Review Article

Managing pediatric otorhinolaryngology patients in coronavirus disease-19 pandemic – A real challenge to the clinicians

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ABSTRACT

The novel coronavirus disease (COVID-19) pandemic is posing unprecedented challenges among the otolaryngologists during managing the pediatric patients. COVID-19 infection is caused by novel coronavirus called severe acute respiratory syndrome coronavirus-2. This infection is transmitted primarily through human contact and by droplet route. The pediatric otolaryngologists have a critical role for managing nose, paranasal sinus, ears, oral cavity, pharynx, and larynx, which are important sites for generating aerosols and virus transmission. Asymptomatic pediatric patients have high risk for viral shedding. In COVID-19 pandemic, the surgical procedure by pediatric otolaryngologists should be limited to the emergency condition. The surgical interventions should limit the viral dissemination. This review article provides an overview of common methods to limit the viral transmission to the otolaryngologists and assisting health-care staffs from COVID-19 infections during the management of the pediatric patients.

Key words: Coronavirus disease-19 pandemic, Flexible nasopharyngolaryngoscopy, Otorhinolaryngology, Pediatric patients, Pediatric tracheostomy

Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) is the causative agent for the outbreak of the coronavirus disease (COVID-19), started in Wuhan, China, since late December 2019 [1]. SARS-CoV-2 was earlier known as the 2019 novel coronavirus (2019-nCoV), an enveloped single-stranded RNA virus [1]. The otolaryngologists have an important role as health-care providers for examining the patients with otorhinolaryngological manifestations. There are concerns for a greater number of the asymptomatic pediatric patients infected with COVID-19 [2]. The pediatric patients often present with diseases related to the upper airway such as sinonasal infections, tonsillitis, pharyngitis, nasal foreign body, airway foreign body, otitis media, and adenoid infections. There are disproportionately a high number of clinicians, infected with COVID-19 during their patient care specifically the pediatric age group [3]. This infection spreads mainly through the respiratory airway by droplets, secretions, and direct contact [4].

Examination and procedure in otolaryngology patients involve upper aerodigestive areas which are high risk for viral transmission, making the pediatric otolaryngologist the most vulnerable health-care professionals. At present, the risk of the viral transmission from the asymptomatic pediatric patients with COVID-19 to the health care workers is often difficult to assess on the basis of the clinical evaluation. The asymptomatic pediatric patients present high chance of the viral shedding during the clinical examination or any surgical procedure on the nose, paranasal sinuses, oral cavity, and laryngopharyngeal region and transmit these infections to the clinicians and assisting team members [5]. The COVID-19 pandemic requires careful assessment of the pediatric patients specifically before any otorhinolaryngological intervention such as laryngotracheobronchial airway, sinonasal tract, oral cavity, and otological procedures.

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METHODS OF THE LITERATURE SEARCH

Research articles regarding managing pediatric otorhinolaryngology patients in COVID-19 pandemic were searched through multiple approaches. First, we conducted an online search of the PubMed, Scopus, Google Scholar, and Medline databases with the word pediatric otorhinolaryngology patients, COVID-19 pandemic, flexible nasopharyngolaryngoscopy in pediatric patients, pediatric tracheostomy, pediatric endoscopic sinus surgery, pediatric mastoid surgery, and hearing screening of the pediatric patients in current COVID-19 pandemic. A search strategy using Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines was developed. Randomized

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controlled studies, observational studies, comparative studies, case series, and case reports were evaluated for the eligibility.

This paper focuses only on the pediatric patients with otorhinolaryngology complaints and their management in COVID-19 pandemic. The search articles with adult and elderly patients with their otorhinolaryngological manifestations with their management are excluded. Review articles with no primary research data were also excluded. The abstracts of the published article were identified by this search method and other articles were identified manually from the citations. This review article reviews the COVID-19 virus, epidemiology, history, and preventions of the viral transmission during managing the pediatric otorhinolaryngology patients in COVID-19 pandemic. This review article presents a baseline from where further prospective trials can be designed and help as a spur for further research in this clinical entity where not many studies are done.

COVID-19 Virus

The etiologic agent for COVID-19 infection was identified as a novel coronavirus, called as SARS-CoV-2, and this disease was called COVID-19 by the World Health Organization (WHO) [6]. This virus was formerly known as 2019-nCoV, positive-sense, single-stranded RNA virus with diameter of 60–140 nm [6]. It is a new variety of the coronavirus which belongs to the genus of beta coronavirus [7]. By far, 2019-nCoV is the seventh member of the coronavirus family which can infect human beings. The incubation period of COVID-19 ranges from 1 to 14 days with a median of 5–6 days. As per the recent study, the incubation period may extend up to 24 days [8]. A longer incubation has implication in quarantine policies and prevention of the spread of the disease. This virus is primarily transmitted through respiratory droplets but also found in blood and stool, thus raising doubts regarding mode of transmission [9].

History

The initial patient of pneumonia due to SARS-CoV-2 manifesting COVID-19 was found in Wuhan, Hubei Province, China in December 2019 [4]. This progressed to widespread infections with human transmission and led to pandemic with disastrous manifestations all over the world. The aerosol transmission of the virus was observed during the COVID-19 crisis, specifically after endoscopic hypophysectomy at Wuhan, where the novel coronavirus infected 14 staff members of the surgical team [10]. The coronaviruses were detected in the upper airway infection way back in 1998 [11]. However, there is limited knowledge in medical professionals about the behavior of the new SARS-CoV-2 in the anatomical area of the ear, nose, and throat.

Epidemiology

The WHO has declared COVID-19 as pandemic disease on March 11, 2020, and COVID-19 had spread to around 199 countries by March 26, 2020, with more than 462,680 positive cases and approximately 20,834 deaths [12]. The pandemic of COVID-19 is affecting the clinical practice for routine patient care. It is also affecting the day-to-day pediatric otorhinolaryngology practice and specifically surgical intervention of the routing and emergency diseases impacting the quality of life. Over a week, the COVID-19 spread to Asian countries, then to Europe and the United States, and finally globally with a rapid doubling time (6.4 days) [13]. It was declared as a public health emergency by the WHO on January 20, 2020 [13].

A majority (81%) of the patients is asymptomatic or present only mild symptoms, whereas approximately 15% show severe forms requiring hospitalization [14]. Approximately 3%–4% of the cases require respiratory support in an intensive care unit (ICU). The mortality or death rate is around 0.39%–4% but it depends on the age of the patients and is more in elderly patients older than 70 years [14]. Although the transmission of this virus mainly occurs through symptomatic patients, it has also been documented in asymptomatic persons and those in incubation period, lasting more than 14 days [14]. These asymptomatic individuals are source of occult transmission.

One of the largest global studies showed that only 2% of the patients were less than 18 years of age [15]. However, the exact incidence of the pediatric COVID-19 may be more as 4.4%–28% are asymptomatic, whereas additional 51% show severe symptoms [16]. At present, data show that approximately 15% of the pediatric COVID-19-positive cases are asymptomatic, whereas approximately 25% present with symptoms of upper respiratory tract infection [1].

Pediatric Patient Assessment

At present, all the pediatric patients coming for otorhinolaryngological consultations are treated as suspected COVID-19 cases until proven otherwise [17]. Asymptomatic or mild symptomatic patients spread COVID-19 in approximately 79% of the documented cases [18]. Before any otorhinolaryngological procedures, the children should be screened for any clinical presentation favoring or suspecting COVID-19 (Table 1).

Viral shedding starts before the onset of the symptoms. The airways of the infected pediatric patients have high viral load particularly in the nose, nasopharynx, oropharynx, larynx, and trachea [19]. The transmission risk of the COVID-19 infections varies for different pediatric otorhinolaryngological procedures and divided into low risk and high risk (Table 2).

Flexible Nasopharyngolaryngoscopy

The flexible nasopharyngolaryngoscopy has restricted indications during COVID-19 pandemic as it has a high risk for viral transmission to the health care workers and other surrounding personnel [20]. It should be performed only in critical conditions such as airway obstruction to assess the site of obstructive pathology and performing intervention in compromised airway. When performing such procedure, the otolaryngologists must wear the personal protective equipment (PPE) such as filtering

Table 1: Clinical screening before otorhinolaryngological procedure in children

Serial number	High-risk clinical presentations
1	Travel history to outside state/country
2	Contact with COVID-19-positive patients
3	Fever
4	Influenza-like symptoms
5	Shortness of breath
6	Cough
7	Sore throat
8	Altered taste sensation
9	Altered smell sensation

Table 2: Transmission risk in pediatric otorhinolaryngology surgical procedure

Low-risk non-mucosal surgery	High-risk transmucosal surgery
Thyroid surgery	Tonsillectomy
Neck dissection	Adenoidectomy
Neck abscess drainage	Direct laryngoscopy
Parotid surgery	Rigid bronchoscopy
Branchial cleft/cyst excision	Endoscopic sinus surgery
Foreign body removal from the ear	Middle ear/mastoid surgery
Pre-auricular sinus excision	Microlaryngeal surgery
	Tongue surgery
	Foreign body removal from nose

face piece 2 (FFP2) mask, gown, head cap, face shield, and protective goggles. After finishing the procedures, PPE should be thrown into the specially made infected waste basin except the protection goggles which can be decontaminated and reused. The flexible endoscope should be kept separately on the table. If the camera is used, must be surrounded with a protective cover. The flexible nasopharyngolaryngoscopy should be properly sterilized. The surface areas of the examination room should be thoroughly cleaned. The next procedure should be delayed at least by 30 min.

Newborn Hearing Screening

This procedure should be performed by the audiologists who have no direct contact with COVID-19 patients [21]. The mother of the baby should be asymptomatic. The audiologist performing the test should wear surgical mask and surgical gloves before and after each test. The gloves should be changed after each test. The equipment used for the hearing screening must be decontaminated after every use.

Pre-operative Testing

Once the surgery is planned for the pediatric patient, pre-operative testing for COVID-19 should be done using nasopharyngeal swab with real-time polymerase chain reaction 48 h before surgery. The emergency surgical procedures should not be delayed as in stridor, hemorrhage, or severe infections. Since the sensitivity of the computed tomography (CT) scan of the thorax is more than 90% [22], it can be performed for immediate results. If the pre-operative report is COVID-19 positive, non-emergency surgery should be delayed for at least 14 days (usual duration of the quarantine period). CT scan of the thorax should be routinely performed in case of laryngotracheobronchial foreign body in children [22]. CT scan of the thorax is highly sensitive and specific to confirm the foreign body in the airway and minimize the negative bronchoscopy rates [23]. If the child is clinically unstable or with stridor, he should be shifted to the operating room (OR) with full precautions and PPE.

Precautions in the OR

The number of the health care workers including the surgeons should be minimal in OR. The surgery should be performed by experienced surgeon in less duration. Everybody in OR should wear protective goggles. The surgeon should use N95 mask, cap, face shield, and gown along with protective goggles. In case of positive case, FFP2 mask should be worn by OR staff. If possible, the surgery should be performed in the negative pressure OR with air purification/filtration system. Surgical techniques producing suspension of the infected tissues should be avoided such as drilling of the mastoid bone, microdebrider for endoscopic sinus surgery, monopolar electrocautery, laser, radiofrequency, coblation, and microdebriders [24].

Anesthesia for Pediatric Otolaryngologic Procedures

The major challenge for anesthesiologists is to deal with suspected or a confirmed case of COVID-19 pediatric patients. A dedicated OR is required for COVID-19-positive cases. Disposable laryngoscope and video laryngoscope should be encouraged during intubations reducing the transmission of infection. In such cases, high-flow nasal cannula should be avoided. Fiber-optic bronchoscopy-guided intubation should be avoided but can be used in emergency. If extracorporeal membrane oxygenation is available, it is preferable in emergency surgical airway in case of positive, suspected, or unknown COVID-19 patients. There should be systematic checklist and appropriated areas for donning and doffing near to the OR.

Adequate hypotensive anesthesia is helpful to reduce bleeding and minimize the related aerosolization of the blood and irrigation fluids. The anesthetists and the team should wear N95 mask, head caps, face shield, protective goggles, disposable gowns, and gloves during intubation and extubation [25]. Children with pneumonia can be deferred for the surgery. In case of patients of pneumonia with false-negative COVID-19 undergoing surgery under general anesthesia, the mechanical ventilation can worsen the status of the COVID-19 patient [26].

Pediatric Tracheostomy

Tracheostomy is a high-risk surgical procedure in COVID-19 pandemic, as it generates aerosols easily transmitting the virus. The elective tracheostomy can be delayed until active COVID-19 infections have passed with consideration of the current

guidelines [27]. Non-fenestrated cuffed tracheostomy should be used to minimize the aerosol spread. There should be initial advancement of the endotracheal tube before performing the tracheostomy. Ventilation should be stopped as it helps to produce aerosols [27]. Before inserting the tracheostomy, the cuff should be checked for any leak.

After tracheostomy, the tube changes should be delayed till infectivity of the patient ceases. Clinician should carefully judge the selection of the method of the humidification and a heat moisture exchanger as an alternate to the wet circuit reducing the aerosol generation. The occluded tracheostomy tube may disrupt the circuit at the time of the emergency enhancing aerosol spread. Different case series of tracheotomies were done at the time of COVID-19 pandemic showing techniques and preventing measures (Table 3) [28-30].

Pediatric Airway Surgery

Microlaryngeal surgery, rigid bronchoscopy, and laryngotracheal reconstruction in pediatric patients are high-risk procedures during the current COVID-19 pandemic and there are enhanced chances of the transmission of the infections to the health care workers because of aerosol generation and prolonged gas flow [27]. Emergency tracheostomy provides a significant risk for virus aerosolization and should be done with extreme caution. Routine direct laryngoscopy, bronchoscopy, or tracheoscopy should be avoided specifically in stable patients without any airway symptoms. If children with airway symptoms are present, surgery may be planned following the COVID-19 testing with the use of appropriate PPE.

Pediatric Endoscopic Sinus Surgery

Non-emergency sinus or nasal surgery should not be performed at the time of the COVID-19 pandemic. Pediatric patients of sinusitis with orbital cellulitis can be recommended for surgery. The sinonasal pathology threatening the vision or resulting in intracranial complications should be planned for endoscopic sinus surgery [23,24]. An external approach can be adopted because of the high viral load in the nasal cavity. In case of the endoscopic sinus surgery, throat pack should be given with caution as the insertion of the throat pack has chance of producing aerosols, however, the secretions of the pharynx may stimulate the coughing during emergency from anesthesia. The nasal bone fracture of the pediatric patient should not be recommended in this current pandemic time unless there is association with nasal septal hematoma [23].

Pediatric Otologic Diseases

Middle ear cleft mucosa such as the mucosal lining of the mastoid air cells and middle ear is considered as part of the upper respiratory airway in terms of the lining epithelium [31,32]. The middle ear cleft connects the nasopharynx by eustachian tube to the mastoid air cells and antrum by aditus [33,34]. Drilling of the mastoid bone can cause clouding of the irrigation and bone dusts, easily contacting facial skin and also inhaled by the surgeon and assisting staff [34]. Children with bilateral otitis media with effusion and hearing loss must be prioritized for tympanostomy tube placement but can be deferred till getting the COVID-19 test report. Mastoidectomy can be deferred if possible and if mastoid exploration is required, adequate PPE must be used by the otolaryngologists and high-speed drill should be avoided.

Mortality

COVID-19 causes high mortality among adult populations, whereas low mortality is found in pediatric age [15]. The early report regarding mortality rate in China was approximately

Table 3: Different case series of open surgical tracheostomies done at the time of COVID-19 pandemic [28-30]

Parameters	Wei *et al.* [28]	Chee *et al.* [29]	Tien *et al.* [30]
Hospital	Queen Mary Hospital, Hong Kong SAR, China	Tan Tock Seng Hospital, Singapore	Sunnybrook and Women's College Health Sciences Centre, Toronto, Ontario, Canada
Number of tracheostomies done	3	15	3
Barrier precautions at time of surgery	Standard PPE, shoe covers, face shield, eye goggles	Standard PPE, shoe covers, powered air-purifying respirator system	Standard PPE, Stryker T4 protection system
Setting	Negative pressure room inside ICU or operation room	Negative pressure room inside ICU	Negative pressure room inside ICU
Intraoperative steps to minimize aerosolization	Complete paralysis of patient, mechanical ventilation stopped before tracheostomy, no suction used during procedure, diathermy avoided as much possible	Complete paralysis of the patient, mechanical ventilation stopped before tracheostomy, limited suction used during procedure, no specific avoidance of diathermy other than during tracheostomy	Complete paralysis of the patient, mechanical ventilation stopped before tracheostomy, no suction used once trachea opened, diathermy avoided as much as possible
Surgical team	Single surgeon, one intensive care specialist, one standby medical or nursing staff	An experienced surgeon, an experienced anesthesiologist, one scrub nurse and one surgical assistant	Senior attending trauma surgeon, most senior surgical staff member available, attending ICU anesthetist and no circulating nurse or scrub nurse.

2.3%, whereas global mortality rate is approximately 6% [15]. The mortality rate among the critical COVID-19 patients is approximately 50% [15].

PPE for Pediatric Emergency

The PPE includes FFP3 masks or powered air-purifying respirator, long sleeved gown, surgical gloves, disposable eye protectors, and face shields. Only with appropriate PPE, examinations of the oral cavity, nasal cavity, and larynx should be undertaken. The risk of the viral transmissions will be minimized by use of the N95 mask and adequate PPE [35]. The strategies for preventing the transmission of the virus include adequate PPE use with head cap, face shield, face, and neck covering of the drapes limiting the spread of the infection particles generated by the high-speed drilling [36]. FFP3 masks with protective goggles or face shield or FFP2 in case of limited resource can be used by the surgical team during the mastoid surgery.

CONCLUSION

Effective management of the pediatric otolaryngology patients needs careful considerations of the health care workers and otolaryngologists considering their safety. The preventive interventions are increased testing of COVID-19 among children, using full PPE during any interventions, experienced otolaryngologist performing the procedures to minimize the workforce, and postponement of elective surgeries and clinic visits.

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