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MAJOR SALIVARY GLANDS TOPOGRAPHY IN RATS AND THEIR RELATION WITH THE SURROUNDING ANATOMICAL TISSUES

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Abstract

The structure of the salivary glands is different depending on the species and diet. The glandular secretion can be serous, mucous or mixed. Within the same order, for instance in rodents, there are dissimilarities between the major salivary glands, even if the diet is similar. In this study, we used five Wistar rats, originating from the University of Medicine and Pharmacy "Iuliu Haţieganu" biobase, in Cluj-Napoca. After inducing neuroleptanalgesia, the method of euthanasia was cervical dislocation and then a stratigraphic dissection was accomplished. We mention that these euthanasia methods are allowed by 2010/63/UE directive of the European Parliament and the Council from September 22nd of 2010, regarding animal protection used for scientific purposes. The external features were assessed and compared to published literature on other similar species. The macroscopic examination revealed that the major salivary glands in rats are similar to those from other species of mammals when referring to the general macroscopic aspect. The parotid gland is localised at the base of the auricular concha, without exceeding the outer ear base, extended distally in the ventral cervical region. The rats' ventral extremity of the parotid gland faces and ends with a sharp angle, toward the scapular-humeral joint, covering the jugular gutter with this layout. Aboral border of the mandibular gland is covered by ventral extremity of the parotid gland, both mandibular glands being near the external jugular veins. As a location, the mandibular glands in rats reside in the sublaryngeal and subtracheal region. Sublingual glands are located orally from the rostral pole of the mandibular glands, maintaining in a certain way the same layout as the mandibular glands.

Key words*: parotid gland, mandibular gland, sublingual gland, rat.*

INTRODUCTION

Differences can be found between the salivary glands in mammals, depending on the species and the type of food (herbivorous, carnivorous or omnivorous) (Baciu, 1970; Tache, 1994).
Amongst salivary gland functions, we include the lubrication of the first segments of the digestive tract, preparing the food for digestion, maintaining the integrity of the buccal cavity, regulating the local bacterial flora, facilitating teeth remineralization, and neutralising bacterial plaque (Yazdani Moghaddam et al., 2009; Tucker and Miletich, 2010; Yasear et al., 2012; Gal and Miclăuș, 2013).
The specialized literature we consulted on didn't contain enough information about the major salivary glands' topography, which is why we decided to undertake a macroscopic investigation of these, and keeping track of some particular aspects of the major salivary glands.

Salivary glands are extension of the digestive tract, being responsible for the secretion of saliva. These represent a group of organs which secrete a watery substance, named saliva, which fulfils several physiological functions. Thus, its role is to moisten the mouth and to dissolve food (Asari et al., 2000; Barone, 2009). Likewise, it ensures the protection of the teeth and also the soft tissues that surrounds them (Asari et al., 2000; Tucker and Miletich, 2010). Salivary glands are found in mammals, reptiles, and birds, being a feature of terrestrial species.
Their structure and development are in close relations with the diet (Barone, 2009).

MATERIALS AND METHODS

In this study, we used 5 Wistar female rats, originating from the University of Medicine and Pharmacy "Iuliu Haţieganu" biobase, in Cluj-Napoca.

The equipment used for this task was the dissection instruments and the Nikon D3000 photo camera.
In the case of our subjects, we induced neuroleptanalgesia by giving a supradose of Xylazin Bio 2% intramuscularly, and after 15 minutes a supradose of Ketamin 10, according to Ramsey's findings (2011).
After inducing neuroleptanalgesia, the euthanasia was done by the method of cervical dislocation. We mention that these methods are approved by the 2010/63/UE directive of the European Parliament and the Council from September 22nd of 2010, regarding animal protection used for scientific purposes.
After euthanizing the subjects, we performed a stratigraphic dissection of the regions containing the major salivary glands.

RESULTS AND DISCUSSIONS

In rats, the parotid gland is a paired organ, situated in the parotid region. The parotid gland is seen after making an incision ventral to the base of the external ear, then removing the skin, the parotid fascia, and the adipose tissue covering the gland.
The images obtained with the subject in latero-lateral decubitus and the latero-lateral photographic exposure show that the parotid gland is localised at the base of the auricular concha, without exceeding the outer ear base. From the ear base, the parotid gland extends distally in the ventral cervical region (Figure 1).
This aspect proves that the parotid gland can be of a cervico-cephalic type when we make a reference to the region that is being occupied by it.
Orally to the parotid gland, a disk-shaped gland can be observed. The length of this gland is only up to the proximal half compared to the length of the parotid gland. This gland is called the extraorbital lacrimal gland. The gland can be easily noticed due to having a darker colour than the parotid gland (Figure 1).
On the side of the parotid gland, glandular parenchyma can be noticed being surrounded by conjunctive septa. The medial side covers both vascular formations and formations such as muscle and nerve. As for the muscle formations, the parotid gland is in accordance with the ventral cervical muscles and the cephalic extremity of the sternocephalic and brachiocephalic muscles.
We point out that the rats' parotid gland covers the oral extremity of these muscles. In the ventral cervical region it can be observed that the parotid gland partially covers Wiborg's triangle.
This leads to the assertion that the lingual-facial vein, retro-mandibular, and the sterno-mandibular muscle tendon are partially covered.
The rats' ventral extremity of the parotid gland faces and ends with a sharp angle, toward the scapular-humeral joint, covering the jugular gutter with this layout. The nerve formations that come into contact with the parotid gland are represented by the branches of cervical spinal nerves, specifically auricular branches. The extraorbital lacrimal gland located orally by the parotid gland, touches with its medial side the branches from the facial nerve, namely the dorsal and ventral buccal nerve. The buccal nerves' origin is covered by the profound side of the parotid gland.

The mandibular gland in rats is a paired gland, located on both sides of the sagittal plane. We note that, compared to the parotid gland, the mandibular gland is darker in colour, with a reddish hue. It has an oval shape with a convex aspect of the upper ventral side, and the dorsal side contacts the underside of the parotid gland (Figure 2).

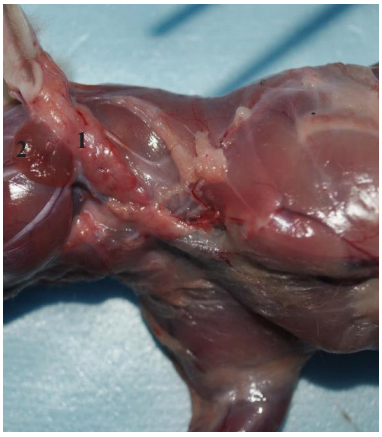

Figure 1. Parotid gland in rats (1); Extraorbital lacrimal gland (2)

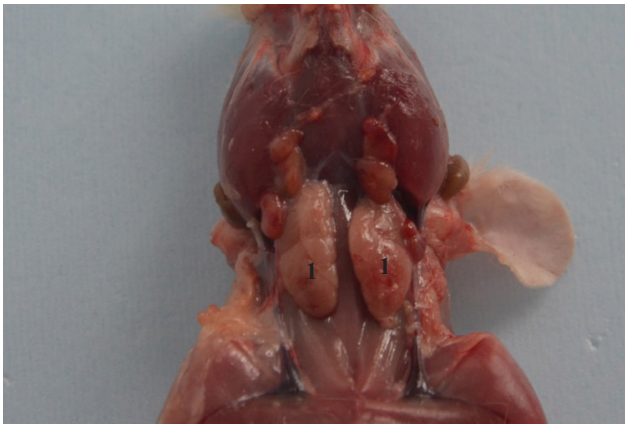

Figure 2. Mandibular glands in rats (1)

Anatomically, we mention that both mandibular glands are near the external jugular veins. As a location, the mandibular glands in rats reside in the sublaryngeal and subtracheal region. The mandibular lymph node is in direct contact with the mandibular gland, and drains the mandibular gland region (Figure 3).

Sublingual glands are located orally from the rostral pole of the mandibular glands, maintaining in a certain way the same layout as the mandibular glands, namely their location on either side of the sagittal plane. Sublingual glands are in connection with the mandibular glands. Their colour is different from the mandibular glands by having a darker shade. The above mentioned features were visible only after removing the common fascia covering both sublingual and mandibular glands (Figure 4).

The location of the sublingual glands was found at the recurved branches of the mandible, caudal from the mandibular lymph node. In terms of general appearance, the two glands appear to be situated at the medial side of the recurved branches of the mandible, in the under-hyoid region.

The vast majority of the studies were based upon the pathological, immunohistochemical or structural parts of these major salivary glands, focusing only on the visible anatomical differences in the species under study. Specialized literature shows studies about the morphology and histology of the major salivary glands (Young and Van Lennep, 1978; Pinkstaff, 1980). A considerable diversity has been observed in the structure of the salivary glands in different species of mammals by both electron microscopy and optical microscopy (Mohammadpour, 2010).

Figure 3. Mandibular glands in rats (1); Mandibular lymphnodes (2)

Some authors maintain that the rats' parotid gland consists of two distinct parts. The first portion is located above the base of the outer ear, disk-shaped, with the medial side being slightly concave, yellow-brown coloured, and the second one surrounding the first in a ventral way (Parhon et al., 1957). Later, this assumption was debunked, revealing the existence of a channel that is connected to the lacrimal groove; this portion actually being the extraorbital lacrimal gland (Jonjic, 2001; Quesenberry and Carpenter, 2004; Di Palma et al., 2006; Amano et al., 2012).

Our results are similar to those of other authors who have also found that the salivary glands in humans and rodents (mice and rats) consist of three pairs of major salivary glands: parotid, mandibular and sublingual (Saracco and Crabill, 1993; Amano, 2011). In laboratory rodents, salivary glands are described in many studies. However, the glands have certain features that prove to be an obstacle to some researchers. This border includes the small sized salivary glands, the thin diameter of the glands channels, and the short lifespan of these animals (Štembírek et al., 2012).

Figure 4. Mandibular gland in rats (1); Sublingual gland in rats (2)

The rats' parotid gland is located behind the ear, in the area below the ear, caudally neighbouring the mandibular gland. This gland is embedded in the subcutaneous adipose tissue. After removing the skin, the gland resembles the pancreatic structure (Jonjic, 2001).

We agree and confirm what Da Cunha Lima Marta et al. (2004) say, namely that the extraorbital lacrimal gland is found beneath the skin, on the lateral side of the cheek region, near the outer ear. As previously mentioned,

this gland has been confused with the parotid gland.

Comparable results have been reported by other researchers as well. In rodents, the sublingual glands are located together with the mandibular glands in the anterior cervical region, between the mandibular and the sternum lymph node. Both glands are enveloped by a common fascia (Amano et al., 2012). As we have seen, sublingual glands have the smallest dimensions compared with the other major salivary glands in rats (Da Cunha Lima Marta et al., 2004).

In rats, the parotid and mandibular gland are about the same size. The mandibular gland is large, elongated, and localized caudally from the mandibular angle. The sublingual gland is small, round, located on the rostral outskirts of the mandibular gland. The sublingual gland's channels run parallel to the mandibular gland, opening at the sublingual plica. Superficial lymph nodes of the head and neck are often confused with salivary glands (Suckow et al., 2006).

The parotid gland of the forest rat (*Neotoma lepigus*) is sitting on one side of the masseter muscle, a portion above the ear base and the other behind it. Cranio-ventrally, the glands give the impression that the two meet one another. In this region, they are placed partially on the mandibular glands. The mandibular glands are in contact with one another along the sagittal line of the neck (Howell, 1926).

The giant African rat (*Cricetomys gambianus*) has three pairs of major salivary glands: parotid, mandibular, and sublingual. These paired glands are well developed. The parotid is oval, flat, and lobed and it extends along the caudal margin of the mandible, towards the ventral side of the larynx and caudally facing the clavicle. The parotid channel has a trajectory towards the mouth, at the rostral edge of the masseter muscle, opening at the second upper molar (Olayemi et al., 2001). The mandibular gland is located in the ventral cervical region, flanked orally by the mandibular lymph node, and medially by its pair.

The sublingual gland is shaped like a lens, being in an intimate contact with the mandibular gland, but with a darker colour. Both channels – mandibular and sublingual – course in a rostral way, along the medial surface of the mandible, but they split up at some point and open separately.

Given the considerably higher size of the African rat compared with the Wistar rat, some authors maintain that the African rat is more suitable for medical research. These things give credit to growing the African rat as a substitute for Wistar rats regarding research (Olayemi et al., 2001).

The African rat is considered to be the future laboratory animal, as a replacement for the Wistar rat, owing to its larger size (Ikpegbu et al., 2014; Mustapha et al., 2015).

CONCLUSIONS

Unlike mice, rabbits and guinea pigs, where the end of the parotid gland slightly surrounds the back of the ear conchae, in rats, the parotid gland is located at the base of the ear, but without exceeding the base of the outer ear. In rats, the ventral extremity of the parotid gland extends ventrally, reaching the ventral cervical region. The ventral extremity of the parotid gland in rats ends with a sharp edge towards the scapulo-humeral joint, in comparison with the ventral extremity of the parotid gland in rabbits, which ends with a sharp edge in the oral region, in contact with the mandibular gland. The parotid gland contacts the mandibular gland. The joint capsule covering both mandibular and sublingual glands is seen in rats. Mandibular glands are in intimate contact with the sublingual glands. The rat has a well-developed extraorbital lacrimal gland, localized anteriorly to the parotid gland.

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