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PEDIATRIC OTOLARYNGOLOGY: CHALLENGES IN PEDIATRIC OTOLARYNGOLOGY (W-C HSU, SECTION EDITOR)

Lessons Learnt from the COVID-19 Pandemic in Pediatric Otolaryngology

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Abstract

Purpose of Review The current COVID-19 pandemic has challenged the international paediatric otolaryngology community: we review its impact in clinical, resource, and human settings.

Recent Findings The SARS-CoV-2 virus, while generally mild in paediatric populations, has caused an increased incidence in severe croup, invasive fungal sinus disease, and multi system inflammatory syndrome (MIS-C). The incidence of other common otolaryngology presentations such as otitis media and tonsillitis has decreased due to quarantine measures. The pandemic has also changed the way in which we work: guidelines for aerosol-generating procedures (AGPs) have changed, digital technology and videoconferencing platforms have flourished, and new pathways of providing healthcare have been developed to minimise footfall and avoid overcrowded waiting rooms. Finally, the importance of personal protective equipment (PPE) to protect healthcare workers and patients cannot be understated, although the mental and physical toll is considerable.

Summary There has been a tectonic shift in paediatric otolaryngology and healthcare globally. Continued adaptability and resilience are required to face these challenges in the coming months. With lessons learnt from managing SARS-CoV-2, we are hopefully well equipped to combat any future pandemics.

Keywords COVID-19 · Pediatric · Infectious disease · SARS-CoV-2

Introduction

The outbreak of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), beginning with the initial notification from Wuhan, China, on 31 December, 2019, heralded an international effort to control and mitigate its effects on the global population. As of 3 April 2022, there have been over 486 million confirmed cases and 6.1 million deaths reported worldwide [1]. In the field of paediatric otolaryngology, we have come together to demonstrate strong clinical leadership, showing an impressive adaptability to rapid change. Drawing on our close international community, we immediately shared the experiences of our colleagues in China, Italy, the Middle East, UK, and the USA, and later, South America, India, the rest of Europe, Africa, and Asia as they battled through repeated waves of coronavirus disease of 2019 (COVID-19) throughout 2020 and 2021 [2]. By virtue of continuous global communication efforts, we adopted — out of clinical necessity — a significant change in the way we work. At this point in time, 28 months since that first notification, it is important to reflect on the lessons learnt

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as we continue to meet the challenges of the COVID-19 pandemic. In this article, we discuss the lessons learnt from a clinical perspective, a resources perspective, and from the human perspective in paediatric otolaryngology. We then consider which of these practices we should bring with us into a post-pandemic world, and how we should act if a new pandemic were to occur.

Clinical Lessons

SARS-CoV-2 has mutated significantly since it was first identified, and we have seen five major variants, with increasing infectiousness but with some reduction in disease severity. The most recent mutation, Omicron sublineage BA.2, which has been increasing in circulation relative to other variants, is the most transmissible variant to date [3]. Fortunately, early data from South Africa suggests that the clinical severity of the BA.2 variant is no worse than the earlier BA.1 variant [4].

COVID infection in paediatric patients is generally mild. Early studies of 171 paediatric patients in Wuhan Children's Hospital demonstrated that up to 15% of COVID-positive children were asymptomatic, with the most common symptoms including fever, cough, and pharyngitis or pharyngeal erythema [5]. Lower respiratory tract infections are less common in children, and mortality is low (0.1%) compared to adults (5–15%) [6]. Although most paediatric patients experience a mild or even asymptomatic clinical course with COVID infection, in our clinical practice, we have seen unique manifestations of the disease in paediatric populations, including croup, fungal sinus disease, and multisystem inflammatory syndrome (MIS-C). Conversely, we saw reductions in acute tonsillitis and otitis media and its complications.

We have seen an increased incidence of COVID-19-associated croup in children. Brewster et al. [7] noted a significant increase in children presenting with croup to a paediatric hospital in Boston, Massachusetts, during a period of Omicron variant dominance. It was hypothesised that the increased incidence of laryngotracheitis may be caused by Omicron's predilection for the upper airways, compared to earlier variants such as Delta. All children tested negative for other viruses. 12% of patients were admitted to hospital: of these, elevated median dosing of adrenaline (8 doses) and dexamethasone (6 doses) indicates that laryngotracheitis caused by COVID-19 may be more severe than the croup we see typically during winter months.

Concerns for invasive fungal disease as sequelae of COVID-19 infection and its treatment were raised in the early stages of the pandemic [8]. Indeed, an increase in the incidence of acute invasive fungal rhinosinusitis has been described post COVID-19 infection [9, 10]. Although described predominantly in the adult population, the paediatric population has not been spared. Anecdotally, colleagues from India saw in increase in paediatric presentations of invasive fungal sinusitis, with seven paediatric presentations from March 2020 to March 2022, compared with zero presentations from March 2018 to February 2020. They detected some unusual and aggressive forms of mucormycosis extending from the paranasal sinus to the nasal skin and dorsum cartilages. All were immunosuppressed: four had diabetes mellitus and three had haematological malignancies. Only two of the seven children tested positive for COVID-19. The exponential rise of mucormycosis in COVID-19 in India is likely multifactorial. Lockdowns, travel restrictions, and restricted access to medical care have worsened glycaemic control for patients with diabetes mellitus. The extensive use of corticosteroids and the inflammation in COVID-19, as indicated by elevated ferritin levels, are other possible risk factors in addition to the SARS-CoV-2 infection itself [11, 12].

Paediatric otolaryngologists have seen patients present with a new paediatric hyperinflammation disorder caused by SARS-CoV-2 and typically developing within 4 to 6 weeks post COVID-19 infection [6]. The cutaneous manifestations of the disease — conjunctival injection, red, cracked lips, perioral desquamation, and a maculopapular erythematous rash — caused some to consider whether the disorder overlapped with Kawasaki disease, although recent literature suggests that MIS-C is a different entity altogether [6]. Children over 5 years are typically affected, and 90% of patients are persistently febrile. 60–80% of patients become haemodynamically unstable with high troponin and NT-pro-BNP levels and symptomatic myocarditis: comparatively, less than 5% of patients with Kawasaki disease suffer from symptomatic myocarditis [6]. Lymphadenopathy, gastrointestinal symptoms, and neurological symptoms are also features. Patients are treated with intravenous immunoglobulin G and high-dose corticosteroids [6].

Conversely, we have seen a decrease in traditional paediatric otolaryngology presentations. Anecdotally most parents following up in paediatric otolaryngology clinics are reporting a decreased frequency of acute tonsillitis and upper respiratory tract infections during the 2-year lockdown. This is likely multifactorial: less school attendance, less interaction with other children due to lockdown laws, and regular mask use. Surveys of parents with children with recurrent tonsillitis could help to understand this phenomenon. A study from New York showed that the percentage reduction in Emergency Department visits was greatest in the paediatric population: this was significant for tonsillitis and peri-tonsillar abscess [13]. Similar findings were noted in the UK [14].

A retrospective study in Netherlands demonstrated that consultations for acute otitis media, otitis media with effusion, and ear discharge reduced by 63%, 57%, and 54%

respectively during the COVID pandemic [15]. In Italy Aldè et al. and Toretta et al. also documented a reduction in number of children seen in outpatient clinics with otitis media with effusion [16, 17].

Resource Lessons

The COVID-19 pandemic has fundamentally challenged the way in which we work in paediatric otolaryngology. Confronted with a rapidly changing clinical landscape, we have had to draw significantly on economic and technological resources, making alterations to our clinical practice to keep both patients and staff safe.

Emergency Presentations

Otolaryngologists are at high risk of contracting COVID-19 due to inevitable proximity to virus-laden upper respiratory tract mucosa and involvement in aerosol-generating procedures [18–22]. The infection of 14 theatre staff during endonasal endoscopic surgery in Wuhan, China, in January 2020, followed by one of the first deaths of an otolaryngologist from COVID-19 on 20 January 2020, alerted the international otolaryngology community to the new occupational hazard associated with our profession [2, 23, 24]. Common otolaryngology intraoperative tools, including electrocautery, bone drilling, harmonic devices, and suction irrigation, have all been classed as aerosol-generating procedures (AGPs) [22]. Additionally, Mick and Murphy [22] argue that most ENT procedures, including flexible nasendoscopy, induce coughing, and cough is aerosol-generating.

Avoidance of AGPs and optimisation of safety for clinicians has compelled the international otolaryngology community to share and publish new guidelines for management of elective and emergency presentations. The Otolaryngology Department at Stanford University suggested deferring all endoscopies unless considered necessary to reduce morbidity within the next 30 days, and wearing a gown, N95 mask, and face shield if endoscopy was indicated [18]. Couloigner et al. [20] suggested using video nasendoscopy to increase the distance between the otolaryngologist and the patient. Lu et al. [25] described using a gel-based local anaesthetic in place of a spray to reduce cough. Pollaers et al. [26] ask: is the procedure is emergent or urgent? Will a delay result in significant morbidity or mortality? Should alternative investigations and therapeutic options that do not involve AGPs be considered? They suggest, for example, ordering a low-dose CT in cases of upper respiratory tract suspected foreign body if safe.

Multiple changes to standard procedures have been suggested to minimise exposure. For example, Pollaers et al. [26] describe using a Perspex suspension box covered with a plastic sheet for paediatric microlaryngoscopy and bronchoscopy. Tracheostomies should use a non-fenestrated, cuffed tube; ventilation should be ceased prior to tube insertion, and tracheostomy tube change should be delayed until the patient is COVID negative [27, 28]. Multiple authors stressed the importance of simulation and preparation in both elective and emergency surgery on patients of positive or unknown COVID status [26, 27, 29]. High levels of personal protective equipment (PPE) and powered air purifying respirators (PAPRs) can hinder communication [28]. The most experienced staff should perform the procedure [26].

A common theme throughout the literature is concern regarding availability of COVID screening testing prior to emergency surgery due to lack of resources and slow testing times [21, 27, 29]: patients are treated as COVID-positive until proven otherwise [26]. Fortunately, 2 years into the pandemic we now have access to rapid, accurate point of care testing for all patients presenting to emergency departments in New South Wales, Australia.

Triage of Outpatient Presentations

Commentary from Seattle illustrated the effectiveness of a traffic light system to triage the clinical need for assessment in a paediatric ENT clinic, due to high risks of caregiver exposure in the ENT outpatient environment [30]. The need to conserve PPE was key in this decision. Hospital traffic was limited, and screening with symptom-related questions and temperature assessment was instituted. Elective cases were postponed, and only emergent cases performed. These emergent cases included severe airway obstruction, foreign body retrievals, soft tissue abscess drainage, complications of sinusitis and otitis media, and post-tonsillectomy haemorrhage. Urgent cases deemed time critical in terms of the child's overall health and developmental outcomes, where a delay of 6 weeks could increase morbidity, such as malignancies and cholesteatoma, were also performed. All patients were tested for COVID-19 to reduce unnecessary PPE use.

A triage system for clinic appointments was created to distinguish patients with urgent clinical issues who needed to be seen in person for a physical examination from those who were appropriate for a telemedicine visit or whose visits could be rescheduled. Using this traffic light system in Seattle Children's Hospital, 24% of visits needed to be in-person, 16% were telemedicine, and 60% were postponed [30]. Clinical staff were re-deployed, and traditional in-person ward rounds transformed into teleconferenced "huddles" in which patient care was discussed. There was the inevitable slowdown in the throughput of operative cases where donning and doffing had to be performed carefully. The use of powered air-purifying respirators (PAPRs) was preferred, but when headlights, loupes, or the microscope had to be used, a N95 mask with

eye protection was used to protect the clinician from COVID-19 transmission.

In our hospitals in Sydney, Australia, several operating theatre spaces were converted to negative pressure rooms. We were selective in performing endoscopy only in cases where potential findings would have significant impact on patient management. In one study at our unit, we found that stridor and objective increased work of breathing were the main variables that correlated significantly with a positive finding on endoscopy, while the variables that correlated with a negative airway finding on endoscopy included oxygen desaturations and the need for CPAP therapy. In other words, to mitigate risks, if the patient had a particular subset of symptoms or signs such as stridor and objective work of breathing, these children would more likely require the procedure, as compared to patients without these signs or symptoms. The latter group may be directed to surveillance over time rather than an immediate procedure, as this may reduce the potential risk of transmission of COVID-19 infection to the healthcare personnel managing the patient.

Telehealth

The economic response to COVID-19 in Australia has been unprecedented, with the Federal Government committing an additional $33 billion in health spending since the beginning of the pandemic [31]. This highly contagious respiratory virus necessitated a rapid paradigm shift in the assessment of patients in an outpatient setting, from an almost entirely face-to-face model to one where telehealth predominated [18, 19, 32, 33]. The Australian government recognised this transition and swiftly introduced new Medicare Benefits Schedule (MBS) item numbers for Telehealth consults on 13 March 2020, allowing general practitioners, specialists, and some allied health providers to bill for telehealth consultations to reduce the spread of COVID-19 and protect patients and providers [34]. The Medicare Benefits Schedule itemises the medical services that the Australian Government subsidises for the population of Australia, an important facet of the socialised health system.

The shift to telehealth presents unique challenges for the assessment of paediatric otolaryngological issues, where assessment is examination-heavy and often involves multidisciplinary teams [19, 32, 33]. These challenges are discussed at length in the literature. Ohlstein et al. [19] describe that those turning down a telehealth consult were older and more likely to be otology patients: the primary reason for doing so was the lack of a physical exam. The authors question, how can we better serve our patients via virtual exams? Sclafani et al. [35•] propose a novel solution: the augmented outpatient otolaryngology teleconsultation, where 10 patients connected their own direct-to-consumer (DTC) otoscope which was linked to the otolaryngologist's computer. These DTC otoscopes are inexpensive digital otoscopes which can be connected to the computer using a USB connector, and the patients can demonstrate their findings on a Telehealth platform. None of the patients had any difficulty connecting the otoscope, and 9 of the 10 patients felt that the physician had performed an adequate physical exam. None of the patients would have preferred an in-person visit. Hoi et al. [32] discussed creative solutions for multidisciplinary care in paediatric otolaryngology, where telemedicine was successfully implemented for seven multidisciplinary paediatric clinics, including aerodigestive disorders, congenital hearing loss, microtia/aural atresia, orofacial clefting, sleep disorders, tracheostomy care, and velopharyngeal dysfunction.

Telehealth has been a useful and necessary tool to protect patients and providers during the COVID-19 pandemic. Its utility as a tool of convenience moving forward out of the pandemic has been recognised both in the literature and by the Australian Government, who have announced that telehealth will continue to be funded by the Medicare Benefits Schedule (MBS) into 2022 and beyond. [33, 36]

Human Lessons

When news of the COVID-19 pandemic broke, we could only watch on as we saw what our colleagues were facing in Wuhan, China. Using every technological resource available to them, our colleagues in otolaryngology, intensive care, and anaesthesia collated and presented their experiences, the likes of which many of us had not seen before. An invaluable resource was quickly produced and distributed on 18 March 2020 by the First Affiliated Hospital of Zhejiang University (FAHZU), outlining their clinical experience in the first 50 days of the pandemic with 104 COVID positive patients [37]. The manual included instructions regarding infection control and prevention, including personal protection equipment (PPE), disinfection protocols, and digital support. They outlined their multidisciplinary management of severely ill COVID-19 patients, and diagnosis and treatment of COVID-19 with antiviral therapy and corticosteroids as it was understood in March 2020. The use of high-level ICU supports such as the artificial liver support system (ALSS), invasive mechanical ventilation, and extra-corporeal membranous oxygenation (ECMO) are also described. Many of these initial protocols have formed the foundations for current practice in infection control and managing severe COVID-19.

On a local level, concerns were initially raised about whether we had adequate supplies of personal protective equipment (PPE) to protect ourselves, our families, our colleagues, and our patients. Previous experience with the Ebola and SARS pandemics had provided us with a

small number of PAPRs, and our surgical team was given individualised units. We were taught how to don, doff, and sterilise the PAPRs. However, despite our access to these devices, they were never employed on a regular basis: the use of N95 masks, goggles, and disposable overalls and other simple measures such as hand washing, social distancing, and regular showering at work became our definitive game plan to avoid transmission of the infection to ourselves, our families, our colleagues, and our patients. This practice was supported by a growing body of literature from the medical community, world health organisations, and governmental institutions.

In a large systematic review and meta-analysis of 172 observational studies across 16 countries, Chu et al. [38••] demonstrated that physical distancing of 1 m or more, the use of face masks (and in particular N95 masks), and eye protection were all statistically significant factors in reducing the transmission of COVID-19. This study was published when it was unknown whether COVID-19 was spread via respiratory droplets or aerosols. Tian et al. [39] analysed 54 studies in 20 countries involving 191,004 healthcare workers during the COVID-19, H1N1, SARS, MERS, and H5N1 pandemics. They confirmed that frontline healthcare workers and those involved in endotracheal intubations were at greatest risk of contracting COVID-19, and that use of PPE such as gloves, gown, surgical mask or N95 mask, face protection, and infection training was protective.

Understandably, there has been a substantial toll on the mental health of healthcare workers throughout the pandemic. Some otolaryngologists were redeployed into areas of need such as the intensive care unit, where staff members were voluntarily self-isolating away from their families for fear of passing on infection [40] A large-scale study of 5062 healthcare workers in Wuhan showed that 29.8%, 24.1%, and 13.5% of respondents reported symptoms of stress, anxiety, and depression respectively in relation to the COVID-19 pandemic [41]. While PPE is fundamental to protect us from contracting COVID, wearing it is challenging and impacts negatively on mental and physical health [21, 41–43]. A survey of 72 anaesthetists, surgeons, and nursing staff demonstrated that enhanced PPE resulted in significant levels of exhaustion (70.8% of respondents), headaches, or exacerbation of existing headache disorders (61.4%) and skin changes [42]. 90.3% of respondents reported difficulties with communication. The impact of enhanced PPE on mental health was profound with somnolence, anxiety, and depression reported in 40.3%, 27.8%, and 19.5% of respondents respectively [42]. In a separate survey of 592 healthcare workers in Singapore, 53.8% reported PPE-related side-effects, predominantly from N95 masks, including pressure injuries (45.5%), mask-induced acne (40.4%), and pain (24.5%) [43].

The past 2 years have demonstrated that the greatest resource at our disposal in navigating unchartered territory is our healthcare workers. Thanks to our early closure of international borders and geographical isolation, Australia has fared comparatively well during the COVID-19 pandemic. As of 3 April 2022, there have been 4.4 million cases and 6367 deaths due to COVID-19 in Australia [44]. The vast majority of these cases have been seen since December 2021, when our international borders opened and Omicron arrived at our shores [44]. As cases increased exponentially in December 2021, it became evident that our most precious resource was finite: healthcare workers. With 2510 healthcare workers in isolation on 30 December 2021, the New South Wales Government made the radical decision to amend isolation laws for critical healthcare workers, allowing asymptomatic frontline workers classed as "close contacts" to leave home isolation to return to work under strict testing conditions [45]. It was finally clear that our healthcare system simply did not have the surge capacity to cope with 2,500 furloughed workers.

Where to From Here?

There are two questions we must now ask ourselves. First, should we face another pandemic — without access to vaccination — what procedures should be followed in the first instance? In a general sense, rapid global scientific collaboration and communication has been key to combating the virus. The sharing of resources like those from FAHZU arguably saved lives as COVID-19 spread across the globe: medical teams in countries newly hit with waves of COVID-19 were able to rely on the experiences of those who had successfully managed the virus in their hospital and implement those tried and tested practices. This global collaboration will be critical should another pandemic occur. Additionally, Chu et al. [38••] demonstrated that physical distancing greater than 1 m, N95 masks, and eye protection are effective in preventing transmission for COVID-19, SARS, and MERS: these basic measures could be employed at least initially as modes of transmission are researched and established. Hospitals will need to ensure adequate supplies of PPE are kept in the event of another outbreak and supply chains are established.

This raises a separate issue. As discussed, studies have demonstrated a significant physical and mental health burden associated with the wearing of PPE, in particular N95 masks [21, 41–43]. Wearability and comfort of PPE should therefore be optimised before we ask our valuable healthcare workers to don it for extended periods.

The second question we ask is: what practices should we take with us into a post-pandemic world? Necessity has forced the international otolaryngology community to alter

traditional techniques for the safety of the clinician and patient. Some of these approaches, such as delaying endoscopies unless urgent, should be repealed as we move forward into a world in which we live with COVID-19. Others, such as telehealth consults, have emerged as useful adjuncts to the otolaryngologist's toolkit [33, 35]. We have seen that challenges associated with telehealth such as otology exams can be overcome with creativity and modern technology [35]. We have seen breakthrough innovations in this space, using artificial intelligence (AI) to capture and interpret images from endoscopic examination of children in rural and remote areas. Habib et al. [46] examined the role of an AI computer-vision algorithm to triage otoscopic images from Aboriginal children in Australia who underwent tele-otology ear health screening. 6527 images from 39 publications were used to diagnose acute otitis media with 99.3% accuracy and chronic otitis media with 96.3% accuracy. Newly developed AI algorithms are now being developed to diagnose and triage ear disease in remote Aboriginal communities in Australia [47]. The Australian Government has recognised the utility of telehealth and has continued to fund it on an ongoing basis [36]. We are faced with an exciting prospect: we now have both the technological and administrative foundations in place to bring otolaryngology services via telehealth to patients in rural and remote Australia, improving access to subspecialised services.

Conclusions

Through necessity, COVID-19 has delivered us a golden opportunity for progress. It has been 28 months since we received the first notification of the COVID-19 pandemic: during this time, we have seen a seismic shift in the practice of medicine and otolaryngology. Advances necessitated by the pandemic, particularly in telehealth and technology, will continue to form part of our practice as we move out of the COVID-19 era.

We are thankful for support of our colleagues, particularly the infectious diseases physicians, epidemiologists, vaccine scientists, frontline workers, and those who have lost their lives, who have helped us to fight on the frontlines of the COVID-19 war. While this has been a devastating time for many around the world, we should celebrate the positive changes that have come from the pandemic. True progress is borne out of hardship, and global collaborative efforts have delivered one of the most remarkable scientific feats of our time: an effective, approved vaccination within 12 months.

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Compliance with Ethical Standards

Conflict of Interest The authors declare no competing interests.

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