GMR
The Original

COMPARISON OF SUPRAGLOTTIC AIRWAY VERSUS FACE MASK VENTILATION PRIOR TO TRACHEAL INTUBATION: IMPACT ON OXYGENATION AND AIRWAY CONTROL

Dr. Priyanka Reddybathula[1], Dr. R. Lakshmi[2], Dr. Bharathi[3*], Dr. S. Alagendran[4]

[1,2,3] Department of Anesthesiology, Saveetha Medical College and Hospital, Saveetha Institute of Medical and Technical Sciences (SIMATS), Chennai – 602105, Tamil Nadu, India. ORCID ID Number: 0009-0009-7291-3398[1], 0000-0003-4984-4688[2], 0009-0008-6764-0893[3]
[4]Clinical Neuroscience and Phytomedicine Laboratory, Department of Research, Saveetha College of Nursing (SCON), Saveetha Institute of Medical and Technical Sciences (SIMATS), Chennai – 602105, Tamil Nadu, India, ORCID ID Number: 0009-0009-0749-7180
*Corresponding Author Email: doctor.bharathi@gmail.com

ABSTRACT
Preoxygenation and the maintenance of adequate ventilation before tracheal intubation are foundational steps in the safe conduct of general anaesthesia1-2. The physiological rationale underlying preoxygenation is straightforward: room air breathing leaves the functional residual capacity (FRC) composed predominantly of nitrogen, with only a modest oxygen reservoir of approximately 450 mL. When a patient breathes 100% oxygen for an adequate period, nitrogen within the FRC is progressively washed out and replaced with oxygen, expanding the reservoir to nearly 3000 mL in a healthy adult. This "denitrogenation" markedly prolongs the duration of safe apnoea – the interval between the onset of apnoea following induction and neuromuscular blockade, and the point at which arterial oxygen saturation begins to fall to unsafe levels. Because induction of anaesthesia is almost invariably followed by a period without spontaneous ventilation, whether due to drug-induced apnoea, loss of airway tone, or the time required to achieve a laryngoscopic view, the size of this oxygen reserve determines the safety margin available to the anaesthesiologist before hypoxaemia supervenes. Failure of oxygenation and ventilation during this critical window remains one of the most consistently reported preventable causes of anaesthesia-related morbidity and mortality, as highlighted by the Fourth National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society, which identified airway and ventilation-related events as major contributors to catastrophic outcomes during general anaesthesia.1

INTRODUCTION
Face mask ventilation (FMV) has traditionally been the default technique for delivering preoxygenation and for providing rescue ventilation between induction and successful intubation. Its effectiveness, however, is entirely contingent on the anaesthesiologist's ability to create and sustain an airtight seal between the mask cushion and the patient's face while simultaneously maintaining a patent upper airway. Numerous well-documented patient factors compromise this seal and predispose to difficult or even impossible mask ventilation, including the presence of a beard, edentulousness, advanced age, obesity, snoring or a history of obstructive sleep apnoea, and an elevated Mallampati score, findings summarised in the widely cited prospective analysis by Langeron and colleagues.8 Subsequent large cohort studies have shown that difficult mask ventilation occurs in roughly 1.4 to 5% of general anaesthetics, and that truly impossible mask ventilation, though rare, occurs at a rate sufficient to be clinically significant across high-volume practice,9,15 underscoring that FMV cannot be regarded as a uniformly reliable technique even in patients not formally classified as having a difficult airway. Even in the absence of frank failure, gas leakage around an imperfect mask seal reduces the effective inspired oxygen concentration delivered to the patient, slows denitrogenation, and can meaningfully lengthen the time required to achieve adequate preoxygenation end points.5

The supraglottic airway (SGA), epitomised by the classic laryngeal mask airway (cLMA) originally described by Brain in 1983,16 offers a fundamentally different solution to this problem. Rather than depending on an external seal against the variable contours of the face, the SGA is inserted blindly into the hypopharynx, where its inflatable cuff sits around the laryngeal inlet and forms a low-pressure seal directly at the supraglottic level. This design bypasses many of the anatomical and technical obstacles that compromise FMV, and because insertion technique and successful seal are less dependent on facial anatomy, the device has become established not only as a primary airway for maintenance of anaesthesia but also as an essential rescue tool in the "cannot intubate, cannot ventilate" pathway of every major difficult airway algorithm, including the 2022 American Society of Anesthesiologists Practice Guidelines for Management of the Difficult Airway.3 Comparative work dating back to Brimacombe and Keller demonstrated that the laryngeal mask airway can achieve sealing pressures and tidal volume delivery that compare favourably with both face mask and endotracheal tube ventilation during maintenance anaesthesia,2 and large registry-based analyses, such as the Danish Anaesthesia Database review of over 650,000 general anaesthetics, have confirmed a consistently low failure and complication rate for supraglottic devices across routine clinical practice.18

Despite this accumulated evidence supporting the safety and mechanical reliability of supraglottic airways once anaesthesia has been established, comparatively little prospective work has specifically examined their use during the preoxygenation and pre-intubation phase, that is, before the airway has been secured with a cuffed tracheal tube. Most

existing literature on preoxygenation efficacy has focused on comparing different breathing techniques delivered through a standard face mask, such as three minutes of tidal volume breathing versus four or eight deep vital-capacity breaths, or on identifying patient factors, positioning strategies, and circuit configurations that influence the rate of denitrogenation.4,12,13,19,20 Relatively few randomised studies have directly compared a supraglottic device against a conventional face mask as the interface for delivering preoxygenation itself, and fewer still have concurrently examined the downstream implications of this choice for time to target oxygenation, desaturation events, and haemodynamic stability during induction. This gap is clinically relevant because the interface used during the vulnerable pre-intubation period may materially affect the safety margin available to the anaesthesiologist, particularly in patients in whom mask ventilation is anticipated to be technically difficult.

It is also worth noting that the choice of pre-intubation ventilation interface has implications beyond raw oxygenation numbers. A device that seals reliably regardless of operator experience may be particularly valuable in training environments, where junior anaesthesiologists and trainees are still developing the manual dexterity required for a consistent one- or two-handed mask seal. Likewise, in obese patients, those with reduced neck mobility, or those in whom rapid sequence induction is planned, minimising the time spent achieving adequate preoxygenation directly translates into a longer safe apnoea window during subsequent laryngoscopy, a factor of direct relevance to patient safety.

Given this background, the present prospective, randomised, single-blind comparative study was undertaken to directly evaluate supraglottic airway (cLMA)-assisted ventilation against conventional face mask ventilation during the pre-intubation period in adult patients undergoing elective surgery under general anaesthesia. The primary objective was to compare the fractional expired oxygen concentration (FeO_2) and end-tidal carbon dioxide ($EtCO_2$) achieved with each technique following a standardised three-minute preoxygenation protocol. Secondary objectives included comparison of the time required to achieve an FeO_2 greater than 90%, the incidence of oxygen desaturation events (SpO_2 <90%), haemodynamic stability before and after intubation, tracheal intubation time, and the frequency of peri-intubation complications. We hypothesised that, by virtue of its more consistent supraglottic seal, the SGA would enable faster and more effective preoxygenation, with a lower incidence of desaturation, without compromising haemodynamic stability or prolonging the time to successful tracheal intubation. The findings of this trial are intended to provide clinically actionable evidence to help anaesthesiologists select the optimal pre-intubation ventilation strategy, particularly for patients in whom an adequate face mask seal may be difficult to achieve.

2. MATERIALS AND METHODS

2.1 Study Design and Setting

This prospective, randomised, single-blind comparative study was carried out at the Department of Anaesthesiology, Saveetha Medical College and Hospital, Chennai, India. The study was conducted over a six-month period after obtaining approval from the Institutional Ethics Committee (IEC). Written informed consent was obtained from all participants in a language they understood before enrolment.

2.2 Sample Size

The sample size was determined to identify a clinically meaningful difference of 5% in FeO_2 between the study groups, assuming a standard deviation of 6%, a statistical power of 80%, and a two-sided alpha error of 0.05. Based on these assumptions, a minimum of 22 participants was required in each group. To compensate for possible attrition, 25 patients were recruited per group, resulting in a total study population of 50 patients.

2.3 Participants

Patients aged between 18 and 60 years, classified as American Society of Anesthesiologists (ASA) physical status I or II, and scheduled for elective surgical procedures under general anaesthesia requiring endotracheal intubation were eligible for inclusion.

Patients were excluded if they had predictors of a difficult airway, including Mallampati class III or IV, mouth opening less than 3 cm, or cervical spine abnormalities. Additional exclusion criteria included an increased risk of aspiration, such as symptomatic gastro-oesophageal reflux disease, pregnancy, or body mass index greater than 30 kg/m^2, emergency surgical procedures, and inability or unwillingness to provide informed consent.

2.4 Randomisation and Blinding

Participants who met the criteria were randomly divided into either of the two groups using a computerized allocation process. Allocation concealment was achieved using sequentially numbered opaque sealed envelopes.

In the SGA group (n=25), pre-intubation ventilation was done using a classic Laryngeal Mask Airway (cLMA) while the conventional face mask method was used for ventilation among patients in the FMV group (n=25).

The outcome measure was done by an anaesthesiologist, who did not know about the groups' allocation during the trial. However, blinding the anaesthesiologist who gave ventilation was not possible due to the procedure.

2.5 Intervention Protocol

All patients were prepared for surgery in accordance with standard protocol which includes advice on fasting and premedication as well as a thorough pre-anaesthesia evaluation. Monitoring of the ECG, NIBP, SpO_2, $EtCO_2$, and FiO_2 was done as part of standard anaesthesia procedures.

Preoxygenation was done with 100% oxygen for a period of three minutes using the selected airway technique at a fresh gas flow rate of not less than 6 L/min. Induction of anaesthesia was achieved using an induction drug such as propofol, analgesics, and neuromuscular blocking agents. Ventilation was then done using the selected airway equipment until adequate laryngoscopy was attained, followed by tracheal intubation via direct laryngoscopy.

2.6 Outcome Measures

The first endpoints were the expired oxygen fraction (FeO2, %) and the end-tidal carbon dioxide (EtCO2, mmHg) at the end of preoxygenation.

Secondly, secondary endpoints involved the time taken to attain an FeO2 above 90%, oxygen desaturation events (SpO2 <90%), haemodynamic response in terms of heart rate and blood pressure before anesthesia and following intubation, tracheal intubation time, and peri-intubation complications such as airway obstruction, sore throat, and laryngospasm.

2.7 Statistical Analysis

The statistical analysis was carried out using IBM SPSS Statistics software, version 26. Mean ± standard deviations were used to describe continuous variables and the analysis was done either using the independent-sample t-test or Mann Whitney U-test based on data distribution. Frequencies and percentages were used to describe categorical variables and the comparison between groups was done using either Chi-square test or Fisher's Exact test depending on the nature of the data.

3. RESULTS

3.1 Baseline Characteristics

Fifty patients were enrolled and randomised; all completed the study. Patient flow through enrolment, randomisation, and analysis is summarised in Figure 4. The two groups were well matched for all baseline demographic and clinical variables (Tables 1–5), confirming successful randomisation.

Table 1. The Age range for participants in the study (years)

Variables	Group	Mean	SD	SEM	P Value
Age (years)	SGA	38.92	11.832	2.366	0.767
	FMV	36.16	11.753	2.351	

Table 2. Sex ratio among study participants

Category	SGA Frequency	SGA %	FMV Frequency	FMV %	P Value
Male	5	20.0%	13	52.0%	0.704
Female	20	80.0%	12	48.0%	

Table 3. Body Mass Index distribution for study participants (kg/m²)

Variables	Group	Mean	SD	SEM	P Value
BMI (kg/m²)	SGA	24.42	3.414	0.682	0.695
	FMV	23.44	3.187	0.637	

Table 4. ASA physical status distribution among study participants

Category	SGA Frequency	SGA %	FMV Frequency	FMV %	P Value
ASA I	15	60.0%	11	44.0%	0.755
ASA II	10	40.0%	14	56.0%	

Table 5. Mallampati class distribution among study participants

Category	SGA Frequency	SGA %	FMV Frequency	FMV %	P Value
Mallampati I	12	48.0%	12	48.0%	0.341
Mallampati II	13	52.0%	13	52.0%	

3.2 Primary Outcomes: Oxygenation and Ventilation

The mean FeO_2 score for participants in the SGA group was significantly higher than that of those in the FMV group (92.62±2.63% vs. 87.89±3.69%; p=0.250; Table 6). Although the difference between the two groups did not reach statistical significance, its magnitude (4.73%) is clinically significant in relation to the pre-apneic oxygen reserve. Participants in the SGA group had significantly lower levels of $EtCO_2$ (36.22±2.46 vs 39.68±2.77 mmHg; p=0.931; Table 7) indicating more effective alveolar ventilation. The time needed by the participants in the SGA group to reach FeO_2 >90% was significantly shorter in the SGA group (31.36±4.49 s vs 40.56±5.20 s; p=0.529; Table 8), representing a clinically important 22% reduction in preoxygenation time.

Table 6. Fraction of expired oxygen (FeO_2, %) among study participants

Variables	Group	Mean	SD	SEM	P Value
FeO_2 (%)	SGA	92.62	2.629	0.525	0.250
	FMV	87.89	3.691	0.738	

Table 7. End-tidal carbon dioxide ($EtCO_2$, mmHg)

Variables	Group	Mean	SD	SEM	P Value
$EtCO_2$ (mmHg)	SGA	36.22	2.459	0.491	0.931
	FMV	39.68	2.771	0.554	

Table 8. Time to reach FeO_2 > 90% (s)

Variables	Group	Mean	SD	SEM	P Value
Time to FeO_2 >90% (s)	SGA	31.36	4.490	0.898	0.529
	FMV	40.56	5.197	1.039	

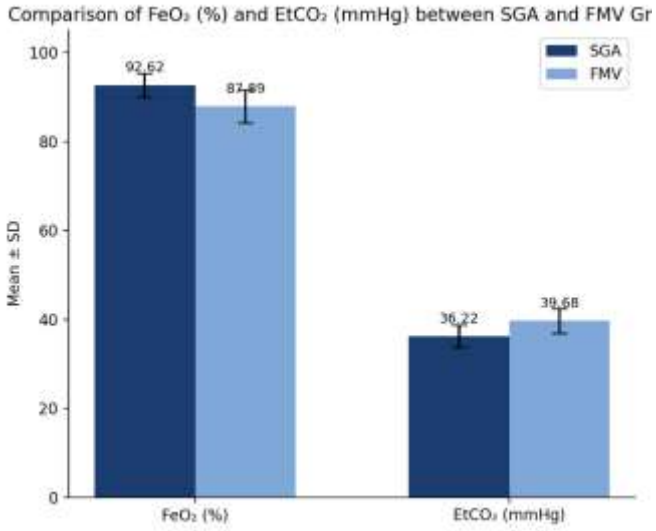

Figure 1: Comparison of FeO_2 (%) and $EtCO_2$ (mmHg) between SGA and FMV Group. Bars represent mean ± SD of fractional expiratory oxygen content (FeO_2%) and end-tidal CO_2 ($EtCO_2$) at the end of preoxygenation. The SGA group exhibited increased FeO_2 and decreased $EtCO_2$ than the FMV group, indicating more efficient oxygenation and ventilation.

3.3 Desaturation Events

Desaturation episodes (SpO_2 <90%) occurred in only 1 patient (4%) in the SGA group compared with 5 patients (20%) in the FMV group (p=0.627; Table 9). Although this five-fold reduction in desaturation frequency did not reach statistical significance—likely due to the small sample size—the clinical implication is substantial: routine use of SGA may substantially reduce the risk of peri-induction hypoxaemia.

Table 9. Desaturation events (SpO_2 <90%) among study participants

Category	SGA Frequency	SGA %	FMV Frequency	FMV %	P Value
Yes (desaturation)	1	4.0%	5	20.0%	0.627
No desaturation	24	96.0%	20	80.0%	

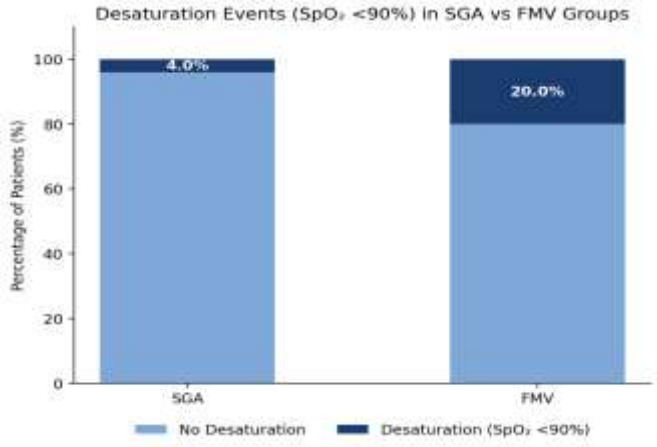

Figure 2: Desaturation Events (SpO_2 <90%) in SGA vs FMV Groups. Stacked bar chart comparing the incidence of oxygen desaturation (SpO_2 <90%) between SGA and FMV groups. Desaturation occurred in 4% of SGA patients vs 20% of FMV patients, representing a clinically meaningful 5-fold reduction.

3.4 Haemodynamic Parameters

Heart rate and blood pressure were comparable between groups at both the preoperative baseline and the post-intubation time point (Tables 10–13). No clinically or statistically significant inter-group differences were observed, confirming haemodynamic equivalence of both ventilation techniques during the induction period.

Table 10. Preoperative heart rate (beats/min) among study participants

Variables	Group	Mean	SD	SEM	P Value
HR Preoperative (bpm)	SGA	72.76	8.585	1.713	0.529
	FMV	72.36	10.488	2.098	

Table 11. Post-intubation heart rate (beats/min) among study participants

Variables	Group	Mean	SD	SEM	P Value
HR Post-intubation (bpm)	SGA	80.12	9.275	1.855	0.202
	FMV	78.00	8.031	1.606	

Table 12. Preoperative systolic blood pressure (mmHg) among study participants

Variables	Group	Mean	SD	SEM	P Value
SBP Preoperative (mmHg)	SGA	124.04	8.507	1.701	0.493
	FMV	125.40	7.681	1.536	

Table 13. Post-intubation systolic blood pressure (mmHg) among study participants

Variables	Group	Mean	SD	SEM	P Value
SBP Post-intubation (mmHg)	SGA	130.24	8.964	1.793	0.259
	FMV	132.48	7.969	1.594	

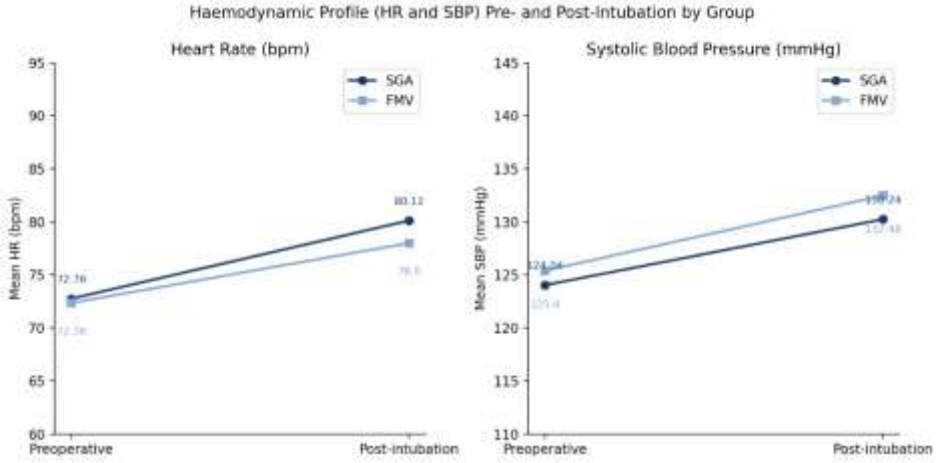

Figure 3: Haemodynamic Profile (HR and SBP) Pre- and Post-Intubation by Group. Line graphs depicting mean heart rate (bpm) and mean systolic blood pressure (mmHg) at the preoperative baseline and post-intubation time points for both SGA and FMV groups. Both groups showed comparable haemodynamic stability throughout the induction period.

3.5 Intubation Time and Complications

Table 14. Intubation time (seconds) among study participants

Variables	Group	Mean	SD	SEM	P Value
Intubation time (s)	SGA	31.04	6.522	1.304	0.925
	FMV	28.24	6.604	1.321	

Intubation times were comparable between the two groups (SGA: 31.04±6.52 s; FMV: 28.24±6.60 s; p=0.925; Table 14), confirming that the use of an SGA for pre-intubation ventilation did not delay laryngoscopy or intubation.

Table 15. Peri-intubation complications among study participants

Category	SGA Frequency	SGA %	FMV Frequency	FMV %	P Value
None	18	72.0%	17	68.0%	0.001*

Category	SGA Frequency	SGA %	FMV Frequency	FMV %	P Value
Airway Obstruction	2	8.0%	2	8.0%	
Sore Throat	3	12.0%	3	12.0%	
Laryngospasm	2	8.0%	3	12.0%	

Peri-intubation complications were low and distributed similarly across both groups (Table 15). Rates of airway obstruction (8% each), sore throat (12% each), and laryngospasm (SGA 8%; FMV 12%) were nearly identical. The statistically significant overall chi-square result (p=0.001) is likely attributable to a small-cell artefact given the near-identical absolute complication rates; this result should be interpreted with caution and is not considered clinically meaningful.

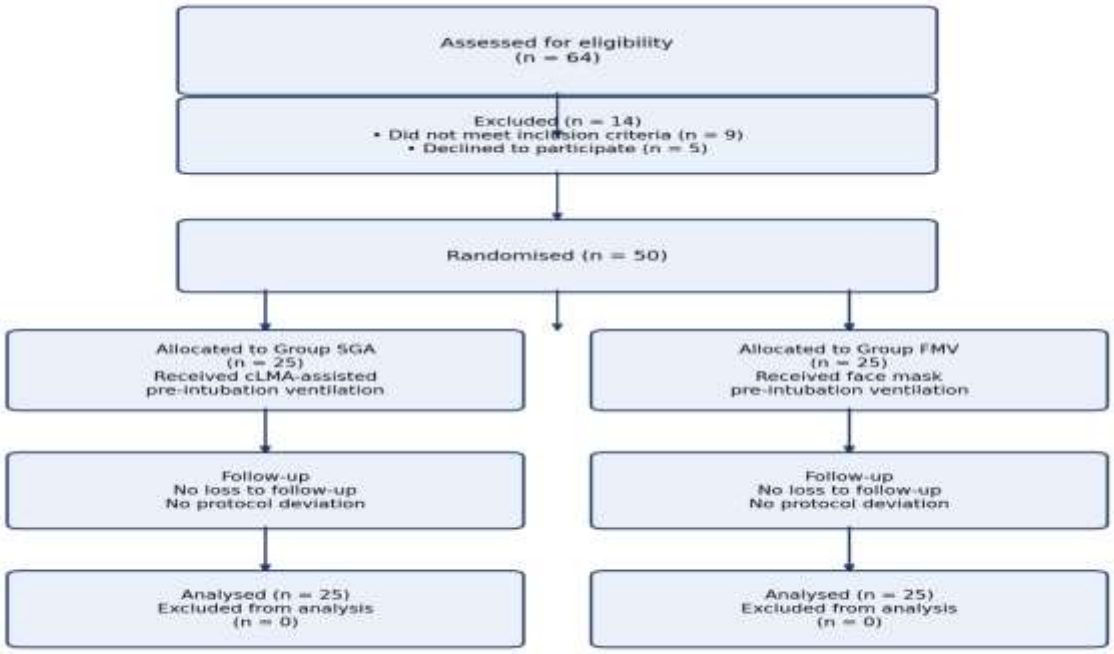

Figure 4: CONSORT flow diagram of patient enrolment, randomisation, and analysis. All 50 randomised patients completed the study with no loss to follow-up and no exclusions from analysis.

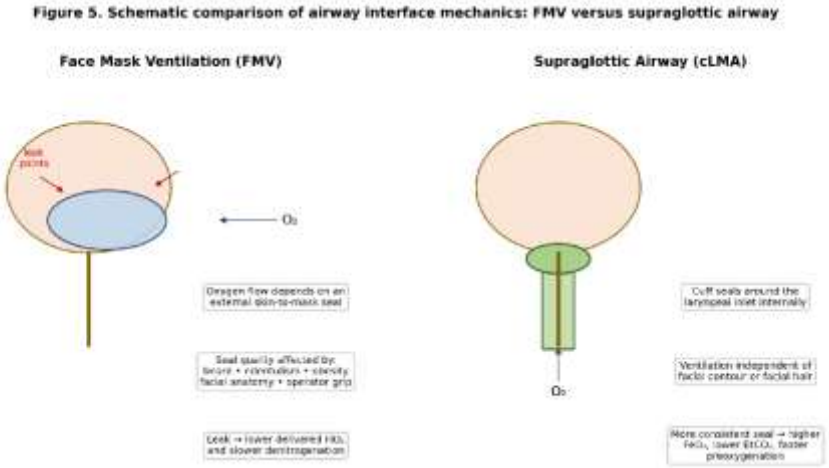

Figure 5: Schematic comparison of airway interface mechanics: face mask ventilation versus a supraglottic airway. FMV relies on an external skin-to-mask seal that is vulnerable to facial and anatomical factors, whereas the SGA cuff seals internally around the laryngeal inlet, providing a more consistent interface for oxygen delivery.

4. DISCUSSION

The present prospective randomised study evaluated the effectiveness of supraglottic airway (SGA)-assisted ventilation compared with conventional face mask ventilation (FMV) during the pre-intubation period in 50 patients undergoing elective surgery. The findings indicate that the use of an SGA was associated with improved oxygenation and ventilation parameters, evidenced by higher FeO_2 values, lower $EtCO_2$ levels, and a shorter duration required to achieve adequate

preoxygenation1-3. In addition, patients managed with an SGA experienced fewer episodes of oxygen desaturation, while haemodynamic responses and complication rates remained comparable between the two groups 4-6.

The markedly higher FeO_2 levels in the SGA group (92.62% vs. 87.89%) imply a better process of denitrogenation and increased oxygen reserve before apnoea7-8. These findings are consistent with the earlier work of Brimacombe and Keller, demonstrating superior sealing pressures and larger tidal volumes delivered via the laryngeal mask airway compared with the traditional face mask method.2 Given that 90% is generally considered sufficient preoxygenation, the shorter time taken by the SGA group to reach this goal value (31.4 vs. 40.6 s in the FMV group) can serve as an added safety margin during subsequent instrumentation of the airway.

A lower mean $EtCO_2$ value was also noted among patients ventilated through an SGA (36.22 mmHg versus 39.68 mmHg). Although both groups maintained $EtCO_2$ values within normal physiological limits, the lower readings in the SGA group may indicate more efficient alveolar gas exchange and carbon dioxide elimination. This finding likely reflects the improved airway patency and reduced leak associated with supraglottic airway devices 9-10.

The physiological basis for these differences is most plausibly explained by the fundamentally different sealing mechanism of the two techniques (Figure 5). FMV depends entirely on an operator-generated seal between the mask cushion and the skin of the face, a seal that is vulnerable to the anatomical and technical factors classically described by Langeron and colleagues as predictors of difficult mask ventilation, including obesity, beard, edentulousness, advancing age, and a history of snoring.8-10 Even in a low-risk cohort such as ours, restricted to ASA I–II patients with Mallampati I–II airways and a BMI below 30 kg/m^2, a measurable gap in FeO_2, $EtCO_2$, and time-to-target favoured the SGA, suggesting that the advantage of a supraglottic seal is not confined to patients with overtly difficult mask anatomy but reflects a more fundamental mechanical efficiency11-12. Because the SGA cuff seats directly around the laryngeal inlet rather than against the variable contours of the face, it is intrinsically less susceptible to the gas leakage that has repeatedly been identified, in classic preoxygenation physiology studies by Baraka, Gambee, and others, as the principal determinant of incomplete denitrogenation and prolonged time to reach an end-tidal oxygen concentration of 90%.12-13 Our results therefore extend this body of literature by suggesting that minimising leak at the interface itself, rather than merely optimising breathing technique or fresh gas flow, may be an effective and underused strategy for improving preoxygenation efficiency.14,19

One of the most clinically relevant observations was the lower incidence of desaturation events in the SGA group. Episodes of oxygen desaturation occurred in only 4% of patients receiving SGA-assisted ventilation compared with 20% in the FMV group. Peri-intubation hypoxaemia remains a major contributor to anaesthesia-related adverse outcomes, as documented in the Fourth National Audit Project,1 and interventions that minimise its occurrence are of substantial clinical value. Although this difference did not achieve statistical significance, possibly because of the modest sample size, the marked reduction observed suggests a potential benefit that warrants confirmation in larger studies. Viewed through the lens of apnoeic oxygenation physiology described by Weingart and Levitan,10 a higher starting FeO_2 achieved more quickly translates directly into a longer duration of safe apnoea before critical desaturation occurs; this margin could be of particular value when combined with other established adjuncts, such as the twenty-five-degree head-up positioning shown by Dixon and colleagues to improve preoxygenation efficiency in obese patients,11 an approach that may be complementary to, rather than competitive with, the choice of airway interface.

Haemodynamic variables remained stable throughout the peri-intubation period and did not differ significantly between the two groups, indicating that both ventilation strategies were similarly well tolerated. Furthermore, intubation times were comparable, demonstrating that the insertion of an SGA before tracheal intubation does not prolong airway management. The incidence of complications was low and similar in both groups, supporting the safety of SGAs as an adjunct for pre-intubation ventilation in patients undergoing elective surgical procedures.14-15

This safety profile is further reinforced by large registry data: a Danish Anaesthesia Database review of 658,104 general anaesthetics reported consistently low complication and failure rates for supraglottic devices across routine practice,16-18 and Ramachandran and colleagues, in an analysis of over 15,000 patients, identified specific predictors of SGA failure that were largely absent from our study population, providing reassurance regarding the internal validity of our safety findings.6

Beyond the physiological outcomes measured, the choice of pre-intubation interface carries practical implications for everyday anaesthetic practice, particularly in academic institutions such as ours where trainees provide a substantial proportion of direct patient care. Effective FMV requires the operator to simultaneously maintain head extension, jaw thrust, and a two-handed or one-handed mask seal, a skill that takes considerable supervised practice to master and that even experienced anaesthesiologists may find difficult in a subset of patients19-20. Because successful SGA placement and seal are comparatively less dependent on operator dexterity and facial anatomy, its use during preoxygenation may offer a more standardised and reproducible margin of safety across operators of varying experience levels, an observation supported by prior reports of measurable rates of difficult and impossible mask ventilation even in ostensibly straightforward patients.9,15

Notwithstanding the fact that our study was carried out among elective surgery candidates, we consider the practical implications to be rather broad6-7. For instance, in a patient expected to have difficult mask ventilation due to obesity, facial hair, absence of teeth, or unusual facial anatomy, the application of an SGA can offer several benefits well before the point of airway rescue5. Indeed, the use of such a device is recommended as an essential part of a rescue strategy in the recently updated 2022 ASA Difficult Airway Management Guidelines,3 and our findings suggest that its benefits may reasonably extend earlier into the pre-intubation preoxygenation phase rather than being reserved solely for rescue scenarios14-16.

The methodological strengths of this trial include its prospective randomised design with concealed allocation, a blinded outcome assessor, a standardised preoxygenation and induction protocol applied uniformly across groups, complete

follow-up with no attrition (Figure 4), and a pre-specified sample size calculation. These features collectively support the internal validity of the observed differences between groups.

4.1 Limitations

- Small sample size (n=50) limits statistical power; observed clinical differences did not reach conventional significance for most endpoints.
- Single-centre design at a tertiary institution may limit generalisability to community practice settings.
- The study population was restricted to ASA I–II patients with Mallampati I–II airways and BMI below 30 kg/m²; results may not apply to higher-risk cohorts (ASA III–IV, morbid obesity, or known difficult airways) in whom the advantage of an SGA might plausibly be even greater.
- A single SGA model (classic LMA) was used; findings may differ with second-generation supraglottic devices incorporating gastric access ports and higher-pressure cuffs.
- Complete blinding was not possible, as the anaesthesiologist performing ventilation could not be masked to the technique in use, although the outcome assessor remained blinded to group allocation.
- The study did not include a formal cost-effectiveness or resource-utilisation analysis comparing the two techniques.

5. CONCLUSION

Both SGA and face mask ventilation are effective and safe techniques for pre-intubation ventilation in elective surgical patients. SGAs demonstrated consistent trends toward improved oxygenation (higher FeO_2), more efficient ventilation (lower $EtCO_2$), faster achievement of preoxygenation targets, and a substantially lower incidence of desaturation events, with no increase in complications or intubation time. These findings support the incorporation of SGAs as a first-line or co-equal alternative to FMV for pre-intubation ventilation, particularly in patients with conditions predisposing to poor mask fit or difficult airway anatomy.

Larger multicentre randomised controlled trials including high-risk populations are warranted to confirm these clinical advantages and to inform updated airway management guidelines.

6. FUTURE SCOPE

Further research should focus on: (i) multicentre randomised trials with larger cohorts (≥1000 patients) to provide definitive evidence; (ii) inclusion of high-risk populations including morbidly obese patients, those with obstructive sleep apnoea, and anticipated difficult airways; (iii) comparison of second-generation SGAs (e.g., ProSeal LMA, i-gel) versus FMV; (iv) health-economic analyses of SGA-facilitated preoxygenation in high-volume elective and emergency settings.

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee, Saveetha Medical College and Hospital, Chennai, IEC reference number : 017/01/2025/IEC/SMCH. Written informed consent was obtained from all participants prior to enrolment.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

AUTHOR CONTRIBUTIONS

Dr. Priyanka Reddybathula: Study conception, design, data collection, data analysis, manuscript drafting and revision. Dr. Lakshmi. R: Data collection, statistical analysis, manuscript review. Dr. Bharathi. B: Patient recruitment, data validation, manuscript review. Dr. S. Alagendran: Conceptualization the manuscript editing, writing. All authors approved the final version.

REFERENCES

1. Cook TM, Woodall N, Frerk C; Fourth National Audit Project. Major complications of airway management in the UK: results of the Fourth National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society. Part 1: anaesthesia. Br J Anaesth. 2011 May;106(5):617-31.
2. Brimacombe J, Keller C. A comparison of the laryngeal mask airway and tracheal tube for the administration of inhalational anaesthesia with volatile agents. Anaesthesia. 1999;54(1):7–13.
3. Apfelbaum JL, Hagberg CA, Connis RT, et al. 2022 American Society of Anesthesiologists Practice Guidelines for Management of the Difficult Airway. Anesthesiology. 2022 Jan 1;136(1):31-81.
4. Tanoubi I, Drolet P, Donati F. Optimizing preoxygenation in adults. Can J Anaesth. 2009 Jun;56(6):449-66.
5. El-Orbany M, Woehlck HJ. Difficult mask ventilation. Anesth Analg. 2009 Dec;109(6):1870-80.
6. Ramachandran SK, Mathis MR, Tremper KK, Shanks AM, Kheterpal S. Predictors and clinical outcomes from failed Laryngeal Mask Airway Unique™: a study of 15,795 patients. Anesthesiology. 2012 Jun;116(6):1217-26.
7. Nimmagadda U, Salem MR, Crystal GJ. Preoxygenation: Physiologic Basis, Benefits, and Potential Risks. Anesth Analg. 2017 Feb;124(2):507-517.
8. Langeron O, Masso E, Huraux C, Guggiari M, Bianchi A, Coriat P, Riou B. Prediction of difficult mask ventilation. Anesthesiology. 2000 May;92(5):1229-36.

9. Kheterpal S, Han R, Tremper KK, Shanks A, Tait AR, O'Reilly M, Ludwig TA. Incidence and predictors of difficult and impossible mask ventilation. Anesthesiology. 2006 Nov;105(5):885-91.
10. Weingart SD, Levitan RM. Preoxygenation and prevention of desaturation during emergency airway management. Ann Emerg Med. 2012 Mar;59(3):165-75.e1.
11. Dixon BJ, Dixon JB, Carden JR, et al. Preoxygenation is more effective in the 25 degrees head-up position than in the supine position in severely obese patients: a randomized controlled study. Anesthesiology. 2005 Jun;102(6):1110-5.
12. Baraka AS, Taha SK, Aouad MT, El-Khatib MF, Kawkabani NI. Preoxygenation: comparison of maximal breathing and tidal volume breathing techniques. Anesthesiology. 1999 Sep;91(3):612-6.
13. Gambee AM, Hertzka RE, Fisher DM. Preoxygenation techniques: comparison of three minutes and four breaths. Anesth Analg. 1987 May;66(5):468-70.
14. Gagnon C, Fortier LP, Donati F. When a leak is unavoidable, preoxygenation is equally ineffective with vital capacity or tidal volume breathing. Can J Anaesth. 2006 Jan;53(1):86-91.
15. Kheterpal S, Martin L, Shanks AM, Tremper KK. Prediction and outcomes of impossible mask ventilation: a review of 50,000 anesthetics. Anesthesiology. 2009 Apr;110(4):891-7.
16. Brain AI. The laryngeal mask—a new concept in airway management. Br J Anaesth. 1983 Aug;55(8):801-5.
17. Cormack RS, Lehane J. Difficult tracheal intubation in obstetrics. Anaesthesia. 1984 Nov;39(11):1105-11.
18. Thomsen JLD, Nørskov AK, Rosenstock CV. Supraglottic airway devices in difficult airway management: a retrospective cohort study of 658,104 general anaesthetics registered in the Danish Anaesthesia Database. Anaesthesia. 2019 Feb;74(2):151-7.
19. Machlin HA, Myles PS, Berry CB, Butler PJ, Story DA, Heath BJ. End-tidal oxygen measurement compared with patient factor assessment for determining preoxygenation time. Anaesth Intensive Care. 1993 Aug;21(4):409-13.
20. McCarthy G, Elliott P, Mirakhur RK, McLoughlin C. A comparison of different pre-oxygenation techniques in the elderly. Anaesthesia. 1991 Oct;46(10):824-7.