Salivary Gland Tumors in Turkey: Demographic Features and Histopathological Distribution of 510 Patients

Yusuf Kızıl · Utku Aydil · Özgür Ekinci · Alper Dilci ·
Ahmet Köybaşıoğlu · Mehmet Düzlü · Erdoğan İnal

Received: 14 September 2012 / Accepted: 3 November 2012 / Published online: 10 November 2012
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Abstract The aim of this study was to evaluate the demographic and clinicopathologic data of salivary gland tumors managed at a tertiary referral medical center in Turkey. The data of 510 patients with salivary gland tumors managed during the period of January 1984 to May 2012, were reviewed. Only primary neoplasms derived from salivary glands were included. Out of 510 neoplasms, 352 (69.0 %) were classified as benign and 158 (31.0 %) were classified as malignant. There was a male predominance and male:female ratio was 1.23 (281/229). The most common location was parotid gland (372/510, 72.9 %) followed by minor salivary glands (97/510, 19.0 %) and submandibular gland (40/510, 7.9 %). The malignancy rates were 21.5, 40.0, and 56.7 % in parotid, submandibular, and minor salivary glands locations, respectively. The most common location for minor salivary gland neoplasms was oral cavity (61/97, 62.9 %). Pleomorphic adenoma (PA) was the most common histopathological type (45.3 %) in the whole study group and also among pediatric patients. The most common malignant neoplasms were adenoid cystic carcinoma (39/510, 7.6 %) and mucoepidermoid carcinoma (5.7 %). Salivary gland tumors are more common in men. The malignancy rate is almost

three times higher in neoplasms derived from minor glands when compared to parotid gland. PA is the most common histopathological tumor type in all locations and in all age groups.

Keywords Salivary glands · Neoplasms · Adenoma, pleomorphic · Parotid gland · Carcinoma, adenoid cystic

Introduction

There are three major salivary glands around oral cavity and hundreds of minor glands throughout the upper aerodigestive system. Some specific histopathological tumor types may have tendency towards specific sites but there is a general rule for salivary neoplasms: the smaller the salivary gland, the higher the rate of malignancy. Mainstay of treatment is surgery for all benign and malignant salivary gland neoplasms [1]. Tumor type, localization, and stage and grade of a malignant tumor may influence extent of a surgery.

Salivary gland malignancies account 3–6 % of head and neck cancers and 0.3 % of all malignancies [2–4]. Incidence rates of malignant and benign neoplasms of salivary glands were reported as 0.2–9.7 and 1.1–2.9 per 100,000, respectively according to epidemiological studies [3]. Although salivary gland tumors are relatively rare, they consist a heterogenous group of lesions with distinct clinicopathological characteristics. World Health Organization (WHO) revised classification of these neoplasms in 2005 to minimize difficulties in diagnosis and management [2]. These tumors have similar histological characteristics leading to difficulties in diagnosis but also have different biological behavior which results in a therapeutic

Presented at the 10th International Otolaryngology Head and Neck Surgery Congress, April 26–28, 2012, Ankara/Turkey.

Y. Kızıl (✉) · U. Aydil · A. Dilci · A. Köybaşıoğlu · M. Düzlü · E. İnal

Department of Otorhinolaryngology Head & Neck Surgery,
School of Medicine, Gazi University, Gazi Ün. Tıp. Fak. KBB
A.D, 06500 Beşevler, Ankara, Turkey
e-mail: yusufkizil@yahoo.com

Ö. Ekinci
Department of Pathology, School of Medicine, Gazi University,
Ankara, Turkey

challenge. The aim of this study is to determine demographic features and histopathological distribution of salivary gland originated neoplasms in a large sample from Turkey.

Materials and Methods

The medical data of the patients with primary salivary gland neoplasms, who were diagnosed and managed at our clinic between the period of January 1984 and May 2012, were reviewed. Our institution is one of the biggest reference and academic centers located in the capital city of Turkey. The demographic and clinical features including gender, age, localization, and histological type of the tumor were obtained. Only final pathology reports were taken into consideration for histopathological diagnosis and only primary neoplastic lesions derived from the salivary glands were included. Cases with congenital anomalies; congenital cysts and masses; chronic sialadenitis and sialolithiasis; vascular and lymphatic malformations like hemangioma, arteriovenous malformation and lymphangioma; basic, lymphatic, salivary or mixed type cysts; granulomatous infections; reactive lymphadenopathies; invasion of the salivary glands by skin cancer were excluded. Schwannoma and lymphoma cases limited to the salivary glands and presenting like a salivary gland tumor were included in the study.

All salivary gland tumors were classified according to the criteria by WHO pathological classification system. The pathological term ‘monomorphic adenoma’ is not present in the most recent WHO pathological classification system but we included the patients with this diagnosis not to affect the results overall.

Results

A total of 510 patients diagnosed as a salivary gland neoplasm fulfilled the inclusion criteria and reviewed in this study.

Locations

The most common location was parotid gland (Fig. 1). The frequency of parotid gland tumors among all salivary gland neoplasms was 72.9 %. Of the 292 benign parotid gland neoplasms, 43 (14.7 %) were originating from the deep

Fig. 1 Distribution of all salivary gland tumors by localization ($n = 510$)

lobe and 249 (85.3 %) tumors were originating from the superficial lobe. Incidence of deep lobe origin for pleomorphic adenoma (PA) and Warthin tumor (WT) were 17.6 % (31/176) and 10.0 % (9/90), respectively. Submandibular and minor salivary gland tumors (MSGTs) constituted 7.9 and 19.0 % of all salivary gland neoplasms, respectively. There was only one sublingual gland tumor in our series.

Almost two-thirds (62.9 %) of the MSGTs were located in the oral cavity (Fig. 2). The most common location in the oral cavity was hard palate (Fig. 3). Among ten oropharyngeal salivary gland tumors, eight were located at soft palate and two were located at base of tongue. The other rare locations of the MSGTs were as follows: three cases in nasopharynx, one case in supraglottic larynx, one case in columella, one case in pterygopalatine fossa, one case in infratemporal fossa, one case in parapharyngeal area.

Malignancy Rate

Out of the 510 salivary gland tumors, 358 (70.2 %) were classified as benign and 158 (29.8 %) were classified as malignant. Malignancy rates in parotid, submandibular, and minor gland locations were 21.5 % (80/372), 40.0 % (16/40), and 56.7 % (55/97), respectively (Table 1). For MSGTs the frequencies of benign and malignant tumors are almost equal at oral cavity (52.5 %) and oropharynx (60.0 %) locations. All of the tumors at other rare locations and almost all of the sinonasal tract (94.4 %) located tumors were malignant (Fig. 4). Within the oral cavity, almost all of the benign tumors were located at hard palate, and the other tumors located at the other subsites were predominantly

Table 1 Benign and malignant salivary gland neoplasms according to the locations

	Parotid (%)	Submandibular (%)	Sublingual (%)	Minor glands (%)	Total (%)
Benign	292 (78.5 %)	24 (60.0 %)	—	42 (43.3 %)	358 (70.2 %)
Malignant	80 (21.5 %)	16 (40.0 %)	1 (100.0 %)	55 (56.7 %)	152 (29.8 %)
Total	372 (100.0 %)	40 (100.0 %)	1 (100.0 %)	97 (100.0 %)	510 (100.0 %)

Fig. 2 Location of the minor salivary gland tumors ($n = 97$)

Fig. 3 Distribution of oral minor salivary gland tumors among the subsites

malignant (Table 2). The malignancy rates for MSGTs located at hard palate and at the rest of the oral cavity were 24.4 and 95.0 %, respectively. When hard palate and soft palate are evaluated together, the rate of malignancy was 24.5 % (12/49). All of the four tumors located at either oral tongue or base of tongue were malignant.

Histological Types

When all locations were evaluated together, the most common benign and malignant tumors were PA and adenoid cystic carcinoma (ACC), respectively (Tables 3, 4).

Fig. 4 Malignancy rates of minor salivary gland tumors according to the locations ($n = 97$)

There were 231 PA cases in our series. PA was the most common histological type in all locations and constituted two-thirds of the benign salivary gland tumors overall. PA constituted 45.3 % of all salivary gland tumors, 64.5 % of benign salivary gland tumors, 47.3 % of all parotid tumors, 60.3 % of benign parotid tumors, 34.0 % of all MSGTs, and 78.6 % of benign MSGTs (Table 3). PA also dominated the submandibular gland and constituted more than 90 % of benign tumors at this location (Table 3). Palate was also a common location for PA. Of the 33 minor salivary gland PAs, 24 were located at hard palate and 5 were located at soft palate. PA constituted 58.5 and 62.5 % of all salivary gland tumors located at hard palate and soft palate, respectively.

Warthin tumor was almost exclusively seen at the parotid location and had a 30.8 % incidence when only benign neoplasms taken into consideration (Table 3). 90 of the 91 WT were derived from parotid gland and only one of these tumors was derived from submandibular gland. There was no WT originating from minor salivary glands in our series.

Myoepithelioma (ME) was the third most common benign tumor and the frequency among benign tumors was 4.5 % (Table 3). Half of the ME cases were derived from the major glands and the other half derived from minor glands. ME constituted 1/5 of all benign MSGTs but only 2.4 % of

Table 2 Distribution of the minor salivary gland neoplasms in the oral cavity subsites

	Hard palate (%)	Floor of mouth (%)	Buccal mucosa (%)	Lips (%)	Anterior tongue (%)	Retromolar trigone (%)	Total (%)
Benign	31 (75.6 %)	—	1 (16.7 %)	—	—	—	32 (52.5 %)
Malignant	10 (24.4 %)	8 (100.0 %)	5 (83.3 %)	2 (100.0 %)	2 (100.0 %)	2 (100.0 %)	29 (47.5 %)
Total	41 (100.0 %)	8 (100.0 %)	6 (100.0 %)	2 (100.0 %)	2 (100.0 %)	2 (100.0 %)	61 (100.0 %)

Table 3 Distribution of benign salivary gland tumors ($n = 358$)

	Parotid (%)	Submandibular (%)	Minor (%)	Total (%)
Pleomorphic adenoma	176 (60.3 %)	22 (91.6 %)	33 (78.6 %)	231 (64.5 %)
Warthin	90 (30.8 %)	1 (4.2 %)	–	91 (25.4 %)
Myoepithelioma	7 (2.4 %)	1 (4.2 %)	8 (19.0 %)	16 (4.5 %)
Monomorphic adenoma	6 (2.0 %)	–	–	6 (1.7 %)
Basal cell adenoma	4 (1.4 %)	–	–	4 (1.1 %)
Schwannoma	4 (1.4 %)	–	–	4 (1.1 %)
Cystadenoma	2 (0.7 %)	–	1 (2.4 %)	3 (0.8 %)
Oncocytoma	2 (0.7 %)	–	–	2 (0.6 %)
Sebaceous lymphadenoma	1 (0.3 %)	–	–	1 (0.3 %)
Total	292 (100.0 %)	24 (100.0 %)	42 (100.0 %)	358 (100.0 %)

Table 4 Distribution of malignant salivary gland tumors ($n = 152$)

	Parotid	Submandibular	Sublingual	Minor	Total
Adenoid cystic carcinoma	6 (7.5 %)	6 (37.4 %)	1 (100.0 %)	26 (47.3 %)	39 (25.7 %)
Mucoepidermoid carcinoma	16 (20.0 %)	1 (6.3 %)	–	12 (21.8 %)	29 (19.1 %)
Adenocarcinoma, Not otherwise specified (NOS)	12 (15.0 %)	1 (6.3 %)	–	4 (7.3 %)	17 (11.2 %)
Squamous cell carcinoma	10 (12.5 %)	1 (6.3 %)	–	–	11 (7.2 %)
Acinic cell carcinoma	7 (8.7 %)	–	–	2 (3.6 %)	9 (5.9 %)
Polymorphous low-grade adenocarcinoma	2 (2.5 %)	1 (6.3 %)	–	6 (10.9 %)	9 (5.9 %)
Carcinosarcoma (malignant mixed tumor)	3 (3.7 %)	2 (12.4 %)	–	1 (1.8 %)	6 (4.0 %)
Lymphoma	6 (7.5 %)	–	–	–	6 (4.0 %)
Oncocytic carcinoma	2 (2.5 %)	–	–	2 (3.6 %)	4 (2.6 %)
Carcinoma ex pleomorphic adenoma	4 (5.0 %)	–	–	–	4 (2.6 %)
Epithelial/myoepithelial carcinoma	3 (3.7 %)	–	–	–	3 (1.9 %)
Clear cell carcinoma	2 (2.5 %)	1 (6.3 %)	–	–	3 (1.9 %)
Sebaceous carcinoma	2 (2.5 %)	–	–	–	2 (1.3 %)
Malignant epithelial neoplasm—untyped	2 (2.5 %)	–	–	–	2 (1.3 %)
Salivary duct carcinoma	1 (1.3 %)	1 (6.3 %)	–	–	2 (1.3 %)
Adenosquamous carcinoma	1 (1.3 %)	–	–	1 (1.8 %)	2 (1.3 %)
Small cell carcinoma	–	1 (6.3 %)	–	–	1 (0.7 %)
Basal cell carcinoma	1 (1.3 %)	–	–	–	1 (0.7 %)
Lymphoepithelial carcinoma	–	1 (6.3 %)	–	–	1 (0.7 %)
Mucinous carcinoma	–	–	–	1 (1.8 %)	1 (0.7 %)
Total	80 (100.0 %)	16 (100.0 %)	1 (100.0 %)	55 (100.0 %)	152 (100.0 %)

benign parotid tumors. It was a palate-specific tumor: out of eight minor salivary gland derived MEs, seven were located at hard palate and one was located at soft palate.

Adenoid cystic carcinoma and mucoepidermoid carcinoma (MEC) were the most common malignant tumors among all salivary neoplasms in our series with frequencies of 7.6 and 5.7 %, respectively (Table 4). MEC was the most common malignant tumor of parotid gland with a frequency of 20.0 % and the second most common among malignant MSGTs. ACC constituted one-third of all malignant submandibular gland derived tumors and almost half of the malignant MSGTs (Table 4). But ACC was only the fifth most common

malignant histopathological type at parotid location. Only 15.4 % of the ACCs, but 55.2 % of the MECs derived from parotid gland. 76.5 % of adenocarcinoma, not otherwise specified (AC-NOS) and 77.8 % of acinic cell carcinoma (ACIN-CC) cases were seen at major glands. On the other hand 66.7 % of polymorphous low-grade adenocarcinoma (PLGA) cases were occurred at minor salivary glands.

Age and Gender

There were 281 males and 229 females in the whole study group and male:female (M:F) ratio was 1.23. There was a

Table 5 Male and female ratio by tumor localization

Localization	Male (n)	Female (n)	Male/female ratio
Parotid gland	200	172	1.16
Submandibular gland	17	23	0.74
Sublingual gland	1	0	–
Minor glands	63	34	1.85
Total	281	229	1.23

Table 6 Male to female ratio by histopathological type

Histopathology	Male (n)	Female (n)	Male/female ratio
Pleomorphic adenoma	108	123	0.88
Warthin's tumor	65	26	2.50
Myoepithelioma	8	8	1.00
Other benign	7	13	0.54
Adenoid cystic carcinoma	30	9	3.33
Mucoepidermoid carcinoma	17	12	1.42
Adenocarcinoma NOS	13	4	3.25
Squamous cell carcinoma	6	5	1.20
Polymorphous low-grade adenocarcinoma	3	6	0.50
Acinic cell carcinoma	4	5	0.80
Other malignant	20	18	1.11
Total	281	229	1.23

female predominance in submandibular gland tumors (M:F = 0.76) and a male predominance in parotid (M:F = 1.16) and submandibular gland (M:F = 1.85) tumors (Table 5). Among histopathological types, there was a strong propensity towards males for WT, ACC, and AD-NOS with 2.50, 3.33, and 3.25 M:F ratios, respectively (Table 6). PA was more common in females with a male to female ratio of 0.88.

The mean age was 45.2 (range, 7–77 years; SD: 15.6), 52.9 (range, 7–88 years; SD: 15.1), and 47.5 years (range, 7–88 years; SD: 15.9) for benign, malignant and the whole series, respectively (Table 7). The mean age of the patients with PA was remarkably lower (41.2 years, SD: 15.6) than the other patients with benign pathologies (Fig. 5). The patients with SCC had the highest mean age among all patient groups (Fig. 5).

Pediatric Group

There were 12 patients who were 16 years old or younger (Table 8). Pediatric tumors constituted 2.4 % of all tumors. The mean age was 11.8 years (range, 7–16; SD: 3.4) and M:F ratio was 1.0. The most common histopathological type was PA. There were two malignant tumors and the malignancy rate in pediatric group was 16.7 %.

Table 7 Age distribution of salivary gland tumors by location

Location	Benign	Malignant	All
Parotid gland	46.1 (SD: 15.0)	52.9 (SD: 16.2)	47.6 (SD: 15.6)
Submandibular gland	37.4 (SD: 17.4)	56.2 (SD: 14.4)	44.9 (SD: 18.6)
Minor glands	43.0 (SD: 17.8)	52.0 (SD: 13.9)	47.9 (SD: 16.2)
All locations	45.2 (SD: 15.6)	52.9 (SD: 15.1)	47.5 (SD: 15.9)

Table 8 Patients in the pediatric group

Patient #	Age	Sex	Location	Histopathology
1	7	M	Parotid superficial lobe	Schwannoma
2	7	F	Parotid superficial lobe	Schwannoma
3	7	M	Parotid superficial lobe	Mucoepidermoid carcinoma
4	11	M	Submandibular gland	Pleomorphic adenoma
5	12	F	Parotid superficial lobe	Pleomorphic adenoma
6	12	M	Hard palate	Pleomorphic adenoma
7	12	M	Soft palate	Pleomorphic adenoma
8	13	F	Hard palate	Mucoepidermoid carcinoma
9	13	F	Parotid deep lobe	Pleomorphic adenoma
10	16	M	Parotid superficial lobe	Pleomorphic adenoma
11	16	F	Submandibular gland	Pleomorphic adenoma
12	16	F	Parotid deep lobe	Pleomorphic adenoma

Fig. 5 Mean ages by histopathological types

Discussion

Difficulties in histological diagnosis, classification, grading, and management of salivary gland neoplasms reflects complex morphological and biological characteristics of this tumor group. Unlike squamous cell carcinoma of upper aerodigestive tract, exact etiology of salivary gland tumors is unknown. Although not very well recognized, radiation exposure, smoking and cellular phone use were related with development of salivary gland tumors in some studies [5–7].

Exact histopathological diagnosis of a salivary gland tumor is of utmost importance for determining correct treatment strategy. However this is not always achieved easily. Fine needle aspiration biopsy and frozen section biopsy are helpful in diagnosis but not ideal [8]. Conventional formalin-fixed, paraffin-embedded tissue investigation after total excision is gold standard however salivary gland tumors are prone to major diagnostic changes when surgical material is evaluated by different pathologists and such a change was reported 9 % in a previous study [9].

This study reports the largest salivary gland tumor series from Turkey to date in English literature. In the present salivary gland tumor series, malignancy rate is 31.0 %. In previous reports, the malignancy rate was reported between 21.7 and 50.0 % (Table 9). This large scale may be due to geographical and racial variations or distinct settings of the studies. General ENT clinics manage all kind of cases but head and neck surgery clinics deal with malignant cases mainly. On the other hand, dental clinics and oral surgery clinics deal largely with MSGTs and one should expect that minor gland tumors and malignancy rates will be higher in such papers from these clinics. For example, in the paper by Tilakaratne et al. [13] the malignancy rate was 50 % but two-thirds of the tumors were MSGTs. This high malignancy rate should not be solely attributed to geographical variables which may represent highly malignant character of the MSGTs. In Turkey, oral and maxillofacial surgery clinics are not established in hospital settings yet and are present in dental schools only. In these clinics, surgeries for major salivary gland tumors are not widely performed and patients with major salivary gland tumors were usually referred to an ENT department. For that reason we believe that our patient profile can represent real distribution of all salivary gland tumors.

In our series, 72.9 % of the tumors were derived from parotid gland. Although much lower rates were reported in some studies originating from oral or dental clinics, many studies reported this rate between 60 and 80 % [4, 10–22]. In our series, the frequencies of deep lobe located benign parotid gland tumors, PA and WT were 14.7, 17.6, and 10.0 %, respectively. Deep lobe location of a tumor may increase some operative risks such as bleeding and facial paralysis. Since surgical treatment of malignant tumors is total parotidectomy, deep lobe location does not change the

treatment strategy. In large series, data about the exact location of the benign tumors within parotid gland are scarce. Kopeć and Szyfter [23] reported that 24 % of all parotid gland tumors involved deep lobe. In a study by Musani et al. [24] the frequency of deep lobe location for benign tumors was 21 %. Colella et al. [25] reported that only 4 % of WT were derived from the deep lobe.

Most of the MSGTs are located within oral cavity but in many of the studies only include oral tumors so that it is not well known the ratio of oral MSGTs in the whole group. In our series 62.9 % of all MSGTs were oral cavity located. Hard palate was the most common location within oral cavity and this is consistent with the literature [10, 26]. In a huge series by Tian et al. [10] only 8.6 % of MSGTs were extra-oral located. But this report and many others evaluate palate as a whole and combine soft palate neoplasms with hard palate located ones. Extremely high malignancy rate in extra-oral located MSGTs was striking in our series and this is parallel to results in the paper by Tian et al. [10].

The most common tumor type was PA in our study. PA is invariably the most common tumor type among all salivary gland neoplasms with reported rates between 38.4 and 67.8 % [4, 10–22]. WT is known as the second most common benign salivary gland neoplasm and this tumor almost always originates from parotid gland as in our series. The frequency of WT in our series was the highest (17.8 %) among frequencies in the literature. Very low incidence rates even zero percent were reported [13, 16, 18, 20]. In contrary, Just the opposite, ME was more common in minor salivary glands according to our results. This is a different finding when compared with previous reports. Lukšić et al. [4], Tian et al. [10], and Wang et al. [17] reported that ME cases are more common in parotid gland. The most common malignant tumor types were ACC and MEC in our series as in the literature [4, 10–22]. There was a location predilection for certain malignant tumor types but MEC has a similar frequency when parotid and minor gland localizations are compared. ACIN-CC and AC-NOS were more common in parotid gland location in our series. On the other hand ACC and PLGA were more commonly derived from minor glands in our series as previously reported [4, 10, 12, 13]. In many previous studies, ACIN-CC is reported to be more common among parotid gland tumors [4, 10, 13]. However there is a discrepancy about distribution patterns of AC-NOS cases among major and minor glands in previous reports. In the studies by Jones et al. [12], de Oliveira et al. [14], and Subhashraj [18]. AC-NOS cases are more common in major glands. However Lukšić et al. [4] and Tian et al. [10] reported that AC-NOS cases are more common in minor glands.

We found that salivary gland tumors are more common in men and M:F ratio was 1.23 in our series. This is

Table 9 Summary of previous large series from different countries

Author	Country	Setting	Department/ resource	n	Malignancy rate (%)	Mean age for benign tumors	Mean age for malignant tumors	M:F ratio	Site distribution (parotid/ submandibular/minor) (%)	PA (%)	WT (%)	OB (%)	ACC (%)	MEC (%)	OM (%)
Tian et al. [10]	China	University hospital	OMFS	6,982,982	32.1	–	–	1.06	61.1/9.5/28.4	47.0	13.8	7.2	9.8	9.6	12.7
Li et al. [11]	China	Collage of stomatology	OMFS	3,461	40.2	41	45	0.99	61.4/10.8/26.4	51.3	4.4	4.1	7.3	7.5	25.4
Jones et al. [12]	UK	Dental school	Oral pathology	741	35.1	–	–	0.76	31.2/5.1/61.8	44.4	4.6	15.9	11.5	8.4	15.2
Lukić et al. [4]	Croatia	University hospital	OMFS	779	35.8	50	56	1.01	65.3/6.6/27.2	47.2	11.2	5.8	12.1	8.6	15.1
Tilakaratne et al. [13]	Sri Lanka	Dental school	Oral pathology	713	50.0	51	52	1.00	22.7/8.6/68.2	38.4	0	4.3	11.4	17.4	10.0
de Oliveira et al. [14]	Brazil	General hospital	General pathology	599	21.7	43 (median)	55 (median)	0.64	68.4/15.5/14.5	67.8	6.3	4.2	6.5	5.0	10.2
Fonseca et al. [15]	Brazil	Dental hospital/ general pathology laboratory	Oral pathology/ general pathology	493	25.2	46	54	0.81	42.4/6.9/31.6	63.7	7.3	3.9	4.5	7.9	12.8
Vuhahula [16]	Uganda	University hospital	General pathology	268	46.6	34	43	0.76	34.0/33.2/32.8	39.9	0	14.2	13.4	9.3	23.1
Wang et al. [17]	China	University cancer hospital	Head and neck surgery	1,176	24.6	–	–	1.04	74.7/21.6/3.2	52.7	17.4	5.3	4.4	6.0	14.2
Subhashraj [18]	India	Regional cancer center	General pathology	684	38.3	43	56	1.05	60.5/17.0/21.9	53.1	3.1	5.6	9.6	7.2	22.1
Kara et al. [19]	Turkey	Four hospitals	General pathology	125	24.0	40	48	1.16	61.6/16.0/20.0	64.0	4.8	7.2	8.8	2.4	12.8
Al-Khateeb and Ababneh [20]	Jordan	Regional pathology center	General pathology	102	29.4	–	–	0.86	51.0/20.6/28.4	53.9	3.9	11.8	12.7	7.8	7.8
Satko et al. [21]	Slovakia	University hospital	Stomatology clinics	1,021	26.1	–	–	0.90	83.0 /10.8/3.2	53.9	9.7	10.4	6.4	5.2	10.6
Mejía- Velázquez et al. [22]	Mexico	Dental school	Pathology	360	23.1	–	–	0.57	78.9/15.8/17.8	65.6	5.6	5.8	5.0	4.7	13.3
Current study	Turkey	University hospital	ENT/general pathology	510	31.0	45	53	1.23	72.9/7.9/19.0	45.3	17.8	7.1	7.6	5.7	17.6

PA pleomorphic adenoma, ACC adenoid cystic carcinoma, MEC mucopidermoid carcinoma, WT Warthin, OB other benign, OM other malignant, OMFS oral and maxillofacial surgery

surprisingly the highest M:F ratio among recent reports. In the literature sex distribution pattern differs geographically. In countries of Latin America, there is a strong female predominance and M:F ratio was reported between 0.57 and 0.81 [14, 15, 22]. Studies from China, India and Sri Lanka report almost equal sex distribution [10, 11, 13, 17, 18]. In European countries, salivary gland tumors are reported to be higher among female or equal in both gender. In our series, the mean age for benign and malignant tumors were 45 and 53 years, respectively. Although there are some differences in previous reports, the mean age of patients with malignant neoplasms is always higher than the patients with benign lesions.

In our study, there were 12 patients in the pediatric age group and the rate of pediatric cases in the whole study group was 2.4 %. The most common tumor type was PA and the most common malignant tumor was MEC. Malignancy rate was 16.7 % in the pediatric group. This rate is lower than the previous studies. Guzzo et al. [27] reported that parotid gland is the main site for pediatric salivary gland tumors (79 %), 71 % of salivary gland tumors are benign, all benign tumors are PA, and the most common malignant tumor is MEC in the pediatric group. In studies by Ribeiro et al. [28] and Liu et al. [29] very high malignancy rates in pediatric groups were reported: 71 and 54 %, respectively. Shapiro and Bhattacharya [30] reported that MEC and ACIN-CC consist 43 and 34 % of all pediatric salivary gland malignancies involving major glands.

In this study, we presented the largest salivary gland tumor series from Turkey to date and compare our data with other worldwide series. Since salivary gland tumors almost always managed by ENT clinics in our country, the patient profile and results may reflect real distribution, demographic and histopathological features of salivary gland neoplasms. In our series, the most striking findings were strong male predominance, very high incidence of WT and low malignancy rate in pediatric age group when compared with the previous studies.

Conflict of interest none.

Financial disclosure none.

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