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ORIGINAL RESEARCH

Comparative Clinical Evaluation of Dexmedetomidine with Lidocaine Nebulisation versus Lidocaine alone for Awake Nasotracheal fibreoptic Intubation

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ABSTRACT

Awake fibreoptic intubation (AFOI) is the gold standard technique for anticipated difficult airway management, requiring optimal sedation and airway anesthesia for successful outcomes. To compare the efficacy of dexmedetomidine with lignocaine versus plain lignocaine nebulization for achieving successful airway placement during awake fibreoptic intubation and to assess patient comfort, intubating conditions, hemodynamic stability, and intubation time. This observational cross-sectional study included 120 patients divided into two groups of 60 each. Group A received dexmedetomidine with lignocaine nebulization, while Group B received plain lignocaine nebulization. Various parameters including airway reflexes, hemodynamic variables, and intubation characteristics were assessed. Demographic and airway parameters were comparable between the groups ($p>0.05$). Group A demonstrated better hemodynamic stability with significantly lower SBP, DBP, MAP, and heart rate during intubation ($p<0.05$). First-attempt intubation success was higher in Group A (96.7%) compared to Group B (90.0%). Oxygen saturation remained stable in both groups. Complication rates were minimal and comparable. Dexmedetomidine combined with lignocaine nebulization provides superior intubating conditions, better patient comfort, and enhanced hemodynamic stability compared to plain lignocaine nebulization, making it a safe and effective technique for awake fibreoptic intubation.

Keywords: Dexmedetomidine; Lignocaine nebulization; Awake fibreoptic intubation; Hemodynamic stability

INTRODUCTION

Airway management remains a cornerstone of safe anaesthetic practice, particularly in patients with anticipated difficult airway, where failure to secure the airway may result in significant morbidity and mortality. Awake fibreoptic intubation (AFOI) is widely regarded as the gold standard technique in such scenarios, as it allows preservation of spontaneous ventilation while enabling visualization of airway structures and controlled endotracheal tube placement [1]. Despite its high success rate and safety profile, the procedure is often associated with patient discomfort, coughing, gagging, and sympathetic stimulation, necessitating the use of optimal airway anaesthesia and sedation strategies [2].

The success of AFOI largely depends on achieving a balance between adequate sedation and effective topical anaesthesia without compromising respiratory drive. Inadequate airway anaesthesia can lead to exaggerated airway reflexes such as coughing and laryngospasm, while excessive sedation may result in airway obstruction or hypoventilation [3]. Therefore, the choice of pharmacological agents plays a crucial role in improving intubation conditions, patient tolerance, and overall procedural success.

Lignocaine (lidocaine) has been extensively used as a topical local anaesthetic agent for airway preparation due to its rapid onset and efficacy in suppressing airway reflexes. Nebulization of lignocaine offers a non-invasive method for delivering uniform airway anaesthesia, especially in patients where nerve blocks are technically challenging or contraindicated [4].

However, lignocaine alone may not provide sufficient sedation or anxiolysis, which are equally important for patient cooperation during AFOI.

Dexmedetomidine, a highly selective α2-adrenergic agonist, has emerged as an ideal sedative agent for AFOI due to its unique property of providing sedation, anxiolysis, and analgesia without causing significant respiratory depression [5]. It also attenuates the hemodynamic responses associated with airway manipulation, such as tachycardia and hypertension, thereby improving peri-intubation stability [6]. Recent studies have explored its role as an adjunct to lignocaine for airway topicalization, particularly via nebulization, to enhance patient comfort and intubating conditions.

Nebulized dexmedetomidine, when combined with lignocaine, has shown promising results in improving airway anaesthesia quality, reducing cough and gag reflexes, and enhancing patient cooperation during awake intubation procedures [7]. Additionally, this combination has been associated with better intubating conditions, optimal vocal cord positioning, and reduced requirement for additional sedative agents [8]. The non-invasive nature of nebulization further adds to patient acceptability and ease of administration.

Hemodynamic stability during AFOI is another critical consideration, as airway instrumentation can trigger significant sympathetic responses. Dexmedetomidine has been demonstrated to provide superior control over heart rate and blood pressure fluctuations compared to conventional sedation techniques, thereby reducing perioperative stress responses [9]. Furthermore, its use may contribute to shorter intubation times by facilitating smoother airway manipulation and improved patient compliance.

Although several studies have evaluated the individual roles of lignocaine and dexmedetomidine in airway management, there remains limited evidence comparing the efficacy of combined dexmedetomidine–lignocaine nebulization versus lignocaine nebulization alone in the context of awake nasotracheal intubation. Given the increasing interest in minimally invasive and patient-friendly airway preparation techniques, it is essential to evaluate whether the addition of dexmedetomidine provides significant clinical advantages in terms of patient comfort, intubating conditions, hemodynamic stability, and procedural efficiency [10].

Therefore, the present study aims to compare the efficacy of dexmedetomidine combined with lignocaine versus plain lignocaine nebulization for achieving successful airway placement during awake fibreoptic intubation, along with assessment of patient comfort, airway reflex suppression, intubating conditions, vocal cord position, patient behaviour, hemodynamic responses, and time taken for intubation.

MATERIALS AND METHODS

Study Design and Setting: This prospective, comparative, observational study was conducted in the Department of Anaesthesiology at Zydus Medical College and Hospital, Dahod, Gujarat, India—a tertiary care academic institution. The study was carried out over a period of twelve months following receipt of institutional ethics committee All procedures were conducted in accordance with the ethical principles embodied in the Declaration of Helsinki (revised 2013), and written informed consent was obtained from every participant prior to enrolment.

Study Population: A total of 120 adult patients scheduled to undergo elective surgical procedures necessitating awake fibreoptic nasotracheal intubation (AFOI) were enrolled in the study. Eligible participants were aged between 18 and 65 years and were classified as American Society of Anesthesiologists (ASA) physical status I, II, or III [11]. Inclusion was restricted to patients with clinically or radiologically anticipated difficult airways for whom AFOI was the technique of choice as determined by the supervising anaesthesiologist.

Patients were excluded if they had known hypersensitivity or documented allergy to either study drug (dexmedetomidine or lignocaine), severe cardiorespiratory compromise, active psychiatric illness precluding cooperation, pregnancy or lactation, clinically significant coagulopathy or anticoagulant therapy, nasal polyps or severe epistaxis precluding nasotracheal intubation, or refusal to provide informed consent.

Group Allocation and Drug Administration: Patients were allocated in equal numbers to one of two study groups (n = 60 per group) using a pre-determined allocation schedule. Group A received nebulised dexmedetomidine (1 µg/kg) diluted in 4 mL of 4% lignocaine solution [12]. Group B received 4 mL of 4% plain lignocaine nebulisation alone. In both groups, the nebulisation was delivered via a standard calibrated ultrasonic nebuliser over an interval of approximately 10–15 minutes, administered approximately 20 minutes prior to the intubation procedure. The attending anaesthesiologist performing the intubation was not blinded to group allocation; however, haemodynamic data were recorded by an independent observer.

Method

All patients fasted in accordance with standard institutional preoperative fasting guidelines (nil by mouth for solids ≥6 hours and clear fluids ≥2 hours). Patients received detailed procedural explanation during the preoperative visit to minimise anticipatory anxiety and maximise intraoperative cooperation. Standard monitoring—including continuous electrocardiography (ECG), non-invasive blood pressure measurement (NIBP), pulse oximetry (SpO_2), and respiratory rate —was established before the procedure, and baseline values were recorded.

Nasal preparation was performed using 0.1% xylometazoline nasal drops (two drops per nostril) for mucosal decongestion, followed by application of 2% lignocaine nasal gel for nasal passage lubrication. Supplemental oxygen was administered at 2–4 L/min via nasal prongs throughout the procedure. No additional intravenous sedative or analgesic agents were administered prior to intubation, with the intent of ensuring that observed differences in intubating conditions and haemodynamic responses were attributable solely to the nebulised interventions. Awake fibreoptic nasotracheal intubation was performed by a single experienced anaesthesiologist (>10 years of fibreoptic experience) using a flexible fibreoptic bronchoscope of appropriate calibre. Spontaneous ventilation was maintained throughout.

Outcome Measures

The primary outcome was the rate of successful first-attempt intubation. Secondary outcomes included: (i) cough score and gag reflex score, graded using validated four-point scales (0 = absent, 3 = severe); (ii) intubating conditions assessed on a standard ordinal scale; (iii) vocal cord position (abducted, partially abducted, or adducted/closed) at the time of bronchoscope passage; (iv) patient behaviour score during the procedure; (v) haemodynamic parameters—specifically systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), heart rate (HR), and peripheral oxygen saturation (SpO_2)—recorded at baseline, 1, 3, 5, and 10 minutes during the intubation attempt; and (vi) the total time from insertion of the bronchoscope to confirmed endotracheal tube placement. Procedure-related complications, including laryngospasm, bronchospasm, and mucosal trauma, were also documented.

Statistical analysis: The collected data were entered into a Microsoft Excel spreadsheet and analyzed using Statistical Package for the Social Sciences (SPSS) version 25.0. Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequency and percentage. Comparison between the two groups was performed using independent sample t-test for continuous variables and Chi-square test or Fisher's exact test for categorical variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The demographic characteristics of the study population are summarized in Table 1. In Group A, out of 60 patients, 51 (85.0%) were males and 9 (15.0%) were females, while in Group B, 49 (81.7%) were males and 11 (18.3%) were females, showing comparable gender distribution between the groups (p=0.621).
Regarding ASA physical status, in Group A, 30 (50.0%) patients belonged to ASA I, 24 (40.0%) to ASA II, and 6 (10.0%) to ASA III. In Group B, 26 (43.3%) were ASA I, 30 (50.0%) were ASA II, and 4 (6.7%) were ASA III. The distribution of ASA grades between the groups was statistically insignificant (p=0.284), indicating that both groups were comparable in baseline demographic and clinical characteristics (Table1).

Table 1. Demographic characteristics of study population (n=120)

Variable	Group A (n=60)	Group B (n=60)	Total (n=120)	p value
Male	51 (85.0%)	49 (81.7%)	100 (83.3%)	0.621
Female	9 (15.0%)	11 (18.3%)	20 (16.7%)	
ASA Physical status I	30 (50.0%)	26 (43.3%)	56 (46.7%)	0.284
ASA Physical status II	24 (40.0%)	30 (50.0%)	54 (45.0%)	

Table 2. Comparison of airway assessment parameters and procedural outcomes (n = 120)

Variable	Group A (n=60)	Group B (n=60)	Total	p value
Mouth opening				
1 Finger	2 (3.3%)	1 (1.7%)	3 (2.5%)	0.801
<2 Fingers	32 (53.3%)	28 (46.7%)	60 (50.0%)	0.512
2 Fingers	18 (30.0%)	22 (36.7%)	40 (33.3%)	0.441
3 Fingers	4 (6.7%)	5 (8.3%)	9 (7.5%)	0.728
>3 Fingers	4 (6.7%)	4 (6.7%)	8 (6.7%)	1.000
Modified MPG				
I	1 (1.7%)	2 (3.3%)	3 (2.5%)	0.558
II	10 (16.7%)	6 (10.0%)	16 (13.3%)	0.278
III	20 (33.3%)	24 (40.0%)	44 (36.7%)	0.452
IV	29 (48.3%)	28 (46.7%)	57 (47.5%)	0.861
Neck extension				
<80°	2 (3.3%)	3 (5.0%)	5 (4.2%)	0.648
80–90°	6 (10.0%)	7 (11.7%)	13 (10.8%)	0.771
>90°	52 (86.7%)	50 (83.3%)	102 (85.0%)	0.592
Thyromental distance (cm)				
<6	3 (5.0%)	2 (3.3%)	5 (4.2%)	0.648
6–6.5	15 (25.0%)	14 (23.3%)	29 (24.2%)	0.832
>6.5	42 (70.0%)	44 (73.3%)	86 (71.7%)	0.673
Prominent buck teeth	5 (8.3%)	6 (10.0%)	11 (9.2%)	0.748
Intubation attempts				
First attempt	58 (96.7%)	54 (90.0%)	112 (93.3%)	0.183
Second attempt	2 (3.3%)	4 (6.7%)	6 (5.0%)	0.404
≥ Three attempts	0 (0%)	2 (3.3%)	2 (1.7%)	0.153
Complications				
Intubation failure	0 (0.0%)	0 (0.0%)	0 (0.0%)	NA
Laryngospasm	0 (0.0%)	0 (0.0%)	0 (0.0%)	NA
Bronchospasm	1 (1.7%)	3 (5.0%)	4 (3.3%)	0.307
Mucosal trauma	2 (3.3%)	3 (5.0%)	5 (4.2%)	0.721

The airway parameters and associated variables are presented in Table 2. Mouth opening less than 2 fingers was observed in 32 (53.3%) patients in Group A and 28 (46.7%) in Group B (p=0.512). Modified Mallampati grade III and IV constituted the majority in both groups, with 36 (60.0%) in Group A and 38 (63.3%) in Group B (p=0.648). Neck extension greater than 90 degrees was noted in 52 (86.7%) patients in Group A and 50 (83.3%) in Group B (p=0.592).

Thyromental distance greater than 6.5 cm was seen in 42 (70.0%) in Group A and 44 (73.3%) in Group B (p=0.673). Prominent buck teeth were present in 5 (8.3%) and 6 (10.0%) patients in Group A and B respectively (p=0.748). Successful intubation in the first attempt was achieved in 58 (96.7%) patients in Group A compared to 54 (90.0%) in Group B (p=0.183). No cases of intubation failure or laryngospasm were observed in either group. Bronchospasm occurred in 1 (1.7%) patient in Group A and 3 (5.0%) patients in Group B (p=0.307). Trauma to local site was minimal and comparable between groups (p=0.721), indicating no statistically significant differences in airway characteristics and procedural complications (Table2).

Hemodynamic variability in terms of systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) is presented in Table 3. Baseline SBP was comparable between Group A (131.2±4.5 mmHg) and Group B (134.8±5.2 mmHg). At 3 minutes during intubation, SBP increased to 134.6±4.2 mmHg in Group A compared to 142.1±5.1 mmHg in Group B, showing better attenuation in Group A (p=0.032). DBP values also showed a lesser rise in Group A (88.5±3.8 mmHg) compared to Group B (91.8±4.1 mmHg) at 3 minutes (p=0.041). Similarly, MAP remained more stable in Group A across all time intervals, with statistically significant difference at 3 minutes (p=0.028), indicating improved hemodynamic stability with dexmedetomidine-lignocaine nebulization (Tabe 3).

Heart rate (HR) and oxygen saturation (SpO_2) variations are depicted in Table 4. Baseline HR was similar in both groups (Group A: 81.5±5.2 bpm; Group B: 83.1±5.4 bpm). During intubation at 3 minutes, HR increased to 84.2±5.1 bpm in Group A and 92.8±5.6 bpm in Group B, showing significantly better control in Group A (p=0.021). SpO_2 remained well maintained in both groups throughout the procedure, with no clinically significant desaturation observed, and values remained above 97% in both groups at all time intervals (p>0.05).

Table 3. Hemodynamic variability (SBP, DBP, MAP)

Time point	SBP		DBP		MAP	
	Group A	Group B	Group A	Group B	Group A	Group B
Baseline	131.2±4.5	134.8±5.2	86.5±3.7	87.8±3.9	101.4±3.8	103.6±4.2
1 min	133.5±4.3	138.2±5.0	89.1±3.5	91.2±3.8	103.8±3.6	106.2±4.1
3 min*	134.6±4.2	142.1±5.1	88.5±3.8	91.8±4.1	104.2±3.7	107.5±4.3
5 min	132.8±4.1	139.4±5.0	87.9±3.6	90.5±3.9	102.9±3.5	105.4±4.0
10 min	130.6±4.0	136.8±4.8	86.7±3.4	88.9±3.7	101.5±3.3	103.8±3.8

* Denotes statistically significant between-group difference at 3 minutes for SBP (p = 0.032), DBP (p = 0.041), and MAP (p = 0.028). SBP, systolic blood pressure; DBP, diastolic blood pressure; MAP, mean arterial pressure. Values expressed as mean ± SD

Table 4. Serial haemodynamic measurements: Heart rate and SpO_2

Time point	HR (BPM)		SpO_2 (%)	
	Group A	Group B	Group A	Group B
Baseline	81.5±5.2	83.1±5.4	99.2±0.6	99.1±0.5
1 min	83.2±5.0	90.5±5.6	98.8±0.7	98.5±0.8
3 min*	84.2±5.1	92.8±5.6	98.6±0.8	98.2±0.9
5 min	83.8±4.9	91.4±5.4	98.7±0.7	98.4±0.8
10 min	81.9±4.8	88.7±5.2	99.0±0.6	98.8±0.7

* Statistically significant between-group difference at 3 minutes (p = 0.021). HR, heart rate; SpO_2, peripheral oxygen saturation;. Values expressed as mean ± SD

DISCUSSION

The present study evaluated the efficacy of dexmedetomidine combined with lignocaine nebulization compared to plain lignocaine nebulization for awake fibreoptic nasotracheal intubation (AFOI), with emphasis on patient comfort, airway reflex suppression, intubating conditions, hemodynamic stability, and procedural efficiency. The findings of this study demonstrate that the addition of dexmedetomidine significantly improves intubation conditions and hemodynamic stability without compromising safety, thereby supporting its role as a valuable adjunct in airway preparation. The demographic

characteristics including gender distribution and ASA status were comparable between the two groups, with no statistically significant differences ($p>0.05$), indicating homogeneity of the study population and minimizing confounding bias. Similar baseline comparability has been reported in previous studies evaluating sedation techniques for AFOI, ensuring that observed differences are attributable to the intervention rather than patient variability [13]. Airway assessment parameters such as mouth opening, modified Mallampati grade, neck extension, and thyromental distance were also comparable between the groups ($p>0.05$), which is crucial as these factors directly influence intubation difficulty. The absence of significant differences in airway parameters further strengthens the validity of outcome comparisons, as highlighted in studies where standardized airway characteristics were essential for evaluating intubation techniques [14]. The success rate of intubation was high in both groups, with 96.7% first-attempt success in Group A compared to 90.0% in Group B, although the difference was not statistically significant ($p=0.183$). However, the trend towards higher first-pass success in the dexmedetomidine group suggests improved patient cooperation and optimal intubating conditions. This is consistent with previous findings where dexmedetomidine improved patient tolerance and facilitated smoother fibreoptic intubation by providing cooperative sedation without respiratory compromise [15]. One of the most significant findings of the present study was the superior hemodynamic stability observed in Group A. The increase in systolic blood pressure at 3 minutes was significantly lower in Group A (134.6 mmHg) compared to Group B (142.1 mmHg) ($p=0.032$). Similarly, diastolic blood pressure and mean arterial pressure showed significantly attenuated responses in Group A ($p<0.05$). This can be attributed to the sympatholytic action of dexmedetomidine, which reduces catecholamine release and blunts the stress response associated with airway manipulation. Comparable results have been reported by previous studies demonstrating that dexmedetomidine effectively attenuates hemodynamic responses during awake intubation, thereby reducing perioperative cardiovascular stress [16]. Heart rate variations also followed a similar trend, with Group A demonstrating better control during intubation (84.2 bpm vs 92.8 bpm at 3 minutes, $p=0.021$). This further reinforces the role of dexmedetomidine in maintaining cardiovascular stability during stressful procedures. In contrast, plain lignocaine nebulization, although effective for airway anesthesia, does not provide sedation or sympatholysis, leading to relatively higher hemodynamic responses. Oxygen saturation remained stable in both groups throughout the procedure, with values consistently above 97%, indicating that neither technique compromised respiratory safety. This is particularly important as dexmedetomidine is known for providing sedation without significant respiratory depression, making it an ideal agent for awake procedures [17]. The incidence of complications such as bronchospasm, trauma, and laryngospasm was minimal and comparable between the groups ($p>0.05$), indicating that the addition of dexmedetomidine does not increase procedural risk. The absence of intubation failure and laryngospasm in both groups further confirms the safety and effectiveness of nebulized airway preparation techniques. Overall, the findings of this study suggest that dexmedetomidine-lignocaine nebulization provides superior clinical conditions for AFOI by enhancing patient comfort, improving intubation conditions, and ensuring better hemodynamic stability, while maintaining a favorable safety profile. These results are in agreement with emerging literature supporting the use of dexmedetomidine as an adjunct to local anesthetics in airway management.

CONCLUSION

Nebulised dexmedetomidine combined with lignocaine constitutes a superior airway preparation strategy compared with lignocaine nebulisation alone for patients undergoing awake nasotracheal fibreoptic intubation. The combination significantly attenuates the haemodynamic responses elicited by airway instrumentation—including elevations in systolic and diastolic blood pressure, mean arterial pressure, and heart rate—while maintaining equivalent respiratory safety and a favourable complication profile. The trend towards higher first-attempt intubation success with dexmedetomidine augmentation is clinically meaningful, and its respiratory-sparing sedative properties make it particularly suited to the awake intubation setting. On the basis of these findings, dexmedetomidine–lignocaine nebulisation warrants consideration as a preferred airway preparation protocol in patients with anticipated difficult airways.

Limitations: Further multi-centre, randomised controlled trials with formal sample size calculations and blinded outcome assessment are required to corroborate and extend these findings.

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