Role of Ultrasonography in Diagnosis and Differentiation of Pleomorphic Adenomas

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Objective: To estimate the utility of ultrasonography in diagnosis and differentiation of pleomorphic adenomas.

Design: From the group of 88 patients examined by ultrasound, who were referred because of the tumor in the preauricular area, submandibular area, or cheek, pleomorphic adenoma was finally diagnosed in 24 (with multiple recurrent tumors in 2 patients).

Results: Ultrasound was able to differentiate between benign and malignant lesions with 96% accuracy in this study. Predicting that the detected tumor was pleomorphic adenoma was possible with up to 84% accuracy. In 15 of 22 patients with primary pleomorphic adenoma, ultrasound guided fine-needle aspiration biopsy. High-resolution probes and harmonic imaging enabled demonstration of histopathologic heterogeneity of pleomorphic adenomas (in 16 primary tumors [73%]). Of primary pleomorphic adenomas, 95% (21/22) had 5 or fewer vessels detectable in the whole lesion.

Conclusions: Modern ultrasound is highly valuable, useful, and reliable in differential diagnosis of tumors in the preauricular area, submandibular area, and cheek. It enables precise localization, measurements, and assessment of the structure of lesions. It may be the first and last imaging method needed to formulate the final diagnosis, or it may guide fine-needle aspiration biopsy. In many cases, ultrasound may also suggest the nature of the tumor.


PLEOMORPHIC ADENOMAS are the most common neoplasms of salivary glands (55%-65%).1,2 They compose up to 82% of all benign salivary gland tumors.2

During the past 2 decades, emphasis on the use of different imaging modalities in diagnosis and differentiation of salivary gland diseases has changed markedly. Ultrasound is being proposed increasingly often as the first diagnostic procedure. Technical progress provides better and better equipped machines, thus enabling more precise preoperative diagnosis.

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The aim of this study was to estimate the utility of ultrasonography in diagnosis and differentiation of pleomorphic adenomas.

METHODS

We analyzed records from a large prospective study, still in progress, of ultrasound in salivary gland diseases. Eighty-eight consecutive patients (41 female and 47 male; age, 14-91 years; mean age, 50 years) with a tumor in the preauricular area, submandibular area, or cheek were included in this study. Diagnoses were confirmed by fine-needle aspiration biopsy and/or histopathologic examination or clinical course (in case of detection of normal lymph nodes as the cause of a tumor in persons with inflammatory disease or without clinical suspicion of any disease). In 15 of 22 patients with primary pleomorphic adenoma, ultrasound was used to guide fine-needle aspiration biopsy. Final diagnoses are given in Table 1.

Most examinations were performed with the use of a 7.5-MHz linear probe on the ultrasound scanner (Siemens Elegra; Siemens, Erlangen, Germany). A few patients were examined with the use of a wide-band 5- to 12-MHz linear transducer on a different machine (Advanced Technology Laboratories, High Definition Imaging, ATL, Bothell, Wash). Basic examination was performed in gray scale with all variables (gain, focus, and depth) set to obtain an optimal-quality image. Subsequently, all lesions were assessed in color and/or power Doppler mode. Low-flow mode and appropriate gain settings (slightly above the level of artifacts) were used to detect as many vessels as possible. In doubtful cases, tissue harmonic imaging mode was also applied. The lesions were examined in at least 2 perpendicular planes together with their surroundings. The cheek area, both parotid glands, and both submandibular glands were carefully examined each time. The
neck was also scanned in all patients to assess lymph nodes. Examination results were recorded digitally, often also on videotape and sometimes additionally on videoprinter images. In case of large masses or when spatial relationship was an important diagnostic factor, panoramic imaging (extended-field-of-view imaging) was used as the documentation mode.

We assessed location, dimensions, shape (oval or polycyclic [lobular]), structure (homogeneous or inhomogeneous without cystic areas, inhomogeneous with cystic areas), margins (distinct or blurred), and vascularization (0 to ++++) of the tumors. Tumors with more or less distinct hypoechoic or hyperechoic areas in relation to the rest of the tumor were classified as inhomogeneous without cystic areas.

Vascularization was assessed according to a subjective 4-grade scale (0, +, ++, +++), where 0 indicated no vessels visible in the tumor in power Doppler low-flow mode; +, a few vessel segments of no more than 3 blood vessels visible in the whole lesion; ++, up to 5 vessels visible in the tumor; and ++++, more than 5 vessels visible in the lesion.

Irregular shape, ill-defined and irregular margins, inhomogeneous structure, and/or abnormal lymph nodes (oval shaped, without an echogenic hilum or with a narrowed hilum, inhomogeneous, or with aberrant vessel pattern) suggested a lesion’s potentially malignant nature.

RESULTS

In all but 2 patients we could discriminate between intrinsic salivary gland tumors and extraglandular masses. Of the 2 exceptions, 1 patient had a lesion in the lower pole of the parotid gland area and the other in the submandibular gland area.

In 1 case of lipoma extending into the deep lobe of the parotid gland and in 3 cases of malignant tumors, we could not measure dimensions of the clinical lesion because of its penetration into the areas inaccessible by the ultrasound beam (mainly behind the bone). In other patients, we successfully performed all measurements.

In 2 patients with recurrent pleomorphic adenoma, we noted more lesions than were found on clinical examination; in 3 patients with Warthin tumor we visualized subclinical lesions in the same or contralateral gland, and in routine follow-up examination we detected 1 clinically silent metastasis.

In 6 patients the lesions fulfilled the ultrasound criteria (given in the “Methods” section) of a malignant tumor. Five of these cases represented true malignancies, and 1 was a hemorrhagic pleomorphic adenoma. One metastasis to the salivary gland presented on ultrasound as benign.

The majority of primary pleomorphic adenomas (16 of 22) had polycyclic shape (Figure 1). Three lesions contained small, oval or irregular cystic spaces (Figure 2). One tumor with cystic spaces also showed irregular, ill-defined margins. Most pleomorphic adenomas were poorly vascularized (grade 0 to ++). Details are presented in Table 2.

COMMENT

The utility of ultrasonography in describing such features of the tumor as its location, dimensions, shape, structure, and relationship to surrounding organs or tissues is well documented in many pathologic lesions in various parts of the body. The same also applies to tumors of the regions where major salivary glands are located.
It is possible to estimate their extraglandular or intra-glandular position. In our study, we had problems in assessing the exact point of origin of only one submandibular tumor and one adjoining the lower pole of a parotid gland so far. In 4 tumors (1 benign and 3 malignant) we could not visualize the whole lesion because of its penetration into the deep lobe of the parotid gland, behind the mandible in the area of ultrasound acoustic shadow.

With the use of ultrasound, subclinical lesions may also be found. In the postoperation study by Gritzmann et al,3 as many as 76% of clinically undetected Warthin tumors were detected by ultrasound. In the present study, we could further demonstrate clinically silent lesions in 3 patients with Warthin tumor and in 2 patients with recurrent pleomorphic adenomas. Also, the metastasis to the salivary gland was discovered during routine follow-up.

The accuracy of detecting malignant disease in salivary glands was 96% in our study (in patients with solid lesions, excluding normal-appearing lymph nodes). The criteria causing us to consider a malignant lesion were classic3-5: irregular shape, ill-defined and irregular margins, inhomogeneous structure, and presence of abnormal lymph nodes: oval shaped, without an echogenic hilum or with narrowed hilum, inhomogeneous, with an aberrant vessel pattern.6-9 In 1 of 46 patients, we suspected that a malignant lesion might be present because of its partially unclear margins and heterogeneous internal structure, but it finally proved to be pleomorphic adenoma with internal hemorrhage. One false-negative diagnosis occurred in the patient with a metastatic tumor. The lesion was 6 mm in diameter, homogeneous, and well defined. In this patient, a history of tongue cancer raised the suspicion of a metastasis despite its pseudobenign presentation on ultrasound examination and led to fine-needle aspiration biopsy. Such pseudo-benign appearance of small or well-differentiated (low-grade) malignancies in different methods of diagnostic imaging, including ultrasound, has been reported in previous studies.4,10-13

On the basis of criteria of polycyclic shape, distinct margins, and structure without cystic areas, we could detect primary pleomorphic adenomas with 77% accuracy (sensitivity, 64%; specificity, 91%). Polycyclic shape turned out to be the most characteristic feature of pleomorphic adenomas in a statistical study by Shimizu et al.4 When we added oval-shaped tumors (Figure 3) to the aforementioned criteria, accuracy increased to 84% (sensitivity, 82%; specificity, 86%). Because of the possibility that small malignant or metastatic tumors may appear benign on ultrasound, like the metastasis of tongue carcinoma described in this study, we suggest, if possible, performing fine-needle aspiration biopsy in each case of salivary gland mass.14

Interestingly, we detected a higher percentage (73%) of inhomogeneous pleomorphic adenomas than has usually been reported previously. So far, homogeneity has been supposed to be the characteristic feature of this tumor.5,11 Also, in the thorough statistical study by Shimizu et al,12 only 9% (2/22) of pleomorphic adenomas were homogeneous on ultrasound. However, the authors described hyperechoic structures in an additional 7 tumors, not classifying them as inhomogeneous. Although
in the article by Schick et al\(^{15}\) the percentage of inhomogeneous pleomorphic adenomas reached as high as 57%, the study group consisted of only 7 tumors. In our work on 22 primary pleomorphic adenomas, only 6 appeared homogeneous. We assume that use of high-resolution probes and tissue harmonic imaging with one of the most modern ultrasound machines simply demonstrates more adequately the true complex histopathologic structure of these lesions. However, not all macroscopically evident concentrations of different tissues or cell types caused inhomogeneity detectable with ultrasound. Even large areas of myxoid or mucous tissue and myoepithelial cells concentrated separately did not produce an adequate inhomogeneity on ultrasound images. Apart from anechoic cystic spaces, the most detectable inhomogeneity in our study caused larger areas of very hypoechoic chondroid tissue on the background of hypoechoic myoepithelial cells (Figure 4). Very hypoechoic echoes of chondroid tissue were previously observed by Shimizu et al.\(^{16}\) It is well known that, in pleomorphic adenomas, hemorrhages or cystic degeneration sometimes occur\(^{13,17}\) and then anechoic spaces visible with ultrasound may appear.\(^{5,15}\) Many different studies proved that cystic anechoic areas are characteristic features of Warthin tumors.\(^{3,4,16}\) They were reported in up to 93%\(^{5}\) of Warthin tumors. We observed certain difference in the shape of these anechoic spaces between pleomorphic adenomas and Warthin tumors. In the latter, they appear most often as irregular branching and glandlike anechoic structures (Figure 5), and in pleomorphic adenomas they are usually small and close to oval in shape (Figure 2). This observation, however, demands further studies on larger numbers of pleomorphic adenomas with cystic areas.

Many previous studies report low vascularization of pleomorphic adenomas.\(^{11,15,18}\) This was consistent also in our work. Most primary tumors (59%) contained up to 3 vessel segments (Figure 6). Ninety-five percent (21/22) of them had 5 or fewer vessels detectable in the whole lesion.

### CONCLUSIONS

Modern ultrasound is highly valuable, useful, and reliable in the differential diagnosis of tumors in the preauricular area, submandibular area, and cheek. It enables precise localization, measurements, and assessment of the structure of lesions. It may be the first and last imaging method needed to formulate the final diagnosis, or it may guide fine-needle aspiration biopsy. In many cases, ultrasound may also suggest the nature of the tumor.

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REFERENCES


