ORIGINAL RESEARCH PAPER

Volume-7 | Issue-9 | September-2018 | PRINT ISSN No 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

TASTE BUDS ON HUMAN EPIGLOTTIS – A MICROSCOPIC STUDY

Anatomy

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ABSTRACT

BACKGROUND: Eventhough the presence of taste buds on epiglottis has been documented, majority of studies were conducted on animals. Human studies are few.

AIMS: To note the distribution and age changes of taste buds on human epiglottis.

MATERIALS AND METHODS: The study was conducted in 41 specimens of epiglottis collected from the Department of Forensic Medicine and Labour Room, Govt Medical College, Kozhikode. Tissue bits from the upper two thirds of epiglottis were fixed, processed, stained and analysed under light microscope.

RESULTS: Taste buds were located in the epithelium lining the posterior surface of epiglottis. Their number varied from 0-7/ low power field. Statistical analysis revealed no significant correlation between the number of taste buds and age.

KEYWORDS

Taste buds, Human epiglottis.

INTRODUCTION

The epiglottis is a thin leaf like plate of elastic fibro cartilage, which projects obliquely upwards behind the tongue and hyoid body, and in front of the laryngeal inlet[1].

Proximal two thirds of both surfaces of epiglottis are lined with stratified squamous epithelium[2]. Some taste buds, similar to those in the tongue are scattered over the posterior surface of the epiglottis and in the aryepiglottic folds[3].

The taste bud is a barrel shaped organ extending the full thickness of the epithelium and opening at the surface via the taste pore[4]. Each taste bud contains about 50 long spindle shaped cells which extend from the basement membrane to the taste pore[4]. Classically, 2 types of cells are described in the taste bud: light gustatory cells and dark supporting or sustentacular cells[4]. A third cell type, the basal cell is now generally recognized and may constitute the precursor of one or both of the other cell types [4].

Taste buds develop during weeks 11-13 by inductive interaction between the epithelial cells of the tongue and invading gustatory nerve cells from the chorda tympani, glossopharyngeal and vagus nerves[5]. Most taste buds form on the dorsal surface of the tongue, and some develop on the palatoglossal arches, palate, posterior surface of the epiglottis and the posterior wall of the oropharynx[5].

The taste cells are continually being replaced by mitotic division of surrounding epithelial cells[6]. The life span of each taste cell is about 10 days in lower mammals, but is unknown for humans[6]. Beyond the age of 45 years, many taste buds degenerate, causing taste sensitivity to decrease in old age[6].

Taste buds in the extreme pharyngeal part of the tongue and epiglottis receive fibres from the internal laryngeal branch of the vagus[1]

Structurally, the laryngeal taste buds resemble the lingual taste buds; but the fundamental difference lies in their functions[2]. Unlike lingual ones, the laryngeal taste buds function more in protective reflexes, which are important in respiratory modulation[2].

AIMS AND OBJECTIVES

1. To note the distribution and age changes of taste buds on human epiglottis.

MATERIALS AND METHODS

41 specimens of epiglottis in the age group 0-80 years were collected. Autopsy specimens were collected from the Department of Forensic Medicine, Medical College, Kozhikode. Specimens of still born babies were taken from the Labour Room of Medical College, Kozhikode. Ethical Committee clearance was obtained for the same.

Exclusion Criteria:

1. Postmortem bodies of burns cases
2. Decomposed bodies
3. Bodies with severe maxillofacial injuries

Tissue bits were taken from the upper two thirds of epiglottis and fixed in Bouin's fluid overnight. They were then processed using ascending grades of alcohol, cleared in xylene and were embedded in paraffin wax. Sections with 6 microns thickness were taken and stained with haematoxylin and eosin. Ehrlich's haematoxylin was used since it could be kept for years after ripening and gave brilliant nuclear stain. Some slides were also stained with Mallory Trichrome providing increased staining time as this enabled better visualization of taste buds. Instead of 15 sec, 2 minutes, sections were stained for 1.5 minutes, 1.5 minutes in Mallory I and II respectively. Results of the microscopic study were analysed using Spearman's correlation.

RESULTS

Taste buds were identified only in 15 cases. They were observed in the epithelium lining the posterior surface of the epiglottis. No papillae were observed. Structurally the taste buds resembled those on the tongue.

Number of taste buds ranged from 0-7 per low power field. For details refer Table 1.

TABLE : 1

Age	Taste buds/ Low power field
13 wks	0
20 wks	0
23 wks	0
27 wks	0
28 wks	0
30 wks	1
5 yrs	0
9 yrs	0
10 yrs	0
12 yrs	0
14 yrs	2
18 yrs	1
20 yrs	0
22 yrs	0
24 yrs	4
25 yrs	3
26 yrs	3
27 yrs	0
32 yrs	0
34 yrs	0
36 yrs	0
38 yrs	1
40 yrs	0
45 yrs	1

46 yrs	0
47 yrs	0
48 yrs	4
50 yrs	4
52 yrs	0
53 yrs	2
56 yrs	0
58 yrs	7
60 yrs	6
61 yrs	0
62 yrs	0
64 yrs	2
66 yrs	0
70 yrs	0
72 yrs	0
75 yrs	1
78 yrs	0

Table 2

			Age	TB/LPF
Spearman's rho	Age	Correlation co efficient	1.000	.655
		Sig (2 tailed)	.	.158
		N	6	6

TB =taste buds. LPF = low power field

Table 2 represents the statistical analysis of the data representing the taste buds/LPF on the epiglottis of fetal specimens. No significant correlation was observed between the number of taste buds/ LPF and age.

Table 3

			Age	TB/LPF
Spearman's rho	Age	Correlation co efficient	1.000	.261
		Sig (2 tailed)	.	.130
		N	35	35

Table 3 represents the statistical analysis of the data representing the taste buds/LPF on the epiglottis

(excluding fetal specimens). No significant correlation was observed between the number of taste buds/ LPF and age.

DISCUSSION

Literature available on 'taste buds on human epiglottis' are few.

Ernest R Lalonde etal[7], conducted a study on the number and distribution of taste buds on the epiglottis, pharynx, larynx, soft palate and uvula in a human new born. He observed a total of 949 taste buds on the epiglottis.

Adrian Jowett etal[8], reported that the taste buds were restricted to the rostral third of the laryngeal aspect of human epiglottis and thus embedded within the stratified squamous epithelium. Shrestha et al[2], conducted studies on animals and humans and found that in almost all samples, the taste buds were solitarily distributed along the stratified squamous epithelium at the posterior side. The present study also agrees with the above. Eventhough the taste buds were not identified in all cases, when present, they were located in the stratified squamous epithelium lining the posterior or laryngeal surface of epiglottis.

Taste buds on epiglottis were identified only in 14 out of 35 cases (excluding fetal specimens). Adrian etal[8], studying human epiglottis in donors aged 70-83 years, also could find taste buds only in 3 of the 5 samples. They also noted that the taste buds on human epiglottis were not associated with papillae. In the present study too, no papillae were observed in relation to taste buds.

In a quantitative study on taste bud distribution in the hamster, Miller etal[9] found 10% of the taste buds on the epiglottis and adjacent region of the esophagus.

According to Palmieri etal[10], taste buds were constantly present in the epiglottis of ruminants like goat, cattle and absent in pig, horse and ass. Shrestha et al[2],also found that the average number of taste buds was higher in herbivorous buffalo, goat and rabbit, while the number was lower in the omnivorous guinea pig, house rat and the human. The density of taste buds was found to be directly proportional to the feeding behavior of mammals, showing their significant role in inducing reflexes for safe passage of bolus through the esophagus and for prevention of the respiratory tract congestion[2]. Ruminating and regurgitating animals have more laryngeal taste buds, owing to the fact that because of their cudding habit, there is double chance of food bolus coming in contact with the epiglottis[2]. Obviously, they would need more reflexes[2]. Adrian etal[8], too noted only a small number of taste buds in human samples. The present study agrees with their view.

Among the fetal specimens, taste buds could be identified in only one case (30 weeks). This is in partial agreement with the study of Belecky etal[11],who stated that the taste buds located on the laryngeal surface of the epiglottis and the aryepiglottic folds of hamster are absent at birth and originate and mature over the following 120 days. But this study disagrees with Palmieri etal[10],who studied herbivores and noted that the taste buds were fairly numerous and showed typical structure in very young kids and calves. As per Gray's Anatomy[1],taste buds have been described on the fetal epiglottis and soft palate, but most disappear from these sites during postnatal development.

Sweazey R D etal[12], stated that the taste buds located on lamb epiglottis shared several structural similarities to taste buds located in the oral cavity and other regions of the pharynx and larynx of many mammalian species. In the present study too, taste buds were observed to be structurally similar to those on the lingual papillae. Fine details of structure could not be identified as this was a light microscopic study.

Ernest R Lalonde etal[7],stated a clustering effect on taste buds. According to him, the taste buds were grouped together. Arey etal[13],attributed the clustering effect to the innervations of taste buds and the formative influence that nerves had on taste bud development. Adrian etal[8], too noted that the taste buds were in 3 clusters, 1 on the midline and 3 laterally. In 2 of these , he detected only a few taste buds, wheras the third possessed around 25 taste buds in each cluster. No such clustering was seen in the present study.

According to Palmieri etal[10],in adult mammals, degenerated taste buds were found and their numbers usually increased with age. No degenerated taste bud was observed in the present study.

The number of taste buds ranged from 0-7/ LPF. Statistical analysis revealed no significant correlation between the number of taste buds per low power field and age. This is in agreement with Adrian etal[8],who noted that the presence and number of human epiglottal taste buds on the posterior(laryngeal) surface of epiglottis is exceptionally variable. But according to Yamamoto etal[14], rat laryngeal taste buds develop postnatally and their total number decreases significantly with age. Kano M etal[15], also noted that human epiglottal taste buds tend to decrease in both male and female humans as age advances. As per Stedman H M etal[16],the number of taste buds in cat epiglottis increased as a logarithmic function of both age and weight, but the correlation with weight was better than that with age. R M Bradley etal[17], found that epiglottal taste buds of sheep increased in number during development and continued to increase until the epiglottis reached its adult size. However, since the increase in taste bud numbers was paralleled by increase in the surface area of the epiglottis, the density of taste buds decreased progressively in the fetus and newborn[17]. After birth, the density remained relatively constant[17].

Because of the large number of taste buds, and the maintenance of their density on the sheep epiglottis, Bradley etal[17], concluded that they have an important functional role in upper airway protective reflexes.

Sanna L etal[18], also emphasized the probable functional role of laryngeal chemoreceptors in protecting deep airways. Shrestha R etal[19], who conducted studies on rat and house shrew, suggested that the epiglottal taste buds might work as chemosensory detectors to initiate the reflex reaction to protect the airway from oral substances during swallowing and drinking.

According to Sweazey R D etal[12], the presence of synapses on both Type I and Type II cells of lamb epiglottal taste buds suggested that both cell types were involved in laryngeal chemoreception. Andrea etal[20], demonstrated the presence of structural differences between taste buds and laryngeal chemosensory clusters by ultrastructural examination. Their study represents a step in the definition of a diffuse chemosensory system composed of taste cell related elements.

In a study conducted in monkeys, Khaisman E B etal[21], suggested that

the innervation apparatus of the taste buds of the epiglottis constituted part of unique afferent system of the organ, ensuring its defensive function. So he proposed to call those taste buds as special structures of the chemoreceptors. Electrophysiological studies have demonstrated that the nerve supply of epiglottis contained chemosensitive fibres (Storey etal[22]; Harding etal[23]). Based on this evidence, R M Bradley etal[17], hypothesized that the taste buds were responsible for chemical sensitivity of the epiglottis and therefore functioned in mediating protective reflexes.

But according to Adrian etal[8], by comparison with the epiglottis of other mammals, the aged human epiglottis carried few taste buds in a different pattern which suggested that they might have a less significant role in protecting the airway. Using a laryngoscopic mirror, Wilson J G[24], applied stimuli to his own larynx and stated that he could taste 'the four primary tastes', though the sensation was quantitatively and qualitatively inferior to the tongue. He therefore rejected the notion that the epiglottal taste buds were a phylogenetic residue and hypothesised that they were part of a reflex mechanism protecting the airway.

In the present study, since the taste buds were identified in the posterior surface of epiglottis which faces the laryngeal inlet, it seems that they may be involved in laryngeal chemoreception, enabling reflexes, in case food particles enter the larynx.

As per Stedman etal[16], the presence of epiglottal taste buds from very early developmental stages, suggested that those receptors might mediate the reflex aphnoea and swallowing that occurred in response to chemical stimulation of the larynx in newborns. But in the present study, taste bud could be detected only in one fetal specimen.

According to Bradley etal[25], any decrease or increase in the density of taste buds could lead to hypo or hyper sensitivity of the epiglottis and therefore result in atypical laryngeal reflexes.

Further studies have to be conducted to assess whether any change in the density of taste buds in the epiglottis of infants might act as a predisposing factor for crib death or SIDS.

CONCLUSIONS

The taste buds are located in the epithelium lining the posterior surface of the epiglottis. This points to their probable role in laryngeal chemoreception enabling protective reflexes ,in case food particles enter the larynx.

Structurally the taste buds resemble those on the tongue.

There is no significant correlation between the number of taste buds and age

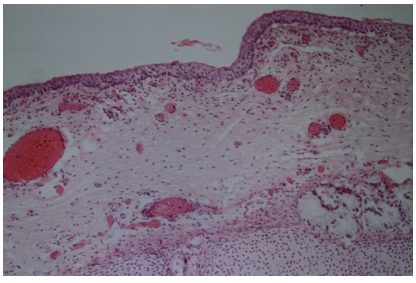


Fig:1-Section of epiglottis of 23 week old fetus .No taste bud seen. Haematoxylin & Eosin staining. Magnification x 100.

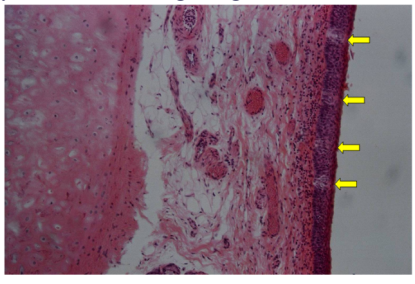


Fig:2-Section of epiglottis of 48 year old showing 4 taste buds (yellow arrow). Haematoxylin & Eosin staining. Magnification x 100.

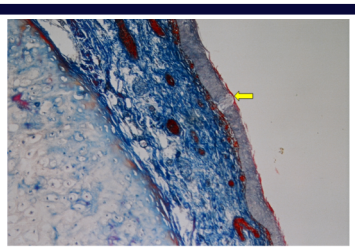


Fig:3-Section of epiglottis, stained using Mallory Trichrome (providing increased staining time). One taste bud seen (yellow arrow). Magnification x 100.

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