

## INTUBATION PRACTICES USING AEROSOL BOX DURING COVID-19 TIMES -A SURVEY

### Anaesthesiology

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### ABSTRACT

Anesthesiologists have taken a leading role in Covid 19 pandemic and this role exposed anesthesiologists to a high risk of contracting Covid 19 infection. Apart from personal protective equipment, barrier devices like aerosol box are used to limit the aerosol spread of virus during airway procedures. **Methodology:** This study was conducted as an online survey. This questionnaire had 29 questions (regarding induction technique, type of laryngoscope, difficulties during intubation, use of adjuncts, any rescue technique, use of aerosol box during extubation, etc), incorporated in google form. Anaesthesia practitioners and trainees (with min. 1 year experience) who are working in COVID ICU or practising anaesthesia, had participated in this survey. The questionnaire was circulated to all over the country via social media. **Results:** sample size was calculated using the RAOSOFT Tool. The sample size was found to be 377. But we got only 120 responses, out of that 95 were using intubation box during Covid pandemic and were considered for statistical analysis. 52 (54.16%) anesthesiologists used rapid sequence induction and 43 (44.79%) used modified rapid sequence induction for intubation while using aerosol box. For perception of difficulty 91 (95.78%) anesthesiologists graded it as a score of 5 or more than 5. Out of 95 responses, 55 (57.89%) anesthesiologists used video laryngoscopes 11 (11.57%) of 95 survey participants who used aerosol box, tested positive during COVID 19 pandemic. **Conclusion:** Aerosol box offers extra protection, but it adds an extra layer of complexity. It makes tracheal intubation more difficult due to unfamiliarity with the device and ergonomic restriction of hand movements

### KEYWORDS

Aerosol box, video laryngoscopes.

### INTRODUCTION:

Anesthesiologists have taken a leading role in Covid 19 pandemic as airway providers and as critical care personnel for their skills in strategic ventilation modes. This role exposed anesthesiologists to a high risk of contracting Covid 19 infection. Many health personnel suffered morbidity and mortality during first wave of this pandemic due to poor understanding of modes of virus transmission, the pathophysiological changes and organ damage done by bug, and drugs that can help to ease the disease.

Endotracheal intubation required to support ventilation and oxygenation in severe Covid 19 patients is one of the most aerosols generating procedures. Hence personal protective equipment (PPE) became the most important barrier to gain protection from the virus droplets. Clinicians also came up with different methods to overcome the aerosol exposure by wearing face shields, N95 mask, goggles and using plastic sheets, tents and aerosol boxes between patients and intubators. [1] With raising cases again and third wave of virus everywhere, barrier system of protection to prevent virus spread is inevitable.

This aerosol box acts as a containment zone and limit the spread of aerosol within the box. Caneli et al demonstrated this with forceful cough with fluorescent dye. [3] Later this aerosol box became famous and many modifications are seen in its design and sizes based on the users need.

This survey was done to assess the use of aerosol box during airway management. The objectives of this study were to assess the intubation practices among anaesthesiologists during COVID-19 times - regard to use of aerosol box and difficulties associated with it, rapid sequence induction and use of aerosol box during extubation.

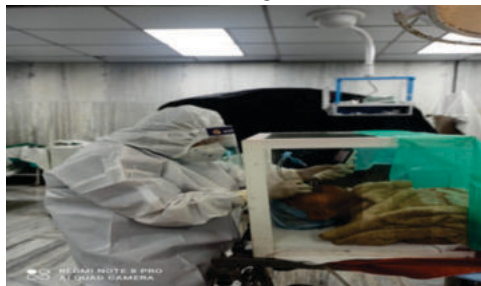


Figure 1- Aerosol Box

### Methodology –

After taking institutional ethics committee approval, this prospective, observational study was conducted as an online survey over 3 months. The questionnaire was designed and validated using content validation method. The questionnaire was sent to 5 experts in the field of anaesthesiology for validation with respect to relevance, comprehension, clarity on 4 point scale ( 1- worse, 4 – best ) and any suggestions. Then changes were made based on their comments. This questionnaire has 29 questions (regarding induction technique, muscle relaxant, type of laryngoscope, difficulties during intubation, use of intubation adjuncts, any rescue technique for difficult airway, use of aerosol box during extubation, contracting covid due to occupational exposure), incorporated in google form.

Anaesthesia practitioners and trainees (with minimum 1 yr of training in anesthesia) who are working in COVID ICU or practicing anaesthesia, had participated in this survey. The questionnaire was circulated to all over the country via social media network like E-mails, WhatsApp. The consent was taken at the beginning of survey. Responses were noted and results were analysed.

The sample size was calculated using the RAOSOFT Tool. Depending on the number of members of Indian Society of Anaesthesiologists, and keeping the margin of error as 5% , with the confidence interval of 95%, response distribution as 50% , the sample size was found to be 377. But we got only 120 responses, out of that 95 were using intubation box during Covid pandemic. So only those 95 responses were considered for statistical analysis.

### Statistical Analysis

All descriptive data were put into the Microsoft Excel sheet. Descriptive statistics like numbers, percentage and proportion Descriptive statistics – mean, percentage and proportion were calculated from the data . It was analysed using SPSS software version 22.

### Aerosol box

Aerosol box was first designed by the Taiwan anaesthesiologist Hua Lian. This aerosol box is made up of simple polycarbon/polyacrylic sheet of plastic material which is transparent in nature. It is square to rectangular in shape with 2 holes on one wall of the box, where the intubating person's hand can be put inside for intubation and other airway manipulations. This aerosol box should be kept over the patient's head in supine position. This aerosol box provides a protective shield between patient's airway and the clinician. [2]

There were many modifications done in the original box to overcome the difficulties during maneuvering. It includes holes in side wall for the assistant's hands, a hole on top for insertion of a bougie to aid intubation, and ports for applying suction to generate a negative pressure. In some modifications, plastic sheet is placed to cover patient's chest instead of plastic wall and tegaderm film is placed as occlusive dressing over holes to make a tight seal.

## RESULTS

The study questionnaire was sent to a total of 600 anaesthesiologists and intensivists. Of these, 120 responded.

Regarding their workplace, 70 (58.33%) of the respondents were working as junior residents in teaching hospital, 14 (11.66%) as senior residents, 15 (12.6%) as teaching faculty; while (3.33%) were working as freelancers, 17 (14.16%) were working as consultants in private set ups.

110 (91.66%) had been managing COVID 19 patients and of them, 102 (92.72%) had intubated COVID 19 confirmed or suspected patients.

95 (79.16%) respondents used aerosol box during intubation, 25 (20.83%) never used it. The reasons cited for not using aerosol box during intubation were following : It may make it cumbersome and uncomfortable, it may make laryngoscopy & intubation difficult, and it was not available everywhere.

52 (54.16%) anesthesiologists used rapid sequence induction and 43 (44.79%) used modified rapid sequence induction for intubation while using aerosol box.

The muscle relaxant of choice for intubation was Suxamethonium for 26 (27.36%), Rocuronium for 29 (30.52%), Vecuronium for 32 (33.68%) and Atracurium for 8 (8.42%).

Out of 95 anesthesiologists who used aerosol box, 50 (52.63%) of them used it for elective intubation only. 65 anesthesiologists (68.42%) took at least two attempts at successful intubation and 12 (12.63%) took more than 2 attempts. [Figure 2]

When asked to grade the perception of difficulty in intubation on a scale of 0-10, where 0 is very easy & 10 is extremely difficult, 91 (95.78%) anesthesiologists graded it as a score of 5 or more than 5, while using aerosol box.

When asked about the reasons of difficulty in intubation using aerosol box, the following were cited. [Figure 3]

- Difficulty in visualization of glottis due to added interfaces making hand eye coordination difficult
- Restriction of hand movements
- Restriction airway manipulation
- Extra effort to hold the box in place, extra space occupied on the table
- Height of the box increases the distance between patient's head and anaesthesiologist
- As intubation is most stressful time, addition of box increases stress further.

55 (57.89%) out of 95, anaesthesiologists used videolaryngoscopes (VDL), non channelled 36 (37.89%) or channelled 19 (20%). Conventional Macintosh laryngoscope was used by 40 (42.10%) doctors. The explanation for choice of VDL was better visualisation and ease of intubation due to non requirement of laryngeal axes alignment. 64 (67.35%) intubators had to change from VDL to conventional and 51 (53.67%) had to change over from conventional to VDL.

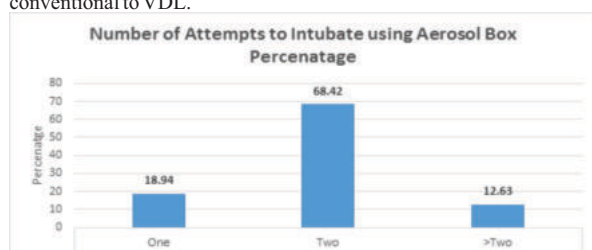


Figure 2- Graph showing attempts taken for intubation.

70 (77.89%) intubators who used aerosol box, required assisted techniques like bougie, stylet, external laryngeal manipulation to facilitate intubation. 55 (57.88%) intubators used a small roll across the scapular blade always to optimize laryngoscopy and intubation while using aerosol box.

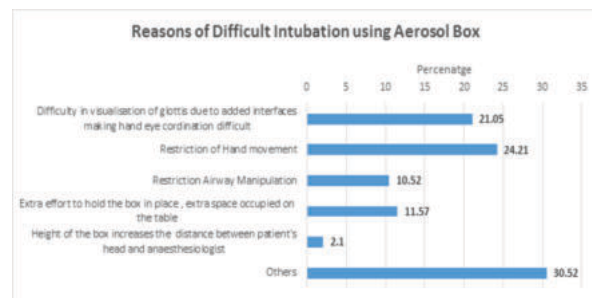


Figure 3- Graph showing difficulties while using aerosol box.

80 (84.70%) intubators had to remove the aerosol box many a times or sometimes to overcome difficulty in intubation [Figure 4] 30 (31.57%) out of 95, intubators practised clamping of ETT till it was attached to the circuit.

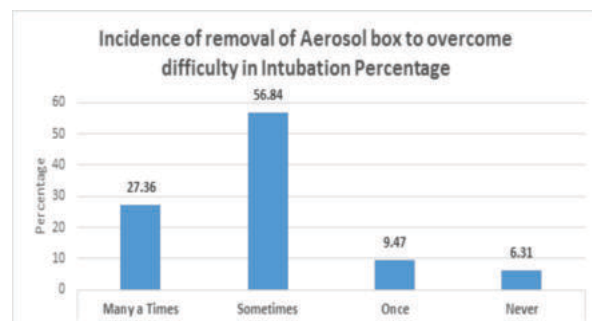


Figure 4 - Graph showing the number of times aerosol box removed while intubation.

Only 20 (21.04%) out of 95 intubators had to use SGA devices to overcome difficulty in intubation due to use of aerosol box. And 6 (6.31%) used Front of neck access (FONA).

51 (53.68%) intubators used only ETCO2 wave form to confirm the correct placement of ETT. Only 73 (76.83%) of 95 respondents used aerosol box during extubation.

The most common method of sterilization for aerosol box used was cleaning with sodium hypochlorite solution and cleaning with soap and water.

45 (47.36%) mentioned that they used alternative barrier devices like using plastic sheets if aerosol box was not available. 89 (93.6%) intubators would not prefer to use aerosol box if given a choice.

11 (11.57%) of 95 survey participants who used aerosol box, tested positive during COVID 19 pandemic.

## DISCUSSION

Airway management is crucial step in the treatment of Covid patients. Anesthesiologists are working at the forefront in this Covid pandemic, either in Covid Intensive care unit (ICU) or in operating rooms (OR) managing Covid suspect patients posted for emergency surgeries. The closed environment of Covid set up, and performance of aerosol generating airway procedures increase the risk of transmission of infection among the anesthesiologists.

2003 SARS (Severe acute respiratory syndrome) outbreak confirmed that airway managers are at a higher risk of contracting the infection. [1] Self protection mandate was implemented toward the end of January 2020 as there was recognition of human-to-human transmission of COVID19 infection. [1,2] Airway managers should wear Level 3 protection, which includes personal protective equipment, N 95 masks, goggles, face shields and gloves. In addition, barrier devices were designed for its use during intubation. Aerosol box is one such barrier device, that was recommended as an additional

resource to be made available as per All India difficult airway association (AIDAA) consensus guidelines. [3]

Preoxygenation or apnoeic oxygenation is recommended during process of intubation. Oxygen of 5 litres/min can be administered using nasal cannula. Yao et al performed preoxygenation for 5 min in all patients either using a face mask supplying 100% oxygen (47%) or by continuing the previous oxygen therapy (53%) [4]. If saturation goes below 95%, then mask ventilation should be done with two-hand technique and tight mask seal using wet gauze around patient's mouth and nose. [2,3]

AIDAA consensus guidelines, recommends rapid sequence induction to avoid mask ventilation and facilitate faster tracheal intubation. [3] In this study 52 (54.16%) doctors used rapid sequence induction (RSI) to facilitate rapid intubation and reduce the exposure to patient. Use of cricoid pressure makes the assistant to lean closer to the patient's airway, thereby increasing the chance of exposure to aerosols. [3] Forty three (44.79%) doctors used modified RSI to confirm ventilation and improve oxygenation in critically ill patients with anticipated difficult airway.

Suxamethonium was the preferred muscle relaxant by 26 (27.36%) anesthetists for intubation, as it allows rapid securing the airway. But in this survey it was noted that, many anesthesiologists used Rocuronium 29 (30.52%) or Vecuronium 32 (33.68%) for better relaxation and favourable side-effect profile compared to short acting suxamethonium.

In this present survey, all 95 (79.16%) anaesthesiologists who used the aerosol box, were not comfortable with that and 12 (12.63%) anaesthesiologists took more than 2 attempts for intubation. In simulation crossover study, Begley et al has compared early generation aerosol box with latest generation aerosol box and found that, first pass success rate was 100 % without box, 75 % with early generation and 83% with latest generation aerosol boxes. Intubation times without box was less than 1 min, but with box was more than one minute in 14 (58%) intubations and was more than 2 minutes in 4 (17%) including one failure in that study. [5]

Elective intubation is preferred over emergency intubation during severe hypoxic state or CPR as it avoids prolonged use of high flow nasal oxygen or non-invasive ventilation. Fifty (52.63%) clinicians used aerosol box in cases of elective intubation only.

For perception of difficulty in intubation using aerosol box, it was graded 5 or more than 5 by 91 (95.78%) of clinicians in this study. Difficult hand eye coordination, restriction of hand movements, restriction of airway manipulation and mental stress were commonly stated reasons for difficulty in intubation. Some authors have pointed out the many 'cons' of the aerosol box including its bulkiness, crowding of instruments inside the box, contamination of inner surface of the box by aerosol and used instruments and poor protection of the staff assisting the airway manager. [13]

Use of aerosol box causes damage to personal protective equipment as gown can catch up at arm hole or stick to occlusive dressing. Begley mentioned 1 breach of personal protective equipment occurred using the early-generation box and seven breaches occurred using the latest-generation box. [5] Apart from these factors, Rakhee Goyal et al has mentioned about difficulty in giving steep ramping position for intubation of obese patients with short neck. [6] This bulky box becomes one more contaminated objects to clean after aerosol procedures; if it is not handled properly, may fall off the bed and potentially injure patient or staff.

There was strong recommendation from Royal college of anesthiologists regarding use of VDL in Covid 19 patients. The transition to videolaryngoscopy as a routine firstline option throughout anesthetic and ICU practice has been reported.

In this present study, 55 (57.89%) anesthiologists preferred videolaryngoscope (VDL) over Conventional Macintosh laryngoscope because of better visualization and ease of intubation due to non requirement of laryngeal axes alignment. The study conducted by Lingzhong Meng, also recommended video laryngoscopy for intubation because it increases the distance between the healthcare worker's face and the patient's face and minimizes the risk of contamination. [1]

Video laryngoscope increases the chances of first attempt intubation for consultant. But for novice or trainee, it takes longer time to intubate. In our study, 70 (58.33%) participants were working as junior residents in teaching hospital, 64 (67.35%) intubators had to change from VDL to conventional and 51 (53.67%) had to change over from conventional to VDL. Ryo Wakabayashi had compared different video laryngoscopes like McGRATH,™ MAC and an AWS-S200NK with conventional laryngoscope. They found that the time to successful intubation were significantly shorter when video laryngoscopes were used for tracheal intubation with the aerosol box ( $p < 0.001$ ). He also mentioned that the effect of an aerosol box on tracheal intubation difficulty is clinically irrelevant when an experienced anaesthesiologist intubates the trachea in a normal airway condition. [7]

After wide implementation of video laryngoscopy in operating rooms, the rate of difficult and failed intubations by skilled providers have declined significantly. [8] As aerosol box increases the difficulty during intubation, airway managers require various assisted techniques. In this study, 70 (77.89%) intubators used assisted techniques like bougie, stylet, external laryngeal manipulation. To optimize laryngoscopy and intubation, 55 (57.88%) intubators used a small roll across the scapular blade while using aerosol box. Eighty (84.70%) intubators had to remove the aerosol box to overcome difficulty in intubation. Thirty (31.57%) out of 95, intubators practiced clamping of ETT till it was attached to the circuit to prevent aerosol spread.

To confirm the correct placement of ETT, use of a stethoscope auscultation is not feasible while wearing PPE. [3] In the present study, 51 (53.68%) intubators used only ETCO<sub>2</sub> wave form to confirm the correct placement of ETT. Capnography, fogging inside of the endotracheal tube, chest movement, SpO<sub>2</sub>, the colour of the patient's skin and mucous membrane are indirect indicators to differentiate between a failed and successful intubation. [2]

In this survey, 20 (21.04%) anesthiologists used supraglottic airway device (SGA) devices to maintain ventilation during difficulty in intubation due to use of aerosol box and 6 (6.31%) used Front of neck access (FONA). If intubation is not done, well-placed SGA in situ, allows continuation of oxygenation and ventilation with the increased risk of aerosolization. [9] In the event of a complete ventilation failure, AIDAA has recommended to proceed with a surgical cricothyroidotomy. [3] A scalpel-bougie technique can also be practiced but jet ventilation through needle cricothyroidotomy should be avoided. [9]

Tracheal extubation is also considered as a higher aerosol generating procedure [3] Various studies had recommended the need of smooth extubation and use of barrier devices for extubation. (A.W. Kangas-Dick et al Erbabacan) [11,12]

But in this survey, only 73 (76.83%) out of 95 anesthiologists used aerosol box during extubation. Forty five (47.36%) anesthiologists had used transparent plastic sheets as alternative barrier devices if aerosol box was not available [9,10]. Eighty nine (93.6%) intubators would not prefer to use aerosol box if given a choice. Tracheal suction should be performed only if required, using the closed suction system. [13]

Prior to reusing the Intubox on another patient, it must be sterilized using a hypochlorite solution in a concentration of 1,000 ppm while donning appropriate PPE. [10] Cleaning with Sodium hypochlorite solution or soap and water were common techniques of sterilization for aerosol box.

After a simulated cough, the "aerosol box" was shown to substantially reduce clinician exposure to aerosol particles. However, there is no evidence to recommend the efficacy of aerosol box in reducing infection rate among clinicians. In our study, 11 (11.57%) survey participants who used aerosol box, tested positive during COVID 19 pandemic. Currently, the evidence for these strategies in limiting aerosol spread is limited to benchtop studies.

The aerosol box reduces the spread of aerosol particles during intubation but distal open end of intubation box redirects aerosol towards patient feet and make patients drapes infected. If that distal part is covered by plastic sheet, then it causes concentration of droplets

underneath it into smaller area. During barrier removal, these trapped aerosol are propelled towards head end of the bed, leading to cross-contamination.

Though aerosol box offers extra protection ,it increases difficulty in intubation. With use of videolaryngoscopy, airway can be secured, but prior practice in airway management using these devices is essential. [3] Yet the aerosol box can expose airway managers to risk of cross contamination.

### CONCLUSION :

With raising cases of Covid 19 and on the verge of third wave, barrier method of prevention is useful to prevent virus contamination. An aerosol box may reduce exposure to contaminations but will increase intubation time and reduced operator's mobility and visibility. Furthermore, the difference in degree of contamination can be overcome by proper donning and doffing of PPE, which reduce the contamination but not the viral load. Clinicians should consider patient safety risks particularly in difficult airway or severely hypoxic patients, since contamination can be mitigated by proper donning and doffing of PPE. So overall aerosol box might decrease contamination but it causes difficulty in securing airway.

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