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Review

Head and neck oncology during the COVID-19 pandemic: Reconsidering traditional treatment paradigms in light of new surgical and other multilevel risks

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ABSTRACT

The COVID-19 pandemic demands reassessment of head and neck oncology treatment paradigms. Head and neck cancer (HNC) patients are generally at high-risk for COVID-19 infection and severe adverse outcomes. Further, there are new, multilevel COVID-19-specific risks to patients, surgeons, health care workers (HCWs), institutions and society. Urgent guidance in the delivery of safe, quality head and neck oncologic care is needed.

Novel barriers to safe HNC surgery include: (1) imperfect presurgical screening for COVID-19; (2) prolonged SARS-CoV-2 aerosolization; (3) occurrence of multiple, potentially lengthy, aerosol generating procedures (AGPs) within a single surgery; (4) potential incompatibility of enhanced personal protective equipment (PPE) with routine operative equipment; (5) existential or anticipated PPE shortages. Additionally, novel, COVID-19-specific multilevel risks to HNC patients, HCWs and institutions, and society include: use of immunosuppressive therapy, nosocomial COVID-19 transmission, institutional COVID-19 outbreaks, and, at some locations, societal resource deficiencies requiring health care rationing.

Traditional head and neck oncology doctrines require reassessment given the extraordinary COVID-19-specific risks of surgery. Emergent, comprehensive management of these novel, multilevel surgical risks are needed. Until these risks are managed, we *temporarily* favor nonsurgical therapy over surgery for most mucosal squamous cell carcinomas, wherein surgery and nonsurgical therapy are both first-line options. Where surgery is traditionally preferred, we recommend multidisciplinary evaluation of multilevel surgical-risks, discussion of possible alternative nonsurgical therapies and shared-decision-making with the patient. Where surgery remains indicated, we recommend judicious preoperative planning and development of COVID-19-specific perioperative protocols to maximize the safety and quality of surgical and oncologic care.

Introduction

The COVID-19 pandemic demands reevaluation of current treatment paradigms in head and neck oncology. Severe acute respiratory syndrome (SARS)-Cov-2 has caused 896,450 infections worldwide as of April 2, 2020 [1], results in severe or critical illness in 20–30% of cases and has a case-fatality rate ranging from 1.4% to 7.2% [2–4]. It disproportionately affects the elderly and individuals with comorbid conditions, which comprise a substantial portion of head and neck cancer (HNC) patients [5,6]. Indeed, the case-fatality rate of individuals >70 years of age has ranged from 8.0% to 22.5% [3,4]. Finally, a nationwide surge in COVID-19 hospital admissions is anticipated and threatens to overwhelm hospital capacity, with potential dire consequences for patients [3,4,7,8].

Surgery has been a longstanding, first-line treatment option for HNC. However, emerging data demonstrate that head and neck oncologic surgery may be less advisable, and in some circumstances, imprudent, due to a confluence of extraordinary, co-occurring, rapidly-

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evolving, COVID-19-related circumstances. Therefore, head and neck oncology treatment doctrines must be reanalyzed for the welfare of patients, providers, health care workers (HCW), health care organizations and society.

Barriers to safe head and neck oncologic surgery

There are now numerous, novel barriers to safe head and neck oncologic surgery. First, our ability to screen for and select COVID-19-negative patients for surgery is limited. Viral shedding and infection transmission occurs during incubation and the median incubation time of SARS-CoV-2 is five days [9,10]. Among COVID-19 positive patients who eventually develop symptoms, 99% will exhibit symptoms by day 14 [9]. Moreover, between 7 and 13% of COVID-19 patients are asymptomatic or minimally symptomatic [4] but may shed virus for weeks. Convalesced COVID-19 patients have exhibited prolonged viral shedding after complete symptom resolution [11]. Unsatisfactory SARS-CoV-2 testing also fails to adequately mitigate this problem. SARS-CoV-2 tests are insufficiently available and insufficiently sensitive. False negative test rates *in symptomatic patients* have ranged from 3 to 68% [12–14] but are more likely to be 16–24% according to the most highly-powered study to date (n = 1014) [15]. Investigators anticipate false negative test rates are likely to be highest near the beginning and end of the disease spectrum: in asymptomatic, infected patients and convalescing patients [16,17]. Ultimately, COVID-19 positive patients may even elude a two-week quarantine with negative SARS-CoV-2 testing.

Second, the virus replicates in the nasal cavity, nasopharynx and oropharynx, which are routine sites of head and neck surgery [18,19]. Even asymptomatic patients have exhibited high viral loads at these sites [18,19]. Third, SARS-CoV-2 is aerosolized, can remain airborne for at least three hours [20] and has been detected in airborne samples in the *hallways* of COVID-19 units [21]. Surgeries performed with general anesthesia involve multiple, routine aerosol-generating procedures (AGPs) such as bag-valve mask ventilation and intubation [22]. These AGPs have been associated with nosocomial infections during previous coronavirus epidemics [22,23]. Head and neck oncologic surgery often involves additional, formal AGPs such as nasogastric tube placement, tracheotomy, repeated endotracheal tube removal and replacement during total laryngectomy, and airway suctioning [22]. Routine use of cautery and suction in upper aerodigestive tract (UADT) surgery, such as transoral robotic surgery, is a continuous AGP. Cautery creates a plume of smoke often requiring constant airway suctioning to both facilitate visualization of the operative field and eliminate the odor of coagulated tissue. Additionally, post-extubation cough, cuff leak, inadvertent ventilatory circuit disconnection are common occurrences in HNC surgery and presumed to be aerosol-generating events (AGEs). Therefore, we submit that head and neck oncologic surgeries involving the UADT are *extraordinarily high-risk for SARS-CoV-2 viral aerosolization and transmission to operating room personnel* [22,23]. Although SARS-CoV-2 circulates in the blood of COVID-19-positive patients [11], there is inadequate data to assess the risk of viral aerosolization in routine, non-UADT oncologic surgeries such as neck dissections, parotidectomies or thyroidectomies.

Fourth, use of necessarily enhanced personal protective equipment (PPE) may significantly impair or even prohibit execution of routine head and neck oncologic surgeries. We are not aware of any evidence to guide decision-making in this regard. As an example, use of the DaVinci console during transoral robotic surgery (TORS) may be difficult with goggles and potentially impossible with powered air-purifying respirators (PAPRs). Use of goggles or a PAPR *with* loupes or an operative microscope for transoral laser microsurgery or microvascular anastomosis might also be challenging or impossible. Therefore, in circumstances in which enhanced PPE is necessary and use of routine operative equipment is not possible, selection of open surgical techniques for indicated oropharyngeal, hypopharyngeal or laryngeal cancers or regional- over free-tissue transfer may be necessary. These adjustments in surgical approach could result in compromised oncologic and functional surgical outcomes, presenting additional risk to patients.

Finally, many, if not most, hospitals have already described shortages in PPE [24]. Other hospitals are anticipating a surge of COVID-19 patients and corollary shortage in PPE [7]. Postoperative patients are highly likely to generate copious, aerosolized secretions for days to even weeks following surgery, which could present dramatic risks to additional HCWs and personal caretakers in the setting of insufficient PPE. In conclusion, given the substantial risks of operating during this pandemic, head and neck oncology patients should be judiciously selected for surgery.

Multilevel risks of head and neck oncologic surgery

The risks of head and neck oncologic surgery must be assessed in light of their potential impact on patients, providers and HCWs, and health care institutions and society. The benefits of continued provision of standard of care oncologic surgeries are commonsense and will not be discussed further below. Serial, frequent reassessment of risk will be necessary. For example, there is now at least one ongoing randomized controlled trial of hydroxychloroquine for post-exposure prophylaxis (NCT04308668), which hopefully will accrue quickly and read out soon. If this study is positive, it may open new avenues that allow head and neck surgery to proceed more safely.

Patients

There are several new patient-level risks of head and neck oncologic surgery. HNC patients are often elderly and/or exhibit multiple comorbidities specifically associated with increased risk for and adverse outcomes in COVID-19 patients, including hypertension, diabetes, coronary artery disease, and chronic obstructive pulmonary disease [5,6]. Patients may escape screening and undergo surgery with an ongoing asymptomatic or prodromal community-acquired COVID-19 infection. SARS-CoV-2 negative patients who undergo surgery will be at increased risk for nosocomial COVID-19 infection via contact, droplet or airborne SARS-CoV-2 transmission [25]. Surgical patients with community-acquired or nosocomial COVID-19 infections will be susceptible to magnified adverse outcomes, including perioperative mortality rates of up to 22.5% [4]. In a recent nationwide study of patients in China, patients with a history of cancer were more likely to become infected with COVID-19. COVID-19-positive patients with a history of cancer were more likely to require invasive ventilation with ICU admission or die (39%, n = 7/18) compared to non-cancer COVID-19-positive patients (8%, n = 124/1572, p = 0.0003) [26]. These findings are not surprising. For example, subclinical or clinical postoperative aspiration is expected in many postoperative HNC patients but could be catastrophic in the setting of COVID-19 pneumonia. Lastly, head and neck oncologic surgery patients often require blood transfusions. At this time, acute shortages in blood supply are anticipated necessitating appropriate patient selection along with potential modifications in preparation, planning and surgery [27].

Providers and health care workers

There are also several HCW-level risks of performing head and neck oncologic surgery at this time. First, the high risk of infection and death among HCWs during this pandemic is well-documented [3,4]. As previously discussed, performing surgery on an asymptomatic or prodromal COVID-19 patient that eludes preoperative screening could be the source of a catastrophic COVID-19 outbreak among HCWs. Anecdotally, such tragedies have already occurred in China and Iran. Second, at a time when social distancing is imperative to prevent COVID-19 transmission, a surgery and hospital admission will require ongoing, close staff-staff, staff-patient, staff-caregiver and patient-caregiver proximity – often for days or, not uncommonly, 1–2 weeks.

Third, there is insufficient data to guide the appropriate level of PPE use to prevent transmission of SARS-CoV-2 to operating room personnel, particularly during surgeries involving prolonged AGPs. Numerous guidelines report N95 respirators sufficiently protect against airborne disease, including COVID-19 [28–31]. However, these guidelines address appropriate PPE for limited AGPs performed in clinic, the ICU and, in one guideline, tracheostomies [30]. Therefore, we *cannot* extrapolate from these positions and *assume* that this level of PPE is also appropriate for surgeries in which *prolonged aerosol-generation within the UADT – sites of known viral replication – are routine.* The CDC specifically states that "for patients with known or suspected COVID-19" undergoing AGPs, "health care providers in the room should wear N95 *or higher-level respirators* [29]. During the SARS 2003 outbreak, the CDC acknowledged that N95 respirators were the "minimum level of respiratory protection required for HCWs…performing AGPs" and that "healthcare facilities in some SARS-affected areas routinely used higher levels of respiratory protection," such as PAPRs "for AGPs on patients with SARS-CoV disease." [32]. Therefore, there is urgent need for the publication of case reports or case series from areas with dense COVID-19 outbreaks regarding the level of respiratory protection required in these surgeries. The substantial uncertainty regarding the necessary level of PPE needed to safely execute these surgeries in unscreened, inadequately screened or even screened asymptomatic patients with false-negative tests represents a critical risk to all operating room staff.

Finally, HWCs caring for postoperative patients with UADT malignancies may perform numerous daily AGPs requiring substantial amounts of enhanced PPE. Patients undergoing a tracheostomy or laryngectomy routinely cough postoperatively and will need regular, AGPs such as open suctioning [33]. Most other patients undergoing UADT surgeries routinely perform aerosol-generating self-suctioning. Therefore, patients admitted with subclinical COVID-19 will present significant risk to providers and HCWs in the operative *and* postoperative settings.

Health care system and societal risks

Head and neck oncologic surgeries present additional risks to health care systems and society. The current trajectory of disease incidence in the United States suggest a nationwide surge in hospital admissions is imminent [7,8]. Further, China and Italy have reported: PPE, ventilator, hospital bed and ICU shortages [8,34,35]; conversion of operating rooms to ICUs [35]; construction of temporary hospitals [34]; and even health care rationing [35]. In worst-case, nightmarish scenarios that have occurred in Italy, health care providers will have to ration ICU admissions or ventilator use and, in effect, decline care to COVID-19 patients with likely fatal consequences [35]. Surgery and subsequent admission of head and neck oncology patients will compete for valuable, limited hospital resources in real-time during the pandemic [36]. Additionally, the possibility of head and neck surgical oncology-related COVID-19 outbreaks described above have the potential to temporarily or permanently decimate the health care workforce [3,34,35].

Reevaluation of head and neck oncology treatment paradigms

Overview

Novel barriers to safe head and neck oncologic surgery and corollary multilevel surgical risks necessitate urgent reevaluation of head and neck oncology treatment paradigms according to disease type and prior treatment. Traditional, standard of care treatments should be observed whenever reasonable. Deviation from the traditional standard of care may be appropriate or necessary in light of the current, extraordinary circumstances. These decisions are likely to be highly patient-, surgeon-, and institution-specific. For example, surgery may be impossible at institutions without available beds or ventilators. Therefore, in the context of the COVID-19 pandemic, *we recommend multidisciplinary assessment of multilevel surgical risk and alternatives to surgery for each case followed by shared decision-making with the patient.*

Multilevel surgical risk stratification during the COVID-19 pandemic

The collective multilevel risks of surgery vary according to patient-, HCW-, surgery- and post-surgery-specific factors and demand development of institutional risk-stratification protocols [37]. We describe a *potential example* of a risk-stratification algorithm in Table 1. Assessment of patient-specific factors should address: patient reliability; number of individuals in the household; number of daily patient exposures to other individuals; number of daily household individual-exposures to other people; patient or other COVID-19 exposures; ability to self-quarantine; access to SARS-CoV-2 testing; and symptoms of COVID-19 [38,39]. The importance of patient reliability cannot be overstated: a recent systematic review of 14 studies reported adherence to quarantine ranged from 0 to 93% [40]. Assessment of HCW-specific factors should account for: symptoms of COVID-19, COVID-19 exposure, access to adequate PPE and availability of routine HCW testing for SARS-CoV-2. Assessment of surgery-specific factors should address: risk and duration of aerosol-generating events and surgical involvement of the UADT. Assessment of post-surgery-specific factors should include: risk and frequency of postoperative AGPs, risk and duration of postoperative observation or admission along with risk and duration of postoperative transfer to a skilled nursing facility or long-term acute care facility.

Evaluation of COVID-19-specific, multilevel surgical risks will be necessary to make informed treatment decisions for head and neck oncology patients eligible for surgery. According to our example (Table 1), we *currently* assume that most HCWs will present high-risk of COVID-19 transmission to patients and each other given the possibility of an asymptomatic disease presentation, their high likelihood of COVID-19 exposure, known inadequate PPE and insufficient SARS-CoV-2 testing nationally (Table 1). We argue that multidisciplinary discussions should specifically attend to cases presenting high-risks of COVID-19 transmission during both surgery *and/or* post-surgery states in all patients – and particularly for high-risk patients. Practically, these high-risk designations will include most mucosal squamous cell carcinomas (SCCs) and sinonasal carcinomas along with ablations requiring regional- or especially free-tissue transfer. We review general head and neck oncology treatment considerations according to disease type, prior treatment, multilevel surgical risks and alternative therapies below.

Assessment of multilevel surgical risk and nonsurgical alternative therapies according to disease type and prior treatment

Primary mucosal SCCs traditionally eligible for surgery or definitive nonsurgical therapy

Primary surgery ± adjuvant therapy and primary radiation ± chemotherapy are long-standing, first-line treatment options for the majority of mucosal squamous cell carcinomas (SCCs). These therapies often exhibit equivalent oncologic outcomes with unique treatment toxicity profiles. Many of these cases will present high-risks of COVID-19 transmission during *and* after surgery. Therefore, for most of these patients, we *temporarily* favor selection of nonsurgical treatment over surgery wherein nonsurgical therapy is a first-line option. Nonsurgical therapy will facilitate primarily outpatient management of these patients. However, it will also present its own unique risks to patients and providers including: immunosuppressive chemotherapy [41], potential need for AGPs including open suctioning during outpatient visits, daily exposure to a radiotherapy center, and symptoms mirroring those of COVID-19 such as cough and sore throat. This recommendation will require frequent, serial reanalysis, especially after: SARS-CoV-2 testing shortages resolve; test validity improves; COVID-19-specific surgical screening, operative and postoperative protocols

Table 1
Example of a Potential Surgical Risk Stratification Algorithm Assessing Collective Risk of SARS-CoV-2 Transmission During the COVID-19 Pandemic Based on Low-Level Evidence.*

	Patient	Health Care Workers	Surgery**	Post-Surgery**
Low-Risk	Self-quarantines for 14 days with symptom diary *and* Negative SARS-CoV-2 test 0–2 days prior to surgery *and* Asymptomatic throughout quarantine and on the day surgery	Asymptomatic *and* Appropriate and adequate PPE *and* Routinely tested for COVID-19	AGEs: possible (e.g. cough) AGPs: no UADT: no Example: brief cutaneous procedure under local anesthesia without suction or oxygen supplementation	AGPs: not anticipated Observation or hospital admission: no or if yes, brief
Medium-Risk	Not applicable	Not applicable	AGPs: definite but likely limited UADT: no Examples: parotidectomy, thyroidectomy, neck dissection	AGPs: frequent *and* Observation or hospital admission: yes, brief Example: limited oral cavity cancer resection
High-Risk	Does not or cannot effectively self-quarantine for 14 days with symptom diary *or* Unable to obtain SARS-CoV-2 test *or* Any unexplained symptoms potentially consistent with COVID-19#	COVID-19 symptoms *or* Inappropriate or inadequate PPE *or* Not routinely tested for COVID-19	AGPs: definite, intense and/or prolonged UADT: yes Examples: tracheostomy, laryngoscopy, laryngectomy, TLM, TORS, oral cavity, sinonasal or otologic resections	AGPs: frequent *and/or* Hospital admission: yes, prolonged

AGE: aerosol-generating event; AGP: aerosol-generating procedure; TLM: transoral laser microsurgery; TORS: transoral robotic surgery.

* Frequent, serial re-evaluation of patient- and surgical-risk will be required, particularly with anticipated improvements in management of patient-level risk. *At the time of manuscript submission*: there is known COVID-19 community spread with unknown disease prevalence; 1% of patients develop symptoms 14 days after exposure; among patients who develop symptoms, SARS-CoV-2 incubates for a median of five-days during which time viral shedding occurs; ~15% of COVID-19-positive individuals are asymptomatic or minimally symptomatic throughout the course of their disease; ~20% of patients with COVID-19 will exhibit false negative SARS-CoV-2 tests. Therefore, there is justification for a conservative assessment of patient-risk for COVID-19. Despite this judicious approach, *a "low-risk" patient could still be COVID-19 positive*, particularly if the patient is not reliable, does not report breaches in quarantine or positive symptoms, or is asymptomatic with a false-negative test. Improved COVID-19 test sensitivity and faster specimen processing, analysis and result generation may be reasonably feasible and could substantially improve management of patient-level risk.

** Surgery- and post-surgery-specific risks may diverge according to this algorithm. For example, a patient undergoing a parotidectomy with neck dissection would present medium surgery-specific risk of COVID-19 transmission to operating room personnel and low-post-surgery-specific-risk of nosocomial COVID-19 or transmission to HCWs involved in postoperative care – assuming admission to a designated, COVID-19-free unit. A patient undergoing partial glossectomy for an early-stage oral cavity cancer and neck dissection without free tissue transfer would present high-surgery-specific risk of COVID-19 transmission to operating room personnel and medium post-surgery-specific risk of nosocomial COVID-19 or transmission to HCWs involved in postoperative care.

Cough, fever, shortness of breath, malaise, fatigue, headache, diarrhea, sore throat or rhinorrhea during quarantine or on the day of surgery

have been developed; PPE is replenished and readily available; hospital bed-, ICU- and ventilator-availability are acceptable; and/or COVID-19 prophylactics, treatments or vaccines have been secured [42–45].

There may be exceptions to this general rule, particularly when adjuvant therapy is not anticipated. Importantly, these exceptions assume availability of hospital beds, ventilators and appropriate PPE, and compatibility of PPE with operative equipment. According to our example in Table 1, a reliable, low-risk patient with a T1aN0 glottic or T1N0 tonsil SCC may present a one-time, high-risk of COVID-19 transmission intraoperatively to operating room personnel followed by medium-risk of COVID-19 transmission postoperatively. In such cases, the collective risks of a one-time surgery may be lower than the collective risks of daily presentation to an outpatient radiotherapy center for seven-weeks.

Primary and recurrent mucosal SCCs traditionally treated with surgery

Patients with primary oral cavity, T4a laryngeal and advanced sinonasal cancers along with recurrent UADT malignancies requiring salvage surgery represent the principal head and neck oncologic treatment quandaries of the COVID-19 pandemic. In low-risk patients with oral cavity or sinonasal cancers for whom a brief postoperative admission is anticipated, the collective benefits of primary surgery may easily outweigh the collective risks. However, select advanced sinonasal cancer and a majority of oral cavity cancer, advanced laryngeal cancer and salvage surgery patients will require a prolonged hospital admission and/or tracheostomy or laryngectomy and/or free-tissue transfer. Intraoperative and postoperative risk of SARS-CoV-2 transmission will be high in these settings. *For these patients, the collective, multilevel risks of surgery should be weighed against the risks of traditionally substandard, alternative therapies and their corollary perceived compromises in oncologic efficacy.* Primary surgery should remain the default treatment and should be chosen whenever reasonable. Conversely, multilevel surgical risks may sufficiently impair, or even prohibit, safe and efficacious surgery along with the safe care of patients postoperatively. In these circumstances, traditionally substandard alternative therapies discussed below may be preferable.

Despite the controversy surrounding its use independent of the COVID-19 pandemic [46,47], neoadjuvant chemotherapy ± cetuximab or neoadjuvant chemotherapy ± immunotherapy may be considered, in certain settings, at this time [48–51]. While induction chemotherapy does not have a role in the routine management of primary or recurrent mucosal SCC treated with surgery [52], it may provide symptomatic relief and effectively delay the need for surgery for a finite period of time. If a health care system has a legitimate target date to deliver safer surgical and postoperative care, systemic therapy may successfully buy enough time to allow the patient to receive the preferred radical surgical approach. Decisions to administer immunosuppressive therapy during a pandemic are complicated, though, since patients with occult SARS-CoV-2 infection would likely experience significant if not fatal complications from the disease [26,41]. Additionally, numerous trials are evaluating the use of neoadjuvant immune checkpoint inhibitors *without chemotherapy* prior to surgery (NCT03952585, NCT 02296684), thereby sparing patients from substantial chemotoxicity. Although systemic therapy without immunosuppression may seem attractive during a pandemic, there is insufficient evidence to guide the use of induction immunotherapy without chemotherapy for primary or recurrent, resectable mucosal SCC patients at this time.

In extenuating circumstances, primary radiation ± chemotherapy may be selected for oral cavity, T4a laryngeal or advanced sinonasal SCC patients. Patients opting for nonsurgical therapy must be aware of the inferior oncologic outcomes and anticipated increased morbidity of this treatment compared to primary surgery [53–58]. In certain salvage cases, definitive re-irradiation may be a reasonable alternative to surgery, particularly if the patient has experienced a prolonged disease-free interval. Re-irradiation ± chemotherapy preserves the possibility of cure, although with substantial concomitant treatment toxicity [59–61]. Among some patients who later fail re-irradiation, a durable disease-free interval may allow for surgical salvage when the COVID-19-specific risks of surgery have been mitigated.

Cutaneous, salivary and thyroid malignancies traditionally treated with surgery

According to our example in Table 1, surgery for most head and neck cutaneous, salivary and thyroid malignancies will present low- or medium-risk of SARS-CoV-2 transmission intraoperatively and postoperatively. Conversely, traditional surgery for certain patients may involve the UADT (e.g. minor salivary gland carcinomas) or free tissue transfer (e.g. temporal bone resection for a cutaneous or parotid malignancy). These patients may present high intraoperative and/or postoperative risk of SARS-CoV-2 transmission. Consequently, multidisciplinary evaluation of multilevel surgical risks and risks of alternative therapies of all cases alongside shared decision-making with patients will be necessary. Assuming adequate hospital-based resources, surgery will likely maintain a principal role in the management of most low-risk patients with cutaneous, salivary and thyroid malignancies. More prolonged delays in surgery may also be considered in certain scenarios. For example, a several-week surgical delay for a patient with a low-grade salivary carcinoma is unlikely to impact their oncologic outcome. Delay of surgery for several weeks, or even months, with serial imaging may be reasonable for some patients with conventional, well-differentiated papillary thyroid carcinomas [62,63].

In select patients, the COVID-19-specific multilevel risks of surgery may outweigh the benefits. In these cases, traditionally substandard, disease-specific alternative therapies may be considered. In patients with cutaneous SCC and basal cell carcinoma (BCC), the longstanding preference for primary surgery over primary radiation ± chemotherapy is based primarily on low-level evidence and patient convenience. Accordingly, patients with advanced cutaneous SCCs or BCCs could receive radical-intent radiotherapy. If not clearly curative, cemiplimab [64] or vismodegib [65] may be considered. Neoadjuvant use of cemiplimab or vismodegib have not been adequately evaluated [66], but may facilitate operative delays under extenuating circumstances. Similarly, there is limited evidence to guide the use of targeted biologic therapy alone in rare salivary gland carcinomas [67,68].

Proceeding with head and neck oncologic surgery during the COVID-19 pandemic

Consider a brief delay in surgery if possible

Urgent head and neck oncologic surgery will still be the best treatment option for many patients after evaluation of multilevel risks, multidisciplinary discussion and shared decision-making with the patient. In these circumstances, institutions may reasonably employ a short-term delay in all non-emergent oncologic surgeries to ensure appropriate patient screening and perioperative planning for patient and HCW safety. The National Comprehensive Cancer Network implicitly supports two centers which are temporarily delaying oncologic surgery during this crisis [36]. For example, the Huntsman Cancer Institute advised rescheduling all “time-sensitive” but non-emergent surgeries (i.e. have to be performed within 48 h) by a “few weeks.” [69] In this interval, surgeons and institutions should rapidly develop COVID-19-specific protocols to provide safe, quality surgical care for head and neck oncology patients.

Develop COVID-19-Specific perioperative protocols for head and neck oncology patients

Collective risk stratification protocol

As previously noted, surgeons and institutions should develop a COVID-19-specific collective surgical risk stratification protocol (Table 1) [37]. Despite a virtual vacuum of data, surgeons and

Table 2
Example of a Potential COVID-19 Pandemic-Specific Algorithm to Determine the Level of Necessary Respiratory PPE for Head and Neck Surgery Based on Low-Level Evidence*

	Low-risk surgery	Medium-risk surgery	High-risk surgery
Low-risk patient	Surgical mask N95-respirator	N95-respirator	N95-respirator PAPR (may be preferred, especially for prolonged AGPs)
High-risk patient	N95-respirator	N95-respirator PAPR	N95-respirator PAPR (may be strongly preferred, especially for prolonged AGPs)

AGP: aerosol-generating procedure; PAPR: powered air-purifying respirator; PPE: personal protective equipment.

* Frequent, serial re-evaluation of necessary surgical PPE according to patient- and surgical-risk will be required, particularly with improvements in management of patient-level risk. *At the time of manuscript submission*: there is reasonable justification for conservative PPE recommendations given the real possibility that a "low-risk" patient could still have COVID-19 (see Table 1, caption). Improved management of patient-level risk, such as improved SARS-CoV-2 test sensitivity, may allow for use of lower levels of PPE in the operating room.

institutions will need to establish algorithms dictating the appropriate level of PPE for head and neck surgery according to patient- and surgery-specific risk factors. We have provided an example of a possible algorithm based on low-level evidence (Table 2). Some studies have questioned the efficacy of N95-respirators against airborne threats and specifically state: respirators may insufficiently protect against aerosolized small viruses [70,71] and mask fit along with appropriate mask use are imperfect and prone to breaches in seal during routine clinical use [71,72]. Conversely, other studies have cited the advantages of PAPRs including nonsignificant reduction in viral transmission compared to N95 respirators [70] along with improved comfort, complete head and neck covering, and high-efficiency particulate air (HEPA) filtration [73–75]. According to another study, use of PAPRs protected 100% of operative personnel (n = 124) throughout 41 "high-risk" procedures (including 15 tracheostomies) in "SARS-related patients" during the 2003 outbreak [37]. Importantly, in this exercise we assume adequate PPE is available to all HCWs operatively *and postoperatively*. Access to PPE will need to be considered, and "contingency capacity" or "crisis/alternate" strategies may also need to be established [76]. In such circumstances, avoidance of surgery is preferred, especially for "high risk" patients, if possible.

COVID-19-specific preoperative planning and preparation

Institutions will also need to develop novel preoperative protocols. Given the high attack rate [77–79] and prolonged aerosolization of this virus [20], augmented infection control and containment training for OR, ICU and floor teams is necessary [73,80]. Teams should seek to minimize AGPs and limit the length of these procedures whenever possible. For example, anesthesia may consider avoiding bag-mask ventilation, employing rapid sequence intubation techniques, and applying intratracheal or intravenous lidocaine to avoid postoperative coughing [81,82]. Teams will also need augmented training in the appropriate use of respirators and enhanced PPE donning and doffing [80]. Surgeons will need to develop COVID-19-specific contingencies, such as preparing for anticipated shortages in blood supply [27]. Since indicated, enhanced PPE may be incompatible with the use of loupes, an operating microscope or the DaVinci console, surgeons should test the use of these devices with enhanced PPE prior to surgery.

COVID-19-specific postoperative protocols

Surgeons and institutions should also develop novel postoperative protocols for head and neck oncologic surgery patients. Limited low-level evidence from the SARS 2003 outbreak suggests these patients should be cared for in entirely separate units, or potentially even separate hospitals, from COVID-19 patients [83–86]. Head and neck oncology patients should have designated HCWs, paths for transport and rooms with appropriate ventilation systems [83–86]. Patients and providers should also be routinely tested for COVID-19 to prevent nosocomial patient infections [80].

Conclusion

The COVID-19 pandemic necessitates temporary modification of current head and neck oncology treatment paradigms. For a majority of patients with mucosal SCCs, we *temporarily* favor proceeding with radiation ± chemotherapy wherever oncologic outcomes are equivalent to surgery + adjuvant therapy. Where surgery is the traditional, exclusive standard of care, head and neck oncologists should evaluate the magnified, COVID-19-specific multilevel risks of surgery and risks of alternative therapies in the context of multidisciplinary discussion and shared decision-making. Despite the amplified risks, surgery will still be indicated for many patients and appropriate preparation will be critical to ensure the safety of the patient, provider and all other involved HCWs.

Declaration of Competing Interest

Baran Sumer discloses the following financial relationships with other organizations.

Co-founder, Consultant, Co-inventor of Patents

OncoNano Medicine Inc., Stocks, Stock Options, Consulting Fees
OncoNano Medicine Inc., Patent Royalties from Patents:
UTSD.P2560US.P1, Serial No. 61/620,774
UTSD.P3107US.P1
UTSD.P2822US.P1

Consultant

Intuitive, Consulting fee
Sanofi Genzyme, Consulting fee
Regeneron, Consulting fee
Cancer Expert Now, Consulting fee.

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