Salivary Glands

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Alexander N. Sencha and Ella I. Peniaeva

Humans have three paired major salivary glands (parotid, submandibular, and sublingual). Each gland has an individual blood supply. The parotid glands are supplied by the branches of the superficial temporal artery, the venous blood drains to the retromandibular veins. The submandibular glands obtain the blood from the facial artery with the venous outflow to the same-name veins. The sublingual glands get their blood supply via the branches of the lingual and facial arteries, venous blood drains to the lingual veins.

High-resolution sonography with intraductal and/or intravenous contrast enhancement is increasingly used to expand the possibility of ultrasound and improve its diagnostic efficiency [1–5]. Additionally, CEUS quantification permits more efficient, reliable, and reproducible data.

As a rule, there is no need to use CEUS in the norm, inflammatory, or degenerative changes of salivary glands. However, this method is efficient in the differential diagnosis of tumors. Focal lesions of salivary glands exhibit different patterns of contrast enhancement, which serve as a valuable diagnostic sign.

The salivary gland CEUS implicates a single intravenous injection of 2.4–4.8 ml of SonoVue®. Normally, the filling with UCA of the normal salivary gland parenchyma is intensive, regular, and symmetric with mild wash-out (Fig. 15.1).

Time-intensity curve parameters of salivary gland CEUS can be used for non-invasive monitoring of treatment in chronic sialadenitis with sialolithiasis and identification of tumor vascularization [6].

Salivary gland cyst typically has specific ultrasound signs, such as anechoic uniform contents with grayscale US and avascular with Doppler imaging. A simple cyst of a salivary gland, as well as of any other location, with CEUS demonstrates a characteristic perfusion defect with no contrast enhancement in all vascular phases (Fig. 15.2).

CEUS is often used to assess the microvascularization of salivary gland neoplasms. The parotid gland develops 70–90% of all salivary gland tumors, 8–10% arise in the submandibular and sublingual glands, and 4.9–22% in small glands [1, 7, 8].

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A. N. Sencha (✉)
Department of Visual and Functional Diagnostics, Federal State Budget Institution "National Medical Research Center for Obstetrics, Gynecology and Perinatology n.a. V.I.Kulakov", Moscow, Russian Federation

E. I. Peniaeva
Department of Ultrasound Diagnostics, Center for Radiological Diagnostics, Private Healthcare Institution "Clinical Hospital "RZD-Medicina" of Yaroslavl City", Yaroslavl, Russian Federation

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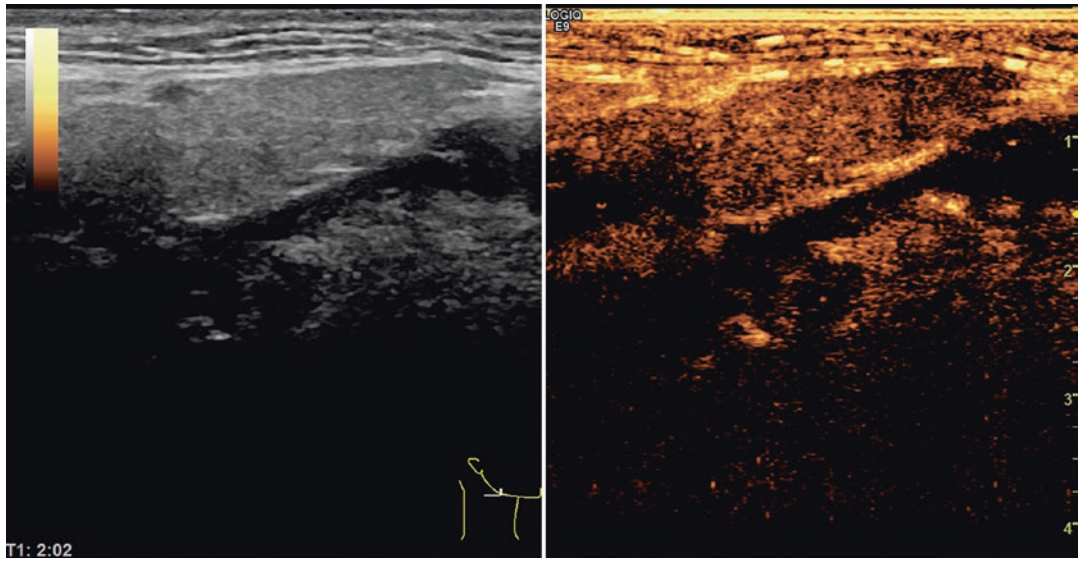

Fig. 15.1 Normal submandibular salivary gland. The venous phase CEUS image. Regular enhancement of the parenchyma

Benign tumors of the salivary glands are most often represented by the pleomorphic adenoma. General sonography with CDI reveals clear boundaries, some circumscribing vessels, and poor blood flow within the neoplasm. With CEUS, pleomorphic adenoma is usually hypoenhanced [9] (Fig. 15.3, Video 15.1). Although some other types of tumors like Warthin's tumor (cystadenolymphoma) may appear hyperenhanced [9].

Perfusion quantification demonstrates hypovascularity of pleomorphic adenoma with low perfusion indices and hypervascularity of adenolymphoma. The study [10] analyzed TICs in various salivary gland tumors and reported that the mean transit time (MTT) and AUC values in benign lesions (14.6 ± 1.24 s and 400.63 ± 53.85, respectively) were lower than the same in malignant tumors. However, cystadenolymphoma exhibited a higher AUC value (515.4 ± 71.26 vs. 285.82 ± 36.44, respectively) and the maximum signal increase (22.74 ± 2.69 dB/s vs. 14.32 ± 2.66 dB/s) than pleomorphic adenoma.

The special aim of CEUS is the detection and differential diagnosis of malignant tumors. Malignancies are observed in 3.6–30% of salivary gland lesions and predominantly affect the parotid glands [1, 11]. The use of UCAs is based on the identification of enhanced vascularity and neoangiogenesis. Most salivary gland malignancies are characterized by chaotic vascular branching, irregular course and caliber of the vessels, arteriovenous shunts, the inconsistency of the vascular wall, and sometimes multiple afferent vessels [1–4, 9] (Fig. 15.4).

Different histological types of salivary gland neoplasms have different qualitative and quantitative characteristics of contrast enhancement. CEUS can be an independent quantitative method for the evaluation of malignant and benign tumors of the parotid gland [10]. The salivary gland's malignancies have indistinct contours and are typically hypervascular. With a quantitative assessment, they are highly perfused [9]. TIC demonstrates the MTT for malignant neoplasms of 17.94 ± 1.62 s, which is significantly higher

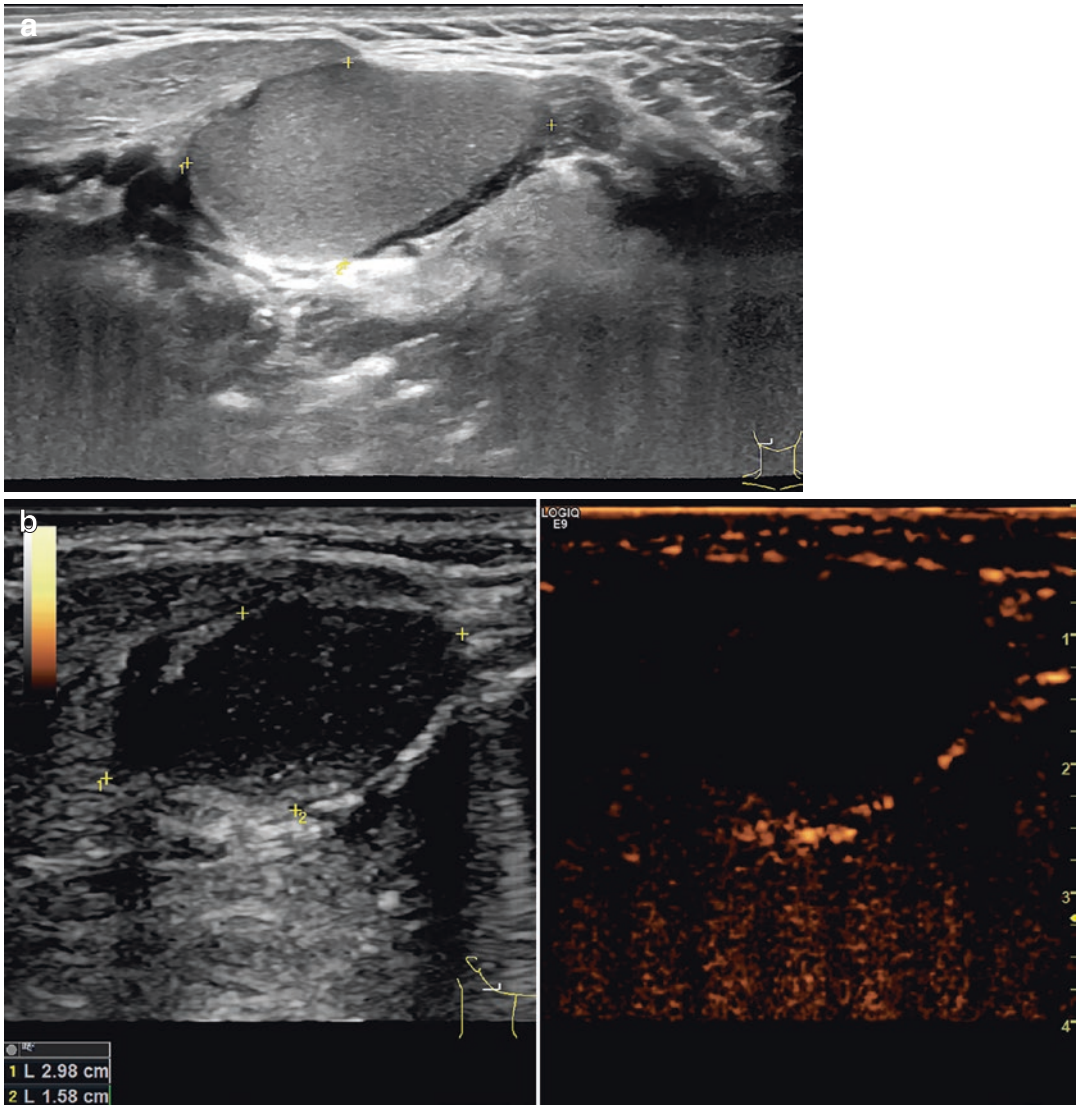

Fig. 15.2 A simple salivary gland cyst. (**a**) Grayscale US image. (**b**) CEUS demonstrates a perfusion defect

than in benign lesions. The AUC value for malignant tumors is also significantly higher (584.9 ± 143.0).

Contrast enhancement enables detailed imaging of the vascular tree of the salivary gland tumors, which exceeds standard Doppler modes [4, 6, 10, 12–14].

CEUS in salivary glands has significant prospects. Further studies and accumulation of practical experience are still necessary.

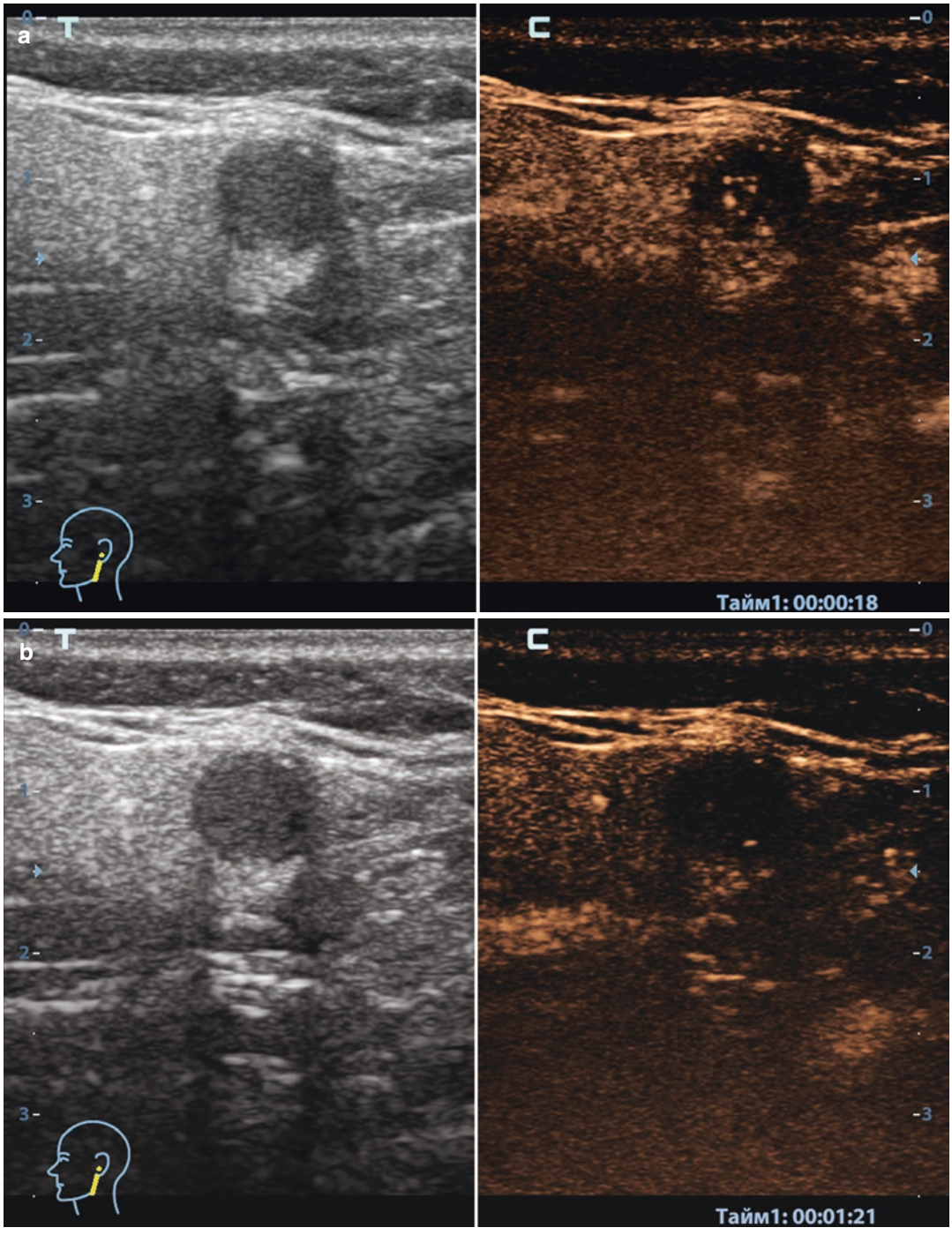

Fig. 15.3 Pleomorphic adenoma of the parotid gland. CEUS images. (**a**) Patient A. The arterial phase CEUS demonstrates hypoenhancement of the lesion. (**b**) Patient A. The venous phase CEUS demonstrates slow wash-out. (**c**) Patient B. Moderate enhancement in the venous phase. (**d**) Patient B. The TIC quantifies slow wash-in and wash-out of the lesion

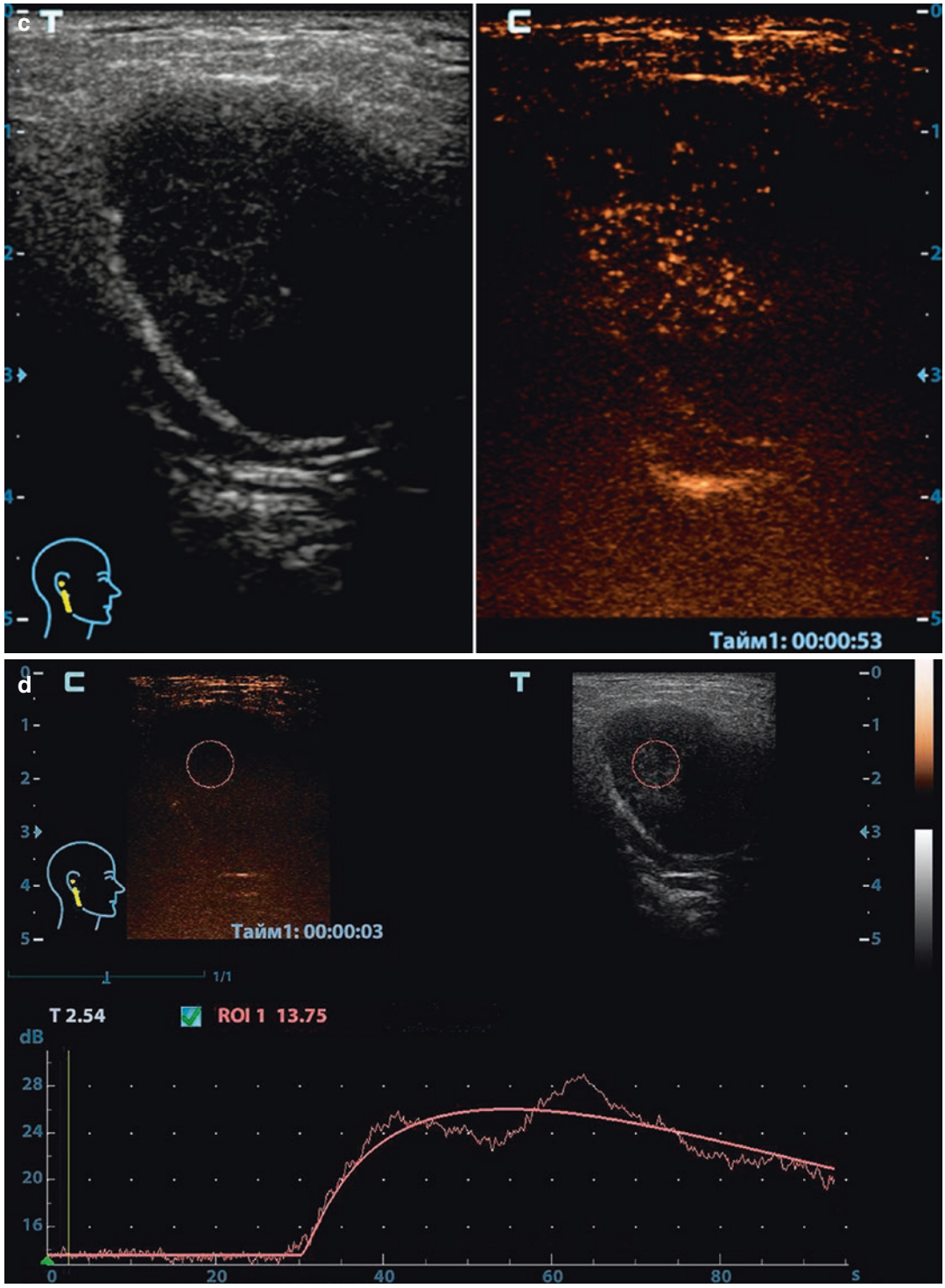

Fig. 15.3 (continued)

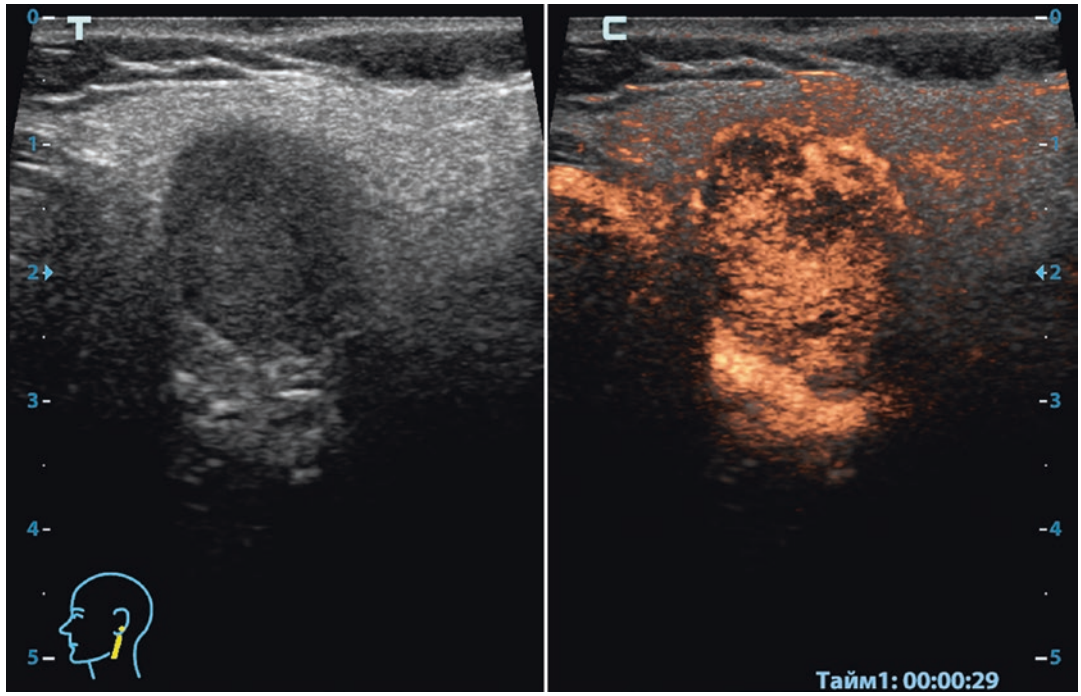

Fig. 15.4 Parotid gland adenocarcinoma. CEUS image with SonoVue® demonstrates irregular hyperenhancement of the tumor in the arterial phase

References

1. Afanas'ev VV. Slyunnye zhelezy. Bolezni i travmy [Salivary glands. Illnesses and injuries]. Moscow: Geotar-Media; 2019.
2. Sencha AN. Ul'trazvukovaya diagnostika. Poverhnostno-raspolozhennye organy [Ultrasound diagnostics. Surface-located organs]. Moscow: Vidar; 2015.
3. Sencha AN. Ul'trazvukovoe issledovanie okoloshchitovidnyh i slyunnyh zhelez. Ot prostogo k slozhnomu [Ultrasound examination of the parathyroid and salivary glands. From simple to complex]. Moscow: MEDpress-inform; 2020.
4. Sencha AN, Mogutov MS, Patrunov YN, Peniaeva EI, Kashmanova AV, Sencha EA. Ul'trazvukovoe issledovanie s ispol'zovaniem kontrastnyh preparatov [Ultrasound examination with contrast agents]. Moscow: Vidar; 2015.
5. Shchipskij AV, Afanas'ev VV. Diagnostika hronicheskih zabolevanij slyunnyh zhelez s pomoshch'yu differencial'no-diagnosticheskogo algoritma [Diagnosis of chronic diseases of the salivary glands using a differential diagnostic algorithm]. Moscow: GOU VUNMC MZ RF; 2001.
6. Strieth S, Siedek V, Rytvina M, Gürkov R, Berghaus A, Clevert DA. Dynamic contrast-enhanced ultrasound for differential diagnosis of submandibular gland disease. Eur Arch Otorhinolaryngol. 2014;271(1):163–9. https://doi.org/10.1007/s00405-013-2523-z.
7. Bykova AA, Kondrashin SA, Agapov VS, Zaderenko IA. Kompleksnaya sonografiya v diagnostike i lechenii opuholej bol'shih slyunnyh zhelez [Complex sonography in the diagnosis and treatment of tumors of the large salivary glands]. Sibirskij onkologicheskij zhurnal. 2002;3:128–32.
8. Sedova YS, Sinyukova GT. Sovremennye vozmozhnosti ul'trazvukovogo issledovaniya v diagnostike opuholej slyunnyh zhelez [Modern possibilities of ultrasound research in the diagnosis of salivary gland tumors]. Ul'trazvukovaya i funkcional'naya diagnostika. 2010;6:117–24.
9. Gou JM, Chen Q, Zhou Q, Liu YX. Quantitative diagnosis of salivary gland tumors with contrast-enhanced ultrasound–a preliminary study. Oral Surg Oral Med Oral Pathol Oral Radiol. 2013;116(6):784–90. https://doi.org/10.1016/j.oooo.2013.09.013.
10. Klotz LV, Gürkov R, Eichhorn ME, Siedek V, Krause E, Jauch KW, et al. Perfusion characteristics of parotid gland tumors evaluated by contrast-enhanced ultrasound. Eur J Radiol. 2013;82(12):2227–32. https://doi.org/10.1016/j.ejrad.2013.08.033.
11. Ihrler S. Speicheldrüsenpathologie: Ausgewählte Themen zu speziellen Problembereichen [Pathology of the salivary glands: selected topics in particular

problem areas]. Pathologe. 2009;30(6):423. https://doi.org/10.1007/s00292-009-1201-9.
12. Alyas F, Lewis K, Williams M, Moody AB, Wong KT, Ahuja AT, Howlett DC. Diseases of the submandibular gland as demonstrated using high resolution ultrasound. Br J Radiol. 2005;78(928):362–9. https://doi.org/10.1259/bjr/93120352.
13. Inohara H, Akahani S, Yamamoto Y, Hattori K, Tomiyama Y, Tomita Y, et al. The role of fine-needle aspiration cytology and magnetic resonance imaging in the management of parotid mass lesions. Acta Otolaryngol. 2008;128(10):1152–8. https://doi.org/10.1080/00016480701827533.
14. Iro H, Zenk J, Escudier MP, Nahlieli O, Capaccio P, Katz P, et al. Outcome of minimally invasive management of salivary calculi in 4,691 patients. Laryngoscope. 2009;119(2):263–8. https://doi.org/10.1002/lary.20008.