HHS Public Access

Author manuscript

J Occup Environ Med. Author manuscript; available in PMC 2019 September 01.

Published in final edited form as:

J Occup Environ Med. 2018 September ; 60(9): e439–e444. doi:10.1097/JOM.0000000000001386.

Head and Neck Cancer in World Trade Center Responders: A Case Series

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Abstract

Objective—To report on cases of head and neck cancer (HNC) among World Trade Center (WTC) responders participating in the WTC Health Program and seen at Rutgers WTC Center of Clinical Excellence.

Methods—Medical records were abstracted by two clinical reviewers and discrepancies resolved. Cases were defined as WTC responders diagnosed with HNC between 9/12/2005 and 12/31/2016.

Results—Sixteen HNC patients met the case definition, most (13) arrived at the WTC location on 9/11 or within the following 2 days and half worked in law enforcement during the 9/1 response.

Conclusions—An association between HNC and WTC exposure is biologically plausible and should be further investigated. Research to enumerate the risk factor profile for these cancers may contribute to understanding mechanisms by which WTC exposure can contribute to carcinogenesis and to prevention and early detection strategies.

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Other support: none.

Authors' Conflict of Interest: None declared

INTRODUCTION

Excess of all cancer incidence was detected among 9/11 World Trade Center (WTC) exposed persons in 2008, only 7 years after the WTC-related exposures[1,2]. Excess cancer has been observed in each of the three longitudinally followed WTC-exposed cohorts: New York City Fire Department (FDNY), the New York City World Trade Center Health Registry at the Department of Health and Mental Hygiene (DOHMH), and the World Trade Center General Responder Health Program (WTC-HP)[1–4]. These registries conduct linkages with state-based cancer registries to determine and confirm cancer diagnoses. In all three cohorts, excess thyroid and prostate cancer incidences have also been observed. An excess of multiple myeloma was observed in in the DOHMH cohort among persons diagnosed in 2007 and 2008[5].

Excess cancer in WTC-exposed populations is biologically plausible because the many workers, volunteers, NYC residents, and visitors were exposed to a variety of airborne toxic environmental exposures, which included known human carcinogens including asbestos, pulverized cement, glass fibers, lead, polycyclic aromatic hydrocarbons, polychlorinated biphenyls, polychlorinated furans and dioxins[6,7]. The WTC dust remained suspended in the air for weeks and was constantly re-suspended by the ongoing recovery and cleanup work occurring on the pile, in residencies and business south of Canal street, and at the landfill on Staten Island where WTC-refuse was transferred. However, participation in a WTC monitoring program may result in early detection of some cancers, possibly leading to overestimated cancer incidence in younger age groups. Additionally, the WTC-HP has open enrollment and participation is voluntary. It is estimated that there are over 91,000 eligible participants[8]. As such, self-selection of symptomatic patients into this cohort might also create an overestimation of disease incidence.

To date, a statically significant excess of head and neck cancer (HNC) has not been identified in reports of WTC exposed populations but the possibility has been noted anecdotally[9]. HNC includes malignancies arising from the oral cavity, pharynx, and larynx (typically excluding salivary glands as the etiology differs from other HNC sites). A non-significant excess of oral and pharyngeal cancer was reported in the WTC-HP cohort in 2008 (SIR: 1.21, 95% CI: 0.75, 1.86)[2] and in the DOHMH cohort diagnosed after 9/11/2001 until Dec 31, 2006 (SIR: 1.13, 95% CI: 0.49 to 2.24), but not among responders diagnosed from 2007 to 2008 (SIR: 0.77, 95% CI: 0.25 to 1.80[1].) WTC–related exposure is a plausible contributor to HNC incidence because inhalation was the primary route of exposure. The dense concentration of suspended large, non-respirable airborne particles in the plume meant that those in the debris cloud resorted to mouth-breathing, intensifying exposure to the oral cavity. Furthermore, both chronic and acute occupational respiratory exposures are causally linked to HNC incidence, as are specific components of WTC dusts including dusts (e.g. wood dust), chemicals (e.g. formaldehyde) and fibers (e.g. asbestos)[10].

Head and neck cancer is rare in the U.S., with an average annual incidence of 11.0 per 100,000 men and women, making up only 2.8% of new cancer cases annually[11]. In the US, the median age at diagnosis for HNC is 64 years old, and these cancers are twice as likely in men as in women. The majority of these tumors are squamous cell carcinomas.

Approximately 75% of HNC, except for cancer of the salivary glands, are attributable to alcohol and tobacco use. However, among oropharyngeal (OP) squamous cell carcinoma[11]. However, up to 40 to 80% of newly diagnosed tumors are associated with infection with oncogenic types of the human papillomavirus (HPV), primarily HPV-16[12,13]. HPV-associated OP cancers appear to have distinct etiology, typically occurring among younger patients who are less likely to have smoked or consumed alcohol in excess before their diagnosis[14].

Under the James Zadroga 9/11 Health and Compensation Act of 2010, [H.R. 847], persons involved in the WTC rescue, recovery, and cleanup efforts may be eligible for benefits that include annual physical and medical examinations and coverage for medial and related expenses of health conditions considered ‘certifiable’ by the CDC’s National Institute for Occupational Health and Safety (NIOSH)[15]. Most solid tumors diagnosed 4 years or more after 9/11, including those of the head and neck, are on the list of possible certifiable conditions added in the Zadroga Act. The addition of many cancers to the list of WTC-Related Health Conditions was recommended by the WTC-HP Scientific/Technical Advisory Committee. The committee’s recommendation was due to the potential for exposure to approximately 70 known and potential human carcinogens during the event and the subsequent rescue, recovery and cleanup work. As well the committee recognized that the latency of many cancers is extended, often comprising decades[16].

The WTC-HP includes 5 Clinical Centers of Excellence (CCE) for responders. At one of these sites: The Rutgers WTC-HP CCE, a physician and coauthor of this manuscript (IU) observed what she believed to be an unusually high number of HNC diagnoses among WTC-HP cohort patients. We report here on the 16 histopathologically confirmed cases of HNC that were diagnosed after September 11, 2005 among WTC responders seen at the Rutgers WTC-HP CCE.

METHODS

Case definition

We conducted a retrospective chart review of the 16 WTC-HP members seen at the Rutgers WTC-HP CCE diagnosed with HNC between September 12, 2005 and September 11, 2016. We used ICD-10 codes to identify and classify the HNC cases into three anatomical subsites using standard ICD-O classifications: oral cavity, oropharynx and larynx.

Data fields and collection

WTC-HP cohort members are eligible to receive annual medical monitoring exams. Before the exam by the physician, patients complete extensive questionnaires about their health complaints, medical history, occupational history, mental health, risk factors, and WTC exposures (initial visit only). We created a chart abstraction instrument to collect information routinely collected during these monitoring visits, focused on risk factors known to increase risk for HNC development, as well as WTC exposure. For this preliminary case series we abstracted the following information: demographics (age at cancer diagnosis, sex, and race/ethnicity), history of cigarette and cigar use (ever, never, former and, when

available, pack- or cigar-years), alcohol use (duration and frequency), cancer specific information (anatomical site and stage at diagnosis), and WTC related exposure information (job during 9/11 recovery work, date of first on WTC location, location of WTC work [i.e. on pile/pit, adjacent to pile/pit, South of Canal St., and/or Landfill]).

Data were abstracted by 2 of the coauthors with a medical background (CC and CW). Abstractors reviewed the patients' WTC medical monitoring data collection forms, as well as their paper and electronic medical records housed at Rutgers WTC-HP CCE. Abstracted data were compared by a 3rd coauthor (JG) and discrepancies resolved by re-review of the relevant information and discussion among all authors. In two cases there was conflicting information with in a patient's chart regarding pack years of smoking. In those cases we reported pack-years as a range (e.g. 30 to 35 pack years).

Data analysis

We summarized the distribution of patient demographics, risk factors, and tumor characteristics. Because we observed that half the patients were age 50 or under, while in the US population the median age of diagnosis for these cancers is 64 years old, we further summarized the data by these two age groupings (≤50; >50). We grouped cancers anatomically by the frequency of occurrence in this case series as either oropharynx/nasopharynx or Laryngeal. We defined smoking status as current, former or never use of cigarette or cigars and to the extent possible characterized pack years among ever cigarette smokers. Heavy drinking was defined for men as >4 drinks on any day or 14 per week and for women as >3 drinks on any day or 7 per week[17].

This study was approved by the Rutgers Biological Health Sciences Institutional Review Board.

RESULTS

Demographic and clinical characteristics

Sixteen HNC patients were identified among the WTC HP cohort seen between 2005 and 2016 at the Rutgers WTC-HP CCE (Table 1). Almost all (n=15; 94%) were male and non-Hispanic white. The median age at diagnosis was 53 years old, ranging from 40 to 72 years. Half (n=8; 50%) of the 16 HNC patients were 50 years old or younger when diagnosed, all of whom were white males. The average age of patients diagnosed between 2005 and 2010 was significantly younger than those diagnosed in 2011 to 2016 (50.0 years (range 44 to 64) vs. 61.1 years (range 48 to 72; p=0.013).

All but one of the tumors were squamous cell carcinomas. Most (n=10; 63%) originated in the pharynx oral cavity and 5 in the larynx (Table 2). Among the patients diagnosed at age 50 or younger all but one tumor originated in the oropharynx. Among the 12 with stage at diagnosis documented, two-thirds (n=8) were stage IVA and the remaining were in stage I or II. Of the squamous cell carcinomas only 3 had a human papilloma virus (HPV) status determination in the pathology report.

Presenting symptoms varied: 7 (44%) were first detected by a mass noticed by the patients (6) or physician (1); for one patient a dentist detected a lesion. The remaining patients reported new onset of symptoms to their health care provider, including hoarseness (n=4), throat pain, palate numbness, and difficulty speaking. Treatment courses varied, with most (10; 63%) having undergone only a surgical intervention and just less than half (7; 44%) receiving both chemo and radiation therapy.

Risk factors and WTC exposure

Of the 16 case-patients, 3 (19%) smoked at the time of diagnosis and 8 (50%) were former smokers. One reported a history of excessive alcohol intake. Twelve (75%) case-patients arrived at the WTC disaster site on 9/11/2001 (n=7) or 9/12/2001 (n=5) during the time of peak acute exposures. Six patients worked on and 7 adjacent the pit/pile. Time between first and last day spent working with the WTC rescue and recovery effort ranged from 1 day to 9 months; for 75% (n=12) of the patients this was longer than 30 days. For 6 (38%) patients work/volunteer activities lasted for at least 7 months. Half (8) of the 16 case patients worked in law enforcement during their WTC service. The remaining 8 worked in variety of jobs including in telecommunications, health care, and construction industry.

Summaries of selected case-patients diagnosed

Patient #1 Caucasian male; worked in telecommunications during the 9/11 response—In summer of 2008, this patient developed a persistent sore throat and left ear pain. CT scan found a right tonsillar mass. Needle biopsy was consistent with the presence of moderately differentiated squamous cell carcinoma. Resection of the floor of the mouth and right tonsil, with right neck dissection revealed a 3.8 cm invasive, moderately differentiated squamous cell carcinoma of the right tonsil and base of tongue, invading into the submucosal muscle. Seven of 43 nodes were positive for carcinoma, one had extracapsular extension. HPV status was not documented. He completed adjuvant chemoradiation therapy for one month in late 2008. As of fall of 2016, his cancer was in remission; however, he has extensive dental damage, is unable to eat solid foods, has severe speaking disability, and marked facial asymmetry.

Patient age at diagnosis: 48

Tobacco use history: Former smoker (quit in 2007); 30 to 35 pack-years

Alcohol use: <1 drink per week

Patient #2 Caucasian male; worked in law enforcement during the 9/11 response—In 2012 the patient noticed a mass on the right side of his neck. Subsequent CT scan found right tonsillar mass. The right tonsillar mass was removed in October 2012. Pathology showed squamous cell carcinoma which tested positive for HPV. Residual cancer was noted in the cervical lymph nodes and stage IVA cancer was diagnosed. In 2015 cancer was noted and a right cystic supraclavicular mass was removed. The patients completed two rounds of high dose chemotherapy and radiation therapy. He is cancer free as of his January 2018 examination. At this time he reports several complications of his chemotherapy

including hearing loss (requiring hearing aids), problems swallowing, decreased ability to taste, and peripheral neuropathy of the legs.

Patient age at diagnosis: 58

Tobacco use history: Former smoker (quit in 2006); 18 to 30 pack- years

Alcohol use history: less than one drink per a week

Patient #4 Caucasian male; worked in law enforcement during the 9/11 response—In mid-2006, the patient identified a left neck mass. CT scan noted a mass with high fluid density with bilateral cervical. He underwent an excisional biopsy. Pathology was consistent with metastatic squamous cell carcinoma. Serial imaging studies in early 2008 noted multiple new cervical lymph nodes, with strong clinical suspicion for recurrent tumor, with asymmetrical left parapharyngeal uptake. He then underwent a direct operative microlaryngoscopy, bronchoscopy, and esophagoscopy. Pathology was positive for moderate to well-differentiated squamous cell carcinoma of the left lateral hypopharyngeal wall, staged at IVA. He completed radiation therapy to his neck in mid-2008. PET/CT scan performed in early 2009 noted patchy, bilateral tonsillar and parapharyngeal hypermetabolic activity. In mid-2009, he underwent repeat direct operative microlaryngoscopy, bronchoscopy, and esophagoscopy. Pathology of the left base of tongue and left lateral pharyngeal wall showed persistent poorly differentiated squamous cell carcinoma. He completed chemoradiation therapy in 2010. In 2014 PET/CT scan showed a suspicious cervical lymph node. Subsequent ultrasound-guided fine needle aspiration biopsy showed metastatic squamous cell carcinoma. The patient underwent left modified radical neck dissection in early 2014. Cervical lymph node positive for metastatic squamous cell carcinoma poorly differentiated with basaloid features in 3/25 lymph nodes. As of fall of 2016, no reported evidence of cancer recurrence.

Patient age at diagnosis: 46

Tobacco use history: none

Alcohol use history: 19 drinks per week

Patient #7 Caucasian male; worked in telecommunications during the 9/11 response—In the fall of 2005, the patient underwent a CT scan of paranasal sinuses as part of an evaluation for sinusitis. An incidental finding of a 3 × 3 × 3 cm nasopharyngeal soft tissue was noted. Pathology of the right tonsil and left nasopharyngeal mass noted a squamous papilloma and poorly differentiated malignant neoplasm consistent with undifferentiated nasopharyngeal carcinoma. In early 2006, he underwent a PET/CT scan, which found an abnormal hypermetabolic nasopharyngeal mass present with maximum SUV value up to 2.9, compatible with active tumor and abnormal left-sided superior cervical lymphadenopathy. The patient completed chemoradiation therapy shortly afterwards. Repeat whole body PET/CT scan in summer of 2008 was negative for cancer. The cancer was in remission as of 2012.

Patient age at diagnosis: 44

Tobacco use history: Current smoker; ~ 40 pack-years

Alcohol use history: No reported excessive alcohol use

Patient #13 Caucasian male; worked in law enforcement during the 9/11 response—In 2010 the patient sought care for a tender 2 cm left neck mass. He was unsuccessfully treated with an antibiotic. A CT scan of neck with contrast confirmed the presence of a 3.2 × 3.0 × 3.3 cm low-attenuation cystic mass in the left submandibular area. The patient then completed an ultrasound-guided aspiration and biopsy of the left submandibular mass. Pathology revealed a poorly differentiated squamous cell carcinoma. Subsequent PET/CT scan reported radiographic findings of "asymmetric focal hypermetabolic uptake in the left palatine tonsil, most likely representing malignancy, and hypermetabolic left level II a necrotic lymph node, consistent with known metastatic disease." In the same month, the patient underwent a left tonsil excision and left modified radical neck dissection. Pathology was consistent with the presence of "invasive moderately differentiated squamous cell carcinoma" of the left tonsil with 0.5mm positive margin and "metastatic squamous cell carcinoma in one out of 47 lymph nodes" stage IVA (T2N2A). The patient completed 2 months of chemoradiation therapy. PET/CT scan in early 2011 reported no radiographic evidence of abnormal focal hypermetabolism. The patient's cancer was in remission as of mid-2017.

Patient age at diagnosis: 50

Tobacco use history: Former (Quit ~2005): 12.5 pack-year smoking history.

Alcohol use history: 2 drinks per month

Patient #15 Caucasian male; worked in law enforcement during the 9/11 response—In early 2007, this patient's dentist noticed a lesion on the base of his tongue. Pathology from an ultrasound-guided fine needle aspiration confirmed squamous cell carcinoma. HPV was negative. The patient then underwent a tongue base resection and radical neck dissection. The patient completed radiation therapy for total of 32 sessions in the fall of 2007. The patient's cancer was in remission as of 2016.

Patient age at diagnosis: 40

Tobacco use history: Never

Alcohol use history: No reported excessive alcohol use.

DISCUSSION

In this case series, we report on 16 WTC-exposed case-patients who were diagnosed with HNC between 2005 and 2016 and had at least one monitoring visit at the Rutgers WTC-HP CCE. Most (13) arrived at the WTC location on 9/11 or within the following 2 days, and half worked in law enforcement during the 9/11 response. Half of the patients in this series were aged 50 years or younger, which may reflect the younger age of this occupational cohort. Cohort members diagnosed 8 years or more post-WTC exposure were on average older than those diagnosed in later years (mean age 61 vs. 50 years old).

HNC patients have a high risk of primary treatment failure and death. The average 5-year survival is 62% for OP cancer patients and 61% for laryngeal cancer[11]. Surviving patients are often left disfigured and at risk for depression, unemployment and suicide[18,19]. A significant proportion of patients have symptoms that persist for many years after treatment ends[20–22]. Surviving HNC patients often report sleep disturbances due to the other common adverse sequelae of the cancer or treatment, including anxiety, depression, and pain[21]. Patients also report a decline in quality of life including an increase in alcohol use even decades after completing treatment[23]. These psychosocial co-morbidities are more prevalent among WTC responders than the general population[24]. Given that the majority of the HNC patients in this case series had OP tumors and were younger on average than those in the general population, the possible role of HPV infection in cancer in this cohort should be explored.

Of note, HPV-associated OP cancer patients have a significant survival advantage over those patients with non-HPV related cancers. Oral infection with human papilloma virus is an established risk factor for some oropharyngeal cancers (OP), including tonsil and base of the tongue. In the general population, HPV infection is a strong positive prognostic indicator for infected OP cancer patients. However, the protective effect of HPV infections may be mitigated among OP cancer patients with WTC-exposure. A review of 87 WTC-exposed patients with OP cancer found that the number of WTC-exposed HNC patients has been steadily increasing since 2002 and that WTC-exposed patients with HPV-positive OP experienced significantly inferior outcomes compared with non-WTC exposed patients with HPV (OP disease free survival after 4 years: 80.1% vs. 65.6%, $p<0.04$)[9].

This case series raises the possibility that WTC exposure might contribute to carcinogenesis of the head and neck. However, the primary population risk factors for these cancers are tobacco and alcohol use, and for oropharyngeal caners, persistent infection with oncogenic types of HPV[14]. In our case series, 31% of cases were among never smokers, consistent with a case control study that report 27% of OP cancers and 13% of laryngeal cancers among never smokers[25]. In our case series, cancer among never smokers all arose from the tongue, possibly consistent with a unique etiology.

There is biological plausibility for an association between WTC exposure and HNC development because of the route of exposure (namely inhalation) and the nature of the exposures, i.e., direct exposure of the mucous membranes to all size particles and all of the airborne components of the debris. Both high-frequency acute exposures as well as chronic low dose exposures have been observed as plausible for one or more of these cancer sites. Furthermore, many occupational respiratory exposures have been associated with increased HNC risk, including wood, cement, and metal dusts (nasopharynx; nasal cavity, and paranasal sinuses)[26,27], formaldehyde (nasopharynx)[28], and asbestos (larynx)[27]. The Rutgers WTC-HP CCE is geographically removed from the WTC site and serves a relatively small proportion of the WTC general responder population. As such, the initial clinical observation of what was thought to be an unusually high number of cases of low incident cancers in a small population drove our investigation. It is possible that there are patient preferences among the WTC CCE, and that our clinic may see a disproportionate number of patients with more severe illness. Given our geographic distance from NYC though, we

think this an unlikely explanation. However, if there is a significant excess of HNC cases in the WTC HP member, it will become evident in the next 5 to 10 years, considering the usual latency of these tumors.

Pathways through which WTC exposure may influence HNC incidence include direct, moderating, and/or mediating effects. A direct effect could occur through genetic damage and/or epigenetic alterations to tissues exposed to WTC dusts and may also facilitate HPV infection and persistence. WTC exposure could also have a moderating effect such that it synergistically enhances the tumorigenic potential of another risk factor, such as tobacco exposure. In 2006, Moline et al. hypothesized that the multiple carcinogens within WTC exposures could themselves have synergistic effects and so increase cancer risk of WTC-exposed individuals[29]. Synergistic relationships between other occupational exposures and modifiable risk factors of HNC incidence have been reported. In a French population-based, case-control study of laryngeal cancer risk, the relationship between asbestos exposure and laryngeal cancer was more than additive among heavy smokers, (relative excess risk due to interaction (RERI)=8.50, 95% confidence interval (CI): 0.71, 23.81 [a RERI of >1 indicates synergism]), whereas effect of asbestos and alcohol consumption were not synergistic (RERI=4.75, 95% CI: 4.29, 11.12)[30].

The patients in this series are part of an ongoing health monitoring program, so increased detection of HNC, or diagnosis at a younger age, may result from patients seeking to join the monitoring program due to symptoms or diagnosis[4]. In addition, routinely attending monitoring visits may lead to a clinician's detection of suspicious findings upon examination that would otherwise go undetected. Our series includes patients from one of 5 WTC-HP CCEs some of which include multiple clinical sites. These patients may differ in terms of demographic and behavioral characteristics from other groups of WTC-exposed persons with HNC. Another limitation of this medical record review was missing information and the possibility of inaccurate data, especially smoking and alcohol history. In other settings, the completeness, validity, and reliability of smoking and alcohol use data collected primarily for health care and monitoring are limited. Such data are subject to misclassification, typically from under-reporting of ever smoking as well as the frequency and intensity of both alcohol and tobacco use[31,32].

A diagnosis of HNC is devastating, especially among WTC-exposed persons who live with the daily stress of current and/or possible adverse health outcomes resulting from their WTC exposures. Research to enumerate the risk factor profile for these cancers across cohorts in the WTC-HP is essential for HNC prevention and control in this vulnerable population and may contribute to understanding mechanisms by which WTC exposure can contribute to carcinogenesis. Further work to identify patterns of disease presentation, including presenting symptoms, should be undertaken to build the evidence base for early detection.

Acknowledgments

Funding sources: The research was supported in part by two grants from US Centers for Disease and Prevention (CDC), National Institute for Safety and Health (NIOSH), the World Trade Center Health Program [U100H008239 and U01OH011322] and the Occupational Safety and Health Education and Research Centers [T42OH008422].

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Table 1

Demographic, clinical, and WTC exposure characteristics of head and neck cancer patients at time of the cancer diagnosis

#	Dx Year	Age	Cancer site	Stage	Presenting symptoms	Occupation	Smoking Status	Heavy Alcohol?	Arrived 2001 WTC site	Time First to Last Day	Location of WTC RR Work
1	2008	48	Tonsil; tongue	IVA	Sore throat; ear pain	Telecomm.	Former	N	11-Sep	9 months	On and adjacent to pile/pit
2	2012	58	Tonsil	IVA	Neck mass	Law enforcement	Former	N	19-Sep	3 months	On and adjacent to pile/ pit; Landfill
3	2008	47	Tonsil	(IVA?)	Neck mass	Law enforcement	Former	Y	13-Sep	1 day	Adjacent to pile/pit
4	2006	46	Tongue; oral cavity	IVA	Neck mass	Law enforcement	Never	N	11-Sep	9 months	South of Canal St.
5	2010	62	Tonsil	IVA	Neck mass	Other	Former	Y	11-Sep	2 days	Adjacent to pile/pit
6	2012	72	Larynx	.	New onset of hoarseness	Construction	Former	N	17-Sep	9 months	Adjacent to pile/pit
7	2005	44	Nasopharynx	.	Sinus symptoms	Telecomm.	Current	N	11-Sep	9 months	Adjacent to pile/pit
8	2015	56	Larynx	I	New onset of hoarseness	Law enforcement	Current	N	12-Sep	4 months	Adjacent to pile/pit; Landfill
9	2013	48	Tongue	I	New oral lesion	Law enforcement	Never	N	11-Sep	9 months	Landfill
10	2007	49	Oral cavity	IV	Palate irritation	Construction	Former	N	12-Sep	2 months	On the pile/ pit
11	2012	68	Larynx	I	New onset hoarseness	Construction	Former	N	1-Dec	1 month	On the pile/ pit
12	2010	64	Larynx	II	New onset hoarseness	Law enforcement	Current	N	11-Sep	1 month	On the pile/ pit
13	2010	50	Tonsil	IVA	Neck mass	Law enforcement	Former	N	13-Sep	7 months	Landfill
14	2016	66	Larynx	IVB	Throat pain	Other	Former	N	11-Sep	2 days	Adjacent to pile/pit
15	2007	40	Tongue		Dentist noticed lesion	Law enforcement	Never	N	12-Sep	3 months	On the pile/ pit
16	2016	60	Tongue	IVA	Difficulty speaking	Other	Never	N	11-Sep	1 week	Adjacent to pile/pit

Table 2

Summary of demographic, clinical, and WTC exposure characteristics of head and neck cancer patients at time of the cancer diagnosis

	(n=16)	%
Age at diagnosis		
≤50 years	8	50%
>50 years	8	50%
Year of diagnosis		
2005-2008	6	37.5%
2009-2016	10	62.5%
Tumor site		
Oropharynx/Nasopharynx	11	68.8%
Larynx	5	31.3%
Stage at dx		
I/II	4	25.0%
IV	8	50.0%
Missing	4	25.0%
Histopathology		
Squamous cell	15	93.8%
How diagnosed		
Suspicious finding - Clinician	8	50.0%
Suspicious finding - Patient	8	50.0%
Surgical intervention		
Yes	10	62.5%
No	6	37.5%
Nonsurgical intervention (+/− surgery)		
Chemo and/or radiation	13	81.3%
Occupation		
Law enforcement	8	50.0%
Other	8	50.0%
Smoking status (cigarette/cigar)		
Current	3	18.8%
Former	8	50.0%
Never	5	31.3%
Arrival date at WTC worksite		
9/11	8	50.0%
9/12 or 9/13	5	31.3%
9/14 or after	3	17.8%
Location of WTC Work		
Any time on pile/pit	6	38.0%
Any time adjacent to pile/pit	7	44.0%
Other	3	18.8%