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STUDY ON THE MORPHO-TOPOGRAPHY AND VASCULARIZATION OF THE PAROTID GLAND IN SMALL RUMINANTS

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Abstract

The parotid gland is one of the major salivary glands present in domestic mammals, mainly developed in herbivores. In the specialized literature, there are studies related to the size and development of the gland in ruminants, analyzing correlations between diet and parotid gland morphometry. The parotid region is an area of interest for clinicians, given the traumatic lesions or tumor formations that can occur in this region and which also lead to pathologies of the large salivary glands. Despite the low incidence of salivary gland diseases in most domestic animal species, inflammatory processes may occur, and medicamentous treatment may be associated with surgical treatment. The study focused on aspects of the morpho-topography and vascularization of the parotid gland in small ruminants, also describing its rapport with vascular-nervous and lymphatic structures. Among the most important differences and individual variations observed are differences in gland morphometry and variations in the topography of the parotid duct.

Key words*: parotid duct, parotid gland, small ruminants.*

INTRODUCTION

The saliva is the result of the secretion of the agglomerated and disseminated salivary glands. The most developed gland in sheep is the parotid gland, which has a single parotid duct (Uzun et al., 2022). Even though salivary gland pathologies are rare in domestic mammals, their symptomatology is severe. It can affect the animal's general condition, dysphagia and inappetence being the main symptoms.

The parotid region in humans has also been studied since the 19th century, considering the benign or malignant tumor processes that can affect the parotid gland (Burns, 1823). Various studies have presented in detail: the parotid fascia, the relationship of the gland to the vascular-nervous structures, and the importance of identifying the facial nerve and its branches when performing surgery in the parotid area (Carr, 1984; Gaughran, 1961; Furstenberg, 1941). There is great interest in understanding the relationships between the constituent formations of this region. The pathologies related to the salivary glands are diverse and may include various conditions, such as trauma, fistulae, inflammation, and neoplastic processes. In the case of benign or malignant tumors at this level, excision of the parotid gland is necessary. A complication of parotidectomy, the procedure used for parotid gland tumors, is an injury to the facial nerve, and preserving its integrity requires special attention (Salih et al., 2022; Gaillard et al., 2005).

There are few scientific studies on the morphology and pathology of salivary glands in livestock, although traumatic injuries involving the cervical-cephalic region are common in these species. In contrast, there are studies on sheep that address the lympho-nodular formations in this region, but also the venous vasculature, more specifically, the distribution of the external jugular vein (Georgescu et al., 2010; Predoi et al., 2011; Predoi & Belu, 2001). Due to the numerous vascular and nervous formations whose path intersects the parotid region, interventions in this area require a good knowledge of the macroscopic morphology of the region.

MATERIALS AND METHODS

The study selected two ruminant species for investigation, namely domestic sheep (*Ovis*

aries) and roe deer (*Capreolus capreolus*). Despite belonging to different families, *Bovidae* and *Cervidae,* respectively, these ruminants share similar anatomical characteristics. The study material comprised anatomical parts from four sheep and two roe deer heads, all of which were adults. The roe deer heads were obtained from hunting grounds in Buzău County, while the domestic ruminant heads were sourced from farms.

The detachment of the head from the trunk was realized at the C5-C6 joint level to maintain the integrity of the regional vascular-nervous structures. First, the vessels were flushed with 0.9% NaCl saline before injection of a natural rubber-based substance to facilitate better distribution. The arteries and veins were injected with different staining before skinning to enhance visualization. The anatomical parts were kept at -10°C for 24 hours to allow for the solidification of the liquid latex.

The dissection was performed in an organized manner, starting with the removal of the skin from the head region. The initial step involved the removal of the parotid fascia and the parotido-auricular muscle, which led to the exposure of the parotid gland. Subsequently, the gland's relationships with the vascular, nervous, and lymphatic formations were closely observed. In individuals where the lumen of the duct was large enough, the same substance used for vascular structures was injected. The Nomina Anatomica Veterinaria - 2017 was referred to identify and describe the anatomical structures.

RESULTS AND DISCUSSIONS

The research conducted by Hoffman (1989) on the digestive systems of 65 ruminant species from the four continents allowed their classification according to diet into concentrate selectors, intermediate (mixed) feeders and grass and roughage eaters. In the present research, we have choosen two species with distinct diets. Roe deer feed mainly on leaves of trees and shrubs, alfalfa, and clover and are considered "browsers", unlike domestic sheep, which eat mainly grass, fibrous, concentrated feed and are called "grazers".

The information on domestic ruminants cannot be generalized to wild species.

Following the research carried out in **sheep**, the dorsal extremity of **the parotid gland** (*Gl. parotis*) extends only cranially from the base of the auricular cartilage without extending beyond the level of the zygomatic arch. There is no retroauricular angle. (Figures 1, 2). The preauricular angle of the gland is located between the auricular and palpebral branches of the terminals of the rostral auricular artery and is irrigated by 2-3 thin branches of the auricular branch. This portion is in turn divided into two processes: the rostral one is irrigated by the palpebral branch and the posterior one receives branches from the auricular branch. The two processes are arranged on either side of the palpebral branch.

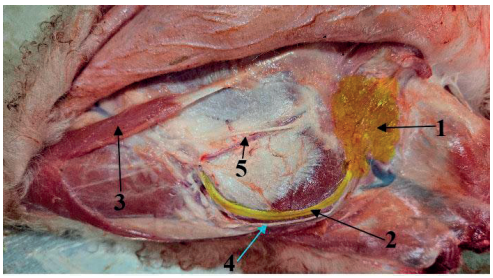

Figure 1. Parotid gland in sheep:
1 - the parotid gland; 2 - the parotid duct; 3 - zygomatic muscle; 4 - ventral buccal branch of the facial nerve; 5 - dorsal buccal branch of the facial nerve

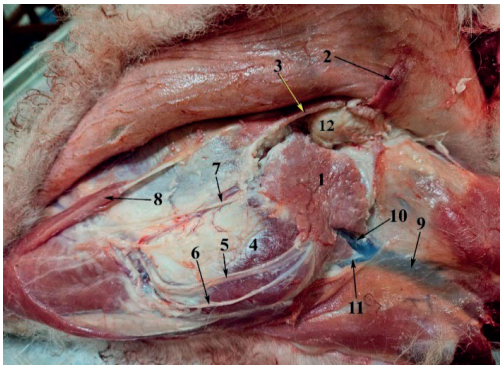

Figure 2. Parotid gland in sheep in relation to vascular-nervous formations:
1 - the parotid gland; 2 - the parotido-auricular muscle; 3 - the zygomaticoauricular muscle; 4 - the masseter muscle; 5 - the parotid canal; 6 - ventral buccal branch; 7 - dorsal buccal branch; 8 - the zygomatic muscle; 9 - external jugular vein; 10 - maxillary vein; 11 - linguofacial vein; 12 - auricular cartilage

The parotid duct (*Ductus parotideus*) arises from the ventral extremity of the gland, crossing

the middle third of the lateral surface of the masseter muscle, and opens through a reduced parotid papilla to the right of the superior first molar. This duct has an average length of 14.5 cm (Figure 3).

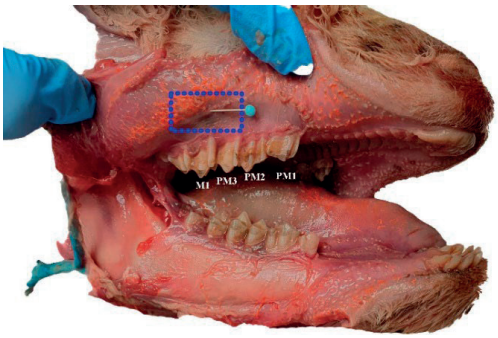

Figure 3. Topography of the opening of the parotid duct in sheep: PM1, PM2,PM3 - premolars; M1 - molar

The rostral auricular nerve, a branch of the facial nerve, emerges before the division of the facial nerve into the dorsal and ventral buccal branches and is located immediately behind the annular cartilage, deep to the gland, about 1 cm deep. The dorsal buccal nerve crosses the gland in a plane that passes midway along the parotid gland's longitudinal axis, about 3 cm from its upper end. The ventral buccal branch runs towards the origin of the gland duct, being located intra-acinar, with an oblique disposition towards the base of the ear (Figure 4).

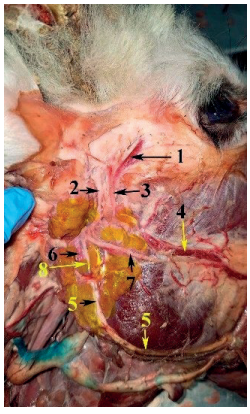

Figure 4. Topography of vascular-nervous structures in relation to the parotid gland in sheep (deep layer):
1 - rostral auricular artery; 2 - rostral auricular nerve;
3 - rostral auricular vein; 4 - transverse facial artery;
5 - parotid duct; 6 - caudal auricular artery; 7 - dorsal buccal branch; 8 - ventral buccal branch

The parotid lymphocenter is entirely or partially covered by the parotid gland, with an average length of 12 mm and an average width of 7 mm. It covers the terminal portion of the aurico-palpebral vein and is irrigated by branches from the transverse facial artery. In one specimen, the parotid lymphocenter was represented by two lymph nodes. The first is located on the surface of the masseter muscle, covering the origin of the transverse facial artery in contact with the inferior border of the dorsal buccal branch. The second, more reduced one is placed caudal of the terminal portion of the anterior auricular vein in relation to the rostral margin of the parotid.

Regarding the arterial vasculature of the parotid gland, a voluminous division branching off at the origin of the transverse facial artery descends obliquely in the middle third of the caudal margin of the masseter muscle and gives along the intraglandular course parotid branches (4-5). Opposite to this voluminous branch, also branching off from the transverse facial artery, are direct dorsal glandular branches or muscle branches, which also indirectly have glandular branches (Figure 5).

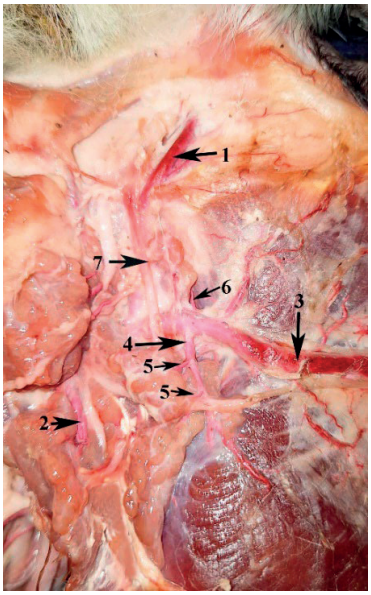

Figure 5. Transverse facial artery in sheep:
1 - rostral auricular artery; 2 - caudal auricular artery;
3 - transverse facial artery; 4 - ventral masseteric branch;
5 - glandular branches arising from the masseteric branch; 6 - dorsal masseteric branch;
7 - rostral auricular vein

The rostral edge of the gland covers the origin of the transverse facial artery from which it receives fine branches.
The dorsocaudal margin of the gland is served by the caudal auricular artery. The ventral extremity does not extend beyond the linguofacial vein. It is supplied with the portion below the origin of the parotid duct by a retrograde branch of the lingual artery parallel to the linguofacial vein.
At the origin of the caudal auricular artery arises the most important parotid branch for the middle portion of the body. This branch is directed ventro-laterally above the anterior belly of the digastric muscle.
In the **roe-deer**, **the parotid gland** forms at the dorsal extremity two angles, pre- and retro auricular; the anterior edge of the gland is convex, being delimited by the vertical branch of the mandible, and the caudal auricular vein delimits the caudal edge. The gland's ventral edge reaches the sterno-zygomatic muscle's upper edge (Figure 6).

Figure 6. The parotid gland of *Capreolus capreolus*: 1 - auricular cartilage; 2 - parotid lymphocenter; 3 - masseter muscle; 4 - external jugular vein; 5 - linguo-facial vein; 6 - parotid gland; 7 - parotid duct; 8 - facial artery; 9 - parotido-auricular muscle; 10 - maxillary vein; 11 - rostral auricular artery

Notably, a distinct triangular-shaped gland lobe connected by a narrow dorsal glandular part located on the lateral aspect of the linguofacial vein was observed. This portion is vascularized by a branch branching from the common carotid artery, the branch terminating in the sterno-zygomatic muscle. Its most caudal angle is at the level of a transverse plane passing through the caudal edge of the atlas wing.

The parotid gland has a maximum length of 10 cm and a maximum width of 4 cm below the base of the auricular cartilage.
Unlike the domestic ruminant, in *Capreolus capreolus*, the parotid lymphocenter is not covered by the parotid gland and is visible after the parotid fascia is removed. A single lymph node formation was observed in both specimens, approximately 2.5 cm long and 1 cm wide.
The facial artery (absent in sheep) gives off an inferior labial artery lying superficially at the ventral edge of the buccinator muscle, straight and then 3-4 branches in a caudal direction on the surface of the masseter. The artery also gives off a buccal branch and an artery corresponding to the angular artery. The parotid duct is detached from the ventral extremity of the dorsal portion opposite the maxillary vein of the gland. This duct follows the medial pterygoid muscle's medial border about 1 cm dorsal to the ventral border of the mandible. It runs up to the vascular notch and exits into the facial plane. The duct follows the facial vein in the inferior third of the masseter margin at its deep surface, the two formations flanked cranially by the facial artery. The duct remains covered by the facial vein for most of its length, up to the level of the upper dental arch where it runs sharply rostral. It then perforates the buccinator muscle and opens at the level of the upper first molar, the parotid papilla being inconspicuous. This duct is approximately 23.5 cm long (Figures 7, 8).

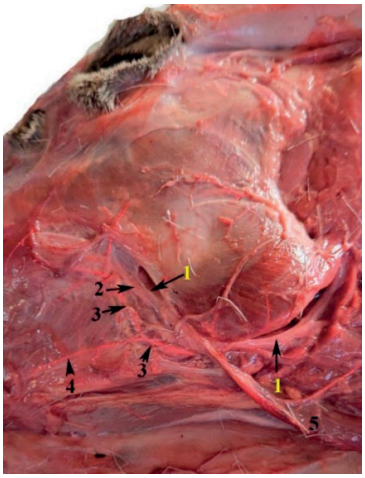

Figure 7. The pathway of the parotid duct in roe- deer: 1 - parotid duct; 2 - facial vein; 3 - facial artery; 4 - inferior labial artery; 5 - sterno-zygomatic muscle

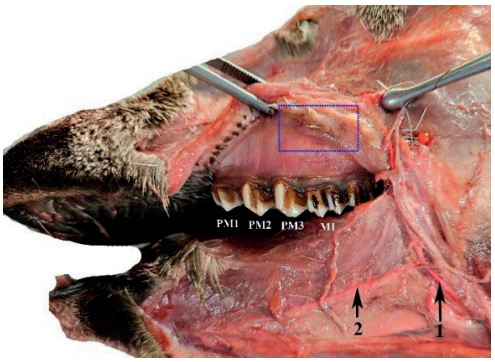

Figure 8. The opening of the parotid duct in *Capreolus capreolus* (after horizontal sectioning of the buccinator muscle):
PM1, PM2,PM3 - premolars, M1 - molar 1;
1- facial artery; 2- inferior labial artery

The table below contains an average of the results obtained from the study, the weight of the animals was measured after slaughter, taking into account the weight of the digestive tract, the content of which was subsequently subtracted (Table 1).

Table 1. Parotid gland

Species	Length	Width	Weight	% of the body mass
Ovis aries	47 mm	23 mm	13 g	0.04%
Capreolus capreolus	100 mm	41 mm	15 g	0.1%

CONCLUSIONS

One particular aspect was the differences in gland development between the two species. Measurements showed that the parotid gland of the roe deer has an average weight of 15 g and represents about 0.1% of the animal's body mass. Compared to the domestic ruminant, where the parotid gland although having a similar average weight of 14 g, represents 0.04%. This difference is the result of the diet of the two species. The deer is a selective species in terms of the plants consumed, choosing the foods with the highest nutritional value, and the resting periods between meals are short, thus requiring the production of a greater quantity of saliva to buffer the ruminal pH to ensure proper digestion.

Regarding the parotid duct, it has a distinct pathway in the two species. In domestic sheep, the duct is shorter, following the lateral surface of the masseter muscle in its inferior third. The duct comes into contact with the dorsal margin of the ventral buccal nerve. In *Capreolus capreolus*, the pathway of the parotid duct is similar to that in cattle, passing initially at the medial aspect of the mandible before returning superficially to the level of the vascular notch. The vascular formations maintain their relationship to the parotid duct along the rostral margin of the masseter muscle. The facial artery lies rostrally, followed by the facial vein, and the duct is located aboral and deep to the vein.
In the individuals examined in the study, regardless of species, the parotid duct opened at the level of the first upper molar.
Salivary glands in ruminants represent a subject of further interest for other studies involving wild and domestic species.

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