Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Original Article

Otolaryngology consultations for COVID-19 patients: A retrospective cohort study of indications, interventions, and considerations

Kunal R. Shetty[a,#,*], Brady J. Anderson[b,#], Jumah G. Ahmad[a], Lucy X. Liu[c], Kevin Chow[a], Samuel G. Erickson[d], Shohan Shetty[e], Amber U. Luong[a,f]

[a] *Department of Otorhinolaryngology–Head and Neck Surgery, McGovern Medical School, The University of Texas Health Science Center at Houston, Houston, TX, United States*
[b] *Department of Otolaryngology–Head and Neck Surgery, The University of Iowa Hospitals and Clinics, Iowa City, IA, United States*
[c] *Department of Otolaryngology–Head and Neck Surgery, LSU Health Shreveport, Shreveport, LA, United States*
[d] *Department of Otolaryngology–Head and Neck Surgery, The University of Oklahoma Health Sciences Center, Oklahoma City, OK, United States*
[e] *Washington University in St. Louis, St. Louis, MO, United States*
[f] *Center for Immunology and Autoimmune Diseases, Institute of Molecular Medicine, McGovern Medical School, The University of Texas Health Science Center at Houston, Houston, TX, United States*

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ABSTRACT

Objective: To identify differences in inpatient otolaryngology consultations and interventions for patients based on COVID-19.
Methods: Records were reviewed for all patients for whom otolaryngology was consulted at a high-volume tertiary care hospital from April 30, 2020 to October 1, 2020. Demographic information, length of stay, COVID-19 status, indication for consultation, and otolaryngology interventions were recorded. Statistical analysis was performed using R software.
Results: Bleeding composed a significantly higher proportion of otolaryngology consults in COVID-19 positive patients (28% vs. 8.4%, $p<0.0001$). Management of bleeding was the most common procedure performed in positive patients (n=37, 35%), and they had a higher median number of interventions performed when compared to bleeding patients who tested negative (1, IQR 1-2 vs. 1, IQR 0-1, $p=0.04$). COVID-19 positive patients with bleeding were more likely to expire than those with other indications for otolaryngology consultation (50% vs. 7%, $p<0.001$).
Conclusion: Bleeding and associated interventions comprised the predominant discrepancy between COVID-19 positive and negative patients in our cohort. We encourage routine use of simple and cost-effective methods to decrease risk of bleeding.

1. Introduction

The Coronavirus SARS-CoV-2 (COVID-19) pandemic devastated communities and healthcare systems around the globe, with over 449 million cumulative confirmed cases worldwide and a death toll upwards of 5.9 million [1]. Healthcare professionals modified routines and procedures to protect

* Corresponding author at: Department of Otorhinolaryngology–Head and Neck Surgery, University of Texas McGovern Medical School, 6431 Fannin Street, MSB 5.036, TX, United States.
E-mail address: kunal.r.shetty@uth.tmc.edu (K.R. Shetty).
# These authors contributed equally to this work.

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themselves, with a cross-sectional multi-institutional survey of 55 otolaryngology departments across North America revealing near-universal (n = 53 of 55, 96.3%) cancellations of elective cases at the height of the pandemic [2]. With these fluctuations in cases and responses, otolaryngology attendings and residents have continued to operate and take call across the country, with inevitable exposure to patients confirmed or under investigation for COVID-19 [2,3]. Although otolaryngologic symptoms of COVID-19 such as olfactory dysfunction, sneezing, and nasal congestion have been well-characterized to date [4], there remains a paucity of literature documenting inpatient trends of otolaryngology consults since the onset of the pandemic, with the few published studies demonstrating variable changes in consult patterns [5,6].

Only one case series and one small cohort study have addressed the issue of oropharyngeal bleeding requiring management by otolaryngology services [7,8]. In response to high rates of thrombotic events observed among patients with COVID-19, therapeutic dosing of anticoagulants was widely adopted as standard treatment, despite the inherently increased risks of bleeding [9–11]. As such, the overall bleeding rate in hospitalized COVID-19 patients is estimated at 2-5%, with a proportion accounted for by upper airway bleeding [8]. Recent findings have questioned the utility of therapeutic anticoagulation in improving overall survival in patients with severe cases of COVID-19, shifting the focus instead to the potential morbidity of this practice [12].

The observed high numbers of interventions for oropharyngeal bleeding in patients with severe COVID-19 infection, in light of new data challenging the benefit of therapeutic anticoagulation [12], prompted this single-institution study of inpatient otolaryngology consult rates based on COVID-19 status. In particular, we sought to determine whether patients with COVID-19 were more likely to require otolaryngology consultation for bleeding than patients without COVID-19, and if they would require a greater frequency of interventions to control their bleeding.

2. Methods

2.1. Ethical Considerations

This study was approved by the Committee for the Protection of Human Subjects of the University of Texas Health Science Center at Houston (IRB: HSC-MS-20-0970). Study participants provided written informed consent.

2.2. Study Design

This was a single-institution retrospective cohort study encompassing all patients with otolaryngology consults at a high-volume, tertiary care hospital, from April 30, 2020 to October 1st, 2020. Data on demographics, COVID-19 status, consult indication, length of stay, and interventions were collected.

2.3. Study Population

All patients for whom otolaryngology was consulted from April 30, 2020 to October 1, 2020 were included. We excluded patients with planned inpatient stays following scheduled operations. COVID-19 status was defined by test results dated within 14 days before or after consultation. Patients were also considered positive if they were being actively treated for COVID-19 related pneumonia or respiratory failure, even if their positive date was more than 14 days before consultation. Receipt of therapeutic anticoagulation was based on protocols established by the intensive care unit or hematology services and was variable. Typically, this involved heparin infusions or daily enoxaparin administration.

2.4. Stratification

Consultations were divided into 12 categories. Trauma included patients evaluated for facial trauma, temporal bone and laryngeal fractures, and traumatic injury to local structures (e.g. facial nerve, parotid duct, etc). Infections included peritonsillar abscess, cellulitis of the head-and-neck, Pott's puffy tumor, epiglottitis, parotitis, and sialadenitis. Bleeding included epistaxis and oropharyngeal hemorrhage. Otologic evaluations included otitis, mastoiditis, hearing loss, vertigo, and infections of the auricle. Post-operative consultations included post-tonsillectomy hemorrhage, loosening of hardware (e.g. mandibulomaxillary fixation devices), and concerns for surgical site infection. Rhinologic evaluations included sinusitis, cerebrospinal fluid leaks, and pituitary masses. Tracheostomy management included consults for placement, accidental decannulation, exchanges, and bleeding from tracheostomy. Head-and-neck masses included consults to investigate suspicions for malignancy, known head-and-neck malignancy, and benign endocrine masses. Airway evaluation included consults that required an assessment of the upper airway secondary to concerns for airway compromise or active stridor that were not secondary to foreign body obstruction. The dysphonia category included consults involving an assessment of the upper airway in patients with altered phonation. Foreign body consults involved an airway evaluation if there was suspicion or known foreign object causing obstruction. Consults for dysphagia were undertaken for patients with concern for aspiration or inability to tolerate oral intake.

Bedside laryngoscopy was performed using a flexible fiberoptic laryngoscope to evaluate consults including dysphonia, dysphagia, foreign body evaluation. Dressing and packing of infectious or post-surgical wounds was undertaken using iodoform quarter or half-inch packing strips and Kerlix (Medline, Illinois, USA) gauze bandage rolls. Management of bleeding in the oropharynx entailed saline or tranexamic acid-soaked Kerlix (Medline, Illinois, USA) gauze bandage rolls. Nasopharyngeal bleeding management involved the application of gelatin absorbable Surgifoam (Ethicon, New Jersey, USA) sponges wrapped in Surgicel (Ethicon, New Jersey, USA) and soaked in oxymetazoline which were placed in the nasal cavities to obtain hemostasis. At our institution, facial laceration closure was rotated between the otolaryngology, plastic surgery, and oral and maxillofacial surgery services. Tracheostomy management includes tracheostomy changes and replacement with flexible laryngoscopy to evaluate for tube/cuff displacement, patency, or post-tracheostomy posi-

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Table 1. Patient Demographics and Insurance Status. P-values represent associations among all three COVID-19 statuses, (chi-square for categorical, df=2; Kruskal-Wallis for numerical). P-values for significant associations using COVID-19 statuses as binary variables (df=1) are included in the text.

	Total (n= 1089)	COVID-19 positive (n=57, 5%)	COVID-19 negative (n=693, 64%)	Untested (n=339, 31%)	P-value
Male	662	37 (5.6%)	417 (63%)	208 (31%)	0.9
Median Age, yrs (IQR)	41 (23, 61)	41 (25, 57)	44 (21, 61)	38 (24, 60)	0.9
Non-Hispanic White	405	7 (2%)	269 (66%)	129 (32%)	<0.001
Hispanic	314	32 (10%)	176 (56%)	106 (34%)	<0.0001
Non-Hispanic Black	302	17 (5.6%)	199 (66%)	86 (28%)	0.6
Asian	41	0 (0%)	32 (78%)	9 (22%)	0.15
Inpatient	732	51 (7.0%)	574 (78%)	107 (15%)	
Emergency Department	357	6 (1.7%)	119 (33%)	232 (65%)	<0.0001
Med LOS, (IQR)	2 (1, 10)	13 (2, 43)	5 (2, 13)	1 (0, 1)	<0.0001
Intervened	708	38 (5%)	454 (64%)	216 (31%)	0.6
Med # Procedures (IQR)	1 (0,1)	1 (0,1)	1 (0,1)	1 (0,1)	0.02
Private Insurance	357	18 (32%)	221 (32%)	118 (35%)	0.7
Medicaid	241	17 (30%)	167 (24%)	57 (17%)	0.02
Medicare	225	8 (14%)	153 (22%)	64 (19%)	0.3
Self-pay	207	12 (21%)	113 (16%)	82 (24%)	0.02
Other	59	2 (4%)	39 (6%)	18 (5%)	0.9

IQR = interquartile range, LOS = length of stay.

tioning. Routine tracheostomy care was performed by respiratory therapists and was not tabulated. Incision and drainage occurred most frequently for management of peritonsillar abscesses. Drainage of other cutaneous abscesses of the head and neck as well as simple hematoma evacuation were similarly performed bedside. Fine needle aspiration and biopsy was undertaken for masses and nodules requiring pathologic diagnosis. Rigid nasal endoscopy entailed the use of a 0-degree scope for an intact nose and a 30-degree scope for a post-surgical evaluation or evaluation of cerebrospinal fluid leak. Closed reduction of facial fractures included those of the mandible and nasal bones and were typically performed in the emergency department. There was no uniform protocol or instrumentation for foreign body removal in the airway. Other bedside interventions included wick placement for otitis externa, lingual frenectomy, and wound vacuum placement.

Procedures requiring intervention in the operating room were diverse and included tracheostomy, direct laryngoscopy, hematoma evacuation, complex abscess incision and drainage, complex laceration repair, endoscopic sinus surgery, and transsphenoidal hypophysectomy among others.

2.5. Statistical Analysis

Statistical analysis was performed using R [13–15]. Chi-square was used to test the null hypothesis that demographic factors, consult indications, and interventions performed were independent of the three COVID-19 statuses (positive, negative, and untested), df=2. Variables in which the null hypothesis was rejected ($p<0.05$) were examined further with chi-square using each COVID-19 status as a binary independent variable (e.g. positive vs. all others) to identify significant associations, df=1. Fisher's exact test was used for variables with observation counts less than five. Tables display the p-value calculated for the initial analysis among all three groups; p-values for further binary analysis within individual groups are included in the text. P-values for all comparisons were adjusted using the Benjamini-Hochberg (BH) method to control the false discovery rate (FDR) [16]. Tables and in-text p-values reflect the lowest acceptable FDR at which the null hypothesis could be rejected, and associations considered significant. We rejected all null hypotheses in which the FDR was equal to or less than 0.05.

Shapiro-Wilks test was used to test normality of numerical variables. Medians were used to evaluate statistical significance of non-normal numerical variables. Kruskal-Wallis ANOVA was used to test the null hypothesis that there was no difference in medians among the three groups. Numerical values exhibiting significant differences among the three groups were then examined using pairwise tests for medians (positive vs. negative, positive vs. untested, and negative vs. untested), with p-values adjusted using the BH method.

3. Results

Of 1,089 otolaryngology consults completed during the period of interest, 693 (64%) were negative, 57 (5%) were positive, and 339 (31%) were untested for COVID-19. Six hundred and sixty-one (61%) were male, and the median age was 41 years (23 – 61 years) (Table 1). Shapiro-Wilks test revealed that none of the measured variables exhibited normal distributions. Analysis of demographic factors revealed an association with race (p=0.001; Table 1), however, investigation into insurance status yielded no association with positive COVID-19 status. Breakdown of consultation proportions by COVID-19 status is demonstrated in Fig. 1.

Bleeding composed a significantly higher proportion of consults in positive patients than all others (28% vs. 8.4%, $p<0.0001$; Table 2; Fig. 1). As such, bleeding management was the most common procedure performed for patients testing positive (n=37, 35%; Table 3). COVID-19 positive patients with bleeding had a higher median number of inter-

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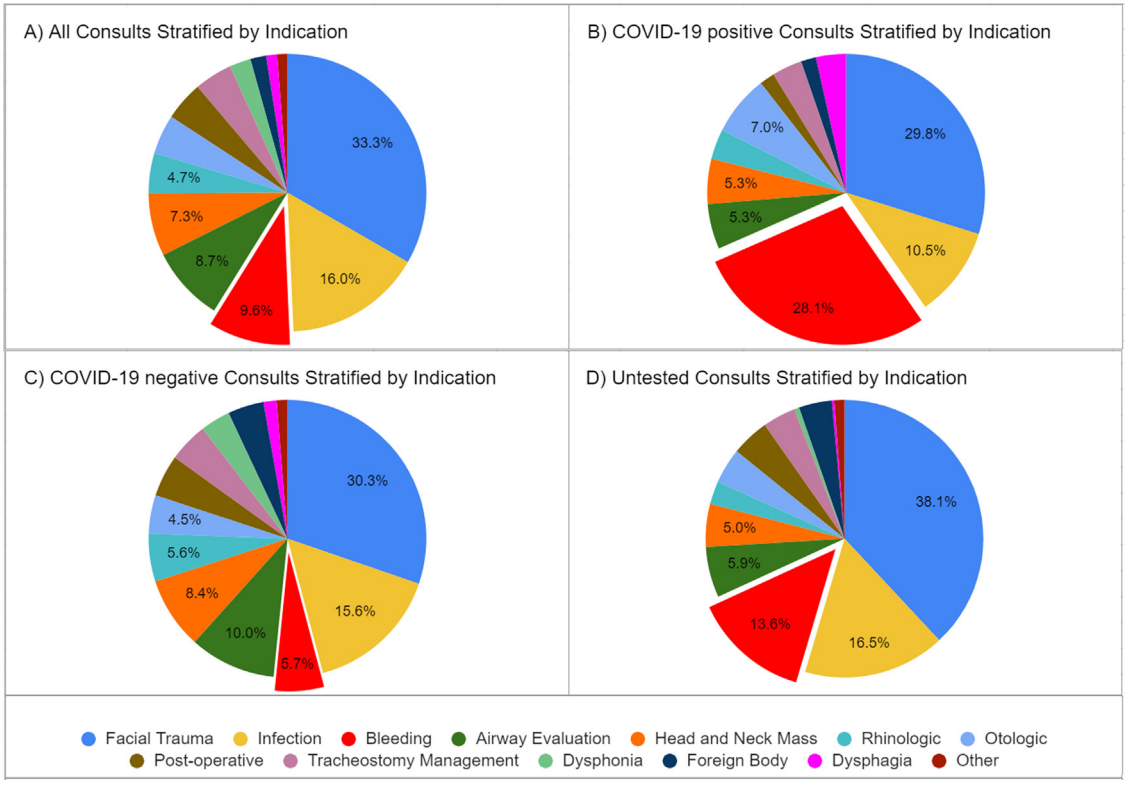

Fig. 1. Otolaryngology consults stratified by indication in A) all consults, B) consults on COVID-19 positive patients, C) consults on COVID-19 negative patients, and D) consults on patients untested for COVID-19.

Table 2. Indications for Consultation. P-values represent associations between all three COVID-19 statuses, (chi-square for categorical, df=2). P-values for significant associations using COVID-19 statuses as binary variables (df=1) are included in the text.

	Total (n=1089)	COVID-19 positive (n=57, 5%)	COVID-19 negative (n=695, 64%)	Untested (n=339, 31%)	P-value
Facial Trauma	363	17 (4.7%)	217 (60%)	129 (36%)	0.13
Infection	174	6 (3.4%)	112 (64%)	56 (32%)	0.6
Bleeding	103	16 (16%)	41 (40%)	46 (45%)	<0.0001
Airway Evaluation	95	3 (3%)	72 (76%)	20 (21%)	0.07
Head and Neck Mass	80	3 (3.8%)	60 (75%)	17 (21%)	0.14
Rhinologic	51	2 (3.9%)	40 (78%)	9 (17.6%)	0.10
Otologic	50	4 (8%)	32 (64%)	14 (28%)	0.6
Post-operative	51	1 (2%)	35 (69%)	15 (29%)	0.04
Tracheostomy Management	48	2 (4.2%)	33 (69%)	13 (27%)	0.9
Dysphonia	27	0 (0%)	25 (93%)	2 (7.4%)	0.01
Foreign Body	20	1 (5%)	6 (30%)	13 (65%)	0.01
Dysphagia	14	2 (14%)	11 (78%)	1 (7.1%)	0.08
Other	13	0 (0%)	9 (69%)	4 (31%)	

ventions performed than bleeding patients who were untested or tested negative (1, IQR 1-2 vs. 1, IQR 0-1, p<0.0001; Table 2; Fig. 2). After excluding consults from the emergency department, this difference held true (1, IQR 1-2 vs. 1, IQR 0-1; p=0.001). Twenty-three (40%) of 57 COVID-19 positive patients for whom otolaryngology was consulted had received therapeutic anticoagulation (TA) up to the day prior to consultation. TA was associated with consultation for bleeding, as otolaryngology was consulted for bleeding in 15 of the 23 COVID-19 positive patients receiving TA but only for one of the 34 COVID-19 positive patients not receiving TA (65% vs. 7%, p<0.0001).

COVID-19 positive patients had longer median lengths of stay than negative and untested patients (13 days, IQR 2-43 vs. 2 days, IQR 1-9, p<0.001; Table 1, Fig. 3). Of the 57 positive patients, 11 (19%) expired during their hospitalization. Nine (81%) died of respiratory failure due to COVID-19. Of the remaining two, one suffered from a subarachnoid hemorrhage while the other succumbed to a mixed cardiogenic-septic shock; both had also developed hypoxic respiratory failure and received therapies targeting COVID-19. Of the 16 COVID-19 positive patients for whom otolaryngology was consulted for bleeding, 8 died (50%). This was a significantly higher rate than positive patients for whom otolaryngology

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Table 3. Procedures Performed. Mean procedures per patient are provided. However, p-values were calculated using non-parametric Kruskal-Wallis test due to a non-normal distribution.

	Total (Mean/per patient)	COVID-19 positive (n=57)	COVID-19 negative (n=695)	Untested (n=339)	P – value (Kruskal-Wallis)
	1,117	100 (1.75)	759 (1.09)	258 (0.76)	0.02
Bedside					
Laryngoscopy	262 (0.24)	15 (0.26)	201 (0.29)	46 (0.14)	<0.001
Dressing/Packing	146 (0.13)	18 (0.32)	103 (0.15)	25 (0.07)	0.13
Bleed Management	109 (0.10)	37 (0.65)	32 (0.05)	40 (0.12)	<0.0001
Laceration Repair	111 (0.10)	4 (0.07)	59 (0.08)	48 (0.14)	0.03
Tracheostomy Management	91 (0.08)	11 (0.19)	70 (0.10)	10 (0.03)	0.03
Incision and Drainage	73 (0.07)	1 (0.02)	32 (0.05)	40 (0.12)	<0.0001
Fine Needle Aspiration and Biopsy	31 (0.03)	0 (0)	21 (0.03)	10 (0.03)	0.5
Nasal Endoscopy	23 (0.02)	2 (0.04)	18 (0.03)	3 (0.01)	0.2
Closed Reduction of Facial Fracture	13 (0.01)	0 (0)	6 (0.01)	7 (0.02)	0.2
Foreign Body Removal	9 (0.008)	0 (0)	3 (0.004)	6 (0.02)	0.10
Other	19	2	10	7	
Operating Room	226	10 (0.18)	199 (0.29)	17 (0.05)	<0.001

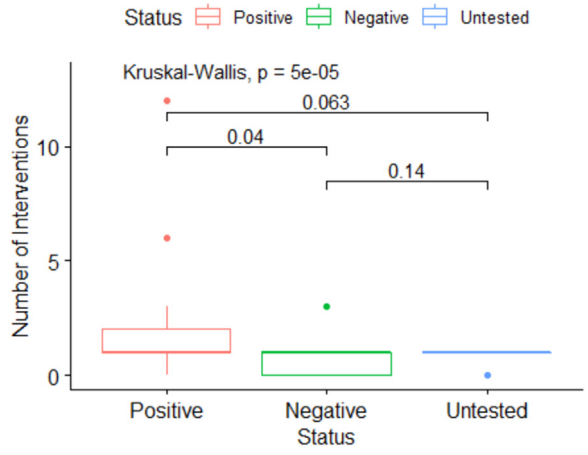

Fig. 2. Median Number of Bleeding Management Interventions between groups. P-values of Kruskal-Wallis test and pairwise Wilcoxon tests are included.

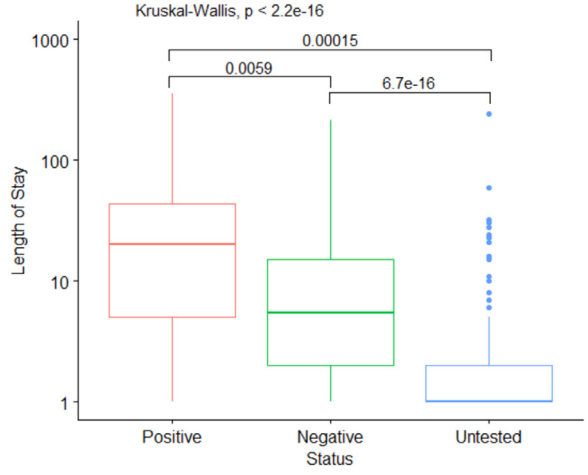

Fig. 3. Median Length of Stay for groups based on COVID-19 status. P-values of Kruskal-Wallis test and pairwise Wilcoxon tests are included.

was consulted for other reasons (50% vs. 7%, p=0.003). Although a higher median age was noted among COVID-19 positive patients who died, this was not statistically significant (53 vs. 38, p=0.07).

Consult rates, likelihood of intervention, and median number of procedures performed for other indications were similar between patients testing positive and negative (Tables 2; 3 and Fig. 1).

4. Discussion

During early stages of the COVID-19 pandemic, high incidences of pulmonary embolism (PE), deep venous thromboses (DVT), and arterial thrombotic events such as stroke were observed and associated with increased mortality among patients with COVID-19, despite treatment with prophylactic anticoagulation [9,10]. In some cases, patients already receiving therapeutic anticoagulation for other reasons demonstrated decreased rates of thrombotic events compared to those who received only prophylactic doses, raising the question as to whether therapeutic anticoagulation should be utilized to decrease thrombotic tendencies in patients with COVID-19 [9–11]. Subsequent observational studies of therapeutic anticoagulation in COVID-19 patients yielded conflicting results with regards to its effect on mortality, thrombotic events, and risk for bleeding, thus underscoring the need for further investigations to determine differences in outcomes [11]. Despite this uncertainty, guidelines have recommended anticoagulation in COVID-19 patients to mitigate some of the prothrombotic effects of the disease [17].

A recent landmark study found that in critically ill patients, anticoagulation with therapeutic dosing did not confer a survival advantage or improve the number of days free of cardiovascular or respiratory organ support as compared to thromboprophylaxis dosing [12]. This finding contrasts with previous cohort studies that have indicated that anticoagulation in COVID-19 positive patients increases overall survival

[18,19]. This group also conducted an analogous trial for patients with COVID-19 who did not require intensive care unit-level support for organ dysfunction. In noncritically ill COVID-19 patients, this trial found that initial therapeutic-dose heparin significantly increased survival probability and reduced the need for cardiopulmonary end-organ support [20]. The changes in treatment that will undoubtedly result from these findings in relation to bleeding risk remain to be seen. At our institution, few protocols were specifically altered for COVID-positive patients.

We sought to examine differences at the patient level by comparing indications for consults, stratified by COVID-19 status (Table 2, Fig. 1). Consults for bleeding comprised the predominant indication for consultation among patients with COVID-19 during the studied period, suggesting that patients with COVID-19 were more likely to bleed than other patients. In addition, increased numbers of bleeding management procedures for COVID-19 positive patients suggest that bleeding in the context of COVID-19 is a complicated condition requiring repeat interventions with associated morbidity, cost, and potential for disease transmission (Table 3). Although unsurprising given the high prevalence of therapeutic anticoagulation used during the time of study, these findings have important implications for both patient management and provider protection.

The standard intervention for epistaxis at our institution involves placing absorbable hemostatic packing such as Surgi-Foam and Surgicel (Ethicon, New Jersey, USA) in the nasal cavity, and saturating it with topical medications such as oxymetazoline, phenylephrine, tranexamic acid, or in refractory cases, epinephrine. The standard intervention for oropharyngeal bleeding in patients who are mechanically ventilated involves placing saline wet Kerlix gauze bandage rolls (Medline, Illinois, USA) in the oropharynx. Success is defined as observed hemostasis upon completion of the procedure. Rebleeding was exceptionally common in the positive cohort (Table 3), accounting for repeat procedures and substantial morbidity attributed to resuscitations from blood loss.

In response, we offer the following anticipatory guidance in COVID-19 positive patients given the increased risk for upper airway bleeding: 1) Additional care orders to include frequently scheduled nasal saline sprays, oral saline rinses, topical lubrication, and humidification. 2) In critically ill patients with significant episodes of bleeding requiring interventions and transfusions, frequent re-evaluation of therapeutic anticoagulation to determine whether the risk outweighs the benefit.

Of paramount importance is the ongoing prevention of transmission by patients to providers, as otolaryngologists are particularly susceptible due to the high volume of aerosol generating procedures in the head-and-neck. Current recommendations are to use N95 mask protection when in contact with positive patients in addition to standard personal protective equipment (PPE), especially when performing aerosol generating procedures [21]. Nasal and oral packing procedures cause coughing, sneezing, and spitting requiring considerable mucosal exposure and suctioning. Need for repeat interventions further expose providers to increased risk of contraction, reinforcing the necessity to obtain definitive hemostasis and decrease repeat encounters. For the five-month period of study, high-risk aerosolizing bedside procedures (laryngoscopy, tracheostomy management, nasal endoscopy, and foreign body removal) were performed a total of 385 times for a mean 0.34 procedures performed per patient. Of note, no otolaryngology residents at this institution contracted COVID-19 during the time period in which this study data was collected. With an abundance of caution, screening, and proper PPE, the risk of transmission can be mitigated.

Increased reports of anxiety, distress, burnout, and overall decrease in mental health were noted in health care providers during the SARS epidemics [22]. As in our cohort, hospitalized patients with COVID-19 requiring evaluation by otolaryngologists are often very ill, with high rates of mortality (Table 1, Figs. 2 and 3). Similarly, symptoms of distress amongst otolaryngology providers have been reported during this COVID-19 era and are increased in states with greater than 20,000 cases or 1,000 COVID-19 related deaths [23]. Although not systematically surveyed, our front-line otolaryngologists commented on the disturbing morbidity associated with repetitive nasal and oropharyngeal packing procedures required to control bleeding in COVID-19 patients. In addition to mitigating patient morbidity, re-evaluating the management of COVID-19 patients with high risk of upper airway bleeding could positively impact the mental health and wellness of otolaryngologists.

There are inherent limitations within our study design that could be addressed in future studies. The retrospective nature is inherently less powerful than a prospective study and is prone to misclassification bias. Correlates between COVID-19 status and race in our cohort (Table 1) lack generalizability due to the small sample size and specialty-specific nature of our study, and inferences may be better explained by more robust epidemiological investigations [24]. In addition, institutional policy undoubtedly affects the role of otolaryngologists in the care of patients with COVID-19. Unlike previous studies, neither airway- nor tracheostomy-related consults composed significant proportions of our positive cohort [6]. This difference is likely derived from institutional consulting practices, as almost all tracheostomies within our cohort were performed by pulmonology and cardiothoracic surgery rather than otolaryngology. For the pulmonology service, there was no reported deviation in policy regarding COVID status. Generally, at our institution, the pulmonology service performs all tracheostomies for the intensive care units. With respect to thoracic surgery, COVID-positive patients were subjectively more likely to be referred for percutaneous tracheostomy compared to routine open tracheostomies. Further studies of otolaryngology consultation patterns at other tertiary care centers may reveal different demographic factors, treatment patterns and outcomes.

Our study corroborated the association between anticoagulated COVID-19 positive patients and bleeding. Further studies evaluating the effect of prophylactic interventions and changes in management are warranted to guide care of the COVID-19 patient in future surges.

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5. Conclusion

Bleeding and associated interventions comprised the predominant discrepancy between COVID-19 positive and negative patients in our cohort. The risk of bleeding in COVID-19 patients should be considered when evaluating the need for therapeutic anticoagulation. We encourage routine use of simple and cost-effective methods to decrease the risk of bleeding in COVID-19 patients.

Disclosure Statement

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Disclosures

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Meeting

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