




Optimizing Airway Surgery in COVID 19 Era

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Received: 22 October 2020 / Accepted: 14 December 2020
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Abstract Otorhinolaryngologists, particularly dealing with airway cases, are subjected to highest risk of COVID 19 aerosolisation, self infection and transmission. Moreover, airway cases, which mostly present as emergency, cannot be deferred. Being a tertiary airway centre and having received a number of airway cases, most of them requiring prompt surgical intervention, our airway surgery and anaesthesiology team had to work in conjunction to adapt and readapt the practice over the past few months, striving to achieve effective airway surgery protocols, to minimize exposure and prevent transmission of COVID 19. To enlist the encountered airway cases during COVID 19 pandemic and to highlight the important inclusions and adaptations in executing the airway surgeries. A retrospective observational study of 7 months duration was carried out. This is a single institutional study, where the sample included the primary as well the referred airway cases. Apart from Tracheotomy, Foreign body bronchus removal, Dilatation

of Laryngotracheal Stenosis (LTS) and excision of Recurrent Respiratory Papillomatosis (RRP), we also have had the experience to deal with congenital Laryngo-tracheo-oesophageal Cleft (LTOC) Type III b, Thyroid surgery to relieve tracheal compression and Bilateral Choanal Atresia repair during the last 7 months. Routine 2 weeks follow up of the patients have been favourable, as there has not been any report or clinical features of transmission of COVID 19. As the airway surgeries could be executed with the incorporation of certain change in practice and as the follow up revealed no evidence of transmission, we attempt to contribute to airway best practice guideline for maintaining the safety of patients and health professionals.

Keywords Airway surgery · Aerosols · Covid 19 · Safety · Guidelines

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Introduction

The novel corona virus disease 2019 (COVID-19) outbreak was declared a pandemic by the World Health Organisation (WHO) on 11th March, 2020. The first case of the COVID 19 pandemic in the Indian state of Assam was reported on 31 March 2020. Initially, in our region, the statistics showed a controlled number of cases. However from the latter half of May, there has been a steady rise in the number of positive cases, and currently as on 30th September, it stands at more than 89,000 confirmed cases. Such a backdrop presents unique challenges for Otorhinolaryngologists. Even more challenging is the management of airway cases. Patients with airway pathology usually seek medical attention as an emergency. The upper aerodigestive tract being the harbouring site of the virus and transmission via aerosols; airway surgeons, anaesthesiologists, and operating room (OR) personnel are subjected to high risk during any procedure. Though there are unavoidable risks and difficulties related to transmission hazard, emergent airway surgeries or procedures cannot be left unattended or deferred. For the benefit and safety of such patients and health personnel, revised safety guidelines or precautions have to be instituted. To deal with airway cases during COVID times, particularly those which require surgical intervention, there has to be an excellent co-ordination between the surgeon and anaesthesiologist as both can work in conjunction to devise adaptations to minimize aerosolisation.

As this pandemic and its challenges are unfolding and posing new tribulations, sharing of recent surgical experiences, especially in the management of airway cases, can go a long way in contributing to the best practice guidelines [3, 11]. When we initially dealt with airway cases, RT PCR test for severe acute respiratory syndrome Corona virus 2 (SARS COV 2) was available only in a few Government centres in our state. Hence because of such logistic issues, we had to strictly assume all cases to be possible positive and take necessary precautions. But eventually, with easy access to Rapid Antigen Detection Test (RADT) as well as RT PCR, even in our institute, screening for COVID 19 could be swiftly carried out.

Through this retrospective study, we are sharing our experience in dealing with airway cases during this ongoing COVID 19 pandemic; particularly pointing out that with necessary alterations in practice, we have been able to carry out the surgical interventions in concerned patients without any major glitches.

Aims and Objective

- (1) To enumerate the airway cases, pediatric as well as adult, which were operated in the last 7 months
- (2) To study the additional precautions and techniques utilized for optimizing the airway surgeries during COVID times
- (3) To contribute to the best practice guidelines for ensuring safety of both patients and health professionals during airway surgery in COVID times

Methodology

A single centre retrospective observational study was done from the month of March to October, 2020.

The cases included in the study were:

- (1) The adult airway cases attending the Outpatient Department (OPD) or emergency, and who required surgical intervention
- (2) The diagnosed paediatric airway cases warranting surgical intervention.

The scope of this study, as already mentioned, is to mainly focus on the modifications incorporated while managing the airway cases, the ulterior aim being the overall safety of the concerned health personnel and patients.

The success of the cases would be measured not only by the surgical outcome to relieve the airway, but also to prevent the transmission of COVID 19. So, a close follow up till 2 weeks was carried out in all the concerned patients and health personnel.

As this pandemic is recent and new perspectives are coming into light with the passing days, facing limitations of available literature to deal with varied airway cases is inevitable. Still, the ones published and accessible has been of undisputed importance, while executing the surgical interventions in airway cases as well as in drafting our study [3, 10, 12]. For searching relevant literature, we have used Google search engine. The recent articles in English, with HTML or PDF copies have been downloaded and accessed.

Result and Discussion

Being a tertiary airway centre, we had to cater to a number of airway cases in the last seven months, amongst which, most required urgent and quick surgical intervention to avoid mortality and longstanding morbidity. All the while, we were closely monitoring the COVID 19 statistics in our region, as the surgical triaging was dependant on it. The surgical triaging or categorization which we initially

followed were adopted and eventually adapted according to the changing COVID 19 trend [22].

The initial cases were the most difficult ones from safety perspective, as screening tests were not readily accessible. Also due to scarce testing sites, the declaration of results took a longer time. Hence categorization of patients was difficult. In fact, we had to consider all cases to be possible positive while rendering necessary treatment. So a blanket cover of PPE and strict protocols had to be implemented during the early couple of months.

But gradually, with easy availability of RT PCR as well as RADT for COVID 19, categorization became easier.

Category A patients are treated and operated in the designated isolation space, unless proven negative in RT-PCR testing (Table 1).

Category B and C patients are admitted and initially attended to in isolation and shifted to usual ward/cabin/OR after a negative COVID 19 RT-PCR (Table 1).

The airway cases with known COVID 19 positive status underwent the same categorization. For proven positive cases, provision has been made to render treatment in COVID designated isolation ward and Operation Room (OR). During the initial peak of the pandemic in our region, the cases were simply classified as surgical emergency and non-emergency. As the COVID trend peaked and plateaued at intervals, categorization had to be revised, as the semi urgent or non-urgent cases, which were earlier deferred, had to be accommodated. Triaging or categorization has been included in several centres as evident from the published literature [22, 26, 30] (Tables 2, 3).

The differences in surgical and anaesthesia techniques, most of which we followed, while managing the airway cases, during this ongoing pandemic, have been highlighted below.

Anaesthesia [4]

- Rapid sequence induction
- Administration of Glycopyrrolate to reduce airway secretions

- Closed circuit ventilation with Heat and Moisture Exchanger (HME) filter
- Minimisation of the use of bag and mask or Positive Pressure Ventilation (PPV)
- Use of comparatively larger size cuffed endotracheal tube
- Surgery under local anaesthesia converted to general wherever possible
- Deeper plane of anaesthesia is always preferable
- Complete neuromuscular block preferred
- Adequate pre-oxygenation in selected cases
- High Flow Nasal Cannula (HFNC) or scope side port oxygenation over bag and mask [10]
- Minimum attendance of health personnel during intubation
- Use of endoscope mask, wherever applicable
- Topical lignocaine instillation to the larynx and trachea after completion of procedure and prior to extubation
- Use of plastic drape barrier covering the head end to minimise spread of aerosols [25]. We have improvised the barrier with disposable plastic. However, due to limitations of surgical accessibility, we are trying to work on a reusable tenting structure to hold the disposable plastic sheet barrier [11].

There has been a re-emergence of TIVA in COVID times as preferred method of NIV [7, 10]. Though it is under discussion in our centre, its use has not been incorporated yet.

Tracheotomy/Tracheostomy [5, 15, 16, 27, 29]

- Under General Anaesthesia with complete paralysis in elective cases where orotracheal intubation is possible
- Metallic tracheostomy tubes are to be avoided to prevent mucosal injury
- A cuffed silicon (Bivona) tracheostomy set is considered to be the best of its kind during tracheotomy; subsequently the tube can be deflated and can be left unchanged for 1 month unless indicated [8]

Table 1 Showing the categorization currently being actively followed in our institution for surgical triaging of airway cases

Category A	The airway cases warranting prompt attention, which required surgical intervention immediately, irrespective of Covid status	Example: foreign body bronchus with respiratory distress, Emergency Tracheotomy to relieve airway obstruction following injury or laryngeal oedema following anaphylaxis
Category B	The airway cases, which required immediate attention and hospital care; and surgery is planned at the nearest time possible	Example: foreign body bronchus without respiratory distress, Congenital airway defect requiring urgent surgery, RRP with airway compromise, Tracheotomy for prolonged ventilation in ICU, Bilateral choanal atresia
Category C	The semi-urgent airway cases, which can be planned electively	Example: repeat or staged airway procedure like second dilatation of tracheotomised case of subglottic tracheal stenosis, Benign vocal fold lesion like polyp, Early vocal fold malignancy

Table 2 Enlisting the included studies related to the COVID 19 pandemic

Source	Study	Date
Journal of Otolaryngology-Head & Neck Surgery(Elsevier)	Recommendations from the CSO-HNS taskforce on performance of tracheotomy during the COVID-19 pandemic	February 2020
JAMA Otolaryngology-Head & Neck Surgery	Surgical considerations for tracheostomy during the COVID-19 pandemic: lessons learned from the severe acute respiratory syndrome outbreak	March 2020
Journal of Health Management	Personal protective equipment: challenges and strategies to combat COVID-19 in India: A narrative review	June 2020
American Academy of Otolaryngology-Head and Neck Surgery (SAGE)	COVID-19 pandemic: what every otolaryngologist-head and neck surgeon needs to know for safe airway management	April 2020
Indian Journal of Otolaryngology and Head & Neck Surgery	Pediatric airway surgeries in COVID 19 Era	July 2020
Tr-ENT (Behbut Cevanşir Otorhinolaryngology-Head and Neck Surgery Society)	ENT surgery during COVID-19 pandemic: tips for safe surgery and how to prioritize them	May 2020
American Academy of Otolaryngology-Head and Neck Surgery (SAGE)	Prince AD, Cloyd BH, Hogikyan ND, Schechtman SA, Kupfer RA. Airway management for endoscopic laryngotracheal stenosis surgery during COVID-19	May 2020
The Malaysian Journal of Medical Sciences	Managing Aerodigestive Emergencies During the COVID-19 Pandemic: challenges for Healthcare Workers	May 2020
Indian Journal of Anaesthesia	Difficult airway management in COVID times	May 2020
International Journal of Pediatric Otorhinolaryngology	Pediatric laryngoscopy and bronchoscopy during the COVID-19 pandemic: a four-center collaborative protocol to improve safety with perioperative management strategies and creation of a surgical tent with disposable drapes	July 2020
JAMA otolaryngology-Head & Neck Surgery	Safety recommendations for evaluation and surgery of the head and neck during the COVID-19 pandemic	March 2020

- A relatively larger sized tube is used, to avoid frequent changing due to blockage
- Adequate pre-oxygenation prior to tracheostomy
- The skin incision should be generous to avoid unnecessary delay in the procedure
- Procedure should be as fast as possible, performed by well-trained hands
- There should be limited use of suction and electrocautery
- Holding the ventilation just before making the tracheal incision will prevent the sudden burst of aerosols
- The tracheostomy hub should be connected immediately to ventilator, preferably with a closed suction system
- Connection with Viral filter or a heat and moisture exchanger (HME) is always recommended
- Training and optimising tracheostomy tube self care at home and video-teleconsultation
- In cases where orotracheal intubation is unfavourable, TIVA or IV deep sedation with HFNC can be preferred [7]
- Use of optical forceps for an expeditious procedure
- Use of glass slide for blocking the vents of the bronchoscope
- Side endoscope port oxygenation
- Good communication with anaesthesiology team for avoiding unnecessary delay and minimisation of PPV
- Swift execution of the procedure when intermittent apnea technique with complete neuromuscular blockade was used as anesthesia
- TIVA or deep IV sedation is a good alternative to PPV
- Plastic drape barrier [26]

Subglottic Tracheal Stenosis [12, 19, 24, 25]

- Preference of repeated Coblation excision and dilatation
- Intralesional steroid instillation
- Relook procedure with balloon dilatation, wherever applicable
- Aerosol minimalisation by closed ventilation via cuffed tracheostomy tube
- CTR and anastomosis is another surgical option, but as it was an open and tedious procedure, was not preferred.

Foreign Body Airway Removal [2, 11, 17]

- Use of video-endoscopy for maintaining distance

Table 3 Showing the chronological spread out of the cases with their age, sex, diagnosis, categorization, surgical intervention and anesthesia used

No	Age/sex	Diagnosis	Categorisation	Surgery	Anesthesia
1	6y/M	Foreign body right bronchus	B	Rigid bronchoscopy and foreign body removal	Intermittent apnea technique with full relaxation and side port oxygenation
2	15D/F	Type IIIb LTOC	B	Open surgical repair of trachea and oesophagus	Tracheal intubation with endotracheal tube (ET) via low tracheotomy and closed circuit ventilation
3	28y/M	Subglottic tracheal stenosis (grade III)	A	Tracheotomy followed by coblation excision, dilatation and intralesional steroid injection	Deep IV sedation followed by closed circuit ventilation via cuffed tracheostomy tube
4	61y/M	Transglottic growth with stridor	B	Tracheotomy	Deep IV sedation
5	55y/M	Papillary Carcinoma of thyroid with retrosternal extension and tracheal compression	B	Total Thyroidectomy with Left sided selective neck dissection (II–V) with central compartment node clearance	Orotracheal intubation by cuffed ET and closed circuit ventilation
6	4 yrs/M	RRP (involving anterior half of both vocal folds and anterior commissure)	B	Video-Laryngoscopic Surgery (Coblation excision)	Orotracheal intubation by cuffed ET and closed circuit ventilation
7	60y/M	Multinodular goitre with tracheal compression	B	Total thyroidectomy	Orotracheal intubation by cuffed ET and closed circuit ventilation
8	26y/M	Subglottic tracheal stenosis (grade IV) (prior tracheotomised)	B	Coblation excision, dilatation and intralesional steroid injection	Closed ventilation via cuffed tracheostomy tube
9	3D/M	Bilateral choanal atresia	B	Endoscopic bilateral choanal atresia repair by septal flap technique	Orotracheal intubation by ET and closed circuit ventilation

Recurrent Respiratory Papillomatosis [25]

- MLS (Microscopic Laryngeal surgery) with video monitor display helped in maintaining some distance with the patient during the procedure
- Use of a smaller sized cuffed ET for passing through the lesion free part of glottis helped in securing the airway
- For excision of the lesion, coblator (Laryngeal wand) was used, which, apart from being a powered instrument, had the advantage of being coupled with suctioning.
- Cold steel instruments' use for excision of laryngeal lesion is another good option during COVID times
- The use of LASER is discouraged because of the plume hazards

Bilateral Choanal Atresia Repair

- Prior oro-tracheal intubation and closed circuit ventilation provided a secure airway
- Endoscopic video assisted repair by posterior septal flap technique was done
- Intranasal stent was not used

- Cold steel micro-earsurgery instruments were used to carry out the surgical steps in the limited intranasal space
- Minimum use of drilling was incorporated
- Regular endoscopic follow up and balloon dilatation using foley's catheter, as and when required

LTOC Type III b Repair/Thyroid or Neck Surgery

- Orotracheal intubation by cuffed ET for open Thyroid/ Neck surgery
- A low tracheotomy and uncuffed ET was utilised in LTOC for an open procedure [9, 10, 14, 20, 21]
- Open and long duration of exposure demanded the best of PPE [13, 16]
- A good alternative would have been a closed endoscopic repair of the LTOC, provided the correct instrumentation was available [9, 10, 14, 20, 21]. Intermittent apnea technique or TIVA with full muscle relaxation would have been options for general anesthesia.
- Use of electrocautery in open neck surgery was limited, instead it was replaced with ties

General Surgical Adaptations [3]

- Use of laser and electrocautery are not recommended because of the risk of aerosolisation with plumes or fumes; Coblater and Microdebrider with incorporated suction are important alternatives
- Any surgery should be as quick as possible
- If there are two surgical options for a case, the one which is relatively of shorter duration or which causes minimal aerosol generation and exposure is preferred.

At all times, we would like to stress on meticulous Doffing-Donning and hand-face hygiene for the smooth operation of the new protocols. There have been innumerable evidence based data and research on the proper use PPE. We cannot ignore the aspect of false negative RT PCR, and how it depends on several factors [17, 18]. Hence, though a pre-operative negative RT-PCR provides some amount of mental relaxation, there should be no difference in maintaining the protocols or precautions.

Personal Protective Equipments (PPE) [3, 13, 28]

For all the cases, the PPE used were in accordance with the guidelines issued by the Ministry of Health and Family Welfare, Directorate General of Health Sciences (Emergency Medical Relief).

Recommendations for an Ideal Use of [6, 28]

- Hazmat suit or proper full sleeve impermeable disposable gown with visor and foot cover over OT scrubs (we have personally used both and found them to be equally effective)
- N 95/ffp2 non valved mask
- Reusable half face respirators are found to be most effective to deal with fogging uses, especially in long surgeries [23]
- Surgical goggles
- Face shield; however face shield is non compliant during use of microscope, when seeing through eyepiece. This can be overcome by visualizing the monitor or by use video-endoscopes
- Double non powdered surgical gloves
- Proper donning and doffing of PPE and ensuring the proper execution of the sterilization chain [3].

Follow Up [1, 6]

As symptoms of COVID 19 infection usually manifest between 5 and 12 days of exposure, all the patients were reviewed either in person or via teleconsultation 2 weeks following surgery [1]. During the tele review, questions

were put forward to inquire about any unusual health concern and the common symptoms of COVID 19 infection. In case of any doubt, RT PCR swab test for COVID 19 was advised. The health of all the healthcare staff associated with the surgeries, were also closely followed up alike. Fortunately, in all the above mentioned cases and the associated health personnel, no apparent untoward event with respect to COVID 19 transmission has been met so far [1].

Conclusion

Otorhinolaryngology practice has been tremendously affected because of the COVID 19 pandemic scenario, as the clinical examination and intervention involved were mostly aerosol generating procedures (AGP). In the early days, when the pandemic hit the Indian nation and extensive lockdown was imposed, a lot of patients with Otorhinolaryngology non-COVID ailments had to face the brunt. But gradually guidelines and protocols were formulated for the service of such patients who required non-delayed medical or surgical attention. We are particularly focusing on airway cases, as most of them required prompt intervention, which if failed to deliver, might result either in mortality or long standing morbidity. Our hospital, being a tertiary airway centre, and having received a good number of such cases (adult and paediatric), have been focusing on ways or adaptations to ensure safe airway surgery, to minimize the COVID 19 viral transmission and to contribute to the best practice guidelines. As the most commonly performed emergency airway surgery is tracheostomy/tracheotomy and which might be urgently required in any centre, the guidelines and adaptations have been highlighted. Some other pertinent surgical adaptations for minimizing aerosol generation include- preference of closed airway surgery over open, wherever feasible; use of cold steel instruments; limited use of coblater and microdebrider is encouraged over electrocautery and LASER. Anaesthesia adaptations are equally important as both intubation and PPV are highly AGPs; hence have been discussed. All our cases as well the associated health personnel have shown no clinical features of COVID 19 infection on follow-up. Hence we believe that with the inclusion of proper adaptations and protocols, airway surgeries can be safely optimized. Though surgical techniques' adaptations or preference might vary and be case-specific, but the general protocols of maintaining safe practice should be diligently followed. There are several other adaptations which we are still working on. We believe that even with the dawn of vaccines in the near future, we believe the safety norms should not slackened. There is a lot to learn and absorb from this ongoing

pandemic. By sharing our experience, we are suggesting that interventions in airway cases need not be unnecessarily delayed; as by making relevant adaptations and by adhering to strict protocols, it is possible to carry out safe airway practices. It is, hereby, our humble attempt at contributing to the best airway surgical practice guidelines, not just to be implemented during this pandemic, but also can be carried forward in the post-pandemic era to ensure greater safety standards of both health personnel and patients.

Availability of Data and Materials All patients' data for the article has been derived from the archived information of the concerned cases.

Compliance with Ethical Standards

Conflict of interest There are no conflicts of interest.

Ethics Approval Institutional ethical committee clearance has been obtained with adherence to the "The Declaration of Helsinki".

Patient's Consent The authors certify that they have obtained all appropriate patient consent forms. In the forms, the patient (s) has/have given her/ his consent for her/his/their images or other clinical information to be reported in the journal.

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