



Cairo University
Faculty of Veterinary Medicine
Anatomy and Embryology Department



***Macro and microscopical study on the respiratory
system of the adult rabbits and domestic cats.***

Thesis presented

By

Yara Sayed Abou Elela Ali Eid

(B. V. Sc. 2011, M. V. Sc. 2014)

(Anatomy and Embryology)

Thesis submitted to

Cairo University

Faculty of Veterinary Medicine

For the degree of

Ph. D.

Under supervision of

Prof. Dr. Safwat Ahmed Ragab

Professor of Anatomy and Embryology

Faculty of Veterinary Medicine

Dr. Samer Mohamed Daghash

Assistant professor Of Anatomy and Embryology

Faculty of Veterinary Medicine

Dr. Mohamed AbdelRazik Khattab

Lecturer Of Cytology and Histology

Faculty of Veterinary Medicine

Dr. Reem Rashad Tahon

Lecturer of Anatomy and Embryology

Faculty of Veterinary Medicine

Cairo University

2018

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ
(قَالُوا سُبْحَانَكَ لَا عِلْمَ لَنَا إِلَّا مَا
عَلَّمْتَنَا إِنَّكَ أَنْتَ الْعَلِيمُ الْحَكِيمُ)

(الآية ٣٢ سورة البقرة)



Cairo University
Faculty of Veterinary Medicine
Anatomy and Embryology Department



Abstract

Name: Yara Sayed Abou Elela Ali Eid

Nationality: Egyptian

Date of Birth: 1/8/1989

Place of birth: Giza

Specialization: Anatomy and Embryology

Degree: Ph. D.

Macro and microscopical study on the respiratory system of the adult rabbits and domestic cats.

Under supervision of:

Prof. Dr. Safwat Ahmed Ragab

Professor of Anatomy and Embryology. Fac. of Vet Med., Cairo University

Dr. Samer Mohamed Daghash

Assistant Professor of Anatomy and Embryology. Fac. of Vet Med., Cairo University

Dr. Mohamed AbdelRazik Khattab

Lecturer of Cytology and Histology. Fac. of Vet Med., Cairo University

Dr. Reem Rashad Tahon

Lecturer of Anatomy and Embryology. Fac. of Vet Med., Cairo University

Key word: Rabbit, Cat, Nasal Cavity, Larynx, lung, anatomy

Studying the anatomical differences of the respiratory system of both rabbit and cat offers a valuable evidence for clinicians regarding the possibility of utilization as models to human being studies. This work was conducted using clinically healthy twenty five for each domestic cats and White New Zealand rabbits, of different sexes and weights. Different techniques were applied from drying, fixed, specimens as well as histological and histochemical studies. The nostrils of rabbit were slit like opening with complete deep cleft philtrum while the cat nostrils were semicircular with shallow grooved philtrum. The nasal septum of rabbit was three layers while in the cat was only single layer. The nasal septum of both rabbit and cat showed high level of acidic mucins in the lining epithelium and low level of neutral mucins. The corniculates and cuniform cartilages were appeared in the larynx of the rabbit and disappeared in the cat. Histologically the thyroid cartilage of both rabbit and cat was hyaline in nature. The lung of the rabbit

and cat was extended from the second rib and reached to the seventh rib in cases of rabbit while in the cat reached the eleventh rib. The middle thyroid artery and vein were appeared only in the rabbit while in the cat the caudal thyroid artery and vein were recognized instead of the middle one.

Dedication

I dedicate this work to my Parents, my husband, my sons, my daughter, my sister and my brother for their love & care to produce this work.

ACKNOWLEDGMENT

First of all, prayerful thanks to our merciful Allah who gave me everything I wish, the ability and patience to finish this work.

*I am profoundly grateful to **Prof. Dr. Safwat A. Ragab** professor of anatomy and embryology, faculty of veterinary medicine, Cairo University for being an inspiring supervision and a great monitor, I would like to express my grateful envy from the heart for continuous advice, valuable constructive criticism, suggestion and the time he invested in working with me. I have learnt a lot from him. Thank you for your immense help.*

*My sincere thanks to **Dr. Samer M. Daghash** assistant professor of anatomy and embryology, faculty of veterinary medicine, Cairo University for his supervision, encouragement and valuable help throughout the work.*

*I wish to express my acknowledgment and gratitude to **Dr Mohamoud AbdelRazik** Lecturer Of Cytology and Histology faculty of veterinary medicine, Cairo University for his supervision and generous help through the work.*

*I am greatly indebted and wish to express my sincere thanks to **Dr. Reem R. Tahon** lecturer of anatomy and embryology, faculty of veterinary medicine, Cairo University for her supervision and great help, interest and valuable advice.*

I would like to thank all the staff and members of the anatomy and embryology department for their help and cooperation.

CONTENT

<i>List of figures</i>	
<i>Introduction.....</i>	<i>1</i>
<i>Materials And Methods</i>	<i>3</i>
<i>A. Morphological study</i>	
<i>I- Gross anatomical study</i>	
<i>Review Of Literature</i>	<i>9</i>
<i>Results.....</i>	<i>44</i>
<i>Discussion</i>	<i>135</i>
<i>II- Histochemical study</i>	
<i>Review Of Literature</i>	<i>159</i>
<i>Results.....</i>	<i>169</i>
<i>Discussion</i>	<i>201</i>
<i>B. Angioarchitecture study</i>	
<i>I Arterial supply</i>	
<i>Review Of Literature</i>	<i>213</i>
<i>Results.....</i>	<i>220</i>
<i>Discussion</i>	<i>245</i>
<i>II. Venous drianage</i>	
<i>Review Of Literature</i>	<i>252</i>
<i>Results.....</i>	<i>257</i>
<i>Discussion</i>	<i>279</i>
<i>SUMMARY</i>	<i>283</i>
<i>REFERENCES</i>	<i>285</i>
 <i>ARABIC SUMMARY</i>	

Table of figures of morphology

Fig. No.		Page
A	A Photograph showing the levels of cross sections of nasal cavity rabbit.	8
B	A Photograph showing the levels of cross sections of nasal cavity cat.	8
1.	A Photograph showing the nostrils of the rabbit	72
2.	A Photograph showing the philtrum of the rabbit.	73
3.	A Photograph showing the nasal cartilages of the rabbit after removal of the skin.	73
4.	A Photograph showing reflection of the upper lip of the rabbit showing Frenulum labii maxillaris.	74
5.	A Photograph showing the nostrils of the cat.	76
6.	A Photograph showing the cat rhinarium (anterior view)	77
7.	A Photograph showing reflection of the nasal septum of the rabbit.	79
8.	A Photograph showing the paraseptal cartilage of the rabbit.	80
9.	A Photograph showing the nasal cartilages of the rabbit.	81
10.	A Photograph showing the nasal cavity of the rabbit (Cross section level A).	81
11.	A Photograph showing the lateral nasal septum of the rabbit .	82
12.	A Photograph showing the nasal cavity (Cross section level D).	83
13.	A Photograph showing the nasal cavity of the rabbit (sagittal section).	84
14.	A Photograph showing the median nasal septum (paramedian section of the cat head).	86
15.	A Photograph showing the nasal cartilages of cat (Transverse section level A).	87
16.	A Photograph showing choanae of cat (Transverse section Level D).	87
17.	A Photograph showing the roof of the oral cavity of cat.	88
18.	A Photograph showing regions of the nasal cavity of the rabbit.	90
19.	A Photograph showing the region of the nasal vestibule of the rabbit.	91

20.	A Photograph showing maxilloturbinates region of the nasal cavity of the rabbit.	92
21.	A Photograph showing the nasal cavity of the rabbit (sagittal section).	93
22.	A Photograph showing the nasal cavity of rabbit (Cross section Level C).	94
23.	A Photograph showing the nasal cavity of rabbit (cross section Level B).	94
24.	A Photograph showing the nasal cavity of the cat (paramedian section.	96
25.	A Photograph showing the nasal cavity of the cat (paramedian section).	97
26.	A Photograph showing nasal vestibule of the cat (paramedian section).	97
27.	A Photograph showing the nasal cavity of the cat (transverse section level B).	98
28.	A Photograph showing the cat nasal cavity (transverse section level c).	98
29.	A Photograph showing the maxillary sinus of the rabbit.	100
30.	A Photograph showing the paranasal sinuses of cat (Sagittal view).	101
31.	A Photograph showing the frontal sinus of cat (dorsal view).	102
32.	A Photograph showing the larynx of the rabbit (dorsal view).	104
33.	A Photograph showing the epiglottic cartilage of rabbit (laryngeal surface).	104
34.	A Photograph showing the epiglottic cartilage of rabbit (lingual surface).	105
35.	A Photograph showing the cat larynx (dorsal view).	105
36.	A Photograph showing the epiglottis of cat (laryngeal surface).	106
37.	A Photograph showing the epiglottis of cat (lingual surface).	106
38.	A Photograph showing the larynx of the rabbit (lateral view).	107
39.	A Photograph showing the thyroid cartilage of rabbit (lateral view).	107
40.	A Photograph showing the thyroid cartilage of rabbit (cranial view).	108
41.	A Photograph showing the larynx of cat (lateral view).	108
42.	A Photograph showing the thyroid cartilage of cat (lateral view).	109

43.	A Photograph showing the thyroid cartilage of cat (caudal view).	109
44.	A Photograph showing the arytenoid cartilage of the rabbit.	110
45.	A Photograph showing the arytenoid cartilage of the cat.	110
46.	A Photograph showing the cricoid cartilage of rabbit (lateral view).	111
47.	A Photograph showing the cricoid cartilage of rabbit (caudal view).	111
48.	A Photograph showing the cricoid cartilage of cat (lateral view).	112
49.	A Photograph showing the cricoid cartilage of cat (caudal view).	112
50.	A Photograph showing the rabbit larynx (sagittal section).	113
51.	A Photograph showing the cat larynx (sagittal section).	113
52.	A Photograph showing the trachea of rabbit (insitu).	115
53.	A Photograph showing the trachea and lung of rabbit.	116
54.	A Photograph showing the rabbit trachea (cross section).	117
55.	A Photograph showing the trachea of the cat.	119
56.	A Photograph showing the trachea of the cat.	120
57.	A Photograph showing the trachea of the cat (cross section).	121
58.	A Photograph showing the bronchial tree of the rabbit (injected by latex).	122
59.	A Photograph showing the bronchial tree of the rabbit (silicone cast)	123
60.	A Photograph showing the bronchial tree of the cat (injected by latex)	124
61.	A Photograph showing the bronchial tree of the cat (silicone cast).	125
62.	A Photograph showing the rabbit thoracic cage after removal of costal muscles showing skeletal relation of the lung (right view).	127
63.	A Photograph showing the rabbit lung (dorsal view).	128
64.	A Photograph showing the rabbit right thoracic cavity after removal of ribs .	128
65.	A Photograph showing the rabbit lung (caudoventral view).	129

66.	A Photograph showing the right accessory lobe of rabbit lung (caudal view).	129
67.	A Photograph showing the left lung of the rabbit.	130
68.	A Photograph showing the left lung of the rabbit.	130
69.	A Photograph showing the cat thoracic cage after removal of costal muscles showing skeletal relation of the lung (right view).	132
70.	A Photograph showing the cat right thoracic cavity after removal of ribs .	133
71.	A Photograph showing the cat lung (dorsal view).	134
72.	A Photograph showing the cat lung (caudoventral view)	134

Table of figures of histochemistry

<u>NO. of plate</u>	<u>Name of plate</u>	<u>Page</u>
1	Plate of nasal vestibule	179
2	Plate of nasal septum at level I	180
3	Plate of Nasal septum at level II.	181
4	Plate of nasal septum at level III.	182
5	Plate of nasal septum at level IV.	183
6	Plate of nasal septum with special stains	184
7	Plate of the maxilloturbinates	185
8	Plate of the maxilloturbinates with special stains	186
9	Plate of the ethmoturbinates	187
10	Plate of the wall of the nasal cavity	188
11	Plate of the paranasal sinuses.	189
12	Plate of the vomeronasal organ.	190
13	Plate of the epiglottis cartilage	191
14	Plate of the epiglottis cartilage with special stain.	192
15	Plate of the arytenoid cartilage	193
16	Plate of the thyroid and cricoid cartilages.	194
17	Plate of the epiglottis with special stain.	195
18	Plate of laryngeal reactivity to PAS stain.	196
19	Plate of the tracheal tissue organization.	197
20	Plate of tracheal mucosa with alcian blue PH1	198
21	Plate of tracheal mucosa with alcian blue PH2.5.	199
22	Plate of tracheal mucosa with to P. A. S. stain.	200

Table of figures of aterial supply

<u>No. of figure</u>	<u>Name of figure</u>	<u>page</u>
1	A Photograph showing the common carotid artery (Rabbit).	230
2	A Photograph showing the common carotid artery (Cat).	231
3	A Photograph showing the thyroid and laryngeal arteries (rabbit).	232
4	A Photograph showing the thyroid and laryngeal arteries (cat).	233
5	A Photograph showing the arterial supply of nostrils (opened infraorbital canal rabbit).	234
6	A Photograph showing the arterial supply of nostrils (Rabbit)	234
7	A Photograph showing the arterial supply of nose (Cat).	235
8	A Photograph showing the deep arterial supply of the nasal cavity (rabbit deep dissection).	236
9	A Photograph showing the major palatine artery (Rabbit reflection of hard palate).	237
10	A Photograph showing the sphenopalatine artery (Rabbit, opened nasal cavity).	237
11	A Photograph showing the major palatine artery (Cat, deep dissection).	238
12	A Photograph showing the major palatine artery (Cat, with reflection of hard palate).	238
13	A Photograph showing the sphenopalatine artery (Cat).	239
14	A Photograph showing the sphenopalatine artery (cat, opened nasal cavity).	239
15	A Photograph showing the origin of tracheosphgeal artery in left side (rabbit).	240
16	A Photograph showing the origin of tracheosphgeal artery in right side (rabbit).	240
17	A Photograph showing the trachioesophageal artery of trachea (rabbit).	241
18	A Photograph showing the tracheosphgeal artery of trachea (rabbit, opened thoracic cavity)	241
19	A Photograph showing the termination of tracheosphgeal artery (rabbit).	242
20	A Photograph showing the bronchiosphgeal artery (Cat).	242
21	A Photograph showing the distribution of pulmonary artery in lung (rabbit, injected with latex).	243
22	A Photograph showing the distribution of pulmonary artery in lung (cat, injected with latex).	244

Table of figures of venous drainage

<u>No. of figure</u>	<u>Name of figure</u>	<u>page</u>
1	A Photograph showing the venous drainage of nose (Rabbit).	266
2	A Photograph showing the venous drainage of nose (Cat).	266
3	A Photograph showing the dorsal nasal vein (Cat).	267
4	A Photograph showing the sphenopalatine (Rabbit).	268
5	A Photograph showing the sphenopalatine and major palatine veins (Cat).	268
6	A Photograph showing the cranial laryngeal vein (Rabbit).	269
7	A Photograph showing the cranial laryngeal vein (Cat).	270
8	A Photograph showing the cranial thyroid vein (Rabbit)	271
9	A Photograph showing the cranial thyroid vein (Cat).	271
10	A Photograph showing the middle thyroid vein (Rabbit).	272
11	A Photograph showing the middle thyroid vein (Rabbit).	273
12	A Photograph showing the thyroid vein (Cat).	274
13	A Photograph showing the internal jugular vein (Rabbit).	275
14	A Photograph showing the tracheoesophageal veins (Rabbit).	276
15	A Photograph showing the oesophageal vein (cat).	276
16	A Photograph showing the distribution of pulmonary vein in lung (rabbit, injected with latex).	278
17	Fig. (17): A Photograph showing the distribution of pulmonary vein in lung (cat, injected with latex).	279

INTRODUCTION

The European common rabbit (*oryctologus cuniculus*) belongs to the family *leporidae* which contains a large number of closely related species formerly included under the single genus *lepus* but distributed among nine genera with living representatives and a large number of extinct ones according to (*horne 1948*).

The domestic cat (*felis catus*) belongs to the family *felidae* which contains a large number of closely related species formerly included under the single genus *felis*. (*Christiansen, 2008*).

The present study aimed to provide a description of the comparative morphological and histochemical features of the respiratory system of rabbit and cat to offer a valuable evidence for clinicians regarding the possibility of utilization of the respiratory system of rabbit and cat as models to human being studies due to it used as human substitutes in olfaction and inhalation tests, both of which require the knowledge of the respiratory airway structure and airflow dynamics within it (*Norris Reinero et al., 2004 & Xi et al., 2016*)

The nasal cavity of rabbit and cat have different aspects of similarity and dissimilarity which has a great clinical importance in autogenous engineered septal cartilage grafts as a model for the human being (*Badran et al., 2017 & Kushnaryov et al., 2014*).

The importance of studying of normal anatomy of the respiratory airway helps in the treatment of different nasal cavity diseases