Original Article

Accuracy of Ultrasound Compared to Histopathology in the Assessment of Salivary Gland Tumors in Yaounde (Cameroon)

Précision de l'Échographie Comparée à l'Histopathologie dans l'Évaluation Des Tumeurs des Glandes Salivaires à Yaoundé (Cameroun)

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ABSTRACT

Context. Salivary gland tumors account for about 2.8 – 10% of all head and neck malignancies on the African continent. The scarcity of the equipment necessary for the specific diagnosis of these tumors has a direct impact on the management and outcome of patients, especially to specify the surgical indications. We aimed to assess the accuracy of ultrasound to determine the type of salivary gland tumors. **Methods.** This retrospective cross-sectional study was done by reviewing files registered in the imaging departments of two reference hospitals in Yaoundé, Cameroon from January 2017 to December 2021. Children and adults with salivary gland tumors were included, and sociodemographic, clinical, ultrasound and histopathological data were collected. Sensitivity, specificity, positive and negative predictive values were used to assess the accuracy. **Results.** A total of 51 participants were included in this study, with a mean age of 36.1 ± 20.2 years and 54.9% of female. Benign tumors were more common (56.9%), with pleomorphic adenoma (48.3%) and adenocarcinoma (36.3%) being the most frequent benign and malignant tumors respectively. The sensitivity and specificity of ultrasound were respectively 72.7% (95% CI: 49.8–89.2) and 96.6% (95% CI: 82.2–99.9). **Conclusion.** Ultrasound is a highly specific and moderately sensitive test for the diagnosis of salivary gland tumors. It could therefore be used to reassure patients who don't have cancer, but confirmation requires further tests.

RÉSUMÉ

Contexte. Les tumeurs des glandes salivaires représentent environ 2,8 à 10 % de tous les cancers de la tête et du cou sur le continent africain. La rareté de l'équipement nécessaire au diagnostic spécifique de ces tumeurs a un impact direct sur la prise en charge et le pronostic des patients, notamment pour préciser les indications chirurgicales. Nous avons cherché à évaluer la précision de l'échographie pour déterminer le type de tumeurs des glandes salivaires. **Méthodes.** Cette étude transversale rétrospective a été réalisée en examinant les dossiers enregistrés dans les services d'imagerie de deux hôpitaux de référence à Yaoundé, au Cameroun, de janvier 2017 à décembre 2021. Les enfants et les adultes présentant des tumeurs des glandes salivaires ont été inclus, et des données sociodémographiques, cliniques, échographiques et histopathologiques ont été recueillies. La sensibilité, la spécificité, les valeurs prédictives positives et négatives ont été utilisées pour évaluer la précision. **Résultats.** Au total, 51 participants ont été inclus dans cette étude, avec un âge moyen de $36,1 \pm 20,2$ ans et 54,9 % de femmes. Les tumeurs bénignes étaient plus fréquentes (56,9 %), avec l'adénome pléomorphe (48,3 %) et l'adénocarcinome (36,3 %) étant les tumeurs bénignes et malignes les plus fréquentes respectivement. La sensibilité et la spécificité de l'échographie étaient respectivement de 72,7 % (IC à 95 % : 49,8-89,2) et 96,6 % (IC à 95 % : 82,2-99,9). **Conclusion.** L'échographie est un test très spécifique et modérément sensible pour le diagnostic des tumeurs des glandes salivaires. Elle pourrait donc être utilisée pour rassurer les patients qui n'ont pas de cancer, mais la confirmation nécessite des tests supplémentaires.

HIGHLIGHTS OF THE STUDY

What is known about the subject
Early detection and treatment of salivary gland tumors could reduce the incidence of new cancer cases by approximately 30 to 50%. Advanced diagnostic as well as specialized histopathology laboratories for cancer diagnosis are not as accessible and are unevenly distributed across the most of low and middle incomes countries

The question addressed in this study
Diagnostic accuracy of ultrasound compared to histopathological analysis.

What this study brings new
Ultrasound is a highly specific and moderately sensitive test for the diagnosis of salivary gland tumors.

Implications for practice, policy or future research
Ultrasound could therefore be used to reassure patients who don't have cancer, but confirmation requires further tests

INTRODUCTION

Salivary glands, which include the parotid, sublingual, and submandibular types, are exocrine glands situated in the mouth and throat area. These glands are commonly affected by tumors that are often asymptomatic until they grow large enough to impinge upon muscles and nerves. Early diagnosis and the effective management of these tumors allows to avoid complications and especially to better specify the surgical indications. The heterogeneous nature of salivary gland tissues gives rise to varied prognoses. Children and adolescents, for example, generally have a better prognosis due to a lower incidence of cervical metastases and less frequent invasion of local soft tissues compared to adults [1–3].

According to GLOBOCAN data from 2018, there were 18.1 million new cancer cases and 9.6 million cancer deaths globally, with ENT cancers accounting for 890,000 new cases and 450,000 deaths. Specifically, salivary gland tumors represent approximately 2.8–10% of all head and neck malignancies in Africa. In Cameroon, the overall cancer mortality rate is high, with 15,796 reported cases and 10,533 deaths, indicating a mortality rate of 66.7%. It is suggested that lowering exposure to known risk factors and improving early detection and treatment could reduce the incidence of new cancer cases by approximately 30 to 50% [4–6].

Radiologic techniques, including computed tomography (CT), magnetic resonance imaging (MRI), and ultrasonography (USG), are instrumental in evaluating salivary gland tumors. Ultrasonography, in particular, is favored due to its low cost, non-invasive nature, and lack of harmful effects. It is effective in assessing the location, size, and echogenicity of tumors, and is crucial in differentiating between benign and malignant imaging patterns of salivary gland tumors. Nevertheless, the similarities between benign and malignant lesions, along with the inherent limitations of this imaging modality, can diminish their accuracy in determining the precise histopathology of salivary gland masses [7,8].

In most of low and middle incomes countries like Cameroon, while basic medical imaging equipment is widely available, advanced diagnostic tools such as CT and MRI scanners, as well as specialized histopathology laboratories for cancer diagnosis, are not as accessible and are unevenly distributed across the country. This disparity results in data that is often incomplete or representative of only a small number of cases [4,9,10]. An ENT surgeon to have as much information as possible beforehand to guide his management, particularly the surgical procedure. The current study aims to address this shortfall by examining the patient profiles of those presenting with salivary gland tumors and evaluating the diagnostic accuracy of ultrasound compared to histopathological analysis.

METHODS

Study design and period
This retrospective cross-sectional study was carried out from February to May 2023 in two reference hospitals in Yaoundé, Cameroon, namely the Yaoundé General Hospital and the Yaounde Gynaeco-Obstetric and Paediatric Hospital.

Study population
We reviewed all the files registered in the imaging departments of these hospitals from January 2017 to December 2021. Participants included were children and adults with salivary gland tumors which had clinical diagnosis as well as ultrasound and histopathology results within the period of interest. All the patients with incomplete files (lacking one important information on these results) were excluded.

Data collection
Subsequent to obtaining approval from the competent ethical and administrative authorities, we collected data using a pretested survey form to gather sociodemographic, clinical, ultrasound and anatomopathological data. The necessary informations were retrieved from patient's medical records.

Statistical analysis
Census and Survey Processing System (CSPro) software version 6.2 and the Statistical Package for the Social Sciences (SPSS) version 23.0 were used for data entry and analysis, respectively. Count and percentage were used to describe qualitative variables while mean and standard deviation were used for continuous variables. For the accuracy evaluation, histopathological examination was considered as gold standard and ultrasound as the test being evaluated. Therefore, we used sensitivity, specificity, negative and positive predictive value (with corresponding 95% confidence intervals) to assess the accuracy.

Ethical consideration
We conducted our study following the standards of the Declaration of Helsinki relating to human subjects in research [11]. An ethical clearance was obtained from the institutional ethics committee of the Faculty of Medicine and Biomedical Sciences of the University of Yaoundé I (N°: 0210/UY1/FMSB/VDRC/DAASR/CSD). Then, we obtained approval from the administrative authorities of the hospitals targeted by our study. We did not request participants' consent as this was a retrospective study performed on data from medical files. However, the information collected was kept confidential and anonymous.

RESULTS

General characteristics of study participants

Out of the 111 files we consulted, 51 met the criteria to be included in this study. The mean age of the participants was 36.1 ± 20.2 years (range 3–80). Most of them were females (54.9%) with a sex ratio of 1.22 females for every male, were single (49.0%), and had a primary level of instruction (49.0%). Details on the sociodemographic characteristics of the participants are found in Table 1.

Table 1: Sociodemographic characteristics of the participants (N=51)

Variables	N	Percent
Age groups		
< 10 years	8	15.7
10-20 years	5	9.8
20-30 years	3	5.9
30-40 years	16	31.4
40-50 years	5	9.8
50-60 years	9	17.6
≥ 60 years	5	9.8
Gender		
Female	28	54.9
Male	23	45.1
Marital status		
Single	25	49.0
Married	10	19.6
Widow(er)	4	7.8
Minor	12	23.5
Level of study		
Not enrolled	3	5.9
Primary	25	49.0
Secondary	16	31.4
Superior	7	13.7
Occupation		
Student	19	37.3
Informal sector player	15	29.4
Housekeeper	11	21.6
Public sector employee	3	5.9
Retired	3	5.9

Clinical, ultrasound, and histopathologic features of the tumors among the participants

The majority of the patients came to the hospital for voluntary consultation, and facial swelling (92.2%) was the main complaint. The salivary gland pathologies were predominantly single (88.2%), located in the parotid region (86.3%), with a hard consistency (56.9%), and were mobile (62.7%). The primary finding upon examination of the mucous membranes was swelling (27.5%), followed by ulceration (3.9%), as detailed in Table 2.

Table 2: Clinical characteristics among the study participants

Variables	Numbers (N=51)	Percent (%)
Complaint		
Facial swelling	47	92.2
Trismus	21	41.2
Facial paralysis	4	7.8
Skin ulceration	3	5.9
Skin discharge	1	2.0
Laterality		
Unilateral single	46	90.2
Bilateral	5	9.8
Tumor location		
Parotid gland	44	86.3
Submaxillary gland	5	9.8
Sublingual gland	2	3.9
Number of nodules		
Single mass	45	88.2
Multiple mass	6	11.8
Consistency		
Hard	29	56.9
Soft	13	25.5
Farm	11	21.6
Contour		
Regular	31	60.8
Irregular	20	39.2
Mobility		
Mobile	32	62.7
Still	19	37.3
Examination of the mucous membranes		
Swelling	14	27.5
Ulceration	2	3.9
Flow	1	2.0

On ultrasound, most of these tumors were unilateral (90.2%), round (52.9%), and had well-defined margins (60.8%). Histopathologic analysis showed that benign tumors (56.9%) were more common than malignant ones (43.1%), with adenocarcinoma being the most prevalent malignant tumor at 36.3% (Table 3).

Table 3: Ultrasound and histopathologic features of the salivary gland tumors

Variables	Numbers (N=51)	Percent (%)
Shape		
Round	27	52.9
Oval	24	47.1
Margins		
Well-defined	31	60.8
Poorly defined	20	39.2
Source of sample		
Needle biopsy	35	68.6
Resection	16	31.4
Type of lesion on ultrasound		
Benign	34	66.7
Malignant	17	33.3
Type of lesion on histology		
Benign	29	56.9
Malignant	22	43.1

Table 3 (continued): Ultrasound and histopathologic features of the salivary gland tumors

Variables	Numbers (N=51)	Percent (%)
Type of benign lesions (n = 29)		
Pleomorphic adenoma	13	48.3
Adenolymphoma	7	24.1
Cysts	5	17.2
Other	3	10.3
Type of malignant lesions (n = 22)		
Adenocarcinoma	8	36.3
Undifferentiated cell carcinoma	4	18.2
Squamous cell carcinoma	3	13.6
Undifferentiated cell adenocarcinoma	3	13.6
Myoepithelial carcinoma	2	9.1
Mucoepidermoid carcinoma	1	4.5
Other	1	4.5

Accuracy of ultrasound as compared to histology

We found that the agreement between the two examinations was 86.3%, with 31.4% of the lesions confirmed as malignant and 54.9% confirmed as benign (Table 4).

Table 4: Accuracy of ultrasound as compared to histological type of lesion

		Histopathological results	
		Malignant	Benign
US results	Malignant	16 (31.4)	1 (1,9)
	Benign	6 (11,7)	28 (54.9)

The sensitivity and specificity of ultrasound were respectively 72.7% (95% CI: 49.8–89.2) and 96.6% (95% CI: 82.2–99.9). The positive predictive value was 94.1% (95% CI: 69.6–99.1) and the negative predictive value was 82.4% (95% CI: 70.2–90.3).

DISCUSSION

Malignancy in salivary glands accounts for 5% of head and neck cancers. Studies on these malignancies have documented a wide range of variations in prevalence, location and patient features [3,12]. In Cameroun, a study has shown a prevalence of malignant salivary gland tumors in 3,05% of all cervico-facial localisations [4,]. Our study had an age range of 3 – 80 years with a mean age of 36.1 ± 20.2 years and peak prevalence in the 2nd and 3rd decades. Conversely, Kumaran *et al* obtained an age range of 14 -71 years with a mean age of 45.01 ± 16.3 years and peak prevalence in the 5th and 6th decades whereas Alsanie *et al* found an age range of 1-106years with a mean age of 56 years and peak prevalence in the 6th and 7th decades for malignant tumors [13,14].

Salivary gland tumors tend to more commonly affect women with a male-to-female ratio of 1 to 1.5. Our study followed this tendency as there was a female predominance with a sex ratio of 1.22 [3]. However, male predominance was common in studies by Djomou *et al* and by Obimakinde *et al* with sex ratio of 1.9 and 1.2 respectively [2,4]. While male supremacy is stated as the reason for male preponderance in some African countries, the readiness to seek medical assistance demonstrated by

women enables earlier diagnoses, improves prognosis among them and explains their numbers among salivary tumor cases. Sex hormones may also influence the growth of cancer as proliferation could be hindered by knockdown or inhibition of androgen receptors [12,15]. Most of the patients in this study came voluntarily to the hospital and presented with more than one complaint, with facial swelling and trismus being the most recurrent. This is comparable to a study by Bommareddy *et al* where 86.5% of the patients presented with swelling only while it was associated to pain in the rest and a study by Reinheimer *et al* where pain (25.3%) was the most reported among the complaints available from patients' records, followed by facial paralysis (3.2%) [16,17]. Clinical study of the characteristics of the swelling and comparison with the histological results using the Chi-square test by Fassih *et al* showed that only the presence of a few symptoms (facial paralysis, fixity to adjacent planes, irregular boundaries and pain) predicted the malignancy of tumors [18].

In addition to enabling the differentiation between benign and malignant lesions through several distinct features, imaging techniques provide essential preoperative information such as the tumor's relationship to nearby structures and its exact location. The ultrasonography of the tumors in our study showed that they were unilateral (90.2%), round (52.9%) and had well-defined margins (60.8%) in most cases. Similar results were obtained by Maseer *et al* where the dominant ultrasound features of the lesions were lobular (35.5%), well-defined boundaries (88.7%), hypoechoic (80.6%) and heterogeneous (51.6%). Another study by Wang *et al* highlighted regular shape (59.0%), well-defined margins (86.9%) and heterogenous echogenicity (64.5%) as main ultrasound characteristics [7,19].

Benign tumors (56.9%) were more prevalent in this study, the main type being pleomorphic adenomas (48.3%) which were common in young adults and mainly affected the parotid gland. The main type of malignant tumor was adenocarcinoma (36.3%). Comparable proportions were observed in studies by Petrovan *et al*, Sando *et al* and Alsanie *et al* which all identified pleomorphic adenoma as the most common benign tumor with prevalence of 33.3%, 47.7% and 70% respectively [10,13,20]. The malignancy of salivary gland tumors could be determined based on many paraclinical and clinical features. The risk of malignancy has been established to be inversely proportional to the size of the gland where the tumor is growing [18].

The correlation between ultrasound and histopathology in our study was strong and positive with a concordance rate of 86.3%. The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of ultrasound for the detection of malignant tumors were 72.7%, 96.6%, 94.1% and 82.3% respectively. The results obtained by Astorri *et al* show an overall concordance rate of 91% whereas Khan *et al* demonstrated diagnostic accuracy of 89.6% with sensitivity (85.7%), specificity (100%), PPV (100%) and NPV (72.5%) [21,22]. This high sensitivity and moderate specificity demonstrated that ultrasound can be a good screening test to exclude and

reassure patients with non-malignant lesions. However, the confirmation of malignancy remaining cases will require other examinations including histopathological analysis.

Limitations of the study

This study was retrospective with a limited sample size. This increases the probability of selection and sampling bias. Incomplete files with missing ultrasound or histopathological information were excluded from the samples, and this may further increase the sampling bias. However, we performed a consecutive and exhaustive sampling. Another limitation is that all the ultrasounds were not performed by the same practitioner and all the samples were not analysed by the same pathology lab technician to ensure consistency in the technics. We used the data present in the patients' records because they are closer to everyday clinical practices in our context.

CONCLUSION

There are a variety of salivary gland tumors affecting the Cameroonian population and ultrasound plays a key role in their assessments, due to its relatively high diagnostic accuracy and its good specificity. The sensitivity was moderate showing that ultrasound may not be a good tool for the positive diagnosis of a malignant lesion. It may rather be better to identify non-malignant lesions according to its high specificity. However, the limited data on this issue, especially in our context, highlights the necessity for further investigation which may help to improve awareness, better management and effective treatment of salivary gland tumors.

Conflicts of interest

The authors declare no conflict of interest.

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