Original Article
Comparative survival outcomes of different treatments for oral tongue squamous cell carcinoma in elderly patients aged 65 years and older: a propensity score matched analysis

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Abstract: Background: The recommended treatments for elderly patients aged 65 years and older with oral tongue squamous cell carcinoma (OTSCC) are ambiguous. The aim of this study is to explore the optimized treatments for the elderly OTSCC patients based on the Surveillance, Epidemiology, and End Results database. Materials and Methods: We retrospectively divided patients into four groups, including both surgery and adjuvant radiation, surgery only, radiation only, and neither surgery nor radiation. Overall survival (OS) and tumor cause-specific survival (TCSS) were evaluated. Kaplan-Meier analysis and Cox regression analysis were adopted to distinguish independent risk factors for OS and TCSS. Results: We identified 1,355 patients aged 65 years and older with OTSCC after propensity score matching. No statistically significant differences were detected for baseline data. Treatment was demonstrated to be an independent prognostic factor for OS and TCSS. The 5-year OS rates were 37.7%, 47.6%, 33.1% and 10.9% in the four groups, and the corresponding 5-year TCSS rates were 70.3%, 67.5%, 68.3% and 60.3%. Generally, no statistically significant differences were detected among treatments of both surgery and adjuvant radiation, surgery only and radiation only for survival. Receiving no treatment showed poor prognosis for OS and TCSS. Subgroup analysis revealed that surgery only presented benefit of OS for early OTSCC, and for advanced OTSCC, surgery and adjuvant radiation displayed better prognosis outcomes. Conclusion: Surgery may be the recommended treatment strategy in elderly patients with early OTSCC. Radiation is optional for those intolerant to surgery. Surgery and adjuvant radiation could be recommended for advanced OTSCC.

Keywords: Oral tongue squamous cell carcinoma, treatments, SEER database, elderly patients, propensity score matching

Introduction

According to GLOBOCAN estimates, cancer of lip and oral cavity affected about 300,373 new cases and killed about 145,353 people all over the world in 2012 [1]. Oral tongue squamous cell carcinoma (OTSCC) is a tongue-derived oral cavity squamous cell carcinoma (OCSCC). In line with the tumor node metastases (TNM) staging system of the American Joint Committee on Cancer (AJCC), OCSCC including OTSCC can

be classified into AJCC stage I-IV [2]. For AJCC stage I and II early OTSCCs, the five-year survival rates were 67% and 51%, while for stage III and IV advanced OTSCCs the five-year disease-specific survival rates were 39% and 27% [3, 4]. When it comes to treatments of patients with early stage OTSCC, either primary surgery or definitive radiation therapy is optional, while the former is recommended [5, 6]. For advanced stage OTSCC, surgery is generally preferred as the initial step, and postoperative radiation

therapy or chemotherapy should be considered to control disease progress [7, 8]. Compared with young patients, elderly patients are more probably intolerant to surgery and radiation treatment. As a result, postoperative complications are more common for them [9]. Moreover, it is more possible for elderly patients to suffer from chronic diseases [10]. All these could aggravate survival outcomes during a long-term follow-up period. However, few studies focused on the analysis of different treatment strategies for OTSCC in elderly patients. So, the recommended treatments for elderly patients with OTSCC are ambiguous nowadays. Therefore, it is necessary to compare survival outcomes of different treatments and investigate the optimized treatment for elderly with OTSCC.

The Surveillance, Epidemiology, and End Results (SEER) program is updated annually by the National Center for Health Statistics. It consists of 18 cancer registries covering approximately 30% of the population in the United States [11]. In this study, we evaluated survival outcomes of different treatments in elderly patients with OTSCC based on the SEER database, including both surgery and adjuvant radiation, surgery only, radiation only and neither surgery nor radiation.

Material and methods

Data sources

The dataset was obtained from the SEER database released in November 2015 through internet access (https://seer.cancer.gov). It included demographic information like gender, age, race, and clinical records of histological grade, AJCC TNM stage, surgery therapy, radiation therapy, as well as follow-up data of survival months and cause of death. We took the SEER November 2015 Research Data for analyses, which contained the SEER 18 registries Research Data and the Hurricane Katrina Impacted Louisiana Cases from 1973 to 2013 (Reference number: 13844-Nov2015).

Inclusion and exclusion criteria

Using R package of SEERaBomb, we extracted patients with OTSCC (International Classification of Diseases for Oncology, Third Edition [ICD-O-3], code C01.9, C02.0, C02.1, C02.2, C02.3, C02.4, C02.8, C02.9) for our study. Patients were included when meeting the following criteria: (1) patients were aged 65 years or older at diagnosis; (2) oral tongue carcinoma was diagnosed between 2004 and 2013; (3) histological types were limited to squamous cell carcinoma (code 8050, 8051, 8052, 8070, 8071, 8072, 8073, 8074, 8075, 8076, 8081, 8082, 8083 and 8084). Patients were excluded according to the following criteria: (1) unknown demographic information; (2) incomplete clinical information; (3) unknown cause of death or unknown survival month.

Statistical analysis

We collected data of gender, age, race, histological grade, AJCC TNM stage, SEER stage, surgical therapy, radiation therapy, cause of death and survival months from the SEER database. According to the surgical therapy and radiation therapy, patients were divided into four groups, including both surgery and adjuvant radiation (Group A), surgery only (Group B), radiation only (Group C) and neither surgery nor radiation (Group D). Gender was classified as male and female. Age was classified as 65-74, 75-84 and ≥ 85 years old. Race was classified as white, black and others. Histologic grade was classified as grade I/II, and grade III/IV. AJCC TNM stage was classified as early (AJCC stage I/II) and advanced (AJCC stage III/IV). SEER stage was classified as localized, regional and distant. Due to the non-randomized assignment and disequilibrium among groups, propensity score matching was performed by R packages of MatchIt. The propensity scores were calculated with parameters of gender, age, race, grade, AJCC stage and SEER stage, using a 1:1 allocation ratio. We described categorical variables as frequencies and percentages. For categorical variables, we chose the Pearson's chi-squared test and Fisher's exact tests to detect the statistical difference. Besides, we selected univariate analysis (Kaplan-Meier analysis) and multivariate analysis (multivariate Cox regression analysis) to distinguish independent risk factors for overall survival (OS) and tumor cause-specific survival (TCSS). For OS analysis, any cause of deaths was defined as events and survivors were defined as censored events. For TCSS analysis, deaths caused by tongue cancer were considered as events, and deaths by other causes or survivors were considered as censored events. All
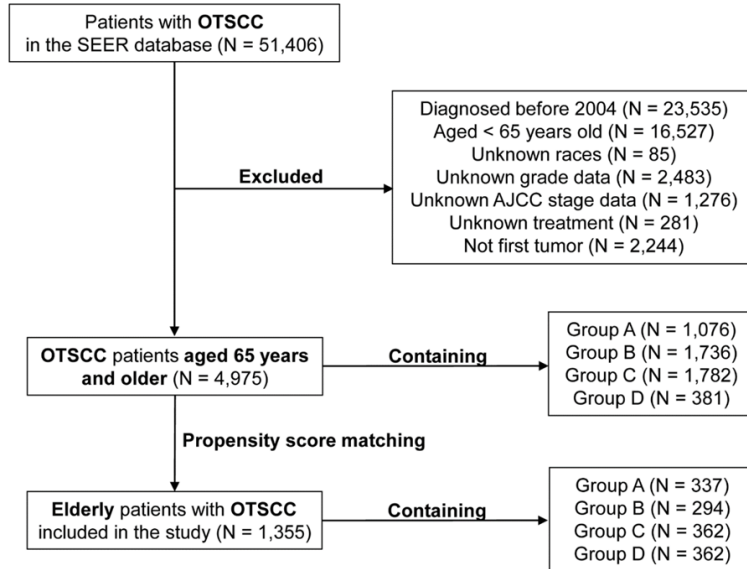
Figure 1. Flowchart of patient enrollment. Notes: OTSCC, oral tongue squamous cell carcinoma; SEER, Surveillance, Epidemiology, and End Results; N, number; AJCC, American Joint Committee on Cancer; Group A, surgery and adjuvant radiation; Group B, surgery only; Group C, radiation only; Group D, neither surgery nor radiation.

the data analysis in this study was conducted by R statistical software version 3.3 (https://www.r-project.org). All *P* values were two-sided and *P* < 0.05 was considered statistically significant.

Results

Baseline characteristics

As **Figure 1** showed, according to the inclusion criteria and exclusion criteria, we finally included 4,975 patients aged 65 years and older with OTSCC from the SEER database. After propensity score matching, 1,355 patients remained for the following analysis. Among them, there were 337 (24.9%) patients in Group A, 294 (21.7%) patients in Group B, 362 (26.7%) patients in Group C, and 362 (26.7%) patients in Group D, respectively. They consisted of 915 (67.5%) male and 440 (32.5%) female patients. **Table 1** showed the patient baseline demographic and clinical information after matching. No statistically significant differences were detected for gender (*P* = 0.597), age (*P* = 0.872), race (*P* = 0.968), histological grade (*P* = 0.339), AJCC TNM stage (*P* = 0.457) and SEER stage (*P* = 0.164) among four groups. Totally, the patients had a high percentage (51.7%) of aged 65-75 years old, more prevalence (87.7%) with the white race, a high proportion of Grade

I/II (63.0%) and AJCC stage III/IV (85.2%).

The influence of different treatments on overall survival

We performed univariate analysis and multivariate analysis to evaluate the OS of elderly patients with OTSCC (**Table 2** and **Figure 2**). The 5-year OS rates were 37.7% in Group A, 47.6% in Group B, 33.1% in Group C, and 10.9% in Group D. Univariate analysis detected age (*P* < 0.001), race (*P* = 0.032), treatment (*P* < 0.001), grade (*P* = 0.028), AJCC stage (*P* < 0.001) and SEER stage (*P* < 0.001) as significant prognostic factors associated with OS. After adjusting these variables in the multivariate analysis, age, race, treatment and SEER stage remained as independent prognostic factors. There were no statistically significant differences for OS among Group A, Group B and Group C, while patients from Group D exhibited high risks when compared with Group A (Group D versus Group A, HR 3.576, 95% CI 2.955-4.327, *P* < 0.001).

The influence of different treatments on tumor cause-specific survival

TCSS were also evaluated by univariate analysis and multivariate analysis (**Table 3** and **Figure 3**). The 5-year TCSS rates were 70.3% in Group A, 67.5% in Group B, 68.3% in Group C, and 60.3% in Group D. Age (*P* < 0.001) and treatment (*P* = 0.001) were found to be associated with TCSS by univariate analysis. Multivariate analysis showed age and treatment as independent prognostic factors. As for treatments of elderly OTSCC patients, we found no statistically significant differences among Group A, Group B and Group C. Meanwhile, Group D displayed with high hazard when compared with Group A (Group D versus Group A, HR 2.126, 95% CI 1.430-3.161, *P* < 0.001).

Subgroup analysis stratified by age, AJCC stage and SEER stage

In elderly patients with OTSCC, we explored the prognostic effects of different treatment strate-

Table 1. Baseline characteristic of elderly patients with oral tongue squamous cell carcinoma in SEER database after propensity score matching

Characteristic	Total (%) 1355 (100.0)	Group A (%) 337 (24.9)	Group B (%) 294 (21.7)	Group C (%) 362 (26.7)	Group D (%) 362 (26.7)	P value
Gender						0.597
Male	915 (67.5)	235 (69.7)	190 (64.6)	245 (67.7)	245 (67.7)	
Female	440 (32.5)	102 (30.3)	104 (35.4)	117 (32.3)	117 (32.3)	
Age						0.872
65-74	701 (51.7)	182 (54.0)	151 (51.4)	184 (50.8)	184 (50.8)	
75-84	474 (35.0)	118 (35.0)	100 (34.0)	128 (35.4)	128 (35.4)	
≥ 85	180 (13.3)	37 (11.0)	43 (14.6)	50 (13.8)	50 (13.8)	
Race						0.968
White	1188 (87.7)	299 (88.7)	259 (88.1)	315 (87.0)	315 (87.0)	
Black	102 (7.5)	22 (6.5)	20 (6.8)	30 (8.3)	30 (8.3)	
Others	65 (4.8)	16 (4.7)	15 (5.1)	17 (4.7)	17 (4.7)	
Grade						0.339
I/II	854 (63.0)	204 (60.5)	198 (67.3)	226 (62.4)	226 (62.4)	
III/IV	501 (37.0)	133 (39.5)	96 (32.7)	136 (37.6)	136 (37.6)	
AJCC stage						0.457
I/II	201 (14.8)	45 (13.4)	52 (17.7)	52 (14.4)	52 (14.4)	
III/IV	1154 (85.2)	292 (86.6)	242 (82.3)	310 (85.6)	310 (85.6)	
SEER stage						0.164
Localized	157 (11.6)	39 (11.6)	44 (15.0)	37 (10.2)	37 (10.2)	
Regional	752 (55.5)	187 (55.5)	171 (58.2)	197 (54.4)	197 (54.4)	
Distant	446 (32.9)	111 (32.9)	79 (26.9)	128 (35.4)	128 (35.4)	

Notes: SEER, the Surveillance, Epidemiology and End Results; AJCC, the American Joint Committee on Cancer; Group A, surgery and adjuvant radiation; Group B, surgery only; Group C, radiation only; Group D, neither surgery nor radiation.

gies on OS and TCSS in subgroups of age, AJCC stage and SEER stage (**Table 4**). For each subgroup of age, AJCC stage or SEER stage, compared with Group A, patients from Group D came with statistically significant gross risks for OS and TCSS. In most cases, those from Group B and Group C showed no statistical difference of survival outcomes when compared with Group A. In particular, in the subgroup of patients aged more than 85 years old, those from Group B presented benefit of OS outcomes significantly (HR 0.462, 95% CI 0.247-0.863, P = 0.016). So did the subgroup of AJCC I/II stage (HR 0.490, 95% CI 0.249-0.964, P = 0.039). For patients aged 65-75 years old, Group B presented poor OS outcomes significantly (HR 1.588, 95% CI 1.171-2.152, P = 0.003). Moreover, in the subgroup of SEER distant stage, Group B presented poor prognosis outcomes of OS and TCSS significantly (HR 1.849, 95% CI 1.279-2.674, P = 0.001; HR 2.551, 95% CI 1.225-5.315, P = 0.012) when compared with Group A.

Discussion

In this study, we first compared the OS and TCSS survival outcomes of different treatments in elderly patients with OTSCC aged 65 years and older. After propensity score matching, no statistically significant differences were detected for baseline data. Consequently, the treatment strategy showed as an independent prognostic factor for OS and TCSS in elderly OTSCC patients. Specifically, patients from Group D showed most harmful prognosis in elderly OTSCC patients. Conversely, the elderly from Group B or Group C showed no statistically significant difference for survival outcomes when compared with Group A. Even after adjusted for gender, age, race, grade, AJCC stage and SEER stage, or after subgroup analysis, the results remained generally. It is worth noting that for patients older than 85 years old or patients with AJCC I/II stage, Group B was more beneficial for OS than Group A. While for AJCC III/IV stage or distant OTSCC, Group A exhibited more

Table 2. Univariate and multivariate analysis for overall survival

Characteristic	5-year OS	Univariate analysis		Multivariate analysis		
		Log Rank χ^2 test	P value	HR	95% CI	P value
Gender		0.6	0.431			
Male	30.2%					
Female	26.3%					
Age		35.4	< 0.001			
65-74	35.8%			Reference		
75-84	23.4%			1.503	1.292-1.749	< 0.001
≥ 85	16.2%			2.030	1.658-2.487	< 0.001
Race		6.9	0.032			
White	30.0%			Reference		
Black	17.1%			1.478	1.155-1.891	0.002
Others	26.8%			0.996	0.718-1.382	0.980
Treatment		280	< 0.001			
Group A	37.7%			Reference		
Group B	47.6%			1.238	0.999-1.534	0.052
Group C	33.1%			1.143	0.934-1.399	0.196
Group D	10.9%			3.576	2.955-4.327	< 0.001
Grade		4.8	0.028			
I/II	27.2%					
III/IV	31.8%					
AJCC stage		14.9	< 0.001			
I/II	44.4%					
III/IV	26.0%					
SEER stage		28.6	< 0.001			
Localized	47.2%			Reference		
Regional	29.5%			1.493	1.172-1.902	0.001
Distant	20.9%			2.053	1.593-2.645	< 0.001

Notes: OS, overall survival; HR, hazard ratio; CI, confidence interval; AJCC, the American Joint Committee on Cancer; SEER, the Surveillance, Epidemiology and End Results; Group A, surgery and adjuvant radiation; Group B, surgery only; Group C, radiation only; Group D, neither surgery nor radiation.
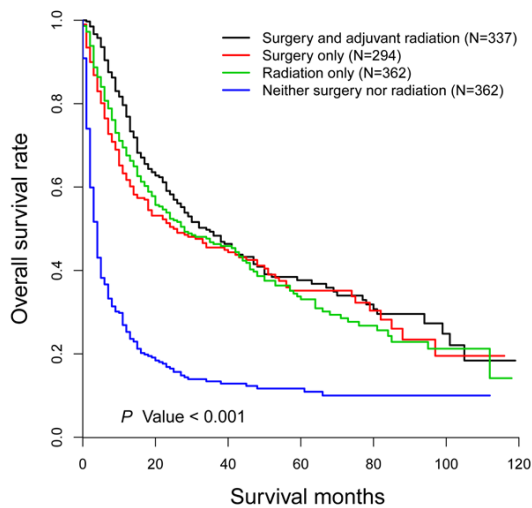

Figure 2. Kaplan-Meier survival curves for OS in elderly patients with OTSCC according to treatments. The x-axis represents survival times, and the y- axis represents survival rates; OS, overall survival; OTSCC, oral tongue squamous cell carcinoma; χ^2 = 280, P < 0.001.

beneficial for OS and TCSS outcomes. It is meaningful that our results could act as the recommended treatment for elderly patients with OTSCC.

Cancer of lip and oral cavity has caused great harm in many countries all over the world. It brought about 300,373 new patients and murdered about 145,353 people around the world in 2012 [1]. Tobacco smoking, alcohol consumption and HPV infection are the major risk factors for oral cavity cancer [12-14]. In 2017, there were 16,400 estimated new cases diagnosed with oral tongue cancer and 2,400 estimated deaths caused by oral cavity cancer in

Table 3. Univariate and multivariate analysis for tumor cause-specific survival

Characteristic	5-year TCSS	Univariate analysis		Multivariate analysis		
		Log Rank χ^2 test	P value	HR	95% CI	P value
Gender		0.8	0.358			
Male	67.6%					
Female	66.5%					
Age		23.2	< 0.001			
65-74	74.3%			Reference		
75-84	58.2%			1.792	1.336-2.405	< 0.001
≥ 85	52.6%			2.219	1.501-3.280	< 0.001
Race		0.9	0.627			
White	67.6%					
Black	63.1%					
Others	75.6%					
Treatment		16	0.001			
Group A	70.3%			Reference		
Group B	67.5%			1.210	0.828-1.769	0.325
Group C	68.3%			1.120	0.777-1.617	0.544
Group D	60.3%			2.126	1.430-3.161	< 0.001
Grade		1.4	0.234			
I/II	66.0%					
III/IV	69.1%					
AJCC stage		0.1	0.751			
I/II	69.9%					
III/IV	66.1%					
SEER stage		0	0.989			
Localized	71.3%					
Regional	67.1%					
Distant	63.3%					

Notes: TCSS, tumor cause-specific survival; HR, hazard ratio; CI, confidence interval; AJCC, the American Joint Committee on Cancer; SEER, the Surveillance, Epidemiology and End Results; Group A, surgery and adjuvant radiation; Group B, surgery only; Group C, radiation only; Group D, neither surgery nor radiation.

strategies in elderly OTSCC patients. Whether the treatment recommendations above are suitable for elderly patients remains unclear. As a result, treatment strategies based on clinical studies in elderly patients are still controversial.

Here we performed an observational trial concentrating on different treatment strategies based on SEER database in elderly OTSCC patients. For most early OTSCC, there were no survival differences among surgery only, radiation only and receiving both surgery and adjuvant radiation. Of the former two strategies, surgery seemed better than radiation when considering OS. For advanced OTSCC, receiving both surgery and adjuvant radiation had an advantage over other treatments. So we recommend that undergoing surgery only is better for early OTSCC in the elderly, and receiving both surgery and adjuvant radiation is more beneficial for advanced OTSCC. Our recommendation for OTSCC patients aged 65 years and older is in accordance with previous guides for oral tongue cancer roughly [17, 18]. The discrepancy lies in, from our perspective, that surgery is superior to radiation for early OTSCC patients when considering OS. It is consistent with other studies which suggested that age should not be a contraindication to surgical approach [19-21]. Since there is an aging trend in the patients with cancer, more and more clinical studies concern treatments of cancer in elderly patients, such as non-small cell lung cancer, renal cell carcinoma and gastric cancer [22-24]. Most of them found that the treatment strategies of elderly patients were slightly different from those of younger people.

the United States [15]. Either surgery or radiation therapy is available for early oral tongue cancer patients (stage I and stage II), which should be decided according to the anticipated functional and cosmetic results as well as the feasibility of the surgery or radiation for the individual patient [16, 17]. Actually, for most early oral cavity cancer patients, surgery is the initial treatment of choice. As for advanced oral tongue cancer (stage III and stage IV), a combination of surgery and radiation therapy is recommended for most patients [18]. However, hardly do these treatment recommendations take the age into account. What's more, currently few studies concentrate on the treatment
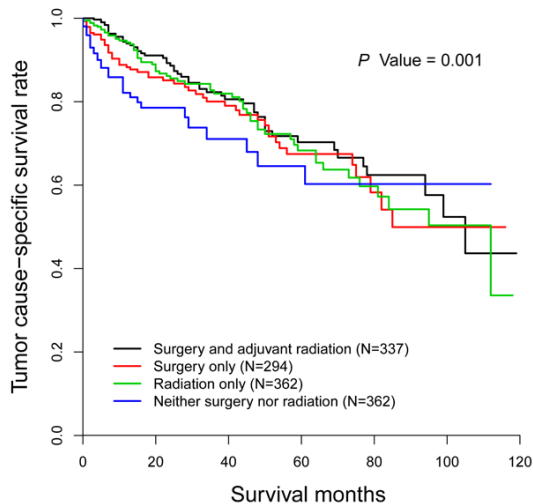
Figure 3. Kaplan-Meier survival curves for TCSS in elderly patients with OTSCC according to treatments. The x-axis represents survival times, and the y-axis represents survival rates; TCSS, tumor cause-specific survival; OTSCC, oral tongue squamous cell carcinoma; $\chi^2 = 16$, $P = 0.001$.

It means that the treatment guidelines need to be revised to apply to the increasing elderly patients.

A variety of potential reasons lead to the difference of treatment strategies between elderly and younger patients. Firstly, it is common that the elderly patients present poor physical functions and more comorbidities than younger patients, which affects the choice of the treatment modality. Because of these, the elderly may be at risk of under-treatment or overtreatment. A study showed that, even in elderly patients with head and neck cancer, there were significant differences of physiological state among the seventies, eighties a nd more elderly. In short, the elder patients are, the worse physiological states become [25]. Secondly, compared with younger adult patients, treatment compliance may be a big problem in elderly patients. The elderly are always accompanied by loss of stress tolerance, a decrease of organ or system function, lack of socioeconomic support, and higher prevalence of depression [26]. Moreover, the worse physiological status of elderly patients may result in more complication after surgery. Thus, it is less likely for them to use the standard cancer treatment or use the same way as younger patients. Thirdly, for the elderly patients, it always comes with a high incidence of postoperative complications, which is mainly caused by the multiple comorbidities [27]. A study pointed out that in elderly patients with gastric cancer, clinical outcomes are strongly associated with severe postoperative complications [28]. The above reasons bring about different treatment strategies between elderly and young patients.

Although this is a study based on a large population, there exist several potential limitations. Firstly, the SEER database lacks information of chemotherapy. Whereas, the preoperative chemotherapy or adjuvant chemotherapy is selective for advanced oral tongue cancer according to the therapy guidelines. If the elderly patients received chemotherapy, they might benefit from it. So it will make a potential confounder in our study. Secondly, data of comorbidities and postoperative complications is not provided by the SEER database. However, comorbidities such as hypertension, diabetes, renal disease are common in the elderly cancer patients as well as complications. These will influence the survival outcomes in elderly patients. Thirdly, for the elderly patients, the classification of survival or death during the follow-up period is too simple. Because different patients owned different functional status and quality of life, which reflected patients' survival quality especially in the elderly. And these data are also missing in the database.

Regardless of the above-mentioned limitations, we confirmed the important role of treatment such as surgery or radiation for survival in elderly OTSCC patients. Contrarily, receiving no therapy resulted in a high risk of mortality. Based on the results, we provided the optimized treatment for elderly with OTSCC. We suggested elderly patients with early OTSCC could just receive surgery. It is optional to receive radiation only for those intolerant to surgery. As for advanced OTSCC, we recommended both surgery and adjuvant radiation. However, randomized studies are necessary to prove it.

Acknowledgements

Disclosure of conflict of interest

None.

Table 4. Subgroup analysis according to age, AJCC stage and SEER stage

Characteristic		Overall survival			Tumor cause-specific survival		
		HR	95% CI	P value	HR	95% CI	P value
Age							
65-74	Group A	Reference			Reference		
	Group B	1.588	1.171-2.152	0.003	1.434	0.819-2.513	0.207
	Group C	0.988	0.731-1.336	0.938	0.664	0.365-1.208	0.180
	Group D	3.699	2.806-4.876	< 0.001	2.028	1.133-3.627	0.017
75-84	Group A	Reference			Reference		
	Group B	1.408	0.988-2.007	0.058	1.395	0.758-2.568	0.285
	Group C	1.337	0.955-1.872	0.091	1.537	0.868-2.723	0.141
	Group D	3.993	2.898-5.502	< 0.001	2.094	1.064-4.120	0.032
≥ 85	Group A	Reference			Reference		
	Group B	0.462	0.247-0.863	0.016	0.841	0.286-2.475	0.753
	Group C	1.191	0.729-1.946	0.485	1.618	0.627-4.175	0.320
	Group D	2.991	1.830-4.887	< 0.001	3.138	1.124-8.763	0.029
AJCC stage							
I/II	Group A	Reference			Reference		
	Group B	0.490	0.249-0.964	0.039	0.392	0.151-1.019	0.055
	Group C	1.139	0.641-2.022	0.658	0.725	0.301-1.748	0.475
	Group D	4.460	2.599-7.653	<0.001	3.115	1.395-6.955	0.006
III/IV	Group A	Reference			Reference		
	Group B	1.394	1.111-1.749	0.004	1.616	1.060-2.465	0.026
	Group C	1.158	0.932-1.439	0.186	1.262	0.836-1.904	0.268
	Group D	3.552	2.892-4.362	< 0.001	1.925	1.201-3.084	0.006
SEER stage							
Localized	Group A	Reference			Reference		
	Group B	0.608	0.296-1.248	0.175	0.877	0.325-2.363	0.795
	Group C	1.308	0.664-2.579	0.438	1.203	0.418-3.463	0.732
	Group D	7.475	3.806-14.684	< 0.001	6.872	2.390-19.763	<0.001
Regional	Group A	Reference			Reference		
	Group B	1.137	0.855-1.513	0.377	1.068	0.643-1.775	0.799
	Group C	1.133	0.860-1.492	0.374	1.102	0.680-1.786	0.695
	Group D	3.123	2.415-4.037	< 0.001	1.723	1.011-2.930	0.046
Distant	Group A	Reference			Reference		
	Group B	1.849	1.279-2.674	0.001	2.551	1.225-5.315	0.012
	Group C	1.222	0.870-1.718	0.248	1.198	0.592-2.425	0.615
	Group D	4.540	3.257-6.328	< 0.001	2.420	1.048-5.588	0.039

Notes: AJCC, the American Joint Committee on Cancer; SEER, the Surveillance, Epidemiology and End Results; HR, hazard ratio; CI, confidence interval; Group A, surgery and adjuvant radiation; Group B, surgery only; Group C, radiation only; Group D, neither surgery nor radiation.

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