Sonographic Assessment of the Salivary Glands among Sudanese Snuff-dippers

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Abstract

Background: The parotid, submandibular, and sublingual glands, as well as the smaller subsidiary glands, are all the examples of the salivary glands. The likelihood of the salivary glands being impacted by snuff components increases due to this close proximity of the salivary glands to the mouth when snuff is used. The aim of this study was to evaluate the salivary glands of the Sudanese snuff-dippers. **Methods:** Sixty-five adult snuff-dippers (research group) and 36 adult nonusers (control group) were enrolled in the study. Sonography of the submandibular and parotid glands was performed; size, blood flow, echogenicity, echotexture, and any other pathological changes were evaluated. The study was conducted in the ultrasound unit at our institution from June 2021 to June 2022. **Results:** The result of the study showed that the average size of the left submandibular gland and left and right parotid glands of snuff-dippers was significantly greater than the average size of nonusers. Blood supply and tissue characteristics were normal. **Conclusion:** The study concluded that the snuff use could affect the parotid and submandibular glands; ultrasonography is a modality of choice in the examination of the salivary glands of snuff users and other tobacco users.

Keywords: Salivary gland, snuff-dippers, ultrasound

Introduction

The parotid, submandibular, and sublingual glands, as well as the smaller subsidiary glands, are all examples of the salivary glands. The parotid, which is the largest gland, enters the mouth through its duct at the level of the second upper molar tooth. The submandibular duct is exposed next to the tongue's frenulum and consists of a superficial component and a deep part. The sublingual glands, which are located on the floor of the mouth, are directly drained by a network of tiny ducts.[1] The likelihood of the salivary glands being impacted by snuff components increases due to this close proximity of the salivary glands to the mouth when snuff is used.

Snuff, or toombak as it is known locally, was first used in Sudan about 400 years ago. It is consistently processed into a loose moist form and is widely used in the nation. The Nicotiana rustica species of tobacco is used to make toombak, and the fermented crushed powder is combined with an aqueous sodium bicarbonate solution. The end product is wet with dark brown color, has a strong aroma, is highly addicting, and is used frequently, especially by men,[2] and sold in bags [Figure 1].

Polonium 210, a nuclear waste, N-nitrosamines, formaldehyde, nicotine, cadmium, cyanide, arsenic, and nicotine oxide are all components of snuff. When a person chew smokeless tobacco, the tissue in the mouth absorbs the addictive chemical nicotine as well as other substances such as lead, formaldehyde, and carcinogens such as cadmium and arsenic.[3] The use of toombak plays a significant role in the etiology of oral squamous cell carcinomas and is suspected to be linked to neoplasm of the salivary glands.[4] The risk for cancer of the oral cavity was high among toombak users, and specific nitrosamines present in toombak may act as principal carcinogens.[5]

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Figure 1: The smokeless tobacco, locally known as toombak in Sudan

Right now, imaging of the salivary glands is best done using ultrasound. The size, shape, echogenicity, and likelihood of localized lesions of the glands are all regularly assessed.[6] The assessment of parenchymal blood flow, the vascular system of glandular tissue, and the vasculature of focal lesions can all be done using Doppler techniques, which can sometimes be very helpful.[7] Salivary gland ultrasonography, a practical, noninvasive technology with great specificity that enables detection of the involvement of the major salivary glands, has recently been developed.[8,9] Salivary gland ultrasound imaging provides crucial details on any change in size, tissue, and blood supply, as well as the identification of malignancies and stones.[10]

Previous studies have been conducted to detect the effect of snuff on oral cavity and its consequences in the saliva in terms of change in pH or change in secretion,[11,12] but the effect of snuff on the salivary glands itself needs to be clarified. The aim of this study was to evaluate the salivary gland changes among snuff-dippers.

Materials and Methods

Subjects

This was a case–control study, based on two groups of adult Sudanese males; 65 snuff-dippers and control group included 36 nonsnuff-dippers; their age ranged 20–68 years. The study included people who are dipping snuff continuously and excluded anyone with signs and symptoms of any salivary gland disorder. The study was conducted in the ultrasound department at our institution from June 2021 to June 2022. The age, weight of both groups, and the duration of using snuff were obtained.

Sonographic scanning

The ultrasound examination of the salivary gland was performed with Alpinion E-Cube 9-2012 Korea machine, with12 MHz linear transducer.

The patient was supine with an extended neck and a slight turn of the head to the opposite side. The parotid gland measurement is challenging due to the more complicated structure of the gland. The probe was placed inferior to the ear in the axial plane and (AP) diameter was taken. In coronal plane with the probe anterior to the ear, a mediolateral (ML) dimension was performed. Both AP and ML diameters of the parotid gland were measured on the same transverse view obtained at the level of the angle of the mandible. Paramandibular depth was also recorded. Regarding the submandibular gland, an (AP) dimension was measured on the longitudinal view parallel to the horizontal ramus of the mandible. ML was measured on the perpendicular view obtained at the half point of (AP) diameter. Three dimensions of each submandibular and parotid gland were measured (anterior-posterior length and paramandibular depths in the transverse axis and the dimensions of craniocaudal height), from which the size was recorded [Figures 2 and 3].

The salivary glands' echogenicity can be compared to either normal thyroid glands (which are identical), nearby muscles (which should be more echogenic than nearby muscles), or normal homogeneity, which is comparable to the thyroid glands.

Because the salivary glands have a complex vascularization, the salivary parenchyma was scanned in the longitudinal and transverse scanning planes to map color flow signals. When a vessel of a specific size was found, the scanning plane was set up along the ideal plane to extend and display it well. Both groups underwent Doppler ultrasounds; the resistance index and pulsatility index were recorded.

Data analysis

Using Microsoft Excel, the data were entered and statistically analyzed using SPSS version 20, IBM (SPSS, version 20 software, IBM Corp. Chicago). The descriptive and group statistics were performed, and statistical significance was set at values <0.05

Ethical approval

Permission was obtained from the Institutional Review Board to perform the study in the ultrasound department (CMRS-MSMDU2021-76). Inform consent was assigned from all participants after they agreed to participate in the study.

Results

The study was conducted on two groups of adult Sudanese males; 65 snuff-dippers and control group included 36 nonsnuff-dippers; their age ranged 20–68 years and weight ranged 52–105 kg with the mean of 71.7 kg as shown in Table 1.

The comparison between the control group and snuff-dippers regarding the size of the submandibular gland and parotid gland on both sides is shown in Table 2. There was a significant difference noted between the control group and the snuff-dippers on the left and right parotid gland as well as the left submandibular gland; the gland size was greater in snuff-dippers. The most significant difference was noted in the left parotid gland, as shown in Figure 4.

Table 1: Descriptive statistics of age and weight for all the participants

	Minimum	Maximum	Mean±SD
Age			
Control	20	65	39.04±13.39
Snuff-dippers	20	68	41.56±12.90
Weight			
Control	52	103	71.42±12.28
Snuff-dippers	55	98	71.93±10.10

SD: Standard deviation

Regarding the echogenicity and blood flow indices [Table 3], the salivary glands showed a normal echogenicity and blood flow (resistive index) on both groups.

Discussion

The study used information from healthy snuff users who do not report any disorder with their salivary glands. They were chosen at random and examined at the Sudan University of Science and Technology – College of Medical Radiological Science's ultrasonography clinic. The results of the research group were compared with those of the control group, which was made up of healthy individuals who did not use snuff and did not report any issue with their salivary glands.

Between the research group and the control group, there was a significant difference in the mean size of the left submandibular gland and bilateral parotid glands; the P values for these differences were 0.047, 0.017, and 0.002, respectively. The size of the left submandibular glands and the right and left parotid glands was greater in snuff-users without any inflammatory or cystic change and tumor; this could be due to the injury to ductal secretory unit as a result of related toxic products.[11] The reduction in saliva causes the increased size of the glands. This result was also revealed by[13] they came to the conclusion that nicotine caused the submandibular salivary ducts to atrophy. Snuff contains the addictive substance nicotine, and salivary duct atrophy results in the salivary gland enlargement. Nicotine effects on the salivary gland also have been studied in mice, which showed that the acinar cells of the salivary gland contained an increased number of enlarged light, immature secretory granules. Similar findings, known as "sialadenosis," have been seen in the parotid gland of animals as well as humans who have been given beta-adrenergic medications aludrin and isoproterenol on a long-term basis.[14] This means that nicotine is a component of snuff that is responsible for increasing the size of the salivary glands in the users. Furthermore, as noted the right and left parotid glands showed a significant increase in size, only the left submandibular gland was increased in size. This is because users habitually placed the snuff in both sides in the upper buccal area, while they use the left side in the lower buccal area.

Regarding the echogenicity and blood flow indices, the salivary glands showed a normal echogenicity and blood

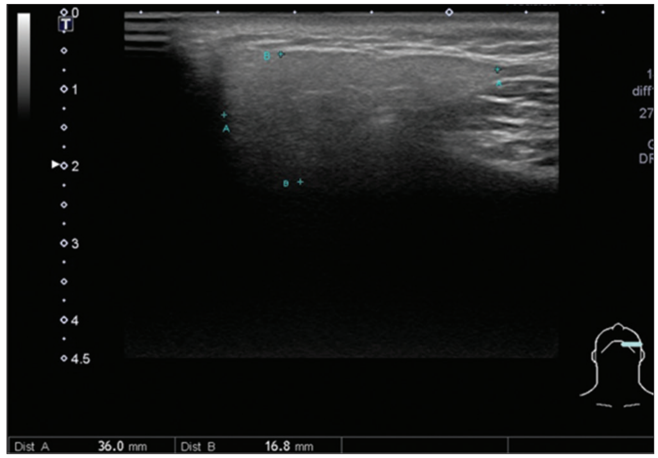

Figure 2: Dimensions of the submandibular gland

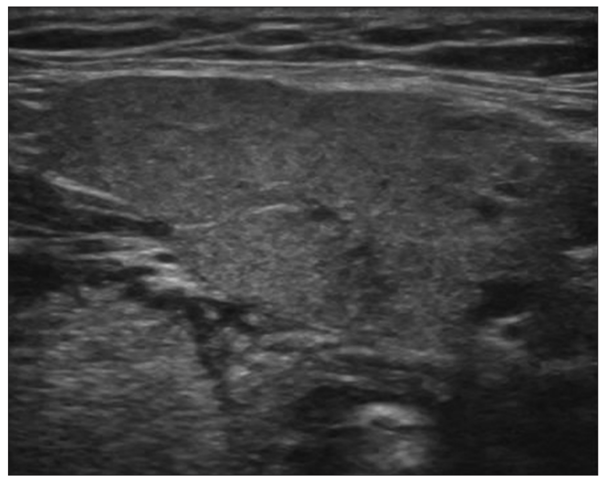

Figure 3: Longitudinal view of the parotid gland

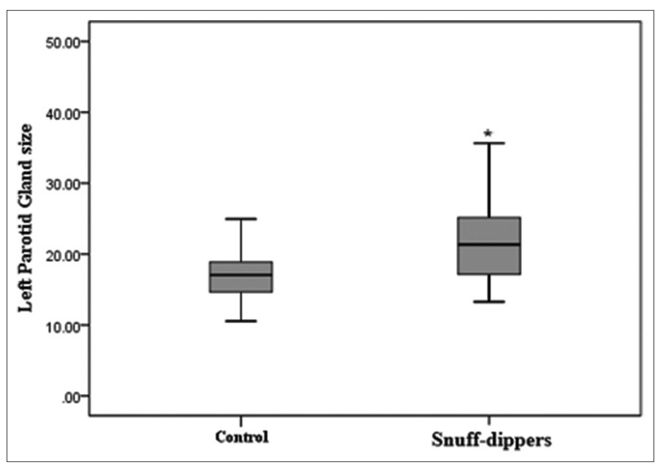

Figure 4: Comparison between the control group and snuff-dippers in size of the left parotid gland, a strike indicates the significant difference ($P < 0.05$)

flow on both groups. This means that snuff cannot affect the tissues of the salivary gland and make them inflamed, but hypertrophy of the salivary gland which is resulted from

Table 2: The size of the submandibular gland and parotid gland in the control group and snuff-dippers

Glands	Case	Mean±SD			
		Right		Left	
Submandibular	Control	13.07±3.44	*P*=0.141	13.11±2.89	*P*=0.047
	Snuff-dippers	14.93±4.40		15.18±4.83	
Parotid	Control	17.31±4.30	*P*=0.017	17.47±4.07	*P*=0.002
	Snuff-dippers	23.30±4.24		22.87±4.45	

SD: Standard deviation

Table 3: The resistive index for the submandibular and parotid glands for both groups

Glands	Case	Mean±SD	
		Right	Left
Submandibular (RI)	Control	0.75±0.03	0.75±0.03
	Snuff-dippers	0.75±0.05	0.75±0.05
Parotid (RI)	Control	0.75±0.03	0.75±0.03
	Snuff-dippers	0.75±0.05	0.73±0.15

SD: Standard deviation, RI: Resistive index

snuff can affect the surrounding cells and make pressure. During the usage of snuff, the users feel increased secretion of saliva; this stimulus action does not cause any change in the resistive index of the Doppler waveform in the parotid or submandibular glands. This result was also approved by Carotti *et al*.[15] who stated that the resistivity values of the parotids and submandibular glands did not show significant changes after lemon stimulation.

Conclusion

Although its statistical power is limited, this study provided evidence that snuff use affects the salivary glands and that snuff users' salivary glands can be routinely examined using ultrasonography. Ultrasound is a great tool for assessing the salivary glands and can be used for routine checks on snuff and other tobacco users. The study concluded that there is no conclusive evidence linking snuff usage to any change in the homogeneity, blood flow, or echogenicity of the salivary gland. According to the study, snuff users' salivary glands were noticeably larger than those of nonusers. However, more research with a larger sample size should be done, taking into account the frequency and duration of the snuff use to be connected with the gland enlargement.

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Conflicts of interest

There are no conflicts of interest.

References

1. Kessler AT, Bhatt AA. Review of the major and minor salivary glands, Part 1: Anatomy, infectious, and inflammatory processes. J Clin Imaging Sci 2018;8:47.
2. Ahmed HG, Mahgoob RM. Impact of toombak dipping in the etiology of oral cancer: Gender-exclusive hazard in the Sudan. J Cancer Res Ther 2007;3:127-30.
3. Food and Drug Administration. Harmful and potentially harmful constituents in tobacco products and tobacco smoke: Established list. Fed Regist 2012;77:20034-7.
4. Ibrahim SO, Lillehaug JR, Dolphine O, Johnson NW, Warnakulasuriya KA, Vasstrand EN. Mutations of the cell cycle arrest gene p21WAF1, but not the metastasis-inducing gene S100A4, are frequent in oral squamous cell carcinomas from Sudanese toombak dippers and non-snuff-dippers from the Sudan, Scandinavia, USA and UK. Anticancer Res 2002;22:1445-51.
5. Badie H, Abdelbadie A, Munsoor MM, Ahmed WA. Histopathological patterns of oral lesions among Sudanese patients. Clin Med 2015;1:52-55.
6. Salaffi F, Carotti M, Argalia G, Salera D, Giuseppetti GM, Grassi W. Usefulness of ultrasonography and color Doppler sonography in the diagnosis of major salivary gland diseases. Reumatismo 2006;58:138-56.
7. Bhatia KS, Dai YL. Routine and advanced ultrasound of major salivary glands. Neuroimaging Clin N Am 2018;28:273-93.
8. Bialek EJ, Jakubowski W, Zajkowski P, Szopinski KT, Osmolski A. US of the major salivary glands: Anatomy and spatial relationships, pathologic conditions, and pitfalls. Radiographics 2006;26:745-63.
9. Carotti M, Salaffi F, Di Carlo M, Barile A, Giovagnoni A. Diagnostic value of major salivary gland ultrasonography in primary Sjögren's syndrome: The role of grey-scale and colour/power Doppler Sonography. Gland Surg 2019;8:S159-67.
10. Luciano N, Baldini C, Tarantini G, Ferro F, Sernissi F, Varanini V, *et al.* Ultrasonography of major salivary glands: A highly specific tool for distinguishing primary Sjögren's syndrome from undifferentiated connective tissue diseases. Rheumatology (Oxford) 2015;54:2198-204.
11. Girja KP, Sundharam BS, Krishnan PA, Devi CS. Biochemical changes of saliva in tobacco chewers tobacco smokers, alcohol consumers, leukoplakia and oral cancer patients. Indian J Dent Res 2002;13:102-7.
12. Anass MA, G Ahmed H. A case-control study of oral epithelial proliferative markers among Sudanese Toombak dippers using micronuclei assay, Argyrophilic Nucleolar organizer region, Papanicolaou and crystal violet methods. Rare Tumors 2013;5:e31.
13. Hanaa HB. The effect of nicotine and caffeine on the salivary glands. International Arab Forensic science and Forensic Medicine Conference; Saudia Arabia: Arab Society for Forensic science and Forensic Medicine 2015;2-14.
14. Jung JW, Choi JK, Byun JS. Effects of chronic nicotine administration on salivary gland in mice: Immunohistochemical study. J Oral Med Pain 2014;39:83-9.
15. Carotti M, Salaffi F, Manganelli P, Argalia G. Ultrasonography and colour doppler sonography of salivary glands in primary Sjögren's syndrome. Clin Rheumatol 2001;20:213-9.