Topographical Anatomy of the Bronchomediastinal Lymph Vessels: Their Relationships and Formation of the Collecting Trunks*

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Summary. This article aims to clarify the topographical relationships of the bronchomediastinal collecting lymph vessels to other structures, in particular the great vessels, the trachea, the esophagus and the mediastinal pleura. Minute dissection was performed on eight cadavers with special reference to the converging collecting lymph vessels which form the bronchomediastinal trunks.

On the right side, the trunks were consistently observed on both the right brachiocephalic vein and the subserous surface of the mediastinal pleura (anterior and posterior mediastinal trunks). The pathway from the right recurrent chain nodes ran laterally behind the carotid sheath and led either into the deep cervical nodes situated on the scalenus anterior or directly into the right venous angle.

On the left side, the trunks showed varying courses. The nodes from which the trunks arose were constant, and classifiable into three groups: the uppermost paratracheal nodes near the recurrent chain nodes, the anterior mediastinal nodes (the left phrenic nodes) surrounding the phrenic nerve in front of and inferior to the aortic arch (the origin of the superior mediastinal trunk), and the left tracheobronchial nodes (the origin of the inferior mediastinal trunk).

The large transverse superficial communicating vessel between the right and left sides was usually found in front of the trachea above the aortic arch; it was often connected to the nodes of the brachiocephalic angle. Deep communications were also found in front of the carina and behind the trachea.

These findings allow the collecting vessels from the thoracic viscera to be divided into two pathways on each side: the anterior and posterior mediastinal trunks on the right side, and the superior and inferior mediastinal trunks on the left side. In addition to the four trunks, the superficial communicating vessel between the right and left sides is also drained from the superior mediastinum. The internal mammary lymph chain, which often emptied directly into the venous angle or into the deep cervical nodes, occasionally joined with the right anterior mediastinal trunk or the left superior mediastinal trunk.

The present knowledge for the evaluation of the regional nodes, which is essential for curative operations of cancer of the lung and the esophagus remains inadequate. There are few available descriptions of the human mediastinal lymphatics. The descriptions of the bronchomediastinal trunk through which the lymph from the thoracic viscera drains have been relatively unclear and at variance among anatomists.

Kutsuna (1968) defined the term “trunk” as a single large collecting vessel which drains into the venous angle, and thus concluded, through numerous injection investigations, that there is no trunk on the left side, and only rarely (6.7%) on the right side. Rouviere (1932) also suspected that single mediastinal trunks were not found on either side. Suzuki (1953) and Hiraki (1953) defined mediastinal trunks as two groups of a few collecting vessels: one collecting from the anterior mediastinal nodes, and the other from the paratracheal nodes. Poirier and Cuneo (1902) also regarded several collecting vessels as trunks and suggested that there are typically two

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and often three bronchomediastinal trunks. They described the efferent vessels from the internal mammary chain, anterior mediastinal nodes and the paratracheal chain as joining to form the trunks. However, this raises questions concerning the relationship between the internal mammary lymph chain and the trunk, as well as the definition of the anterior mediastinal nodes.

JOSSIFOW (1930) classified the main efferent vessels from the thorax into three trunks: 1) the truncus mediastinalis anterior which originates from the brachiocephalic angle nodes and runs on the anterior surface of the brachiocephalic vein; 2) the truncus mediastinalis posterior which lies behind the brachiocephalic vein; and 3) the truncus mammarius running along the internal mammary artery. The trunk from the right recurrent chain which runs directly into the right venous angle was also included in his classification. His description seems to be clearest regarding the mediastinal trunk, and was thus used as the basis for our terminology.

The definition of the anterior mediastinal nodes is quite varied, due to the numerous nodes spread throughout this wide region. In Morris' Human Anatomy (11th ed., 1953), the anterior mediastinal nodes are divided into two main groups, a superior one entirely within the superior mediastinum, and an inferior one located on the convex surface of the diaphragm. The superior group is subdivided into right, left and transverse sets. The right superior set is located along the front of the superior vena cava (SVC) and the right brachiocephalic vein, usually near the phrenic nerve. These nodes are situated at the angle of the right and left brachiocephalic veins, the "Lymphoglandulae anguli anomyi" (BARTELS, 1909). These nodes, herein termed the brachiocephalic angle nodes, are considered to be an important point of termination for the communicating vessels.

The left superior set consists of several nodes located in front of the aorta and the left common carotid artery. The lowermost node of this set, the "node of the ductus arteriosum", is a constant node found in front of the obliterated ductus arteriosus. The subaortic nodes termed by NARUKE et al. (1978) within this set possibly indicate an extensive group of nodes including some of the left tracheobronchial nodes. The topographic anatomy of the area surrounding the 'aortic window' (HAAGENSEN et al., 1972) is described here and its relationship to the mediastinal lymphatics is discussed.

We shall here discuss the detailed dissection of the mediastinal lymphatic pathways and attempt to clarify the critical communications in this region.

**MATERIALS AND METHODS**

Minute dissection was performed without any method of injection in the cervical and upper thoracic regions of eight adult cadavers (5 males and 3 females). In order to accurately record the location of each node and vessel, a sketch was made and photographs were taken after each dissection of one lymph node and one lymph vessel using fine forceps. This sequential process was repeated throughout the entire cervicothoracic region, as previously reported by one of the present authors (DEKI and SATO, 1988).

After routine postmortem procedures, lymph vessels characteristically showed a soft appearance and grayish brown color. The valves of the large vessels appeared as a string of beads. A stereoscopic microscope was occasionally used for the dissection of very fine vessels; however, most procedures were performed with the naked eye.

**RESULTS**

1. **The right mediastinal lymphatics** (primarily Figs. 1-9)

There was some semblance to the arrangement of the mediastinal collecting lymph vessels on the right side. The right paratracheal node chain was consistently well developed and was the primary origin of the right mediastinal collecting vessels. Within the wide space behind the SVC, numerous lymph vessels convened and passed through the spacious area in the connective tissue space (e.g., Figs. 1, 5, 9). The upper nodes of the right paratracheal nodes occasionally coalesced with the brachiocephalic angle nodes as in Specimen 2 (Figs. 2, 15). The right paratracheal nodes also had numerous communications with the pretracheal nodes.

Superficial and deep pathways

The superficial pathway was composed of one or a few collecting lymph vessels which arose at the brachiocephalic angle and connected with the deep lymphatics. The right internal mammary chain occasionally joined the mediastinal collecting pathway. The brachiocephalic artery was the only obstacle in the superficial lymphatic communication between the pretracheal and the right paratracheal nodes. Large connecting vessels running across the anterolateral surface of the brachiocephalic artery were consistently found (Figs. 1, 4).
Fig. 1. Specimen 1 (No. 1708, female). The collecting lymph vessels from the right paratracheal nodes run in front of (arrows) and behind the right brachiocephalic vein. The brachiocephalic artery and the SVC have been partly removed. Numerous vessels in front of the trachea connect the left and right paratracheal regions. These vessels converge on an elongated node (lower asterisk, see also Fig. 7). Several superficial communicating vessel reach a large node (upper asterisk) on the left common carotid artery (see also Fig. 11). (Figures 1-9 are of the right side).

Abbreviation for figures

Artery: thin lines with stripes  
Vein: thin lines  
Nerve: thick black lines  
Lymphatic vessel: thin wavy lines  

THY thyroid gland  
ESO esophagus  

AO aortic arch  
CA common carotid artery  
SA subclavian artery  
BA brachiocephalic artery  
VA vertebral artery  
PA pulmonary artery  

SVC superior vena cava  
JV internal jugular vein  

SV subclavian vein  
BV brachiocephalic vein  
AZ azygos vein (azygos arch)  
VV vertebral vein  

MA internal mammary (thoracic) artery, vein and lymphatic chain  

TH thoracic duct  

X vagus nerve  
R recurrent laryngeal nerve  
P phrenic nerve  
C cardiac nerve (sympathetic and vagal)  

LG ligamentum arteriosum  
PL mediastinal pleura
The deep pathway, composed of several collecting vessels reaching the right venous angle, followed a short course which was typically located inferior to the subclavian artery and attached to the subserous surface of the mediastinal pleura, with the exception of a large collecting vessel from the meiddle of the right recurrent chain at the level of the cupula of the pleura (see below for details).

In Specimen 1 (Figs. 1, 4, 5), the collecting vessels, primarily from the right paratracheal nodes, ran in front of and behind the right brachiocephalic vein and the SVC. As the brachiocephalic angle nodes were small, the large vessels ran inferiorly along the brachiocephalic vein and terminated at the right paratracheal nodes behind the SVC. Several large vessels running over the brachiocephalic artery also terminated at the paratracheal nodes.

In Specimen 2 (Fig. 2), the collecting vessels from the right paratracheal nodes, after running on the subserous surface of the mediastinal pleura under the subclavian artery, as in Specimen 1, ran over the artery and the scalenus anterior, and reached the venous angle. A large collecting vessel from the well-developed brachiocephalic angle nodes (Fig. 2 arrows) ran on the anterior surface of the right brachiocephalic vein and drained into the right venous angle via a thick collecting vessel (small arrowheads). From the paratracheal nodes situated behind the SVC, collecting vessels (star) originate to run between the mediastinal pleura and the right subclavian artery and attach to the pleura. A superficial communicating vessel (large arrowhead) from the brachiocephalic angle nodes in front of the trachea and drains into the left deep cervical nodes close to the left venous angle (see also Fig. 15). A thick draining vessel (arrows) originates from the brachiocephalic angle nodes.
Communication between the right and left sides

The superficial communication between the lymphatics of the right and left sides was often found in front of the superior portion of the trachea and above the aortic arch. The communicating vessels were covered by the fascia, which connects the capsule of the thyroid gland and the pericardium.

In Specimen 3 (Fig. 3), the brachiocephalic angle nodes were unclear and the superficial pathway was primarily made up of a superficial communicating vessel (Fig. 3 star) in front of the trachea. On the right side, the communicating vessel terminated at the brachiocephalic angle (Figs. 1, 2) or directly at the right venous angle (Fig. 3). This communicating vessel crossed the inferior thyroid veins anteriorly or posteriorly and was consistently connected to the pretracheal nodes. In Specimen 1 (Figs. 1, 11), the communicating vessel, closely connected with a large node (Figs. 1, 11 asterisk) on the left carotid artery, ran over the artery (Figs. 11, 14 arrows). The communicating vessel in Specimen 1 terminated at the left venous angle, while that in Specimen 3 at the left deep cervical nodes (Fig. 12).

Another communicating pathway between the right and left paratracheal nodes was found in front of the inferior portion of the trachea.

In Specimen 1 (Fig. 1), numerous vessels from the right paratracheal chain and from the left paratracheal chain were located behind the SVC. Most of them converged at an elongated node (Fig. 1 asterisk).
Fig. 4. Photograph of Specimen 1 (No. 1708, female) showing the large collecting vessels running in front of the brachiocephalic vein. The transverse cervical vein has been removed. Large cervical lymph vessels (lower green arrowheads), appearing as strings of beads, empty into the right venous angle. The communicating vessels (upper green arrowheads) between the paratracheal and pretracheal nodes run over the brachiocephalic artery. The red arrowhead indicates the suprascapular artery.

Fig. 5. Deeper dissection of Figure 4. Numerous lymph vessels run posterior to the SVC above the azygos arch (blue pin). The right subclavian artery has been partly removed. The vagus (X) and the recurrent laryngeal nerve (R) are indicated by the yellow arrowheads. Most of the superficial lymph vessels of Figure 4 are visible.

Fig. 6. Photograph of Specimen 1 showing the pathway from the infracarinal nodes to the highest mediastinal nodes as seen from behind. The thoracic duct (TH, green pin) and a large collecting vessel (green arrowheads) run along the left and right sides of the esophagus (ESO), respectively. Two nodes, the highest right mediastinal nodes (star) close to the origin of the recurrent laryngeal nerve (upper yellow arrowhead), are well developed (see also Fig. 7).
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on the right side of the trachea. The efferents from this node joined a few large collecting vessels on the subserous surface of the mediastinal pleura.

Also, in Specimen 2 (Fig. 15) numerous vessels from the infracarinal nodes and the left tracheobronchial nodes ran obliquely upward and crossed the right inferior cardiac nerve (Fig. 15 asterisks). A distinct collecting vessel from the right paratracheal nodes crossed the anterior surface of the trachea and drained into the terminal portion of the thoracic duct (Fig. 15 small arrows).

Right recurrent chain
As the origin of the right recurrent laryngeal nerve is situated behind the subclavian artery, the right paratracheal nodes are separated from the recurrent nerve chain. However, as the highest right mediastinal nodes (KINOSHITA et al., 1976), situated in juxtaposition with the origin of the right recurrent laryngeal nerve, were located very close to the superior portion of the right paratracheal chain, the paratracheal node chain was intimately related to the recurrent nerve chain.

In Specimen 2, a large vessel arose from the right recurrent chain to run laterally in front of the sympatheic nerves and the vertebral vein and behind the carotid sheath, and ultimately join the short common trunk near the venous angle (Fig. 2 small arrowheads). Such a collecting vessel was also found in Specimen 1 (Fig. 1) behind the common carotid artery, and in Specimen 4 (Figs. 8, 9, note the fascial relations). Although the large collecting vessel from the right recurrent chain usually showed a direct lateral course, in Specimen 3 (Fig. 3) the vessel showed an inverted U-shaped course which ran along the inferior thyroid artery and reached the medial group of the deep cervical nodes located on the scalenus anterior.

Fig. 7. Specimen 1. Posterior view of the pathway from the infracarinal nodes to the highest right mediastinal nodes (stars), which are situated behind the subclavian artery close to the origin of the right recurrent laryngeal nerve. These nodes communicate with the infracarinal nodes via a large vessel (arrows) which runs behind the trachea. A node situated between the subclavian artery and the esophagus also communicates with the pathway from the infracarinal nodes. The efferent vessels from the highest mediastinal nodes primarily run anteriorly over the subclavian artery and drain into the right venous angle. An asterisk indicates the elongated node shown in Figure 1.
Fig. 8. Photograph of Specimen 4 (No. 1825, male) emphasizing the right large collecting vessels (arrow) and their topographical relationships. The right internal jugular vein (JV) and the subclavian vein (SV) have been reflected laterally. The connecting fascia between the carotid sheath and the prevertebral fascia is pierced by a large collecting vessel (arrow) from the right recurrent chain. Other large vessels are found along the brachiocephalic artery (BA) and behind the right brachiocephalic vein (BV).

Fig. 9. A deeper detailed dissection of Figure 8. The brachiocephalic artery (BA) and the right common carotid artery (CA) have been cut and the right subclavian artery (SA) is reflected laterally. The vagus nerve (X) has also been cut. Behind the origin of the right recurrent laryngeal nerve, the highest right mediastinal nodes (black arrowhead) are well developed and connected with the lymph vessel (arrow in Figs. 8, 9). The superior vena cava (SVC) and the right brachiocephalic vein are reflected laterally so as to show the right paratracheal nodes (star).
Internal mammary chain

The right internal mammary chain joined the anterior mediastinal collecting vessels either directly or close to the brachiocephalic angle nodes. This chain, however, did not consistently converge on the anterior pathway.

In Specimen 1, the right internal mammary chain was divided into two routes. One route ran along the internal thoracic vein and joined the small brachiocephalic angle nodes. This route communicated with the large vessels on the right brachiocephalic vein. The other route ran directly to the right venous angle along the internal thoracic artery (Fig. 1).

In Specimen 2, the internal mammary chain typically converged on the nodes surrounding the origin of the internal thoracic artery. The efferents of these nodes communicated with the deep pathway from the right paratracheal nodes. Close to the venous angle, some nodes of this internal mammary chain joined the superficial vessel running from the brachiocephalic angle nodes (Fig. 2). In Specimen 3, the right internal mammary chain drained directly into the right venous angle (Fig. 3).

The communication between the right and left internal mammary chains, described in many textbooks (e.g. Jossifow, 1930) as running just below the left brachiocephalic vein, was not found in this study. Such a communication was, however, observed in another series of dissection by the authors.

Fig. 10. Specimen 5 (No. 1628, male). The lymphatics in the cervicomediastinal transitional area, showing various thick vessels (arrowheads) which arise from the well developed left phrenic nodes and run along the internal thoracic artery to drain into the left venous angle. The thoracic duct divides into two terminal branches (small arrows).

(Figures 10-17 are of the left side)
2. The left mediastinal lymphatics (primarily Figs. 10-17)

On the left side, the development of the anterior mediastinal nodes varied by specimen, with the exception of the left phrenic nodes (see below). The courses of the collecting vessels and their relationship to the left brachiocephalic artery and vein were also varied. The loose connective tissue space, in which the left mediastinal lymphatics were developed, was separated into the superficial and deep spaces by the aortic arch and the left pulmonary artery. The left phrenic nerve and the internal thoracic artery and vein ran through the center of the superficial space. The fat body of the thymus remnant was situated on the roof of the superficial space and the left vagus nerve ran along the floor of the space. Several nodes of the anterior mediastinal nodes were often found in the center of the superficial space. We consider these nodes to be separate from the other anterior mediastinal nodes, and have designated them the left phrenic nodes. In the deep space, the left tracheobronchial nodes were consistently well developed and closely connected with other regions. The left bronchomediastinal collecting vessels primarily arose from the left phrenic node and the left tracheobronchial node groups.

Fig. 11. Specimen 1. Numerous left collecting vessels originating from the lymphatic plexus in front of the aortic arch surround the left brachiocephalic vein and drain into the left venous angle (see also Figs. 13 and 14). The thick vessel (arrows) from the right side communicates with a large node (asterisk, see also Fig. 1) in front of the left common carotid artery. The left brachiocephalic vein and the internal jugular vein have been partly removed.
**Phrenic nodes**

In Specimen 5 (Fig. 10) the left phrenic nodes located in front of the aortic window, close to the left phrenic nerve, and behind the fat body of the thymus remnant, were well developed. Two primary efferents from these nodes ran along the internal thoracic artery, one above and the other below the subclavian vein (Fig. 10 arrowheads). These vessels reached a collateral of the thoracic duct close to the venous angle.

In Specimen 1 (Figs. 11, 13, 14), contrary to the Specimen 5, the lymphatic vessels formed a plexus co-existent with a venous plexus in front of the aortic arch. The lymphatic plexus was communicated with the left venous angle by large lymph vessels that surrounded the left brachiocephalic vein.

**Internal mammary chain**

The left internal mammary chain drained into the left phrenic nodes in Specimen 5, and into the lymphatic plexus in Specimen 1.

In Specimen 5 (Fig. 10), a large node was found in the angle formed by the brachiocephalic artery and the left common carotid artery. This node was connected with the left phrenic nodes by several distinct vessels, and also communicated with the pretracheal and right paratracheal regions. There were no collecting vessels between the right venous angle and this node.

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**Fig. 12.** Specimen 3. From the left tracheobronchial nodes, a short collecting vessel (large arrow) drains into the thoracic duct, and a long collecting vessel (small arrows) drains into the left venous angle nodes. A large communicating vessel (star, see also Fig. 3), connecting the venous angle of both sides, also connects with the termination of the thoracic duct. The aortic arch and the brachiocephalic veins have been removed.
Superficial transverse communicating vessel and the thoracic duct

The superficial communicating vessel which connected the right and left sides crossed the common carotid artery and terminated at the left venous angle, joining the anterior mediastinal nodes, the deep cervical nodes, and the thoracic duct.

In Specimen 1 (Fig. 11), the superficial communicating vessels from the right paratracheal nodes (see also Figs. 1, 4) ran in front of the trachea, connected with a large node on the left common carotid artery, and joined the thoracic duct near the left venous angle (Fig. 11 arrows). The pretracheal nodes connected with the left recurrent chain, and communicated with the above-mentioned large node.

In Specimen 2, a large communicating vessel (Figs. 2, 15 arrowhead) from the brachiocephalic angle...
Fig. 15. Specimen 2. Lymphatic chains along the trachea and bronchi communicate with the thoracic duct. A short communicating vessel (large arrow) connects the left tracheobronchial nodes and the thoracic duct. A collecting vessel from the right paratracheal nodes drains into the termination of the thoracic duct (small arrows). The right half of the superficial communicating vessel (arrowhead) has been removed. Communications between the right and left sides in front of the carina (asterisks) and the right collecting vessels (star) are also seen (see also Fig. 2).
nodes ran in front of the trachea and terminated at
the left deep cervical nodes close to the left venous
angle.

In Specimen 3 (Fig. 12), the thoracic duct was
connected with a superficial communicating vessel
(Fig. 12 star) which divided into several terminal
branches. The branches converged on the deep cer-
vical nodes, which were regarded as the last interme-
diate nodes for the lymph flow, or Virchow's nodes.

The pattern of termination of the thoracic duct
varied among specimens. The intermediate node of
the terminal part of the thoracic duct was not found
consistently, as noted by ADACHI (1953). In Specimen
5 (Fig. 10), the thoracic duct was divided into two
terminal branches which ran below and above the
subclavian artery to reach the left venous angle. In
this specimen, three cervical trunks were found, two
of which joined the thoracic duct. The intermediate
nodes of the terminal portion were not found in
Specimens 1 (Fig. 11), 2 (Fig. 15) or 6 (Fig. 16), either.

**Left recurrent chain**
The cervical portion of the left recurrent chain is
continuous with the left paratracheal nodes, due to
the lengthy course of the left recurrent laryngeal
nerve. Here, this chain was not always well devel-
oped. The left tracheobronchial nodes, which were
consistently well developed, were at the inferior end
of this chain. Numerous collecting vessels arose from
these nodes. One pathway from these nodes ran on
the subserous surface of the mediastinal pleura along
the thoracic duct as in Specimen 3 (Fig. 12 small
arrows), and another ran upward to the right para-
tracheal node chain (Fig. 15 asterisks).

Contrary to the inferior end, the superior end of the
left recurrent node chain varied among specimens,
occasionally being unclear. In Specimen 6 (Fig. 16), a large collecting vessel (Fig. 16 arrowheads) from the upper portion of the left paratracheal node chain joined the thoracic duct behind the common carotid artery. This collecting vessel ran upward along the tracheoesophageal branch of the inferior thyroid artery. The pretracheal nodes also connected with the collecting vessel. Although this type of left collecting vessel was rarely found, it may correspond to the consistent collecting vessel on the right side which is situated more superiorly and runs laterally (Figs. 8, 9).

Left tracheobronchial nodes
The left tracheobronchial nodes were the primary origin of the deep collecting vessels as mentioned above. In Specimen 3 (Fig. 12), there was a long distinct collecting vessel from the left tracheobronchial nodes which ran along the cardiac nerves and the thoracic duct. Another short vessel arising from the left tracheobronchial nodes drained into the thoracic duct near the ligamentum arteriosum.

In Specimen 2, a short connecting vessel (Fig. 15, 17 large arrow) from the left tracheobronchial nodes (Fig. 17 asterisk), as seen in Specimen 3 (Fig. 12), ran on the anterior surface of the esophagus and drained into the thoracic duct close to the mediastinal pleura at the level of the third vertebral body. This vessel was dilated and accompanied the collateral vessels close to the thoracic duct. The blood regurgitated into the vessel from the thoracic duct.

Node of the ligamentum arteriosum
In Specimen 2 (Fig. 15), a large node situated close to the ligamentum arteriosum in front of the pulmonary artery was regarded as the node of the ligamentum arteriosum. The efferents of this node were unclear, but in another specimen, the draining vessels from the node ran along the left phrenic nerve and joined the left phrenic nodes. The communication between the node of the ligamentum arteriosum and the left tracheobronchial nodes was hardly visible because the aortic window (HAAGENSEN et al., 1972), bounded by the inner margin of the aortic arch and the superior margin of the pulmonary artery, and through which the superficial and deep spaces (see above) communicate, was narrowed by the ligamentum arteriosum and by the left recurrent laryngeal nerve. The collecting vessels from the left pulmonary hilus ran to the left tracheobronchial nodes, coursing not through the aortic window, but largely along the left principal bronchus.

We often found several nodes situated in front of the anterior aspect of the left pulmonary artery. These nodes closely connected with the node of the ligamentum arteriosum. On the left side they drained into the left phrenic nodes, while on the right side, their efferents ran along the right phrenic nerve and joined the right internal mammary chain and/or the collecting vessels from the right paratracheal nodes.

DISCUSSION

NARUKE et al. (1978) suggested that, in lung cancer, the metastatic invasion of the subcarinal nodes (herein termed infracarinal nodes) has a significant influence on the prognosis. KINOSHITA et al. (1976) reported that the prognosis of an esophageal cancer
patient is closely related to the metastatic invasion of the nodes, "the highest right mediastinal nodes" which are situated close to the origin of the right recurrent laryngeal nerve. Consistent with these clinically observed facts, the present study revealed that the infracarinal nodes were closely connected with the upper portion of the right paratracheal chain via numerous ascending lymph vessels (Figs. 1, 15). Direct communication was also detected between the infracarinal nodes and the highest right mediastinal nodes through the lymph vessels passing behind the trachea (Fig. 7 arrows).

The collecting vessels of the thoracic viscera, including the major lymph nodes mentioned above, have been described in the previous injection-performed studies (SHIMAZAKI, 1931; KUTSUNA, 1968). Consequently, numerous draining pathways have been suggested in relation to the various sites of injection. However, the connections of these collecting vessels and their topographical relationships to the other mediastinal structures have remained to be determined.

Our findings indicate the origin of the collecting vessels to be located in several limited regions in the mediastinum: the right paratracheal nodes, the brachiocephalic angle nodes, the left phrenic nodes and the left tracheobronchial nodes. The pretracheal nodes, situated above the aortic arch, can also be considered an important origin of the superficial communicating vessel which connects the right and left common collecting vessels. In addition, a large collecting vessel consistently originated from the right recurrent chain, although the vessel was located at the base of the neck, not in the superior mediastinum.

One or more collecting vessels arose from each region mentioned above, and groups of vessels took consistent courses. These, therefore, indicate that each group of vessels constitutes a 'trunk', which can be further defined from its origin and course. Consequently, it is unlikely for there to be a single mediastinal trunk on either side.

The collecting vessels from the right paratracheal nodes ran behind the brachiocephalic vein on the subserous surface of the mediastinal pleura, and those from the brachiocephalic angle nodes ran in front of the right brachiocephalic vein. These pathways appear to be consistent with the trunci bronchomediastinales posterior and anterior, respectively, as defined by JOSSIFOW (1930).

The large collecting vessel from the right recurrent chain, which ran laterally behind the carotid sheath, seems to comprise one of the right posterior collect-

ing vessels. This is supported by findings that the right recurrent chain is continuous with the right paratracheal nodes, and that this collecting vessel also runs on the subserous surface of the mediastinal pleura, as do the posterior collecting vessels. This vessel seems to be called 'truncus bronchomediastinalis posterior suprema'. This vessel occasionally originated from the right highest mediastinal nodes which are situated at the inferior end of the recurrent chain.

The 'truncus bronchomediastinalis posterior suprema' mentioned above was rarely found on the left side, due to the poorer development of the left paratracheal nodes, including the cervical recurrent chain.

The collecting vessels arising from the left phrenic nodes showed variable courses in reaching the left brachiocephalic vein, the common carotid artery and the subclavian artery. The vessels from the left tracheobronchial nodes consistently took a deep course, draining into the thoracic duct at variable levels. When draining into the thoracic duct near the left venous angle, the vessels took long courses along the thoracic duct. Due to their courses and origins, it is appropriate that the left collecting vessels are classified into the superior and inferior trunks, rather than anterior and posterior trunks as on the right side.

The right and left internal mammary chains only partially contributed to the formation of the mediastinal collecting trunks as mentioned above; the internal mammary chain join only the anterior (right side) and superior (left side) trunks. The efferents from the anterior aspect of the radix of the lung, which ran along the phrenic nerve, could be considered as joining the internal mammary chain.

In addition to the above mentioned four trunks, the superficial communicating vessels between the lymphatics of the right and left sides also drained into each side, either into the pretracheal nodes or the left recurrent chain (cervical part of the left paratracheal nodes).

On the right side, the superficial communicating vessel typically joined the brachiocephalic angle nodes. The anterior trunks often overlapped with the communicating vessels. As a result, the communicating vessel ran superficial to the right carotid sheath. The right recurrent chain primarily drained into another collecting vessel (truncus bronchomediastinalis posterior suprema) and also joined the communicating vessel.

According to MORRIS' textbook (SCHAEFFER, 1953), the transverse set, regarded as the retromanubrial nodes, is made up of two or three small nodes along
the left brachiocephalic vein. These nodes are united by vessels that form an anastomosis between the right and left sets of anterior mediastinal nodes. In the present study, however, the communicating vessels were usually not formed by the chains of the transverse set, but rather by large vessels. They connected only with the brachiocephalic angle nodes, and then communicated with the right and left venous angles.

The internal mammary chain often converged on the brachiocephalic angle nodes on the right side, while consistently converging on the left phrenic nodes. The superficial communication did not run through the region of the left phrenic nodes (Fig. 11). Moreover, the brachiocephalic angle nodes, which may correspond to the retromanubrial nodes, were not essential for the formation of the communicating vessels, since a large communicating vessel was found when the brachiocephalic angle nodes were small (Fig. 1) or when the communication was separated from the right brachiocephalic vein (Fig. 3). In another specimen (not described in this article) in which the valves of the superficial communicating vessel were examined, lymph was thought to flow to the left.

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