Hospitalizations of more than 5 days predict for worse outcomes after radiotherapy for head and neck cancer

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Background Patients undergoing chemoradiation for head and neck squamous cell carcinoma (HNSCC) are predisposed to unplanned hospitalizations.
Objective To assess the factors associated with prolonged hospitalization and its impact on patient outcomes.
Methods We assessed the outcomes of patients hospitalized for ≥5 days or <5 days in 251 patients with advanced HNSCC who were undergoing radiotherapy during 2000-2012.
Results Patients who had been hospitalized for ≥5 days were more likely to be admitted for infection, acute renal failure, and/or dehydration. We found no other patient, tumor, or treatment characteristics associated with prolonged hospitalizations. Hospitalizations of ≥5 d were associated with a higher incidence of delays in radiotherapy (RT; odds ratio [OR], 2.49; 95% confidence index [CI], 1.09-5.69; *P* = .03) and worse performance status after RT (OR, 5.76; 95% CI, 1.85-18.38; *P* = .003). On multivariate analysis, hospitalization of ≥5 days predicted for worse local-regional control (hazard ratio [HR], 1.85; 95% CI, 1.08-3.17; *P* = .03) and time to treatment failure (HR, 1.64; 95% CI, 1.03-2.61; *P* = .04), and performance status after RT predicted for worse local-regional control, time to treatment failure, progression-free survival, and overall survival.
Limitations As a retrospective review, we report only hypothesis-generating observations, which may have been affected by having incomplete patient information.
Conclusions Hospitalizations of ≥5 days was associated with infections and/or dehydration and predicted for worse disease control. Our results suggest that patients may benefit from efforts to reduce hospitalization length by minimizing precipitators of hospitalizations as well as interventions to reduce the length of hospital stays.

Patients who undergo radiotherapy for locally advanced squamous cell cancer of the head and neck (HNSCC) have multiple factors that predispose them to hospitalization during treatment. First, many of these patients have significant smoking and alcohol use, which predisposes them to pulmonary and cardiovascular comorbidities and increased hospitalizations.[1,2] Second, chemoradiation is associated with a five-fold or greater increased risk of grade 3 or greater mucositis and esophagitis, creating the conditions for dehydration, which necessitates hospitalization.[3-6] Third, platin-based chemotherapy also predisposes to additional hematologic and renal toxicities that may result in increased hospitalizations. Consequently, several groups have shown that up to 24% of patients undergoing chemoradiation for HNSCC experience unplanned hospitalizations.[3]

However, the extent to which the hospitalizations have an impact on patient outcomes remains unclear. Complications that necessitate hospitalization may result in treatment delays or chemotherapy dose modifications that adversely affect disease control. In addition, prolonged hospitalizations may have an impact on the patient's long-term performance status, which may be associated with worse outcomes. Patients who are hospitalized during treatment may be inherently prone to worse outcomes. Therefore, predicting how hospitalizations affect patient outcomes would assist us in managing our patients more effectively. Here, we report on how we evaluated which characteristics predicted for unplanned hospitalizations during radiotherapy for locally advanced HNSCC and the extent to which hospitalizations had an impact on patient outcomes.

Methods

Study population

We used a retrospective database of 803 patients with HNSCC to select 299 patients with stage III-

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IVB disease who were treated with radiotherapy at the University of Illinois Medical Center at Chicago during 2000-2012, which encompasses the period during which hospital admission and discharge summaries were routinely included in the electronic medical record. We excluded 48 patients who lacked adequate hospitalization records due to hospitalizations or other interventions at outside treatment facilities, giving us a total of 251 patients for analysis. The patients were analyzed under the University of Illinois Medical Center internal review board protocol 2011-1075 in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration of 1999, as revised in 2000.

Variables

We defined the length and number of hospitalizations based on the discharge summary. In this patient cohort, the mean and median length of hospitalization were 4.99 days and 2 days, respectively. Although the median length of hospitalization was significantly associated for overall survival (OS) on univariate analysis, the mean length of hospitalization was significantly associated with time to treatment failure (TTF), progression-free survival (PFS), and OS. Because the mean length of hospitalization, 5 days, was significantly associated with more outcome measurements, it used as the cut-off for further analysis. To further define the length of hospitalization used in this study, we assessed the impact of hospitalization length of ≥1 day, ≥3 days, ≥5 days, ≥7 days, and ≥10 days on PFS in our patient population. A hospitalization length of ≥5 days again was the cut-off, with the highest significance for worse PFS, and was used in all further analysis.

Hospitalizations were categorized based on the admitting diagnosis, including infection/neutropenia, dehydration, acute renal failure, feeding tube placement, shortness of breath/chronic obstructive pulmonary disease (COPD) exacerbation. We approximated a patient's comorbidity burden by using a modified Charlson Comorbidity Index[7] (0 = no comorbidities: 12% 1y mortality; ≥5 = high comorbidities: 85% 1y mortality) and performance status by using the Karnofsky Performance Status (KPS)[8] scale (100 = normal, no complaints; 0 = dead).

Staging was categorized using the American Joint Committee staging system at the time of diagnosis. Cost of hospitalization was calculated by multiplying the total hospital days for each patent by $1,561, which is the cost per day of hospitalization for Illinois state hospital in 2011 (The Henry J Kaiser Family Foundation; hppt://kff.org). We defined chemoradiation where chemotherapy was given as induction chemotherapy and/or as concurrent chemoradiation.

Acute toxicity was scored using the Radiation Therapy Oncology Group's common toxicity criteria. We defined radiotherapy delay as RT courses that were completed 7 days or more after the anticipated finish date. A KPS of < 70 before and after RT was assessed either from documentation of performance status in the patient's medical record or the patient's placement in a skilled nursing facility at the indicated time point. (A KPS score of ≥70 means that patients are able to care for themselves and a score of <70 means that patients require assistance.) Time to local control (LC), regional control (RC), local-regional control (LRC), PFS, and OS were determined from the last date of RT. Patterns of LRC were determined as the first failure with any component of local or regional failure, respectively. PFS was calculated as the time to any failure or death from any cause. OS was calculated as the time to death from any cause.

Statistical analysis

Statistical analysis was performed using JMP version 10 (SAS Institute). All tests to determine statistical significance were 2-sided, and statistical significance was defined as $P < .05$. Discrete variables were compared with chi-square test and continuous variables were compared with the t test. Differences between medians were assessed using the Wilcoxon test. Survival curves were plotted using the Kaplan-Meier method. For univariate analysis, we selected factors that were significantly different between patients with hospitalizations ≥5 days or <5 days. Multivariate analysis was performed using nominal logistic regression analysis to adjust for explanatory confounding prognostic variables with P value <.1 on univariate analysis. Multivariate analysis for locoregional control (LRC), diabetes mellitus, PFS, and OS was performed using Cox proportional hazards models, and multivariate analysis of toxicity was performed using nominal logistic regression analysis.

Results

Population, tumor, and treatment characteristics

Median follow-up was significantly shorter for patients with hospitalizations ≥5 days, compared with <5 days (14.2 months and 22.1 months, respectively; $P = .01$; Table 1). Patients with hospitalizations of ≥5 days were associated with increased delays in RT course compared with those with hospitalizations of <5 days (29.4% vs. 16.9%, $P = .02$), increased feeding tube placement during RT (55.3% and 34.3%; $P = .002$), and worse performance status after radiotherapy (KPS < 70: 15.3% and 5.4%; $P = .02$). There was no difference in length of hospitalization based on patient age, gender, pretreatment performance status, comorbidity index, primary site, overall stage, tumor stage, or nodal stage, as well as alcohol or smoking use (Table 1). Furthermore, there was no significant difference in patient's history of liver disease, diabetes, cerebrovascular accidents, myocardial infarction, COPD, or congestive heart failure.

Hospitalization characteristics

Patients with hospitalizations of ≥5 days had more hospitalization events than did those hospitalized for <5 days (100.0% vs 25.3%, respectively; $P < .0001$), more total median hospital days (11 days vs 0 days; $P < .0001$), and more total number of hospitalization events (2 vs 0; $P < .0001$), as shown in Table 2. Furthermore, hospitalizations of ≥5 days correlated with more hospitalizations for dehydration (45.7% vs 6.6%; $P < .0001$), higher incidence of acute renal failure (17.7% vs 1.2%; $P < .0001$), and more infections (40.0% vs 4.2%; $P < .0001$). On multivariate analysis, hospitalizations of ≥5 days were significant only for patients who were experiencing infection, acute renal failure, or dehydration (Table 3). Furthermore, a KPS of <70 after RT was associated with hospitalizations of ≥5 days (hazard ratio [HR], 5.76; 95% confidence index [CI], 1.85-18.38; $P = .003$) and hospitalizations for infection (HR, 4.50; 95% CI, 1.18-22.77; $P = .03$). In addition, RT delays during radiotherapy were associated with hospitalizations of ≥5 days (HR, 2.49; 95% CI, 1.09-5.69; $P = .03$). Given that hospitalization length is likely a continuous risk factor, we also assessed the risk of hospitalization length on post-RT KPS scores and RT delays (Table 3). Hospitalization length was significantly associated with worse performance status after radiotherapy per day of hospitalization (HR, 1.07 per hospitalization day; 95% CI, 1.01-1.14; $P = .03$) but was not associated with increased delays in RT.

Outcomes

Hospitalizations ≥ 5d was associated with worse TTF ($P = .02$), PFS ($P = .003$), and OS ($P = .005$), as shown in Figure. On univariate analysis, LRC and/or TTF were associated with hospitalizations of ≥5 days, intravenous fluids during RT, RT delays, and a KPS of <70 after RT. PFS was associated with hospitalizations, RT delays, and a KPS of <70 after RT. OS was associated with hospitalizations and KPS < 70 after RT. On multivariate analysis, hospitalizations of ≥5 days and KPS < 70 after RT were associated with worse LRC and TTF, whereas only KPS < 70 was associated with worse PFS and OS (Table 4). When length of hospitalization was assessed as a continuous variable, length of hospitalization, KPS < 70 after RT, and IVF during RT were significantly associated with TTF, PFS ,and OS. KPS < 70 after RT remained significant for LRC. (Table 5)

Discussion

Here, we found that hospitalizations of 5 days or longer predicted for worse disease control. Furthermore, as a continuous risk factor, length of hospitalization remained significant for disease control and survival. We found that dehydration, acute renal failure, and febrile neutropenia were causative factors for prolonged hospitalizations. By contrast, we did not find that comorbidities or selective

TABLE 1 Patient, tumor, and treatment characteristics[a] (N = 251)

Characteristic	Length of hospitalization, d <5 (n = 166)	Length of hospitalization, d ≥5 (n = 85)	*P* value[b]
Median age, y (IQR)	59.3 (50.6-66.9)	57.8 (48.5-63.5)	.21
Median follow-up, mo (IQR)	22.1 (9.7-48.1)	14.2 (6.5-29.9)	.01
Comorbidity index, n (%)			.49
Medium	107 (64.5)	51 (60.0)	
High	59 (35.5)	34 (40.0)	
Chemoradiation, n (%)			.75
Yes	140 (84.30)	73 (85.8)	
No	26 (15.7)	12 (14.1)	
Tumor stage, n (%)			.47
T0-2	51 (30.7)	30 (35.3)	
T3-4b	115 (69.3)	55 (64.7)	
Nodal stage, n (%)			.48
N0-2a	86 (51.8)	40 (47.1)	
N2b-3	80 (48.2)	45 (52.9)	
Primary site, n (%)			
Hypopharynx	10 (6.0)	6 (7.1)	.85
Larynx	34 (20.5)	16 (18.8)	
Nasopharynx	12 (7.2)	4 (4.7)	
Oral cavity	38 (22.9)	27 (31.8)	
Oropharynx	42 (25.3)	21 (24.7)	
Other	30 (18.1)	11 (12.9)	
RT delays, n (%)			.02
No	138 (83.1)	60 (70.6)	
Yes	28 (16.9)	25 (29.4)	
IVF during RT, n (%)			.08
Yes	65 (39.2)	44 (51.8)	
No	101 (60.8)	41 (48.2)	
Feeding tube during RT, n (%)			.002
Yes	57 (34.3)	47 (55.3)	
No	109 (65.7)	38 (44.7)	
KPS[c] at 1 mo after RT, n (%)			.02
≥70	120 (72.3)	59 (69.4)	
<70	9 (5.4)	13 (15.3)	
Not stated	37 (22.3)	13 (15.3)	

IQR, interquartile ratio; IVF, intravenous; KPS, Karnofsky Performance Status scale; RT, radiotherapy

[a]While not formally presented, we did not observe any statistical differences between hospitalizations of <5 days or ≥5 days for gender ($P = .29$), liver disease ($P = .28$), diabetes mellitus ($P = .83$), cerebrovascular accidents ($P = .63$), myocardial infarctions ($P = .96$), chronic obstructive pulmonary disease ($P = .71$), congestive heart failure ($P = .20$), alcohol use ($P = .56$), smoking history ($P = .39$), stage grouping ($P = .55$), use of postoperative radiotherapy ($P = .49$), mucositis grade ≥3 ($P = .93$), dermatitis grade ≥3 ($P = .80$). b For analysis of categorical variables, a 2-sided chi-square test was used. For analysis of medians, a Wilcoxon/Kruskal-Wallis test was used. cKPS range, 0-100; a score of ≥70 means patients are able to care for themselves and a score of <70 means they require assistance.

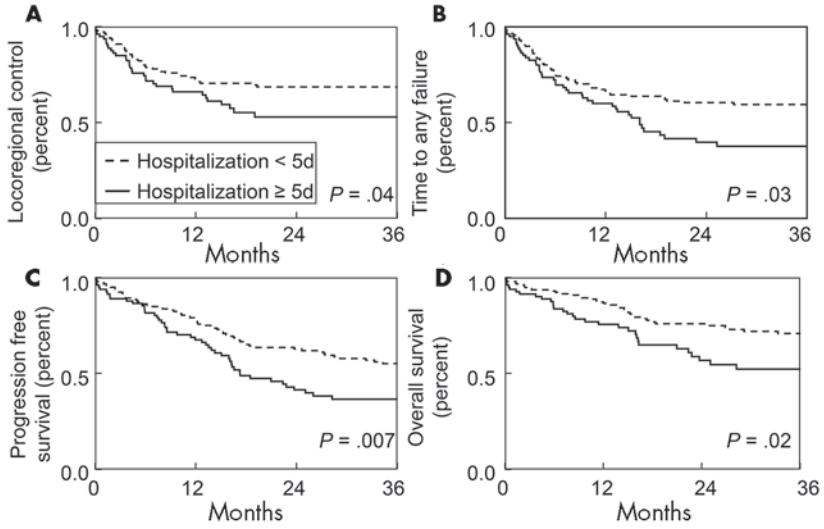

FIGURE 1 Kaplan-Meier analysis of outcomes in patients with hospitalizations of <5 days or ≥5 days. A, Locoregional control; B, time to failure; C, progression-free survival; D, overall survival for patients with stage III-IV head and neck squamous cell carcinoma who have been treated with radiotherapy.

The log rank test was used to assess for differences in outcomes.

TABLE 2 Characteristics of hospitalization (N = 251)

Characteristic	Length of hospitalization, d <5 (n = 166)	≥5 (n = 85)	*P* value[b]
Hospitalized, n (%)			< .0001
Yes	42 (25.3)	85 (100.0)	
No	124 (74.7)	0 (0.0)	
Total hospital days (IQR)	0 (0-1)	11 (7-14.5)	< .0001
Total hospitalizations (IQR)	0 (0-1)	2 (1-3)	< .0001
Reason, n (%)			
Infection			< .0001
Yes	7 (4.2)	34 (40.0)	
No	159 (95.8)	51 (60.0)	
Dehydration			< .0001
Yes	11 (6.6)	38 (45.7)	
No	155 (93.4)	47 (54.3)	
Acute renal failure			< .0001
Yes	2 (1.2)	15 (17.7)	
No	164 (98.8)	70 (82.3)	
Median cost, $ (IQR)	0 ($0-$0)	$16,390.5	< .0001

IQR, interquartile ratio

medical conditions predicted for worse hospitalizations. Patients who were hospitalized for ≥5 days had more treatment delays as well as worse functional status after radiotherapy. Furthermore, prolonged hospitalizations predicted for worse disease control. Therefore, our results suggest that nephrotoxic events and/or infections during radiotherapy predisposed patients to prolonged hospitalizations causing treatment delays, worse functional status, and subsequently worse disease control.

In our series, about 51% of patients were hospitalized, which is higher than the 36% of patients who are hospitalized because of chemoradiation as reported by Elting and colleagues.[3] However, they treated only 47% of the entire patient population with chemotherapy. By contrast, our results are consistent with other reports showing that chemotherapy administration during treatment of head and neck cancers resulted in hospital admissions for half of the patients.[9,10] Previous reports demonstrated that mucositis and feeding tubes during radiotherapy affected hospitalizations and treatment delays. Mucositis has been defined as a causative factor for hospitalization in 16%-34% of head and neck cancer patients who are treated with radiotherapy.[6] Several groups have reported that mucositis increased the frequency of hospitalizations and treatment delays,[3-6] but we did not observe that mucositis contributed to prolonged hospitalizations. Nevertheless, we did observe that indicators of severe mucositis such as dehydration and acute renal failure predisposed to hospitalizations of 5 or more days, consistent with the impact of mucositis on hospitalizations. Furthermore, in previous studies,[3-6] mucositis was associated with treatment delays in 10%-18% of patients, which is lower than our results for which we report 28.8% of patients requiring a treatment break. Still, our increased hospitalization events is likely not due to lower rates of prophylactic feeding tube placement because 23% of our patients started RT with a prophylactic feeding tube, which is similar to 18% in previously reported patients.[3] Similarly, as with Lee and colleagues,[11] we found that prophylactic feeding tubes did not reduce the risk of overall hospitalizations. Fever and neutropenia due to chemotherapy were also significantly associated with hospitalizations of ≥5 days, so prolonged hospitalizations likely reflected a combination of various treatment toxicities including infection and renal toxicities.

We also observed that the length of hospitalization predicted for worse disease control and overall survival. Still, it remains unclear whether prolonged hospitalizations led to

TABLE 3 Multivariate analysis of hospitalization (N = 251)

		Odds ratio (95% confidence interval) [P value]			
		Hospitalizations of ≥5 days (categorical variable)		No. of hospital days (continuous variable)	
	Hospitalizations[1]	Post-RT KPS < 70	RT delays	Post-RT KPS < 70	RT delays
Hospitalized ≥5 days	na	5.76 (1.85-18.38) [.003]	2.49 (1.09-5.69) [.03]	na	na
Feeding tube during RT	1.62 (0.80-3.31) [.18]	1.90 (0.72-5.24) [.20]	1.58 (0.82-3.04) [.17]	1.55 (0.58-4.20) [.48]	1.51 (0.78-2.91) [.22]
IVF during RT	1.21 (0.58-2.61) [.61]	1.05 (0.40-2.77) [.92]	1.54 (0.80-2.95) [.20]	0.96 (0.36-2.52) [.94]	1.47 (0.77-2.83) [.24]
Hospitalized for infection	18.8 (7.56-52.55) [<.0001]	4.50 (1.18-22.77) [.03]	0.83 (0.32-2.05) [.70]	3.50 (0.88-20.46) [.07]	1.05 (0.41-2.52) [.91]
Hospitalized for ARF	21.98 (4.83-159.06) [<.0001]	4.19 (0.65-83.99) [.15]	0.68 (0.17-2.29) [.54]	4.07 (0.58-88.44) [.18]	0.77 (0.18-2.64) [.69]
Hospitalized for dehydration	11.59 (4.92-29.37) [<.0001]	1.43 (0.45-5.11) [.56]	0.59 (0.24-1.38) [.23]	0.91 (0.31-3.09) [.88]	0.74 (0.31-1.67) [.48]
No. of hospital days[b]	na	na	na	1.07 (1.01-1.14) [.03]	0.97 (0.93-1.02) [.20]

ARF, acute renal failure; IVF, intravenous fluids; KPS = Karnofsky Performance Status; na, not applicable; RT, radiotherapy

[a]Although post-RT KPS and RT delays were significantly different between hospitalizations of ≥5 days and <5 days, these variables not included in the multivariate analysis for factors associated with hospitalizations as they would be effects of prolonged hospitalization and not causes. b The relationship between post-RT KPS and RT delays were assessed using total hospital days as a continuous variable in nominal logistic regression. Odds ratios are given as increased risk per day of hospitalization.

worse outcomes or whether patients who were predisposed to worse outcomes were also more likely to be hospitalized. Similar reports have demonstrated that prolonged hospitalizations correlated with increased mortality in patients with renal transplants[12] or sickle cell disease.[13] Our data suggests that prolonged hospitalizations may lead to worse functional status and increased treatment delays, resulting in worse overall survival and possibly disease control. In our study, the events precipitating hospital admissions, such as infections and renal toxicity, were not significantly associated with worse outcomes on univariate analysis suggesting that prolonged hospitalizations may have a direct impact on outcomes. At this point, our observations of prolonged hospitalizations and the subsequent impact on patient's

TABLE 4 Multivariate analysis of outcomes (N = 251)

	Hazard ratio (95% confidence interval) [P value]			
	LRC	TTF	PFS	OS
Hospitalized ≥5 days	1.85 (1.08-3.17) [.03]	1.64 (1.03-2.61) [.04]	1.52 (0.99-2.32) [.06]	1.48 0.85-2.54) [.16]
Post-RT KPS < 70	4.01 (2.00-7.54) [.0002]	2.92 (1.53-5.23) [.002]	3.44 (1.94-5.78) [<.0001]	3.79 (1.86-7.21) [.0005]
IVF during RT	1.71 (1.02-2.94) [.04]	1.70 (1.08-2.68) [.02]	1.45 (0.97-2.21) [.07]	1.57 (0.93-2.49) [.09]
RT delays (no delays referant)	0.93 (0.52-1.75) [.81]	0.71 (0.44-1.20) [.19]	0.63 (0.41-1.02) [.06]	0.65 (0.37-1.20) [.16]

IVF, intravenous fluids; KPS, Karnofsky performance status; LRC, locoregional control; OS, overall survival; PFS, progression-free survival; RT, radiotherapy; TTF, time to treatment failure

TABLE 5 Multivariate analysis of outcomes (N = 251)

	Hazard ratio (95% confidence interval) [*P* value]			
	LRC	**TTF**	**PFS**	**OS**
No. of hospital days[a]	1.01 (0.98-1.05) [.23]	1.03 (1.00-1.05) [.02]	1.03 (1.01-1.06) [.005]	1.04 (1.00-1.07) [.03]
Post-RT KPS < 70	4.43 (2.23-8.27) [<.0001]	3.10 (1.63-5.51) [.001]	3.69 (2.10-6.18) [<.0001]	4.07 (2.00-7.68) [.0003]
IVF during RT	1.73 (1.00-3.04) [.05]	1.84 (1.15-2.98) [.01]	1.66 (1.08-2.57) [.02]	1.79 (1.04-3.16) [.04]
RT delays (no delays referant)	0.86 (0.48-1.59) [.61]	0.70 (0.43-1.16) [.16]	0.64 (0.41-1.01) [.06]	0.66 (0.37-1.19) [.16]

[I]VF, intravenous fluids; KPS, Karnofsky performance status; LRC, locoregional control; OS, overall survival; PFS, progression-free survival; RT, radiotherapy; TTF, time to treatment failure

[a]Hazard ratios are given as increased risk per day of hospitalization.

functional status can only be hypothesis generating.

We also found that prolonged hospitalizations predisposed patients to worse performance status after radiotherapy as well as increased treatment delays. Radiation treatment breaks have long been associated with worse disease control in many anatomic sites, including the head and neck.[14] Although only 22% of patients who were hospitalized for <5 days required a treatment break, 41.9% of patients hospitalized for ≥5 days required a treatment break consistent with previous reports, indicating that hospitalizations were a major factor in RT interruptions.15 In addition, previous groups have also shown that prolonged bed rest due to lengthy hospitalizations was associated with cardiovascular, respiratory, and musculoskeletal changes, among others.[16-18] Here, we found that 15.1% of patients had decreased functional status after radiotherapy, which may be an indication of deconditioning with prolonged hospitalizations. Rehabilitative interventions and physical activity in cancer patients have been shown to improve functional status[19] and decrease hospitalizations.[20,21] Furthermore, patients undergoing radiotherapy were shown to have even greater functional gains with rehabilitation.[19] Therefore, it is interesting to speculate how rehabilitative interventions may decrease hospitalization stays and potential treatment delays to have a positive impact on outcomes.

This study remains limited, as with any retrospective review. First, we only have hospitalization records from our own institution and cannot account for hospitalizations during radiotherapy that occurred at outside facilities. If undocumented hospitalizations at outside facilities were a significant event, we would likely have observed more treatment delays in patients with shorter hospitalizations. Furthermore, we excluded 48 patients whom we deemed did not have sufficient records for us to be able to assess hospitalization. In doing so, we potentially biased the analyzed population to include more hospitalized patients because patients may have had more complete treatment records. Consequently, we cannot exclude that this bias may account for our increased rate of hospitalizations compared to other studies. Second, our treatment delays are greater than some previous reports,[3-5] yet are less than other reports of treatment delays in up to 45% of patients[15] supporting the impact of hospitalizations on treatment delays. Third, we chose hospitalizations of ≥5 days or <5 days based on the distribution of hospitalizations in our patient population. Nevertheless, the length of hospitalizations is likely a continuous risk factor with no absolute demarcation to indicate worse outcomes. In addition, our patient population had heterogeneous patient and treatment characteristics. Still, multivariate analysis did not indicate that these factors significantly impacted hospitalizations or outcomes. In addition, we cannot address whether hospitalizations caused or were just associated with a worse prognosis. Finally, we cannot account for interventions or admissions to nursing facilities that may have reduced the length of hospitalization in these patients. Nevertheless, if these interventions decreased hospitalizations, then such interventions may potentially improve outcomes and survival. Thus, while caveats remain, our observations are still consistent that prolonged hospitalizations during treatment impact the patient's functional status and subsequent outcomes.

In conclusion, we find that prolonged hospitalizations were associated with treatment delays, worse functional status and worse outcomes after radiotherapy for locally advanced HNSCCs. We speculate that prolonged hospitalizations lead to treatment delays and worse functional outcomes that predispose patients to worse disease control and survival. Furthermore, efforts to minimize hospital admissions and rehabilitative interventions during hospitalizations may help to decrease the detrimental impact of

prolonged hospitalizations. Thus, we propose that outpatient and inpatient efforts to reduce the lengths of hospitalizations during treatment may benefit patients undergoing aggressive treatments for head and neck cancers.

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