A Study on the Diverticular Enlargement of the Rat’s Submandibular Duct

Soon Chuol Kim

Department of Anatomy, Yonsei University, College of Medicine, Seoul, Korea

ABSTRACT

As recently as 1972 research on the submandibular duct reservoir was reported by Butcher (1972) using Long-Evans and Wistar rats. The occurrence of the submandibular duct reservoir in other species of rodents has not been determined.

The author has attempted to observe the occurrence of the submandibular duct reservoir in adult albino rats of the Sprague-Dawley strain as well as in mice and rabbits and to observe the morphodifferentiation of the submandibular gland, especially the submandibular duct reservoir in the rats.

The whole submandibular and sublingual ducts associated with the glands and the sublingual caruncle were carefully excised under a stereomicroscope after perfusing the animal with 10% formalin solution. The submandibular and sublingual complexes were, in toto, post-fixed in Zenker’s solution for 24 hours and sectioned serially. To observe the prenatal phase of the morphogenesis of the submandibular gland, serial sections of the head and neck at daily intervals from 14 days to 20 days in utero, were all fixed using Bouin’s solution.

The results have shown that in the serial sections of the glandular complexes of the adult rats, a diverticular enlargement of the submandibular duct near the sublingual caruncle existed and was connected to the ordinary narrow excretory duct distal to the diverticular enlargement of the submandibular duct. The submandibular duct reservoir followed by the short terminal excretory duct opened into the oral cavity through the sublingual caruncle. The lining epithelium of the diverticular enlargement of the submandibular duct was the pseudostratified columnar type.

No sublingual duct reservoir was found in the Sprague-Dawley strain rats that were investigated.

In the mouse and the rabbit there was no submandibular duct reservoir found.

The anlage of the submandibular gland was first observed in the 14 day old in utero specimens. In the 17 day old in utero specimens, an apparent submandibular duct reservoir was present and the terminal buds (anlage of acini) were well differentiated. Secretory materials were seen in the lumina of the submandibular duct and in the terminal buds. These findings indicate that the secretion of the submandibular gland cannot enter the oral cavity until at least 16 days in utero.

INTRODUCTION

In rodents the submandibular glands are
composed of two main portions, the secretory and the ductal portions. The submandibular secretion is collected easily from the sublingual caruncle that is located anteriorly between the mandibular incisors in albino rats. (Bloom and Fawcett, ’70; Leeson and Leeson, ’70)

It was believed that the submandibular duct was a simple cylindrical structure of uniform diameter.

As recently as 1972 research on the submandibular duct reservoir was reported by Butcher (1972) using Long-Evans and Wistar rats. The occurrence of the submandibular duct reservoir in other species of rodents has not been determined.

The author has attempted to observe the occurrence of the submandibular duct reservoir in adult albino rats of the Sprague-Dawley strain as well as in mice and rabbits and to observe the morphodifferentiation of the submandibular gland, especially the submandibular duct reservoir in the rats.

MATERIALS AND METHODS

Young adult Sprague-Dawley rats, mice and rabbits were used. Anesthetizing with ether, they were perfused with 10% formalin or Baker’s solutions for 30 minutes. Exposing the submandibular glands by the median incision of the neck, they were wholly excised using the stereomicroscope (x4). The excised tissue were postfixed with Zenker’s solution for 24 hours and embedded in paraffin. The blocks were serially sectioned at 8μ, and stained with hematoxylin and eosin. (Jacoby, ’59; Jacoby and Leeson, ’59; Leeson and Booth, ’61)

To observe the prenatal phase of the morphogenesis of the rat submandibular gland, female Sprague-Dawley rats were caged. At 5:00 PM, a male rat of the same strain was placed in a placed in a breeding cage with the female and left over night until 8:00 AM of the following morning. Vaginal smears were taken and the date when sperm was found was considered as the first prenatal date. The heads of the fetuses from 14 days to 20 days were fixed in Bouin’s solution, then embedded in paraffin, sectioned serially at 8μ and stained in hematoxylin and eosin. (Redman, ’71; Redman and Sreebny, ’70)

RESULTS

In the adult rats the submandibular and the sublingual ducts ran parallel from the gland to the sublingual caruncle. The proximal portion of their ducts were lined with pseud stratified epithelium and the submandibular duct was larger than the sublingual duct in diameter (Fig. 1, 2). The distal portion of the submandibular duct near the sublingual caruncle was enlarged abruptly and formed a diverticular enlargement and its lumen was more or less folded and lined with pseud stratified epithelium.

Stratified muscles were found in the deep wall of the reservoir (Fig. 2, 3). The submandibular duct reservoir led into the short terminal excretory duct which opened into the oral cavity through the sublingual caruncle (Fig. 4, 5).

The sublingual duct had an equal diameter and there was no reservoir such as the submandibular duct reservoir. It opened lateral to the sublingual caruncle.

In the mouse and the rabbit no submandibular duct reservoir was found.

The anlage of the submandibular gland was first observed in the 14 day old in utero specimens as an elongated downgrowth of the oral epithelium into the underlying mesenchyme. The anlage elongates into a stalk and the distal end of which became a terminal bulb.
1975

A Study on the Diverticular Enlargement of the Rat's Submandibular Duct

On the 15th day small cleavages appeared in the stalk and the terminal bulb but not in the intermediate portion of the stalk. On the 16th day in the submandibular stalk a lumen was noted for the entire length and 4 or 5 branches extended from the terminal bulb and terminated in 1 or 2 terminal buds. There were no lumina in the branches and buds. The lining epithelium of the stalk were pleomorphic. On the 17th day the lumen appeared in the branches and buds. In the excretory duct near to the oral mucosa reservoirs were seen. On the 18th day the terminal buds were well differentiated and the lumen of the reservoir became enlarged. (Fig. 6). On the 19th and 20th day the lobule was well developed but had much interlobular connective tissue. The reservoir seemed well developed (Fig. 7, 8). The sublingual gland was differentiated independently.

DISCUSSION

It was believed that the submandibular duct was only a simple tubule before the reporting of the submandibular duct reservoir in Long-Evans and Wistar rats by Butcher (1972). Since Butcher (1972) had reported the reservoir in Long-Evans and Wistar rats, the author attempted to find it in Sprague-Dawley rats and proved it by using the histologic method. In the mouse and the rabbit there were no reservoirs. It might be present in some animals, but certainly not in all. Cutler and Chandhry (1974) reported that morphodifferentiation of the secretory cells began on the 16th day in the rat fetus and matured in 3 or 4 weeks postnatally. The secretory function began on the 18th prenatal day, when the lumen appeared in the terminal buds. Gestner et al (1963) reported that on the 17th prenatal day there was secretory action in the submandibular duct and began to secrete material on the 19th prenatal day. In the exocrine gland, when the excretory duct had a lumen and the secretory cells were polarized there was secretory function.

In this study on the 17th prenatal day the lumen was present for the entire length of the submandibular duct, the terminal buds were matured and the reservoir was present. Secretory function began from this time. The fact that the lumen in the reservoir was folded still allowed the secretory material to pass easily as well as to store it in.

REFERENCES


Fig. 1. The proximal portion of the excretory ducts. H-E stain. 100 x

Fig. 2. The submandibular duct reservoir. H-E stain. 100 x

Fig. 3. The submandibular duct reservoir. H-E stain. 100 x

Fig. 4. The distal portion of the excretory ducts. H-E stain. 100 x
Fig. 5. The distal portion of the excretory ducts. H-E stain. 100 x

Fig. 6. The submandibular duct reservoir on the 8th prenatal day. H-E stain. 100 x

Fig. 7. The submandibular duct reservoir on the 19th prenatal day. H-E stain. 100 x

Fig. 8. The submandibular duct reservoir on the 20th prenatal day. H-E stain. 100 x