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Approaching Otolaryngology Patients during the COVID-19 Pandemic

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Key words

COVID-19; SARS-CoV-2; Personal protection equipment (PPE); Healthcare worker (HCW); Infection control measures; Pre-examination; Tracheotomy;

Abstract

Objective: Describe COVID-19 patient presentations requiring otolaryngology consultation, and provide recommendations for protective measures based on the experience of ENT departments in four Chinese hospitals during the COVID-19 pandemic.

Study Design: Retrospective case series

Setting Multi-center

Subjects and Methods: Twenty hospitalized COVID-19 patients requiring ENT consultation from three designated COVID-19 hospitals in Wuhan, Shanghai, and Shenzhen were identified. Data on demographics, comorbidities, COVID-19 symptoms and severity, consult reason, treatment, and PPE use were collected and analyzed. Infection control strategies implemented for ENT outpatients and emergency room visits at the Eye and ENT Hospital of Fudan University were reported.

Results: Median age was 63 years, 55% were male, and 95% were in severe or critical condition. Six tracheotomies were performed. Post-tracheotomy outcomes were mixed (2 deaths, 2 patients comatose, all living patients still hospitalized). Other consults included epistaxis, pharyngitis, nasal congestion, hyposmia, rhinitis, otitis externa, dizziness and tinnitus. At all hospitals powered air-supply filter respirators (PAPR) were used for tracheotomy or bleeding control. PAPR or N95-equivalent masks plus full protective clothing were used for other complaints. No inpatient ENT providers were infected. After implementation of infection control strategies for outpatient clinics,

emergency visits, and surgeries, no providers were infected at the Eye and ENT Hospital of Fudan University.

Conclusions and Relevance COVID-19 patients require ENT consultation for many reasons including tracheotomy. Otolaryngologists play an indispensable role in the treatment of COVID-19 patients but due to their work are at high risk of exposure. Appropriate protective strategies can prevent infection of otolaryngologists.

Introduction

COVID-19 is an infectious respiratory disease caused by the novel virus severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).¹⁻⁴ As of March 26th, 2020, 462684 cases of COVID-19 have been reported in 199 countries and regions.⁵ On March 11th, 2020, the World Health Organization (WHO) declared COVID-19 a global pandemic.⁶

Due to lack of adequate awareness and sufficient infection control plans during the early stages of the pandemic, many healthcare workers (HCW) were infected. In particular, HCWs in “non-infectious disease” specialties such as otolaryngology were infected at higher rates than colleagues in the same hospitals.^{3,7,8} According to the data of Italian National Health Agency, 6414 healthcare workers have been infected SARS-CoV-2 as of March 26th, 2020.⁹

Otolaryngologists are by the nature of their work at high risk for exposure to respiratory pathogens. During the course of routine evaluation and management of patients, otolaryngologists and their staff will inevitably come into direct contact with upper respiratory tract secretions or blood, which may become aerosolized during an inadvertent sneeze or cough.¹⁰ Such events can occur during a nasal and upper airway endoscopy, while performing a nasal culture or nasopharyngeal swab for SARS-CoV-2, or simply during routine examination of the oral cavity and oropharynx, exposing the healthcare provider to potentially infectious agents. Clinical data indicates that approximately half of the patients with COVID-19 do not have fever during early stages of the disease, with some patients presenting to the otolaryngologist with fairly

innocuous symptoms such as nasal congestion, sore throat and hyposmia.^{3,11-14} Other patients may present with or be followed for upper aerodigestive track malignancies. These patients commonly complain of cough and sore throat, and co-existing COVID-19 infection may not be considered at presentation. This puts providers and other patients at high risk of infection due to insufficient PPE use unless a high level of clinical suspicion is maintained. In the inpatient setting, critically ill patients with respiratory failure commonly require endotracheal intubation and/or a tracheotomy for respiratory support. In a previous study, 6.30% (15/238) patients required tracheotomy during the severe acute respiratory syndrome (SARS) outbreak in Singapore.¹⁵ According to clinical statistics, 7.3-32% of patients with COVID-19 progress to a severe or critically ill condition, a number of whom may subsequently require tracheotomy for a variety of reasons.^{3,4,7,11,16} Some of these patients may develop complications such as pharyngeal ulcers or bleeding from the tracheotomy site, requiring further ENT care. Other emergent events unrelated to COVID-19 but occurring in COVID-19 patients such as epistaxis also require ENT intervention. Given all of these possible routes of exposures, it is critical for ENT departments and providers to establish proper and sufficient infection control measures.

There is little in the literature documenting how ENT departments should approach otolaryngologic diseases in patients infected with SARS-CoV-2 and how to best protect otolaryngologists during the COVID-19 pandemic. It is not clear how to best establish efficient strategies to carefully identify and triage patients and ensure appropriate protection during outpatient and inpatient otolaryngology care. Wuhan was the

epicenter of the SARS-CoV-2 outbreak in China, while Shanghai and Shenzhen are large metropolitan centers which were also affected by the pandemic. This article aims to review the otolaryngologist experience treating COVID-19 patients in these cities, and to propose appropriate protective measures based on these experiences.

Methods

Study Design and Participants: This case series was approved by the Institutional Ethics Committee of Shenzhen Third People's Hospital of, Wuhan Chinese and Western Medicine Hospital and Shanghai Public Health Clinical Center. All COVID-19 patients admitted to Wuhan, Shenzhen, and Shanghai hospitals from January 14th, 2020 to March 20th, 2020 who received consultation in one of these respective ENT departments were included. Oral consent was obtained from patients. The three hospitals, Chinese and Western Medicine Hospital of Tongji Medical College, Huazhong University of Science and Technology (one of the designated hospitals for COVID-19 in Wuhan), Shenzhen Third People's Hospital (the only designated hospital in Shenzhen) and Shanghai Public Health Clinical Center of Fudan University (the only designated hospital for adults in Shanghai) are responsible for the treatment for COVID-19 patients as assigned by the government. The Eye and ENT Hospital of Fudan University is responsible for ENT consultation for COVID-19 patients in Shanghai assigned by the government. In response to the pandemic, the Eye and ENT Hospital of Fudan University also quickly implemented a variety of protective strategies for ENT inpatient and outpatient care including pre-appointment screening, triaging, restriction of non-

urgent clinic visits and surgeries, telemedicine, and proper protective equipment. The infection status and condition of patients and their ENT providers were monitored through March 20th, 2020.

Patient Selection and Management: The subjects involved in this study were COVID-19 patients for whom ENT was consulted for tracheotomy or management of ENT-related symptoms including epistaxis, nasal congestion, allergic rhinitis, sore throat, hyposmia, dizziness and tinnitus. Of the COVID-19 inpatients from January 14th, 2020, to March 20th (327 cases in Shanghai; 421 cases in Shenzhen; and 1500 cases in Wuhan Chinese and Western Medicine Hospital), 20 patients met criteria and were included for study.

Data Collection: Data was obtained from 3 hospitals: Wuhan Chinese and Western Medicine Hospital (12 patients), Shenzhen Third People's Hospital (6 patients), and Shanghai Public Health Clinical Center (2 patients) which had consultation from the Eye and ENT Hospital of Fudan University. Patients were hospitalized from January 14th, 2020, to March 20th, 2020. The medical records of patients were analyzed by the research team. Clinical as well as treatment and outcome data were obtained from data collection forms in the electronic medical records. The data were reviewed by a team of trained otolaryngologists. The recorded information included demographic data, comorbidities, severity classification and symptoms of COVID-19, reason for ENT consultation, patient outcomes, provider protection level, and infection of HCWs during ENT consultation. Data from outpatient clinics, emergency room, emergency surgeries, elective surgeries and telemedicine encounters at Eye and ENT Hospital of

Fudan University were also reviewed.

Statistical Analyses: A descriptive analysis was performed. Categorical variables were described as frequency rates and percentages, and continuous variables were described using mean, median, and interquartile range (IQR) values.

Results

Patient Characteristics

The study population included 20 hospitalized COVID-19 patients seen as consults by otolaryngology. Median age was 63 years (range, 32-72 years), 11/20 (55%) were male, and 19/20 (95%) were in a severe or critical condition. Of these patients, 7/20 (35%) were recommended for a tracheotomy after the consultation. The median age of the tracheotomy group was 65.3 years, and all of them were critically ill with one or more chronic diseases such as diabetes, hypertension and/or coronary artery disease (Table1). Six of seven patients ultimately underwent a tracheotomy, including three surgical tracheotomy (ST) and three percutaneous dilational tracheotomy (PDT). The average intubation time for patients undergoing tracheotomy was 12.6 days. As of March 20th, 2020, 2/6 (33.3%) of these patients were hospitalized in improving condition, while 4/6 (66.7%) did not improve significantly. Three patients underwent PDT for prolonged intubation after being unable to be weaned from ventilation over 10-14 days. Of these patients, two were still hospitalized at the time of data collection and improving. The third patient presented with severe pneumonia, ARDS, sepsis,

myocarditis, metabolic acidosis with decompensated respiratory acidosis, electrolyte disturbances (hyperkalemia, hyponatremia) and sleep apnea hypopnea syndrome. This patient was treated with continuous renal replacement therapy (CRRT) and extracorporeal membrane oxygenation (ECMO) accompanied by intra-airway hemorrhage before tracheotomy. Ten days after tracheotomy, the patient experienced bleeding from the nose and mouth. Nineteen days after tracheotomy, obstruction of ECMO flow occurred, and the patient died after recanalization. Another three patients underwent ST. The first was a cerebral infarction patient with atrial fibrillation, hypertension, diabetes, cerebral hernia, and anemia who underwent tracheotomy to prevent the occurrence of aspiration pneumonia. He remained in a coma after tracheotomy. Another patient experienced dyspnea after extubation, necessitating an emergent ST rather than reintubation. He was also in a coma as of the date of data collection. The third patient underwent ST because of repeated extubation and reintubation, and underwent ST for the second time due to airway bleeding 9 days later. Epistaxis occurred on day 7 after the second tracheotomy, which resolved after temporary packing with non-dissolvable packing for two days. This patient eventually died on day 10 after the second ST. Overall, outcomes after tracheotomy were mixed with 2 deaths, 2 patients comatose, and all living patients still hospitalized.

Six of the twenty patients (30%) presented with unilateral (3 cases) or bilateral (3 cases) epistaxis. Two patients with bilateral epistaxis had previously been on anticoagulants. Five patients were utilizing noninvasive assisted ventilation or high-flow oxygen through nasal canula, and one patient had been treated with ECMO. Their

noses were temporarily packed with no further bleeding after removal of their packing 2 days later. No postprocedural complications occurred in the 6 patients except in the one patient who was treated with ECMO. He remained in a coma as of data collection.

Of the other seven patients, two were evaluated for sore throats and two for nasal congestion (one of whom also had hyposmia). The last three patients presented with symptoms of rhinitis, otitis externa, and tinnitus, respectively. Other than the hyposmia, the symptoms of these seven patients were alleviated or ameliorated with routine medical treatment (Table 2).

Infectious Control in HCWs

When treating patients for common otolaryngologic diagnoses or symptoms such as rhinitis, nasal congestion, hyposmia, sore throat, dizziness, tinnitus, and otitis externa, the otolaryngology HCWs in the epidemic center (Wuhan) and other areas (Shenzhen, Shanghai) took third-level protection and second-level protection, respectively (Table 3, Figure 1). The second-level protective measures include wearing medical protective masks equivalent to N95 respirators, eye protection such as goggles or face shields, work clothes, disposable isolation gowns and/or coveralls, shoe covers, gloves, and hair covers. The third-level protection measures added a powered air-supply filter respirator (PAPR) such as a positive pressure headgear or a comprehensive respiratory protective device according to expert consensus in China.¹⁷

Otolaryngologists performing a tracheotomy or procedures for control of hemorrhage in circumstances of tracheal/oral bleeding or epistaxis in patients infected with SARS-CoV-2 utilized third-level infection control measures whether in Wuhan,

Shenzhen or Shanghai. Importantly, proper technique for donning and doffing PPE must be practiced in order to effectively protect otolaryngology providers (Figure1). Under the guidance of trained staff in the isolation ward, providers disposed of the waste and sharps properly, and disinfected personal supplies brought out from the contaminated area after the procedures. Outer protective equipment was removed at the entrance of the semi-contaminated area. The inner protective equipment was removed in the semi-contaminated area and personal supplies were disinfected again.¹⁸ Furthermore, careful attention was given to proper hand hygiene and avoiding contact with the eyes, nose and mouth. The otolaryngology healthcare worker was then quarantined in designated isolation locations for 14 days after the consultation. Healthcare workers in Wuhan and Shenzhen took their temperature 4 times every day and took nucleic acid tests twice spanning a 24 hour period. HCWs in Shanghai took their temperature 2 times every day and took nucleic acid tests on days 7, 12, and 14, a total of 3 times. At the time of data collection, no otolaryngologists who participated in the care of the patients in this study had become infected with SARS-CoV-2.

The three hospitals in Wuhan, Shenzhen and Shanghai were designated for treatment of COVID-19 patients, and so their outpatient clinics and emergency departments were closed. However, the Eye and ENT Hospital of Fudan University cares for one of the largest number of ENT patients in China, and continued to do so throughout the pandemic. Since the announcement of obvious human-to-human transmission on January 20, 2020, the Eye and ENT Hospital of Fudan University reduced its large number of outpatient visits immediately by eliminating non-urgent

visits, stopped elective surgery, avoided upper aerodigestive tract endoscopic examinations as much as possible, developed outpatient and emergency room triage flowcharts (Figure 2), and improved staff training on infection control measures. In the pre-examination areas for the emergency rooms, outpatient clinics and inpatient wards, HCW's used first-level protection measures consisting of work clothes, isolation gowns, hair cover, normal surgical masks, and gloves when necessary. Second-level protection was used in the isolation ward, and third-level protection in the operating room and when performing invasive procedures. The protection level can be adjusted according to the specific type of encounter and working areas (see Table 3 for details). We developed and followed these procedures, and then gradually increased outpatient appointments, tumor-related surgery, and then finally open elective surgery according to the pandemic situation. At present, our clinic and surgical volume has returned to baseline. One quarter as many outpatient visits and one sixth as many elective surgeries were performed from January 20, 2020 to March 20, 2020 compared to the same period of 2019. In lieu of normal patient visits, 5765 telemedicine encounters were performed. No further HCW or patient infections have occurred.

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Discussion

In this clinical study of 20 COVID-19 patients seeking ENT consultation, 5 patients who had previously been endotracheally intubated were converted to a tracheotomy and one patient underwent a tracheotomy only. Otolaryngologists performed a tracheotomy for these patients for management of secretions, repeated endotracheal intubation, and

for long-term endotracheal intubation. Data from non-COVID-19 infected critically ill patients suggests that early tracheotomy (within 10 days of intubation) has been associated with more ventilator-free days, shorter ICU stays, shorter duration of sedation and lower long-term mortality rates, though other studies have found that timing of tracheotomy does not affect important clinical outcomes.^{19,20} In this study, 4 of the 6 patients (66.7%) who underwent tracheotomy subsequently were in a coma (2 cases) or died (2 cases) which underscores the fact that in this small patient cohort the majority of patients did not achieve clinical benefit from the tracheotomy performed. Another report from China also suggests against benefit from tracheotomy for COVID-19 patients.²¹ There is also data from the SARS treatment experience suggesting that tracheotomy was not associated with significant improved outcome.²² Tracheotomy is also associated with a number of potential complications including tracheal bleeding. Without specific treatment for the infection, the mortality rate once a patient goes into severe or critical ARDS is as high as 70%, which also may argue against proceeding with tracheostomy on patients with COVID-related ARDS.²³ Taken in combination with our clinical experience in China, we recommend that long term intubation should not on its own be an indication for tracheotomy in COVID-19 patients, as the risk to patients and providers likely outweighs any marginal benefits in this scenario. Rather, tracheotomy should only be utilized in specific situations such as airway obstruction where the potential for successful extubation is otherwise compromised or in circumstances where tracheotomy placement might positively impact a patient's potential for successful weaning of minimal ventilatory support. These scenarios do

require careful consideration when medical resources including ventilators are in limited supply in the setting of widespread community infection. In agreement with recent recommendations released by ENT UK, we believe such clinical situations should be evaluated in a multidisciplinary fashion such that consensus among specialists regarding potential for clinical benefit following tracheotomy as weighed against the risk of the procedure is agreed upon prior to proceeding with the procedure.²⁴

In this study, 30% of consults were for epistaxis. This finding may be associated with the patients breathing dry cold air (due to hospitals turning off heating systems to minimize airborne transmission), long-term oxygen inhalation, utilizing anticoagulants, acquired coagulopathies secondary to severe illness, and comorbidities such as hypertension or diabetes. Given that the SARS-CoV-2 viral load has been found to be highest in the nose, any intervention involving the nasal cavity – particular those that could produce aerosolized blood or secretions – should be considered high risk, and appropriate PPE should be utilized accordingly.²⁵

SARS-CoV-2 is very infectious, with a control reproduction number that may be as high as 6.47 (95% CI 5.71-7.23), which is higher than the SARS transmission number in 2003.^{26,27} As previously discussed, ENT providers may be subjected to high risk exposures in a variety of different scenarios. For this reason, it is important that health workers in ENT departments use standard precautions consistently when providing care to COVID-19 patients. Rigorous implementation and adherence are crucial for the control of outbreak situations. Based on our previous experience of performing

tracheotomy during SARS, no medical or nursing staff member was infected after carrying out the procedure while taking all the precautions and wearing the appropriate protective apparel.^{15,22,28,29} Medical units should provide graded protection for healthcare workers according to the job position, work area, and the level of exposure risk.¹⁷ PPE is the most obvious aspect of infection control. PPE must be correctly selected and used in a safe manner. Based on expert consensus in China, HCWs adopted third-level protection measures when performing invasive procedures such as tracheotomy or control of bleeding. The second-level protection measures can be taken for evaluation, treatment, or throat swab sampling of patients in the isolation ward. The utilization of PPE in second-level protection and third-level protection here roughly corresponds to standard PPE and enhanced PPE, respectively, as previously described by the CDC.^{15,29} Wuhan was the epicenter of the pandemic with a higher incidence of disease than Shenzhen and Shanghai. As such, during consultation of COVID-19 patients with sore throat and nasal congestion, otolaryngologists in Wuhan and Shenzhen adopted third-level and secondary-level infection control plans, respectively, with no resulting provider infections at either hospital. These clinical results suggest that the adoption of such graded protection measures is feasible and effective. Healthcare workers could choose different-level protection according to disease prevalence, the degree of exposure risk, and the availability of PPE equipment. While in this study all otolaryngology providers were quarantined for 14 days after caring for COVID-19 positive patients, the ultimate lack of infection of any of these providers may indicate that such quarantine is not necessary if appropriate PPE and other

infection control measures are utilized. Serial temperature checks and viral testing could be used instead to confirm providers are not infected without having to remove them from the workforce, a key concern given the potential volume of COVID-19 patients requiring care. Further study is necessary to determine what is the minimum sufficient level of PPE to prevent infection with COVID in different clinical scenarios.

It is not always possible to identify patients with SARS-CoV-2 infection on clinical presentation alone as early symptoms are non-specific. This can lead to high risk exposures in the outpatient setting if high clinical suspicion is not maintained. In one example, a patient who was seen in the otolaryngology department for a sore throat and mild cough was subsequently diagnosed with COVID-19, illustrating the importance of careful triage of outpatients.³⁰ Some evidence also indicates that hyposmia or loss of smell may be an early symptom of SARS-CoV-2 infection, which may be particularly relevant to otolaryngologists.^{13,14} In our cohort, there was at least one case of a mild severity patient who initially presented to an otolaryngologist for hyposmia. At the Eye and ENT Hospital of Fudan University proactive implementation of a variety of protective strategies immediately at the start of the outbreak resulted in no HCW infections occurring despite high exposure risk, indicating the effectiveness of these policies. Notably, as the overall prevalence of disease stabilized, the hospital was able to increase its clinical and surgical volume back to baseline while still having no HCW infections. While this is in part a reflection of the success of national disease control measures in China, it also suggests that with proper patient screening, protective equipment, and training even a high risk specialty such as otolaryngology can practice

safely and effectively in the midst of the COVID-19 pandemic.

There were some limitations to our study. As with all retrospective studies, the conclusions that can be drawn are limited by the observational and heterogenous nature of the data. There are also only 20 subjects included in this study. As such, this may not fully display the clinical characteristics of COVID-19 patients requiring ENT consultation. It also limits the conclusions that can be drawn regarding the feasibility and effectiveness of the protective measures taken by the otolaryngology providers participating in the diagnosis and treatment.

Conclusions

We found that COVID-19 positive inpatients can require intervention by an otolaryngologist for a variety of reasons, of which a tracheotomy was the most common in this study. Otolaryngologists play an indispensable role in the treatment of COVID-19 patients, but due to the inherent nature of their work are at high risk of exposure whether working in outpatient clinics, the emergency room, or inpatient wards. Appropriate use of PPE titrated to the level of exposure can prevent SARS-CoV-2 infection among otolaryngologists. Establishment of strategies of caring for general ENT patients during COVID-19 outbreak can protect healthcare workers.

Author Contributions

Yilai Shu, Xuezhong Liu and Chong Cui, contributions to conception and design, and analysis and interpretation of data, drafting the article, final approval of the version to be published; **Qi Yao, Di Zhang**, contributions to acquisition of data, analysis and interpretation of data, conception and design; **Yu Zhao**, contributions to conception and design, interpretation of data, revising it critically for important intellectual content, final approval of the version to be published; **Kun Zhang**, contributions to conception and revising; **Eric Nisenbaum**, contributions to revising it critically for important intellectual content; **Pengyu Cao**, contributions to acquisition of data; **Xiaolong Huang, Dewen Leng, Chunhan Liu, Keqing Zhao, Ning Li, Yan Luo, Bing Chen, Roy Casiano, Donald Weed, Zoukaa Sargi, Fred Telischi, Hongzhou Lu, James C. Denny III, Yilai Shu, Xuezhong Liu** contributions to conception, revising it critically for important intellectual content and final approval. All of them are in agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Disclosures

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References

1. Zhou P, Yang X-L, Wang X-G, et al. A pneumonia outbreak associated with a new coronavirus of probable bat origin. *Nature*. 2020.
2. Wu F, Zhao S, Yu B, et al. A new coronavirus associated with human respiratory disease in China. *Nature*. 2020.
3. Wang D, Hu B, Hu C, et al. Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China. *Jama*. 2020.
4. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet (London, England)*. 2020.
5. Coronavirus disease 2019 (COVID-19) Situation Report –66. World Health Organization. March 26, 2020 https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200326-sitrep-66-covid-19.pdf?sfvrsn=81b94e61_2 March 27, 2020
6. WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020
<https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020> March 27, 2020
7. McGoogan ZWJM. Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19) Outbreak in China. Summary of a Report of 72 314 Cases From the Chinese Center for Disease Control and Prevention. *Jama*. 2020.
8. Patel ZM, Fernandez-Miranda J, Hwang PH, et al. Precautions for Endoscopic Transnasal Skull Base Surgery During The COVID-19 Pandemic. *Neurosurgery*. 2020.

9. Integrated surveillance of COVID-19 in Italy, 26 March 2020
UPDATE. https://www.epicentro.iss.it/coronavirus/bollettino/Infografica_26marzo%20ENG.pdf March 27, 2020
10. Tran K, Cimon K, Severn M, Pessoa-Silva CL, Conly J. Aerosol generating procedures and risk of transmission of acute respiratory infections to healthcare workers: a systematic review. *PloS one*. 2012;7(4):e35797.
11. Guan WJ, Ni ZY, Hu Y, et al. Clinical Characteristics of Coronavirus Disease 2019 in China. *N Engl J Med*. 2020.
12. Chen N, Zhou M, Dong X, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *The Lancet*. 2020.
13. Mao L, Wang M, Chen S, et al. Neurological Manifestations of Hospitalized Patients with COVID-19 in Wuhan, China : a retrospective case series study. *medRxiv*. 2020.
14. Baig AM, Khaleeq A, Ali U, Syeda H. Evidence of the COVID-19 Virus Targeting the CNS: Tissue Distribution, Host-Virus Interaction, and Proposed Neurotropic Mechanisms. *ACS chemical neuroscience*. 2020.
15. Chee VW, Khoo ML, Lee SF, Lai YC, Chin NM. Infection control measures for operative procedures in severe acute respiratory syndrome-related patients. *Anesthesiology*. 2004;100(6):1394-1398.
16. Yang X, Yu Y, Xu J, et al. Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study. *The Lancet Respiratory Medicine*. 2020.

17. Chun-hui L, Xun H, Meng C, et al. Expert consensus on personal protection in different regional posts of medical institutions during novel coronavirus pneumonia(COVID-19) epidemic period. *Chinese Journal of Infection Control*. 2020;19(3):1-15.
18. Ke-lei G, Yong L, Chang-ning X, wei-hong J, Dong-hai H. Summary of the indications and suggestions on the protective measures of tracheotomy during the outbreak of novel coronavirus pneumonia. *Chinese Journal of Otorhinolaryngology-Skull Base Surgery*. 2020;26(01):9-13.
19. Hosokawa K, Nishimura M, Egi M, Vincent JL. Timing of tracheotomy in ICU patients: a systematic review of randomized controlled trials. *Critical care (London, England)*. 2015;19:424.
20. Wang F, Wu Y, Bo L, et al. The timing of tracheotomy in critically ill patients undergoing mechanical ventilation: a systematic review and meta-analysis of randomized controlled trials. *Chest*. 2011;140(6):1456-1465.
21. Yu S, Yajuan H, Hongjun X. Recommendations for diagnosis and treatment of emergency diseases in ENT surgery during the prevention and control of new coronavirus. *Zhonghua liu xing bing xue za zhi = Zhonghua liuxingbingxue zazhi*. 2020.
22. Wei WI, Tuen HH, Ng RW, Lam LK. Safe tracheostomy for patients with severe acute respiratory syndrome. *The Laryngoscope*. 2003;113(10):1777-1779.
23. Liu Y, Sun W, Li J, et al. Clinical features and progression of acute respiratory distress syndrome in 1 coronavirus disease 2019. *medRxiv*. 2020.
24. Guidance for Surgical Tracheostomy and Tracheostomy Tube Change during the COVID-19 Pandemic <https://www.entuk.org/tracheostomy-guidance-during-covid-19->

[pandemic](#) March 27, 2020

25. Zou L, Ruan F, Huang M, et al. SARS-CoV-2 Viral Load in Upper Respiratory Specimens of Infected Patients. *The New England journal of medicine*. 2020.
26. Tang B, Wang X, Li Q, et al. Estimation of the Transmission Risk of the 2019-nCoV and Its Implication for Public Health Interventions. *Journal of clinical medicine*. 2020;9(2).
27. Bauch CT, Lloyd-Smith JO, Coffee MP, Galvani AP. Dynamically modeling SARS and other newly emerging respiratory illnesses: past, present, and future. *Epidemiology (Cambridge, Mass)*. 2005;16(6):791-801.
28. Yam LY, Chen RC, Zhong NS. SARS: ventilatory and intensive care. *Respirology (Carlton, Vic)*. 2003;8 Suppl:S31-35.
29. Tien HC, Chughtai T, Jogeklar A, Cooper AB, Brenneman F. Elective and emergency surgery in patients with severe acute respiratory syndrome (SARS). *Canadian journal of surgery Journal canadien de chirurgie*. 2005;48(1):71-74.
30. Zhang K, Zhao Y, Cui C, et al. Zhong Hua Er Bi Yan Hou Tou Jing Wai Ke Za Zhi.[Submitted][Suggestions for Early Identification of 2019 Novel Coronavirus Infection in Otolaryngology Head and Neck Surgery.][Article in Chinese]

Tables

Table 1. Clinical Presentations of COVID-19 Patients with ENT Symptoms (N=20)

Clinical Presentations	Symptoms Consulted by Otolaryngologists							Total
	Tracheotomy	Epistaxis	Pharyngitis	Nasal Congestion /Hyposmia	Rhinitis	Dizziness and Tinnitus	Otitis Externa	
No./Total No.(%)	7/20 (35%)	6/20 (30%)	2/20 (10%)	2/20 (10%)	1/20 (5%)	1/20(5%)	1/20(5%)	20
Age, median	65.3	62	67	34	48	52	62	63
Sex, female/male	1/6	4/2	0/2	2/0	1/0	0/1	1/0	9/11
COVID-19 Phenotype, No.								
Mild	0	0	0	1	0	0	0	1
Severe	0	5	1	1	1	1	1	10
Critical	7	1	1	0	0	0	0	9
Complaints and Symptoms of COVID-19, No.								
Fever	6	2	2	0	1	0	1	12
Cough	3	4	2	1	1	0	1	12
Fatigue	0	1	0	0	0	0	0	1
Shortness of Breath	2	0	0	0	0	0	0	2
Chest Congestion	1	1	1	0	0	1	0	4
Nasal Congestion	0	1	0	1	0	0	0	2
Diarrhea	1	1	0	0	0	0	0	2
Comorbid Disorder, No.								
Hypertension	6	2	2	0	0	0	0	4
Diabetes	3	2	0	0	0	1	0	6
Coronary Heart Disease	2	0	0	0	0	0	0	2
Hyperlipidemia	0	1	1	0	0	0	0	2
Cerebrovascular Disease	1	0	0	0	0	0	0	1
COPD	1	0	0	0	0	0	0	1
Valvular Heart Disease	0	0	1	0	0	0	0	1
Chronic Kidney Disease	0	1	0	0	0	0	0	1
Meniere Disease	0	0	0	0	0	1	0	1

Hepatitis B Infection	0	0	0	0	0	0	1	1
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Table 2. Managements of COVID-19 Patients with Otolaryngologic Complaints

Complaints and Symptoms Consulted by Otolaryngologists	Therapy for COVID-19 before Consultation	Therapy for ENT Symptoms	Length of Intubation	Complications of Treatment	Post-treatment Outcome	Medical Protection Class for ENTs	ENTs Infection ^a
Tracheotomy (n=7) ^b							
Prolonged intubation for 16 days, Intra-airway bleeding	Intubation, CRRT, ECMO	PDT	16 days	None	Deceased 19 days later	Third-level	None
Prolonged intubation for 10 days	High-flow oxygen, Intubation	PDT	10 days	None	Improved but still hospitalized	Third-level	None
Prolonged intubation for 10 days	Intubation	PDT	10 days	Lung Secretions Discharge	Improved but still hospitalized	Third-level	None
Prevention of hypostatic pneumonia	None	ST	None	None	Lung infection recovered, comatose	Third-level	None
Dyspnea after extubation	High-flow oxygen, Noninvasive assisted ventilation, Intubation, CRRT	ST	17 days	None	Comatose	Third-level	None
Repeated extubation, then intra-airway bleeding	Noninvasive assisted ventilation, Intubation, ECMO	ST (x2)	10 days	Intra-airway hemorrhage on day 9 after the first ST, Epistaxis occurred on day 7 after the second tracheotomy	Died of cardiac arrest during a lung transplant 10 days after the second ST	Third-level	None
Epistaxis (n=6)							
Unilateral (3)	Noninvasive assisted ventilation (2), Nasal high-	Hemostasis with packing	None	Hemoptysis (3)	Resolution of epistaxis (3)	Third-level	None

	flow oxygen (1)						
Bilateral (3)	Noninvasive assisted ventilation (1), Nasal high-flow oxygen (1)	Hemostasis with packing	None	Hemoptysis (2)	Resolution of epistaxis (2)	Third-level	None
	ECMO (1)	Hemostasis with packing	None	-	Resolution of epistaxis, comatose, (1)	Third-level	None
Pharyngitis (n=2)	Noninvasive assisted ventilation (2), CRRT (1), ECMO (1)	Compound Borax (1)/Chlorhexidine (1) Mouthwash	None	Pharyngeal Reflex (1)	Symptoms alleviated (2)	Third-level (Wuhan)/Second-level(Shenzhen)	None
Nasal Congestion (n=1)	None	Oxymetazoline Nasal Spray	None	Sneeze	Symptoms alleviated	Third-level (Wuhan)	None
Nasal Congestion and Hyposmia(n=1)	None	Renault Court Nasal Spray	None	-	Nasal congestion alleviated, hyposmia not alleviated	Second-level(Shenzhen)	None
Rhinitis (n=1)	Nasal high-flow oxygen	Fluticasone Propionate Nasal Spray	None	Sneeze	Symptoms alleviated	Third-level(Wuhan)	None
Dizziness and Tinnitus (n=1)	Nasal high-flow oxygen	Betahistine in Remission	None	None	Symptoms alleviated	Third-level(Wuhan)	None
Otitis Externa (n=1)	Noninvasive assisted ventilation	Mupirocin	None	None	Symptoms alleviated	Third-level(Wuhan)	None

Abbreviations: ECMO, extracorporeal membrane oxygenation ; CRRT, continuous renal replacement therapy; ST, surgical tracheostomy; PDT, percutaneous dilational tracheostomy; ENT, ear, nose, and throat department.

^a HCWs in Wuhan and Shenzhen took their temperature 4 times every day and took nucleic acid tests twice spanning a 24 hour period. HCWs in Shanghai took their temperature twice every day and took nucleic acid tests on days 7, 12, and 14. ^b One patient declined tracheotomy after comprehensive assessment of the patient's condition.

Table 3. Medical Protection for Otolaryngologists

Medical Protection Class for HCWs	Application or Occasion	Normal Surgical Mask	Medical Protective Mask ^a	Goggles /Face Shield	PAP R	Work Clothes	Coverall (Protective Clothing)	Isolation Gowns	Gloves	Shoe Covers	Hair Cover
First-level	Pre-examination and triage of outpatients ^b	●	○			●		○	○		●
	Normal Outpatient, Emergency, Ward ^b	●	○	○		●		○	●		●
	Touring or cleaning in potentially contaminated area outside isolation ward		●			●		●	●	●	●
	Intubation, tracheostomy nasal/laryngeal endoscopy for ordinary patients		●	○		●		●	●		●
	Surgery on ordinary patients ^{b, c}	●	○			●			●		●
	Medical observation area for HCWs	●				●					●
	Close contact of tracheotomy ^{d, e}		●	○		●	○	●			●
Second-level	Normal consultation, physical examination, nursing or sampling in isolation ward ^e		●	●		●	●	○	●	●	●
	Transport or accompanying examination of suspected or confirmed patients		●	●		●	●		●	●	●
Third-level	Intubation, tracheostomy, nasal/laryngeal endoscopy for suspected or confirmed patients ^f		●	●	○	●	●		●	●	●
	Surgery on suspected or confirmed patients		●	●	○	●	●	○	●	●	●

^{b, f, g}

“●”Priority selection, “○”Selection if necessary, “blank” Not selected.

Abbreviation: PAPR, powered air-purifying respirator; HCW, healthcare worker.

^a The same or higher level of protective masks as N95 masks; ^b Medical protective masks and normal surgical masks are not used at the same time; ^c The work clothes here are scrubs; ^d Protective clothing or isolation gowns could be used according to the possibility of infection after close contacts. ^e Generally, the isolation gowns and protective clothing are not used at the same time. Some operations may contaminate protective clothing. For nursing or when moving between different isolation patients, it is recommended to use isolation gowns in addition to protective clothing; when in close contact with a tracheostomy, protective clothing or isolation gowns could be used according to the possibility of infection after close contacts. ^f If PAPR is selected, medical protective masks and goggles / face shield are not used.^g Wear an isolation gown if necessary (when prone to contamination).

Figure Legends

Figure 1. Medical Protection of Health Care Workers. Example of provider wearing first-level (a), second-level (b), and third-level (c) protection. d. Protocol for donning and doffing personal protective equipment.

Figure 2. Algorithm for Triage of Patients During COVID-19 Pandemic. a. Recommended pre-check and triage algorithm for outpatient clinics and emergency room. **b.** Recommended algorithm for pre-operative triage.

Figure 2

