Ultrasonographic features and vascular patterns of the submandibular gland

〔ORIGINAL〕

Ultrasonographic features and vascular patterns of the submandibular gland

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Abstract

The ultrasonographic features and intranodal vascular patterns of the submandibular glands were evaluated to establish criteria for the diagnosis of salivary glands. There were significant differences between the internal echo of the submandibular glands and the parotid glands and the tongue. The internal echo of the submandibular gland indicated the lowest intensity. The internal echo intensity in the under 30% weight/height ratio group was hypoechoic, and the echo intensity in the over 50% weight/height ratio group was hyperechoic. The ratio of the obvious posterior echo of the submandibular glands were 11.0-15.0%. The ratio of the obvious boundary echo of the submandibular glands were 2.5-3.6%. No lateral shadow was observed. Continuity of the bifurcation part with the trunk was observed in 17 facial arteries (68%), 14 submental arteries (56%), and these arteries were easily examnined. Continuity was observed in 1 branch of the external carotid artery (4%), and the suprahyoid branch of the lingual artery was not observed.

Introduction

Ultrasonography is frequently used in the diagnosis of soft tissue lesions in the head and neck region because of its noninvasiveness and ease of application[1-5]. To conduct a correct sonographic diagnosis of submandibular usual gland lesion complaints, such as tumors, cysts, and inflammations, it is necessary to compare the usual ultrasonographic features and the intranodal vascular patterns of the submandibular gland with abnormal features. The features of submandibular glands on ultrasonograms are expressed subjectively, according to the clinical experience of the observer and this method always involves uncertainties caused by differences in experience.

In this study, the ultrasonographical features and the intranodal vascular patterns of the submandibular glands were evaluated to develop criteria for the diagnosis of salivary glands.

Key words : Submandibular gland, Internal echo, posterior echo, Power Doppler imaging

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Materials and Methods

Examination of the ultrasonographic features was performed using a Echo Camera 210DX Ⅱ with a 5.0 MHz linear array transducer (Aloka, Tokyo, Japan). The B-mode transverse planes were obtained, and all ultrasonographic images were analyzed by one of the authors (T.O.). To standardize the settings on the image analyzing equipment, the receiving gain was kept constant at the following condition: near gain 5, far gain 3 , and gain 6. The transducer surface with echo-gel was placed on the back skin to prevent air artifacts.

The ultrasonographic image analyzing, XL500, was by Olympus-avio, Tokyo, Japan with an image processor (TVIP4100) and soft ware by Image Command4198. After the command for measuring density was selected, the brightness on the CRT representing the internal echoes were measured. The ROI (region of interest) for measuring the internal echoes were set on the subumandibular glands, the parotid glands and the tongue, respectively. The average of the brightness on the three different sites was calculated.

The ultrasonographic examination was performed bilaterally on the submandibular glands of 100 healthy volunteers : 60 males (mean age, 25.5 years ; range, 23-36 years) and 40 females (mean age, 23.9 years ; range, 23-27 years).

The ultrasonographic features of the submandibular glands are shown in figure1. The internal echo, posterior echo, boundary echo, and lateral shadow were evaluated. The internal echo represents the average of the echo intensity of the submandibular glands, measured by image processer XL500. To investigate the relation between individual differences and the internal echo intensities, the under 30% weight/height ratio group was compare with the over 50% weight/height ratio group. The posterior echo was represented by the increased echo intensity of the posterior region of the submandibular gland. The difference in echo intensity between the anterior and posterior regions of the gland, and then the ratio of the submandibular glands with obvious posterior echos were calculated. The boundary echo was represented by the increase in echo intensity of the region surrounding the submandibular gland, the existence of submandibular glands with obvious boundary echos were evaluated. The lateral shadow was defined as a low echo intensity area that appeared from the lateral side in the submandibular gland to the posterior region. The blood flow of the submandibular glands were evaluated using Power Doppler US (SSD-1700 ; Aloka, Tokyo, Japan). A transverse scan was performed using a 7.5MHz transducer. All images were obtained by a Power

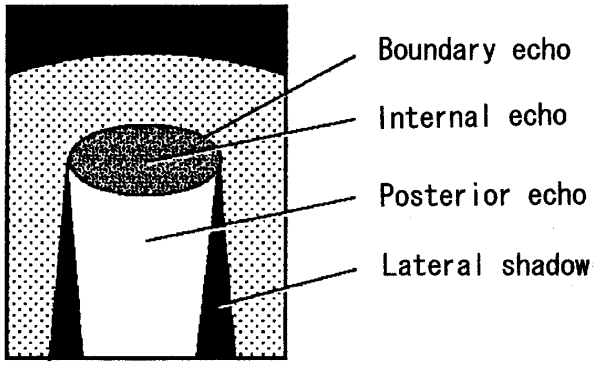

Fig.1 Ultrasonographic features of the submandibular glands

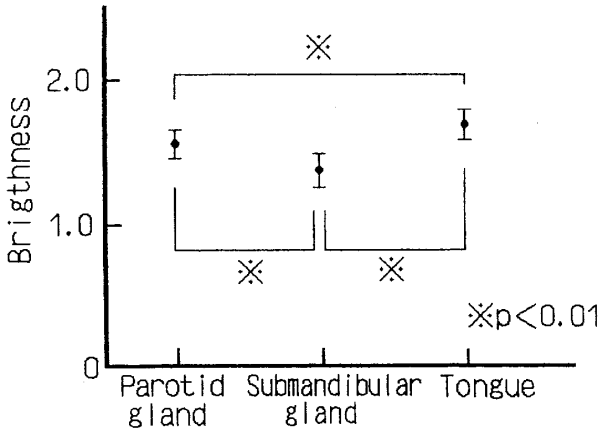

Fig.2 Internal echo intensity of the submandibular and parotid glands and the tongue

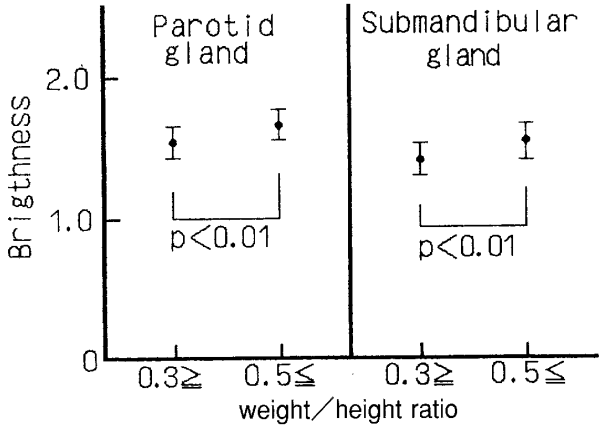

Fig.3 Relation between the individual difference and the internal echo intensity

Doppler unit under the following conditions : gain, 80dB ; depth, 42mm ; and velocity scale of Power Doppler, ±10cm/sec. The color-write priority of the Power Doppler was maximized for the display of flow color information.

The power Doppler examination was performed in the submandibular glands of 25 healthy volunteers : nineteen males (mean age, 24.2 years ; range, 22-28 years) and six females (mean age, 24.2 years ; range, 22-27 years).

All images were in principle obtained of the right side of the submandibular gland. In the branch of the facial artery, the submental artery, the lingual artery, the palatine ascending artery, the suprahyoid branch of the lingual artery, and the branch of the external carotid artery around the submandibular gland, ultrasonographic images were obtained using the Power Doppler. The continuity of the bifurcation of the trunk and each artery was examined for delineation of blood flow in the artery. The number of intraparenchymal arteries was calculated on the images obtained with an oblique sagittal orientation parallel to the mandibular plane.

Results

There were no statistically significant differences between male and female images : The right and the left internal echo, all of the internal echoes were compared for the submandibular glands, the parotid glands, and the tongue. There were statistically significant differences between the internal echo of the submandibular glands and the parotid glands and the tongue by using the Student t test ($p<0.01$). The internal echo of the submandibular gland indicated the lowest intensity (Fig.2).

To investigate the relation between individual differences and internal echo intensities, the under 30% weight/height ratio group was compared with the over 50% weight/height ratio group. The internal echo intensity of the under 30% weight/height ratio group was hypoechoic, and the echo intensity in the over 50% weight/height ratio group was hyperechoic (Fig.3). The posterior echo was represented by an increased echo intensity of the posterior region of the submandibular gland. The averages of the posterior echo intensity were 0.55-0.58 (brightness). The ratio of submandibular glands with obvious posterior echos was 11.0-15.0% (Table1). The ratio of submandibular glands with obvious boundary echos was 2.5-3.6%,

Table.1 Posterior echo of the submandibular gland

		echo intensity (brightness)	appearance rate (%)
Male	right	0.57 ± 0.21	11.7
	left	0.58 ± 0.20	11.7
Female	right	0.57 ± 0.19	11.0
	left	0.55 ± 0.23	15.0

Table.2 Boundary echo lateral shadow appearance rate (%) of the submandibular gland

		boundary echo	lateral shadow
Male	right	3.3	0
	left	3.3	0
Female	right	3.6	0
	left	2.5	0

Table.3 Visualization of bifurcation part with outside branch of the submandibular gland

n=25

	number of visualization
branch of facial artery	17 (68%)
branch of submental artery	14 (56%)
branch of lingual artery	9 (36%)
branch of palatine ascending artery	5 (20%)
branch of suprahyoid branch of lingual artery	0 (0%)
branch of external carotid artery	1 (4%)

no the lateral shadow was observed (Table2).

Table 3 shows the continuity of the bifurcation part with the trunk of each artery examined for delineation of the blood flow in the artery. Continuity of the bifurcation part with the trunk were observed in 17 facial arteries (68%), in 14submental arteries (56%), in 9 lingual arteries (36%), in 5 palatine ascending arteries (20%), in 1 branch of the external carotid artery (4%), and no suprahyoid branch of the lingual artery was observed around the submandibular gland. The average number of the intraparenchymal arteries of the submandibular gland was 1.96. A representative image obtained with an oblique sagittal orientation parallel to the mandibular plane is shown in Fig.4.

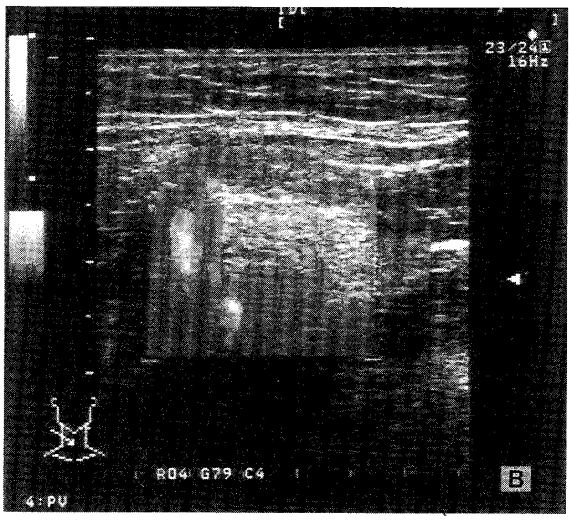

Fig.4 Power mode Doppler image obtained with an oblique sagittal orientation parallel to mandibular plane show intraparenchymal arteries.

Discussion

Ultrasonography is frequently used for the soft tissue of the head and neck regions because of its noninvasiveness and ease of use[6-9]. In addition to this diagnostic modality that is uniquely adapted for use with superficially located anatomic soft tissue structures such as the salivary glands[10], B-mode scanning, gray

scale imaging, and transducer development has enabled real-time examination. Ultrasonography may also provide morphological features of internal organs, vascular patterns[11-13]. Among the major salivary glands, the submandibular gland and the parotid gland mainly has been examined using ultrasonography. The structural changes of the gland parenchyma and the details of surrounding structures have been identified. This method resultion differences caused by the kind of salivary gland and individual differences that have been shown by radiologists, clinically[5].

It is considered that the usual ultrasonographic features and intranodal vascular patterns of submandibular gland, can be compared with and distingnished from the abnormal features. A few other studies of salivary glands by ultrasonographic scanning under specified conditions have been reported[14,15]. In the study, the ultrasonographic features and the intranodal vascular patterns of the submandibular glands were evaluated to develop criteria for a diagnosis of submandibular gland lesions.

The internal echo intensity of the parotid gland was more hyperechoic than that of the submandibular gland. The tongue intensities were the most hyperechoic of all echoes observed here. These results suggest that the internal echo intensity is related to the quantity of fatty tissue. The echo intensity is increased when there are considerable differences in acoustic impedance between gland parenchyma and fatty drops[16]. Because the salivary gland echo intensity increased with age of subject, the unchanging echo intensity of the tongue could be an in important index when internal echos are examined. The internal echo intensity in the under 30% weight/height ratio group was hypoechoic, and the echo intensity in the over 50% weight/height ratio group was hyperechoic (Fig.3). These results suggest that the echo intensity increased by a specific quantity of fatty tissue of both the submandibular gland and the subcutaneous tissue. Thus, individual differences must be considered in interpreting ultrasonographic images. Submandibular glands with boundary echoes were very few (2.5-3.6%). The boundary echo is greatly influenced by the boundary form, and the surface of the submandibular gland may be assumed to be relatively smooth. No lateral shadow caused by slight differences in the density of the submandibular gland and the surrounding structure was observed.

The continuity of the bifurcation part with the trunk of each artery was examined for a delineation of blood flow in the artery, the continuity of the bifurcation part with the trunk were observed in 17 facial arteries (68%) and, 14 submental arteries (56%), these arteries could be examined easily. Continuity was observed in one branch of the external carotid artery (4%), and no suprahyoid branch of the lingual artery was observed. These results suggest that the trunk of the artery is small, that it shows low flow signals, and congenital defects of blood vessel.

The results showed that the ultrasonographic features and the intranodal vascular patterns of the submandibular glands could be evaluated to establish criteria for diagnosis.

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