Quantitative diagnosis of salivary gland tumors with contrast-enhanced ultrasound—a preliminary study

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Objective. To quantitatively analyze the value of qualitative diagnosis of salivary gland masses with contrast-enhanced ultrasound (CEUS).
Study Design. The enhanced sonographic features of 68 salivary gland masses were analyzed to differentiate them. The final diagnoses were confirmed by biopsy pathology.
Results. We observed from the perfusion kinetics of CEUS that most pleomorphic adenomas manifested lower enhancement and well-defined margins; most Warthin tumors presented with higher enhancement and well-defined margins; and most malignant tumors had higher enhancement and poorly defined margins. Their time-intensity curves showed pleomorphic adenomas were hypovascularized with a poor perfusion, whereas Warthin tumors and malignant tumors were hypervascularized with a rich perfusion. Additionally, malignant tumors showed significantly shortened time to peak and richer maximum signal intensity compared with Warthin tumors.
Conclusions. The features of salivary gland masses identified with CEUS were helpful in the differential diagnosis of salivary gland masses. (Oral Surg Oral Med Oral Pathol Oral Radiol 2013;116:784-790)

The location of tumors in the salivary glands may risk distorting patients' facial appearances, causing a heavy psychologic burden for these patients. Accurate preoperative differential diagnosis of the salivary gland tumors is critical to prognosis. Preoperative surgical planning will make a significant difference in patient recovery. However, the salivary glands are unique in the diversity and complexity of their pathologies.[1] Fine-needle aspiration cytology is widely used as a first-line technique for the diagnosis of salivary gland pathologies, but many studies have highlighted its limitations, including a high rate of false-negative results and poor accuracy for distinguishing between the various types of malignant tumours.[2,3] Unlike fine-needle aspiration cytology, which is mainly a cytologic diagnostic method, core needle biopsy performed in tumors can provide sufficient tissue samples for histology and immunohistochemistry.[4] Unfortunately, core needle biopsy may cause such complications as local tumor seeding, postoperative hematoma, and infections, because it breaks the intact mass capsule.[5] So the qualitative diagnosis of salivary gland tumors is challenging and needs continuous exploration for new diagnostic methods.

Contrast-enhanced ultrasound (CEUS) as a new imaging modality of ultrasound in the differential diagnosis of salivary gland tumors has been extensively explored in recent years and may provide a new option in clinical diagnosis. CEUS offers such advantages as providing ionizing radiation–free, real-time imaging, using an inexpensive method, as well as the possibility of frequently repeated applications compared with nuclear medicine, computed tomography, magnetic resonance imaging, and other technologies. Also, the contrast agent is a blood pool imaging agent and does not leak in the interstitial spaces.[6,7] Since Gramiak and Shah[8] used contrast agents for cardiac ultrasound in 1968, the advent of new ultrasound techniques and the development of ultrasound contrast agents, or echo enhancers, has greatly widened the diagnostic spectrum of ultrasound in recent years.[9,10] CEUS not only describes lesional microvascularity, particularly of echo-free areas, but also provides measurable and comparable perfusion kinetics[11] and more objective quantitative diagnostic data for clinical diagnosis. Few studies on the CEUS of salivary gland masses have been reported. In this study, the changing quantitative parameters of salivary gland masses with CEUS and imaging features were retrospectively analyzed so as to obtain more diagnostic information.

Statement of Clinical Relevance

The enhanced sonographic features of the salivary masses in our study showed some particularities that may provide valuable diagnostic information. Contrast-enhanced ultrasound could be applied to differentiate pleomorphic adenomas, Warthin tumors, and malignant tumors, and it is important for surgeons to know preoperatively the categories of the salivary gland tumors before choosing a proper way to treat them.

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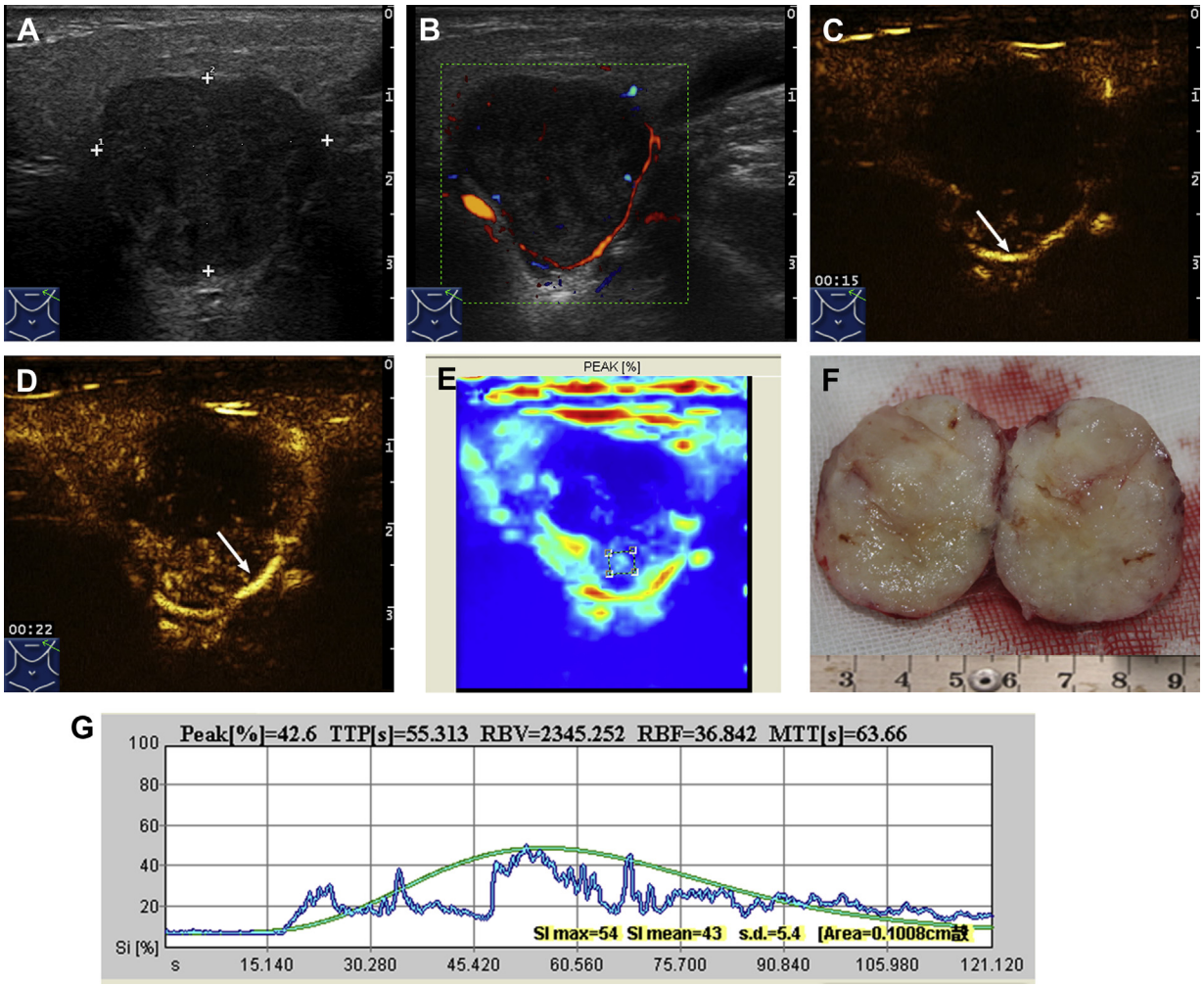

Fig. 1. Pleomorphic adenoma (PA) in B-mode sonography (**A**); the hypovascularized PA in color Doppler sonography (**B**); PA showing centripetal enhancement, hypoenhancement, and well-defined margin (*arrows*) after the administration of contrast agent (**C**, **D**); 3-dimensional pseudocolor simulation figure of PA and region of interest (**E**); surgical sample of PA (**F**); and contrast-enhanced ultrasound time-intensity curves of PA (**G**).

MATERIALS AND METHODS

Patients

This retrospective study was approved by the Institutional Review Board, and before procedures were performed, written and informed consent was obtained from all patients. The study was approved by the Ethical Committee of Sichuan Provincial People's Hospital. A total of 63 consecutive patients (39 males, 24 females) who presented with 68 salivary gland tumors were included in this study. They ranged in age from 16 to 80 years, with a mean age of 52 ± 17 years. The maximum axial diameter of the tumors ranged from 1.0 to 6.9 cm, with a mean diameter of 2.9 ± 1.2 cm. All patients underwent a preoperative conventional ultrasonic examination (grayscale sonography, Figure 1, *A*, Figure 2, *A*, and Figure 3, *A*; and color Doppler sonography, Figure 1, *B*, Figure 2, *B*, and Figure 3, *B*) and CEUS examination. All cases were further checked by pathology after the surgical procedures. All patients had no serious heart, lung, or blood diseases and no salivary gland diffusing diseases such as Sjögren syndrome.

Instruments and methods

MyLab90 (Esaote SpA, Genoa, Italy), using an LA523 with 4 to 13 MHz and LA522 with 3 to 9 MHz linear array transducers, was employed. Sulfur hexafluoride (SonoVue; Bracco, Milan, Italy) was used as a contrast agent. According to the manual, 4.8 mL of contrast agent was injected into the cubital vein, followed by a 5-mL saline flush. A timing device was started at the same time as the bolus injection. The diffusion of the contrast agent into the lesion was observed. The entire imaging process lasted about 2 minutes. It was recorded and saved with a 120- to 180-second dynamic image on the hard drive of the ultrasound machine for documentation and analysis.