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To what extent has the last two decades seen significant progress in the management of older patients with head and neck cancer?

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ABSTRACT

Introduction: Life expectancy is rising and consequently also the number of older patients with head and neck cancer. Different treatment regimens are often applied for older patients. The aim of this study is to investigate how treatment patterns and survival rates have changed over the past 20 years in older patients with head and neck squamous cell carcinoma (HNSCC).
Materials: Patient and tumour characteristics, treatment and 5-year survival data from the Netherlands Cancer Registry of patients aged ≥60 years diagnosed with HNSCC in 1990–1995 and 2010–2015 were compared using chi-square test and relative survival analysis.
Results: Data of 14,114 patients were analyzed. Oral cavity cancer treatment did not change over time, while survival improved from 54% to 58% ($p = 0.03$). Oropharyngeal and hypopharyngeal cancer treatment shifted towards non-surgical, with survival improving from 31% to 51% ($p < 0.01$) and 26% to 34% ($p < 0.01$), respectively. Laryngeal cancer treatment changed towards surgery in stage I and non-surgical treatment in stage III and IV disease. Survival in laryngeal cancer stage I remained stable and favorable at a relative survival rate of around 90%. Survival non-significantly changed from 54% to 49% for stage III disease and from 37% to 33% for disease.
Conclusion: Relative survival increased for all head and neck cancer sites in older patients, except for laryngeal cancer. For oropharyngeal, hypopharyngeal and advanced laryngeal cancer, a shift towards non-surgical treatment modalities was observed.

Author(s) contribution

Study concepts: G.B. Halmos, B.F.A.M. vd Laan.
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Quality control of data and algorithms: B.A.C. van Dijk, M.F. van der Kamp.
Data analysis and interpretation: B.A.C. van Dijk, M.F. van der Kamp, G.B. Halmos.
Statistical analysis: B.A.C. van Dijk, M.F. van der Kamp.
Manuscript preparation: M.F. van der Kamp, G.B. Halmos.
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Introduction

Over the past decades, life expectancy has been rising [1]. Cancer can be considered an age-related disease, either directly or through age-related factors [2,3]. More than half of head and neck cancer cases occur in patients aged 60 years or older [4], and the proportion of these older patients is increasing [4,5].

Treatment protocols have changed over time, becoming more (sub)site- and stage-specific. Treatment recommendations became more individualized due to a multidisciplinary approach [6]. Treatment of advanced head and neck cancer has changed towards non-surgical treatment modalities such as conformal and intensity-modulated radiotherapy and additional systemic therapy, such as

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Cetuximab, to reduce treatment burden and retain functionality [7,8]. Several studies show similar survival rates when applying concomitant chemoradiotherapy instead of surgical treatment in advanced stage laryngeal cancer to preserve laryngeal function [9,10]. Based on these studies, the organ preservation protocol was introduced. Treatment of early stage laryngeal cancer has also developed. Transoral laser surgery is nowadays widely used, since this technique has shown good results with reduced complications, good local control and respectable functional outcome [11–15].

Earlier research identified differences in treatment patterns between younger and elderly patients, with older age being predictive of receiving non-standard treatment [16,17]. With the increase of age, head and neck squamous cell carcinoma (HNSSC) patients are less likely to undergo surgical, multimodality and tumour-directed treatment [18]. This despite the fact that several studies have demonstrated that elderly patients can tolerate more intensive treatment with similar response and survival outcomes [2,19–22].

To our knowledge, it has not yet been investigated how treatment regimens and survival rates have changed over time in older HNSCC patients. The aim of our study is to compare changes between 1990-1995 and 2010–2015 in older HNSCC patients in (1) the numbers of patients, (2) treatment and (3) relative survival.

Methods and Materials

Patients

Anonymous data were obtained from the Netherlands Cancer Registry (NCR). The most important signaling source for the NCR are pathology reports from the nationwide network and registry of histo- and cytopathology in the Netherlands (PALGA). Trained NCR personnel gather population-based data on patient, tumour and treatment characteristics directly from the medical records. The NCR was shown to encompass a high level of reliability and completeness [23].

Patients were included in the study when they were aged 60 years and older with a newly diagnosed invasive squamous cell carcinoma (SCC) of the oral cavity, oropharynx, hypopharynx, or larynx, diagnosed between in 1990–1995 or 2010–2015. In case of multiple tumours in the head and neck region, only the first diagnosed tumour was included. Patients with distant metastasis were excluded. Included variables were gender, age, final stage, treatment regimen and vital status. This study was approved by the privacy review board of the NCR.

Age categories

In this study, a cut-off for patients aged 60 years and older was chosen. For detailed analysis of the role of age in head and neck cancer treatment and survival in older patients, patients were categorized into 5 age groups: 60–64 years, 65–69 years, 70–74 years, 75–79 years and ≥80 years.

Tumour staging

Tumours were staged according to the UICC TNM classification system, editions TNM_4 (1987), revised TNM_4 (1992) in the cohort of 1990–1995 and TNM_7 (2010) in the cohort of 2010–2015. Stage was categorized as stage I, II, III and IV.

Treatment categories

For treatment, we distinguished surgery, radiotherapy, chemotherapy or combinations of these modalities and no (tumour-directed) treatment. The proportionate share of surgery, radiotherapy and chemotherapy for the specific sites was compared between the entire cohort of the two periods as well as for the specific age groups.

Statistical analysis

Baseline characteristics were compared between the two periods and presented as frequencies. Pearson's chi-square test was used to compare the distribution of variables for the two periods.

Survival rates were based on the number of years between the date of diagnosis and the date of death, emigration, or censoring date (January 31, 2019). Relative survival rates were calculated using the Ederer II method for relative survival [24]. In brief, this is the ratio of the observed survival rate compared with the expected survival rate (based on sex, age and calendar year number from Statistics Netherlands (CBS)). Poisson regression modeling was used to calculate relative excess risk of dying [25] for period 2010–2015 compared to period 1990–1995.

P-values are presented to indicate whether a statistically significant difference between the periods existed, a p-value <0.05 was considered statistically significant.

Statistical analyses were performed using Stata/SE 14.2.

Results

Patient and tumour characteristics

In total, 14,114 patients were included in the analyses (Table 1). The number of all 60+ HNSCC patients was larger in the second period. In the second period, the number of oral cavity and hypopharyngeal SCC patients almost doubled (from 1569 to 3061 and 380 to 714, respectively). The number of oropharyngeal SCC more than doubled (from 719 to 1919 patients), while the number of laryngeal SCC remained more or less consistent (2772 in 1990–1995 and 2989 in 2010–2015).

The population of the Netherlands grew from 1,48,92,574 to 1,65,74,989 inhabitants, and life expectancy has gradually increased from 77 years in 1990–1995 to 81–82 years in 2010–2015 [26]. In our study, the male-to-female ratio changed from 3.2:1 to 2.1:1. This increase in the proportion of women was most pronounced in laryngeal SCC. The proportion of stage IV disease was larger in the second period and was observed for all tumour sites.

Treatment modality

Surgical treatment vs. non-surgical treatment

Changes between the two periods regarding treatment and age are shown in Tables 2 and 4. Treatment in oral cavity SCC was not different between the investigated periods, surgical treatment was still the cornerstone of the treatment with 85% in all age categories ($p = 0.89$), varying between 78% and 89% in 2010–2015 (Table 2a). The proportion of non-surgical treatment in oropharyngeal SCC was significantly larger in 2010–2015 (80%) than in 1990–1995 (56%), $p < 0.01$ (Table 2b). This larger proportion was observed in all age categories, except in those aged 80 years or older. The proportion of non-surgical treatment in hypopharyngeal SCC showed a similar pattern: the proportion equaled 81% in 2010–2015 and 55% in 1990–1995 and significantly increased in all age groups except those aged 80 years or older (stable at 77%), $p < 0.01$ (data not shown). The proportion of non-surgically treated laryngeal SCC patient significantly decreased from 77% in 1990–1995 to 63% in 2010–2015 $p < 0.01$ (Table 3). Table 3 shows changes in treatment modality by stage for laryngeal SCC. The proportion of non-surgical treatment decreased for stage I and II tumours and increased for

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Table 1
Patient characteristics per tumour site compared between 1990-1995 and 2010–2015.

	HNCSC- all sites			**Oral cavity**			**Oropharynx**			**Hypopharynx**			**Larynx**		
	1990–1995	2010–2015	p-value	1990–1995	2010–2015	p-value	1990–1995	2010–2015	p-value	1990–1995	2010–2015	p-value	1990–1995	2010–2015	p-value
Total	5440 (100%)	8674 (100%)		1569/5440 (29%)	3061/8674 (35%)		719/5440 (13%)	1919/8674 (22%)		380/5440 (7%)	714/8674 (8%)		2772/5440 (50%)	2989/8674 (34%)	
Gender															
Man	4143 (76%)	5884 (68%)	<0.01	868 (55%)	1602 (52%)	0.05	507 (71%)	1264 (66%)	0.02	303 (80%)	567 (79%)	0.90	2465 (89%)	2451 (82%)	<0.01
Woman	1298 (24%)	2789 (32%)		701 (45%)	1459 (48%)		212 (30%)	655 (34%)		77 (20%)	147 (21%)		307 (11%)	529 (18%)	
Age category[a]															
60–64	1381 (25%)	2388 (28%)	<0.01	347 (22%)	739 (24%)	0.12	221 (31%)	679 (35%)	<0.01	108 (28%)	234 (33%)	<0.01	705 (25%)	736 (25%)	<0.01
65–69	1381 (25%)	2260 (26%)		350 (22%)	739 (24%)		189 (26%)	552 (29%)		91 (24%)	216 (30%)		751 (27%)	753 (25%)	
70–74	1142 (21%)	1517 (17%)		303 (19%)	523 (17%)		157 (22%)	338 (18%)		79 (21%)	122 (17%)		603 (22%)	534 (18%)	
75–79	788 (14%)	1192 (14%)		231 (15%)	444 (15%)		90 (13%)	187 (10%)		60 (16%)	74 (10%)		407 (15%)	487 (16%)	
≥80	748 (14%)	1317 (15%)		338 (22%)	616 (20%)		62 (9%)	163 (9%)		42 (11%)	68 (10%)		306 (11%)	470 (16%)	
cTNM															
I	1552 (29%)	2297 (27%)	<0.01	358 (23%)	942 (31%)	<0.01	48 (7%)	110 (6%)	<0.01	16 (4%)	16 (2%)	<0.01	1130 (41%)	1229 (41%)	<0.01
II	1260 (23%)	1601 (19%)		413 (26%)	674 (22%)		73 (10%)	255 (13%)		41 (11%)	69 (10%)		733 (26%)	603 (20%)	
III	861 (16%)	1252 (14%)		269 (17%)	277 (9%)		174 (24%)	310 (16%)		77 (20%)	109 (15%)		341 (12%)	556 (19%)	
IV	1530 (28%)	3385 (39%)		413 (26%)	1081 (35%)		396 (55%)	1226 (64%)		228 (60%)	515 (72%)		493 (18%)	563 (19%)	
Unknown	237 (4%)	139 (2%)		116 (7%)	87 (3%)		28 (4%)	18 (1%)		18 (5%)	5 (1%)		75 (3%)	29 (1%)	

[a] Age at diagnosis.

stage III and IV tumours. In stage I, non-surgical treatment significantly decreased from 86% in 1990–1995 to 40% in 2010–2015, $p < 0.01$. In stage IV, the preferred treatment shifted from surgical treatment towards non-surgical treatment, demonstrated by a significant increase from 36% in 1990–1995 to 66% in 2010–2015 for non-surgical treatment ($p < 0.01$).

Chemotherapy

In Table 4, chemotherapy treatment in HNSCC in the specific age categories was compared between 1990-1995 and 2010–2015. The proportion of chemotherapy was significantly higher in 2010–2015 (13%) compared to 1990–1995 (4%) ($p < 0.01$). This higher proportion was exclusive for the younger age groups: the proportion significantly increased from 5% to 24% in the 60–64 age category ($p < 0.01$), from 5% to 19% in 65–69 age category ($p < 0.01$), and from 3% to 5% in the 70–74 category ($p = 0.03$). No significant changes were observed in patients aged 75 years and older.

5-Year relative survival

The 5-year relative survival rate for all HNSCC was comparable for both periods: 57% in 1990–1995 and 58% in 2010–2015 ($p = 0.40$, data not shown). Fig. 1 displays differences in survival between the two periods per tumour site.

In oral cavity SCC (Fig. 1), a significant increase in survival rates from 54% to 58% was observed in all 60+ patients ($p = 0.03$) with the largest increase observed in the 75–79 age category from 50% to 60% ($p < 0.01$).

Also in oropharyngeal SCC, a significant increase was observed in all 60+ patients (from 31% to 51%, $p < 0.01$) and in the 60–79 age categories (varying between 25–36% to 40–54%, $p < 0.01$, Fig. 1).

Likewise, a significant increase was observed in all 60+ hypopharyngeal SCC patients (from 26% to 34%, $p < 0.01$), and in the 60–64 and 70–74 age categories (from 25% to 38%, $p = 0.02$; and 21% to 36%, $p = 0.04$, respectively; Fig. 1).

For laryngeal SCC, the survival rate was comparable for the two periods (69% in 1990–1995 and 68% in 2010–2015; $p = 0.31$) (Fig. 1). No notable differences among the different age categories were observed.

For laryngeal SCC, stage-specific analyses were additionally conducted and are shown in Fig. 2. A stable survival rate of 90% was observed in stage I laryngeal SCC, $p = 0.88$, with minor insignificant differences between the periods in all age categories. In stage II, relative survival rate estimates were mostly (but never significantly) higher in the second period. Relative survival rates did not improve, with non-statically significant lower rates in 2010–2015 compared to 1990–1995 for stage III and stage IV tumours (54% to 49%, $p = 0.45$ and 37% to 33%, $p = 0.09$, respectively).

Discussion

In this study, we identified evident changes in the treatment regimens of older HNSCC patients between 1990-1995 and 2010–2015. Most notable is the shift in primary treatment of oropharyngeal SCC from surgical towards non-surgical treatment. This treatment paradigm shift was accompanied by significantly improved survival rates.

Furthermore, the proportion of non-surgical treatment in early stage laryngeal SCC was lower in 2010–2015 compared to 1990–1995, probably due to the introduction of transoral laser surgery. This change did not affect the favorable survival rates of these patients. However, the introduction of organ preserving protocols in advanced stage laryngeal SCC do not seem to have resulted in improved survival rates. Moreover, survival rates decreased in 2010–2015 compared to 1990–1995 albeit at an

Table 2a
Proportion of surgically[a] treated patients in oral cavity SCC by age category for 1990–1995 and 2010-2015.

Oral cavity SCC			
Age category[b]	1990–1995 n (% of total)	2010–2015 n (% of total)	Δ%, (95% CI), p-value[c]
60–64	289 (87%)	596 (86%)	−1%, (−6%; 4%), 0.66
65–69	292 (86%)	614 (87%)	1%, (−3%; 6%), 0.60
70–74	258 (89%)	431 (87%)	−3%, (−7%; 2%), 0.29
75–79	173 (82%)	361 (89%)	7%, (1%; 13%), 0.02
≥80	232 (80%)	391 (78%)	−3%, (−8%; 3%), 0.37
All 60+	1244 (85%)	2393 (85%)	0, (−2%;-2%), 0.89

[a] Surgically treated = primary surgical treatment with or without adjuvant treatment modalities (i.e. systemic therapy and/or radiotherapy).
[b] Age at diagnosis.
[c] $p < 0.05$ was considered statistically significant.

Table 2b
Proportion of non-surgical[a] treated patients in oropharyngeal SCC by age category for 1990–1995 and 2010–2015.

Oropharyngeal SCC			
Age category[b]	1990–1995 n (% of total)	2010–2015 n (% of total)	Δ%, (95% CI), p-value[c]
60–64	100 (50%)	498 (79%)	29%, (21%; 36%), <0.01
65–69	99 (57%)	414 (81%)	25%, (17%; 32%), <0.01
70–74	83 (58%)	251 (80%)	22%, (13%; 31%), <0.01
75–79	41 (56%)	126 (79%)	23%, (11%; 36%), <0.01
≥80	33 (75%)	102 (85%)	10%, (−3%; 23%), 0.14
All 60+	356 (56%)	1394 (80%)	24%, (20%; 28%), <0.01

[a] Non-surgical treated = systemic therapy and/or radiotherapy, other.
[b] Age at diagnosis.
[c] $p < 0.05$ was considered statistically significant.

Table 3
Proportion of non-surgical[a] treated patients in laryngeal SCC by stage for 1990–1995 and 2010-2015.

Laryngeal SCC			
Stage	1990–1995 n (% of total)	2010–2015 n (% of total)	Δ%, (95% CI), p-value[b]
I	949 (86%)	481 (40%)	−46%, (−50%;-42%), <0.01
II	669 (93%)	520 (88%)	−5%, (−8%;-2%), <0.01
III	230 (70%)	467 (89%)	18%, (13%; 24%), <0.01
IV	164 (36%)	326 (66%)	31%, (24%; 37%), <0.01
All stages	2035 (77%)	1799 (63%)	−13%, (−16%;-11%), <0.01

[a] Non-surgical treated = systemic therapy and/or radiotherapy, other.
[b] $p < 0.05$ was considered statistically significant.

Table 4
Chemotherapy in different age categories for 1990–1995 and 2010–2015 in HNSCC.

Chemotherapy			
Age category[a]	1990–1995 n (% of total)	2010–2015 n (% of total)	Δ%, (95% CI), p-value[b]
60–64	75 (5%)	574 (24%)	19%, (16%; 21%),<0.01
65–69	63 (5%)	420 (19%)	14%, (12%; 16%), <0.01
70–74	37 (3%)	75 (5%)	2%, (0%; 3%), 0.03
75–79	16 (2%)	17 (1%)	−1%, (−2%; 1%), 0.30
≥80	14 (2%)	13 (1%)	−1%, (−2%; 0%), 0.09
All 60+	205 (4%)	1099 (13%)	9%, (8%; 10%), <0.01

[a] Age at diagnosis.
[b] $p < 0.05$ was considered statistically significant.

insignificant degree. No specific age-related changes regarding treatment regimen were observed between the two periods.

Our study showed an increase in the proportion of oropharyngeal, hypopharyngeal and oral cavity SCC. This increase of oropharyngeal SCC was also observed in other studies, most expressed in young, white patients, and thought to be related to HPV infection [27–32]. However, these studies described incidence trends that were established more than a decade ago. A more recent study found that also in older patients the incidence of (HPV-related) oropharyngeal cancer is increasing [33]. Increased incidence of HPV-related oropharyngeal cancer in older patients may also partly explain the increased survival in our cohort, since

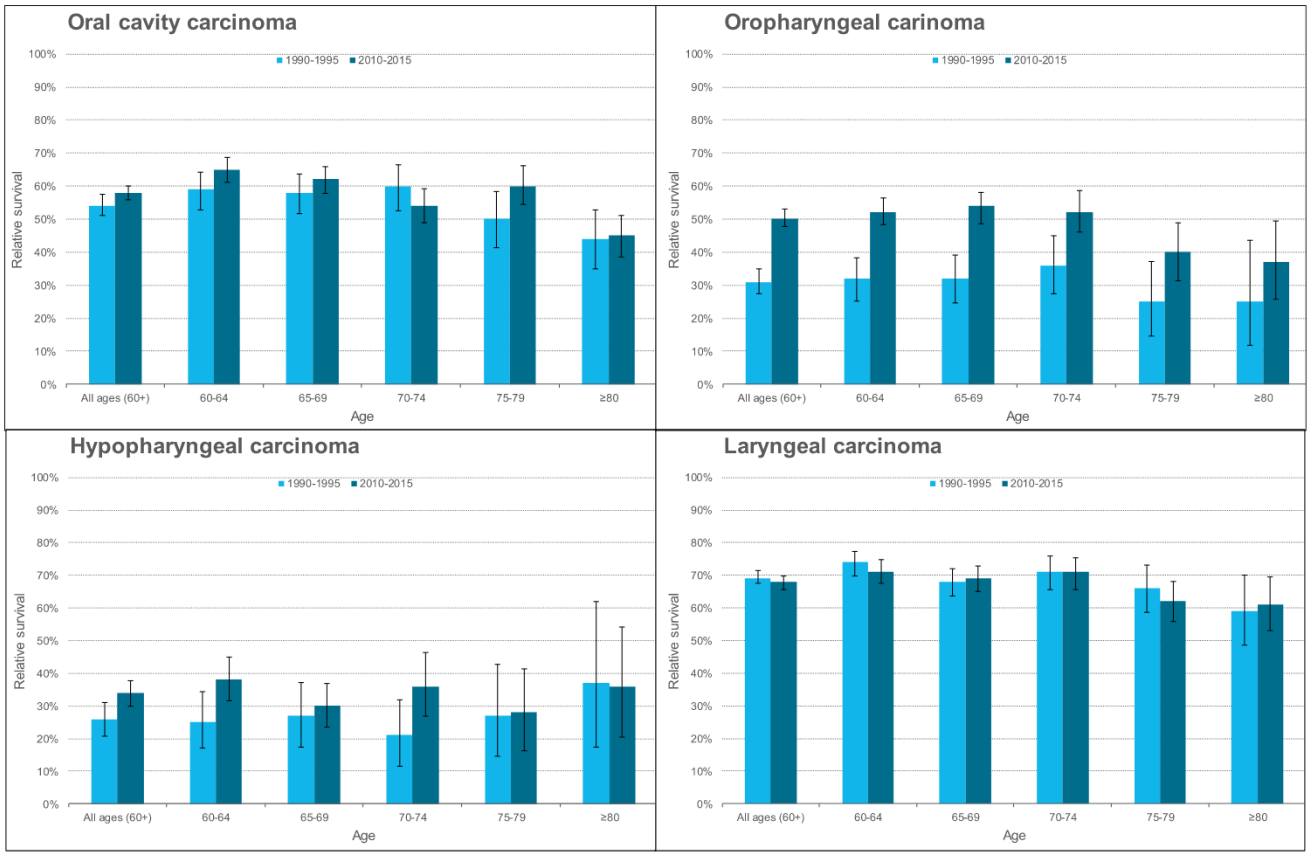

Fig. 1. Five-year relative survival per age category per site HNSCC.

HPV-positive oropharyngeal cancers represent a unique disease entity with superior survival compared to HPV-negative oropharyngeal SCC [33–35]. Unfortunately, information on HPV status was not available for this study. Nevertheless, in a study of Rietbergen et al. a significant increase in the proportion of HPV-positive oropharyngeal SCC in the Netherlands was observed, from 5.1% in 1990 to 29.0% in 2010 ($p = 0.001$) [36].

Tobacco smoking and alcohol use are the most well known risk factors for oral cavity SCC [37]. Over the last decades an increase in the incidence of oral cavity SCC has been observed [30,38,39]. However, this increase has been reported to be most pronounced in young, non-smoking women, a subgroup that is not included in the current study [30,38]. In non-smoking oral SCC patients, tongue SCC is frequently seen in young female patients while gingival/buccal SCC affects elderly women [40]. The reason for the increase of oral cavity SCC in this population of young women remains unknown [38,41]. The higher proportion of oral cavity SCC in 2010–2015 might be explained by the ongoing effect of tobacco smoking in the 80s and 90s, which may have resulted in an increase in oral cavity SCC approximately 20 years later. In the Netherlands, the total percentage of smokers (>18 years) decreased from 35% in 1990–1995 to 25% in 2010–2015 [42]. Unfortunately, data on this item was lacking in our study cohort for this time period. However, this effect would then also be expected in the group of laryngeal SCC patients, of which tobacco smoking is likewise a major risk factor [43]. In this study a lower proportion of laryngeal SCC was observed in 2010–2015 compared to 1990–1995 (in particular in men), which may actually reflect the impact of antismoking campaigns. This decrease in laryngeal SCC is also confirmed by other authors [29,44].

The higher proportion of stage IV disease in 2010–2015 compared to 1990–1995 was seen in all primary HNSCC sites. This higher proportion may be explained by improved diagnostic imaging, resulting in the ability to detect smaller metastases and better possibilities to visualize bone invasion. However, since this was not the scope of our study, we cannot substantiate this statement.

Since the 1990s, the management of head and neck cancers has improved with the use of concurrent chemoradiation [9,10,45,46]. Radiotherapy techniques, including three-dimensional conformal radiotherapy (3D-CRT), intensity-modulated radiotherapy (IMRT), and proton radiotherapy, have been developed. With these techniques the conformal degree of target areas is increased and the radiation dose and toxicity of surrounding organs are therefore reduced [47,48]. Also the introduction of transoral laser surgery has contributed to reduced morbidity rates and fewer complications, resulting in an improved of quality of life [49,50]. Similarly, advances in the overall care of the patients, including individual nutritional support, have resulted in the improvement of quality of life and reduced complication rates [51]. These developments have undoubtedly also improved the survival rates of HNSCC patients. The findings for this time period are mirrored in similar studies in other European countries [52]. The most striking increase in survival in our study was seen in oropharyngeal SCC patients, which was also observed in several other studies [33,35]. The rise in incidence of HPV-related oropharyngeal cancer, linked to better prognosis, is one of the logical explanations to the improved survival rates [35]. However, the treatment shift towards non-surgical treatment and development of non-surgical treatment techniques are possibly also responsible for these improved survival rates in oropharyngeal SCC [46].

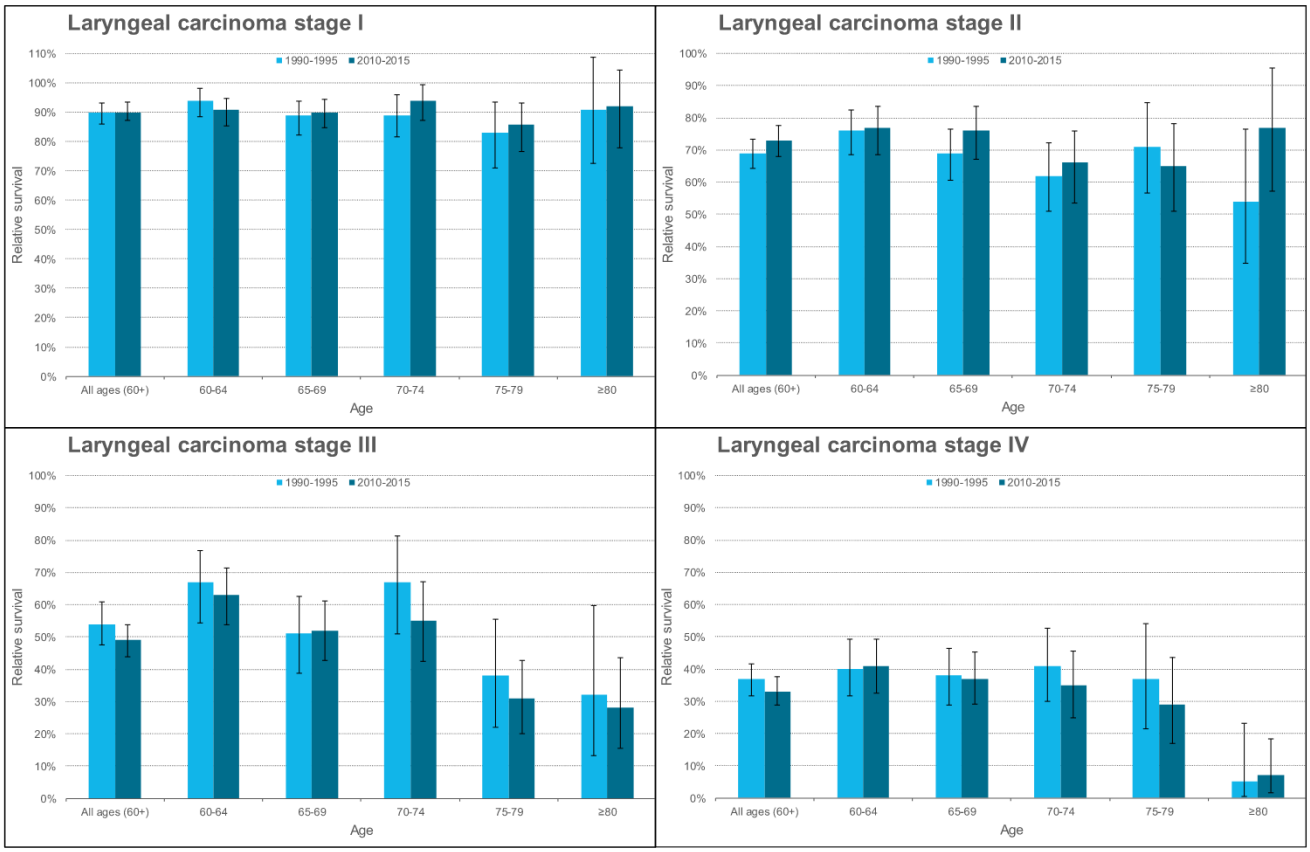

Fig. 2. Five-year relative survival per age category in stage I-IV laryngeal SCC.

Laryngeal SCC survival rates were consistent between 1990-1995 and 2010–2015. Worldwide, this lack of improvement of survival in laryngeal SCC is confirmed [44,53–55]. The shift towards organ-preservation treatment is assumed to be one of the reasons for this lack of improvement [55–57]. The decrease in primary surgical treatment and increase in (chemo-)radiotherapy in laryngeal SCC found in our study is confirmed by Timmermans et al., in 2016 [57], and this is no surprise since the Dutch guidelines for laryngeal SCC were adjusted after the publication of a consensus document by the Dutch Head and Neck Society [58]. In our study, survival mainly decreased in patients older than 70 years with stage III and IV disease, although this decrease was not statistically significant. These patients have been excluded from adjuvant chemotherapy since the 2009 adjustment to the guidelines based on the study of Pignon et al. [45] In this study, chemotherapy was more often part of the treatment in the latter period in 'younger' patients, while low percentages and no significant increase was observed in patients >75 years. A recent publication has shown that treatment with chemoradiation for HNSCC is also feasible and effective for the older patient population [59]. Therefore, this may be a topic for reconsideration. Likewise, Moye et al. confirmed that older patients receiving stage-appropriate treatment for early and late stage cancer had oncologic outcomes equivalent to those of their younger counterparts, and suggest that advanced age alone should not preclude patients from receiving stage-appropriate therapy [60]. Consequently, treatment decisions should be made according to a patients' general condition and comorbidities, and not rely purely on chronological age.

Despite the unimproved survival rates following the shift towards organ-preservation treatment protocols, some positive effects have been observed following amendments in laryngeal SCC treatment protocols. For stage I disease, survival rates have remained favorable since the introduction of minimal invasive transoral laser surgery [61]. This technique offers the potential for organ preservation with less functional morbidity than open surgery, as well as less toxicity, a shorter treatment schedule, and decreased expenses compared to with radiotherapy. Furthermore, transoral laser surgery can be performed repeatedly in case of recurrent disease or a second or third primary laryngeal carcinoma, while radiotherapy can essentially be applied only once. Minimal invasive transoral laser surgery has a comparable voice and quality of life outcomes in early laryngeal cancer compared to radiotherapy [62,63].

Strengths of our study are the inclusion of a representative cohort from the population-based Netherlands Cancer registry (NCR) with a large number of patients. Furthermore, we had detailed data on specific head and neck cancer sites, rather than analysis for head and neck cancer in general. There are also limitations that warrant discussion. First, there is no general consensus regarding the definition of elderly, and the cut-off of age in "elderly" patients highly differs among studies. Research suggests that HNSCC patients may have higher biological age due to their unhealthy lifestyle, compared with patients with other solid malignancies [64]. Additionally, the guidelines for chemotherapy for patients ≥70 changed 2009. To evaluate a possible effect not only in patients ≥70, also patients 60–69 were included. Based on those arguments, a cut-off value of HNSCC patients aged 60 years and older was chosen. Second, in the NCR, data regarding tobacco use and alcohol consumption, comorbidity, functional outcome, quality of life and specific tumour characteristics such HPV tumour status were not available for the investigated time period. Additional information on these items would have been relevant for the complete picture of our findings.

Conclusion

In most of the primary tumour sites of older HNSCC patients, survival improved over time with an exception of laryngeal SCC. This phenomenon was observed in parallel with a larger proportion of non-surgical treatment modalities for oropharyngeal, hypopharyngeal and advanced laryngeal SCC in 2010–2015 compared to 1990–1995.

Declarations of competing interest

None.

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