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CASE REPORT

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The Importance of Elastography in the Early Diagnosis of Highly Differentiated Parotid Tumors: a Case-Report

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ABSTRACT

It is indisputable that high-resolution ultrasound (US) is the diagnostic gold standard for the evaluation of superficial parotid gland diseases. It is a dynamic, quick, simple, easily available, cost-effective, non-invasive procedure, with absence of ionizing radiation examination that can be performed safely and in special categories of patients such as pregnant women and children. It is widely accepted that on US, benign tumors have clear, smooth and well-defined borders, homogeneous hypoechoic parenchyma and a defined distribution of vessels. On the other hand, malignant lesions usually have unclear borders; also, they are inhomogeneous and sometimes can have areas of necrosis, increased hypoechogenicity and diffuse vascularization. However, many times these findings are not decisive due to the overlap that often occurs in parotid tumors. Shear wave elastography (SWE) represents a new imaging technique that provides additional information about tissue elasticity and stiffness in a selected region of interest. Since malignant tissues show greater stiffness than benign ones, sonoelastography is used to assist differential diagnosis between malignant and benign lesions. In many other organs, such as breast, thyroid, prostate and liver, it has been already successfully used for the differential diagnosis between malignant and benign lesions. The present article highlights the role of elastography in the diagnosis of a small malignant tumor in the left parotid gland of a 73-year-old female patient.

Keywords: ultrasound, sonoelastography, Virtual Touch Imaging Quantification (VTIQ), parotid tumor, mucoepidermoid carcinoma (MEC).

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INTRODUCTION

Accurate preoperative assessment in the differential diagnosis between parotid tumors is extremely important, as it will determine the extent and the type of surgical approach (1). It is widely accepted that on ultrasound (US), benign tumors have clear, smooth and well-defined borders, homogeneous, hypoechoic parenchyma and a defined distribution of vessels (central or peripheral). On the other hand, malignant lesions usually have unclear borders, they are inhomogeneous, and sometimes can have areas of necrosis, increased hypoechogenicity and diffuse vascularization (2). However, many times these findings are not decisive due to the overlap that often occurs in parotid tumors. Thus, a benign tumor can show heterogeneity as in the case of pleomorphic adenomas, while some malignant tumors appear with smooth borders and homogeneous parenchyma, resembling benign lesions (3). In these cases, we cannot accurately distinguish between a benign and malignant tumor, using only US and color Doppler.

Recently, sonoelastography, a non-invasive ultrasound technique, represents a major innovation as an additional method for evaluating lesions of the head and neck, including the parotid gland (4) and cervical lymph nodes. In many other organs, such as breast, thyroid, prostate and liver, it has been already successfully used for the differential diagnosis between malignant and benign lesions. The use of this diagnostic 'tool' relies on measuring the elasticity and stiffness of tissues. Shear wave elastography (SWE) is a novel technique that uses an acoustic radiation force impulse (ARFI) to generate shear waves, which propagate perpendicular to the ultrasound beam, causing transient displacements. Shear waves travel faster through stiffer tissues. This technique has higher reproducibility and lower dependence on the operator. Virtual touch™ imaging quantification (VTIQ) is a quantitative method of tissue stiffness through measurement of shear wave velocity (SWV), which is created by the application of a mechanical force through the transducer and creation of a color stiffness map of the region of interest over a B-mode image (5). The advantage of VTIQ is that many small regions of interest are selected and evaluated simultaneously, as shown in Figure 1 (6).

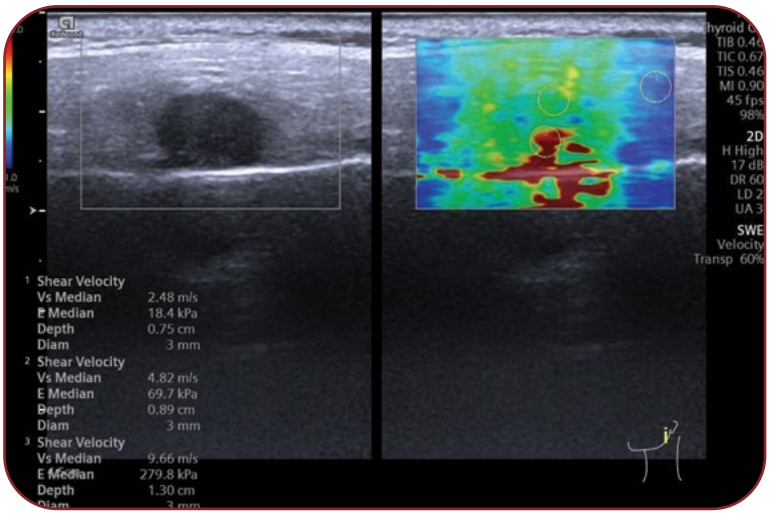

FIGURE 1. Virtual touch imaging quantification (VTIQ) of parotid gland tumor with shear wave velocities ranging from 2.48 to 9.66 m/s. Selected regions of interest, in which VTIQ measurements were performed, are represented by yellow circles. Two measurements were obtained within the lesion in areas of slowest (color-coded in green) and fastest (color-coded in red) shear waves. Additionally, one measurement was performed in healthy tissue (color-coded in blue) outside of the parotid lesion ("peripheral shear wave velocity").

Several recently published studies focused on the role of sonoelastography in the differential diagnosis between malignant and benign lesions of the parotid gland (4, 7). However, there is wide variation in their results, with sensitivity ranging from 40% to 100% and specificity from 26% to 97% (8, 9). Our article aims to highlight the value of modern sonoelastography in the differential diagnosis of a small lesion of the parotid gland in a 73-year-old Caucasian patient. ❑

CASE PRESENTATION

A 73-year-old Caucasian non-smoker woman came to the Otolaryngology Department of our hospital with a painless, slowly growing swelling in the left parotid region, which had been clinically detected by chance by her dermatologist a few months ago. The overlying skin was normal and the function of facial nerve intact. She had no palpable neck lymph nodes or fever. From the patient's medical history, there were no other oncological diseases or a similar case in her family. A complete ultrasound examination of the head and neck region was carried out, including B-mode, colour-coded Doppler

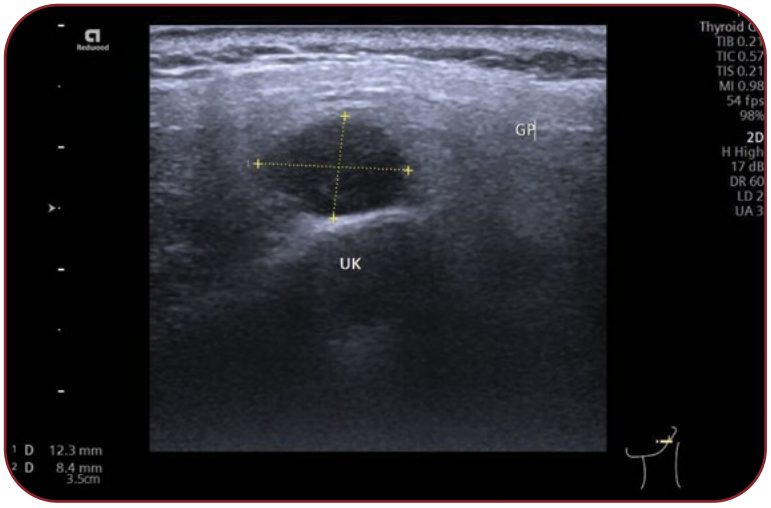

FIGURE 2. A round, hypoechoic, homogeneous mass with relatively blurred margins in the left parotid gland

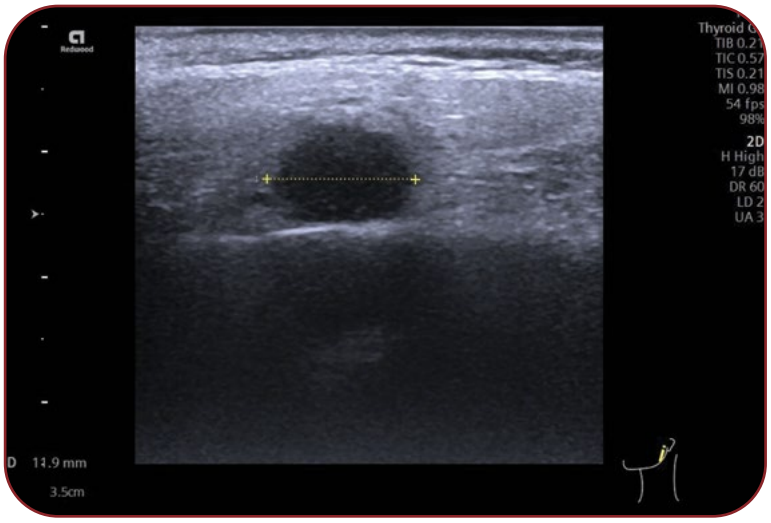

FIGURE 3. A round, hypoechoic, homogeneous mass with relatively blurred margins in the left parotid gland

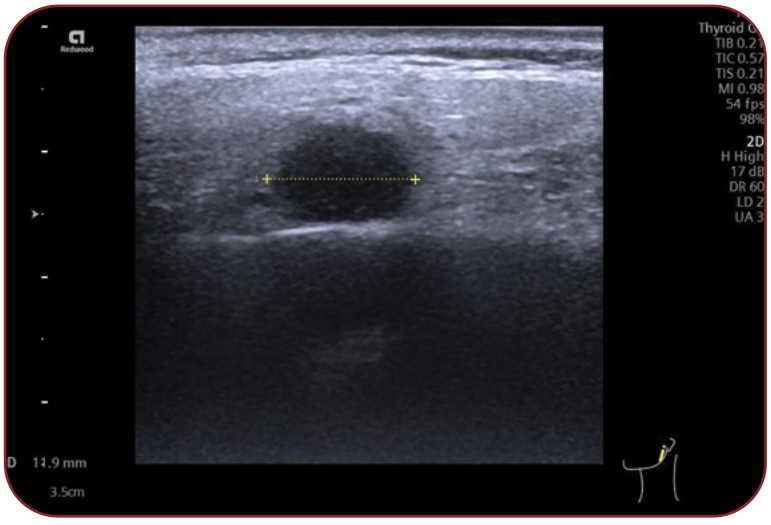

FIGURE 4. Absence of vascularity on color Doppler and relative blurred margins

mode and elastographical assessment of the tumor. The examination was performed with a Siemens Acouson Redwood device equipped with the VTIQ. A high frequency linear-array transducer 10 MHz was used. The patient was placed supine and facing upwards. A round, hypoechoic, homogeneous mass measuring 12.3 x 8.4 x 12 mm was revealed at level I of the left parotid gland. It had relatively blurred margins without internal calcifications (Figures 2 and 3). Color Doppler evaluation revealed absence of vascularity (PRF=976) (Figure 4). Although the tumor was small, it was relatively hard elastographically (diffuse stiffness of 4 m/s), which could indicate a pleomorphic adenoma or a highly differentiated malignoma. Therefore, the patient was recommended to perform a fine needle aspiration (FNA) and be re-examined in three months.

Unfortunately, the patient came for re-examination after six months without FNA and then a small increase in the size of the lesion was found and elastographically the stiffness had increased to maximal 5.31 m/s and a diffuse increase in stiffness of 4.1 m/s with extension beyond the limits of the tumor (Figures 5 and 6). No suspicious cervical lymph nodes were identified. Regarding the patient's medical history, she was receiving anticoagulant treatment for cardiac arrhythmia. The result was evaluated as suspicious and an immediate complete parotidectomy was suggested.

After a preoperative evaluation, including hematological and cardiological tests, a total parotidectomy with intraoperative monitoring of the facial nerve under general anesthesia was performed. Biopsy was fixed in formalin and sent to a referral laboratory for histological preparation and examination. Postoperatively, the patient had a House Brackman score II which improved very quickly. Eight days later, the stitches removed safely, as the patient followed the aftercare instructions. The results of the histological examination revealed low grade mucoepidermoid carcinoma (MEC) of the parotid gland with disease-free margins (pT1). The decision of the tumor board was not to perform adjuvant radiotherapy. Now the patient is under close medical supervision every three months. So far, at the six-month follow-up (U/S examination and CT scan) there were no signs of recurrence. ❑

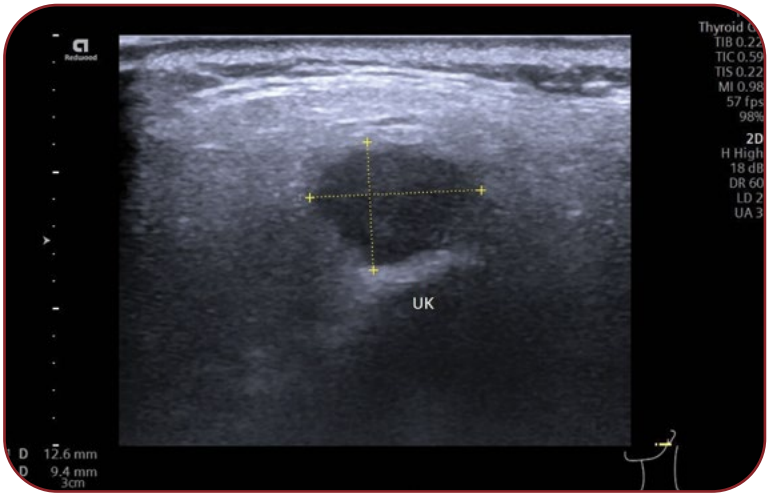

FIGURE 5. Small increase in the size of the lesion

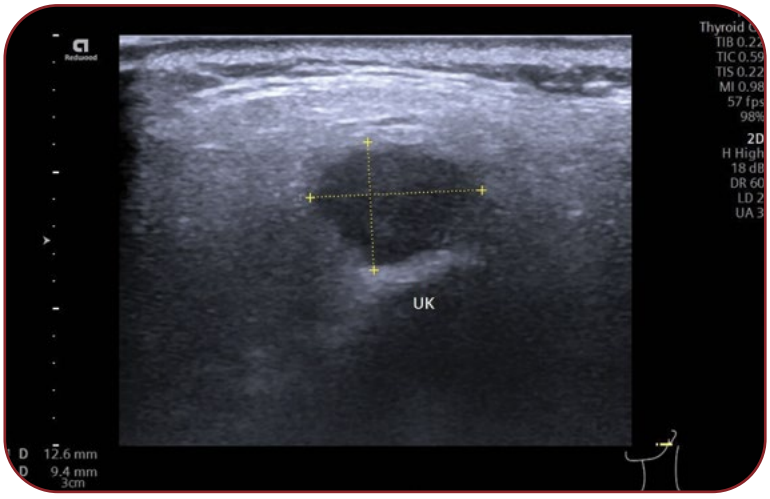

FIGURE 6. The lesion appeared with a maximal stiffness of (5.31 m/s) and a diffuse increase in stiffness of 4.1 m/s with extension beyond the limits of the tumor on Virtual Touch™ Imaging Quantification (VTIQ). Low shear wave velocity (SWV) is marked in blue and maximum SWV in red. The increased stiffness (red region) at deep border of the lesion represents the stiffness of the mandibular bone and is therefore not measured as it is considered an artifact. The proximity of parotid tumors to bony structures is a factor that generates artifacts and can make the results difficult to interpret. Therefore, the examiner's experience and multiple repetitions (at least three horizontal and three vertical ones) of the elastographic examination are important.

DISCUSSION

Salivary gland tumors represent ~1% of all malignant tumors and 2-6% of head and neck tumors, while 85% of these tumors involve the parotid gland and usually the superficial lobe (10). They pose a significant diagnostic challenge because of the wide variety of possible differential diagnoses and the complex anatomic relationships with vessels, bony structures and the presence of the facial nerve. Although most lesions are benign (about 80% of parotid lesions), neither clinical nor imaging approach can establish the diagnosis with absolute certainty. For this reason, image-guided needle biopsy (fine needle aspiration cytology, FNAC), which is an invasive technique, is used to confirm the diagnosis. However, many times the results are non-diagnostic and need to be repeated. Core needle biopsy (CNB) is a more reliable method but it has complications and cannot be performed in very small tumors or lesion near bony structures or the facial nerve (11). The detection and characterization of parotid masses is important in their surgical planning, which depends on the type, size and location of the tumor. Proper preoperative evaluation is necessary to avoid complications associated with extended surgical techniques (12).

Mucoepidermoid carcinoma is the most commonly encountered salivary gland neoplasm which accounts for 10–15% of all salivary gland tumors. The most common site for MEC is the parotid gland. The mean age of occurrence is 55 years, with a slight predilection for women. It frequently presents as a mass with a low-grade histological appearance. The main treatment is surgical resection with disease-free margins. Postoperative radiation therapy is recommended only in cases of advanced stage, high malignancy tumor, perineural or lymphatic infiltration, positive resection margins, extraparotid extension, or lymph node involvement. Tumor stage and grade are important predictors of survival. So, five-year disease-free survival rate is 22.5% for high grade and 97.0% for low grade MEC tumors (13).

Ultrasound is the first procedure that should be performed immediately after clinical examination to evaluate head and neck masses. Elastography is a relatively new non-invasive technique that brings additional specific information to be incorporated into ultrasound examinations and helps to characterize, without biopsy, the nature of cancerous masses. Recently, several original studies have focused on the value of sonoelastography in the differential diagnosis between malignant and benign lesions of the parotid gland. It is widely accepted that malignant parotid tumors are stiffer than benign ones. However, in the international literature there is no consensus regarding its usefulness. Cantisani *et al* evaluated 63 parotid tumors and reported

that there was a statistically significant difference in elastographic evaluation between benign and malignant parotid tumors with a high sensitivity of 94% and specificity of 89% (14). Other authors describe a lower performance of sonoelastography, but also significant (15). In another study, Klintworth *et al* emphasized the value of elastography as they discovered characteristic patterns such as the "garland" sign which was observed in malignant tumors of the parotid gland (8). Celebi and Mahmutoglu (16) found that the diagnostic accuracy of sonoelastography was better for low-malignancy tumors such as mucoepidermoid carcinoma, carcinoid and metastases of basal cell carcinoma. Mansour *et al* support the value of elastography in the diagnosis of parotid lesions but admit that it must be evaluated in larger series of patients (17). Jering's prospective study aimed to identify clearly indicative values. Shear wave velocity more higher than 6.0 m/s was more frequently observed in malignant tumors, while SWV less than 3.5 m/s was more common in benign parotid lesions (4).

On the other hand, Dumitriou *et al* observed little benefits from elastography in differentiating between benign and malignant parotid tumors (18). A recent meta-analysis of Zhang *et al* revealed a sensitivity of 67% and a specificity of 64% for the differential diagnosis between malignant and benign parotid lesions, which was considered unsatisfactory. However, the authors concluded that quantitative elastography methods were superior to qualitative ones (9). In contrast, a meta-analysis conducted in 2016 (19) evaluated the results of nine studies on elastography in 581 salivary gland lesions, highlighting good sensitivity (76%) and specificity (73%) values.

In our opinion, elastography has a high positive predictive value in cases with high stiffness (SWV > 6 m/s) and diffuse increase of stiffness with extension beyond the tumor margins. On the other hand, the parotid region lays between bones that cause artifacts and therefore, the examiner's experience and multiple repetitions (at least three horizontal and three vertical ones) of the elastographic examination are important. Of course, for tumors of the deep lobe MRI is the gold standard (20). ❑

CONCLUSIONS

In conclusion, our case report highlights the value of elastography in the examination of parotid lesions, assisting the correct diagnosis at the initial stage of examination and allowing early recognition and treatment of malignant tumors. Therefore, further multicenter studies should confirm the potential clinical use of elastography in parotid gland neoplasms. ❑

Conflicts of interest: none declared.
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