

Elective otological healthcare under COVID-19 contaminations risks

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ABSTRACT

The COVID-19 pandemic has raised unprecedented challenges for all types of medical personnel and health care workers. The avidity of the novel coronavirus for oropharynx and nasopharynx renders otolaryngologists at particular risk of infection. Therefore, the resumption of elective otological care requires personal protective equipment (PPE), thorough (pre)screening and irrefutable hand hygiene. A literature search was conducted on May 5th, 2020. All recommendations concerning otological ENT (Ear Nose Throat), both during outpatient consultation and in the operating theatre, were scored for abundance. Highly recurrent advice was using PPE during each patient encounter, social distancing in the waiting room and teleconsultation before each consultation. Concerning audiological testing, most articles advised social distancing during testing and remote hearing screeners. For resumption of elective otological surgery, preoperative screening, adequate PPE, and minimal staffing to reduce the contamination risk were most frequently advised. Awaiting an effective vaccination for the novel coronavirus, all elective otological health care requires critical appraisal of each case to assess the infectious risks for both patient and health care personnel.

Keywords: Audiology, contamination risk, COVID-19, healthcare, otology, personal protective, equipment

Introduction

COVID-19, caused by the novel coronavirus SARS-CoV-2, was declared a global pandemic as of January 2020 by the World Health Organization (WHO) (1, 2). The virus is transmitted through respiratory droplets and aerosols. The most common initial symptoms of COVID-19 are dry cough, sore throat, dyspnea, smell and taste disturbance, fever, fatigue and myalgia (3-7). The second clinical phase is characterized by high fever, hypoxemia and pneumonia-like symptoms. In severe cases, this phase is followed by rapid-onset acute respiratory distress syndrome (ARDS) caused by an auto-immune cytokine storm (8).

Empiric estimations of the reproductive number of the virus reached $R=2.8$ (9). European and Middle East countries responded by imposing restrictions on social contact ("social distancing") in a strategy to flatten the curve of transmission. A limited lockdown was announced on March 17th, 2020 in Belgium and March 2nd, 2020, in Iran, later strictly enforced by local authorities.

Because of close contact with contagious patients, all healthcare workers are at risk of infection. However, since human-to-human spread occurs mainly through respiratory secretions, specialties dealing with the aerodigestive tract are even more at risk. It was reported that otolaryngologists face a significantly high risk (risk ratio 2.13) (10-12). As for otology, no articles demonstrating the novel coronavirus' avidity for the ear mucosa have been published. However, long before the outbreak of this pandemic, other coronaviruses have been demonstrated in the middle ear of patients with acute otitis media. Moreover, it has been shown that mucosal lining of the oropharynx and nasopharynx is characterized by an extremely high viral shedding of the novel coronavirus. The direct connection with the middle ear through the Eustachian tube makes otological procedures therefore suspect for viral shedding of the virus (13). It was rapidly recognized that personal protective equipment (PPE) is of the utmost importance in these professional groups (14).

In the heat of the pandemic, all non-acute and elective healthcare was delayed to avert the risk of infection and to safe-

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guard the hospital capacities. About otology, fortunately, acute life-threatening diseases are rare. However, many diseases are not considered self-limiting and will eventually need medical attention (15). Several countries published empirical guidelines in how to prioritize otologic surgery during the lockdown (16-18).

In Belgium, the governmental restrictions appeared effective in flattening the curve but caused an economic burden. Healthcare institutions were avoided by patients requiring non-COVID-19 related care in fear of contamination (15). Policymakers have realized that lockdown is even more dangerous than COVID-19 itself, perhaps, and society must restart somehow (19). Government elaborated a plan for gradual reduction of the constraints, starting on May 4th, 2020, in Belgium, and on May 25th, 2020, in Iran. This decree means that otological care must be foreseen in the presence of a COVID-19 infection threat and a considerable risk of a 'second wave' of infections. Resumption of the practice will, therefore, require a pragmatic approach and case-by-case evaluation (20-23, 3).

Currently, evidence-based protocols or guidelines for otologic care under COVID-19 contamination risk are not yet available. Moreover, some local authorities or even hospitals have different guidelines depending on the local supplies and circumstances. This article aims to assemble all available evidence to illustrate relevant issues in restarting elective care in otology; both in outpatient care (including audiology) and in the operating theatre.

Methods

A systematic review of the literature was conducted using the databases of PubMed, and Cochrane Library on May 5th, 2020. We searched for articles relating to COVID-19, otolaryngology, otology and audiology. Articles were excluded if the main subject was not in relation to the set domain. Bibliographies were screened for related articles to verify that all significant articles were included. Subsequently, all abstracts were screened for eligibility in the review. A selection was made for full-text appraisal and the most recurring advices were scored for abundance. This approach rendered an impact score for a piece

of advice. For example, 5/24 means that 5 out of 24 articles concerning otology made a recommendation on this topic. For audiology, a score of 3/4 signifies that 3 out of 4 articles in the audiology subsection suggested this advice. For all articles found, the publication date was used for the creation of an overview of the evidence expansion per month.

Results

Fifty-nine articles or commentaries were found and reviewed. Of these, thirty-one articles concerned otolaryngology in general and six were specified towards otology. Three articles discussing audiology, six articles about pediatric otolaryngology and five articles about head and neck malignancies were found. Moreover, there were five articles discouraging tracheotomy during the COVID-19 pandemic and three articles about ear nose throat (ENT) residency training. Twenty-four articles concerning otology and four concerning audiology were selected for full text review and frequency counts of specific advice. Table 1 shows frequency counts for all advice concerning the outpatient department, table 2 advices concerning audiology and table 3 advices concerning the operating theatre. Table 4 shows the expansion of available evidence in the first months of 2020.

Outpatient Care

After halting elective care for two months, otologists are now faced with an increasing demand of patients with a semi-urgent problem. However, since close contact with patients necessitates personal protective measures, quick elimination of this demand will most likely not be possible. A critical appraisal of the indication for a consultation will merit. Routine check-ups could still be omitted from the agenda and teleconsultation by use of video- and/or telephone conference call could screen if any prioritizations for potentially dangerous diagnoses are present. This teleconsultation might also help patients contemplate the need to come to the hospital and take away some hesitation in this respect in case of a neglected symptom. This advice was found in 11/24 articles, as shown in Table 1. In Belgium, telemedicine (consultations by phone or internet) has been appreciated by the government and can even be charged to the public national health insurance as caretaking (5/24). During these teleconsultations, it is very important to screen for symptoms of the novel coronavirus. This remote intake should include questioning contact with COVID-19-positive individuals and symptoms such as dry and persisting cough, dyspnea, loss of olfaction or taste, fever and headache. Such basic screening could be conducted by a well-informed secretary or by a well-organized online system. If the patient denies all symptoms and suspect contact, an appointment can be planned. If any of the COVID-19-related remote screening questions are answered positively, a semi-urgent consultation could occur after COVID-19-related testing. The combination of nasopharyngeal swab and tomographic imaging of the thorax provides reliable evidence [24]. An urgent consultation for a patient with suspicious answers on the screening questions can be scheduled at the end of the program. The use of a separate consultation room for established or suspicious positive patients is strongly advised. The infrastructure of this box should be reduced to the bare minimum and attention for maximal PPE and proper disinfection afterward are paramount.

Main Points:

- COVID-19 has posed unprecedented challenges for the medical world and the lasting presence of the novel coronavirus causes persistent risk of infection for otologists and audiologists.
- Literature concerning otolaryngology during and after the COVID-19-pandemic increased exponentially, but evidence-based data is still scarce.
- Recommendations for restarting outpatient care most frequently advised using personal protective equipment during each patient encounter, social distancing in the waiting room and teleconsultation before each consultation.
- For audiological testing, social distancing during testing and remote hearing screeners were most frequently recommended.
- For elective otological surgery, recommendations about pre-operative screening, adequate personal protective equipment, and minimal staffing to reduce the contamination risk were most abundant.

Table 2. Recommendations per article in the audiology subsection

Audiological examination	Kozin ED et al	UK's audiology professional bodies	Swanepoel DW et al	Eby TL et al
Hygiene teaching		X		
Social distancing		X	X	X
PPE		X		
Disinfection of material		X		
Air purifier				
Remote hearing screeners	X	X	X	X

PPE: Personal protective equipment

the preimplantation trajectory for patients eligible for cochlear implants.

Poorly ventilated soundproof booths pose a challenge. General directives in averting COVID-19 recommend facilitating natural aeration as much as possible. However, in audiology booths this might render proper determination of the audiological thresholds impossible. If possible, audiology booths should be used alternatingly and chairs, surfaces, headphones and tympanometers should be disinfected rigorously between patients and left unattended for minimally 10 minutes (1/4). The use of air purifiers has not been proven efficient, but might be considered since soundproof walls are thought to compile microdroplets more than regular types (0/4). The COVID-19 pandemic will usher the audiological discipline to rethink itself. Rather than high-touch service with several face-to-face appointments, low- to no-touch services will have to be the future. The appointments can be divided into two categories: diagnostic assessments requiring a conventional sound-treated room to detect possible ear disease, or assessments for hearing aid fittings for which alternative point of care services may be suitable (26). Always consider the possibility of remote care in the first instance (27). Remote air conduction audiometry can flag asymmetrical hearing losses that could infer referral for traditional high-touch audiological assessments (4/4) (16, 28, 29).

Operating Theatre

Performing elective surgeries in the presence of COVID-19 risks will require thorough preoperative screening, both diagnostic screening and eligibility screening. With the 'primum non nocere'-paradigm in mind, elective surgery is only to be conducted if the benefits of the intervention outweigh the risks for both patient and operating room (OR) personnel. The number of article recommendations of this subsection can be found in Table 3.

The operating time should be minimized as much as possible in order to minimize the risk of exposure (2/24). The surgery should be conducted by the most experienced staff member (5/24). The presence of residents should be made possible, with PPE made available. Due to the limitations on outpatient

consultations and elective surgery as well as potential redeployment in other wards during the pandemic, the course of training of the current resident cohort has already been significantly altered (30, 31). Surgery training must resume and surgeons in training will have to accept the same infection risk as the experienced surgeon.

Remote screening concerning the urgency of the otologic condition and preoperative screening for COVID-19-related symptoms goes parallel with the protocol for outpatient consultations. There has been debate about computed tomography scanning of the chest proving a better screening tool than swabs, which potentially have a high false negative rate. Radiologist claim to be able to diagnose typical corona lesions at the level of the lungs in non-symptomatic cases. A recommendation to scan the lungs before elective surgery would make much sense, as 15/24 articles reported this. Only by doing so, occult pneumonia and extubation problems can be diagnosed and predicted. The high-risk cases should be postponed as much as possible until the COVID-19 symptoms or pneumonia have subsided, should the otologic condition allow it.

Low-risk patients with negative screening with a nasopharyngeal swab and negative chest imaging seem to be eligible for surgery if the usual risk-benefit analysis of elective interventions deems this acceptable. Protecting all OR personnel implies the use of more extensive PPE than the during pre-COVID-19 era (20/24). Several articles advise the use of a powered air-purifying respirator (PAPR) for high-risk surgery. However, the demanding use, donning and doffing of this aid and its visibility constraints have raised recommendations against it. Gordon et al. described using a fully draped exoscope during mastoidectomy, permitting the use of maximal PPE without comprising on surgical visualization of surgical time (32). Furthermore, the use of additional draping material might be beneficial (5/24). Chen et al presented the use of an OtoTent (a commercially available 1060 Steri-drape in which a hole with a 6 cm diameter was cut) to enclose both microscope lens and surgical field (33). Our institute's experience showed that the OtoTent is both effective and financially favorable compared to a second microscope drape and a gamma nail drape. The former showed positioning problems and the latter proved to be more expensive. Figures 1 a-c show the draping system of the different drapes listed. The need for high-speed drilling demands critical appraisal since, even long before the emergence of the novel coronavirus, research has proven that this surgical technique generates aerosolization of bone particles (34). Keeping this in mind in the following months, it is advisable to use manual approaches, such as curettage, as much as possible and to allow a minimum of attendees into the operating theatre (11/24 and 10/24).

Performing the intubating process is assigned to one of the anesthesia team's staff members, after preoxygenation with 100% oxygen for preferably 3 minutes, with a facial mask sealed over the patient's face. Particular interventions, such as stapedotomy, might be conducted using a laryngeal mask airway to avoid aerosolization during intubation. When the duration of the surgery requires intubation, a high-efficiency hydrophobic filter could be placed between the facial mask and the corrugated tubing to reduce aerosolization risks (35).

Table 3. Recommendations per article in the operating theatre subsection

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	Xu K et al	Kozin et al	Ty- some JR et al	Jackler RK et al	Saadi RA et al	Boc- LA et al	Bet- JT et al	Kow- LP et al	Givi B et al	Lavin- sky J et al	For- JD et al	AOO- HNS et al	Lüers JC et al	Vuk- N et al	Chan J et al	Pattis- apu P et al	Tay JK et al	Panu- BA et al	Zhao C et al	Liu Z et al	Khari- wala SS et al	AAO- NHS et al	Gordon SA et al
Pre-operative screening	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
PPE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Additional draping	X						X														X		X
Reducing OR time	X									X													
Minimization of attendees	X			X	X	X		X	X	X	X	X	X	X		X		X	X	X	X		X
Most experienced staff member	X			X						X		X											X
Avoid drilling	X			X	X	X	X		X	X	X	X	X	X		X		X	X	X	X		X
Intubation and extubation	X	X			X	X	X	X	X	X	X			X		X		X	X	X	X		
Hypotension to minimize bleeding	X																						
Negative pressure to reduce viral load	X	X						X	X									X		X			
PPE: personal protective equipment; OR: operating room																							

There is evidence that gauze pads around the tube would absorb oral secretions and eye protection minimizing contact with the patient's tears (36). During the intervention, hypotension facilitated by the anaesthetist is recommended to minimize bleeding and to reduce the necessity for suctioning (1/24). Before extubation, oral secretions should be rigorously suctioned. Yang et al. demonstrated that intravenous lidocaine administration prior to extubation could diminish the risk of heavy coughing during awakening (37). All nonessential staff should leave the room during the intubation and extubation process (10/24). During the surgery, door movements should be kept to a minimum and explicit hazard signaling should indicate the high infection risk. Regarding infrastructure, a negative pressure environment is ideal for lowering possible dissemination rates of the virus and air changes at a high frequency reduce viral load in the operating theatre (6/24) (37).

Table 4. Expansion of available evidence concerning COVID-19 and ENT per month

January 2020	0
February 2020	0
March 2020	8
April 2020	38
May 2020	12

However, recourses and policies may vary between countries but also between hospitals. The authors are aware that in some hospitals, specific equipment, such as powered air-purifying respirator (PAPR), may be limited but advocate that the use of PPE should be dictated by patient and provider safety, not equipment availability.

Conclusion

COVID-19 has startled the medical world in an unprecedented way. Because of the ongoing threat of infection and fear of a 'second wave', resumption of elective care in otology will be challenging. The mucosal lining of the middle ear, including the Eustachian tube and mastoid cells, is considered respiratory mucosa and are therefore, it is also believed to shed viral particles, posing a significant risk for otology and audiology health services. During the COVID-19 contamination risk, infection threat burdens elective otologic care with extensive considerations of patient and personnel safety. Prudence and thorough patient selection and testing are paramount. Persistent use of maximal PPE when conducting an intervention involving the middle ear or mastoid is therefore advised in patients with a high risk of a COVID-19 infection. Minimization of possible aerosol spread must be one of the primary concerns. While data is still scarce on the transmission risk of COVID-19 during manipulation of the middle ear and mastoid, the highest available standard of personal protection is advisable.

Table 5. Required PPE for audiologists and otologist in outpatient care

	Proximity	Activity	Hand & respiratory hygiene	Gloves ♦	Aprons	Fluid-resistant surgical mask II (FRSM)	Eye protection
In Clinic	Where you can work in an area maintaining 2m separation	Case history, explanation, instruction, rehab & counseling etc.	✓	✗	✗	✗	✗
	Where working in close contact (within 2m) conducting procedures with low risk of splashes, droplets of blood or body fluids	Any audiological procedure other than those listed below	✓	Optional ▲	Optional ▲	✓ ★	Optional ▲
	Where working in close contact (within 2m) conducting procedures with high risk of splashes, droplets of blood or body fluids	Wax removal (any procedure) for a NON-PERFORATED TM. Use a non-fenestrated suction tube with micro-suction. Caloric/vestibular chair BAHA abutment site care Case by case where risk identified	✓	✓	✓	✓ ★	✓ +
Home	Domiciliary setting where environment not under practitioner control	Any audiological procedure	✓	✓	✓	✓	Optional ▲

▲ Risk assess refers to utilizing PPE when there is an anticipated/likely risk of contamination with splashes, droplets of blood or body fluids. Where staff consider there is a risk to themselves or the individuals they are caring for, they should wear a fluid repellent surgical mask with or without eye protection as determined by the individual staff member for the care episode/single session.

★ Ask patient to wear face mask where possible.

+ With regard to micro suction, consider whether the viewing apparatus, e.g. microscope/loupes, provides adequate eye protection & to use goggles/visor would impede view.

♦ Consider risk of cross contamination and dexterity inhibited, good hand hygiene can negate need for gloves

TM: Tympanic membrane, BAHA: Bone-anchored hearing aid

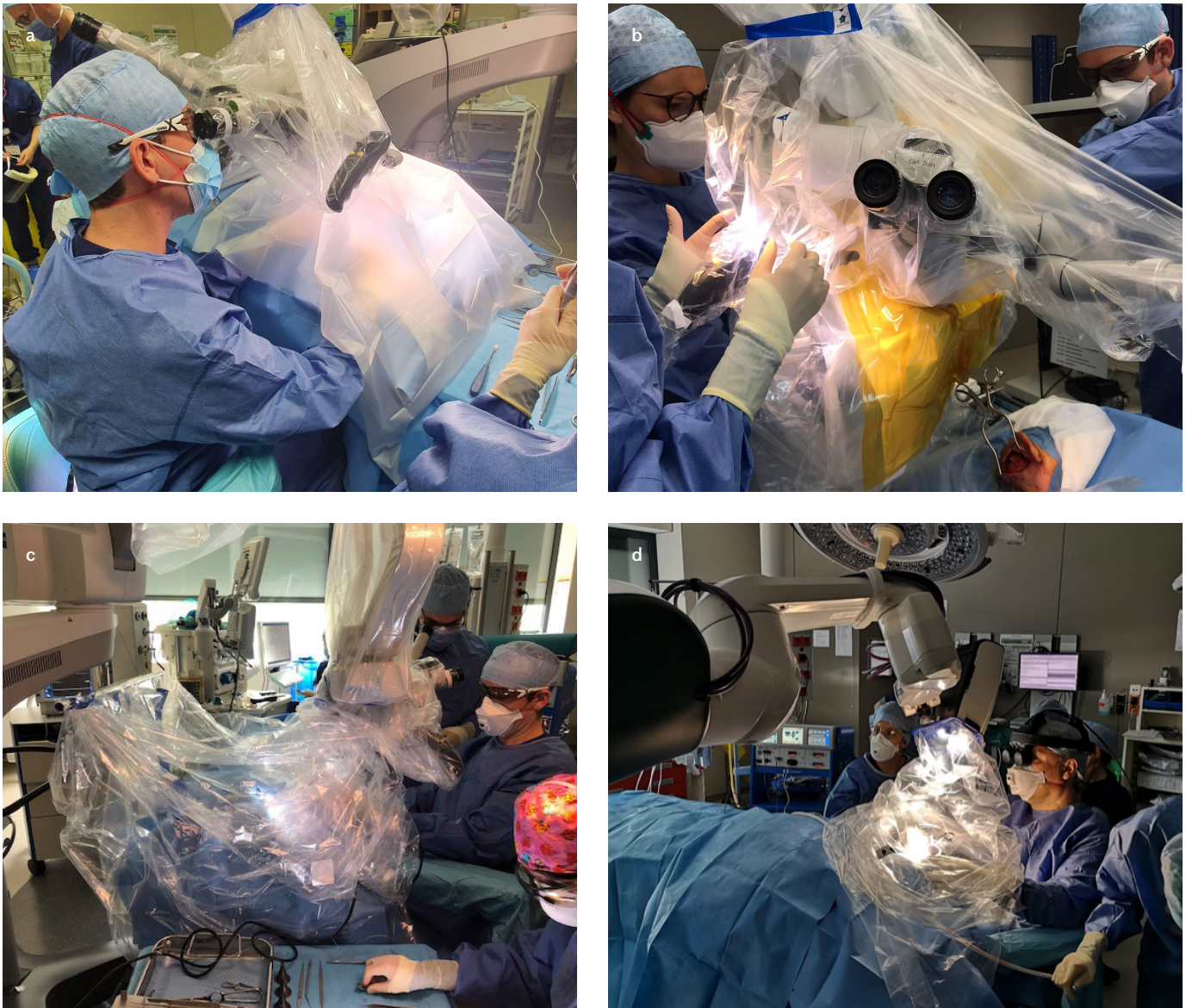


Figure 1. a-d. Different additional draping options during otologic surgery; (a) OtoTent, (b) Gamma nail drape, (c) Microscope drape, (d) Exoscope drape.

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