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COMPARISON OF FIBER-OPTIC ASSESSMENT IN MIDLINE VERSUS ROTATIONAL INSERTION TECHNIQUE OF AIR-Q IN PEDIATRIC SURGERIES: A RANDOMISED DOUBLE BLIND INTERVENTIONAL STUDY IN DEPARTMENT OF ANAESHESIOLOGY, S.M.S. MEDICAL COLLEGE AND HOSPITAL JAIPUR

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ABSTRACT

Background: Effective airway management in pediatric anesthesia is challenging due to anatomical differences. The Air-Q supraglottic airway device (SAD) is widely used, but optimal insertion techniques remain understudied. This study compares the midline and rotational techniques for Air-Q insertion in pediatric patients, focusing on fiber-optic bronchoscopic (FOB) assessment of laryngeal view. **Methods:** In this randomized, double-blind study, 120 children (ASA I-II, aged 5-12 years) undergoing elective surgeries under general anesthesia at S.M.S. Medical College, Jaipur (2022-2023), were equally divided into two groups: Group A (midline insertion, n=60) and Group B (rotational insertion, n=60). Primary outcomes included FOB laryngeal view (Brimacombe score), insertion time, and first-attempt success rate. Secondary outcomes were oropharyngeal leak pressure (OLP), ease of insertion, hemodynamic stability, and complications (cough, sore throat, laryngospasm, blood on device). **Results:** No significant difference was found in FOB laryngeal view (p=0.310), with 48.3% (Group A) and 36.7% (Group B) achieving Grade 4. Insertion time was shorter with the rotational technique (11.32 ± 1.08 vs. 12.28 ± 1.09 seconds, p<0.001). First-attempt success rates (93.3% vs. 96.7%, p=0.675) and ease of insertion (93.3% vs. 96.7% easy) were comparable. OLP (22.05 ± 2.5 vs. 22.4 ± 1.8 cmH2O, p=0.381) and complications (cough: 5% vs. 1.7%; blood on device: 8.3% vs. 6.7%) showed no significant differences. Hemodynamic parameters were similar, except for higher mean arterial pressure in the midline group at certain time points. **Conclusion:** The rotational technique for Air-Q insertion is faster but offers no significant advantage over the midline technique in FOB laryngeal view, ease of insertion, success rate, OLP, or complications. Both techniques are safe and effective for pediatric airway management under controlled ventilation.

KEYWORDS

Air-Q, supraglottic airway device, pediatric anesthesia, midline insertion, rotational insertion, fiber-optic bronchoscopy, laryngeal view, Brimacombe score, insertion time, oropharyngeal leak pressure, complications

INTRODUCTION

Airway management is a critical task for anesthesiologists, with endotracheal intubation being a common but invasive method that may cause complications like dental damage, soft tissue injury, and hemodynamic instability[1]. Supraglottic airway devices (SADs), such as the laryngeal mask airway (LMA), were developed to provide effective ventilation without laryngoscopy, reducing complications[2]. Since their introduction in 1988, LMAs have been widely used, particularly in pediatric anesthesia, due to their ease of insertion and lower risk of hypoxia, coughing, and laryngospasm. Pediatric airways pose unique challenges due to anatomical differences (large occiput, tongue, high larynx, and floppy epiglottis), increasing the risk of hypoxia and improper device placement.[3-4]

The Air-Q, a second-generation SAD, is designed for both primary airway management and as a conduit for tracheal intubation without traditional laryngoscopy. Its features, including a wider airway tube, detachable connector, and absence of an epiglottic bar, make it suitable for pediatric patients, providing better laryngeal views and safer intubation[5]. While various LMA insertion techniques (midline, rotational, laryngoscopy-guided) have been studied, few have compared fiber-optic bronchoscopic assessment of laryngeal views for Air-Q insertion in pediatric patients.[6-9]

This randomized, double-blind study evaluates the midline versus rotational insertion techniques of the Air-Q in pediatric surgeries, focusing on fiber-optic bronchoscopic assessment of laryngeal view, ease of insertion, intubation success rate, airway seal pressure, and safety.

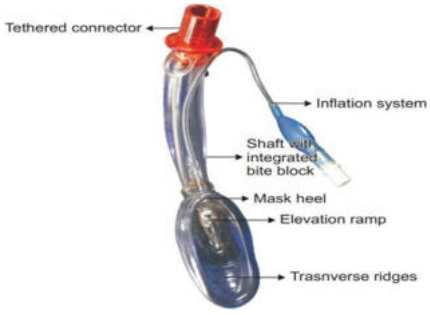


Fig: 1 Air Q

Aim: To compare the fibre-optic bronchoscopic assessment in midline versus rotational insertion techniques of Air-Q in paediatric surgeries.

Objectives: To determine the difference in ease of insertion, mean time taken for insertion and mean grading of laryngeal view in two different techniques (Midline versus Rotational) of Air-Q insertion with fibre-optic bronchoscope in both groups. To determine difference in number of attempts for successful insertion of Air- Q with each technique and complications associated.

MATERIALS AND METHODS:

This hospital based, Prospective randomization double blinded interventional study was conducted in Department of Anaesthesiology, SPINPH, S.M.S Medical College and hospital, Jaipur (Rajasthan). The study was registered with clinicaltrials.gov (REF /2023/08/071752) before patient enrolment.

Study Universe:
Paediatric patients in age group 5-12 years undergoing elective surgery.

Sample Size: 60 patients in each group, Calculated assuming 80% study power and alpha error of 0.05 to verify the expected difference of 25% in FOB grading in rotational v/s midline technique of Air-Q insertion (72.5%v/s 47.5%) as per seed article[2].

Sampling Technique: Sampling randomization through opaque sealed envelope method.

Blinding: The anaesthesiologist, who assessed the laryngeal view was blinded to technique used for Air-Q insertion.

Study Groups: The study was conducted in following two groups of patients. Each group consists of patients (n = 60/group). Group A (n= 60)- Air-Q was inserted using midline insertion technique. Group B (n= 60)-Air-Q was inserted using rotational insertion technique

Inclusion Criteria

- Parents or caregiver willing to participate in study.
- A.S.A. I and II
- Age range between 5 years to 12 years.
- Weight between 10 to 30 kg
- Elective inguinal, urological procedures for which SADs are

routinely used.

Exclusion Criteria-
- Patient with acute upper respiratory infection.
- Patient with difficult airway.
- Surgery time more than one hrs.
- Emergency surgeries

Pre-Anaesthetic Check-up: Pre-anaesthetic check-up was performed a day before the surgery that includes: Complete medical and surgical history of the patient including any known drug allergy.

General And Systemic Examination- Vital parameters like blood pressure, pulse, temperature, respiratory rate and weight was recorded

Statistical Analysis: The data was coded and entered into Microsoft excel spreadsheet. Analysis was done using Epi info software version 7.2.1.0 statistical software. Categorical variables were summarized as frequency and percentage. Continuous variables were summarized as mean and standard deviation and were analyzed using independent student's' test. P value <0.05 was be taken as statistically significant.

Procedure

a. After checking PAC, taking written informed consent and confirming fasting status, patient was taken on operation table. Routine non-invasive monitor was attached and base line parameters were noted i.e. heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure and SPO2 will be noted, ECG was also attached.
b. Patient were premedicated with inj. Glycopylorate 0.005mg/kg, inj. Fentanyl 2mcg/kg, inj. Midazolam 0.05mg/kg through already secured intra-venous cannula and I.V. fluid started as per hospital protocol.
c. Preoxygenation was done with 100% oxygen for 3-5 minutes.
d. Induction was done with inj. Thiopentone 5-6mg/kg + inj. Succinylcholine 1.5mg/kg.
e. Mask ventilation was performed and appropriate size of Air-Q (based on the weight of patient) was inserted according to group allocation Following insertion, the Air- Q cuff was inflated as recommended (0.5 mL and 1 mL for sizes 1.5 and 2, respectively) to maintain cuff pressure in the range of 20-30 cmH2O, and the anaesthesia machine's breathing circuit was connected to the proximal end of the Air-Q. Time taken for insertion, ease of insertion and number of attempts were noted. Adequate ventilation was confirmed by bilateral chest movement and capnography. If any obstruction or inadequate ventilation with a significant leak observed the Air-Q was reinserted using the same technique The Anaesthesiologist who performed Fiber-optic bronchoscopy was unaware of the technique of Air-Q insertion. He or she assessed the laryngeal view.
f. The score of the laryngeal view was determined by the position of the tip of the FOB at the distal outlet of the Air-Q.
g. The Brimacomb scoring system was used for fibre optic grading. Anaesthesia was maintained with O2+N2O (4:6) +sevoflurane (2.5%) + relaxant (Inj. Atracurium0.5mg/mL Loading dose and 0.1mg/mL maintenance dose. Controlled ventilation was performed. Oropharyngeal leak pressure was determined by audible noise after closing APL valve, with fresh gas flow at 3L/min until equilibrium was reached and then released. hemodynamic parameters were noted at definitive interval. After completion of surgical procedure, sevoflurane was discontinued and patient was reversed with inj. neostigmine (0.05mg/kg) and inj. glycopyrrolate (0.01mg/kg). The Air-Q was deflated and patient was extubated when fully awake.
h. Any bloodstained and post operative complication were noted. Patient was shifted to recovery room.

Techniques Of Air -Q Insertion -

A. Classic Midline Technique: Patient's mouth opened by stabilizing the patient's neck and head with the non-dominant hand. The lubricated Air-Q mask was placed with a slight forward angle at the base of the tongue, and the Air-Q was positioned by gently applying downward and inward pressure. Resistance to further advancement of the device determined correct placement.[7]

B. Rotational Technique: The Air-Q inserted with its lumen facing backwards in the rotational technique group. When resistance was felt in the posterior pharyngeal wall, the device was rotated 180 degrees and then passed downwards into position.[7]

FOB Grading Of Laryngeal View Through Air-Q (Brimacombe Scale) [10]
- **Grade-4** -only vocal cords seen
- **Grade-3**- vocal cords and posterior surface of epiglottis were observed.
- **Grade-2-**vocal cords and tip of anterior surface of epiglottis were observed.
- **Grade-1-**Vocal cord not seen, but function adequately
- **Grade-0**- Failure to function where vocal cord not seen fibre-optically.

The Ease Of Insertion Of Device Categorized Into [11]
- **Easy**- An easy insertion is defined as an insertion within the pharynx without resistance in a single manoeuvre.
- **Difficult**- A difficult insertion is the one in which there is resistance to insertion or where more than one attempt is required to seat the device within the pharynx.
- **Time Of Insertion** -The time interval between picking up the device and obtaining effective ventilation is recorded.
- **Number Of Attempts**- If the airway device was completely or partially obstructed, or if there was a considerable leak, it was withdrawn and reinserted. A maximum of three insertion attempts were permitted before the device placement was declared a failure. In the event of a failure, an alternative airway device was employed to secure the airway.

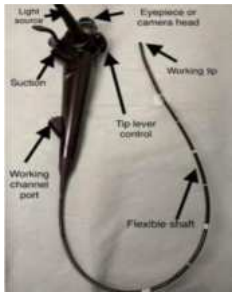
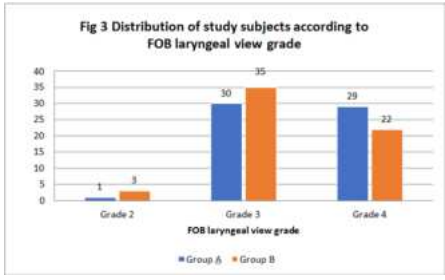


Fig: 2 Fiberoptic Bronchoscope

Observations And Results

Demographic parameters were comparable in both the group to avoiding confounding factor.



Distribution of study subjects according to FOB laryngeal view grade (Brimacombe score).

Table 1 Comparison Of Among Study Groups

Factors	Group A (n=60)	Group B (n=60)	P value
Time to insert device in sec (Mean ± SD)	12.28 ± 1.09	11.32 ± 1.08	0.001
Oropharyngeal Leak Pressure	22.05 ± 2.5	22.4 ± 1.8	0.38

Group A has a mean insertion time of 12.28 ± 1.09 seconds, while Group B has a mean insertion time of 11.32 ± 1.08 seconds. The P-value for the difference in mean insertion times is 0.001, indicating a statistically significant difference. Group A had a mean Oropharyngeal Leak Pressure (OLP) of 22.05 cmH2O (±2.5), while Group B had a mean OLP of 22.4 cmH2O (±1.8). The P value of 0.381 indicates that the difference in OLP between the two groups is not statistically significant, suggesting that the observed variations in OLP are likely due to chance rather than any specific factor being investigated.

Table 2: Distribution Of Study Subjects According To Attempts Of

Insertion

Attempts of insertion	Group A		Group B		Total	
	N	%	N	%	N	%
1st attempt	56	93.3	58	96.7	114	96.7
2nd attempt	4	6.7	2	3.3	6	3.3
Total	60	100	60	100	120	100

In Group A, 93.3% of subjects had a successful first attempt, and 6.7% required a second attempt. In Group B, 96.7% of subjects had a successful first attempt, and 3.3% required a second attempt. Overall, 95.0% of subjects had a successful first attempt, and 5.0% required a second attempt. The chi-square test result $X^2 = 0.175$, P = 0.675 indicates no significant difference in the number of attempts between the groups.

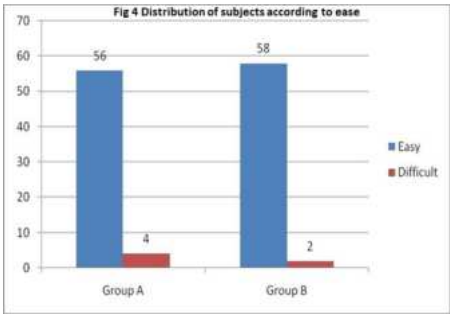


Fig 4 shows in Group A, 56 (93.3%) of insertions were categorized as easy, and 4 (6.7%) were categorized as difficult. In Group B, 58 (96.7%) of insertions were categorized as easy, and 2(3.3%) were categorized as difficult. Overall, 100% of insertions were categorized as easy across both groups. Since all insertions are ultimately classified as easy when combined, a P-value could not be calculated to compare the groups statistically.

Table 3: Incidence Of Complications Among Study Groups

Complications	Group A		Group B		P value
	N	%	N	%	
Cough	3	5.0	1	1.7	0.505
Sore throat	0	0.0	0	0.0	-
Laryngospasm	0	0.0	0	0.0	-
Blood on device post removal	5	8.3	4	6.7	1.000

Table no. 3 shows in Group A, 5.0% experienced cough, and 8.3% had blood on the device post removal, while no subjects reported a sore throat or laryngospasm. In Group B, 1.7% experienced cough, and 6.7% had blood on the device post removal, with no reports of sore throat or laryngospasm. The P-values indicate no significant difference between the groups for cough (P = 0.505) and blood on the device post removal (P = 1.000). Since there were no cases of sore throat or laryngospasm in either group, a P-value could not be calculated for these complications.

DISCUSSION

The study compared the midline and rotational techniques for Air-Q insertion in pediatric patients, focusing on fiber-optic bronchoscopic (FOB) assessment of laryngeal view (Brimacombe score), insertion time, ease of insertion, first-attempt success rate, oropharyngeal leak pressure (OLP), hemodynamic stability, and complications. The FOB view showed no significant difference between groups (p=0.310), with 48.3% in Group A (midline) and 36.7% in Group B (rotational) achieving Grade 4, and 50% (Group A) versus 58.3% (Group B) achieving Grade 3. This aligns with some studies but contrasts with **Gaddam et al. (2019)[7]** and **Ghai et al. (2011)[9],** who reported superior FOB views with the rotational technique in children with normal airways, and **Jagannathan et al. (2012)[13],** who noted benefits in difficult airways.

Insertion time was significantly shorter for the rotational technique (11.32 ± 1.08 seconds) compared to the midline technique (12.28 ± 1.09 seconds, p<0.001), consistent with Gaddam et al. (2019). Variations in insertion time definitions across studies (e.g., **Malhotra et al., 2016)[12]** may explain discrepancies. First-attempt success rates were high (93.3% for midline, 96.7% for rotational, p=0.675), aligning with Gaddam et al. (2019) and Jagannathan et al. (2012) but differing from **Sinha et al. (2011)[18] and Darlong et al. (2015)[16].** Ease of insertion was comparable (93.3% easy in Group A, 96.7% in Group B), with no statistical difference.

OLP was similar between groups (22.05 ± 2.5 cmH2O for midline, 22.4 ± 1.8 cmH2O for rotational, p=0.381), consistent with **Darlong et al. (2015) and Whyte et al[17].** but differing from Jagannathan et al. (2012) and Sinha et al. (2011), possibly due to age and weight variations. Hemodynamic parameters (SBP, DBP, HR, MAP) showed no significant differences, except for a higher MAP in the midline group at certain time points, contrasting with Gaddam et al. (2019). Complications (cough, blood on device) were low and not significantly different (p=0.505 for cough, p=1.000 for blood), aligning with **Wahba et al. (2020)[14].**

Summary

This randomized, double-blind study conducted at S.M.S. Medical College, Jaipur (2022-2023) involved 120 children (ASA I-II, aged 5-12 years) undergoing elective surgeries under general anesthesia, divided into Group A (midline Air-Q insertion, n=60) and Group B (rotational insertion, n=60). Key findings include:

- No significant difference in FOB laryngeal view (p=0.310).
- Shorter insertion time with rotational technique (11.32 ± 1.08 vs. 12.28 ± 1.09 seconds, p<0.001).
- Comparable first-attempt success rates (93.3% vs. 96.7%, p=0.675) and ease of insertion (93.3% vs. 96.7% easy).
- No significant difference in OLP (22.05 ± 2.5 vs. 22.4 ± 1.8 cmH2O, p=0.381).
- Higher MAP in the midline group at certain time points, but no differences in SpO2, EtCO2, or other hemodynamic parameters.
- No significant differences in complications (cough: 5% vs. 1.7%; blood on device: 8.3% vs. 6.7%).

CONCLUSION

The rotational technique for Air-Q insertion is faster than the midline technique but shows no significant differences in FOB laryngeal view, ease of insertion, first-attempt success rate, OLP, or complications. Both techniques are effective and safe for pediatric airway management under controlled ventilation with muscle relaxants.

Limitation: Our study only included healthy children with normal airway anatomy; therefore results may not be applicable to those with complex airway anatomy. This study focused on children who were under controlled ventilation after administration of muscle relaxant. Therefor the result may not be applicable to those who did not receive neuromuscular blockade.

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