Thoracic duct in cats (Felis catus)

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SUMMARY

To describe the origin, course and termination of the thoracic duct in cats, eight adult healthy cats of both sexes and of different ages, were examined. Abdominal cavity was opened with a median incision under general anaesthesia. Then, Indian ink was injected into the lymph nodes of the abdominal cavity, and into the popliteal lymph nodes. After exsanguination by the conventional methods, the animals were fixed with 10 % formalin. Then, the thoracic duct was investigated by dissection. In all cats the thoracic duct arising from the craniodorsal part of the Cisterna chyli as a single trunk at the level of L2 entered the thoracic cavity through the aortic hiatus of the diaphragm. In the caudal and middle mediastinum it had a rope ladder appearance around the intercostal arteries and dorsal to the thoracic aorta. Forming a single trunk at the level of T8, it ran cranioventrally up to the level of the cranial thoracic aperture. At this level the thoracic duct joined as a single duct the left external jugular vein in six cats, and the venous angle in two cats. Between T1 and T2, the thoracic duct was divided into two parts 1 cm before entering the venous system in one cat. During its course as a single channel the thoracic duct had a beaded appearance because of having valves. In the light of the normal anatomical position of the thoracic duct in the cat we suggest that the thoracic duct may be cannulated in its initial and terminal portions.

KEY-WORDS : anatomy - cat - thoracic duct.
Introduction

Cats are used in human and veterinary medicine as experimental animals. Lymph samples are analysed in immunologic [12], biochemical [20] and pharmacologic [22] studies; pathologic changes [8] occur in the lymphatic vessels and lymph nodes in infectious diseases, and the cancerous lymphoid cells join the venous system via the lymphatic vessels [9]. The thoracic duct may be obstructed or ruptured as a result of congenital abnormalities, trauma, infectious processes or malignancy thus resulting in chylothorax in small animals [5, 17]. Therefore, the exact anatomical knowledge of the lymphatic system may be important in both collection of lymph samples and the proper diagnosis and treatment of pathologic disorders related to lymphatic system. The morphology of the thoracic duct has been well documented in dogs [3, 4, 6, 14, 21]. In the literature, however, very little was known on the lymphatic system of cats, regarding the thoracic duct. Previous anatomical descriptions concerning the thoracic duct in cats are rather superficial and/or conflicting [1, 10, 13, 15]. In the present study, we thus aimed to describe the formation, course and termination of the thoracic duct in cats.

Materials and methods

Recorded data of a total of 8 adult cats used in this study are arranged in Table I. All cats were obtained from Konya Municipality Animal Care & Shelter Centre. They were judged to be clinically healthy based on physical examination, laboratory evaluation (serum chemistry, complete blood cell count), abdominal and thoracic ultrasonography. All procedures were approved by the Ethic Board of Veterinary Faculty, the University of Selcuk. Animals were anaesthetised with 2 mg/kg xylazin HCl (Rompun® - BAYER, Istanbul, Turkey) and 10 mg/kg ketamin HCl (Ketanez® - ALKE, Istanbul, Turkey), IM. Under anaesthesia, approximately 0.5 cc Indian ink (Monopol®, DERYA, Istanbul, Turkey) was injected into each hepatic, cecal, colic, jejunal and medial iliac lymph nodes following the opening of the abdominal cavity with a median incision, and also into the popliteal lymph nodes following the dissection of the popliteal region in order to identify the thoracic duct macroscopically. Moreover, to make the left tracheal trunk more visible, the dye solution was injected mainly into tongue, gum, cheek, palate tonsils and soft palate, considering that the left tracheal trunk may empty into the thoracic duct. Thirty minutes later, they were killed by exsanguination from the right common carotid artery without regaining consciousness, and fixed with 10 % formalin. Then, the formation, course and termination of the thoracic duct were revealed by fine dissection, and the observations were recorded and photographed.

Results

The thoracic duct of cats, originating from the craniodorsal part of the Cisterna chyli as a single trunk at the level of L2 and of the origin of the celiac artery, entered the thoracic cavity through the diaphragm’s aortic hiatus in company with the aorta (Figs. 1, 2). During its intra-thoracic course on the left side of the median plane, dorsal to the thoracic aorta and ventral to the azygos vein, the thoracic duct cranially extended very close to the left lateral lamina of the dorsal mediastinal pleura to form a rope-ladder-like network around the intercostal arteries. It ran cranially up to the level of T8 in the mediastinal fat dorsal to the thoracic aorta. Forming a single trunk ventral to the body of T8 by the union of the network mentioned above, the thoracic duct crossed the left side of the thoracic aorta and inclined ventral to the left longus colli muscle, at which level it was located in a space with full of fat between the esophagus and this muscle. There was no evidence of communications between the thoracic duct and the caudal and azygos vein systems at the full length of mediastinum.

In the cranial mediastinum the thoracic duct closely related to the left lateral lamina of the cranial mediastinal pleura ran obliquely in a cranioventral direction on the dorsolateral surface of the esophagus and crossed dorsally the left common carotid artery at the level of T2-3. Then, about in angle of 45° it curved ventrally in a bow-like/arched direction, and run up to the level of the cranial thoracic aperture (Fig. 3). We observed that very thin lymphatic vessels arising from the surface of the esophagus joined directly the thoracic duct in two cats. In its cranial mediastinal course the thoracic duct had laterally intimate contact with the left ansa subclavia, the costocervical vein and artery. The efferent lymphatic vessels from the cranial mediastinal lymph nodes also opened directly into the thoracic duct.

At the level of the cranial thoracic aperture, the thoracic duct joined the left external jugular vein in six animals, and the junction of the left subclavian and external jugular veins, so-called venous angle, in two animals. In all cats, the thoracic duct terminated as a single trunk in the venous system, and was dorsally related to the phrenic nerve next to its terminal segment. Between T1 and T2, the thoracic duct was divided into two parts 1 cm before entering the venous sys-

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TR: Turkish Angora Red Tabby.
SB: Short-haired cat Bi-colour.
SS: Short-haired Silver spotted.

Table I. — Materials.
Discussion and conclusions

Although the efferent vessels of the lumbar aortic lymph nodes were reported to drain into the thoracic duct [7, 13] or into the lumbar trunks [19], in this study it was recorded that they emptied into both the Cisterna chyli and medial iliac lymph nodes as reported earlier [19]. Although some researchers noted that the lymphatic vessels from the axillary [7], sternal, deep and superficial cervical lymph nodes [18] opened directly into the thoracic duct, in our study similar findings were not seen. Others recorded that the thoracic duct may independently terminate in the left brachiocephalic vein [3, 4], internal jugular vein or subclavian vein [21] in the dog, or in the right venous angle as a common trunk formed with the terminal portion of the right lymphatic duct in the cat [13] and monkey [11]. In this study the thoracic duct was determined to join the left external jugular vein or the venous angle, which is consistent with the findings of other researchers [1, 10, 13, 16, 19]. In the literature, although the thoracic duct was reported to join the venous system into two or three branches [13, 16, 19, 21], we showed that it joined as a single trunk the venous system in all cats. The thoracic duct received craniodorsally the left tracheal trunk in two cats as noted by Mc CLURE et al. [15] and SAAR and GETTY [19], immediately before entering the left external jugular vein.

In preparation of permanent thoracic lymph fistulas in the terminal point of the thoracic duct of cats, it should be avoided puncturing the pleura, and to avoid injuring the thoracic duct it should be taken into consideration the fact that the thoracic duct may be divided into two parts before terminating in the venous system. Moreover, to prevent retrograde bleeding, the opening in the duct should be placed far enough (at least 1 cm) from the thoracic duct-venous junction to insure the interposition of a competent valve between the junction and the duct opening. Regarding a cat suspected of rupture of the thoracic duct in clinical examination, it should be considered that the rupture may occur in the cranial mediastinal course of the thoracic duct because it runs as a single channel in this part. We suggest that the intercostal arteries encircled by a rope-ladder-like network of the thoracic duct in the caudal and medial mediastinum may diminish lymph flow rate carried out by pulsation of adjacent aorta, because lymph fluid of the thoracic duct in cats may flow fast due to the fact that the cat is a very flexible and active animal in comparison with other animal species, and/or we also think the intercostal arteries may form a protective cage for the thoracic duct.

In conclusion, it was found that the origin and course of the thoracic duct in cats were not variable except its termination manner. We think the embryological and physiological studies are required to understand thoroughly the functional importance of rope ladder pattern of the thoracic duct in cats. We hope that this study will shed light on future studies on the lymphatic system in the cat, and that it contributes to the present anatomical knowledge concerning the thoracic duct in this species.

Acknowledgements

The authors are deeply grateful to the Selcuk University Research Fund (Project num. 99/015) for the financial support.

References


THORACIC DUCT IN CATS (*FELIS CATUS*)

Fig. 1 (Cat N° 8). — The origin of the thoracic duct, left lateral view - the left kidney and retroperitoneal sublumbar fat were removed; the visceral organs were drawn ventrally.

Fig. 2 (Cat N° 5). — The origin of the thoracic duct, left dorsolateral view - the intercostal arteries, celiac artery, caudal vena cava, azygos vein, left kidney and retroperitoneal sublumbar fat were removed; the thoracic duct together with the thoracic aorta and diaphragm were drawn ventrally.

Fig. 3 (Cat N° 8). — The course of the thoracic duct in the thoracic cavity and its termination in the left external jugular vein - left lateral view.

**Figures:***

- **Figure 1:** Thoracic duct origin, left lateral view.
  - a: thoracic duct; b: cisterna chyli; c: lumbar trunk; d: visceral trunk; e: jejunal trunk; f: colic trunk; g: colic lymph node; h: first lumbar vertebra; i: right kidney; k: thoracic aorta; l: dorsal costoabdominal artery; m: abdominal aorta; n: celiac artery; o: cranial mesenteric artery; p: left renal artery (sectioned); r: caudal vena cava; s: azygos vein; t: diaphragm; u: esophagus; v: stomach; y: transverse colon; z: descending colon.

- **Figure 2:** Thoracic duct origin, left dorsolateral view.
  - Additional labels: intercostal arteries, celiac artery, caudal vena cava, azygos vein, left kidney and retroperitoneal sublumbar fat removed; thoracic duct, thoracic aorta, and diaphragm drawn ventrally.

- **Figure 3:** Thoracic duct course and termination.,
  - a: thoracic duct; b: thoracic aorta; c: intercostal artery; c': dorsal costoabdominal artery; d: aortic arch; e: left subclavian artery (sectioned); f: left common carotid artery; g: left brachiocephalic vein; h: left external jugular vein; i: left subclavian vein; k: cranial mediastinal lymph node; l: longus colli muscle; m: esophagus; n: first lumbar vertebra; o: first thoracic vertebra; p: azygos vein.