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Original Article

Submandibular gland biometry by high frequency ultrasound

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ABSTRACT

Introduction: Submandibular glands are involved in many disease processes. Acute viral and bacterial inflammatory diseases are the most common causes of submandibular gland enlargement. Reduction in their size is observed in chronic inflammation and after radiation therapy. Various benign and malignant neoplasms also affect them. Therefore it is important to know the normal range of measurements as a reference. High frequency ultrasound is an easily available and reliable radiological investigation used for primary evaluation of the submandibular glands. The study was conducted to determine biometry of submandibular gland in healthy adults by high frequency ultrasound.

Methods: Total 100 subjects from third to seventh decade underwent high frequency ultrasound of submandibular gland. There were equal numbers of both genders in each decade. Length, depth, width and volume of both glands were recorded.

Result: The mean antero-posterior length was 3.26 ± 0.34 cm, paramandibular depth was 1.74 ± 0.27 cm and lateral-medial width (transverse) was 2.23 ± 0.37 cm. Volume measurement by ultrasound was 7.06 ± 2.51 ml.

Discussion: Measurement of size and volume of submandibular gland is now easily possible with the help of high frequency ultrasound. These can be used as reference value in determining increase or reduction in size of the gland in various disorders.

1. Introduction

Paired submandibular salivary glands are located behind mandible in the submandibular triangle. They are not palpable. The size of the gland varies in focal or general disease process. Inflammatory diseases are the most common whereas tumors are uncommon.[1] When there is bilateral enlargement, it is difficult to compare with the other gland.[2] Change in size and volume of the gland was also noted after chorda tympani section surgery.[3,4] Thus information about the gland size is important for the clinician.

High frequency ultrasound is well accepted radiological investigation used for submandibular gland evaluation. It is usually first and the only investigation done in submandibular gland diseases. Various studies have been done for evaluation of focal benign and malignant lesions.[5,6,7] Only one study has reported normal ultrasonographic biometry of submandibular glands.[8,9] Present study was undertaken to measure submandibular gland dimensions and volume in healthy adults by high frequency ultrasound.

2. Materials and methods

Total 100 adult subjects (50 male, 50 female) free from salivary gland disease were included in the study. Prior informed consent was taken. The study was approved by the institutional ethics committee. There were ten male and ten female subjects from third to seventh decade each. Subjects with body weight more or less than 20% according to Broca's formula[10] were excluded. Obesity and Anorexia were avoided in the selection of subjects. Other exclusion criteria were previous history of salivary gland disease and glands with altered echotexture or having focal lesion on ultrasound.

For ultrasound examination the neck was extended by keeping pillow below the shoulder. The head was turned away from the side examined. All subjects underwent ultrasound of submandibular gland with 7.5–12 MHz linear broadband high frequency transducer. My lab 50 and My lab 40 Ultrasound and Color Doppler machines manufactured by M/s Esaote, Italy were used. All subjects were examined by a single operator.

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Fig. 1. Ultrasound image showing anteroposterior length and paramandibular depth.

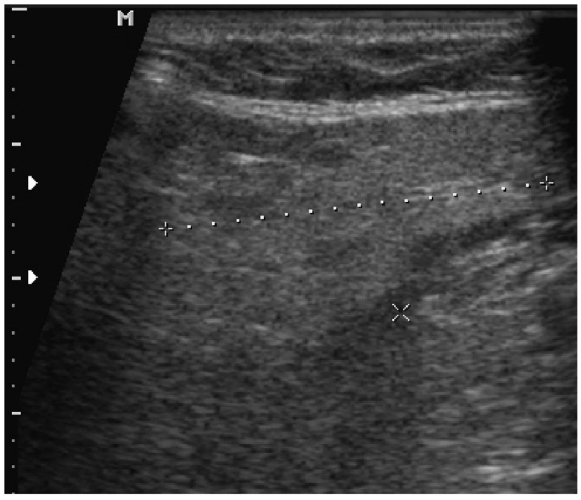

Fig. 2. Ultrasound image showing mediolateral width.

Submandibular glands were evaluated in two planes- para mandibular longitudinal and mediolateral transverse (Figs. 1 and 2). The glands were scanned at an angle that visualised as much of the gland as possible. The maximum dimensions in antero-posterior length and paramandibular depth was measured in plane parallel to mandible. Lateral-medial width was recorded in plane a perpendicular to above. The volume of the gland was determined by the prolate ellipsoid method. The formula used was volume = length × width × height × 0.52 measured in two planes.[9] Mean of measurements and volume in each age group was calculated.

3. Result

The mean body weight of the subjects included was 70.16 ± 3.96 kg in males and 56.98 ± 3.80 kg in females. The mean antero-posterior length of the submandibular gland was found to be 3.26 ± 0.34 cm. The paramandibular depth was 1.74 ± 0.27 cm whereas the lateral-medial width (transverse) was 2.23 ± 0.37 cm. The dimensions varied within standard deviation in various age groups. The mean volume of the gland was 7.06 ± 2.51 ml. No statistically significant correlation was found in the dimensions of the submandibular gland with genders, body weight and age of the subjects.

The measurements of submandibular glands in various age groups were as per Table 1.

4. Discussion

Sub-mandibular glands are the second largest paired salivary glands. Generally, the shape of the submandibular gland in longitudinal and transverse sections is close to a triangle.[6] The gland is involved in number of pathologies and thereby undergoes change in size. Inflammatory diseases are more common than tumors.[1] Glands can be enlarged in acute sialadenitis of viral or bacterial origin.[6] Tuberculosis can present acutely with sialadenitis.[12] Sarcoidosis may present with painless enlargement. Increase in submandibular gland size is very common in Sjögren's syndrome, an autoimmune syndrome predominantly affecting middle aged women.[13] Usually both glands are involved, so it is difficult to compare the size with contralateral gland.[2]

In chronic recurrent infection and post-radiation status the gland size reduces. Volume of the ipsilateral submandibular gland decreases in the late postoperative period after chorda tympani section surgery.[3] Considering this scenario it is important to know biometry of the submandibular gland as a reference.

High frequency ultrasound is widely used for evaluation of the submandibular gland. It is user friendly and involves no radiation. Frequently ultrasound points to final diagnosis or gives the differential diagnosis.[12]

To the best of our knowledge study by Dost et al. is available on normal dimensions of salivary glands by high frequency ultrasound.[8,9] They studied biometry of submandibular and parotid glands in 50 healthy adults. Uzun et al. measured sub-mandibular glands and volume in 99 patients while studying effect on their size and function after chorda tympani section surgery for middle ear disease.[3] The comparison between these studies is shown in Table 2.

The anteroposterior length was nearly matching with both studies. The transverse width was similar with Uzun et al.[3] The depth did not correlate with either study. This may be due to difference in study population.

Table 1
Submandibular glands dimensions and volume in various age groups.

Age	Anteroposterior length (cm)	Paramandibular depth (cm)	Lateral-medial width (cm)	Volume (ml)
21–30	3.34 ± 0.27	1.73 ± 0.22	2.28 ± 0.39	7.04 ± 2.20
31–40	3.44 ± 0.33	1.76 ± 0.27	2.29 ± 0.38	7.44 ± 2.39
41–50	3.38 ± 0.33	1.79 ± 0.30	2.39 ± 0.45	7.85 ± 3.27
51–60	3.08 ± 0.34	1.75 ± 0.31	2.33 ± 0.35	6.78 ± 2.60
61–70	3.04 ± 0.22	1.67 ± 0.26	2.30 ± 0.22	6.16 ± 1.55
Overall mean	3.26 ± 0.34	1.74 ± 0.27	2.23 ± 0.37	7.06 ± 2.51

Table 2
Comparison of dimensions and volume calculation.

Study	Number	Length in cm	Depth in cm	Width in cm	Volume in ml
Dost et al.[8,9]	100	3.50 ± 0.57	1.43 ± 029	3.37 ± 0.54	3.5 ± 1.5
Uzun et al.[3]	99	3.28 ± 0.43	1.17 ± 0.21	2.55 ± 0.53	9.82 ± 2.4l
Present study (2014)	200	3.26 ± 0.34	1.74 ± 0.27	2.23 ± 0.37	7.06 ± 2.5

The volume measurement differed from both studies but correlated well with the volume measurement in cadavers done by Dost et al.[8,9] They have calculated the volume by ultrasound using Simpson's method. This formula is dependent on single or two dimensions. They have also calculated the cadaveric volume by dissecting the gland and measuring the amount of water displaced after submerging the dissected gland in a calibrated vessel. Although the gland measurements on ultrasound and cadaveric study were similar, there was significant mismatch of ultrasound volume measurement (3.5 ± 1.5 ml) with that of cadaver (6.9 ± 2.3 ml). The prolate ellipsoid method used in this study uses three dimensions by ultrasound for volume measurement of different organs or mass lesions.[11] The formula used by Uzun et al. is not known.[3]

5. Conclusion

The biometry of submandibular glands does not correlate with genders, body weight and age of the subjects. These normal submandibular gland dimensions and volume measurement by high resolution ultrasound can be used as a reference to determine enlargement or atrophy of the gland in various disorders.

Conflict of interest

Authors do not have any conflict of interest. The authors declare that this study has received no financial support.

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