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**Original Research Article**

# Comparison of extubation response with Ambu AuraGain and endotracheal tube

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## ABSTRACT

**Background:** Airway management poses significant challenges for anesthesia and critical care providers. The Ambu Aura is an innovative supraglottic airway device that is compatible with magnetic resonance imaging. It is designed to be disposable, phthalate-free, and allows for the use of traditional cuffed tracheal tubes in patients of all ages. The present study was aimed to compare the hemodynamic changes and complications in endotracheal tube and Ambu AuraGain extubation in patients undergoing surgery.
**Methods:** This was a randomized, controlled study conducted on 30 ASA I/II patients undergoing surgery. The patients were divided into two groups, group T (n 15): endotracheal tube and group A (n = 15): Ambu AuraGain respectively. The hemodynamic parameters such as heart rate (HR), mean arterial pressure (MAP) were measured at extubation and at 1 minute, 3 minutes, 5 minutes, 7 minutes, 10 minutes, 13 minutes and 15 minutes after extubation and compared between the groups.
**Results:** Ambu AuraGain showed significant decrease in HR and MAP 1 minute, 3 minutes, 5 minutes, 7 minutes, 10 minutes, 13 minutes and 15 minutes after extubation when compared to endotracheal tube and it was found to be significant. Further, the frequency of cough (6.7% versus 26.7%; p=0.002) and laryngospasm (0% versus 13.3%; p=0.002) was lower in Ambu AuraGain when compared to endotracheal tube.
**Conclusions:** Ambu AuraGain may be a viable alternative to traditional endotracheal tubes in clinical settings with good safety profile.

**Keywords:** Ambu AuraGain, Cough, Endotracheal tube, Heart rate, Mean arterial pressure

## INTRODUCTION

The incidence of complications during extubation, recovery, and emergence is comparable to the complications which occur during intubation.[1] Endotracheal extubation results in a transitory increase in blood pressure and heart rate as a result of increased sympathoadrenergic activity due to the activation of epipharynx and laryngopharynx.[2] In majority of the patients, the high blood pressure and rapid heart rate can be well tolerated, however in some cases there exits an aggravated response with less tolerability and leads to cardiac ischemia and decompensation, pulmonary edema and cerebral hemorrhage.[3] The respiratory complications include cough, sore throat, laryngospasm, and bronchospasm, ultimately resulting in hypoxemia.[4] Laryngospasm is the primary reason for upper airway blockage following extubation.[5] It is also important to consider the patient's level of consciousness and ability to follow commands, as well as their overall strength and

respiratory muscle function. Factors such as the presence of a tracheostomy, the use of sedatives or neuromuscular blocking agents, and the presence of underlying lung disease can all impact the patient's ability to successfully wean from mechanical ventilation.[6] Therefore, a comprehensive assessment of the patient's readiness for extubation is essential in order to minimize the risk of complications and ensure a smooth transition to spontaneous breathing. Meanwhile, it is advisable to consider an alternative method to reduce these pressor responses. The classical laryngeal mask airway (LMA), developed by Dr. Archie Brian, a British anaesthesiologist, offers a convenient and efficient placement method for anaesthetists. It also provides improved hemodynamic stability during the induction and emergence process, minimal increase in intraocular and intracranial pressure, reduced incidence of coughing during emergence, and a lower likelihood of experiencing a sore throat in adults.[7] Regrettably, the use of LMA is limited in several locations, leading to its replacement by 2nd generation LMAs.[8]

The Ambu AuraGain device is a supraglottic airway device that is designed to provide a secure airway during anesthesia and emergency situations. It features an anatomically curved airway tube that is designed to mimic the natural shape of the airway, allowing for easy insertion and optimal seal.[9] The device also includes a gastric access port, allowing for the passage of gastric contents and the ability to decompress the stomach if necessary. Additionally, the Ambu AuraGain device is equipped with a pilot balloon and inflation valve, allowing for easy confirmation of proper placement and adjustment of the cuff pressure. Overall, the Ambu AuraGain device offers a reliable and effective option for airway management in a variety of clinical settings.[10] In this backdrop, the present study was carried out to compare the extubation response Ambu AuraGain and endotracheal tube in a clinical setting.

## METHODS

This was a randomized, controlled study conducted to evaluate the effect of extubation response to endotracheal tube extubation and Ambu Aura Gain removal. The study was conducted in the department of anesthesiology and critical care, Al-Ameen Medical College and hospital Vijayapura and the ethical approval was obtained for the study. By using the convenient sampling technique, ASA I and II patients, of either sex, of age group 18-50 years, scheduled for surgery under general anesthesia, were enrolled for the study.

### *Inclusion criteria*

The study included patients classified as American Society of Anesthesiologists (ASA) grade I and II, encompassing both sexes and aged between 18 and 50 years.

### *Exclusion criteria*

Patients with hypertension, CVD, upper respiratory disease, renal and hepatic disease, high BMI exceeding 30 kg/m$^2$, pregnant individuals, and those anticipated to have a difficult intubation during preanesthetic evaluation were excluded from the study.

A total of 30 patients (15 in each group) were enrolled in the study, who were then randomly assigned groups T and group A. Patients were interviewed and examined one day before the scheduled surgery. Pre-operative evaluation and relevant investigations (complete blood count, liver function tests, renal function tests, blood sugar, ECG and x-ray chest) as per case record form were done. No hypnotic medications were given to the patient on the night before surgery.

After obtaining written informed consent, patients were taken into the operation theatre and standard ASA monitors were attached [electrocardiography (ECG), oxygen saturation ($SpO_2$), non-invasive blood pressure (NIBP), end-tidal carbon-dioxide ($EtCO_2$)]. Baseline parameters were recorded. Intravenous (i.v.) access was secured with a 20G cannula and an infusion of Ringer's lactate at the rate 10-15 ml/kg was started.

Patients were pre-oxygenated with 100% oxygen for 3 min and pre-medicated with glycopyrolate 0.2 mg i.v., ondansetron 4 mg i.v., midazolam1mg i.v. and fentanyl 2 µg/kg i.v.

They were induced with propofol 2 mg/kg i.v. and neuromuscular blockade was achieved with atracurium 0.75 mg/kg or vecuronium 0.1 mg/kg i.v. Laryngoscopy was done after 3 minutes of giving muscle relaxant and intubation achieved with 8.0-8.5 mmID cuffed endotracheal tube for males and 7.0-7.5 mmID for females. Appropriate size Ambu AuraGain was used as per patients' weight. Correct placement of the tube was confirmed by auscultation and square wave capnography.

Anesthesia was maintained with a mixture of nitrous oxide:oxygen (50:50), isoflurane (0.8-1.2%) and incremental doses of injection atracurium/injection vecuronium, using closed circuit with mechanical ventilation. Twenty minutes prior to the expected time of extubation, isoflurane was discontinued. The patients were divided into 2 groups. Group T (n=15): endotracheal tube, group A (n=15): Ambu AuraGain.

After regain of spontaneous respiration, residual neuromuscular blockade was reversed using injection Neostigmine 0.05 mg/kg and injection glycopyrrolate 8 µg/kg i.v. Oro-pharyngeal secretions were cleared by gentle suction. HR, SBP, DBP, MAP and $SpO_2$ were again recorded at the time of reversal.

The time of starting the study drug was recorded. Heart rate (HR), mean arterial pressure (MAP) and oxygen

saturation ($SpO_2$) were recorded prior to extubation and at 1, 2, 3, 5, and 10 minutes after extubation/Ambu Aura removal.

Patients were extubated, when the extubation criteria, as follows, were fulfilled: sustained head lift and hand grip for 5 seconds, adequate level of consciousness and maximum inspiratory pressure ≥40 to 50 cm $H_2O$ respectively.[11]

Extubation quality was rated using extubation quality 5-point scale: 2- smooth extubation, minimal coughing; 3-moderate coughing (3 or 4 times); 4- severe coughing (5 to 10 times) and straining; 5- poor extubation, very uncomfortable (laryngospasm and coughing >10 times).

Other monitoring criteria included were as follows: time to eye opening and time to extubation i.e. interval between cut-off of nitrous oxide to eye opening and extubation, respectively, were recorded. Number of coughs per patient was monitored for 15 minutes post-extubation. Any occurrences of laryngospasm, bronchospasm or desaturation over a period of 15 minutes post-extubation were noted. Above monitoring parameters HR, MAP and $SpO_2$ were recorded again after extubation and at 1 minute, 3 minutes, 5 minutes, 7 minutes, 10 minutes, 13 minutes and 15 minutes after extubation.

***Data analysis***

The data were shown as mean±SD. Unpaired student t test was done to compare between the two groups. A $p<0.05$ was considered as statistically significant.

## RESULTS

The comparison of heart rate between the endotracheal tube and Ambu AuraGain group was shown in Table 1. The heart rate was significantly decreased in Ambu Aura LMA group when compared to endotracheal tube at post extubation 1 minute (p=0.0003), 2 minutes (p=0.00002), 3 minutes (p=0.00009), 5 minutes (p=0.00001) and 10 minutes (p=0.0001) respectively.

**Table 1: Comparison of heart rate between the endotracheal tube and Ambu AuraGain.**

| Heart rate (bpm) | Endotracheal tube (n=15) | Ambu Aura LMA (n=15) | P value |
|---|---|---|---|
| **Baseline** | 88±12.5 | 88±8.1 | 0.99 |
| **Post extubation 1 minute** | 110±10.9 | 96±9.08 | 0.0003* |
| **Post extubation 2 minutes** | 108±12.13 | 94.74±9.92 | 0.00002* |
| **Post extubation 3 minutes** | 105±12.7 | 91.6±10.16 | 0.00009* |
| **Post extubation 5 minutes** | 102±9.8 | 88.4±11.07 | 0.00001* |
| **Post extubation 10 minutes** | 100±13.7 | 87.23±10.29 | 0.0001* |

*Indicates significant ($p<0.05$), unpaired student test.

**Table 2: Comparison of mean arterial pressure between the endotracheal tube and Ambu AuraGain.**

| Mean arterial pressure (mmHg) | Endotracheal tube (n=15) | Ambu Aura LMA (n=15) | P value |
|---|---|---|---|
| **Baseline** | 109.3±6.7 | 108±8.2 | 0.38 |
| **Post extubation 1 minute** | 119.6±9.02 | 104.23±10.7 | 0.00004* |
| **Post extubation 2 minutes** | 115.33±6.32 | 101.28±5.36 | 0.00001* |
| **Post extubation 3 minutes** | 112±8.87 | 99.46±10.7 | 0.00081* |
| **Post extubation 5 minutes** | 110.12±4.42 | 97.35±9.66 | 0.000097* |
| **Post extubation 10 minutes** | 108.87±6.36 | 98.2±5.38 | 0.00008* |

*Indicates significant ($p<0.05$), unpaired student test.

**Table 3: Comparison of complications between the endotracheal tube and Ambu AuraGain.**

| Parameters | Endotracheal tube (n=15) | Ambu Aura LMA (n=15) | P value |
|---|---|---|---|
| **Mean time for device removal (seconds)** | 14.66± 2.1 | 12.61 ± 3.1 | $0.99^{aNS}$ |
| **No. of bouts of coughs (N, %)** | 4 (26.7%) | 1 (6.7%) | $0.002^{b*}$ |
| **Laryngospasm (N, %)** | 2 (13.3%) | 0 (0%) | $0.002^{b*}$ |
| **Soft tissue trauma (N, %)** | 0 | 0 | - |
| **Desaturation ($SPO_2$<90%) (N, %)** | 0 | 0 | - |

*Indicates significant ($p<0.05$), a- unpaired student test; b- Chi square test

The comparison of mean arterial pressure between the endotracheal tube and Ambu AuraGain group was shown in Table 1. The mean arterial pressure was significantly decreased in Ambu Aura LMA group when compared to

endotracheal tube at post extubation 1 minute (p=0.00004), 2 minutes (p=0.00001), 3 minutes (p=0.0008), 5 minutes (p=0.00009) and 10 minutes (p=0.00008) respectively.

The comparison of complications between the endotracheal tube and Ambu AuraGain groups was shown in Table 3. There was no significant difference in the mean time for device removal for endotracheal tube and Ambu AuraGain groups (p=0.32). The number bouts of coughs was lower in Ambu AuraGain when compared to endotracheal tube and it was significant (6.7% versus 26.7%; p=0.002). Meanwhile, none of the patients in the Ambu AuraGain group showed laryngospasm and in endotracheal tube 2 (13.3%) of the patients showed laryngospasm and it was significant (p=0.002).

## DISCUSSION

One of the primary factors that can influence a successful extubation response is the patient's respiratory status. It is important for anaesthesiologists to assess the patient's ability to breathe independently and maintain adequate oxygen levels before proceeding with extubation. Additionally, factors such as underlying medical conditions, the duration of intubation, and the presence of respiratory distress can also impact the likelihood of a successful extubation. By carefully evaluating these factors and implementing appropriate interventions, healthcare providers can help ensure a smooth and successful extubation process for their patients.[3] The Ambu AuraGain is a supraglottic airway device that can be used as an alternative to an endotracheal tube for airway management. It is designed to provide a secure airway and ventilation in situations where intubation may not be feasible or appropriate. The AuraGain is inserted through the mouth and sits above the vocal cords, allowing for effective ventilation without the need for a traditional endotracheal tube.[12]

Tracheal extubation can result in a range of physiological responses, including increased heart rate, elevated blood pressure, irregular heart rhythms, reduced blood flow to the heart, coughing, restlessness, narrowing of the airways, increased bleeding, and raised intra ocular and intra cranial pressure.[13] These temporary changes have minimal impact on patients with ASA grade I and II undergoing general surgical procedures. However, they can be a significant concern for anesthesiologists when dealing with patients who have intracerebral space occupying lesions. In such cases, a sudden increase in blood pressure during or immediately after extubation could lead to elevated cerebral blood flow, intracranial pressure, and decreased cerebral perfusion pressure. This, in turn, can result in increased intracranial bleeding, higher morbidity, and mortality.[14]

In the present study, the heart rate was significantly decreased in Ambu Aura LMA group when compared to endotracheal tube at post extubation 1 minute (p=0.0003), 2 minutes (p=0.00002), 3 minutes (p=0.00009), 5 minutes (p=0.00001) and 10 minutes (p=0.0001). Likewise in a study done by Zhang et al the heart rate 10 minutes after extubation was lower in Ambu Aura group when compared to tracheal intubation and it was significant (92 versus 102 bpm; p=0.001).[15]

In our study, the mean arterial pressure (MAP) was significantly decreased in Ambu Aura LMA group when compared to endotracheal tube at post extubation 1 minute (p=0.00004), 2 minutes (p=0.00001), 3 minutes (p=0.0008), 5 minutes (p=0.00009) and 10 minutes (p=0.00008). Likewise, in a study done by Öterkuş and Kuşderci, there was a significant decrease in the MAP in the Ambu Aura when compared to ETT at post intubation and post extubation and it was significant ($p<0.05$).[16]

In the present study, the number bouts of coughs (6.7% versus 26.7%; p=0.002) and the incidence of Laryngospasm was lower in Ambu AuraGain when compared to endotracheal tube and it was significant. Similarly, in a study done by Safaeian et al the complication rate was increased in ETT group when compared to the LMA group.[17] In another study, the Ambu AuraGain group showed less complication when compared to the I-gel, but it was not significant.[18] In another meta-analysis study done by the Koo et al, the incidence airway obstruction and cough was higher in endotracheal tube group as compared to LMA group during awake and deep extubation/removal.[19]

When the SGA is used as the primary airway device, it is crucial to ensure a tight seal around the glottis. This is necessary to enable effective positive pressure ventilation and prevent air pollution in the operating theatre. At the same time, the use of second-generation SGAs with gastric access port aids in deflating the stomach, reducing gastric insufflations, and preventing the aspiration of contents. The oropharyngeal seal pressures serve as an indicator of the effectiveness of the seal around the larynx.[20]

The main limitations of the study were as follows, emergency cases were not included and blinding was not done and it may cause bias in the study. In addition, the study included small sample size.

## CONCLUSION

Based on our observations, we conclude that although both endotracheal extubation and Ambu Aura LMA removal are associated with increased cardiovascular and respiratory hemodynamic, but responses with Ambu Aura LMA has lesser severity and persists for shorter period as compared to endotracheal extubation.

### *Recommendations*

Ambu Aura should be preferred in elderly, hypertensive, diabetic patients for surgeries whenever possible, that

will help to improve the quality of anesthesia thereby reducing adverse events and risks during extubation of the surgery. Further studied are needed in larger population before its recommendation in high-risk patients with coronary artery diseases, chronic obstructive pulmonary diseases, hypertensive, cerebrovascular diseases and in neurosurgeries.

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## REFERENCES

1. Apfelbaum JL, Hagberg CA, Connis RT, Abdelmalak BB, Agarkar M, Dutton RP, et al. 2022 American Society of Anesthesiologists Practice Guidelines for Management of the Difficult Airway. Anesthesiology. 2022;136(1):31-81.
2. Prajwal Patel H, Shashank M, Shivaramu B. Attenuation of hemodynamic response to tracheal extubation: a comparative study between esmolol and labetalol. Anesth Essays Res. 2018;12(1):180-5.
3. Benham-Hermetz J, Mitchell V. Safe tracheal extubation after general anaesthesia. BJA Educ. 2021;21(12):446-54.
4. Asai T, Koga K, Vaughan RS. Respiratory complications associated with tracheal intubation and extubation. Br J Anaesth. 1998;80(6):767-75.
5. Koga K, Asai T, Vaughan RS, Latto IP. Respiratory complications associated with tracheal extubation timing of tracheal extubation and use of the laryngeal mask during emergence from anaesthesia. Anaesthesia. 1998;53(6):540-44.
6. Wallace S, McGrath BA. Laryngeal complications after tracheal intubation and tracheostomy. BJA Educ. 2021;21(7):250-7.
7. Rahman MM, Munir MMH, Sardar K, Khan AS, Chowdhury AN, Rahman MK, et al. Endotracheal tube and proseal laryngeal mask airway in elderly hypertensive diabetic patients undergoing routine laparoscopic surgical procedures: a comparison of hemodynamic parameters. J Bangladesh Coll Phys Surg. 2018;36:153-8.
8. Singh K. Second generation supraglottic airway (SGA) devices. In: Special Considerations in Human Airway Management. IntechOpen; 2021:1-35.
9. Sudheesh K, Chethana G, Chaithali H, Nethra S, Devikarani D, Shwetha G. A new second-generation supraglottic airway device (Ambu® AuraGain) versus intubating laryngeal mask airway as conduits for blind intubation- a prospective, randomised trial. Indian J Anaesth. 2019;63(7):558-64.
10. Zaballos M, Escribá F, López S, Zaballos J, Montero J, Fernández I, et al. Multicentric observation studio for the Ambu® AuraGain® mask on adult patients. Rev Esp Anestesiol Reanim. 2021;68(2):73-81.
11. Saraswat N, Kumar A, Mishra A, Gupta A, Saurabh G, Srivastava U. The comparison of Proseal laryngeal mask airway and endotracheal tube in patients undergoing laparoscopic surgeries under general anaesthesia. Indian J Anaesth. 2011;55(2):129-34.
12. Singh K, Gurha P. Comparative evaluation of Ambu AuraGain™ with ProSeal™ laryngeal mask airway in patients undergoing laparoscopic cholecystectomy. Indian J Anaesth. 2017;61(6):469-74.
13. Thakore S, Kundra P, Garg R. A descriptive survey of tracheal extubation practices among Indian anaesthesiologists. Indian J Anaesth. 2021;65(3):210-5.
14. Phaphagire NB, Ubale P, Syed BA. Haemodynamic responses to tracheal extubation or laryngeal mask airway removal in patients undergoing short surgical procedures: a comparative and clinical study. Asian J Pharm Clin Res. 2023:16(2);44-8.
15. Zhang Q, Sun Y, Wang B, Wang S, Mu F, Zhang Y. Comparative study of the Ambu® AuraOnce™ laryngeal mask and endotracheal intubation in anesthesia airway management during neurosurgery. J Int Med Res. 2020;48(2):030006052090260.
16. Öterkuş M, Kuşderci H. The effectiveness of the Ambu® AuraGain™ laryngeal mask on hemodynamic and respiratory parameters in patients undergoing septoplasty: a randomized prospective clinical study. J Surg Med. 2021;12:735494.
17. Safaeian R, Hassani V, Movasaghi G, Alimian M, Faiz HR. Postoperative respiratory complications of laryngeal mask airway and tracheal tube in ear, nose and throat operations. Anesthesiol Pain Med. 2015;5(4):e25111.
18. Lee J H, Jang YE, Kim EH, Kim HS, Kim JT. Flexion decreases the ventilation quality of the Ambu® AuraGain™ laryngeal mask in paralysed children: a prospective randomised crossover study. Acta Anaesthesiol Scand. 2018;62(8):1080-5.
19. Koo CH, Lee S, Chung S, Ryu JH. Deep versus awake extubation and LMA removal in terms of airway complications in pediatric patients undergoing anesthesia: a systemic review and meta-analysis. J Clin Med. 2018;7(10):353.
20. Gaur Y, Jaju R, Paliwal N, Choudhary U, Bihani P, Janweja S. Comparison of clinical performance of Ambu® AuraGain™ and BlockBuster® in anaesthetised preschool children- a randomised controlled trial. Indian J Anaesth. 2023;67(5):420-5.

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