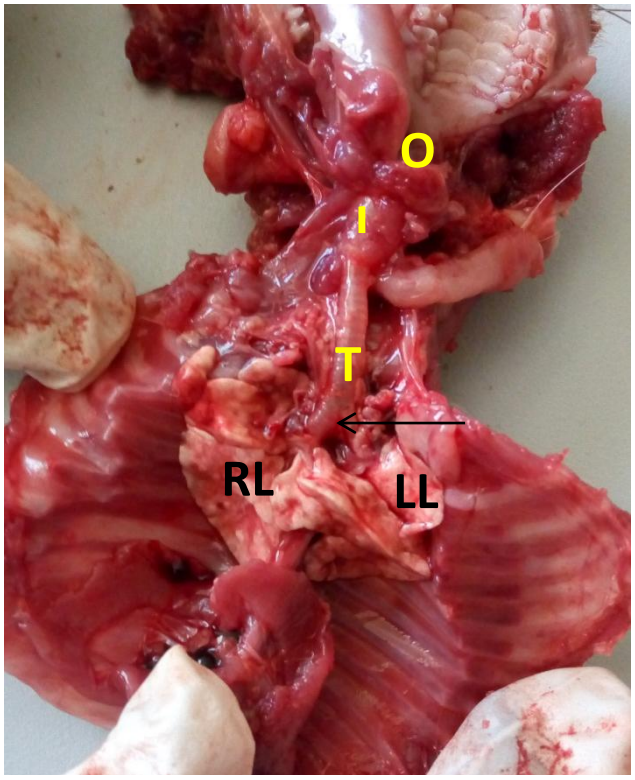

FIG.2 showing the oral cavity (O), larynx (L), trachea (T), right lung (RL) left lung (LN) and tracheal bifurcation (arrow**).**

Fig. 11 Photomicrograph of hedge hock trachea showing the trachea –C shape Cartilage and epithelial H&E x100

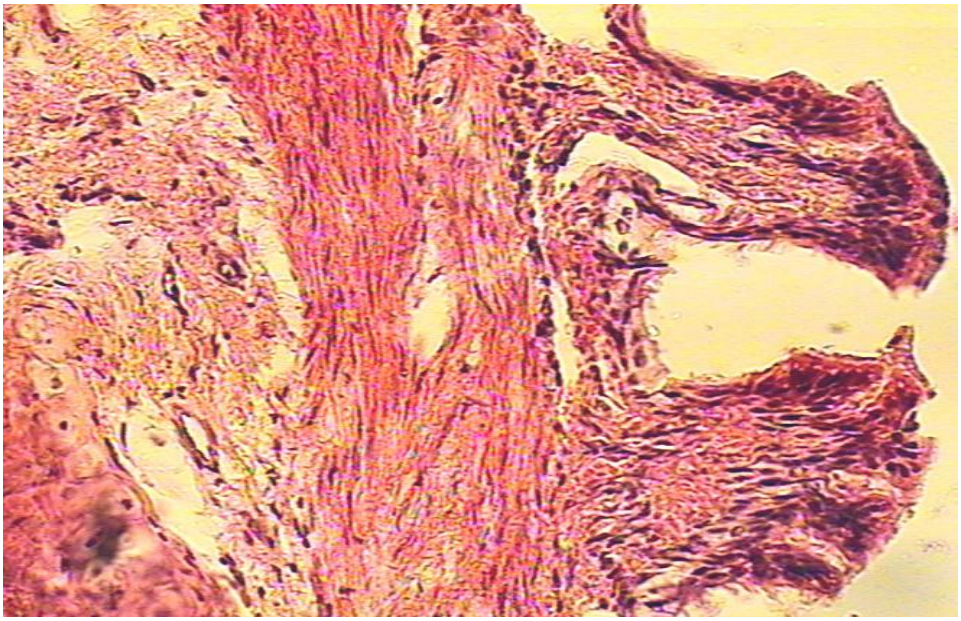

Fig. 2 Photomicrograph of hedge hock trachea showing the trachea –C shape Cartilage and epithelium H&E x100

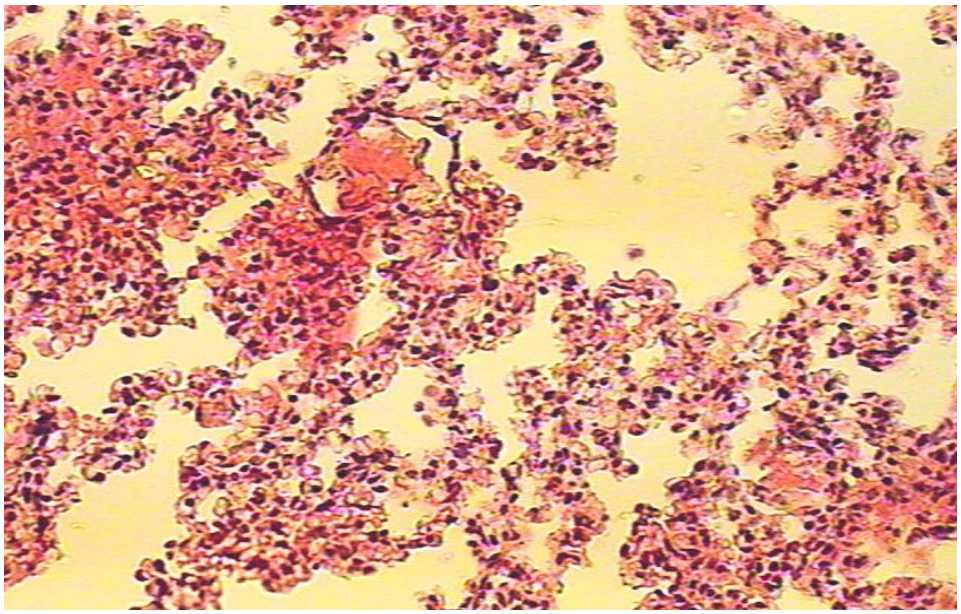

Fig. 3 Photomicrograph of hedge hock lung showing the blood vessel (arrows), Terminal bronchiole (XC) and alveoli (AL) H&E x100

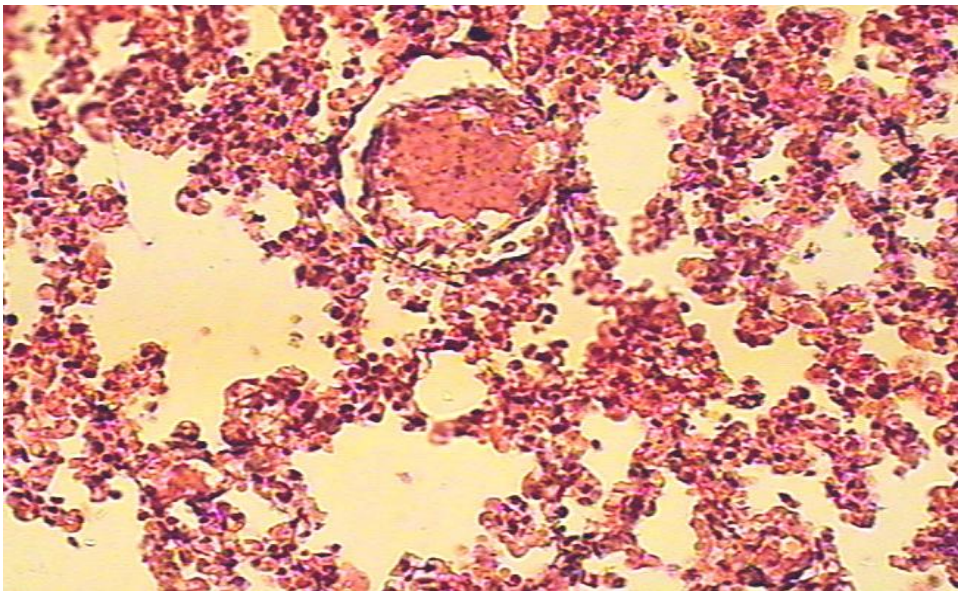

Fig. 5 Photomicrograph of hedge hock lung showing the blood vessel (arrows), Terminal bronchiole (XC) and alveoli (AL) H&E x400

Reference

[1] Al-anbki, A.A. and Atya, M. A. (2013). Anatomical, Histological and radiological study of trachea and lung in domesticated local rabbits. M.Sc. Thesis submitted to Veterinary Medicine College, university of Baghdad.

[2] Carlton, H.M. (1980): Histological and histochemical methods. Carlton's histological techniques, 5th edition, *Churchill livingstone Edinburgh*, UK 8:61 – 328

[3] David Attenborough (2014). *Attenborough's Natural Curiosities 2*. Armoured Animals. UKTV.

[4] Drury, R.A.B., Wallington, E.A., and Camerron, S.R. (1967). Processing of tissues. Carleton histological techniques 4th edition *Oxford University press,London*, UK Pp. 57 – 78

[5] Hutter, R. (2008). *Atelerixalbiventris*". IUCN Red list is threatened species, version 2008. *International union for conservation of nature*. *Retrieved* 30th August 2009. Database entry include a brief justification of why this species is of least concern.

[6] Hutterer, R. (2005). "Order Erinacenopha". In Wilson, D.E: Reeder, D,M Mammal species of the world. A taxonomic and geographic reference (3rd ed) *John's Hopkins University press Pp* 212 – 217.

[7] Ibe, C.S., Salami, S.O. and Onyeanusi, B.I. (2011). Macroscopic anatomy of the lower respiratory system nocturnal burrowing rodent African ginat pouched rat *Cricetomys gambianus*, water house 1840) Anat. Histo. Embryo. 40: 112-113.

[8] Jane, C., Digger, J. (2009). A first record of latrine used by European hedgehogs. *Erinaceuseuropaeus*. *Mammalia* 73/2: 145 – 147

[9] Jean, S. Johnson, C. W., M., Maryanna, Q., Warner, D., Lahart, W.J. (2010). Human Biology and Health. *Englewood cliffs; prentice hall*. Pp. 108 – 118.

[10] List of hedgehog disease" *wildlifeinformation*.org. Achieved from the original on 26th july, 2010. *Retrieved* 2009.
[11] Moore, K.L., Dalley, A.F. (1999). Clinically oriented anatomy. Philadelphia: *Lippincott Williams and Wilkins*
[12] Pawlina, W. (2015). Histology, a text and atlas (7th ed.) Pp. 670 – 678
[13] Ramchandi, R., Bates, J. H., Shen, X., Suki, B. and Tepper, R.S. (2001). Air way branching morphology of mature and immature rabbit lungs. *J. Appl. Physiol*., 90:1584-1592

* C Yakubu1. " Analysis of The Tracheobronchi of Hedge Hog: Histomophometric Studies." IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS) 11.4 (2018): 78-85.