Asian Journal of Biomedical and Pharmaceutical Sciences
ISSN : 2249 - 622X

RESEARCH ARTICLE

Received on: 15-03-2014
Accepted on: 02-04-2014
Published on: 15-05-14

A. Kalita *
Sr. Assistant Professor
Department of Veterinary Anatomy and Histology
College of Veterinary Sciences and A.H. Central Agricultural University,
Selesih, Aizawl, Mizoram – 796 014, India.
Email: arup.kalita@gmail.com

Conflict of Interest: None Declared !

QR Code for Mobile users

DOI: 10.15272/ajbps.v4i30.470

Gross Anatomy of the Respiratory System of Mizo Local Pig (Zo Vawk)

A. Kalita
College of Veterinary Sciences and A.H. Central Agricultural University,
Selesih, Aizawl, Mizoram – 796 014, India

Abstract

The present investigation provides a baseline data on gross anatomy of respiratory system of Mizo local pig (Zo vawk). The values of the biometrical measurements were less corresponding to the smaller shape, size and lesser body weight of Mizo local pigs. They have relatively longer nasal cavities corresponding to the long facial part of the head. The laryngeal prominence is found absent on the ventral surface of thyroid cartilage. The first tracheal ring is slightly wider and larger and no fusion between tracheal rings. The right extra pulmonary bronchus is shorter and wider than left extra pulmonary bronchus. The surface lobulations are clearly visible on the lung corresponding to the thick interlobar and interlobular connective tissue.

Keywords: Gross anatomy, Respiratory system, Mizo local pig

Cite this article as:
A. Kalita. Gross Anatomy of the Respiratory System of Mizo Local Pig (Zo Vawk). Asian Journal of Biomedical and Pharmaceutical Sciences; 04 (31); 2014; 18-23. DOI: 10.15272/ajbps.v4i30.470

INTRODUCTION

The respiratory system is essential for gaseous exchange between air and blood. In addition to that it performs olfaction, phonation and thermoregulation of the body. Anatomical study on the respiratory system has been done extensively in domestic mammals. However, studies on this system in indigenous varieties of pigs especially that of Mizoram are still lacking.

Animals living in different zones of altitude have to cope-up structurally and functionally with different levels of atmospheric pressure and oxygen tension for optimum respiratory activities. The indigenous pigs of Mizoram are distributed within the range of 500-1000 meters high altitude. Anatomical study on the respiratory system in this variety of pig is, therefore, essential to elucidate the structural peculiarities in connection with their functional status at such high altitude.

METHODS

The Mizo local pigs are reared in semi intensive system in the pig farm of the College of Veterinary Sciences and Animal Husbandry, Central Agricultural University, Selesih, Aizawl, Mizoram, India, following the standard management procedures. Adequate feed, drinking water and health care are provided to the animals. Excess numbers of animals than the parent stock are slaughtered by using captive bolt pistol for commercial purpose. Organs of respiratory system of 10 (ten) apparently healthy adult indigenous pigs of Mizoram (Zo vowk) of either sex were utilized for the research project. The respiratory systems were exposed in-situ by fine dissection and photographed to record the topographical position. The organs were then removed from the body and the gross anatomical features and biometrical parameters were recorded. Weight was measured on monopan balance, length, width and diameter with the help of scale and vernier calipers and lung volume by saline displacement method [1]. Median and cross sections of the head were made to expose the nasal cavity and biometrical measurements were recorded.

The biometrical data were statistically analyzed as per the methods of Snedecor and Cochran [2] by using SYSTAT Version 6.0.1., 1996 SPSS INC software. The mean and standard error (SE) of the organ parameters were estimated and presented in tabular forms. The statistical comparisons of the data between right and left side of some organs were carried out by using paired'ṭ' test.

RESULTS

The indigenous pigs of Mizoram are popularly known as Mizo local pig or Zo vawk in Mizo language. They are normally small, timid and sensitive animals but mothers become very aggressive during lactation. External morphological observation revealed that they possessed small, straight, pointed head, and very thick and glossy hairs. They were almost similar to the "doom" variety pigs of Assam except the "pot belly" feature (Fig.1a). The mean adult body weight and length recorded in the present investigation were 225.50 ± 1.65 kg and 66.50 ± 1.97 cm respectively.

Gross Anatomy and Biometry:

Conducting Airways:

Nostrils:

Nostrils of Mizo local pig were found to be almost round to oval in shape. They were embedded within the planum rostrale and less dilatable. The snout was supported by the rostral bone (Os rostrale) and well projected dorsally (Fig. 1b). The philtrum was indistinct. The mean vertical diameter of right nostril was 1.29 ± 0.07cm and that of left nostril was 1.27 ± 0.07cm. The mean horizontal diameter of right and left nostrils were 0.99 ± 0.05cm and 0.98 ± 0.55cm respectively (Table 1). Vertical and horizontal diameters of right and left nostrils did not differ significantly ($P<0.05$)

The nostrils of the Mizo local pig were round to oval in shape and less dilatable as they were embedded within the planum rostrale. Ghosh [3] and Frandson *et al.* [4] also opined similarly. The gross anatomical features of the snout and philtrum conformed to that of common large breeds of pig as observed by Hare [5], Nickel *et al.* [6] and Dyce *et al.* [7].

Parameter	Right Nostril	Left Nostril
Vertical Diameter (cm)	1.29 ± 0.07^{a}	1.27 ± 0.07^{a}
Horizontal Diameter (cm)	0.99 ± 0.05^{b}	0.98 ± 0.05^{b}

Table 1: Biometry of nostrils of Mizo local pig

N.B.:- (i) The mean showing same superscript does not differ significantly ($P<0.05$) (ii) Sample size, n = 10

Nasal Cavity:

Both right and left nasal cavities were relatively long (Fig. 1c). The mean length of right nasal cavity (18.90 ± 0.28 cm) and left nasal cavity (18.86 ± 0.27 cm) were 28.42% and 28.36 % of mean body length (66.50 ± 1.97cm) respectively. The width gradually increased from cranial to caudal. Mean width of right nasal cavity was 2.51 ± 0.08 cm and that of left nasal cavity was 2.48 ± 0.07 cm (Table 2). Length and width of right and left cavities did not differ significantly ($P< 0.05$).

Parameter	Right Nasal Cavity	Left Nasal Cavity
Length (cm)	18.90 ± 0.28^{a}	18.86 ± 0.27^{a}
Width (cm)	2.51 ± 0.08^{b}	2.48 ± 0.07^{b}

Table 2: Biometry of the nasal cavity of Mizo local pig

N.B.:- (i) The mean showing same superscript does not differ significantly ($P<0.05$) (ii) Sample size, n = 10

The length and width of nasal septum conformed that of the nasal cavities. The mean thickness of the septum was 0.59 ± 0.04 cm. (Table 3).

Parameter	Nasal Septum
Length (cm)	18.90 ± 0.28
Width (cm)	2.51 ± 0.08
Thickness (cm)	0.59 ± 0.04

Table 3: Biometry of Nasal Septum of Mizo local pig

N.B.:- Sample size, n = 10

The dorsal nasal concha extended to the level of third cheek tooth (Fig. 1c). The mean length and thickness of right dorsal nasal concha were 13.55 ± 0.23 cm and 0.49 ± 0.05 cm and that of left one were 13.57 ± 0.24 cm and 0.46 ± 0.05cm respectively.

The ventral nasal concha showed dorsal and ventral spiral lamellae enclosing recess (Fig. 1d). The mean length and thickness of right ventral nasal concha were 9.42 ± 0.31 cm and 0.20 ± 0.02 cm and that of left one were 9.48 ± 0.29 cm and 0.20 ± 0.03 cm respectively.

The small middle nasal conchae were attached to the ethmoid labyrinth. Mean length and thickness of right one were 1.72 ± 0.07 cm and 0.20 ± 0.03 cm and that of left one were 1.70 ± 0.07 cm and 0.22 ± 0.03 cm respectively (Table 4).

The length and thickness of right and left nasal conchae did not differ significantly (P<0.05).

Parameter	Dorsal Nasal concha		Ventral Nasal concha		Middle Nasal concha	
	Right	Left	Right	Left	Right	Left
Length (cm)	13.55 ± 0.23[a]	13.57 ± 0.24[a]	9.42 ± 0.31[a]	9.48 ± 0.29[a]	1.72 ± 0.07[a]	1.70 ± 0.07[a]
Thickness (cm)	0.49 ± 0.05[b]	0.46 ± 0.05[b]	0.20 ± 0.02[b]	0.20 ± 0.03[b]	0.20 ± 0.03[b]	0.22 ± 0.03[b]

Table 4: Biometry of Nasal Conchae of Mizo local pig

N.B.:- (i) The mean showing same superscript does not differ significantly (P<0.05)

(ii) Sample size, n = 10

The comparatively higher length of nasal cavities as recorded in the present study could be related to the characteristic long face of the indigenous pig of Mizoram (Fig 1a). Hare [5], Nickel *et al.* [6] and Dyce *et al.* [7] also recorded long nasal cavity of pig. Other gross anatomical features of nasal cavity of Mizo local pig including nasal septum, nasal conchae, vomaro nasal organ, nasal meatuses and choanae were also observed to be similar as mentioned by Hare [5], Nickel *et al.* [6] and Dyce *et al.* [7].

Larynx:

The cavity of the the larynx of Mizo local pig showed wide vestibule and narrow infraglottic cavity (Fig. 1e).

The wall of the larynx was supported by four cartilages viz. thyroid, cricoid, arytenoid and epiglottis (Fig. 1f).

The ventral unpaired thyroid cartilage did not present rostral cornu, thyroid fissure and thyroid foramen. None of the animal studied showed laryngeal prominence on the ventral surface of thyroid cartilage.

The unpaired cricoid cartilage was attached caudally to thyroid cartilage and showed long lamina and prominent median crest.

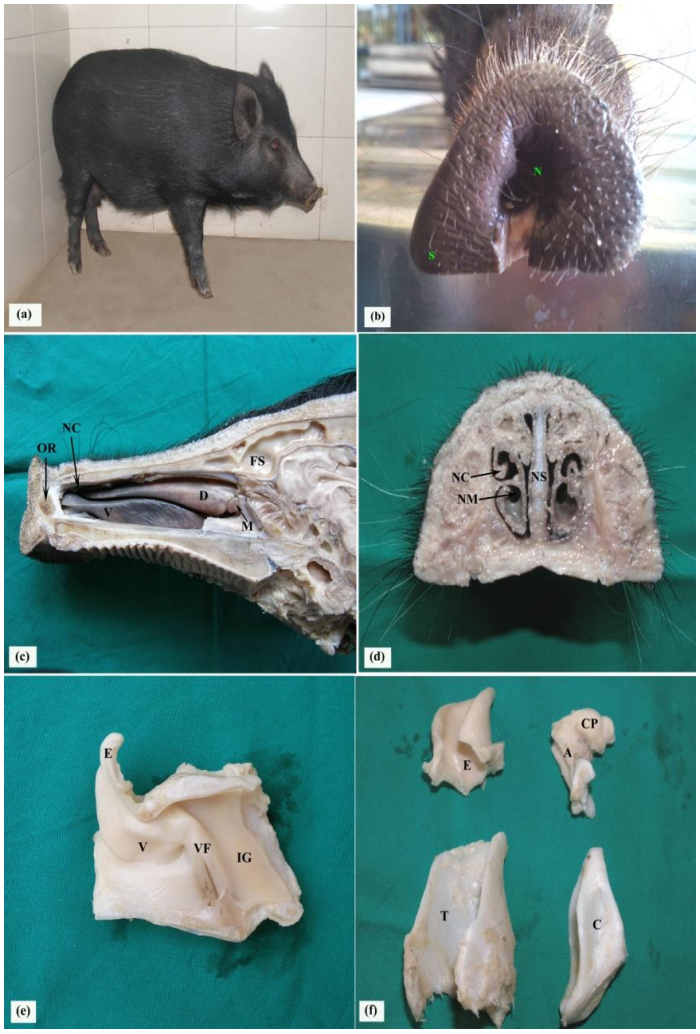

Fig. 1: Respiratory System of Zo Vawk. (a) Photograph of Mizo local pig (Zo vawk). (b) Head of Mizo local pig showing nostrils (N) and snout (S). (c) Longitudinal section of the face showing nasal cavity (NC), Os rostrale (OR), dorsal (D), ventral (V), middle (M) nasal conchae and frontal paranasal sinus (FS). (d) Cross section of the face showing nasal septum (NS), nasal conchae (NC) and nasal meatuses (NM). (e) Longitudinal section of larynx of Mizo local pig showing epiglottis (E), vestibule (V), vocal fold (VF) and infraglottic cavity (IG). (f) Laryngeal Cartilages of Mizo local pig showing epglottis (E), arytenoid (A) with well developed corniculate process (CP), thyroid (T) and cricoid (C) cartilages.

The paired arytenoid cartilages located dorsally on either side. The characteristic large, dorsomedially

fused corniculate processes were found in all the animals observed.

The rostrally located epiglottis was unpaired and showed high sides forming a deep trough.

The mean length of larynx was 5.74 ± 0.12 cm and the width was 3.34 ± 0.13 cm (Table 5)

Parameter	Larynx
Length (cm)	5.74 ± 0.12
Width (cm)	3.34 ± 0.13

Table 5: Biometry of larynx of Mizo local pig

N.B.:- Sample size, n = 10

Larynx of the Mizo local pig showed almost similar gross anatomical features as observed by Hare [5], Nickel *et al.* [6] and Dyce *et al.* [7] in common large breeds. However, laryngeal prominence of thyroid cartilage, recorded by Nickel *et al.* [6] in older pigs could not be found in the present study.

Trachea:

The trachea of Mizo local pig was observed to be relatively short, circular cartilaginous tube (Fig. 2a). Tracheal rings were complete and the right end slightly overlapped the left end dorsally .The first tracheal ring was found to be larger and wider than rest of the rings (Fig. 2b). Fusion of tracheal rings was recorded in none of the animals under investigation. Presently 25 – 28 numbers of rings were recorded. The mean length of trachea was 13.97 ± 0.91 cm and mean diameter was 2.36 ± 0.08 cm (Table 6)

Parameter	Trachea
Length (cm)	13.97 ± 0.91
Diameter (cm)	2.36 ± 0.08
No. of tracheal rings	25 - 28

Table 6: Biometry of trachea of Mizo local pig

N.B.:- Sample size, n = 10

The shorter length of trachea may be attributed to the shorter length of the neck of these animals. Accordingly to Hare [5], tracheal length in common large breeds of pig was 15-20 cm with 32–36 numbers of tracheal rings. Complete or partial fusion of some tracheal rings, as mentioned by Nickel *et al*. [6] was not found in the animals studied presently.

Extra-pulmonary bronchus:

Extra pulmonary parts of right and left primary or principal bronchi and tracheal or right apical lobar bronchus showed similar gross anatomical structures as trachea. Biometrical measurements (Table 7), however, revealed that left primary bronchus (1.71 ± 0.12 cm) was longer than right primary bronchus (0.72 ± 0.07 cm) and their length differed significantly (P<0.05). Reversely, the diameter of right primary bronchus (1.44 ± 0.06 cm) was greater than that of the left primary bronchus (0.07 ± 0.08 cm) and also differed significantly (P<0.05). The mean length and diameter of tracheal bronchus were 0.78 ± 0.06 cm and 0.69 ± 0.04 cm respectively (Fig. 2c)

Parameter	Right Primary Bronchus	Left Primary Bronchus	Tracheal Bronchus
Length (cm)	0.72 ± 0.07^{a}	1.71 ± 0.12^{b}	0.78 ± 0.06
Diameter (cm)	1.44 ± 0.06^{a}	0.67 ± 0.08^{b}	0.69 ± 0.04

Table 7: Biometry of Extra Pulmonary Bronchus of Mizo local pig

N.B.:- (i) The mean showing different superscripts differ significantly (P<0.05)

(ii) Sample size, n = 10

Presently it was observed that the length of left primary bronchus was more than right primary bronchus but the diameter was less than right one in Mizo local pig. However such observation was not mentioned by Hare [5], Nickel *et al.* [6] and Dyce *et al*. [7] in common large breeds.

The tracheal bronchus arose on the right side and ventilated the right apical lobe in all the animals investigated. The similar general concept was put forwarded by Hare [5], Nickel *et al.* [6] and Dyce *et al.* [7]. Nakakuki [8] also reported the occurrence of tracheal bronchus from the right side of trachea in pigs. On the contrary Mouton *et al.* [9] reported the occurrence of tracheal bronchus on the left side of trachea in pigs in some cases.

Lung:

Lungs of the Mizo local pig showed characteristic shape and lobation of porcine species (Fig. 2d). The lobulation was clearly visible on the surface in fixed specimen (Fig. 2c).

The extent of right lung was from the caudal border of 1st rib to caudal border of 9th rib. The right cardiac notch was narrow and bounded at the level of ventral end of 3rd rib and adjacent intercostals spaces (Fig. 2e).

The left lung extended from cranial border of the 2nd rib to the cranial border of 9th rib. The left cardiac notch was wider and occupied 2nd, 3rd and ventral part of 4th intercostals spaces (Fig. 2f).

The mean weight and volume of the whole lung were measured as 327.40 ± 3.97 gm and 381.80 ± 18.64 ml respectively. The mean weight of the whole lung constituted 1.45% of the mean body weight. The mean weight of the right lung (209 ± 2.00gm) was 0.93% of the mean body weight and 63.99% of the mean whole lung weight and that of the left lung (117.90 ± 2.00 gm) was 0.52% of the mean body weight and 36.01% of the mean whole lung weight.

The mean volume of the right lung (224.30 ± 7.61 ml) and left lung (157.50 ± 12.39 ml) were 58.75% and 41.25% of the mean whole lung volume respectively.

The mean length of right lung was 20.13 ± 0.39 cm and that of left lung was 15.34 ± 0.53 cm which were 31.70% and 24.16% of the mean body length respectively.

The paired t-test analysis revealed significant differences (P<0.05) in regards to weight and volume of right and left lungs, length of right and left lungs and dorsoventral and craniocaudal length of apical and diaphragmatic lobes of right and left lungs (Table 8A, 8B).

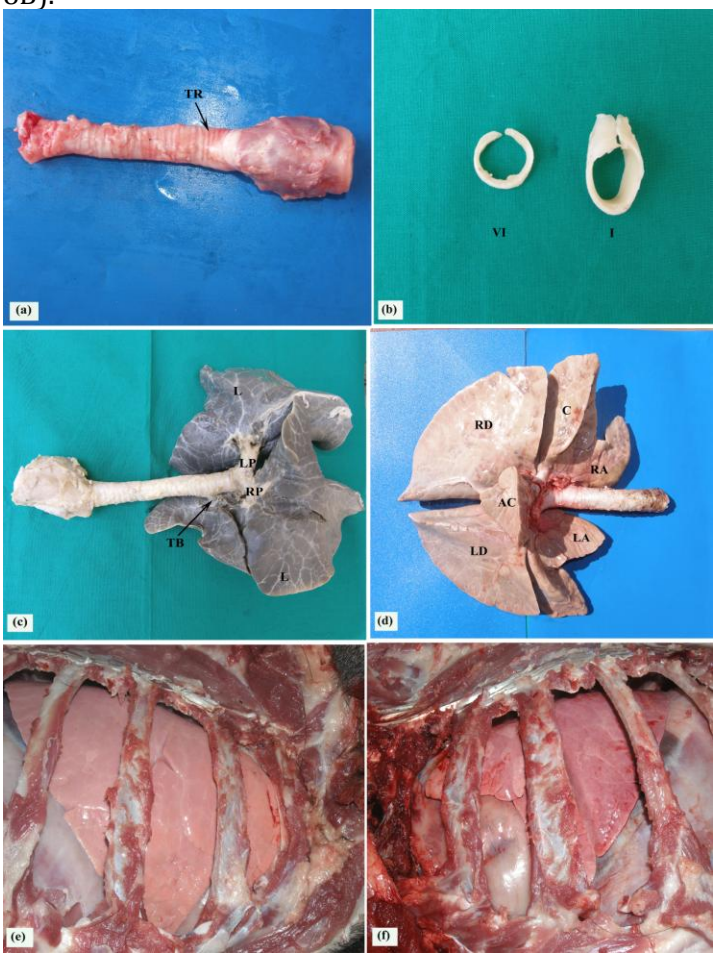

Fig. 2: Respiratory System of Zo Vawk. (a) Trachea showing tracheal rings (TR). (b) First and Sixth tracheal rings. (c) Lungs showing right (RP) and left (LP) primary bronchi and tracheal bronchus (TB) and distinct surface lobulation (L). (d) Ventral view of lungs showing right apical (RA), left apical (LA), cardiac (C), right diaphragmatic (RD), left diaphragmatic (LD) and accessory (AC) lobes. (e) Right lung of Mizo Local Pig *in situ*. (f) Left lung of Mizo Local Pig *in situ*.

Parameter	Whole Lung	Right Lung	Left Lung
Weight (gm)	327.40 ± 3.97	209.5 ± 2.00[a]	117.9 ± 2.00[b]
Volume (ml)	381.80±18.64	224.3 ± 7.61[a]	157.50 ± 12.39[b]
Length (cm)		20.13 ± 0.39[a]	15.34 ± 0.53[b]

Table 8A: Biometry of the lungs of Mizo local pig

N.B.:- (i) The mean showing different superscripts differ significantly (p<0.05)
(ii) Sample size, n = 10

Parameter	Right Apical Lobe		Left Apical Lobe		Right diaphragmatic Lobe		Left Diaphragmatic Lobe		Right Cardiac Lobe		Accessory Lobe
	Dorso ventral	Cranio caudal	Dorso ventral	Cranio caudal	Dorso ventral	Cranio caudal	Dorso ventral	Cranio caudal	Dorso ventral	Cranio caudal	
Length (cm)	7.07 ± 0.19[a]	9.91 ± 0.18[a]	12.42 ± 0.31[b]	8.97 ± 0.26[b]	10.75± 0.23[c]	13.31± 0.20[c]	8.69 ± 0.30[d]	12.05± 0.20[d]	9.66± 0.08	5.93± 0.21	6.19 ± 0.15

Table 8B: Biometry of the lobes of the lungs of Mizo local pig

N.B.:- (i) The mean showing different superscripts differ significantly (p<0.05)
(ii) Sample size, n = 10

Gross anatomical features, topography and lobation of the lungs of indigenous pigs of Mizoram did not show characteristic difference from the lung of common large breeds as observed by Hare [5], Nickel *et al*. [6], Nakakuki [8] and Dyce *et al*. [7]. However, the surface lobulation, especially on the fixed specimen of lungs of indigenous pigs were distinctly visible (Fig. 2c). This may be correlated to the higher amount of connective tissue in the lungs of these animals which might, in turn be attributed to the higher elasticity of the lung in these animals. Surface lobulation in common large breeds of pigs were observed to be less distinct by Hare [5], Nickel *et al.* [6] and Dyce *et al.* [7]. On the contrary Todo and Herman [10] found well demarcated lung lobules in Yorkshire breed.

Lesser values of the biometrical parameters recorded in the present investigation might be correlated to the smaller size, weight and length of the body of these animals.

ACKNOWLEDGEMENT

The authors are grateful to The Honourable Vice Chancellor and The Director of Research, Central Agricultural University, Imphal, India for sanctioning and funding the research project under intra mural research programme. Special thanks goes to The Dean, C.V.Sc. & A.H. Selesih, Aizawl for providing all the facilities to carry out the research work.

REFERENCES

1. Scherle W. A simple method for volumetry of organs in quantitative stereology, Mikroskopie. 1970; 26: 57-60.
2. Snedecor GW, Cochran WG. Statistical methods. 9th edn. Iowa State University Press, Ames. 1994; 124-130.
3. Ghosh RK. Primary Veterinary Anatomy. 3rd edn. Current Books International, Kolkata. 2003.

4. Frandson RD, Wilke WL and Fails AD. Anatomy and Physiology of Farm Animals. 6th Edn. Lippincott Williams and Wilkins, Philadelphia. 2003.
5. Hare WCD. Respiratory System. In, Sisson and Grossman's The Anatomy of the Domestic Animals , Vol. 2., Getty, R. (edn.) 5th edn. W.B. Saunders Co. Philadelphia. 1975.
6. Nickel R, Schummer A and Scifurle E. The Viscera of the Domestic Mammals. 2nd Revised Edn. Translated and Revised by Sack, W.O., Verlag Paul Parey, Berlin. 1979.
7. Dyce KM, Sack WO and Wensing CJG. Text Book of Veterinary Anatomy. 3rd Edn. Saunders, Philadelphia. 2002.
8. Nakakuki S. Bronchial tree, lobular division and blood vessels of the pig lung. J. Vet. Med. Sc. 1994; 56 (4): 685-9.
9. Mouton WG, Pfitzner J, Bessel JR and Maddern GJ. Bronchial anatomy and single-lung ventilation in the pig. Can. J. Anesth. 1999; 46 (7): 701-3.
10. Todo G and Herman PG. High-Resolution Computed Tomography of the Pig Lung. Investigative Radiology, 1986; 21 (9): 689-96.

