Sonography of the salivary glands

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Abstract Due to their superficial position, the parotid, the submandibular, and the sublingual glands can be imaged with high-resolution transducers. In acute inflammatory diseases sonography can differentiate between obstructive or non-obstructive sialoadenitis. Abscess formations may be detected and the maturation of the colligation may be controlled. Abscesses may be punctured under US guidance. In Sjögren’s syndrome the sonographic changes correlate with the histological destruction, and in acute forms hypervascularization is found in color Doppler. In fibrotic cases the stimulation-induced hyperemia is impaired. In sialoadenosis inflammatory and tumorous lesions can be ruled out by sonography. Tumors of the salivary glands can be visualized with high sensitivity. Like other imaging methods the specificity in assessment of the histology of a tumor is low. Multilocular lesions, such as sarcoidosis, lymphoma, metastases, or cystadenolymphoma, are discussed. In deep located, malignant tumors or when the tumor cannot be delineated completely, MR or CT are obligatory to delineate the tumor. Sonography enables the diagnosis of cysts or ranulae. The accuracy of sonography in assessment of sialolithiasis is approximately 90%. Non-opaque stones can be visualized, too; however, small stones of less than 2 mm are difficult to detect since the posterior shadow may be missing. The concrements can be differentiated into intraductal or intraglandular stones. Indirect signs, such as ductal dilatations or inflammatory changes, may be found. Pseudotumorous lesions, such as hypertrophy of the masseter muscle, tuberculosis, sarcoidosis, or lymphoepithelial lesions in AIDS, are discussed. In children the main differential diagnosis of salivary gland pathologies are addressed. In many diseases sonography is the first-line imaging modality in assessment of salivary glands.

Keywords Salivary glands · Tumors · Concrements · Sonography · Sjögren’s syndrome · Sialoadenitis

Introduction

Due to the superficial position of the major salivary glands, most parts are accessible by high-resolution transducers. Only a little portion of the parotid gland may be hidden by the acoustic shadow of the mandible [1]. In many diseases sonography is the first-line imaging for the evaluation of the salivary glands.

Sonographic technique

Mainly linear transducers with a frequency of 5–12 MHz are used for the investigation of the salivary glands. It is of importance that the salivary glands are bilaterally investigated, since many diseases occur bilaterally. In large lesions transducers with a lower frequency are sometimes advisable in order to delineate the lesion completely. For deeply locat-
ed parotid lesions an enoral approach with an endocavitary probe or a fingertip transducer may be of advantage.

If a tumor is suspected, the cervical lymph nodes have to be examined, too. Color Doppler may be useful to investigate inflammatory or tumorous lesions. Color Doppler is performed by comparing the vessel density with a normal reference gland or by comparing the vessel density in a tumor with the normal parenchyma. In a tumor the peak systolic flow is measured; however, the correction of the angle of the Doppler beam and the interrogated vessel may be difficult. In Sjögren’s syndrome the reaction on the systolic blood flow caused by sucking of a lemon stick can be measured. Usually, the systolic peak velocity is at least double after stimulation.

**Sonographic anatomy**

All salivary glands are homogeneous echogenic glandular organs. The normal sizes of the salivary glands have been evaluated [2].

**Parotid gland**

The parotid gland is localized in the retromandibular fossa. Anatomically, a part superficial to the main plane of the facial nerve and a part located deep to this plane are differentiated. The facial plane is not visualized sonographically. The caudal part of the parotid gland is called cervical lobe. In most cases the retromandibular vein can be delineated sonographically. Lesions should be localized with regard to this vein. Usually, the normal intraglandular ducts are rarely visualized even with modern very high-frequency transducers. Also the main duct (Stenson’s duct) is only rarely visualized in a non-dilated status. This duct runs superficial to the masseter muscle. The anterior part of the main duct is localized in the corpus adiposum buccae and turns medial through the buccinator muscle. In this region often extraglandular salivary tissue can be found. The echo structure of the gland is usually homogeneous and the echogenicity is comparable to that of the thyroid gland.

Sonographically, the parapharyngeal space is only rarely visualized with sufficient quality. The internal carotid artery and the internal jugular vein and the posterior or belly of the digastric muscle are not constantly demonstrable. Due to acoustic absorption and dispersion, also the deep part of the parotid gland is sometimes difficult to visualize.

**Submandibular gland**

The submandibular gland is located anterior and caudal to the parotid gland. Sometimes the salivary tissue of both glands is located adjacent. The main anatomic structures in this submandibular region are beside the gland, the mandible, the mylohyoid muscle, the anterior belly of the digastric muscle, and the facial vessels [3]. The facial artery runs posterior to or even in the submandibular gland. On a typical oblique section of the submandibular gland the tonsils are visualized as hypoechogenic areas cranio-posterior to the submandibular glands. Normally, the glands show a triangular shape. The non-dilated intraglandular ducts are only rarely visualized sonographically. After stimulation with a lemon stick they may be more visible. The main submandibular duct (Wharton’s duct) originates from the deep portion of the gland and runs in an ascending way anterior to the caruncula in the floor of the mouth. The main duct can be differentiated from the lingual vessels by color Doppler.

**Inflammatory diseases**

**Acute sialadenitis**

Endemic parotitis, caused by a virus, is the most frequent acute infection. Usually, the clinical presentation is sufficient for a definitive diagnosis [7]. In 75% of cases both parotid glands are enlarged. In 25% there is unilateral enlargement. Sonographically, the glands are enlarged with a more rounded shape, with a convex lateral surface and a hypoechogenic structure (Fig. 1) [5, 6]. Color Doppler demonstrates hyperemia (Fig. 2). Acute bacterial sialadenitis occurs predominantly in elderly and debilitated patients. In approximately 50% of cases of sialolithiasis sialadenitis is associated. The main task of sonography in inflammatory diseases is to exclude ductal obstructions [8, 9]. In severe infections liquefactions have to be excluded, especially in diabetic patients. Air is occasionally found in an infection [10]. In gray-scale sonography meticulous investigations are necessary in order to visualize moving debris in an abscess. This debris sometimes can be echogenic [11]. In these cases color Doppler may help to differentiate the hyperemic, surrounding parenchyma from the avascular central liquefaction. An abscess can be punctured under US guidance.

Tuberculosis of the salivary glands is rare, but it may mimic a malignant tumor. These infections lead to very