Original Article

HISTOLOGICAL STUDY OF HUMAN SUBLINGUAL GLAND WITH SPECIAL EMPHASIS ON INTERCALATED AND STRIATED DUCTS

Rehana Rana, Liaqat Ali Minhas*, Zarmina Saga, Azhar Mubarik*****

Islamic International Medical College Rawalpindi, *Rawal Medical College Rawalpindi, **Rawalpindi Medical College Rawalpindi, ***Army Medical College Rawalpindi

ABSTRACT

Objective: To study the histomorphological characteristics of human sublingual gland, specially of intercalated and striated ducts.

Study design: Descriptive study

Place and duration of study: Army Medical College from Jan 2002 to Dec 2002

Materials and methods: Fifteen sublingual glands (right and left) from postmortem cases were obtained from District Headquarter Hospital Rawalpindi, within twelve hours of death. Five micrometer thick sections were made and stained with Haematoxylin and Eosin (H&E). Morphology of intercalated and striated ducts was studied and their number was counted.

Results: The mean number of intercalated ducts in the right gland "a" and "b" parts, and in the left gland "a" and "b" parts was 1.45±0.14, 1.39±.009, 1.31±0.11 and 1.18±0.10 respectively. The mean diameter of intercalated ducts in the same parts was 19.76±0.44µm, 20.6±0.53µm, 20.34±0.49µm and 19.84±0.98µm respectively. The mean number of striated ducts in the right gland "a" and "b" parts, and in the left gland "a" and "b" parts was 0.55±.008, 0.57±.008, 0.80±0.14 and 0.80±0.14 while mean diameter of striated ducts in the right gland "a" and "b" parts, and in the left gland "a" and "b" parts was 49.90±4.70µm, 53.23±2.50µm, 61.68±3.93µm and 57.73±2.85µm respectively.

Conclusion: The difference between the mean number and diameter of the ducts of right and left glands was statistically insignificant.

Keywords: Demilunes, Intercalated ducts, Striated duct.

INTRODUCTION

A salivary gland is any cell or organ discharging a secretion into the oral cavity. There are major salivary glands located at some distance from the oral mucosa with which they are connected by extra glandular ducts, and the minor salivary glands which lie in the mucosa or submucosa opening directly through the mucosa. In humans the major salivary glands comprise the paired parotid, submandibular and sublingual glands. The major salivary glands have numerous lobes composed of lobules linked by dense connective tissue containing excretory ducts and blood vessels. Each lobule has a single duct whose branches begin as acini or "end-pieces". The secretions of the acini pass through the intralobular ducts which include the intercalated and striated ducts and then interlobular or excretory ducts and ultimately into one or more main ducts which discharge saliva into the oral cavity[1].

The sublingual glands are smallest of the major salivary glands. In humans these are about 3-4 cm long and about 3-4 gm in weight, located deep in the mucous membrane of the floor of the mouth[2]. The sublingual glands consist of a major gland and about 8-30 small independent glands[3]. The classical sublingual gland is a mixed gland, with mucous acini outnumbering the seromucous acini. Literature reveals lack of accurate information about the intercalated and striated ducts in the sublingual glands. Available data suggests paucity of ducts as compared to other salivary glands. The smallest ducts are comparable to intercalated ducts but the large ducts for the most part lack the distinguishing features of striated ducts[3]. The sublingual gland in the rabbit is almost entirely mucus producing and consequently appears much paler under the microscope[4].

As the intercalated ducts are less in number most of the terminal alveoli are often quite elongated and open directly into the larger interlobular ducts at the periphery of the

Correspondence: Dr Zarmina Saga, Head of Anatomy Department, Rawalpindi Medical College (RMC) Rawalpindi
Email: zarsohail@hotmail.com
Received: 12 Feb 2010; Accepted: 23 Oct 2012

lobule. Some investigators believe that typical intercalated ducts are entirely lacking[5]. Both segments of the intralobular ducts are poorly developed, and intercalated ducts are virtually absent. There is absence of striations in the columnar cells lining the intralobular ducts that reabsorb sodium from the saliva[6].

Some interesting facts about the salivary glands have been observed which need further explanation. It is known that the sublingual saliva has a higher concentration of sodium than would be expected on the basis of secretion rate alone. Thus the absence or paucity of striated ducts in the sublingual gland helps to explain the tonicity of the saliva liberated by these glands[7].

The review of literature shows marked differences in opinion, regarding the presence and morphology of the intercalated and striated ducts. Histological structure of the parotid and submandibular salivary glands has often been studied in detail, but the sublingual salivary glands have not been given enough attention. Keeping in view the existing knowledge, the present work is designed to study in detail the histological structure of human sublingual salivary glands, specially of the ducts.

MATERIALS AND METHODS

This descriptive study was carried out in Army Medical College Rawalpindi, from Jan 2002 to Dec 2002.

Sublingual glands (both right and left) were obtained from fifteen postmortem cases from within twelve hours of death. The specimens were collected from District Headquarter Hospital, Rawalpindi. The cadavers with injury to the glandular area and any obvious pathology in the glandular area, were not included.

Longitudinal incision of about 4 cm to the mucous membrane was made in the floor of the mouth on both sides of the root of the tongue. The greater parts of sublingual glands thus exposed were dissected out completely (Fig.1). Each specimen of sublingual gland was cut into two halves a and b, placed in separate bottles of 10 % formalin for 24-48 hours, then treated and fixed. Then five micrometer thick sections were made and stained with Haematoxylin and Eosin (H and E) for detailed histological study.

In each section four random observations were made under 40 X objective, within a square of an eye-piece reticule measuring 0.09 mm^2 which was calibrated against the stage micrometer. This measured square was used for counting the number of intercalated ducts, striated ducts, acini and demilunes. Following points were noted:

Types of glandular acini and number of mucous, serous acini and demilunes were also counted.

Presence or absence of intercalated and striated ducts, if present then morphology of the lining epithelium was studied.

The number of ducts were counted. Four random observations per slide were made and then the mean was taken.

Diameter of all the transversely or almost transversely cut ducts was measured. The scale of the eyepiece micrometer was superimposed on the intercalated and striated ducts. Number of divisions of the eyepiece from one basement membrane to the opposite basement membrane of transversely or almost transversely cut ducts were counted and multiplied by three, the same repeated for that duct at right angles. The mean of the two diameters was considered as the actual diameter in microns.

Computer software SPSS version 10.0 was used to analyze the data. Data was described through descriptive statistics. Independent sample's t-test was used to compare different variables between different parts and p-value < than 0.5 was considered as significant.

RESULTS

The specimens were collected from fifteen cadavers; all were male and their age was ranging from 22 to 60 years.

On gross examination each gland was seen to be pale in colour, ranging in size between 3-4 cm in length and about 1 cm in width. The connective tissue covering the gland was very thin and thus almost transparent, so that the lobulation could be seen through.

The histological structure of all the four parts of the sublingual glands, right "a" and

"b", left "a" and "b" was almost the same. The sections were surrounded by a layer of irregular connective tissue capsule, from which the septa were arising and dividing it into various lobules. Each lobule had spherical masses of cells, the acini, and ducts (Fig. 2).

In H and E stained sections acini were acidophilic as well as basophilic. In acidophilic acini the cells were pyramidal in shape with distinct outline encircling a large lumen. The nuclei were dark blue and flattened lying against the base of the cells. The cells were filled with small vacuoles which gave a foamy appearance. These acini were identified as mucous acini (Fig. 2). The other type of acini was formed of pyramidal shaped basophilic cells encircling a small and irregular lumen. They were much smaller in size than the mucous acini and identified as serous acini. Some of the mucous acini on were capped by basophilic cells, as crescent shape demilunes (Fig .3).

The mean number of transversely cut mucous acini and serous acini in the "a" and "b" parts of right and left glands was studied. The difference between the number of acini of "a" and "b" parts of both was statistically insignificant (p> 0.05 table-1).

The mean number of serous demilunes in "a" and "b" parts of right and left gland was calculated and their difference was statistically insignificant (p >0.05, table-1).

Table-1: Mean number of glandular acini in human sublingual glands.

Type		Mean±SE	Statistical significance of difference between a & b	After pooling data right/left gland Mean ±SE	Statistical significance of difference between right & left gland
HS-ra	Mucous	23.55±0.95	Mucous	Mucous	Mucous
	Serous	3.28±0.20	p>0.05	22.94±1.02	p>0.05
	Demilunes	8.98±0.60	Serous	Serous	
HS-rb	Mucous	22.93±1.35	p>0.05	3.30±0.20	
	Serous	3.31±0.23	Demilunes	Demilunes	Serous
	Demilunes	8.30±0.69	p>0.05	8.64±0.61	p>0.05
HS-1a	Mucous	22.11±0.60	Mucous	Mucous	
	Serous	3.16±0	p>0.05	22.16±0.81	
	Demilunes	8.45±0.69	Serous	Serous	Demilunes
HS-1b	Mucous	2240±1.11	p>0.05	3.15±0.22	p>0.05
	Serous	3.35±0.22	Demilunes	Demilunes	
	Demilunes	8.13±0.57	p>0.05	8.29±0.56	

HS-ra=human sublingual –right anterior HS-rb= human sublingual –right posterior
HS-la=human sublingual –left anterior HS-lb= human sublingual –left posterior

Table-2: Mean number of intercalated and striated ducts in human sublingual glands.

Type	Mean ±SE	Statistical significance of difference between a & b	After pooling the data right /left glands Mean ±SE	Statistical significance of difference between Right & left
ICDHS-ra	1.45±0.05	p>0.05	1.35±0.10	p >0.05
ICDHS-rb	1.39±.009			
ICDHS-la	1.31±0.11	p >0.05	1.29±0.11	
ICDHS-lb	1.18±0.10			
SDHS-ra	0.55±.008	p >0.05	0.62±.005	p >0.05
SDHS-rb	0.57±.008			
SDHS-la	0.80±0.14	p >0.05	0.80±0.14	
SDHS-lb	0.80±0.41			

ICDHS-r/l-Intercalated duct human sublingual-right/left
SDHS-r/l-Intercalated duct human sublingual-right/left
a/b-anterior /posterior

Within the lobules two types of ducts were found. One type of duct was lined by low cuboidal cells, having a round nucleus and acidophilic cytoplasm. These were identified as intercalated ducts (Fig.2). The other type of ducts were lined with columnar cells with a round or oval nucleus present in the center or closer to the apices of the cells with eosinophilic

between mean diameter of ducts of the two glands was statistically insignificant (p> 0.05, table-3).

After pooling the data difference between the mean number of acini, demilunes, ducts and the mean diameter of the ducts of right and left glands was found to be statistically insignificant.

Table-3: Mean diameter (microns) of intercalated and striated ducts in human sublingual glands.

Type	Mean±SE (µm)	Statistical significance of difference between a & b	After pooling data right/left gland Mean ±SE (µm)	Statistical significance of difference between right & left
ICDHS-ra	19.76 ±0.44	p>0.05	20.10±0.41	p>0.05
ICDHS-rb	20.6±0.53			
ICDHS-1a	20.34±0.49	p>0.05	20.06±0.40	
ICDHS-1b	19.84±0.98			
SDHS-ra	49.90±4.70	p>0.05	52.46±2.32	p>0.05
SDHS-rb	53.23±2.50			
SDHS-1a	61.68±3.93	p>0.05	59.70±2.96	
SDHS-1b	57.73±2.85			

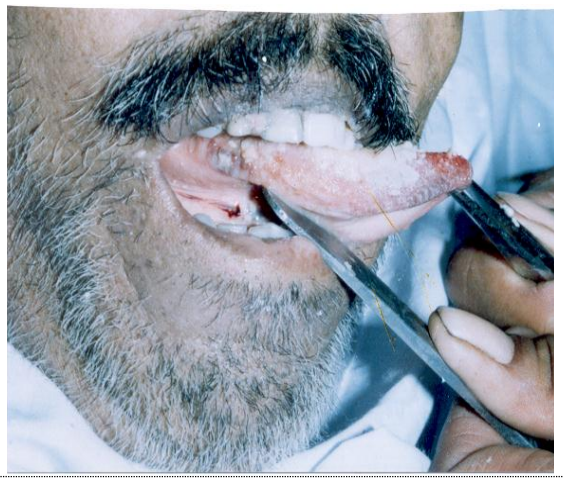

Fig. 1: Photograph showing dissection of human sublingual glands.

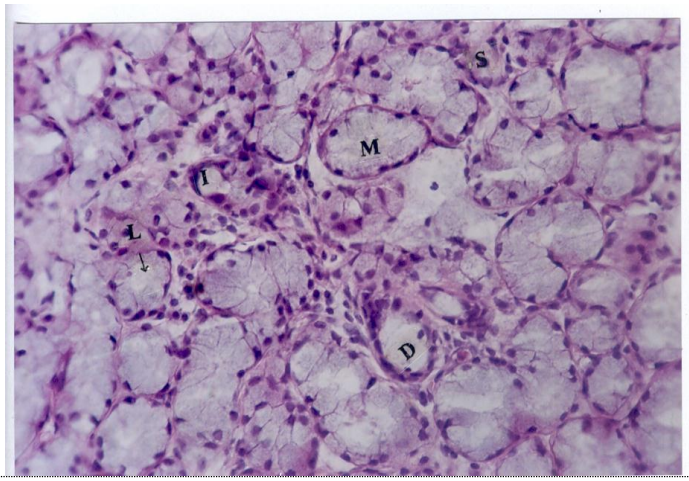

Fig 2. Human sublingual gland showing mucous acini (M) with lumen (L), serous acini (S), striated duct (D) and intercalated duct (I). H & E stains

elongated striations under the nuclei. These were identified as striated ducts (Fig. 2).

The number of intercalated and striated ducts in "a" and "b" parts of right and left glands was counted. The difference between mean number of intercalated and striated ducts of right and left gland was statistically insignificant (p > 0.05, table-2).

The diameter of intercalated ducts and striated ducts was measured. The difference

DISCUSSION

In the present study sublingual glands were studied in human. In human paired sublingual glands were seen to be 3-4 cm long and 1 cm in width, lying deep to the mucous membrane of the floor of the mouth in the form of one composite gland on either side of the frenulum of tongue. This observation is not in agreement with Leppi[8] reporting that the gland is formed of two components greater and lesser

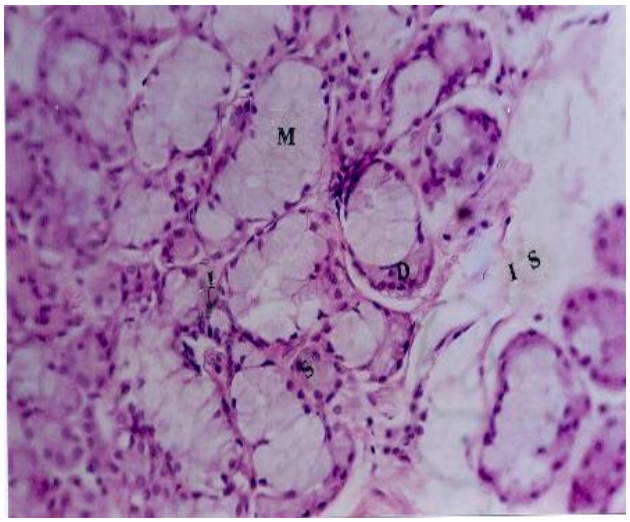

Fig.3. Human sublingual gland showing mucous acini (M), serous acini (S), demilunes (D) and interlobular septum (IS). H and E stain.

sublingual glands, the greater part present only in 50% cases while lesser is always present in the anterior portion of the paralingual space. Greater (major) sublingual glands is a composite organ and has 8—30 smaller glands bound by connective tissue to a single organ comprising the lesser (minor) sublingual gland. In current study only the part called greater sublingual gland was studied.

Microscopically all the glands were surrounded by a connective tissue layer forming the capsule of variable thickness from which septa go inside and divide the glands into lobules. Lobules consist of mucous and serous acini and also intercalated and striated ducts. This has also been reported by Telford and Bridgman[9].

Mucous acini in sublingual glands were much more in number than the serous acini . Similar observation are made by Pinkstaff[10], but Munger[11] concluded that human sublingual gland is a pure mucous gland and that the observed differences among cells are a part of a developmental continuum between sparsely granulated and mucous filled cells. The mucin synthesized by these glands requires special stains to demonstrate its presence in the form of granules[12]. It has been observed that the bulk of the cells are occupied by poorly stained eosinophilic flocculent material which represents disrupted and fused mucus droplets[13]. Some of the mucous acini were capped by serous cells called demilunes. This finding was similar to that of Ichikawa and Ichikawa[14], but not in agreement with the findings of Eversole[12] that in human sublingual glands demilunes have seromucous cells.

Serous acini were also seen but were few in number. They usually have inconspicuous lumen as has been described by Klein that small central lumen is not visible in light microscopy. The nuclei were not very dense as already reported by Pinkstaff[10] because these nuclei have lace like chromatin. The marked basophilia of the cytoplasm is due to an abundance of rough endoplasmic reticulum. It is also suggested that minute channels are present between the demilunes cells and the mucous cells, which join with the lumen of the acinus.

The intercalated ducts were present in the human sublingual glands but they were very few in number. But Pinkstaff[10] reported their absence in sublingual glands. Shakleford and Wilborn reported that intercalated ducts are highly pleomorphic anatomical entities in different species, which merit particular caution in the assignment of nomenclature[15]. The lumen of the intercalated ducts was small but clearly seen. In Human both the mean number and diameter of the intercalated ducts anterior and posterior parts of the glands and the right and left glands was statically insignificant.

Striated ducts in human sublingual glands, although very few in number, but prominently seen because they were larger in size as compared to the acini. Shakleford and Wilborn[15] observed similar striations which they called "vertical striations" present at the bases of the cells up to the nuclei.

CONCLUSION

In humans the mean number and diameter of the striated ducts anterior and posterior parts

and the right and left sublingual glands was statistically insignificant.

REFERENCES

1. Williams, Bannister LH, Berry MM, Collins P, Dyson M, Dussek JE, et al. Gray's Anatomy, 38th edi. Churchill Livingstone, London 1998; 1691-9.
2. Bloom W, Fawcett D W. A text book of histology,12th ed. Chapman and Hall, New York 1994; 566-75
3. Riva A, Riva-Testa F. Ultrastructural observations on human sublingual gland. Am. J. Anat. 1998; 181: 385-92.
4. Mclaughlin C A, Chiasson R B. Laboratory anatomy of the rabbit, 3rd ed. Brown Publishers, Washington DC 1990; 59-80
5. Kelly D E, Wood R L, Ender's A C. Bailey's Textbook of Microscopic Anatomy, 18th ed. Williams and Wilkins, Baltimore 1984; 573-82
6. James K A. Oral development and histology, 2nd ed. Thieme Medical Publisher, New York 1994; 350-80.
7. Chauncey H H, Feller RP, Henriques B L. Comparative electrolyte composition of parotid, submandibular and sublingual secretion. J. Dent. Res.1966; 45: 1230-6.
8. Leppi TJ. Gross anatomical relationship between primate submandibular and sublingual salivary glands. J. dent. Res. 1967; 46: 359-65
9. Telford I R, Bridgman C F. Introduction to functional histology. Harper and Row, New York 1990; 335-50
10. Pinkstaff C A. The cytology of salivary glands. International review of cytology 1980; 63: 141-261.
11. Munger B L. Histochemical studies on seromucous and mucous secreting cells of human salivary glands. Am. J. Anat. 1962;115: 411-30
12. Eversole L R. The mucoprotein histochemistry of human mucous acinar cell containing salivary glands: Submandibular and sublingual glands. Arch. Oral. Biol. 1972; 17:43-53.
13. Klein R M. Development, structure and function of salivary glands. In: Avery J K, Steel P F, eds. Oral development and histology. Thieme Medical Publishers Inc, New York 1994; 352-81
14. Ichikawa M, Ichikawa A. Light and electron microscopic histochemistry of the serous secretory granules in the salivary glandular cells of the Mongolian Gerbil and Rhesus monkey. Anat. Rec. 1977; 189: 125-40.
15. Shakleford J M, Wilborn W H. Structural and histochemical diversity in mammalian salivary gland. Ala. J. Med. Sci. 1968; 5(2): 180-203