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Examination of care processes and treatment optimization for head and neck cancer patients in a community setting “hub and hub” model

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Abstract

Objective: To examine referral pattern, the timing of diagnostic/staging processes, and treatment initiation for new head and neck cancer patients in a community setting.

Methods: Patients with a newly diagnosed previously untreated diagnosis of head neck cancer managed at Asplundh Cancer Pavilion/Abington Memorial Hospital from October 2018 to March 2020. Source of referral and preceding workup were examined as well as intervals between initial head and neck consult and various timepoints of treatment initiation.

Results: One hundred and five patients were included in the study. The primary referral sources were external general otolaryngology (56.3%). Oral surgery and dermatology obtained tissue biopsy approximately 80% of the time before referral. The average time from the ordering of initial staging positron emission tomography/computed tomography to finalized results was 14 days (range: 10–25 days). Patients referred from dermatology and oral surgery were more likely to require single modality care, namely definitive surgical management. Time to treatment initiation average was 37 days (range: 29–41 days). Patients with longer treatment times noted significantly higher times to both radiation and medical oncology consults (48.42 vs. 18.13 days; $P < 0.001$).

Conclusions: No notable differences in treatment initiation times were identified based on referral source or extent of workup performed before head/neck surgery consult. It appears the largest opportunities for improvement in terms of reducing overall treatment length exist in the optimization of radiation initiation time.

KEYWORDS

head and neck cancer, package time, referral source, time to treatment initiation, total treatment length

Highlight

- Head/neck cancer, treatment initiation.

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INTRODUCTION

Head and neck squamous cell carcinoma (HNSCC) and primary head and neck salivary malignancies are typically aggressive malignancies that remain comparatively understudied.^{1,2} Treatment algorithms for institutions are commonly modeled after the National Comprehensive Cancer Network guidelines but this cohort has been historically challenging with known disparities in both treatment and clinical outcomes.^{3–7} Given the myriad of potential issues which may occur before, during, or after treatment which can be related to items such as speech, swallowing, disfigurement, malnutrition, tobacco/alcohol cessation, transportation, and/or financial concerns, a multidisciplinary team approach has been associated with improved clinical outcomes and is now commonplace at the majority of tertiary centers.⁸

Optimal time to treatment initiation (TTI) has been a focus of investigation in head and neck cancer with several studies noting detrimental effects on overall survival (OS) if treatment was not initiated promptly.^{9,10} The impact of total package time for HNSCC patients has been evaluated with meta-analysis noting a reduction in package time to benefit locoregional control and OS.^{9,11,12} While diagnosis to treatment initiation time, overall treatment package time, and timely initiation of adjuvant therapy are noted to be associated with survival there is considerable heterogeneity with what is considered the definition of delay in treatment initiation or prolonged package time.

Given the importance of timely treatment initiation, additional studies examining optimization of initiation, barriers, and causes of delay are warranted in this population. When changes are implemented in the delivery of cancer care within a health system, additional investigation is warranted to evaluate for the impact of those changes on the initiation and overall outcomes. As health systems further integrate care models, the impact on cancer care has not been well described. Two models which have been developed to increase horizontal and vertical integration of patients and providers within a health care system; the “hub and spoke” models (designed to redirect and centralize patients for care) and the “hub and hub” model (designed to expand health system footprint while developing multiple tertiary and quaternary care sites).¹³ Baseline descriptive studies are lacking which examine the impact of these models on treatment delivery as it relates to efficiency, cost, treatment initiation and package time, and detailed clinical outcomes.^{13–15} This study aims to examine the clinical processes at a newly developed community-based clinical site for head and neck cancer treatment, an example of a “hub and hub” model, at Sidney Kimmel Cancer Center at Thomas Jefferson University.

METHODS

Internal institutional review board approval through Thomas Jefferson University was obtained before the onset of this investigation (Control 20E.437). This study was a retrospective chart review of patients between October 2018 and March 2020 who were assigned a diagnosis of head and neck cancer and treated at Asplundh Cancer Pavilion/Abington Memorial Hospital, a community-based division of the Sidney

Kimmel Cancer Center at Abington—Jefferson Health. Abington Memorial Hospital has 665 beds, is a level—2 trauma center, had Magnet designation, and has approximately 30,000 inpatient admissions, and 500,000 outpatient visits annually. Radiation oncology, medical oncology, cytology/pathology, speech pathology, nutritionist, lymphedema therapist, and social work are located on site with the head and neck surgery clinic. Hundred percent of new cancer cases are presented at multidisciplinary tumor board.

During the initial chart review, 155 patients evaluated by the primary investigator (PI) for a new diagnosis of head and neck cancer were identified. The following patients were excluded: those with incomplete records regarding treatment, those who received therapy without curative intent, diagnoses of thyroid cancer or lymphoma, and those who sought definitive therapy external to the health system. One hundred and five patients met inclusion criteria. Demographics and clinical pathologic staging data were obtained and assigned according to the American Joint Commission on Cancer (Edition 8) staging system.

Given one of the goals of this study was to examine the patient source and referral patterns at a new community location, patients were subdivided into groups based on the type of referring provider and whether biopsy and/or staging scans had been completed before referral to head and neck surgery. In all cases in this study, the PI (head/neck surgeon) was the first member of the multidisciplinary team at Abington-Jefferson to evaluate the patient. This not only reflected typical patient flow but also allowed for further evaluation of time to consult with additional providers such as medical and radiation oncology. After the initial head/neck surgery evaluation, length of time was recorded for various clinical processes such as, from biopsy to finalized pathology, from pathologic diagnosis to positron emission tomography (PET) scan, from head neck surgeon evaluation to radiation/medical oncology consult, from surgery consult to definitive OR intervention, TTI, and package time.

Descriptive statistics were used to analyze demographic data in this study. Continuous variables were analyzed for normalcy, with *t*-tests and analysis of variance were used for normative data. χ^2 Analysis was used for categorical variables. Logistic and linear regressions were used to determine whether referral source, biopsy performed at outside location, or PET scan ordered before first visit with the PI affected time interval to initiation of treatment. Multivariate regression analysis was used to identify potential confounding variables such as age, ethnicity, gender. Statistical significance was defined as $p < 0.05$.

RESULTS

One hundred and five patients were included in the study. A total of 94.8% of patients identified as Caucasian while 4.2% identified as African American and 1.0% Asian (Table 1). Oropharyngeal neoplasms comprised the largest percentage of treated lesions (34.4%) followed by oral cavity lesions (22.9%) and cutaneous lesions (19.8%). Table 1 also reflects various histologies within the cohort and treatment modalities. Referral source data were available on 91% ($n = 96$) of patients, and five main referral pathways emerged: primary care provider, oral surgeon, otolaryngologist, dermatologist, and

TABLE 1 Referral source, demographics, subsite, histology (n = 96)

Characteristics	Frequency	Percent (%)
Referral source		
Primary care provider	20	20.8
Otolaryngologist	54	56.3
Oral surgeon	9	9.4
Dermatologist	6	6.3
Other provider	7	7.3
Race		
Caucasian	91	94.8
African American	4	4.2
Asian	1	1.0
Site		
Oral cavity	22	22.9
Oropharynx	33	34.4
Larynx	10	10.4
Hypopharynx	5	5.2
Skin	19	19.8
Salivary gland	4	4.2
Other	3	3.1
Histology		
Mucosal SCCA	71	74.0
Cutaneous SCCA	9	9.4
Melanoma	4	4.2
BCC	8	8.3
Carcinoma ex pleomorphic	1	1.0
Mucoepidermoid	2	2.1
Adenoid cystic	1	1.0

Abbreviations: BCC, basal cell carcinoma; SCCA, squamous cell carcinoma.

other (included external medical and radiation oncologist). The primary referral sources were external general otolaryngology (56.3%), followed by the primary care provider (20.8%).

As would be expected, the majority of dermatology referrals were skin malignancies, and the majority of oral surgery referrals were oral cavity carcinomas. Oral surgery and dermatology obtained tissue biopsy approximately 80% of the time before referral. In both otolaryngology and primary care referrals, the oropharynx was the most common subsite, 35.2% and 55.0%, respectively (Table 2). Referring otolaryngologists obtained tissue diagnosis of malignancy 50.0% of the time before referral, compared to primary care referrals which had biopsy confirmation 35.0% of the time. When a biopsy was needed for tissue diagnosis at the time of consult, the average time from biopsy to finalized pathology was 4 days. No dermatologist

or oral surgeon had obtained a staging PET/computed tomography (CT) before referral. Biopsy-proven patients referred from primary care were twice as likely to have a staging PET/CT already performed compared to patients referred from otolaryngology. The average time from ordering of initial staging PET/CT to finalized results was 14 days (range: 10–25 days).

Patients referred from dermatology and oral surgery were more likely to require single modality care, namely definitive surgical management, approximately 80% of the time (Table 2). TTI average was 37 days (range: 29–41 days; Table 3). Patients from primary care and otolaryngology referrals were more likely to require either nonsurgical or multimodality treatment, and this is reflected in increased comparative package and total treatment times (Table 3). Forty-nine percent of patients had a total treatment length greater than 100 days. This cohort included patients who underwent definitive nonsurgical management and patients requiring adjuvant therapy. Those with longer treatment times saw significantly higher times to both radiation and medical oncology consults (48.42 vs. 18.13 days; $P < 0.001$). For those who underwent definitive radiation therapy, those with treatment times greater than 100 days had an average time from head/neck consult to radiation oncology of 51.30 days compared to 15.05 days ($P < 0.001$). For patients who received adjuvant therapy those with treatment time over 100 days averaged 47.39 days from head/neck consult to radiation consult compared to 29.80 days ($P = 0.026$). Time to medical oncology consult for those with prolonged treatment time was 45.06 versus 12.78 days ($P < 0.001$).

DISCUSSION

This investigation provides novel insight into the referral and case distribution as well as treatment initiation patterns at a newly developed community-based academic-affiliated multidisciplinary head/neck oncology practice. Development of this practice and others like it is of particular relevance in terms of incorporation into both current and future healthcare delivery models which are both patient-centric in terms of location and further horizontally integrated. This practice functions as a “hub and hub” model within the Jefferson Health Enterprise which allows patients to undergo complex tertiary and quaternary level oncologic care locally and eliminate redirection to a single centralized point of care.

This study also examines in detail the average length of time associated with various clinical processes such as staging scans, pathology, OR scheduling, and other subspecialist referrals. When evaluating new patients based on the type of referrer in this particular cohort, one can see that for dermatology and oral surgery, these cases were typically managed definitively with surgery, and thus will inherently have shorter overall treatment times. This is opposed to primary care and otolaryngology referrals which more often received either definitive radiation/chemoradiation, or adjuvant therapy, and this will impact both package and overall treatment time. As a result, a direct comparison of the package and overall treatment times in this cohort is not significant, but meaningful information can be garnered

TABLE 2 Primary tumor subsite and prior workup based on referral source (n [%])

Characteristics	Referral source (n = 96)				
	PCP	OTO	OMFS	Derm	Other
Biopsy before referral					
No	13 (65.0)	27 (50.0)	2 (22.2)	1 (16.7)	2 (28.6)
Yes	7 (35.0)	27 (50.0)	7 (77.8)	5 (83.3)	5 (81.4)
PET before referral					
No	14 (70.0)	47 (87.0)	9 (100.0)	6 (100.0)	6 (85.7)
Yes	6 (30.0)	7 (13.0)	0	0	1 (14.3)
Primary site					
Oral cavity	3 (15.0)	9 (16.7)	8 (88.9)	0	2 (28.6)
Oropharynx	11 (55.0)	19 (35.2)	1 (11.1)	0	2 (28.6)
Larynx	3 (15.0)	7 (13.0)	0	0	0
Hypopharynx	0	5 (9.3)	0	0	0
Skin	1 (5.0)	11 (20.3)	0	5 (83.3)	2 (28.6)
Salivary	2 (10.0)	0	0	1 (16.7)	1 (14.2)
Other	0	3 (5.5)	0	0	0
Treatment modality					
Surgery	2 (16.7)	10 (21.7)	7 (77.8)	5 (83.3)	1 (14.3)
Radiation	0	7 (15.2)	0	0	1 (14.3)
Radiation + chemotherapy	2 (16.7)	15 (32.6)	1 (11.1)	0	2 (28.6)
Surgery + radiation	7 (58.3)	9 (19.6)	1 (11.1)	1 (16.7)	2 (28.6)
Surgery + radiation + chemotherapy	1 (8.3)	4 (8.7)	0	0	1 (14.3)
Immunotherapy + surgery	0	1 (2.2)	0	0	0

Abbreviations: Derm, dermatology; OMFS, oral/maxillofacial surgery; OTO, otolaryngology; PCP, primary care provider.

TABLE 3 Time intervals for various clinical timepoints

Time interval (days)	All groups	PCP	OTO	OMFS	Derm	Other
H&N to PET/CT	14.23	12.89	10.00	15.67	25.00	15.75
H&N to OR	21.81	29.80	20.03	20.78	16.50	11.60
Time to rad onc consult	27.31	43.75	30.56	22.00	14.33	30.42
Time to med onc consult	24.48	20.00	25.00	10.00	-	25.00
TTI	37.56	32.20	41.52	29.56	32.50	37.00
Package time	50.41	71.89	50.75	16.11	15.83	66.57
Total treatment	83.17	106.12	89.62	40.00	32.33	83.29

Abbreviations: CT, computed tomography; d, days; Derm, dermatology; H&N, head and neck surgeon consult; OMFS, oral/maxillofacial surgery; OR, definitive surgery; OTO, otolaryngology; PCP, primary care provider; PET, positron emission tomography; TTI, time to treatment initiation.

from the various entry points into the practice, and the clinical workup (biopsy, staging imaging, OR scheduling, radiation/medical oncology referrals, for e.g.) as it leads up to the treatment initiation will contribute to the treatment initiation and overall treatment time. These processes serve as numerous areas of focus for consistency of care and quality improvement.

Scott et al.¹⁶ noted in a survey of primary care providers that two-thirds of respondents were unsure of the correct otolaryngology subspecialist that dealt with various problems. Limited understanding of the various subspecialties in otolaryngology could potentially be the reason that a significant proportion of the patients referred to our institution were from general

otolaryngology over that of direct primary care referral. We also observed differences in the extent of workup of the patient before the referral, where in most cases referred by dermatology and oral surgery, no staging or cross-sectional imaging had been obtained. Primary care and otolaryngologists were less likely to have a tissue confirmation at the time of referral. This may be related to the high degree of clinical suspicion, desire for biopsy by specialist, or individual clinical workflow or comfort which may not accommodate for a biopsy prior. Interestingly, in the case of primary care referrals, patients with biopsy-confirmed malignancy were more likely to have PET/CT before referral than biopsy-confirmed patients from otolaryngology. While this additional workup before head/neck surgery consult may be beneficial, it may be at the expense of prolonged initiation time given that in this study the date of the head/neck surgery visit serves as the start date and workup by external provider before that date is not reflected in the time. One can estimate that at the primary care visit when presumed pathologic adenopathy is encountered, that a referral to schedule biopsy with interventional radiology is placed (often requiring labs first), followed by pathology finalization, then when confirmed, ordering and scheduling the staging PET/CT. This workflow may take several weeks. When one factor in cases that may be initially referred by primary care to general otolaryngology for further workup, by the time the patient presents to the head/neck clinic, the patient has seen three different providers before initiating treatment. Given the time associated with staging workups, it is easy to demonstrate the value of such quality improvement efforts as point of care biopsy with rapid adequacy, prompt pathology turnaround, and readily available clinic slots for head/neck surgery, radiation, and medical oncology clinic availability in terms of reducing initiation times.

Since the time of this study, an additional radiation oncology provider has been added to accommodate the influx of patients from this head/neck oncology practice given this was identified as an area for improvement in the prolonged treatment time cohort. Goel et al.¹⁷ noted the minimum threshold for package time before mortality risk begins to rise is less than 83 days. Adjusting for all measured factors, all patient averages within our study fell below this threshold, inferring no significant mortality risk as a result of delays in package time.

A limitation of this study is the heterogeneity, thus meaningful comparison of treatment initiation and package times of the cohort cannot be performed. Despite different subsite or histology, the majority of head and neck cancer patients share very similar initial workup with prompt biopsy, quick/reliable pathology turn around, prompt staging imaging, tumor board evaluation, and then either OR scheduling, or readily available radiation/medical oncology evaluation/treatment. Additional evaluations such as nutrition, speech pathology, dental, audiology are commonly occurring simultaneously. In the case of a p16 positive versus p16 negative oropharyngeal cancer patient for example, while staged differently, will have similar initial workup and thus we feel that it is appropriate for this analysis to consider these patients in the same

group given this is not a survival analysis. Particular patients treated with single modality therapy, particularly surgery, will inherently have shorter initiation, package, and overall treatment times. Given this, we found the more meaningful analysis to include the referral sources and prior workup as well as the timing associated with such items as time to PET/CT and finalized pathology which will be similar between all patients. In addition, patients who were treated with definitive radiation undergo very similar treatment initiation pathways in that a comparison for treatment time can be appropriate regardless of subsite or stage. One can argue against any combination of a cohort for comparison given that more advanced stage and higher acuity patients may be able to be moved through the system faster and result in reduced initiation times. While this may be true, these cases are more often the exception than the rule and while there are always ways to expedite care within the healthcare system, improved consensus as it relates to acceptable initiation/package/treatment times and what constitutes delayed/prolonged times for the majority of cases (which do not present acutely) is also equally needed.

CONCLUSION

Our results suggest that a comprehensive head and neck oncology program can be instituted in a community setting. In this study, referrals to the head/neck surgery clinic were noted to originate from multiple disciplines with varying degrees of imaging and/or biopsies. Given the initial staging, workup is quite similar for the majority of head/neck cancer patients, workflows that optimize new patient evaluation, rapid pathologic evaluation/results, prompt PET/CT scheduling, and coordination of timely consults with other members of the multidisciplinary team will benefit nearly all patients in terms of reduction in treatment initiation time regardless of subsite or stage. Given the known relationship between treatment initiation and survival, additional investigation is warranted as to how best to define standards and consensus as to what constitutes a treatment delay.

CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

ETHICS STATEMENT

This study has been approved by the Thomas Jefferson institutional review board.

AUHTOR CONTRIBUTIONS

Harleen K. Sethi: study design, acquisition of data, statistical review, manuscript preparation, final review. **Elijah Walker:** study design, acquisition of data, statistical review, manuscript preparation, final review. **Travis Weinsheim:** study design, acquisition of data, statistical review, manuscript preparation, final review. **Matthew J. Brennan:** study design, acquisition of data, statistical review, manuscript preparation, final review. **Christopher E. Fundakowski:**

study design, acquisition of data, statistical review, manuscript preparation, final review.

DATA AVAILABILITY STATEMENT

Study data is maintained in de-identified secure database.

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