

WFUMB position paper. Incidental findings of the salivary glands

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Abstract

A salivary incidentaloma (SI) stands for any focal salivary lesion, independent of size, discovered by any imaging method including ultrasonography (US), computed tomography (CT), magnetic resonance imaging (MRI), multimodal positron emission tomography (PET) combined with CT or MRI, or X-ray imaging, performed for another reason, in the absence of known salivary glands' disease. The article presents a detailed analysis of salivary gland diseases with the emphasis on neoplasms. It describes frequency of SIs found on imaging, their prevalence, epidemiology and clinical significance. The probability of malignancy or malignant transformation of a SI, its imaging features, recommended treatment, management and follow-up, as well as ethical issues, psychological burden, informed decision making, economical consequences and costs are discussed. The general prevalence of SIs is low, but is dramatically increasing over time, and may rise significantly in selected groups of oncologic patients. SIs most frequently turn out to be benign primary neoplasms or pseudotumors, including intraparenchymal lymph nodes. SIs detected by other imaging methods should be subsequently assessed with US. Solid SIs demand ultrasound guided fine-needle aspiration cytology (US-FNAC). Neoplasms should undergo surgery. Post-operative US follow-up is mandatory for malignant tumors and recommended for benign neoplasms.

Keywords: salivary gland; incidentaloma; guideline; neoplasia; inflammation

Introduction and definition

The World Federation for Ultrasound in Medicine and Biology (WFUMB) is dedicated to the advancement of ultrasound (US) by encouraging research, promoting international cooperation, disseminating scientific information and improving communication and understanding in the world community using ultrasound in medicine and biology [1]. WFUMB is addressing the issue of in-

cidental findings with a series of publications “Incidental imaging findings – the role of medical ultrasound” [1]. So far adrenal gland IF have been described in detail [2].

The definition of a salivary incidentaloma (SI) encompasses any focal salivary lesion, independent of size, discovered by any imaging method including ultrasound (US), computed tomography (CT), magnetic resonance imaging (MRI), multimodal positron emission tomography (PET) combined with CT or MRI, or X-ray imaging, performed for other reason, in the absence of known salivary glands' disease [1].

Major salivary glands are symmetrically located in the head and neck and include the parotid gland, submandibular salivary gland and sublingual salivary gland. Accessory parotid glands may be located in the cheek along the Stenon duct, the excretory duct of a parotid gland. Apart from them, there are hundreds of minor salivary glands, which are not apparent on conventional imaging,

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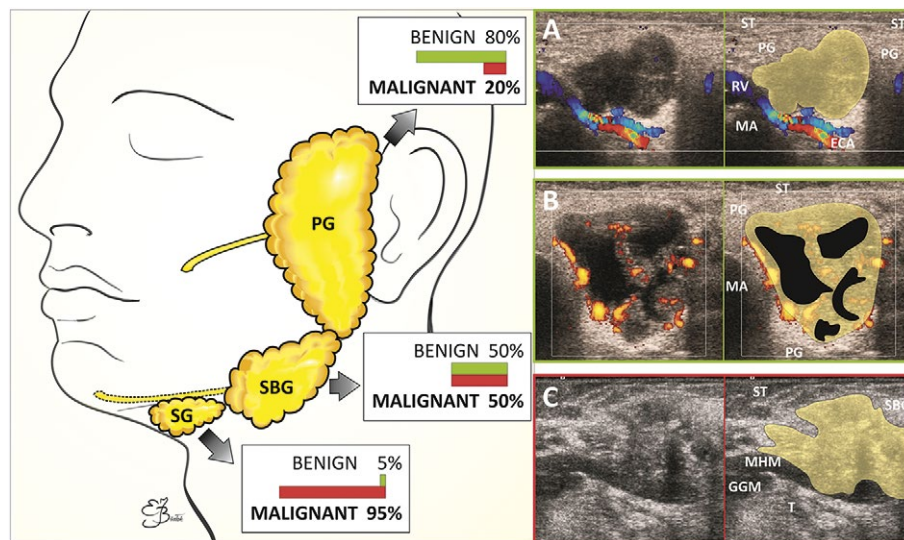


Fig 1. Morphology in relation to frequency of benign and malignant salivary gland tumours. The scheme of major salivary glands with images representing most common neoplasms (A-C) (tumors shadowed on yellow). Percentages for the ratios of benign to malignant salivary gland neoplasms according to Bradley [5]. A – pleomorphic adenoma. B – Warthin tumor. C – adenoid cystic cancer. ECA – external carotid artery; GGM – genioglossus muscle; MA – acoustic shadow behind the mandible bone; MHM – mylohyoid muscle; PG – parotid gland; RV – retromandibular vein; SBG – submandibular salivary gland; SG – sublingual salivary gland; ST – subcutaneous tissue; T – tongue.

in the submucosa of digestive and respiratory tracts. Salivary gland tissue may be also heterotopically located in different neck structures.

Most common diseases of salivary glands are inflammation and sialolithiasis [3]. They often coexist and nearly always cause symptoms. The incidence rates of salivary tumours appear to be low, but reliable data are difficult to obtain and vary depending on the study due to a lack of studies screening large populations, due to changing histopathological classifications (newest one WHO classification dates from 2017 [(4)]), probable differential incidence rates between different populations, and improvement of imaging methods, which increases detection rates.

Estimates of salivary gland neoplasms incidence rate range from 0.4 to 13.5 per 100,000 population [5]. Most of the salivary gland neoplasms are benign (e.g., 86%) [6]. Malignant epithelial salivary gland neoplasms constitute only about 3-6% of all head and neck malignancies [5].

Salivary gland neoplasms are mainly primary and have epithelial origin. Mesenchymal (nonepithelial) neoplasms make up only 1.9-5% of all major salivary gland neoplasms [7]. Lymphomas are rarely found, are mostly non-Hodgkin and mainly due to systemic involvement, seldom as primary disease [8]. Metastases are less common, accounting for about 1% (108/10,944) of cases according to Seifert et al [9] and occur in the parenchyma or within intraparenchymal lymph nodes of the parotid or

submandibular salivary glands. The origin of metastases to salivary glands is usually from within the head and neck particularly the cutaneous malignancies squamous cell carcinoma and melanoma [9,10]. However, depending on geographic location, metastases may be found prevailing over primary parotid neoplasms, like in Australia, reaching 75% (178/232) of the patient cohort [10], which is connected with regional elevated incidence of skin cancers. Additionally, there are reports showing a rising incidence of metastases to parotid glands over recent decades in other countries such as Germany [11]. Most often (61-87%) the neoplasms occur in the parotid [6,12-14], less commonly in the submandibular salivary gland (9.5-11%) and minor salivary glands (9-28.5%) and least commonly in the sublingual salivary gland (0.5-1%) [6,12,14]. The ratios of 100:10:1:10 for site distribution of salivary gland neoplasms between parotid, submandibular, sublingual and minor salivary glands were suggested by Willis in 1953 [15] and confirmed in subsequent studies [5]. The trend of increasing frequency of tumor malignancy is inverse to the salivary glands size. The lowest rate of malignancy (9-32%) is noted in largest parotid glands, in which tumors are most commonly encountered, followed by submandibular salivary gland (25-43%) and minor salivary glands (40-62%), and up to 75-100% in sublingual salivary glands, which are fortunately the rarest sites of neoplastic growth [6,12,14,16]. Bradley [5] suggested percentages for the ratios of benign to malignant salivary gland neoplasms are 80% vs.

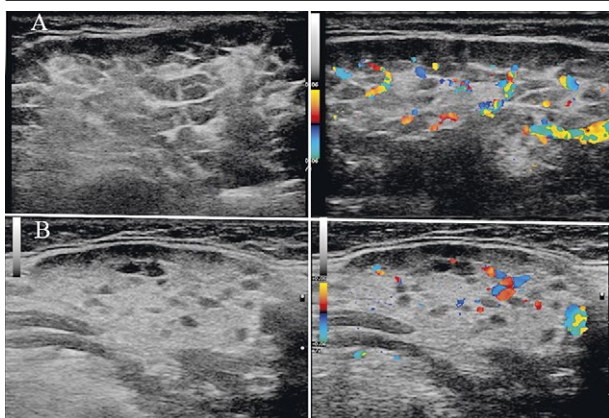


Fig 2. Gray scale and colour Doppler of the parotid gland (A) and submandibular gland (B) in a patient with Sjögren syndrome. Note the hypoechoic diffuse nodular lesions, hyperechoic fibros septa and increased vascularity (especially in parotid gland).

20% for parotid gland, 50% vs. 50% for submandibular salivary gland, 5% vs. 95% for sublingual salivary glands and 20% vs. 80% for minor salivary glands (fig 1). Therefore, lesions in submandibular salivary glands should be regarded as highly suspicious for malignancy and even more so in the sublingual salivary glands.

Pleomorphic adenomas (mixed tumours) and Warthin tumors (cystadenolymphomas) are the main benign neoplasms, constituting 93% [6,13,17]. The malignant salivary neoplasms are most commonly mucoepidermoid carcinoma, adenoid cystic carcinoma and adenocarcinoma not otherwise specified (NOS) accounting for about 65% of cases [6,14,17]. Salivary tumors may be multiple, of the same origin or of different type - most often Warthin tumor, occurring either synchronously or metachronously in the same salivary gland or in different ones [17]. Carcinomas of the major salivary glands are a heterogeneous group of neoplasms, ranging from low grade to aggressive malignancies, with etiologic and biological variability showing varying prevalence according to age, gender, race, and geographic location even within the same country [14,17-19].

Chronic inflammatory diseases may also present themselves as solid lesions, single or multiple. This includes granulomatous diseases such as tuberculosis or sarcoidosis and chronic sclerosing sialadenitis (Küttner tumor) [3]. Sjögren Syndrome, an autoimmune disease, may present as scattered multiple small, oval areas disseminated in both parotid and submandibular salivary glands [3] (fig 2).

Lack of high quality large prospective trials makes it difficult to define reliable evidence-based guidelines concerning the management of salivary gland incidental findings.

Chances of detecting SIs

Reports relating to SIs on CT or MRI are scarce. Parotid gland masses were incidentally detected in 2.5% (5/225) of patients undergoing CT cranial angiography [20]. On MRI (1.5T) SIs were reported only in 0.26% (2/700) of patients at the age of 73 years [21] and in 0.27% (2/730) of patients who underwent imaging of the temporomandibular joint [22]. More data is available concerning SIs on PET/CT. The frequency of incidental findings on 18F-fluorodeoxyglucose (FDG) PET/CT scans showing 18F-FDG uptake in parotid glands ranged from 0.4% to 1.73% [23-25]. Only 4 % of focal parotid incidental uptake (FPIU) turned out to be malignant in the study group of Makis et al [24] and 9.6% in the meta-analysis of Treglia et al [26]. However, Ustun et al [25] reported an incidence of parotid metastases amounting to 36.4% and similarly high values of 45% were reported by Mabray et al [27], where FPIU was frequently a manifestation of the patient's known malignancy (metastasis or lymphoma). It has to be noted that the high malignancy rates in incidental masses detected on multimodal PET imaging are mostly due to the fact that PET/CTs are performed mostly in oncologic patients, with high probability of metastases. Britt et al [28] performed a retrospective review of 771 patients who underwent parotidectomy. Within the group of parotid masses found incidentally on CT, MRI or PET/CT, carried out for an unrelated indication, the overall rate of malignant neoplasms was 6% (4/67). In the group where masses were identified in symptomatic patients owing to pain, facial nerve dysfunction, palpable mass or other reasons, the frequency of malignant neoplasm was higher, 32.7% (230/704) [28].

A dramatic increase in the prevalence of parotid incidentalomas (PIs) over time detected on imaging was identified by Britt et al [28]. Their study reports a 155% increase over a 20-year study period (1994-2013), where 4% of all parotidectomies were performed for PIs during the first decade and 10.2% during the second decade.

The percentage of PIs that were malignant, detected by various imaging methods, was 5% (95%CI 2, 10) [29]. The histology of the SIs found on CT, MRI, PET/CT or PET/MRI should be confirmed using fine-needle aspiration cytology or core biopsy guided by US [30,31].

On US, SIs may also be detected during scans performed for thyroid, lymph nodes or carotid arteries assessment. Salivary glands screened by Onda et al during thyroid US revealed abnormal incidental findings in about 4% of patients (36/908). This included atrophy/swelling, unclear boundaries of the gland or hypervascularity in addition to internal heterogeneity, as well as tumors [32]. Tumors underwent fine needle aspiration cytology

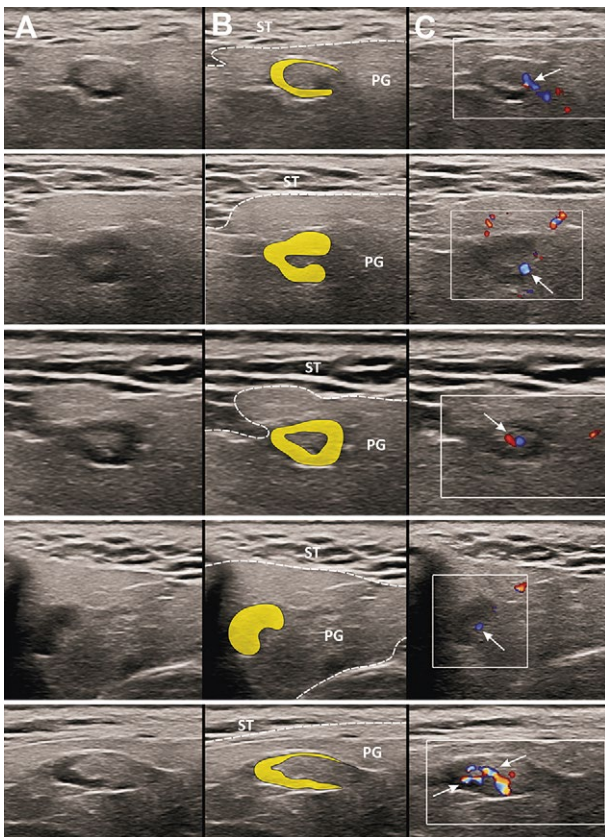


Fig 3. Normal intraparenchymal lymph nodes in the parotid gland, which should not be mistaken for a pathologic lesion: A) raw gray-scale images; B) lymph nodes parenchyma marked with yellow; border of the parotid gland marked with a dashed line; PG – parotid gland; ST – subcutaneous tissue; C) color Doppler images showing hilar or central branching lymph node vessels – arrows.

(FNAC), while other abnormalities were evaluated with further blood tests and imaging studies [32].

Specific categories of incidental findings in salivary glands are typically calcification or stones/sialoliths [33]. Calcifications were reported in parotid glands in 4% of noncontrast head CT and revealed association with HIV, alcoholism, chronic kidney disease, autoimmune disease and elevated alkaline phosphatase [34]. From 350 incidental findings identified in 999 cone-beam CT of the head and neck, submandibular gland stones constituted 0.8% [35]. Incidental reports have also been reported from the sublingual gland revealing multiple sialoliths on orthopantomograms [36]. In cases of salivary glands calcification/stones detected by an imaging method which does not provide visualization of the gland parenchyma and excretory ducts, US should be taken in consideration as it permits differentiation between true stones, phleboliths or tumor calcification. A stone may also be incidentally discovered on US performed for other reasons. In

the Sigismund et al study, US allowed for detection of stones not causing symptoms in 2.6% (61/2,322) of patients with sialolithiasis [33].

It is important not to mistake intraparenchymal lymph nodes, which are intrinsic structures especially in parotid glands parenchyma, from true focal abnormalities. This may be challenging, especially for inexperienced sonographers (fig 3) and in indeterminate cases, US-FNAC should be performed.

In summary, allowing for the difference amongst all the reported studies, the prevalence of SIs on imaging ranges from 0.26% to about 10%, with the rate of malignancy of 4% rising to 45% in SIs detected on FDG PET/CT studies. One should be aware that these studies having PET/CT will be a highly selected group of patients, likely with known malignancy.

Salivary gland neoplasm

Prevalence, epidemiology

The etiology of salivary gland neoplasm in most patients is unknown [37] but their occurrence is associated with high and low-dose irradiation, explosion to silica dust, nickel, rubber manufacturing, using kerosene as a cooking fuel, high serum cholesterol, low vitamin intake and low intake of dark yellow vegetables [38]. In Epstein-Barr virus infections, a higher incidence of undifferentiated carcinoma, Warthin's tumor and salivary T-cell lymphoma was reported in AIDS patients [38]. Warthin tumors are strongly associated with smoking [38]. Recent studies revealed specific chromosomal abnormalities and gene mutations connected with benign and malignant salivary neoplasms [38]. It is hoped that these genetic markers may in future be useful in salivary glands' neoplasms diagnosis, therapy and prognosis [38,39].

Clinical significance

Clinical significance of SIs depends on the method of their detection. The most significant lesions seem to be tumors detected on multimodal PET imaging showing FDG uptake but these examinations were typically performed in patients with a known malignancy for staging [27]. SIs detected by other imaging modalities are most likely benign primary neoplasms or pseudotumors, including intraparenchymal lymph nodes.

Salivary glands and their incidentalomas

Two of the most common benign salivary gland neoplasms may undergo malignant transformation.

Pleomorphic adenomas (PA), are the most common neoplasms of salivary glands and may undergo malignant transformation to carcinoma in about 0.15 - 2.86% of new cases, or in 3.2-3.3 % of recurrent cases (as re-

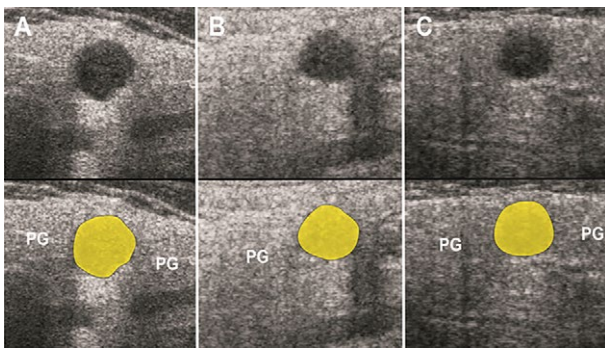


Fig 4. These lesions all have similar grey-scale ultrasound appearances but are of different aetiologies: A) small pleomorphic adenoma; B) small mucoepidermoid cancer; C) Small reactive lymph node without apparent hilum. All presented masses demand further work-up by means of US-guided FNAC.

ported Valstar et al from analysis of 3.506 cases of PA from Dutch pathology registry [40] and Andreassen et al from analysis of 5.497 patients from The Danish Pathology Data Bank [41]. Recurrence of PA are usually multifocal and encountered in about 6.7%, especially after incomplete resection of a PA, with a median time to first recurrence of 7 years [40]. The rate of re-recurrence of PA may reach 46.6%, posing a significant problem for these patients [41]. Warthin tumors may undergo malignant transformation much less often than PAs, in about 0.5% of cases [42]. However, in a retrospective histological evaluation by Alnoor et al the prevalence rate of lymphoid neoplasia in Warthin tumors was found higher, 3.4%: with overt lymphoma in 2.2%, and in situ follicular neoplasia of 1.1% [43]. An interesting issue is the possibility of high-grade transformation within salivary gland carcinoma, usually previously low grade, which implies increased aggressiveness and poorer prognosis. The concept has been introduced in the latest 4th edition of WHO classification of tumors [4].

Imaging features including echo texture

Low-grade salivary malignancies may show slow growth and no typical malignant features, mimicking benign tumors [3], especially when less than 20 mm in size (fig 4). Some small metastases may show pseudo-benign imaging features. This poses a serious pitfall for imaging specialists where accurate differentiation of benign from malignant salivary lesions in conventional imaging is usually not possible.

Obviously, in case of aggressive or high-grade tumors irregular shape, spiculated or ill-defined margins, infiltration of surrounding tissues, inhomogeneous structure and the presence of abnormal lymph nodes malignancy is likely [3,19,44] (fig 1, fig 5). Nevertheless, the lack of above mentioned imaging features does not completely exclude malignancy. In the study by Borsetto et al only 33.3% of all confirmed malignant tumors had characteristic imaging features of malignancy [45]. The most commonly occurring benign salivary neoplasms, pleomorphic adenoma and Warthin tumors, have a few typical but not pathognomic imaging features. Pleomorphic adenomas (PAs) often have lobulated, polycyclic margins and may be inhomogeneous [3,46], which reflects their complex histopathological nature, with epithelial and myoepithelial cells arranged in mucoid, myxoid or chondroid background, sometimes with osseous metaplasia or lipomatous differentiation [47] (fig 1, fig 6). PAs are usually poorly vascularized but have varying vascular density [3,46]. Polycyclic shape is a poor discriminant of benign and malignant salivary neoplasms, where either may present with any shape [3]. In Warthin tumors (WTs) anechoic spaces reflecting their histopathological composition are often encountered (up to 93% by Shimizu et al) [48]. The stroma of a WT is composed of dense lymphoid tissue with cystic areas lined by a bilayered epithelium, which may present papillae [47]. However,

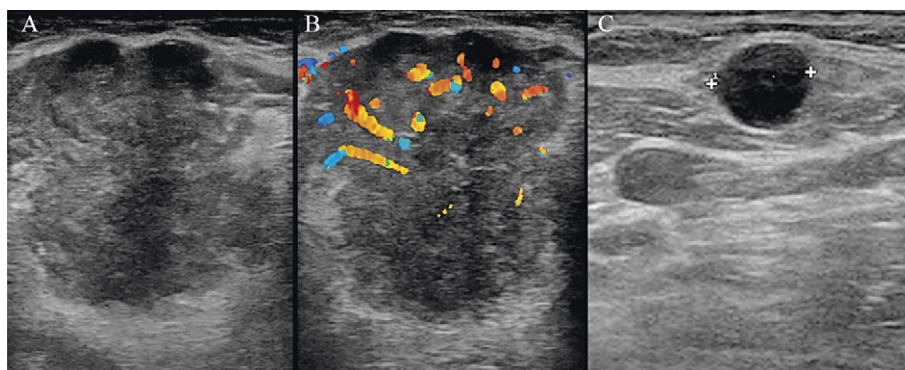


Fig 5. Mucoepidermoid carcinoma of the parotid gland, grey scale (A) and Color Doppler (B) (irregular shape, ill defined margins, inhomogenous appearance and hypervascularized tumor) associated with round, hypoechoic and without hilum regional metastatic lymphnode (C).

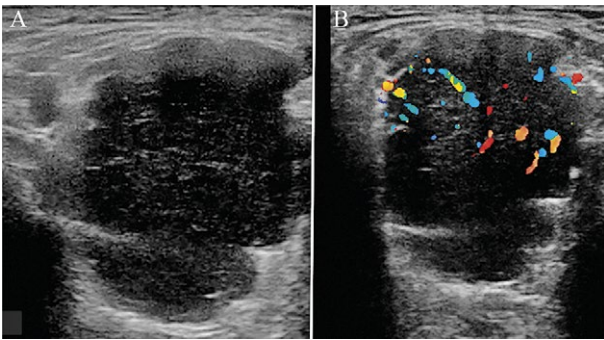


Fig 6. Pleomorphic adenoma, grey scale (A) and color Doppler (B) with lobulated, polycyclic margins, slightly inhomogeneous and moderate vascularised

other benign and malignant salivary neoplasms may also present with internal fluid-like components [46,49]. Most WTs are very well vascularized [3] (fig 7).

US contrast agents and elastography

Relatively newer US techniques include ultrasound contrast agents and elastography. Neither of them has been revolutionary in characterising salivary gland neoplasms. Application of microbubble contrast allows for additional assessment of microvasculature of tumors and contrast kinetics, but present studies are limited in number and are based on insufficiently large and selected populations of patients, which does not allow for drawing far-reaching conclusions [50]. According to Bhatia et al, elastography appears suboptimal for detection of malignancy in the salivary glands because of overlapping elastic properties between benign and malignant lesions [51]. Similar conclusions are drawn from a meta-analysis concerning parotid lesions, showing heterogeneous study results and indicating a limited value of elastography in differential diagnosis between malignant and benign tumors, which may be due to their histopathological variety [52]. However, higher stiffness in shear wave elastography (SWE) may indicate a parotid lymphoma in primary Sjögren Syndrome, promising the potential use of SWE for early diagnosis, biopsy guidance and possibly treatment monitoring [53].

Contrast-enhanced and nuclear medicine techniques

Like US, conventional CT and MRI even with additional post-contrast imaging does not allow for a reliable differentiation between malignant and benign salivary neoplasms because of a significant overlap in morphological features between the two groups. Moreover, these two latter techniques are much more expensive, may have contraindications, are less quickly available, CT utilizes ionizing radiation and CT/MRI contrasts have potential side-effects. Irregular margins and invasion of local structures on CT/MRI detected lesions, similar

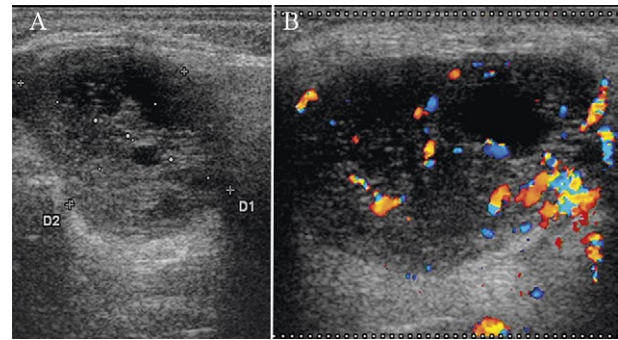


Fig 7. Warthin tumour, grey scale (A) and colour Doppler (B): inhomogeneous structure, with fluid component (cystic areas) and hypervascularisation (courtesy Dr Manuela Lenghel)

to US, suggests malignancy [19,44]. However, these features may not be present, especially in lower-grade or smaller sized malignancies. On MRI, an additional feature suggesting malignancy is hypointensity on T2-weighted images [19,44]. Newer MRI sequences bring additional values and can improve diagnostic accuracy, however do not allow for definite detection of tumor malignancy and are time consuming. High diffusion restriction on diffusion-weighted-imaging (DWI) corresponding with its derived low apparent diffusion coefficient (ADC) values and high intratumoral susceptibility signal intensity (ITSS) on susceptibility-weighted imaging (SWI), the latter an indirect indicator of angiogenesis, may indicate malignancy [54]. However, Warthin tumors may have confusing features, showing even higher diffusion restriction than malignant tumors and similar ITSS [54]. Low and progressive wash-in on dynamic contrast-enhanced perfusion-weighted imaging (DCE-PwI) in association with high ADC values were observed only in benign neoplasms [55]. But Warthin tumors ADC values and contrast enhancement curve patterns overlapped with lymphomas and malignant tumors [55]. Recently introduced amide proton transfer-weighted (APT_w) MRI can be useful in discriminating malignant from benign tumors of the major salivary glands, where APT_w-signals in malignant tumors are significantly higher than in benign ones [56]. However, this needs confirmation in further multicentre studies. It is not possible to differentiate benign from malignant salivary gland tumors based on 18F-FDG PET/CT, as benign neoplasms may show FDG uptake [24]. An interesting fact is the specific character of Warthin tumors, which are commonly hot on 99mTc scintigraphy unlike the majority of other benign and malignant salivary neoplasms [57]. This may be used as an adjunct to the decision making process when suspected Warthin tumors are managed conservatively with clinical observation in patients who have significant comorbidities, refuse surgery or are of advanced age [58].

Combined imaging criteria

In cases of sizable salivary lesions or tumors in the deep parotid lobe or in case of malignant tumor, where there is a need for assessment of the deep lying lymph nodes (e.g. at the base of the skull, retropharyngeal, retrotracheal), inaccessible by US, preoperative MR or CT is indicated to determine patient management or for surgical planning [19]. In case of advanced and high-grade malignant tumors, a staging chest CT is recommended [19]. Kikuchi et al suggested that the diagnostic algorithm of parotid tumors begin with DWI MRI in order to exclude pleomorphic adenomas based on high ADC values, with subsequent ^{99m}Tc scintigraphy to exclude Warthin tumors, leaving core needle biopsy (CNB) to be performed in the remaining cases [57]. However, such an algorithm appears far more expensive than US-FNAC and US follow-up.

Image (US) - guided biopsy

The procedure of cell sampling for cytology assessment by aspiration with use of a needle is described using two interchangeable terms: fine needle aspiration biopsy (FNAB) and fine needle aspiration cytology (FNAC). Recommendations, including those issued by The Education Committee of The American Head and Neck Society (AHNS) within the series “Do you know your guidelines“, United Kingdom National Multidisciplinary Guidelines and The National Comprehensive Cancer Network (NCCN) Guidelines, advocate US guided FNAC (US-FNAC) as a standard first-line procedure for all salivary tumors [19,59,60], whether solid or cystic [49]. US-FNAC is simple in technique, almost painless, with rare complications, fast, minimally invasive, easily available and is cost-effective. The of accuracy FNAB will vary depending on the experience of the center expressed by the amount of examined and treated patients, sampling methods, the person who is performing the procedure: a pathologist, a radiologist or a clinician, and they are better when FNAB is monitored with US [61,62].

To improve accuracy, FNAC is best performed at a high-volume case load center [63] and reported by an expert histopathologist [59]. The Education Committee of the AHNS grants permission to perform FNAB without US guidance if the lesion is easily accessed anatomically or palpable [19], however, US guidance is advisable where available. The drawback of FNAC is its moderate to low sensitivity, with varied reported percentages, 78%; with 95%CI 74%, 82% (n=5647 patients) [61], as low as 58-59% (n=371 FNAC; n=554 FNAC) [64,65] or as high as 82% (n=996 patients) [66]. One of the reasons, as with imaging, are the intrinsic properties of low-grade malignancies, with no significant cell atypia possible to be recognized basing only on their morphology [64]. The

specificity and negative predictive value (NPV) of FNAC in differentiating malignant from benign salivary lesions is high, but with large diversity in reported percentages [61]. In a meta-analysis of 5647 patients, specificity was 98% (95%CI 97%, 98%) [61] and other studies have cited 99% [64]. NPV for determining parotid malignancy was reported ranging between 91 and 95% [63-65,67]. False negative results are unfortunately possible in FNAC; therefore, patients with results negative for malignancy should be monitored with US. In case of rapid enlargement or suspicious US features, US-FNAC should be repeated. Core needle biopsy (CNB) is reported to have better sensitivity than FNAB, reaching 88.2-89.6% [64,68]. Nevertheless, CNB requires local anesthesia, is regarded more invasive and potentially exposes the patient for the risk of facial nerve injury, seeding of tumor cells, hematoma or inflammation, therefore it should be limited to cases where the definite diagnosis is not possible with FNAC or when lymphoma is suspected [69,70].

Follow-up

There are no established guidelines for the follow-up post-treatment of malignant salivary neoplasms. The Committee of the AHNS [19] suggests individual adjustment of the scheme of monitoring and present conventional schedule with repeated clinical examinations and history (“every 1-3 months in the first year, every 2-6 months in the second year, every 4-8 months up to five years and later each year”) and imaging after 3 months with the same modality as before treatment. Special attention is advocated for adenoid cystic carcinoma where regular neck imaging and consideration of annual chest CT to enable early detection of recurrence or metastases [19]. We recommend regular US-follow up post resection of not only malignant, but also of benign, salivary neoplasms. The latter, for example, in pleomorphic adenomas frequently recur and in the case of Warthin tumors, there is possible metachronous appearance.

Surgery and other treatment options

The general first-line treatment option for primary salivary neoplasms is surgery [19,59] apart from lymphomas, which are treated with chemotherapy [71]. For submandibular salivary glands, total excision of the gland is performed, while for parotid glands, the extent of surgery depends on the size, location and the nature of the tumor. This may include extracapsular dissection, partial superficial parotidectomy and superficial parotidectomy [45,72]. Elective neck lymph nodes dissection is considered for all malignant tumors but is mandatory for high-grade and high-stage neoplasms. A therapeutic neck dissection is mandatory when clinically positive lymph node metastases are present [19]. In some cases, adjuvant radiotherapy (RT) or chemoradiation therapy

is recommended after surgery with malignant tumors [19,59]. Radiotherapy however may cause salivary gland hypofunction and xerostomia which will impair the patient's quality of life [73]. In cases where occasional, conservative management is chosen of an incidental solid salivary mass, US follow-up is mandatory, with repeated US guided FNAC when suspicious ultrasound features or when rapid growth are observed.

Clinical scenarios and role of ultrasound

Detection of SI by ultrasound

The inclusion of salivary gland screening in the protocol of US examinations of other head and neck structures depends on the available time, national regulations and meticulous examination of the sonologist. In case of detection of a SI by US, the next step is to suggest US-FNAC/FNAB and US follow up, depending on the cytopathology result, as well as a consultation by an otorhinolaryngology specialist.

Ethical issues, psychological burden

The general public are generally less aware of the spectrum of salivary glands diseases in comparison with pathologies of other human organs. They usually do not connect salivary glands with cancer or other neoplastic diseases, as they do in case of breast, prostate, lungs, liver or brain. Some are even not conscious of having such glands.

Therefore, SIs suggested for control imaging or FNAB usually do not concern people very much.

Informed decision making

When a SI FNAC result suggests primary salivary malignancy, there are usually no reasons from the patient to refuse surgery, however that may depend on life expectancy. If a detected mass is relatively small and FNAC results are benign, US follow-up should be recommended after informing the patient about possible false negative cytology result and low, but potential risk of malignant transformation. The increased risk of post-operative complications when operating on a larger neoplasm detected later, should also be discussed.

Economic factors

US suggested for follow up or FNAB verification of a SI is relatively cheap. FNAB in superficial organs usually has no complications or only minor ones. Therefore, the costs of observing or verifying an SI are relatively low, especially taking into consideration the low prevalence of SIs. However, when malignancy is suggested by FNAB, further imaging of a SI is needed: CT or MRI. Nevertheless, early detection leads to treatment at an earlier stage, which is probably more cost-effective as well for the individual patient, as for the medical system.

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Conflict of interest: none

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