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Author(s)	SUGIMURA, Makoto; KUDO, Norio; TAKAHATA, Kurahiko
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**STUDIES ON THE LYMPHONODI OF CATS IV.
MACROSCOPICAL OBSERVATIONS ON THE LYMPHONODI IN
THE THORACIC CAVITY AND SUPPLEMENTAL
OBSERVATIONS ON THOSE IN THE HEAD AND NECK**

Makoto SUGIMURA, Norio KUDO
and Kurahiko TAKAHATA

*Department of Veterinary Anatomy,
Faculty of Veterinary Medicine,
Hokkaido University, Sapporo, Japan*

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INTRODUCTORY

This paper is one report of a series of studies on the lymphonodi of the cat. In this paper, macroscopical observations of lymphonodi in the thoracic cavity and supplemental ones on those of the head and neck are described; furthermore the lymphatic system of the cat's whole body is treated in summary form.

MATERIALS AND METHODS

For this research 28 cats, aged 20 days to 8 years, were used as represented in table 1.

Out of 28, 6 cases were used for observations of the course of the thoracic duct.

In most specimens India ink was injected into lymphatic vessels by the methods described in the writers' previous reports, while in some specimens Neoprene latex 601 A was injected.

Some difficulty was met with in making the injections into the lymphatic vessels of the lungs and thymus in a few specimens only. But, in adult cats, since the nodes drained by lymphatic vessels of the lung have particles of coal dust and their color is black to the naked eye before injecting with India ink, the writers were able to conjecture the origin of these afferent vessels.

RESULTS

1. Neoprene Latex as an Injection Material for Lymphatic Vessels

In this observation, Neoprene latex 601 A was tested to find whether it was applicable for demonstration of lymphatic vessels and moreover for framing of the neoprene cast. For the injection technique one is referred to TAKAHATA's report. Latex was diluted with tap water 4 times when it was used, and in some

TABLE 1. *Materials Used for These Observations*

EXP. NO.	SEX	AGE	WEIGHT (g)
1	♂	1 Month	200
2	"	2 Months	550
3	"	4 "	900
4	"	5 "	1,250
5	"	8 "	1,400
6	"	1 Year	3,200
7	"	1 "	3,400
8	"	3 Years	3,800
9	"	3 "	3,900
10	"	4 "	5,400
11	♀	20 Days	100
12	"	20 "	100
13	"	1 Month	300
14	"	4 Months	1,100
15	"	7 "	1,650
16	"	9 "	3,400
17	"	10 "	2,400
18	"	1 Year	1,850
19	"	1.5 Years	2,600
20	"	2 "	2,550
21	"	5 "	3,000
22	"	8 "	2,400
23*	♂	2 Months	500
24*	"	4 "	1,500
25*	"	8 "	2,800
26*	"	1 Year	2,400
27*	♀	2 Years	2,200
28*	"	?	2,900

Remark: * Material used only for observation of the course of the thoracic duct.

specimens colored to red (Rubber Red 2BL) or blue (Rubber Fast Blue CPL).

For injection into peripheral lymphatic vessels, the latex was injected directly into each organ; in some cases (ovary, testis and thyroid gland) the injection was successful and in other organs it ended in failure. Even in successful cases, as

latex took the form of large particles in vessels and was accumulated in the related nodes, it must be reported not to pass through the nodes as far as their efferent vessels.

If latex is injected directly into a node, it appears instantly in its efferent vessel. But the injected Neoprene latex does not reach as far as India ink does.

The thoracic duct was successfully injected with Neoprene latex from the lumbar and intestinal trunks. Beautiful neoprene cast specimens of the thoracic duct were obtained in most injected cases; first, India ink was injected into the lumbar and intestinal trunks, subsequently from each trunk Neoprene latex was injected far enough to reach to the vein. Then, for macerating the thoracic duct full of latex it was immersed in industrial hydrochloric acid (Fig. 4).

2. Groups of Lymphonodi Found in the Thoracic Cavity

The lymphonodi found in the thoracic cavity may be divided into 12 groups by their localities as follows (Plate I).

1) *Lnn. sternales*: Longest diameter 1.46~0.1 cm, situated along *A.* and *V. thoracica interna* at the level of the second costal cartilage; in one animal (No. 13), in addition to the above-mentioned nodes, several small ones were found along *V. thoracica interna* between the second and sixth costal cartilages, covered by *M. transversus thoracis*, shape ellipsoid or irregular.

2) *Lnn. mediastinales craniales*: Longest diameter 1.85~0.05 cm, situated along *Vena cava cranialis*, *A. brachiocephalicus* and *A. subclavia sinistra* on the ventral face of the trachea and esophagus, mostly ellipsoid and in part gourd-shaped or irregular in shape; in detail—two nodes commonly are situated at the cranial and caudal angles of the juncture of *Vena cava cranialis* with *V. vertebralis dextra*. One node laid at the caudal angle of the juncture of *V. brachiocephalicus sinistra* with *Axis costocervicalis sinistra* and other one or two nodes occurred along *A. subclavia sinistra*. Comparatively large one situated between *Vena cava cranialis* and *A. brachiocephalicus* on the medial line of the trachea. In one case (No. 5) these several nodes fused to form a dumbbell shape.

3) *Lnn. anguli brachiocephalici*: Longest diameter 1.3~0.1 cm, situated at the cranial angle of the juncture of *V. brachiocephalicus dextra* and *sinistra* on the ventral side of the trachea near the thoracic inlet, shape flattened ellipsoid or spherical.

4) *Lnn. paratracheales*: Longest diameter 1.05~0.05 cm, occurred commonly touching a line drawn from the trachea to *M. longus colli* on the right face of the trachea lying between the root of *V. azygos* and *Lnn. mediastinales craniales*. Other ones were found inconstantly on the left face of the trachea, covered by the arch of the aorta. Their shape is flatly ellipsoid or spherical.

5) *Lnn. mediastinalis ventralis*: Longest diameter 0.35~0.1 cm, situated commonly along the pericardial and diaphragmatic rami of *V. thoracica interna* near the apex of the pericardium and in some cases found near the cranial face of the pericardium. Most of them are spherical in shape.

6) *Lnn. mediastinales dorsales*: Longest diameter 0.53~0.05 cm, occurred along

TABLE 2. *Number of Lymphonodi Appearing in Each Group*

GROUPS OF LYMPHONODI	EXPERIMENT. NO.																						TOTAL	AVERAGE
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22		
<i>Sternales</i>	1	1	1	1	2	5	1	1	1	2	3	4	6	2	1	2	2	1	1	1	3	2	44	2.0 ±1.42
<i>Mediastinales cran.</i>	4	8	6	3	1	4	3	7	5	8	2	5	2	6	5	6	4	6	3	2	4	4	98	4.45±1.35
<i>Anguli brachiocephalici</i>	4	4	4	3	4	2	2	1	2	4	6	2	5	3	3	3	2	2	2	2	3	3	66	3.0 ±1.20
<i>Paratracheales</i>	{ R.	3	1	2	3	3	1	2	1	2	2	4	1	4	1	2	1	1	1	1	1	1	46	1.77±0.98*
	{ L.	3	.	.	.	2	.	1	.	.	.	.	.	.	.	.	1	.	.	.	.	.
<i>Mediastinalis vent.</i>		.	.	1	.	.	1	.	1	.	.	.	.	.	.	.	.	1	.	1	1	.	6	1.0 ±0
<i>Mediastinales dors.</i>	{ R.	1	2	3	1	5	2	.	2	2	5	.	2	3	.	.	.	5	.	1	4	1	46	2.42±1.43*
	{ L.	.	1	1	.	.	.	.	.	.	.	.	.	3	.	.	2	.	.	.	.	.
<i>Intercostales</i>	{ R.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	8	1.33±0.58*
	{ L.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	2	1		
<i>Diaphragmaticus</i>	{ R.	.	1	.	.	.	1	.	1	.	.	.	.	.	1	.	1	1	.	.	.	.	7	1.0 ±0*
	{ L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
<i>Tracheobronchiales cran. dext.</i>		2	1	1	1	1	2	1	1	1	1	2	1	2	1	1	1	1	1	1	1	1	26	1.18±0.39
<i>Tracheobronchiales cran. sinist.</i>		1	1	1	1	2	2	1	1	2	1	1	1	1	1	2	2	2	1	1	1	1	28	1.27±0.46
<i>Tracheobronchiales caud.</i>		1	2	2	2	1	1	1	1	2	2	1	1	1	1	1	3	1	1	1	1	1	29	1.32±0.57
<i>Bronchopulmonales</i>	{ R.	1	.	2	1	.	.	.	.	.	.	.	.	.	.	2	.	1	.	.	.	.	12	1.33±0.50*
	{ L.	.	.	2	.	.	1	.	.	.	.	.	.	.	1	.	.	1	.	.	.	.
Total		21	22	28	16	21	22	12	17	17	25	19	17	27	17	17	20	25	15	11	17	15	416	18.91±4.55

Remarks: R: Right side. L: Left side.

*: Average number of lymphonodi per one individual side.

V. azygos and *Aorta* on the ventral face of the body of the thoracic vertebrae, shape mostly spherical. These small nodes occurred inconstantly in each intercostal space, but the occurrences of them on the caudal thoracic vertebrae are more numerous than those on the cranial thoracic vertebrae.

7) *Lnn. intercostales*: Longest diameter 0.25~0.08 cm, occurred inconstantly along *A.* and *V. intercostalis* in the dorsal ends of the intercostal spaces, shape usually spherical.

8) *Ln. diaphragmaticus*: Longest diameter 0.85~0.15 cm, occurred inconstantly on the diaphragmatic pleura at the termination of the diaphragmatic nerves, and at *Foramen venae cavae*, shape usually spherical.

9) *Lnn. tracheobronchiales craniales dextri*: Longest diameter 1.4~0.22 cm, situated on the right obtuse angle of the bifurcation of the trachea. Shape usually ellipsoid but partly gourd-shaped or irregular in shape.

10) *Lnn. tracheobronchiales craniales sinistri*: Longest diameter 1.2~0.15 cm, situated on the left obtuse angle of the bifurcation of the trachea, shape ellipsoid or irregular.

11) *Lnn. tracheobronchiales caudales*: Longest diameter 1.2~0.15 cm, situated on the caudal angle of the bifurcation of the trachea, shape ellipsoid or irregular.

12) *Lnn. bronchopulmonales*: Longest diameter 0.62~0.22 cm, found on the chief bronchi in the lung, shape usually spherical.

In well-nourished fattened cats, all lymph nodes of the above-mentioned groups were embedded in the fatty tissue.

3. The Number of Lymphonodi

The lymphonodi found in the thoracic cavity are distributed into the above classified groups of lymphonodi as indicated in table 2.

In regard to the numbers of lymphonodi found in the thoracic cavity, no remarkable sexual nor individual differences were noted. But comparatively large variations of numbers were found in some groups, such as *Lnn. sternales* and *Lnn. mediastinales dorsales*. Especially, it is worthy of note that variations of number of lymphonodi found in the thoracic cavity are more conspicuous than those in the head, neck, body surface, thoracic and pelvic limbs, but less conspicuous than those in the abdominal and pelvic cavities.

4. The Ratio of Occurrence of Each Categorized Group

Each group of lymphonodi was respectively included into the groups differentiated by the ratio of occurrence as indicated in table 3.

1) Group of constant existence (existence ratio of 100%): This group includes *Lnn. sternales*, *Lnn. mediastinales craniales*, *Lnn. anguli brachiocephalici*, *Lnn. paratracheales dextri*, *Lnn. tracheobronchiales craniales dextri*, *Lnn. tracheobronchiales craniales sinistri* and *Lnn. tracheobronchiales caudales*.

2) Group of nearly constant existence (existence ratio less than 100%, but over 80%): This group is not found in the thoracic cavity.

3) Group of inconstant existence (existence ratio less than 80%): In this group are

TABLE 3. *Ratio of Occurrence of Each Group*

GROUPS OF LYMPHONODI	NUMBERS OF CASES		RATIO OF EXISTENCE (%)	GROUPS DIFFERENTIATED BY RATIO OF OCCURRENCE
	Lymphonodi Found	Lymphonodi Searched for		
<i>Sternales</i>	22	22	100.0	} Constant
<i>Mediastinales cran.</i>	22	22	100.0	
<i>Anguli brachiocephalici</i>	22	22	100.0	
<i>Paratracheales</i>	{ R.	22	100.0	} Inconstant
	{ L.	4	18.2	
<i>Mediastinalis vent.</i>		6	27.3	
<i>Mediastinales dors.</i>	{ R.	15	68.2	
	{ L.	4	18.2	
<i>Intercostales</i>	{ R.	2	9.1	
	{ L.	4	18.2	
<i>Diaphragmaticus</i>	{ R.	6	27.3	
	{ L.	1	4.5	
<i>Tracheobronchiales cran. dext.</i>	22	22	100.0	} Constant
<i>Tracheobronchiales cran. sinist.</i>	22	22	100.0	
<i>Tracheobronchiales caud.</i>	22	22	100.0	
<i>Bronchopulmonales</i>	{ R.	5	22.7	} Inconstant
	{ L.	4	18.2	

included *Lnn. paratracheales sinistri*, *Ln. mediastinalis ventralis*, *Lnn. mediastinales dorsales*, *Lnn. intercostales*, *Ln. diaphragmaticus* and *Lnn. bronchopulmonales*.

The lymphonodi of the inconstant group in the thoracic cavity appear to be more numerous in the right side than in the left side, except for *Lnn. intercostales*.

5. The Places of Origin of Afferent Lymphatic Vessels

Each group of lymphonodi received lymphatic vessels whose origins were as indicated in table 4.

1) *Lnn. sternales* in all cases receive the lymphatic vessels arising from the ventral portion of the costal pleura, *Pars sternalis* and *costalis* of the diaphragm and the ventro-cranial portion of the abdominal wall, also in many cases from the pericardial sac. In some cases these nodes receive the lymphatic vessel originated from the heart and the efferent vessels from *Lnn. mediastinales craniales*, *Lnn. anguli brachiocephalici*, *Ln. diaphragmaticus* and other nodes of this group. When *Ln. mediastinalis ventralis* is present, the efferent vessel in all cases enters into the nodes of this group.

2) *Lnn. mediastinales craniales* in all cases receive the lymphatic vessels which arise from the heart, trachea and thymus, and in many cases, moreover, from the dorso-cranial portion of the costal pleura, pericardial sac, esophagus, *Lnn. sternales*, *Lnn. paratracheales*,

Lnn. tracheobronchiales craniales dextri, *Lnn. tracheobronchiales craniales sinistri* and other nodes of this group. In some cases, these nodes received the lymphatic vessels arising from the dorso-medial portion of the costal pleura, *Pars costalis* and *sternalis* of the diaphragm, and the efferent vessels of *Lnn. anguli brachiocephalici*, *Lnn. mediastinales dorsales*, *Ln. diaphragmaticus*, *Lnn. tracheobronchiales caudales* and *Lnn. bronchopulmonales*. Moreover, some branches of the thoracic duct, in slightly more than one half of cases, entered into this group.

3) *Lnn. anguli brachiocephalici* in all cases receive the lymphatic vessels arising from the trachea, esophagus and thyroid gland, and in many cases receive the efferent vessels of *Lnn. mediastinales craniales* and other nodes of this group. Moreover, in some cases these nodes receive the lymphatic vessels arising from the dorso-cranial portion of the costal pleura and heart, and also the efferent vessels of *Lnn. sternales*, *Lnn. tracheobronchiales craniales dextri*, *Lnn. tracheobronchiales craniales sinistri*, *Lnn. cervicales profundi* and some branches of the thoracic duct. In slightly more than one half of the present cases some branches of *Truncus jugularis* entered into the nodes of this group.

4) *Lnn. paratracheales* receive lymphatic vessels from various origins: in many cases from the esophagus and in some cases from the dorso-cranial and dorso-medial portion of the costal pleura, heart, trachea, and moreover, the efferent vessels of *Lnn. mediastinales craniales*, *Lnn. mediastinales dorsales*, *Lnn. intercostales*, *Lnn. tracheobronchiales craniales dextri*, *Lnn. tracheobronchiales craniales sinistri*, *Lnn. tracheobronchiales caudales*, other nodes of this group and some branches of the thoracic duct.

5) *Ln. mediastinalis ventralis* in all cases receives the lymphatic vessels arising from *Pars costalis* and *sternalis* of the diaphragm and in many cases from the pericardial sac, but it does not receive the efferent vessels from other nodes.

6) *Lnn. mediastinales dorsales* in all cases receive the lymphatic vessels originating from the dorsal portion of the costal pleura. In some cases the efferent vessels of *Lnn. intercostales*, other nodes of this group and some branches of the thoracic duct enter into the nodes of this group.

7) *Lnn. intercostales* in all cases receive the lymphatic vessels arising from the dorsal portion of the costal pleura.

8) *Ln. diaphragmaticus* in all cases receives the lymphatic vessels arising from *Pars costalis* and *sternalis* of the diaphragm.

9) *Lnn. tracheobronchiales craniales dextri* in all cases receive the lymphatic vessels arising from the lungs and in some cases from the pericardial sac, esophagus, *Lnn. paratracheales*, *Lnn. bronchopulmonales dextri* and one branch of the thoracic duct.

10) *Lnn. tracheobronchiales craniales sinistri* in all cases receive the lymphatic vessels which arise from the lungs and in some cases from the pericardial sac and esophagus. Moreover, in some cases the efferent vessels of *Ln. diaphragmaticus*, *Lnn. tracheobronchiales caudales*, *Lnn. bronchopulmonales sinistri*, other nodes of this group and one branch of the thoracic duct enter into the nodes of this group.

11) *Lnn. tracheobronchiales caudales* in all cases receive the lymphatic vessels arising from the lungs and in some cases from *Pars costalis* and *sternalis* of the diaphragm, the esophagus, one branch of the thoracic duct and other nodes of this group.

TABLE 4. Showing Areas of Origin of Afferent Lymphatic

GROUPS OF LYMPHONODI	REGIONS OF ORIGIN OF													
	Costal pleura					Pars costalis and sternalis of diaphragm	Pericardial sac	Heart	Lung	Trachea	Esophagus	Thymus		
	Dorsal portion			Ventral portion										
	1st~4th intercostal spaces	5th~8th intercostal spaces	9th~12th intercostal spaces ¹⁾											
<i>Sternales</i>	F	•	•	•	22	22	6	3	•	•	•	•		
	S	•	•	•	22	22	8	22	•	•	•	•		
	%	•	•	•	100.0	100.0	75.0	13.6	•	•	•	•		
<i>Mediastinales cran.</i>	F	14	1	•	•	3	5	22	•	3	17	3		
	S	22	22	•	•	22	8	22	•	3	22	3		
	%	63.6	4.5	•	•	13.6	62.5	100.0	•	100.0	77.3	100.0		
<i>Anguli brachiocephalici</i>	F	1	•	•	•	•	•	2	•	5	5	•		
	S	22	•	•	•	•	•	22	•	5	5	•		
	%	4.5	•	•	•	•	•	9.1	•	100.0	100.0	•		
<i>Paratracheales</i>	F	7	5	•	•	•	•	1	•	1	17	•		
	S	22	22	•	•	•	•	22	•	3	22	•		
	%	31.8	22.7	•	•	•	•	4.5	•	33.3	77.3	•		
<i>Mediastinalis vent.</i>	F	•	•	•	•	6	4	•	•	•	•	•		
	S	•	•	•	•	6	6	•	•	•	•	•		
	%	•	•	•	•	100.0	66.7	•	•	•	•	•		
<i>Mediastinales dors.</i>	F	16			•	•	•	•	•	•	•	•		
	S	16			•	•	•	•	•	•	•	•		
	%	100.0			•	•	•	•	•	•	•	•		
<i>Intercostales</i>	F	5			•	•	•	•	•	•	•	•		
	S	5			•	•	•	•	•	•	•	•		
	%	100.0			•	•	•	•	•	•	•	•		
<i>Diaphragmaticus</i>	F	•	•	•	•	6	•	•	•	•	•	•		
	S	•	•	•	•	6	•	•	•	•	•	•		
	%	•	•	•	•	100.0	•	•	•	•	•	•		
<i>Tracheobronchiales cran. dext.</i>	F	•	•	•	•	•	1	•	18	•	1	•		
	S	•	•	•	•	•	8	•	18	•	22	•		
	%	•	•	•	•	•	12.5	•	100.0	•	4.5	•		
<i>Tracheobronchiales cran. sinist.</i>	F	•	•	•	•	•	3	•	17	•	6	•		
	S	•	•	•	•	•	8	•	17	•	22	•		
	%	•	•	•	•	•	37.5	•	100.0	•	27.3	•		
<i>Tracheobronchiales caud.</i>	F	•	•	•	•	3	•	•	18	•	7	•		
	S	•	•	•	•	22	•	•	18	•	22	•		
	%	•	•	•	•	13.6	•	•	100.0	•	31.8	•		
<i>Bronchopulmonales</i>	F	•	•	•	•	•	•	•	6	•	•	•		
	S	•	•	•	•	•	•	•	6	•	•	•		
	%	•	•	•	•	•	•	•	100.0	•	•	•		

Remarks: F: Number of cases whose area of origin was found. S: Number of Lymphatic vessels arisen from 1) emptied into *Lnn. lumbales cran.* Most efferent vessels of 2), 3), 4) and some efferent vessels of 5), 8), 9), the thoracic duct.

12) *Lnn. bronchopulmonales* in all cases receive the lymphatic vessels which arise from the lungs and in one case from *Lnn. tracheobronchiales caudales*.

In addition to the above-mentioned lymph stream, the writers found that lymph streams which arise from various organs entered directly into the thoracic duct or other lymphatic trunks without passing through any nodes and then into the vein; the lymphatic vessels arising from the dorsal portion of the costal pleura, in 14 cases among 22 (Nos. 1, 2, 3, 7, 8, 10, 14, 16, 17, 18, 19, 20, 21 and 22), emptied directly into the thoracic duct, subclavian trunk or the efferent vessels of *Lnn. mediastinales craniales* and then entered into the venous angles. Some branches of lymphatic vessels which arise in the neck from the trachea (Nos. 6 and 7), esophagus (No. 7) and the thyroid gland (Nos. 1, 6, 7, 8, 15 and 18) emptied directly in the efferent vessel of *Lnn. retropharyngici* or jugular trunk and then in the venous angles. Some branches of lymphatic vessels originating in the thoracic cavity from the esophagus (Nos. 16, 17 and 18) entered into the thoracic duct. Lastly, the writers found that the lymphatic vessels arising from the thymus, in one case (No. 20), entered into the efferent vessels of *Lnn. sternales* and the lymphatic vessels themselves extend to the venous angles.

6. Main Lymphatic Trunks

Detailed descriptions of the lymphatic trunks of the cat were presented by SUZUKI.¹⁶⁾ But, in the matter of the collateral drainage of the thoracic duct, his statements and the writers' results are in some disagreements. The obtained results are simply described as follows (Plates I and II).

The lymphatico-venous communication system of the cat has been found to fall in two typical districts, the angle of confluence formed by the union of *V. jugularis externa* and *V. jugularis interna* (common jugular angle) and the angle of confluence formed by the union of *V. jugularis externa* and *V. subclavia* (jugulo-subclavian angle), in the right and left sides, as described by HUNTINGTON and McCLURE, and McCLURE and SILVESTER.

Ductus thoracicus begins from *Cisterna chyli* at the crura of the diaphragm. It extends to form a network around *Aa. intercostales* along the dorsal side of the thoracic aorta (ref. Plate II). After passing the arch of the aorta it forms a single trunk and runs along *A. subclavia sinistra*. Near the thoracic inlet it divides into several branches which enter into the left venous angles. Along the course of the thoracic duct not rarely the collateral drainages which pass through some lymph nodes appear as stated in the preceding clause.

Truncus subclavius is in all cases formed by the confluence of the efferent vessels of *Lnn. axillares craniales* and *Ln. infraclavicularis* and passes along *A. and V. axillares* in the right and left sides respectively. It enters into the

jugulo-subclavian angle and common jugular angle in the right side. In the left side, it is confluent into the thoracic duct in many cases.

Truncus jugularis, a short trunk of approximately several mm, is formed by the confluence of the efferent vessels of *Lnn. retropharyngici*, *Lnn. cervicales profundi*, *Lnn. cervicales superficiales dorsales* and *ventrales* near the common jugular angle in many cases and enters into the venous angles in the right and left sides each. In the left side it is confluent into the thoracic duct in some cases. Also, in some cases, this trunk is not formed and the efferent vessels of above-mentioned nodes enter separately into the venous angles.

Truncus bronchomediastinalis is not present in the cat, as stated by SUZUKI¹⁶; in the thoracic cavity, most efferent vessels of *Lnn. sternales*, *Lnn. mediastinales craniales*, *Lnn. anguli brachiocephalici* and some efferent vessels of *Lnn. paratracheales*, *Lnn. tracheobronchiales craniales dextri*, *craniales sinistri* and *caudales* generally divide into the right and left sides and enter into the venous angles. These courses are exceedingly variable and no single trunk is formed.

Ductus lymphaticus dexter is not found because two lymphatico-venous communications exist in the cat. But in some cases, the above-mentioned trunks emptied into the rudimentary jugular lymph sac (HUNTINGTON & McCLURE) which forms a connection between both districts of lymphatico-venous communication.

7. The Number of 3 Types of Lymphonodi According to the Nature of Afferent Lymphatic Vessels

Each type of lymph nodes, Z, ZT and T, whose classification was described in the writers' first report, is distributed in the groups as represented in table 5.

In *Lnn. sternales*, types Z and ZT were slightly less than one-half of cases each (21 among 44 cases, 47.7% each) and the remainder (2 cases, 4.6%) were type T.

In *Lnn. mediastinales craniales*, the majority of cases (70 among 85 cases, 82.4%) were type ZT, 12 cases (14.1%) type T and the remainder (3 cases, 3.5%) type Z.

In *Lnn. anguli brachiocephalici*, 38 among 56 cases (67.9%) were type ZT, 12 cases (21.4%) type Z and the remainder (6 cases, 10.7%) type T.

In *Lnn. paratracheales*, slightly more than one-half (23 among 42 cases, 54.8%) were type ZT, 13 cases (31.0%) type Z and 6 cases (14.2%) type T.

In *Lnn. mediastinalis ventralis*, all cases were type Z.

In *Lnn. mediastinales dorsales*, 29 among 45 cases (64.4%) were type Z, the remainder (16 cases, 35.6%) type ZT.

In *Lnn. intercostales*, all cases were type Z.

In *Lnn. diaphragmaticus*, also all cases were type Z.

In *Lnn. tracheobronchiales craniales dextri*, most of cases (16 among 19 cases, 84.2%) were type Z and the remainder (3 cases, 15.8%) type ZT.

In *Lnn. tracheobronchiales craniales sinistri*, the majority of cases (20 among 24 cases, 83.3%) were type ZT and the remainder (4 cases, 16.7%) type Z.

TABLE 5. *Numbers of Writers' Proposed 3 Types Found in Each Group of Lymphonodi*

GROUPS OF LYMPHONODI	TYPES OF LYMPHONODI						TOTAL	
	Z		ZT		T		Cases	%
	Cases	%	Cases	%	Cases	%		
<i>Sternales</i>	21	47.7	21	47.7	2	4.6	44	100.0
<i>Mediastinales cran.</i>	3	3.5	70	82.4	12	14.1	85	100.0
<i>Anguli brachiocephalici</i>	12	21.4	38	67.9	6	10.7	56	100.0
<i>Paratracheales</i>	13	31.0	23	54.8	6	14.2	42	100.0
<i>Mediastinalis vent.</i>	6	100.0	0	0	0	0	6	100.0
<i>Mediastinales dors.</i>	29	64.4	16	35.6	0	0	45	100.0
<i>Intercostales</i>	8	100.0	0	0	0	0	8	100.0
<i>Diaphragmaticus</i>	7	100.0	0	0	0	0	7	100.0
<i>Tracheobronchiales cran. dext.</i>	16	84.2	3	15.8	0	0	19	100.0
<i>Tracheobronchiales cran. sinist.</i>	4	16.7	20	83.3	0	0	24	100.0
<i>Tracheobronchiales caud.</i>	21	87.5	2	8.3	1	4.2	24	100.0
<i>Bronchopulmonales</i>	10	90.9	1	9.1	0	0	11	100.0

In *Lnn. tracheobronchiales caudales*, most of cases (21 among 24 cases, 87.5%) were type Z, 2 cases (8.3%) type ZT and only one case (4.2%) type T.

In *Lnn. bronchopulmonales*, most of cases (10 among 11 cases, 90.9%) were type Z and one case (9.1%) type ZT.

The nodes of type T were small in size, generally approximately 1 mm in diameter, and showed a specific feature; it seems that the nodes of only type T do not independently form a group (BAUM's "Lymphocentrum"²⁾), but those of types Z and ZT, even if small in size, do take part in the formation of such a group. That is, the nodes of type T appear as accessory ones to those of types Z or ZT in the writers' groups of lymph nodes.

8. The Reversible Lymphatic Communication among Lymphonodi

In this observation, each type of the reversible lymphatic communication, whose types (A, B and C) were classified in the writers' first report, appeared in those three groups as indicated in table 6.

Such communication was found in *Lnn. mediastinales craniales*, *Lnn. anguli brachiocephalici*, *Lnn. tracheobronchiales craniales sinistri* and between *Lnn. mediastinales craniales* and *Lnn. anguli brachiocephalici*.

With regard to types, in *Lnn. mediastinales craniales* all cases were type C. In *Lnn. anguli brachiocephalici*, 5 among 7 cases (71.4%) were type C and the remainder (2 cases, 28.6%) were type B. In *Lnn. tracheobronchiales craniales sinistri*, appeared one case which

TABLE 6. Showing Types of Communication in Each Group of Lymphonodi

GROUPS OF LYMPHONODI	TYPES OF COMMUNICATION						TOTAL	
	A		B		C		Cases	%
	Cases	%	Cases	%	Cases	%		
In { <i>Mediastinales cran.</i>	0	0	0	0	3	100.0	3	100.0
{ <i>Anguli brachiocephalici</i>	0	0	2	28.6	5	71.4	7	100.0
{ <i>Tracheobronchiales cran. sinist.</i>	0	0	1	100.0	0	0	1	100.0
Between <i>Mediastinales cran.</i> and <i>Anguli brachiocephalici</i>	0	0	1	100.0	0	0	1	100.0
Total	0	0	4	33.3	8	66.7	12	100.0

showed type B. Between *Lnn. mediastinales craniales* and *Lnn. anguli brachiocephalici*, the one case which appeared was also type B. No type A lymphatic communication was found in the thoracic cavity.

9. The Lymph Stream through the Above Lymphatic Communication in Living States

Since the cases of the above reversible lymphatic communication were observed under the condition of lymphatic injection at high pressures after death of the animals, there is some doubt whether the lymph actually flows reversely through the lymphatic communication in the living state. Attempt was made to investigate the direction of movement of lymph stream through the lymphatic communication often found between *Lnn. epigastrici caudales* and *Lnn. subinguinales superficiales*, whose common lymph stream seems to flow from the former to the latter in the case which is lacking in such reversible communication.

The used 7 cats were anesthetized and injected with a suspension of India ink in 0.85% NaCl aqueous solution under low pressure into the subcutaneous tissues of the external pudenda, whose area empties into only *Lnn. subinguinales superficiales*. If communication exists between the two nodes and the lymph can flow reversely through that communication in the normal state, it should flow retrogressively from *Lnn. subinguinales superficiales* to *Lnn. epigastrici caudales*, even if the India ink is injected at low pressure.

The India ink which was injected at low pressure colored black only the caudal area of *Lnn. subinguinales superficiales*, but did not extend to *Lnn. epigastrici caudales*. Other injections under somewhat high pressure resulted in fulling *Lnn. subinguinales superficiales* with the ink in all cases; moreover, in 2 cases (4 sides), connected by the communication between the two nodes, the

coloring matter got to *Lnn. epigastrici caudales*.

In conclusion, it is suggested that the lymph can flow in retrograde through the writers' "reversible lymphatic communication" under certain conditions, such as high tissue pressure, but not in the normal state.

10. Supplementary Results in the Head and Neck Areas

In addition to the results described in the writers' first report, some supplementary findings in the areas of the head and neck are offered in this paper.

Ln. cervicalis profundus is situated along *V. jugularis interna* and *A. carotis* in most cases as described in the writers' first report. In this observation, furthermore, some nodes which ought to be included in *Ln. cervicalis profundus* on the basis of their location were found on the ventral face of the trachea (Nos. 3, 13 and 15). All of them showed type Z without receiving an efferent vessel from other nodes. Since more than two of these nodes appeared in some cases, the name "*Ln. cervicalis profundus*" was revised to "*Lnn. cervicales profundi*".

The results of macroscopical observations of *Lnn. cervicales profundi*, a consolidation of 21 cases in the writers' first report and 22 cases in this observation, are as follows: ratio of occurrence: 13 among 43 cases (30.2%); inconstant group: number ($\bar{x} \pm \sigma$): 1.54 ± 0.25 ; types of nodes: type Z, 6 among 20 (30.0%), type ZT, 14 (70.0%).

Since it is suggested that the groups of lymph nodes (BAUM's "Lymphocentrum"²⁾) are fundamentally formed of nodes of types Z and ZT, but not of nodes of only type T as above-mentioned, the writers' *Lnn. submandibulares laterales caudales* and *mediales caudales* which associate with nodes of only type T were included with *Lnn. submandibulares laterales* and *mediales* respectively.

Next, the origins of afferent vessels which had not been detected at the time of previous report are described; lymphatic vessels arising from the gums of the maxilla and mandibula in all cases divide and enter into *Lnn. submandibulares laterales* and *mediales* each. The lymphatic vessels arising from *Gl. mandibularis* in most cases enter into *Lnn. retropharyngici* and in some cases into *Lnn. parotidici caudales* (Nos. 3 and 9) or *Lnn. submandibulares laterales* and *mediales* (Nos. 9 and 10). The lymphatic vessels originating from *Gl. sublingualis* and entering into *Lnn. retropharyngici* in one case were successfully used in injection experiments.

DISCUSSION

The lymph nodes found in the thoracic cavity were divided into 12 groups by their locations.

The lymphatic systems in the thoracic cavity of the cat have been described

in detail by SUZUKI¹⁶⁾ and TOMITA, and simply by REIGHARD and JENNINGS, and TAYLOR and WEBER. The writers' classification of the lymph nodes has taken cognizance of the descriptions of the above authors, but in several findings, some revisions and supplements are necessary in the detailed descriptions: the writers' *Lnn. mediastinales craniales* correspond to a group of SUZUKI's *Lnn. mediastinales ventrales craniales dextri et sinistri*, *Ln. brachiocephalicus* and some one lying caudally in contact with the right common trunk of *Vv. vertebralis* and *costocervicalis* in *Lnn. paratracheales*. In many cases SUZUKI's categorized nodes were distinguished by the present writers, but in some cases those nodes appeared to fuse into a single dumbbell shaped body. Therefore, one group of the above noted categorized nodes of SUZUKI should be considered the same as the present writers' group named *Lnn. mediastinales craniales*.

SUZUKI's *Lnn. paratracheales* include all nodes lying along the trachea in the neck and thoracic cavity, except for the present writers' *Lnn. mediastinales craniales* and *Lnn. anguli brachiocephalici*. But, the present writers found that as to afferent and efferent lymphatic vessels, the lymph nodes lying along the trachea in the neck were differentiated clearly from those in the thoracic cavity; the writers gave a name, *Lnn. cervicales profundi*, to the former for distinction from the latter which SUZUKI's named *Lnn. paratracheales*.

SHIDA stated that *Lnn. intercostales dorsales* and *ventrales* appeared in the dorsal and ventral ends of the intercostal spaces respectively in the cat. But no detailed description was given as to the numbers, sizes, efferent and afferent vessels. The nodes corresponding to SHIDA's *Lnn. intercostales ventrales* were identified in only one case in the writers' research, but in this report were included in their *Lnn. sternales* with regard to their afferent and efferent vessels. On the other hand, the name of the nodes corresponding to SHIDA's *Lnn. intercostales dorsales* was changed to *Lnn. intercostales*, because they are homologous with *Lnn. intercostales* of the dog (ELLENBERGER and BAUM).

The present writers' *Ln. mediastinalis ventralis*, *Lnn. mediastinales dorsales* and *Ln. diaphragmaticus* are not described in the reports of the above-mentioned investigators; they are the newly-described lymph nodes in the cat.

The writers' *Ln. mediastinalis ventralis* is situated commonly along the pericardial and diaphragmatic rami of *V. thoracica interna* in the mediastinal pleura. This node corresponds to *Lgll. mediastinales ventrales* of the horse and cattle in their position (SISSON).

Some small nodes which occurred along *V. azygos* and *Aorta* on the ventral face of the body of the thoracic vertebrae correspond to *Lgll. mediastinales dorsales* of cattle (SISSON) with regard to their location, afferent and efferent vessels. Accordingly, the writers equated them *Lnn. mediastinales dorsales*.

The writers' *Ln. diaphragmaticus* which is situated on the diaphragmatic pleura near the termination of the diaphragmatic nerves agrees with *Lgll. diaphragmaticae* of cattle (SISSON).

In regard to the numbers of lymph nodes found in the thoracic cavity, no remarkable sexual and individual differences were noted. From the general state of numbers of lymph nodes, variations are most conspicuous in the nodes of the abdominal and pelvic cavities, comparatively conspicuous in those of the thoracic cavity and few in those of the body surfaces. The fact is noted in connection with the functions of the organs of peripheral areas.

The writers' inconstant groups categorized by their occurrence ratios include *Lnn. paratracheales sinistri*, *Ln. mediastinalis ventralis*, *Lnn. mediastinales dorsales*, *Lnn. intercostales*, *Ln. diaphragmaticus* and *Lnn. bronchopulmonales* in this observation.

It could be pointed out that the occurrence of such inconstant groups have no relation with ages and sexes, but appeared at definite positions.

According to JOB and HASHIBA, nodes which are found in certain locations of the cat are absent in the rat and guinea-pig. On the contrary they appear almost constantly in the horse and cattle, according to SISSON. Moreover, it has been known up to the present that the lymph node is absent in the amphibian, reptile and most of the birds.

This fact is interesting with regard to the phylogenetic view according to which the number of nodes becomes numerous with the evolution of the animals.

The afferent and efferent lymphatic vessels of each group of nodes in the thoracic cavity of the cat were described in detail in this paper.

In addition to general lymphatic streams, some lymphatic vessels which originate from the diaphragm, costal pleura, thymus, esophagus, trachea and thyroid gland were found to empty into the thoracic duct and jugular trunk without passing through any lymph node and then enter directly into the venous angles.

Such a lymphatic vessel was described in some cases of the dog, rat and other animals by BAUM¹⁾, CAYLOR et al. and ENGESET without discussion of their comparative anatomical significance or considerations of the mechanism of occurrence.

The writers investigated such lymphatic vessels from the standpoint of comparative anatomy using the rat, rabbit, mink, cat, dog and goat^{15,19)}. From obtained results, it is clear that occurrences of such lymphatic vessels differed between the animal species and were related intimately with the degree of appearance of a special fixed lymph node in accordance with peripheral areas from which afferent vessels originate; for example, what vessels originate from

the thyroid gland has relationship with *Lnn. cervicales profundi* and what arise from the costal pleura are related with *Lnn. mediastinales dorsales* and *Lnn. intercostales*. Furthermore, it is known that a lymphatic vessel appears prior to developments of the lymph node in the ontogeny and phylogeny. Accordingly, it was suggested that such a lymphatic vessel which empties directly into the vein without passing through a node maintains an undifferentiated state without developing a node which ought ordinarily to develop along the course of the lymphatic vessel.

The lymphatic trunks and lymphatico-venous communications of the cat have been described by HUNTINGTON and McCLURE, KIDA, McCLURE and SILVESTER, MUKAO, and SUZUKI¹⁶⁾.

The lymphatico-venous communications appeared at two points of the common jugular angle and jugulo-subclavian angle in the right and left sides each. This finding agreed with the descriptions of the above investigators.

Interesting findings in regard to the lymphatic trunks are the network formations and collateral drainage system, which can be cubically demonstrated by Neoprene latex injection, especially in the thoracic duct. The branches of the thoracic duct were shown to pass through many nodes, such as *Lnn. mediastinales craniales* in many cases, as described by McCLURE and SILVESTER, and SUZUKI¹⁶⁾, and moreover also in some cases of *Lnn. mediastinales dorsales*, *Lnn. tracheobronchiales craniales sinistri*, *Lnn. tracheobronchiales caudales*, *Ln. infraclavicularis* and *Lnn. anguli brachiocephalici*, as pointed out newly by the present writers. Accordingly, such nodes are related with the peripheral lymph gathered from almost all parts of the body. This finding should be noted in respect of the physiological and pathological standpoint.

SUZUKI¹⁶⁾ found that the right branch streams of the thoracic duct passed through *Lnn. tracheobronchiales craniales dextri* in 8 among 10 cases. But the present writers could substantiate that finding in only one among 6 cases.

The communications among lymph nodes, through which lymphatic fluid streams reversibly, were divided into three types of A, B and C: Type A: a connection by which lymph is able to stream reversely through a valveless-like vessels; Type B: a connection whose lymphatic vessels with a single flowing direction alternate with each other among nodes; Type C: connection by lymphatic networks with valves in various places. Hitherto, it seems that no particular attention has been paid to such lymphatic communications.

After the works of ANDO, and GULLAND, the primordia of the lymph node arise first as the lymphatic sac and plexus. The earliest node, the primary lymph node, develops by a transformation of the lymphatic sac, and the secondary lymph node originates from the lymphatic plexus somewhat later to form a complete

structure after birth. The former corresponds to the jugular, lumbar or iliac node and the latter to a peripheral node, such as the parotic, inguinal and the like, which appear later along the course of lymphatic vessels. Furthermore, GULLAND stated that the lymphatic plexus makes the capsule and marginal sinus, but partly continues as afferent and efferent vessels among nodes after birth. ANDO pointed out that the primordia which originated from the lymphatic sac disunite to become numerous and that between the separated primordia a lymphatic plexus communicates in the embryonic period. It seems that the writers' reversible lymphatic communications derive from a remainder of such lymphatic plexus after birth. It may be evidence that the occurrences of such a communication are more numerous in body surfaces where the lymphatics develop later than in deep areas, such as in the thoracic and abdominal cavities. As a rule, the lymphatics may be changed from type C, the original form, to types B and A, the advanced forms, or only type A may be the form connected solely with the marginal sinus in the multiplicable condition of nodes; this was reported in the rabbit by ANDO.

Lymph by way of such communications among nodes may flow from the periphery towards the center of the body in the living normal state. But if the tissue pressure in the peripheral areas becomes higher because of some condition, such as acute inflammation and others, the lymph is able to flow clearly adversely; moreover it is worthy of note as within the range of possibility that there may be a retrograde movement of malignant neoplasm or bacteria among comparatively far apart nodes.

The writers divided the lymph nodes into three types: Z, ZT and T, in consideration of some structural differences among them. Macroscopical observations were made. Nodes of type Z receive only a peripheral lymph, type T receives only lymph passed through other nodes and type ZT receives both sorts of lymph. The occurrences of each type differed among the groups of lymph nodes which are determined by their locations. As a rule, no definite differences were macroscopically detected between types Z and ZT, but only type T showed a specific feature; type T is a small node, approximately 1 mm in diameter, which does not form into a group at a definite position (BAUM's "Lymphocentrum"²⁾) but appears as an accessory one accompanying types Z and ZT without exception.

In connection with the sizes of nodes, type Z and ZT of the writers' constant and nearly constant groups are comparatively larger ones, but those of the inconstant group are usually small nodes like type T. However, the former act as a collecting places of lymph and, unlike type T, form themselves into a group at definite positions.

Such a small node appearing in BAUM's "Lymphocentrum"²⁾ was described without consideration of the appearances of afferent vessels by HORII, JOB, SUZUKI¹⁷⁾, and other workers. It was stated by SUZUKI¹⁷⁾ that their structures usually showed embryonal features and by HORII that no structural differences appeared according to positions of occurrence.

But, from the occurrence ratios, types classified by appearances of afferent vessels and sizes of the node, the writers suggest, at least, that there is a somewhat fundamental structural difference among nodes of 3 groups as follows: 1) the nodes of types Z and ZT in the writers' constant and nearly constant groups—sizes comparatively larger, appeared independently at a definite position; 2) the node of types Z and ZT in the writers' inconstant group—size small, appeared independently at a definite position, moreover some of them are related probably with a lymphatic vessel which empties directly into the vein without passing through a lymph node as above-mentioned; 3) the nodes of type T, without being related with groups classified by their occurrence ratios—small, accessory ones accompanying types Z and ZT.

The correctness of the above suggestions should be ascertained by microscopical observations.

In addition to the results described in the writers' first report, some supplementary findings in the areas of the head and neck were described in this paper.

Since it is suggested that the groups of lymph nodes (BAUM's "Lymphocentrum"²⁾) are fundamentally formed by nodes of types Z and ZT, but not by nodes of only type T, the writers' *Lnn. submandibulares laterales caudales* and *mediales caudales* which were grouped with nodes of only type T should be included with *Lnn. submandibulares laterales* and *mediales* respectively and erased from this report.

SUMMARY

The results of the already published three reports and this paper are summarized as follows (ref. the summarized table):

1. The 48 groups of lymph nodes were distinguished by their positions in the cat. Out of them, 9 groups: *Lnn. subinguinales profundi*, *Lnn. epigastrici craniales*, *Ln. femoralis lateralis*, *Ln. prefemoralis*, *Lnn. intestinales*, *Lnn. sacrales laterales*, *Ln. mediastinalis ventralis*, *Lnn. mediastinales dorsales* and *Ln. diaphragmaticus*, as lymph nodes in the cat, are herein described for the first time on the basis of the writers' observations. Furthermore, in 13 groups (* mark) some revisions have become necessary in detailed descriptions.

2. Each group of lymph nodes was placed in either the constant (100%),

TABLE 7. Summarized Results

LOCATION	GROUP OF LYMPHONODI	NUMBER ($\bar{x} \pm \sigma$)	SIZE (Max.~Min.) (cm)	OCCURRENCE
Head and Neck	1) <i>Lnn. submandibulares med.</i>	1.74±0.77	2.4 ~0.05	Constant
	2) <i>Lnn. submandibulares lat.</i>	1.88±0.87	1.9 ~0.05	"
	3) <i>Lnn. parotidici cran.</i>	1.14±0.35	0.86~0.1	Nearly Constant
	4) <i>Lnn. parotidici caud.</i>	3.62±1.5	3.1 ~0.05	Constant
	5) <i>Lnn. retropharyngici</i>	1.02±0.15	2.25~0.15	"
	6) <i>Lnn. cervicales superficiales dors.*</i>	2.1 ±0.46	3.22~0.1	"
	7) <i>Lnn. cervicales superficiales vent.*</i>	1.1 ±0.28	1.46~0.08	Nearly Constant
	8) <i>Lnn. cervicales profundis*</i>	1.54±0.25	0.45~0.1	Inconstant
Thoracic and Pelvic Limbs, Body Surface	9) <i>Lnn. axillares cran.</i>	1.15±0.38	1.95~0.05	Constant
	10) <i>Lnn. axillares caud.</i>	3.21±1.29	1.95~0.05	"
	11) <i>Ln. infraclavicularis</i>	1.0 ± 0	0.45~0.1	Inconstant
	12) <i>Lnn. subinguinales superficiales</i>	1.17±0.4	1.95~0.05	Constant
	13) <i>Lnn. subinguinales profundis**</i>	1.4 ±0.12	0.55~0.05	Inconstant
	14) <i>Lnn. epigastrici cran.**</i>	2.0 ± 0	0.12~0.03	"
	15) <i>Lnn. epigastrici caud.</i>	2.41±1.25	2.4 ~0.05	Nearly Constant
	16) <i>Ln. popliteus</i>	1.0 ± 0	1.2 ~0.15	Constant
	17) <i>Lnn. ischiadici*</i>	1.1 ±0.3	1.0 ~0.1	Nearly Constant
	18) <i>Ln. femoralis lat.**</i>	1.0 ± 0	0.33~0.08	Inconstant
	19) <i>Ln. prefemorales**</i>	1.0 ± 0	0.52~0.05	"
Abdominal and Pelvic Cavities Visceral	20) <i>Lnn. gastrici dext.**</i>	1.65±0.87	2.0 ~0.1	Nearly Constant
	21) <i>Lnn. gastrici sinist.*</i>	1.11±0.32	1.45~0.7	Inconstant
	22) <i>Lnn. subpylorici</i>	1.08±0.28	1.55~0.3	Constant
	23) <i>Lnn. lienales**</i>	1.65±0.96	2.2 ~0.2	Inconstant
	24) <i>Lnn. gastrolienales*</i>	1.54±0.62	2.0 ~0.35	Constant
	25) <i>Lnn. hepatogastrici**</i>	2.04±1.14	3.05~0.15	"
	26) <i>Lnn. intestinales**</i>	1.70±1.15	0.9 ~0.15	Inconstant
	27) <i>Lnn. mesenterici communes*</i>	5.17±3.93	7.9 ~0.05	Constant
	28) <i>Lnn. caecales</i>	1.77±0.61	1.4 ~0.3	Nearly Constant
	29) <i>Lnn. mesocolici dext.</i>	4.38±3.05	3.4 ~0.1	Constant
	30) <i>Lnn. mesocolici med.</i>	4.08±2.05	2.82~0.1	"
31) <i>Lnn. mesocolici sinist.</i>	2.58±1.21	1.45~0.5	"	
Parietal	32) <i>Lnn. lumbales cran.</i>	3.71±1.61	1.45~0.05	"
	33) <i>Lnn. lumbales caud.</i>	7.09±3.91	1.75~0.05	Nearly Constant
	34) <i>Lnn. ilici ext.</i>	4.17±2.61	2.75~0.06	Constant
	35) <i>Lnn. ilici int.</i>	2.58±1.54	2.75~0.06	"
	36) <i>Lnn. sacrales lat.**</i>	1.4 ±0.93	0.45~0.05	Inconstant
Thoracic Cavity	37) <i>Lnn. sternales</i>	2.0 ±1.42	1.46~0.1	Constant
	38) <i>Lnn. anguli brachiocephalici</i>	3.0 ±1.2	1.3 ~0.1	"
	39) <i>Lnn. mediastinales cran.*</i>	4.45±1.35	1.85~0.05	"
	40) <i>Lnn. paratracheales*</i>	1.77±0.98	1.05~0.05	"
	41) <i>Ln. mediastinalis vent.**</i>	1.0 ± 0	0.35~0.1	Inconstant
	42) <i>Lnn. mediastinales dors.**</i>	2.42±1.43	0.53~0.05	"
	43) <i>Lnn. intercostales*</i>	1.33±0.58	0.25~0.08	"
	44) <i>Ln. diaphragmaticus**</i>	1.0 ± 0	0.85~0.15	"
	45) <i>Lnn. tracheobronchiales cran. dext.</i>	1.18±0.39	1.4 ~0.02	Constant
	46) <i>Lnn. tracheobronchiales cran. sinist.</i>	1.27±0.46	1.2 ~0.15	"
	47) <i>Lnn. tracheobronchiales caud.</i>	1.32±0.57	1.2 ~0.15	"
	48) <i>Lnn. bronchopulmonales</i>	1.33±0.5	0.62~0.22	Inconstant

Remarks: *: Lymph node in which some revisions had become necessary in detailed description.

** : Lymph node which was described for the first time on the base of these observations.

Number of 1)~19), 36), 40), 42), 43), 44) and 48) : Average number per one individual side.

MAIN AREAS	
Afferent (from)	Efferent (to)
lower lip, mental area, buccal gland	2), 5), 7)
upper lip, eyelid, 1), 4)	5), 7)
eyelid, face, head, parotid gland	4)
eyelid, auricle, parotid gland	2), 7)
{deep area of head and neck, mandibular gland, lingual gland, thyroid gland, 1), 2)	jugular trunk—to vein
neck, thoracic limb	jugular trunk—to vein
neck, ventral wall of thorax, 1), 2), 4)	6), jugular trunk—to vein
trachea, esophagus, thyroid gland	38), jugular trunk—to vein
thoracic limb, cranial wall of thorax, 10)	11), subclavian trunk—to vein
thoracic limb, caudal wall of thorax, lumbar area	9)
thoracic limb, cranial wall of thorax, 9)	subclavian trunk—to vein
hip, external pudenda, pelvic limb, 15)	13), 34), 35)
ventral wall of abdomen, pelvic limb, 12), 16)	34), 35)
cranio-ventral wall of abdomen	37)
caudo-ventral wall of abdomen, pelvic limb	12)
pelvic limb	13), 34), 35)
pelvic limb, anus	35), 36)
hip, pelvic limb	34)
lumbar area, pelvic limb	34)
stomach	25)
stomach	24)
stomach, pancreas, duodenum	25)
spleen, stomach	24)
stomach, spleen, pancreas, diaphragm	32), intestinal trunk—to cisterna chyli
liver, stomach, duodenum	32), intestinal trunk—to cisterna chyli
jejunum, ileum	27)
pancreas, duodenum, jejunum, ileum	32), intestinal trunk—to cisterna chyli
caecum	29)
ileum, caecum, ascending colon	32), intestinal trunk—to cisterna chyli
transverse and descending colons	32), intestinal trunk—to cisterna chyli
descending colon, rectum	33), 34)
{diaphragm, kidney, suprarenal body, testis, ovary, wall of abdomen, 24), 25), 27), 29), 30), 33), 34)	cisterna chyli—to thoracic duct
uterus, testis, ovary, 31), 34), 35)	32), lumbar trunk—to cisterna chyli
{uterus, testis, ovary, urinary bladder, wall of abdomen, pelvic limb, 12), 13), 16), 18), 19), 35)	32), 33), lumbar trunk—to cisterna chyli
{rectum, wall of abdomen, uterus, urinary bladder, tail, hip, pelvic limb, 12), 16)	33), 34), lumbar trunk—to cisterna chyli
tail, anus, pelvic limb, 17)	35)
{diaphragm, ventral wall of thorax and abdomen, pericardial sac, 41), 44)	39), to vein
cranial wall of thorax, trachea, esophagus, thyroid gland, 8)	39), to vein
heart, trachea, esophagus, thymus, 37), 38), 40), 45), 46), 47)	38), to vein
esophagus, dorsal wall of thorax	39)
diaphragm, pericardial sac	37)
dorsal wall of thorax, 43)	thoracic duct—to vein
dorsal wall of thorax	42), thoracic duct—to vein
diaphragm	37), 39), 46)
lung	39)
lung	39)
lung	39), 46)
lung	45), 46), 47)

nearly constant (less than 100%, over 80%) or inconstant (less than 80%) group determined by that occurrence ratio. The inconstant group, it showed a specific feature in that it consists of small nodes, generally less than 6 mm in the longest diameter.

3. In regard to the numbers of lymph nodes, some remarkable individual variations were noted in the abdominal cavity only, but not in other areas. No definite variations were found by sexes or between the right and left sides of the body.

4. The afferent and efferent lymphatic vessels of the above groups of lymph nodes have been described in the writers' series of reports.

5. In addition, three kinds of specific lymph streams were distinguished and discussed, as follows:

1) The branch lymph streams of the thoracic duct and jugular trunks were detected in some cases. Some branches of the thoracic duct passed through *Lnn. mediastinales craniales*, *Lnn. tracheobronchiales craniales dextri*, as has already been stated in respect to the cat. The writers, furthermore, found for the first time some branches of the thoracic duct which passed through *Lnn. mediastinales dorsales*, *Lnn. tracheobronchiales craniales sinistri*, *Lnn. tracheobronchiales caudales* and *Ln. infraclavicularis*, and some branches of the jugular trunk which passed through *Lnn. anguli brachiocephalici*. In the thoracic duct of the cat, the network formation surrounded *Aa. intercostales* in all cases.

2) Some peripheral lymphatic vessels, originating from the trachea, esophagus, thyroid gland, thymus, diaphragm, costal pleura, testis and ovary, empty directly into the jugular trunk, thoracic duct, lumbar trunk or cisterna chyli without the lymph passing through a node and then pour into the venous angles. The appearance of such lymphatic vessels is related intimately with the degree of occurrence of the special fixed nodes in accordance with the peripheral areas of their origin. It was suggested that such lymphatic vessels maintain an undifferentiated state without developing any appropriate node.

3) The writers found lymphatic communications by which lymph streams reversely among lymph nodes. The communications are divided into three types as follows: type A—connection by which lymph is able to stream reversely through a valveless-like vessel; type B—connection whose lymphatic vessels with single flowing direction alternate with each other among nodes; type C—connection by lymphatic networks with valves at various places. To the matter of this finding, no attention has been paid particularly until now. The occurrences of such communications are more numerous in the body surface than those in the thoracic and abdominal cavities. From the obtained results and from consideration of the development of the lymphatics, it seems that such communications derive

from a remainder of a lymphatic plexus which appeared in the course of the developmental process. The third type is C, an original form, which may be changed from type B to type A, a more advanced one. A lymph stream by way of such communications among nodes may flow from the periphery towards the body center in the normal living state. But if the tissue pressure in the peripheral areas is made higher by some conditions, such flow can clearly be reversed.

The three kinds of specific lymph vessels should be noted in pathology and physiology to act as a specific pathway of the lymph.

6. The writers divided lymph nodes into three types of Z, T and ZT, and made macroscopic observations with considerations of the structural differences among the nodes of each type. The node of type Z receives only peripheral lymph, that of type T receives only lymph which has passed through other nodes and that of type ZT receives both sorts of lymph. The occurrences of each type differed among the groups of lymph nodes which were determined by their locations. As a rule, no definite differences were macroscopically detected between types Z and ZT, but only type T showed a specific feature; type T is small node, approximately 1 mm in diameter, which does not join into groups at a definite position but appears as an accessory one accompanying types Z and ZT without exception.

7. From the ratio of occurrences, types classified by appearances of afferent vessels and sizes of lymph nodes, the writers suggest, at least, that there is something of structural difference among nodes of 3 groups as follows: 1. nodes of types Z and ZT in the writers' constant and nearly constant groups, 2. nodes of types Z and ZT in the writers' inconstant group, 3. nodes of type T, without falling into groups classified with relation to their ratio of occurrence. The suggestion should be followed up by microscopical observations.

8. In this observation, Neoprene latex was used in an attempt to find whether it was applicable for demonstration of lymphatic vessels. Neoprene latex is within the range of possibility of use as an injection material for comparatively larger vessels, but more advanced study is necessary before it can be recommended for injection into the peripheral lymphatic vessels.

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Symbols Common to Figs. 1, 2 and 3

- a. *Lnn. sternales*
- b. *Lnn. mediastinales craniales*
- c. *Lnn. anguli brachiocephalici*
- d. *Lnn. paratracheales*
- e. *Ln. mediastinalis ventralis*
- f. *Lnn. mediastinales dorsales*
- g. *Lnn. intercostales*
- h. *Ln. diaphragmaticus*
- i. *Lnn. tracheobronchiales craniales dextri*
- j. *Lnn. tracheobronchiales craniales sinistri*
- k. *Lnn. tracheobronchiales caudales*
- l. *Lnn. bronchopulmonales*
- m. *Lnn. retropharyngici*
- n. *Lnn. cervicales superficiales ventrales*
- o. *Lnn. cervicales profundi*
1. *Ductus thoracicus*
2. *Truncus subclavius*
3. *Truncus jugularis*
4. to *Lnn. lumbales craniales*
5. to *Lnn. hepatogastrici* and *Lnn. gastrolienales*
6. to *Lnn. mediastinales craniales*
- I. *Aorta*
- II. *Vena cava cranialis*

- III. *Vena cava caudalis*
- IV. *V. azygos*
- V. *V. subclavia*
- VI. *V. jugularis externa*
- VII. *V. jugularis interna*
- VIII. *V. thoracica interna*
- IX. *V. brachiocephalica*

EXPLANATION OF PLATES

PLATE I

- Fig. 1. Lymphonodi and lymphatic vessels of the thoracic cavity; Right view.
- Fig. 2. Lymphonodi and lymphatic vessels of the thoracic inlet; Ventral view.
- Fig. 3. Lymphonodi and lymphatic vessels at the hilus of the lung; Dorsal view.

PLATE II

- Fig. 4. Network of the thoracic duct. Neoprene latex cast.
- Fig. 5. Diagram of the above photograph; V-XIII, the 5th to 13th intercostal arteries.

Fig. 1

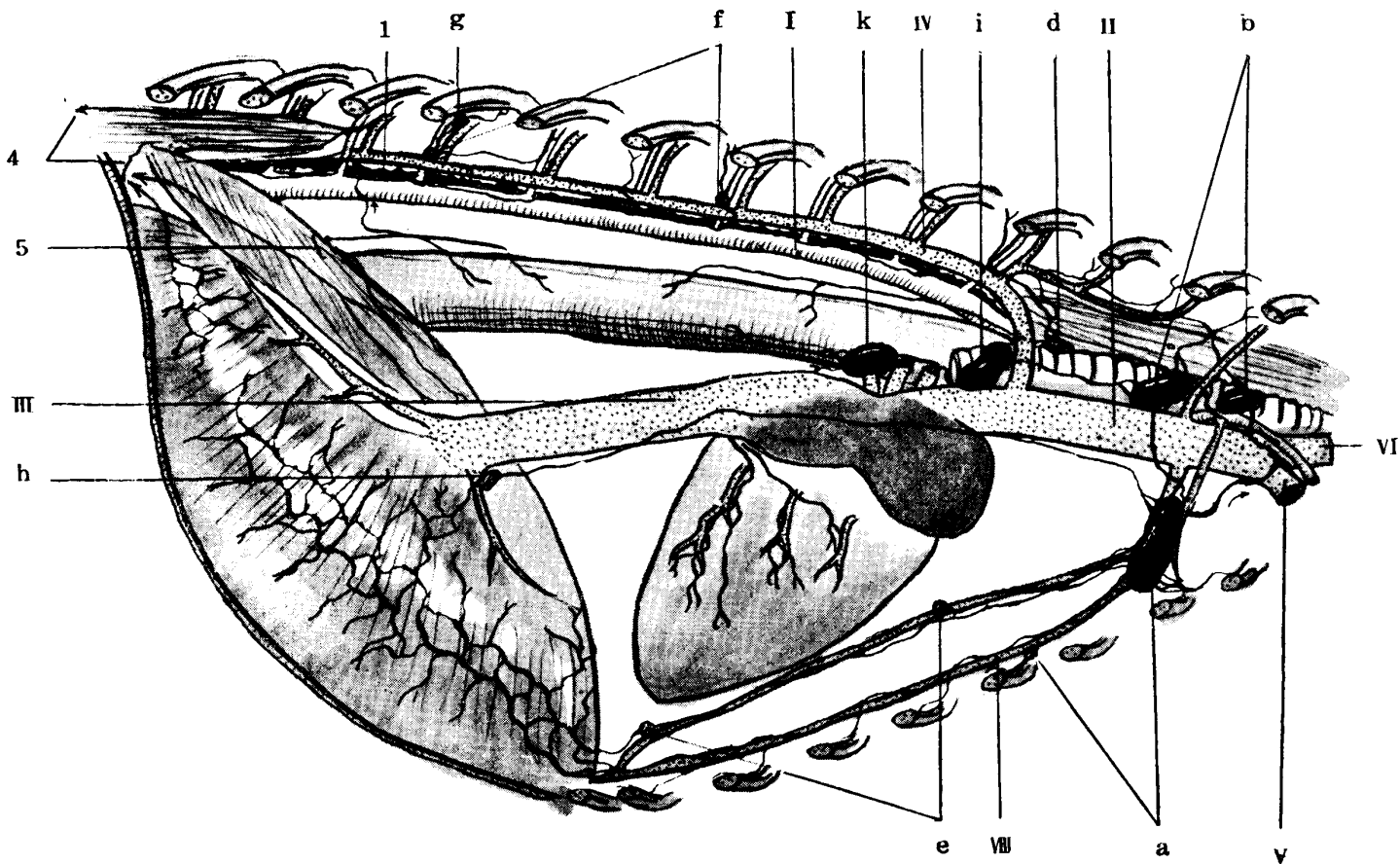


Fig. 2

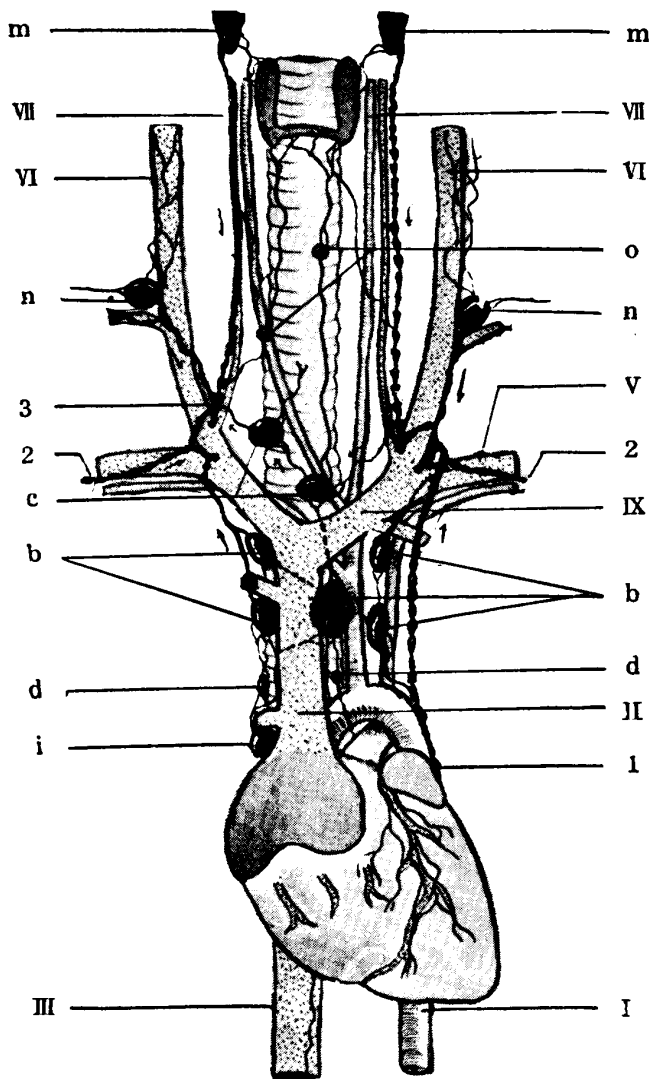


Fig. 3

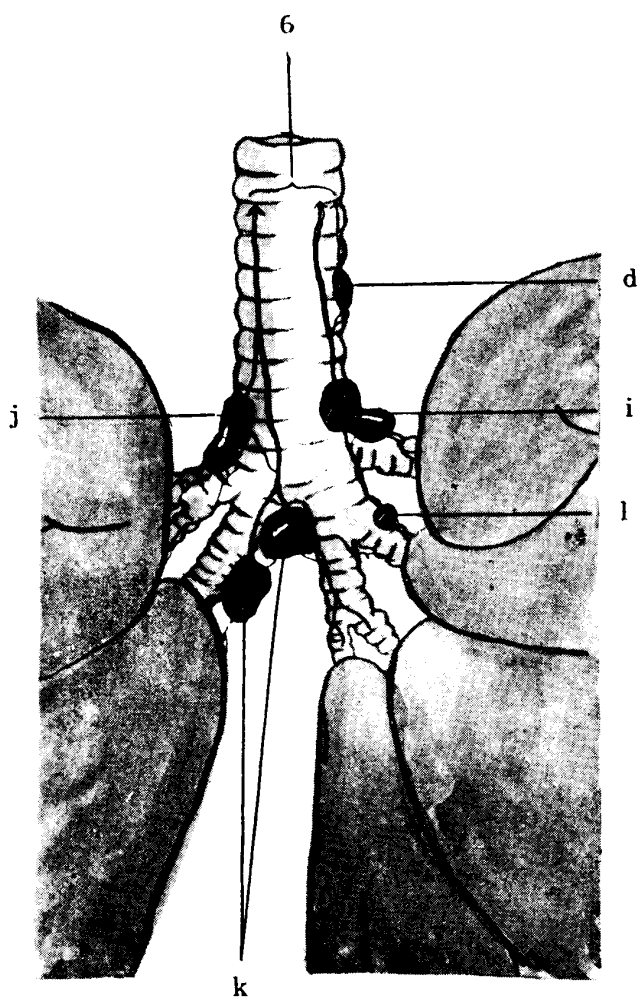


Fig. 4

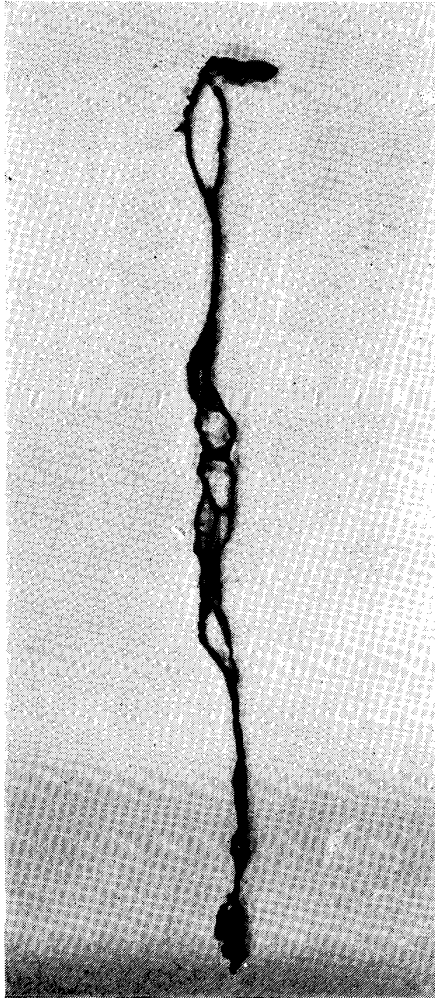


Fig. 5

