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Predictors of recurrence and disease-free survival for salivary gland tumors among children and young adults in Kampala, Uganda: a retrospective follow-up study

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Abstract

Background Salivary gland tumors are a group of tumors which are highly heterogeneous, and they are uncommon among children and young adults. We aimed to investigate the predictors of recurrence and disease-free survival for salivary gland tumors among children and young adults.

Methods We retrospectively extracted clinical, pathologic, and follow-up data of patients who were diagnosed histologically with salivary gland tumors from January 2013 to December 2018 at the department of pathology, Makerere University in Kampala, Uganda. Then, we applied Cox regression analysis to determine the predictors of disease-free survival using hazard ratio as the measure of probability of the survival with 95% confidence interval. We also used Kaplan–Meier curves to analyze the disease-free survival. $P < 0.05$ was considered significant.

Results A total of 144 patients with salivary gland tumors were included in the present study who were aged not more than 20 years with mean age of 13.9 ± 4.5 years. Over one quarter (26.4%, $n = 38$) of the salivary gland tumors that were analyzed in the present study were malignant. The prevalence of recurrence was (27.1%, $n = 39$), and the mean disease-free survival was 58.7 ± 1.9 months. Category of the salivary gland ($AHR = 1.36$, 95% $CI = 0.137–0.942$, $p = 0.037$) and behavior of the tumors ($AHR = 1.82$, 95% $CI = 0.729–0.990$, $p = 0.023$) were the potential predictors of disease-free survival.

Conclusion Over one quarter of the patients had malignant salivary tumors, and also, one-third of the patients developed recurrence at the end of the follow-up period of 6 years. Involvement of minor salivary glands and having a malignant salivary gland tumor both have shown increased risk of recurrence as well as short disease-free survival. Therefore, patients with minor salivary gland involvement and those with malignant variants require optimal surgical resection of the tumors for possible prevention of early recurrence and increasing the survival of the patients without relapse of such tumors after initial resection of the primary lesions.

Keywords Salivary gland tumors, Recurrence, Disease-free survival, Predictors

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Background

Salivary gland tumors (SGTs) are a relatively rare group of heterogeneous neoplastic lesions with striking morphological variation and wide difference in incidence worldwide [1, 2]. SGTs represent less than 5% when compared to their incidence in the population of adults [3]. SGTs are broadly classified into benign and malignant tumors. Epidemiologically, benign SGTs predominate malignant types of SGTs which account for approximately 5% of all head and neck cancers [4–6]. SGTs show an inherent biological behavior that may dictate their propensity for recurrence after a couple of years following treatment [4].

Despite instituting treatment to patients with SGTs, yet recurrences have been reported in various hospital settings. Surgery with or without postoperative radiotherapy has resulted in effective disease control for many patients, though disease recurrence, in the form of both locoregional recurrence and distant metastasis, has been reported to occur beyond 20 years after completion of definitive treatment [4, 7]. The diversity of SGTs in terms of histopathology affects the recurrence rate and disease-free survival (DFS) and therefore creating challenges to the available treatment options [4, 8, 9]. Studies have shown that patients with SGTs have variable overall survival rates [10, 11] and DFS [12, 13]. These have implications in prognostication of such tumors. Some studies have reported various molecular aberrations of SGTs that have been suggested to compromise prognosis [14–16], though this remains controversial to date and yet not well reported.

Regarding local and regional recurrence of SGTs, studies have reported contrasting results. In a study by Fu et al., local and regional recurrence were found to be 28% and 6%, respectively [17]; however, such results seem to be more favorable than those reported elsewhere [18, 19]. For instance, in a study that was conducted by Spiro where most patients were treated with surgery only, a locoregional recurrence rate of 39% for the parotid gland, and an even higher rate (60%) for submandibular and minor SGTs, was reported [20]. Another study reported a local recurrence and regional recurrence rate of 21% and 10%, respectively [5]. Also, Armstrong et al. reported locoregional recurrence rate of 40% for combined treatment (surgery and postoperative radiotherapy) and 69% for surgery alone [21].

There is quite scanty data regarding recurrence rate and disease-free survival of patients with SGTs particularly children and young adults in most of sub-Saharan African countries in which Uganda is included. This affects both understanding and practice in the management of patients with SGTs. Therefore, we aimed to determine recurrence and DFS and their predictors among children and young adults with SGTs.

Methods

Study design and setting

This was a retrospective follow-up study which was conducted at the Department of Pathology, Makerere College of Health Science (MakCHS), which is a constituent of Makerere University in Kampala, Uganda. All clinical and histopathological data were obtained from the Department of Pathology, whereas follow-up data were obtained from the Kampala Cancer Registry which is also under the Department of Pathology.

Patients' characteristics and selection criteria

This study consisted of data of patients who were diagnosed histologically from January 2013 to December 2018. After being diagnosed, they were treated and followed up for 6 years (from January 2013 to December 2018). All cases with complete clinical information (age, sex, tumor size, tumor behavior, anatomical location, and category of salivary gland involved), histological result (definitive histopathological diagnosis), and follow-up information (duration of follow-up since diagnosis to last contact and vital status at last contact) were included in the analysis. We excluded all cases of incomplete clinical information, missing histological diagnosis, and incomplete follow-up data.

Sampling method and sample size estimation

The sampling method used was convenience sampling (non-probability method) in which sampling of the cases was done simultaneously until all the cases with the inclusion criteria were included in the analysis. A total of 144 cases with SGTs aged not more than 20 years were included in the present study.

Follow-up procedure of the patients

We used retrospective follow-up data which were recorded and kept at the KCR. Patients were diagnosed from January 2013 to December 2018, and they were followed up since diagnosis for a period of 6 years. Follow-up of the patients was done through various ways including calling the patients and/or relatives using their phone numbers and visiting them at their home places. All patients that were considered to have been lost to follow-up due to refusal to pick the phone calls, unreachable phone calls, and having no clinical endpoint at the end of the study period were all censored during analysis.

Data collection procedure and research tool

All retrospective clinical data regarding age, sex, duration of illness, site of tumor, and biological behavior of the tumor were extracted from the patients' files and entered in the data collection sheet which we used as a research tool. Pathologic information (histological diagnosis,

tumor grade, lymphovascular invasion, and perineural invasion) was extracted from the patient's pathology report and was entered in the data collection form as well. Also, we retrieved the retrospective follow-up data of the patients from the KCR, and we included them in the analysis of both recurrence and DFS.

Statistical analysis

We used SPSS program version 23.0 (IBM statistics, Chicago, USA). Data cleaning was performed by running frequencies and crosstabs. All continuous variables were summarized in mean ± standard deviation (SD) and median (interquartile range (IQR)), and all categorical variables were presented in frequencies and proportions. Cox regression analysis was the model which was used in determining the prognostic factors for recurrence and DFS of the patients. Hazard ratios (HRs) were the measure of risk of recurrence and short DFS which were determined at 95% confidence interval (CI). The clinical endpoint in this study was development of recurrence. In analyzing the DFS, we used Kaplan–Meier curves with log rank test as a measure of the *p*-value for comparing of development of recurrence between two groups of every study variable. A two-tailed $p < 0.05$ was considered significant.

Results

Selection process of the patients included in the analysis

For the period of 6 years (2013–2018), a total of 1972 head and neck tumors (HNTs) were diagnosed at the hospital. Of the 1972 HNTs, 483 tumors were SGTs in both adulthood and pediatric populations. Figure 1 shows the schematic selection process of the study cases.

Clinical information of the patients

A total of 144 patients with SGTs were included in the present study. The mean age of the patients was 13.9 ± 4.5 years (range: 3–20 years). Over half (55.6%, $n = 80$) of the patients were females with male to female ratio of 1:1.3. Most (44.4%, $n = 64$) of the subjects were in age group of 16–20 years. The vast majority (73.6%, $n = 106$) of the SGTs were benign, and also, majority

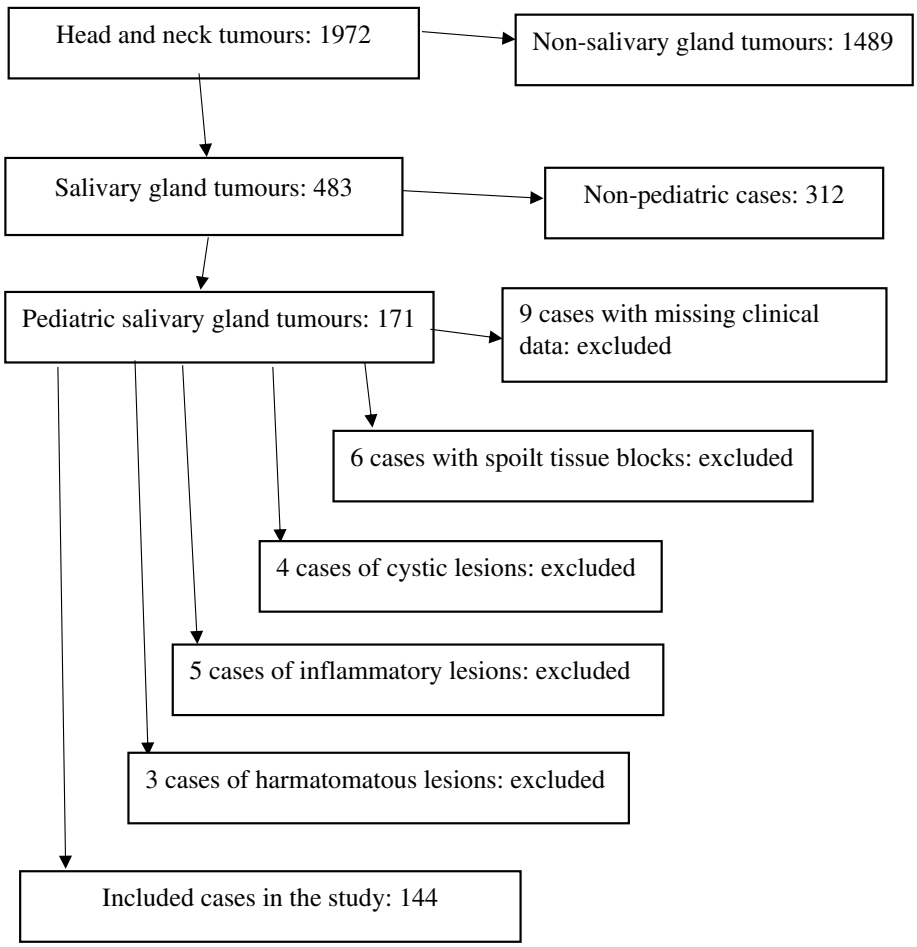

Fig. 1 Schematic process of selection of the study cases

(73.6%, $n=106$) of the tumors were involving major salivary glands.

The overall mean tumor size and that for benign and malignant SGTs were 7.4±4.6 cm, 7.3±5.3 cm, and 7.6±1.8 cm, respectively. Majority (75.7%, $n=109$) of the patients had tumor size > 5 cm. The recurrence rate of SGTs was 27.1% ($n=39$) with mean duration for recurrence of 57.4±23.7 months. The first patient was diagnosed with a recurrent disease after 7 months after initial surgical resection of the primary tumor. A total of 27.1% ($n=39$) SGTs analyzed in the present study were malignant among which 3.5% ($n=5$) were metastatic to the salivary glands. Most (45.1%, $n=65$) of the patients were managed surgically, and only 4.2% ($n=6$) died. Postoperative complications were recorded in 18.1% ($n=26$) of all the patients that were analyzed. Of those who died, 3 patients had malignant SGTs, and 1 patient had benign SGT along with hypertension. Regarding the distribution of the masses among patients, we found that most (56.9%, $n=82$) of the patients had tumor masses involving the parotid gland followed by involvement of the submandibular gland which was found in 13.9% ($n=20$) of all the patients (Table 1).

Clinical features of the patients

Figure 2 shows the clinical characteristics of the patients. Majority (72.2%, $n=104$) of the patients had non-ulcerating lesions; mobile (62.5%, $n=90$) masses and painless masses were found in majority (63.2%, $n=91$) of the patients. Other clinical features included facial palsy ($n=1$), sinus discharge ($n=1$), and bloody discharge ($n=1$).

Histopathological diagnosis of the salivary gland tumors

Regarding distribution of the histopathological types of the tumors in this study, majority (64.5%, $n=93$) of the tumors comprised of pleomorphic adenoma, and mucoepidermoid carcinoma was the most common malignant SGT which comprised (12.5%, $n=18$) of all malignant SGTs. Of the malignant tumors analyzed, approximately one quarter (25.6%, $n=10$) were secondary to the salivary glands (Table 2).

Disease-free survival analysis

The follow-up period for the patients was 6 years (2013–2018) with mean follow-up duration of 57.4±23.7 months. A total of 27.1% ($n=39$) patients had the event of interest (recurrence) at the end of the follow-up period. Also, a total of 32% ($n=46$) patients were lost to follow-up at the end of the 6 years of the follow-up duration. The mean and proportion of DFS in the present study were 58.7±1.9 months (range: 7–72 months) and 72.9%, respectively. Figure 3a–f presents the K-M curves for the DFS based on the compared groups.

Patients who were aged more than 10 years had a relatively reduced duration of living without relapse of the disease compared to the patients with less or equal to 10 years, although the difference was insignificant (log rank $p=0.157$) (Fig. 3a). The duration of developing recurrence between females and males was not distinctively different due to occasions of overlapping survival curves (log rank $p=0.689$) (Fig. 3b). The probability of surviving without developing recurrence for patients in whom there was involvement of minor salivary glands was significantly shorter than that of patients with involvement of major salivary glands (log rank $p=0.026$) (Fig. 3c).

Regarding tumor behavior, we observed that patients with malignant SGTs had a highly significantly shorter duration of surviving without relapse of the tumors compared with patients who were diagnosed with benign tumors (log rank $p<0.001$) (Fig. 3d). Patients with SGTs with tumor size of ≤ 5 cm had a relatively shorter duration of before developing recurrence compared to patients who had SGTs with tumor size > 5 cm, although the difference was insignificant (log rank $p=0.112$) (Fig. 3e). Additionally, patients who had a lag duration of > 10 months before seeking medical service had a shorter duration of developing relapse after treatment than patients who sought medical care in ≤ 10 months but without significant difference (log rank $p=0.159$) (Fig. 3f).

Prognostic factors for disease-free survival of the patients

Type of salivary gland and tumor behavior remained to be the significant predictors of development of recurrence in the present study even after adjusting for each variable during multivariate analysis. We found that for patients in whom the SGTs had involved major salivary glands, the risk of developing recurrence was 1.36 times more than in whom SGTs had involved major salivary glands, and the difference was significant ($AHR=1.36$, 95% $CI=0.137–0.942$, $p=0.037$). Also, patients who had malignant SGTs had a 1.82-fold increased risk of developing recurrence compared with patients who had benign SGTs ($AHR=1.82$, 95% $CI=0.729–0.990$, 0.023). The presence of ulceration showed increased risk for recurrence under univariate analysis only. We found that patients who were diagnosed with SGTs which were ulcerated had a 2.51-fold increased risk of developing recurrence compared with other patients in whom the SGTs were not ulcerated, but the difference was insignificant ($CHR=2.51$, 95% $CI=0.191–0.680$, $p=0.002$). However, this variable did not remain a potential predictor of recurrence under multivariate analysis (Table 3).

Table 1 Clinical information of the patients investigated ($N = 144$)

Variable	Frequency (*n*)	Percentage (%)	Mean ± SD
Age (years)			13.91 ± 4.516
3–5	14	9.7	
6–10	15	10.4	
11–15	51	35.4	
16–20	64	44.4	
Sex			
Male	64	44.4	
Female	80	55.6	
Category of salivary gland			
Major	106	73.6	
Minor	38	26.4	
Tumor behavior			
Benign	106	73.6	
Malignant	38	26.4	
Recurrence			
Present	39	27.1	
Absent	105	72.9	
Duration of recurrence (months)			57.42 ± 23.652
7–12	10	6.9	
13–36	26	18.1	
37–60	6	4.2	
61–72	102	70.8	
Methods of recurrence detection			
Physical examination	91	63.2	
Imaging	53	36.8	
Tumor size (cm)			7.41 ± 4.586
≤ 5	35	24.3	
> 5	109	75.7	
Duration of onset of symptoms to hospitalization (months)			27.35 ± 26.761
≤ 10	44	30.6	
> 10	100	69.4	
Lymph node involvement			
Yes	16	41.0	
No	23	59.0	
Tumor grade			
I	8	20.5	
II	17	43.6	
III	14	35.9	
Category of malignant tumors			
Primary	34	23.6	
Metastatic tumors to salivary glands	5	3.5	
Treatment modalities			
Surgery	65	45.1	
Surgery and radiotherapy	15	10.4	
Radiotherapy	21	14.6	
Chemotherapy	30	20.8	
Radiochemotherapy	13	9.0	
Complications			
Facial nerve weakness	13	9.0	

Table 1 (continued)

Variable	Frequency (*n*)	Percentage (%)	Mean ± SD
Frey's syndrome	8	5.6	
Keloid formation	5	3.5	
Status of the patients at last contact			
Alive	120	83.3	
Dead	6	4.2	
Unknown	18	12.5	
Anatomical location			
Buccal	15	10.4	
Soft palate	14	9.7	
Hard palate	7	4.9	
Parotid gland	82	56.9	
Submandibular gland	20	13.9	
Sublingual gland	4	2.8	
Lower lip	2	1.4	

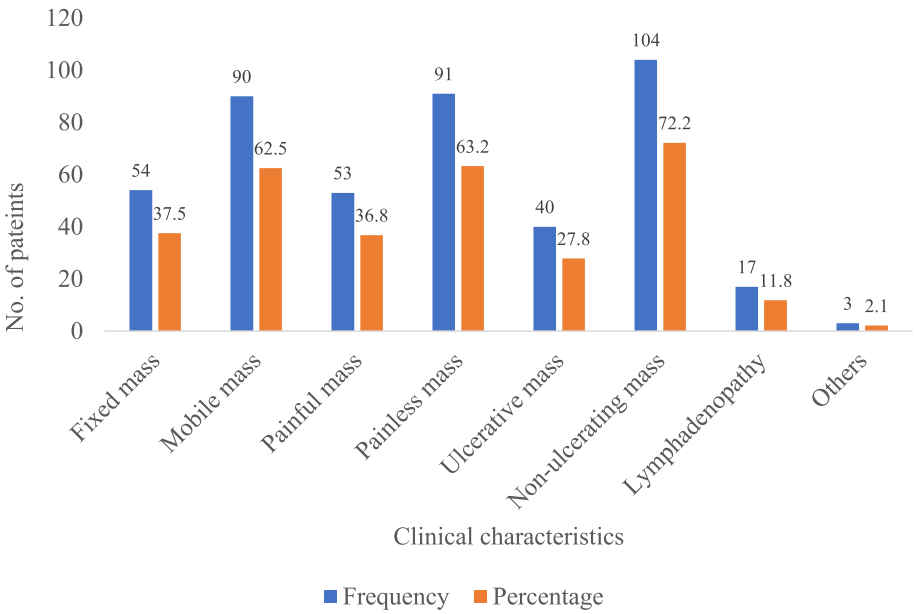

Fig. 2 Clinical presentation of the patients ($N = 144$)

Discussion

Large studies that highlight on SGTs in either pediatric or young adults are very scarce. Most of studies available in the English literature include case reports and case series. This may pose challenges regarding comparison of various characteristic features of SGTs across studies including ascertaining for proper management approaches due to lack of large studies with large power.

In our study, the male to female ratio was 1:1.3 indicating that the incidence of SGTs among females was relatively higher than that of males. Also, the vast majority of patients analyzed in our study were diagnosed with benign SGTs which were more located in the parotid gland. This is similar to the findings in the previous studies of Scaramellin et al. and Da Cruz Perezi et al. which both included pediatric patients, and it was reported that majority of the patients were females [22, 23]. However, Ethunandan et al. reported male preponderance in their study which also included patients aged not more than 18 years [24]. Other two previous studies [6, 23] which included adult patients also reported male preponderance contrary to the finding in the study of Iyad et al. which reported female preponderance among adult patients with SGTs [25]. Lack of studies with large

Table 2 Histopathological subtypes of the salivary gland tumors ($N = 144$)

Variables	Frequency (*n*)	Percentage (%)
Benign tumors		
Pleomorphic adenoma	93	64.5
Granular cell tumor	2	1.4
Lymphangioma	3	2.1
Oncocytoma	3	2.1
Carvenous hemangioma	5	3.5
Warthin tumor	2	1.4
Malignant tumors		
Mucoepidermoid carcinoma	18	12.5
Rhabdomyosarcoma	8	5.6
Squamous cell carcinoma	3	2.1
Adenoid cystic carcinoma	3	2.1
Adenocarcinoma	4	2.8

samples for patients with SGTs particularly for pediatric patients may explain the difference in the incidence of SGTs as per sex of the patients in the studies reported.

The recurrence rate from initial surgical removal of the primary tumors in our study was generally higher compared with, for example, recurrence rates of 8.5%, 9.4%, and 13% but lower than 44.2% and close to 26.1% which were reported in previous studies [23, 24, 26–28]. However, the recurrence rate in our study was similar to that which was reported in the studies of Gilbert et al. and Cruz et al. which included adult patients [23, 29]. Different biological and modifiable factors may explain the difference of recurrence rate for SGTs observed in various studies. For instance, for studies which included only malignant SGTs, it was reported that a significant number of patients developed recurrence at a short time following surgical removal of the primary tumors [30]. Also, studies that included only adult patients showed quite higher recurrence rates of SGTs compared with recurrence rates of SGTs reported in studies which included only children and adolescents.

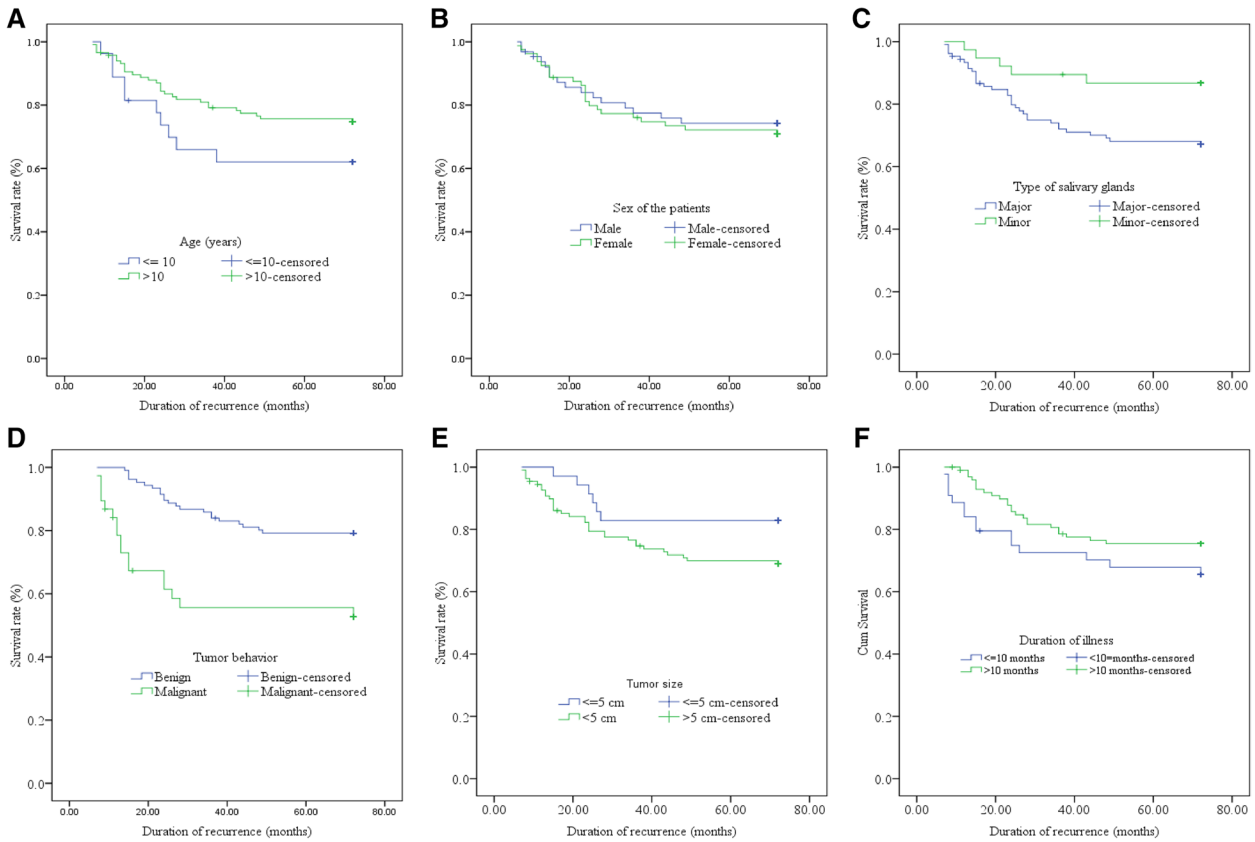

Fig. 3 **a** K-M curves for disease-free survival of the patients based on age of the patients. **b** K-M curves for disease-free survival of the patients based on sex to recurrence. **c** K-M curves for disease-free survival of the patients based on type of the salivary glands. **d** K-M curves for disease-free survival of the patients based on tumor behavior. **e** K-M curves for disease-free survival of the patients based on tumor size. **f** K-M curves for disease-free survival of the patients based on duration of illness

Table 3 Prognostic factors for disease-free survival of the patients

	Univariate analysis		Multivariate analysis	
Variables	**CHR (95% *CI*)**	***p***	**AHR (95% *CI*)**	***p***
Age (years)				
≤ 10	Ref		Ref	
> 10	1.67 (0.812–3.423)	0.164	0.75 (0.363–1.557)	0.443
Sex				
Male	Ref		Ref	
Female	1.14 (0.601–2.155)	0.691	0.89 (0.469–1.702)	0.731
Type of salivary gland				
Major	Ref		Ref	
Minor	2.77 (1.085–7.093)	**0.033**	1.36 (0.137–0.942)	**0.037**
Tumor behavior				
Benign	Ref		Ref	
Malignant	3.13 (1.658–5.900)	**< 0.001**	1.82 (0.729–0.990)	**0.023**
Duration of illness (months)				
≤ 10	Ref		Ref	
> 10	1.58 (0.0829–3.012)	0.165	0.88 (0.392–1.983)	0.760
Tumor size (cm)				
≤ 10	Ref		Ref	
> 10	1.99 (0.834–4.750)	0.121	1.46 (0.587–3.622)	0.417
Presence of ulceration				
Yes	2.51 (0.191–0.680)	**0.002**	0.55 (0.260–1.225)	0.148
No	Ref		Ref	

Survival of patients with SGTs after initial surgical removal of the primary tumors has been found to be influenced by a number of factors. The DFS of 91.7% which was reported in a study of Ethunandan et al. included pediatric and adolescent patients with SGTs [24]. Another study which also included children reported DFS of 63% which is lower than the DFS in the present study [23]. Furthermore, three studies which included adult patients with SGTs reported DFS of 54.6% [31] and 69% [32] which were lower than DFS observed in the present study but close to 71% which was reported in the study of Chen et al. [4]. Although it has been shown that the survival of children and adolescent patients with SGTs is better than that of adults aged more than 50 years [33], still such relation is not very linear because some discrepancies have been reported. This could be explained by a number of factors including variation in the follow-up duration, difference of timely medical hospitalization, and lack of availability of sophisticated surgical and radiotherapy in other parts of the world where patients are more likely to develop recurrence and metastasis, and even they may be diagnosed with residual disease which all are more likely to contribute to poor prognosis [6, 33].

DFS like other forms of survival such as overall survival, cause-specific survival, and progression-free survival for SGTs is either positively or negatively influenced by variables such as tumor behavior, age, sex, lymph node involvement, and tumor size [23, 25, 29]. Although patients with tumor size of more than 10 cm at diagnosis in our study had increased risk of short or poor DFS compared to patients with tumor size of less than 10 cm, but the association was not significant contrary to the findings in the studies of Sultan et al. and Da Cruz Perez et al. [23, 25]. Studies have shown that large primary tumors are more likely to spread to adjacent and distant body parts [29, 34]. Also, large tumors are more likely to pose treatment challenges including inability to be excised completely due to involvement of vital structures such as nerves and blood vessels [35].

Furthermore, we observed that patients with involvement of minor salivary glands had shorter DFS compared with patients in whom there was involvement of major salivary glands similar to the observation in the study of Therkildsen et al. [36]. In another study, it was found that over 50% of SGTs that develop in minor salivary glands were more likely to be malignant despite low incidence of SGTs in minor salivary glands compared with major salivary glands [37]. This may be due to the fact that malignant SGTs are more likely to develop in minor salivary gland than major salivary glands [38]. Although malignant SGTs are rare, they are known for metastasis, and they are attributed to poor overall survival, high cause-specific survival, and short DFS [39, 40]. This is similar to the observation in our series in which it was observed that patients with malignant SGTs had significantly shorter DFS than those with benign SGTs. Malignant SGTs usually grow by infiltrating into adjacent structures, spread easily to cervical lymph nodes, and the vast majority of them have high grade [41].

Other factors including age and male sex in our study were not associated with decreased DFS unlike findings in other studies [23, 25, 29, 36] in which male sex and old age were associated with poor overall survival and decreased DFS. It has been reported that the prognosis of children and adolescent patients with SGTs is better than that of adult patients because of lower frequencies of cervical spreading, the absence of local soft tissue extension, and having tumors with low tumor grades [25].

The accepted guidelines for the management of SGTs are based on either the tumor is benign or malignant. Benign SGTs are treated by total surgical excision, and all surgical margins must be ensured that are free from the tumor cells [42]; however, enucleation is no longer recommended due to high risk of recurrence and possibility of damage to the facial nerve [43]. Postoperative radiotherapy is recommended commonly for cases with

recurrence because it has proven to increase locoregional control and it has minimum chance of causing damage to the facial nerve [43]. Malignant SGTs are managed depending the clinical stage of the tumor. Both stage 1 and stage 2 malignant SGTs which have no any evidence of lymph node metastasis are managed by radical resection with optimal preservation of facial nerves together with long-term follow-up which is necessary for prevention of recurrence [44]. Primary malignant tumors (stages 3 and 4a) which usually are greater than 4 cm in size with a tendency to invade adjacent bones and nerves are managed by radical surgical resection with any involved tissues in order to ensure negative surgical margin 84.

Partial or total parotidectomy is used for treatment of advanced SGTs together with extensive excision of the involved adjacent tissue when there is evidence for perineural invasion (PNI) and connective tissue infiltration [45]. Also, lateral temporal bone or pharyngo-maxillary space resection may be necessary in very severe cases of malignant SGTs involving parotid glands [46]. Although both submandibular and sublingual SGTs are supposed to be radically resected along with removal of the adjacent structures such as branches of facial nerves, the floor of the mouth, and a part of the mandible, the nature of such anatomical locations poses challenge with operability of the tumors from such anatomical sites [47]. Also, one study showed that lymphadenectomy helps to clear the gross disease [48]. In patients with evident cervical lymph node metastasis, a modified radical or total radical neck dissection is often performed to ensure complete removal of cancerous entities [42, 43]. For stage 4b primary tumors which are extensive and they involve craniofacial base and pterygoid plates, these are managed using definite radiotherapy and/or chemotherapy due to inoperability [42].

While surgical intervention with negative margins alone may be sufficient to terminate benign or small low-grade salivary gland tumors, malignant neoplasms would require adjuvant radiotherapy postoperatively. The application of adjuvant radiotherapy is often prescribed to patients in the advanced or recurrent stages, with lymph node metastasis, tissue infiltration, and undetermined margins [42, 43]. Systemic chemotherapy is reserved for cases with distant metastasis. There are numerous both mono- and poly-chemotherapy that are used as a palliative treatment for patients with SGTs that do not benefit from local treatment modalities such as surgery or radiation [49]. However, Due to lack of congruent evidence-based data, the decision of using either adjuvant chemotherapy in the treatment of malignant SGTs or as a palliative agent must be on case by case so as to prevent possible related complications [50].

Our study had some limitations including the following: small sample size seen in the present study contributed to low power of the study. Also, availability of a small population size limited the use of systematic sampling which might have prevented issue selection bias. A relatively short duration of follow-up might have contributed to lack of sufficient observation of the occurrence of the clinical endpoints.

Conclusions

Our study has shown a number of children and young adults with relatively a large percentage of malignant SGTs. Also, this study reports a significantly high rate of recurrence which was marked by short mean DFS in a lot of children and young adults from a resource-limited setting. Additionally, it has been shown that having a malignant SGT and location of such SGTs in minor salivary glands both showed correlation with high recurrence and short DFS. Therefore, these independent predictors of recurrence and DFS in this study may be used as criteria for close follow-up of patients after undergoing surgical removal of the primary SGTs in order to monitor recurrence and/or short DFS.

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Authors' contributions

EAMV, conception, data curation, methodology, and writing the first draft of the paper; JJY, conception, designing, curation of data, methodology, and writing of the first draft of the manuscript; AIN, methodology, curation of data, and writing the first draft of the manuscript; EDM, conception, curation of data, and writing of the first draft of the manuscript; and ZSA, conception, designing, and writing the first draft of the manuscript. The authors read and approved the final manuscript.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the institutional review board (IRB) of the School of Biomedicine of Makerere College of Health Sciences. Consent to participate is not required as it is a retrospective study.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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