

Lymphatic Drainage of the Cranial Abdominal Mammary Gland (A1) in the Pregnant Domestic Cat and Lactating Domestic Cat

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Abstract. The study initiated by us aims to describe, interpret and elucidate several aspects regarding the topography, the morphology and the drainage of the mammary lymphatic circulatory system. Because this paper is part of a more complex research project we chose to present a comparative study with results regarding the cranial abdominal mammary gland (A1) in pregnant cats and lactating cats. We have used the method of radiographic indirect lymphography with a contrast agent. The lymphographies were taken in the Radiology Laboratory of the Faculty of Veterinary Medicine, Cluj-Napoca, using a TEMCO GRx-01 type fixed radiographic equipment. This study method has allowed us to underline the mammary lymphatic drainage and interglandular lymphatic connections.

Keywords: lymphatic connections, tumors, cat, lymphatic centre, lymphography.

INTRODUCTION

The study of the lymphatic system in the cat has theoretical and practical value due to the implication of this system in the good functioning of the organism as a whole, through its direct link to the body's immune system, through its morphological connection to the circulatory system, but also because of the fact that almost all tumors disseminate through this system, and lymph nodes can be a starting point for tumor development.

In cats, the tumors of the mammary gland are considered as being third ranked, based on the frequency of their incidence, after hematopoietic and skin tumors. Compared to humans and dogs, at least 85% of the feline mammary tumors are malign (Dorn et al., 1968; Lana et al., 2007; Misdorp et al., 1991; Morris and Dobson, 2001).

The studies of the mammary lymphatic drainage and interglandular lymphatic connections in cat should be of high importance for the surgeon not only for performing the most adequate surgical excision but also for determining an accurate post-surgical prognosis.

MATERIALS AND METHODS

The study was conducted on 11 European common breed cats, clinically healthy and well kept, from a rural background. The 11 cats of various ages (2-6 years), with a bodyweight range of 2.5 to 4 kg, were divided in two groups, according to the physiological state of the mammary gland. Group I consisted of 5 pregnant cats and group II consisted of 6 lactating cats.

From all the investigative methods cited in the specialized literature, we have used indirect lymphography with a contrast agent. The lymphographies were taken in the

Radiology Laboratory of the Faculty of Veterinary Medicine, Cluj-Napoca, using a TEMCO GRx-01 type fixed radiographic equipment.

For each subject, we have supervised behavior and physiological parameters (pulse, breathing, temperature). The cats were kept in individual cages, and all lymphographies were performed one day later after the accommodation of each animal.

Every subject underwent neuroleptanalgesia through intramuscular administration of 10% Acepromazine, 0.5 mg/kg of body weight, and 10% Ketamine, 20 mg/kg of body weight. After the induction of the anesthesia, the whole mammary region was sheared, shaved and disinfected with medicinal alcohol.

After the neuroleptanalgesia settled in completely, we have moved on to injecting the contrast agent. This task has been performed with 27-G needles in the subareolar region and in the mammary parenchyma. The injection was slow, trying to maintain an equal pressure all through the administration of the substance to one mammary gland. 0.5 ml of Optiray were used for each studied mammary gland. To facilitate absorption, each gland was lightly massaged after the shot (Kvasnicka et al., 1971; Mortimer, 1990). The injection of the Optiray 350 contrast agent was made in a single spot, taking care not to puncture a blood vessel. This was avoided by slightly pulling on the teat of the mammary gland (Pereira et al., 2008).

After administrating the contrast medium, followed the radiologic exposure of the cats in dorso-ventral and latero-lateral decubitus, with ventro-dorsal and latero-lateral exposure. The examination was made with serial exposures taken at 1, 5, 10, 15, 25, 30, and 35 minutes after the administration of the contrast agent.

RESULTS AND DISCUSSIONS

Group I

Group I consisted of 5 pregnant cats.

In two of the cats, the lymphatic vessels underlined by lymphography drain the cranial abdominal gland in an exclusive caudal direction, going to the superficial inguinal lymphocenter. In cats, this lymphocenter represents the caudal epigastric lymph nodes and the mammary lymph nodes (Fig. 1).

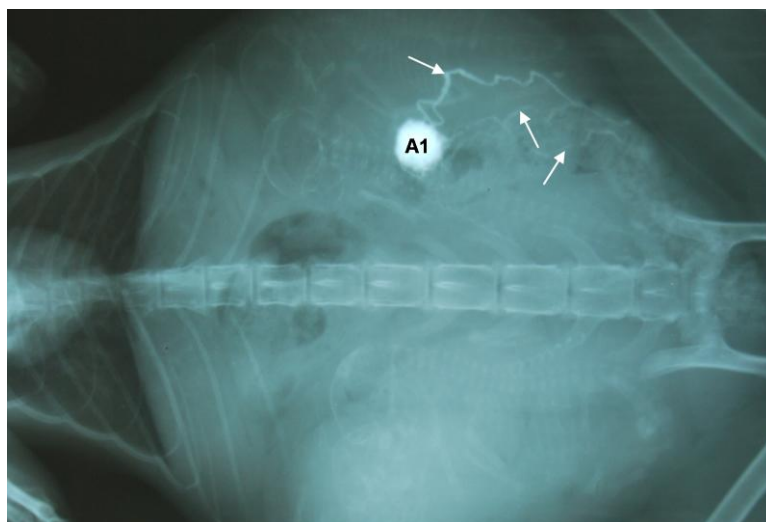


Fig.1. Ventro-dorsal lymphography, 1 min. after the contrast agent administration – lymphatic vessels draining the gland caudally.

A particular feature that we have noticed in 3 of the cats was the presence of a lymphatic vessel which drains the cranial abdominal gland and then joins the caudal abdominal gland. Regarding these 3 cases, the drainage of the A1 gland was made in both directions, cranially and caudally. Cranially, the lymph is led to the axillary lymphocenter, without any connection to the T2 gland. Caudally, the lymph reaches the caudal epigastric and mammary lymph nodes (Fig. 2).

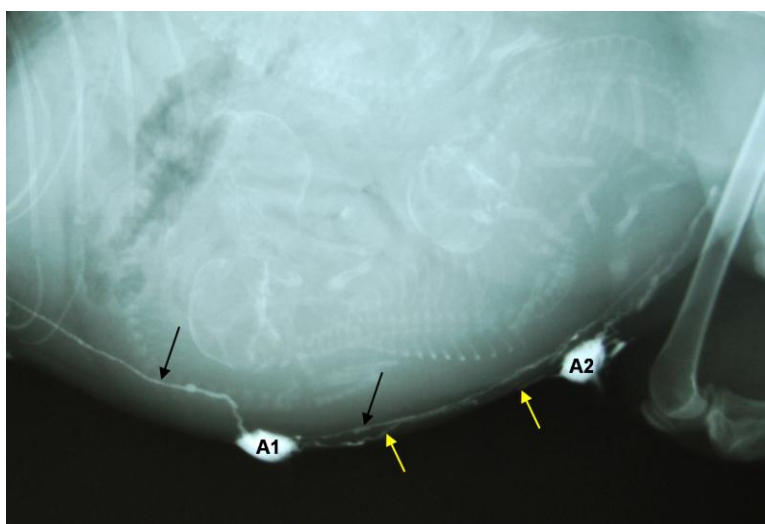


Fig.2. Double drainage – cranial and caudal – of the A1 gland (immediately after the injection), with the ventral lymph vessel (right arrows) leading to the parenchyma of the A2 gland.

In 3 out of the 5 subjects, we have underlined a connection between the cranial and caudal abdominal mammary glands. Regarding this feature, it can be said that the lymph from the A1 gland is drained through one of the caudal epigastric lymph nodes, but not before passing it through the parenchyma of the A2 mammary gland (Fig. 3).

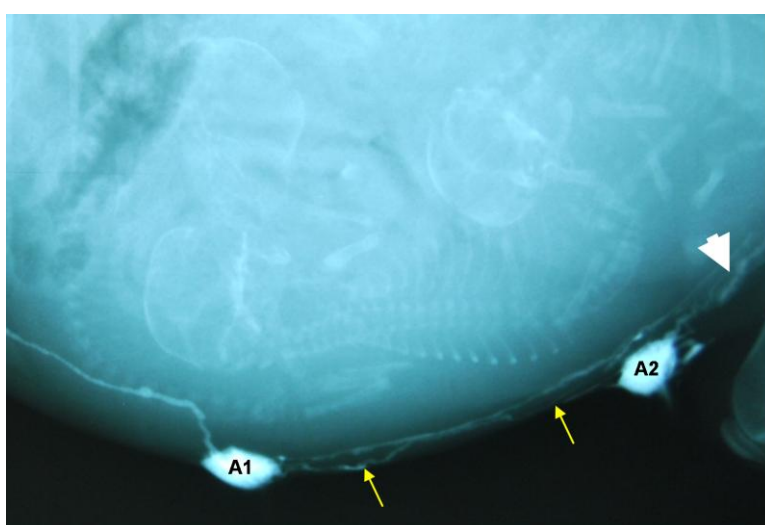


Fig.3. Double drainage – cranial and caudal – of the A1 gland (immediately after the injection), with the ventral lymphatic vessel (thin arrows) leading into the parenchyma of the A2 gland, and then draining into the caudal epigastric lymph node (white arrow).

The lymphatic vessel which by-passes the A2 mammary gland goes to the superficial inguinal lymphocenter and drains the lymph through the mammary lymph node, which can be felt subcutaneously, being placed at the base of the last pairs of mammary glands (Fig. 4).

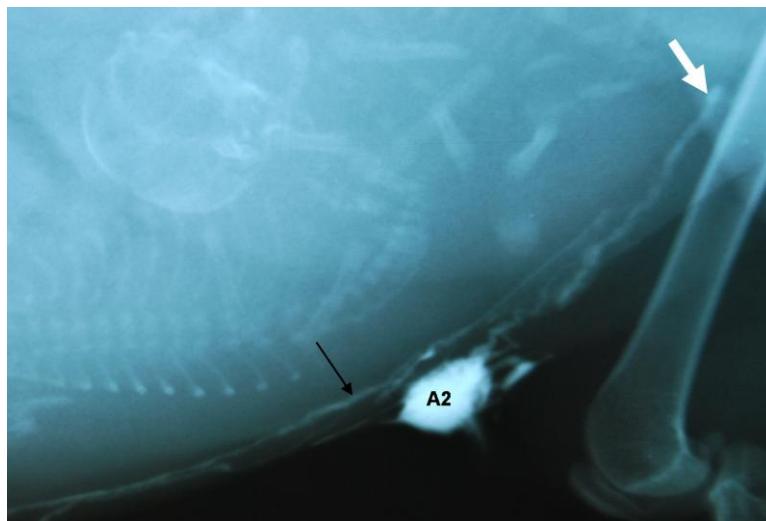


Fig.4.Lymphatic vessel (black arrow) from the A1 mammary gland which drains through the superficial inguinal lymph node (white arrow).

The results that we have obtained through this lymphographic study on 5 pregnant cats show that the cranial abdominal mammary gland (A1) can present an exclusive caudal drainage, as encountered in 2 cats, or a double drainage, both cranial and caudal – as seen in 3 cats.

Caudally, the lymphatic vessel drains into the superficial inguinal lymphocenter and cranially in the axillary lymphocenter, and in the accessory axillary lymph node respectively. This is confirmed by literature (Papadopoulou et al., 2009; Raharison and Sautet, 2006, 2007; Vollmerhaus and Roos, 1997). The notion of the lymphatic drainage of this gland through the proper axillary lymph node is confirmed by some authors (Raharison and Sautet, 2007), but in our study, this aspect has not been noticed.

The results of our research have underlined the existence of certain connections between the cranial (A1) and the caudal (A2) mammary glands in 3 out of the 5 cats. This aspect has been infirmed by certain authors (Papadopoulou et al., 2009; Raharison and Sautet, 2006, 2007; Vollmerhaus and Roos, 1997) and confirmed by a single author (Mailot et al., 1980).

Group II

The 6 cats in the second group have been chosen due to the functional state of the mammary glands, all of them lactating at the moment of performing the study.

Because of its topography the cranial abdominal mammary gland is the first one that presents milk secretion.

Based on the images that we have obtained we were able to emphasize the mammary parenchyma together with the subcutaneous lymphatic vessels belonging to the mammary gland's structure.

The perfect visualization of the mammary parenchyma along with the subcutaneous lymphatic vessels belonging to the mammary gland's structure was possible due to the lactating state of the mammary gland. This situation was found in 5 out of 6 cats.

The only exception to this situation is the cat number 1.

The latero-lateral radiologic exposure and the latero-lateral decubitus of the cats allowed us to obtain a lymphography in which we have visualized caudal lymph drainage of the cranial abdominal mammary gland (A1). This is reflected by the presence of two lymphatic vessels (in 5 out of 6 cats, exception to this situation is the cat number 1), draining caudally to the inguino-femoral lymphocenter (Fig.5) .

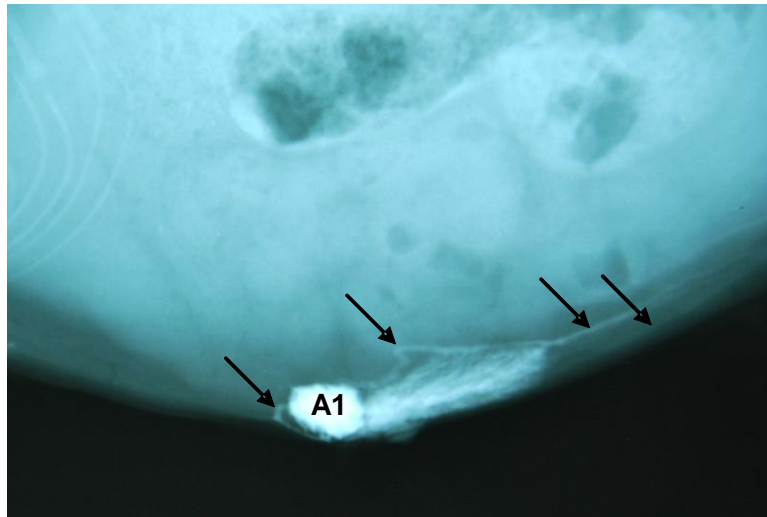


Fig.5. Two lymph vessels draining caudally the A1 gland.

In 3 out of 5 cats in which the mammary parenchyma was imaged, a lymphatic vessel approaches the adjacent mammary gland of the cranial abdominal mammary gland. It enters in the parenchyma of the caudal abdominal mammary gland and the other lymphatic vessel becomes afferent to the caudal epigastric lymph node, situated exactly at the base of the caudal abdominal mammary gland (Fig.6).

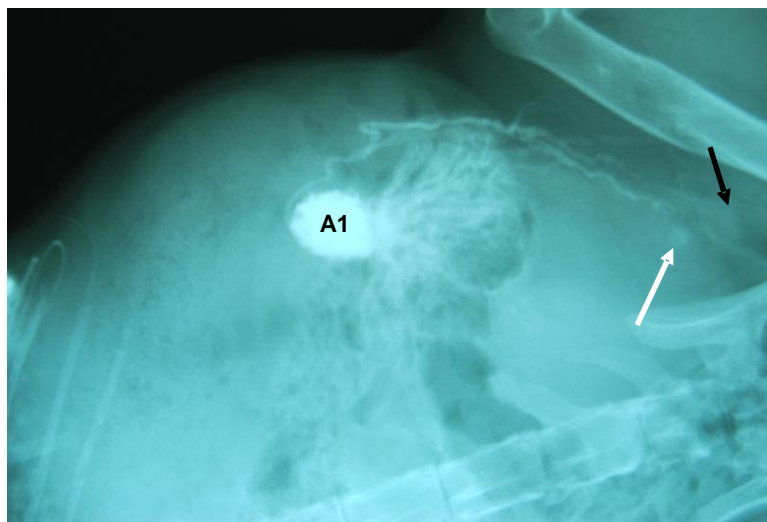


Fig.6. The connection between A1 and A2 (white arrow), and the lymphatic drainage through the caudal epigastric lymph node (black arrow).

On the ventro-dorsal lymphography realized at 5 minute interval after injection of the contrast medium, it can be noticed that the efferent lymphatic vessel of the caudal epigastric

lymph node becomes afferent for the mammary lymph node (Fig.7). It is important to mention that in this type of lymphography the mammary lymph node is not very well opacified (Fig.7)

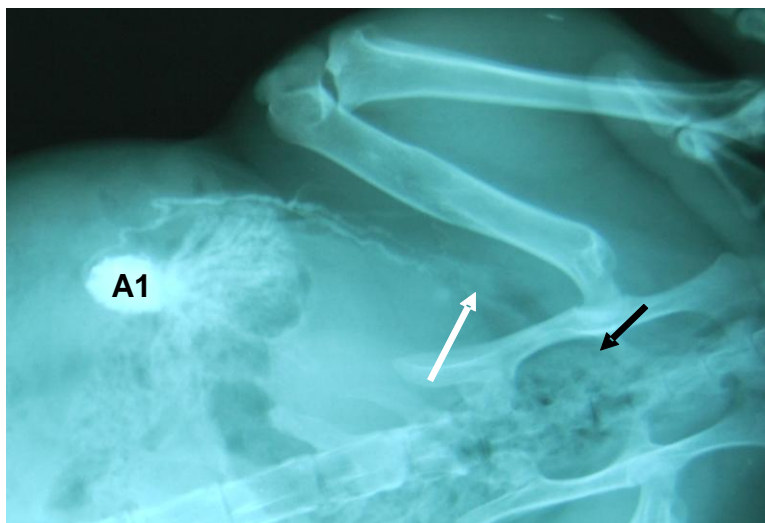


Fig.7. Afferent lymphatic vessel (white arrow) for the mammary lymph node (black arrow).

As it was already mentioned, the case number 1 presents some particularities compared to the findings in the other cases. Even though the mammary parenchyma was not revealed in this cat, due to lymphography it was noticed the tendency of the contrast medium to protrude in the papillary canal (Fig.8).

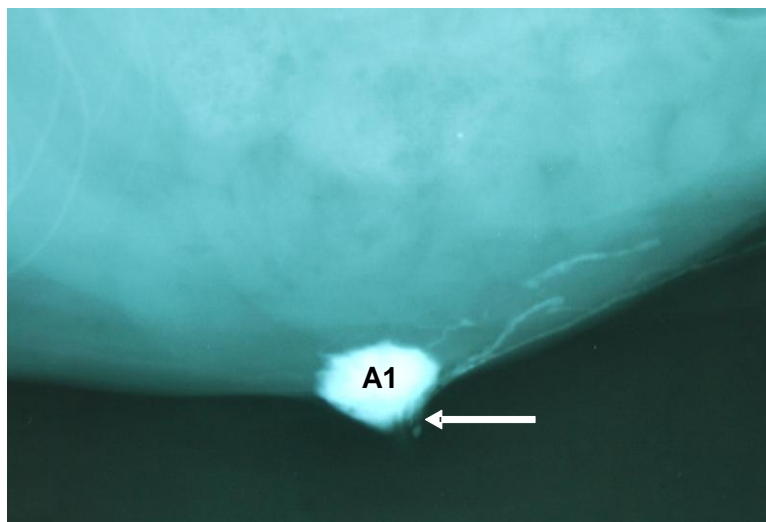


Fig.8. Distribution of the contrast agent in the papillary canal and the caudal drainage.

Both ventro-dorsal and latero-lateral radiologic exposure indicates the caudal drainage of the cranial abdominal mammary gland. This drainage is realized through three lymphatic vessels in the direction of the superficial inguinal lymphatic center. No connections between mammary gland A1 and A2 were noticed in this case (Fig.8).

Regarding the lactating cats research group, we must mention that the results obtained from it confirm only the caudal drainage of the cranial mammary gland. According to the literature and the results obtained by us in the first group the cranial abdominal mammary gland (A1) in cat can present double drainage, both cranial and caudal.

Our results based on the lactating cats group lymphographic study showed the existence of interglandular connections between the cranial (A1) and the caudal (A2) mammary glands in 3 out of the 6 cats. As we mentioned in the first group this aspect has been infirmed by certain authors (Papadopoulou et al., 2009; Raharison and Sautet, 2006, 2007; Vollmerhaus and Roos, 1997) and confirmed by a single author (Mailot et al., 1980).

CONCLUSIONS

- Our results revealed interglandular connections between the cranial abdominal A1 mammary gland and the caudal abdominal A2 mammary gland, in 3 (60%) pregnant cats and in 3 (50%) lactating cats.
- The exclusive caudal drainage of the cranial abdominal mammary gland A1 was revealed in 8 (72.72%) out of 11 cases.
- The double lymphatic drainage, both cranial and caudal, for the cranial abdominal mammary gland A1 was imaged only in 3 pregnant cats.
- The present study demonstrated that the first relay of the lymphatic drainage from the A1 mammary gland can be the axillary lymph center, more precisely the accessory axillary lymph node, if the gland presents cranial drainage, and the inguinal superficial lymph node, more exactly the caudal epigastric lymph node or the mammary lymph node, if the gland presents caudal drainage.
- None of the individuals have presented lymphatic vessels making connections between heterolateral cranial abdominal (A1) mammary glands.
- The mammary parenchyma and the increased number of lymphatic vessels were very well visualized in the lactating cats, due to the fact that the gland is in the secretory phase.
- By injecting a quantity of 0.5 ml of Optiray 350 contrast agent in the parenchyma and subareolar region of each studied mammary gland, we have obtained good results in lymphographic image quality.
- The Optiray 350 non-ionic contrast medium used by us has not altered the health of the cats included in this study.

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