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COMPARATIVE STUDY

# Nasotracheal Fiberoptic Intubation: Patient Comfort, Intubating Conditions and Hemodynamic Stability During Conscious Sedation with Different Doses of Dexmedetomidine

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**Abstract** The study aims to evaluate the efficacy of two doses of dexmedetomidine for sedation during awake fiberoptic intubation (AFOI). The study was designed in a prospective, randomized, double-blinded manner and carried out in an academic medical university. Forty young co-operative patients aged 15–45 years of either sex belonging to ASA class I-II, planned for elective maxillofacial surgery formed the study group. All patients received midazolam 0.05 mg/kg, glycopyrrolate 0.2 mg, ondansetron 4 mg, and ranitidine 50 mg IV 15 min before as premedication, oxygen by nasal cannula, and topical local anesthetics to the airway. Patients were randomly assigned to one of the groups; dexmedetomedine 1 μg/kg IV (Group L), or dexmedetomidine 1.5 μg/kg IV (Group H). Observer's Assessment of Alertness/Sedation (OAA/S) was assessed. Primary outcome measurements were: HR, MAP, $SpO_2$ and $EtCO_2$ and secondary outcome measurements were: intubation scores by vocal cord movement, coughing and limb movement, fiberoptic intubation comfort score, nasotracheal intubation score and airway obstruction score. On the first post-operative day, recall, level of discomfort during fiberoptic intubation, adverse events and satisfaction score were also assessed. There were no significant hemodynamic differences between the two groups. OAA/S was significantly better with dexmedetomidine 1.5 μg/kg ($p < 0.05$) and patients were significantly calmer, more cooperative and satisfied during awake fiberoptic intubation with dexmedetomidine 1.5 μg/kg with fewer transient adverse effects. Dexmedetomidine 1.5 μg/kg proved to be more effective for sedation for awake fiberoptic intubation.

**Keywords** Dexmedetomidine · Awake fiberoptic intubation

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## Introduction

Awake nasotracheal fiberoptic intubation is an established method of securing a difficult airway. Both optimal intubating conditions and patient comfort are paramount while preparing the patient for fiberoptic intubation. One challenge associated with this procedure is to provide adequate sedation while maintaining a patent airway and ensuring ventilation. An ideal sedation regimen would provide patient comfort, blunting of airway reflex, patient co-operation, hemodynamic stability, amnesia and the maintenance of a patent airway with spontaneous ventilation. Hence short-acting and easily titratable analgesics are excellent choices for the intensely stimulating but usually brief airway manipulation during fiberoptic nasotracheal intubation. Many agents have been reported to achieve conscious sedation for intubation including alfentanil [1, 2], midazolam [3], ketamine [4], propofol [5, 6], remifentanil [5, 7, 8] and dexmedetomidine [9–13].

Dexmedetomidine, an α2-adrenoceptor agonist, is a valuable drug for use during fiberoptic intubation as it induces sedation and analgesia without depressing respiratory function [14, 15]. Furthermore, dexmedetomidine facilitates a decrease in salivary secretions, which is a desirable effect during fiberoptic intubation [16]. Propofol and dexmedetomidine have been used in target controlled infusions to provide consistent pharmacodynamic effects with a safe predictable sedation level to avoid complications

related to deep sedation [17]. It has been reported that a loading dose (1 μg/kg) of IV dexmedetomidine provided conscious sedation without respiratory depression or upper airway obstruction for fiberoptic nasotracheal intubation [18]. In a study, dexmedetomidine was used in combination with midazolam for awake fiberoptic intubation (AFOI) and the patients were significantly calmer and more cooperative than midazolam alone [3].

Till date, no study comparing two different doses of dexmedetomidine has been conducted for awake fiberoptic intubation. Therefore, the present study was designed in a prospective, randomized, double-blind manner to find optimal and effective dose of dexmedetomidine for fiberoptic nasotracheal intubation.

## Material and Methods

After getting approval from Ethical Committee of the University, an informed consent was taken from all the patients. This prospective, randomized, double-blind study was conducted in young co-operative patients aged 15–45 years of either sex belonging to ASA class I-II, planned for elective maxillo facial surgery. Exclusion criteria were: patient's refusal for consent, nasal mass, bleeding disorder, patients allergic to study medication, patients with gastro-esophageal reflex, uncontrolled hypertension, morbid obesity, pregnancy, ischemic heart disease, reactive airway disease, hepatic or renal disorders, a history of nasopharyngeal surgery or drug abuse and a long term use of benzodiazepines or tricyclic antidepressants.

All patients fasted for at least 6 h before the surgery. Multichannel physiologic monitors were applied and baseline hemodynamic variables (heart rate, systolic BP, diastolic BP, mean arterial pressure, $SpO_2$ and ECG) were recorded. Intravenous line was established and each patient received lactated Ringer's infusion. All patients were premedicated with midazolam 0.05 mg/kg, glycopyrrolate 0.2 mg, ondansetron 4 mg, and ranitidine 50 mg IV 15 min before the start of the study. Prior to starting airway manipulation, every patient received topical anaesthesia of the nasal mucosa of both nostrils with a vasoconstrictor (xylometazoline 0.1 %) and lidocaine 2 % nebulisation for 10 min.

Patients were randomly assigned to the following study groups using a computer generated random number table, dexmedetomedine 1 μg/kg IV (Group L), or dexmedetomidine 1.5 μg/kg IV (Group H).

Airway manipulation was started 10–15 min after administration of the loading dose. More patent nostril was chosen for intubation, the other nostril was used for oxygen insufflation (3–4 l/min). Nasal fiberoptic intubation was done with spiral tube (7–7.5 mm diameter in men, 6.5–7 mm diameter in women). After orientation and localization of the laryngo-epiglottic region, 2 ml of lidocaine 2 % was sprayed on the supraglottic region through the working channel of the bronchoscope. Additionally, 2 ml of lidocaine 2 % was sprayed on the vocal cords immediately before passage of the tracheal tube over the bronchoscope. After successful passage of the tube through the vocal cords and after identification of the carina, the tube was secured and the cuff inflated. Propofol 1–2 mg/kg IV and vecuronium bromide 0.08 mg/kg was used to induce general anaesthesia and mechanical ventilation was established.

The Observer's Assessment of Alertness/Sedation Scale (OAA/S) was used to assess sedation by measuring four component categories, and the total score was assigned (Table 1) [19]. OAA/S was determined first before start of study medication and then every 2 min during airway manipulation. On the first post-operative day, an investigator blinded to the protocol, evaluated the patients on their recall and level of discomfort during fiberoptic intubation.

The primary outcome measurements were: (1) Intubation scores as assessed [20] by (i) Vocal movement; 1 = open, 2 = moving, 3 = closing, 4 = closed. (ii) Coughing 1 = none, 2 = slight, 3 = moderate, 4 = severe. (iii) Limb movement; 1 = none, 2 = slight, 3 = moderate, 4 = severe. (2) Patient tolerance as assessed by a five-point fiberoptic intubation comfort score 1 = no reaction, 2 = slight grimacing, 3 = heavy grimacing, 4 = verbal objection, 5 = defensive movement of head and hands. (3) 3-point assessment immediately after nasotracheal intubation 1 = cooperative, 2 = Restless/minimal resistance, 3 = Severe resistance/GA required immediately. Airway obstruction score was also assessed (1 = patient airway, 2 = airway obstruction relieved by neck extension, 3 = airway obstruction requiring jaw retraction). Hypoxic episode ($SpO_2$ <90 %) and need of atropine or adrenaline for bradycardia was also recorded. A post-operative visit was undertaken the day after operation during which the level of recall (memory of pre-anaesthetic preparations, topical anaesthesia, endoscopy and intubation), adverse events (hoarseness, sore throat) and satisfaction scores (1 = excellent, 2 = good, 3 = fair, 4 = poor) were also assessed.

### Statistical Analysis

Power calculation identified a minimum requirement for 10 patients to be randomized to each group in order to demonstrate a 20 % difference in intubation scores with a power of 0.9 and a type-1 error of 0.05. To allow for study error and attrition, we included 20 patients in each group.

Continuous data were summarized as Mean ± SD while discrete (categorical) in %. The groups were compared by

**Table 1** Observer's assessment of alertness/sedation scale (19)

| Assessment categories | | | | |
|---|---|---|---|---|
| Responsiveness | Speech | Facial expressions | Eyes | Score level |
| Responds readily to name spoken in normal tone | Normal | Normal | Clear, no ptosis | 5(alert) |
| Lethargic response to name spoken in normal tone | Mild slowing or thickening | Mild relaxation | Glazed or mild ptosis(less than half the eye) | 4 |
| Responds only after name is called loudly and/or repeatedly | Slurring or prominent slowing | Marked relaxation (Slack jaw) | Glazed or marked ptosis(half the eye or more) | 3 |
| Responds only after mild prodding or shaking | Few recognizable words | – | – | 2 |
| Does not respond to mild prodding or shaking | – | – | – | 1(deep sleep) |

Sum score 20–18 = alert, 17–15 = light sedation, 14–11 = heavy sedation, under 10 = unable to cooperate

independent Student's 't' test. The discrete (categorical) variables were compared by chi square ($\chi^2$) test. The outcome measures (heart rate, systolic BP, diastolic BP, mean BP, $SpO_2$ and $EtCO_2$) of two groups over the periods (time) were compared by repeated measures of two factor (periods and groups) analysis of variance (ANOVA) using general linear models (GLM) and the significance of mean difference between the groups was done by Tukey's multiple contrast test after ascertaining the homogeneity of variance by Levene's test. A two-sided ($\alpha = 2$) $p < 0.05$ was considered statistically significant. All analyses were performed on STATISTICA (window version 6.0).

## Results

Forty patients were enrolled for the study and all patients underwent successful awake nasotracheal intubation. The patients were assigned to Group L (n = 20) and Group H (n = 20). Both the groups were similar with respect to demographic characteristics such as age, sex, weight and ASA class (Table 2).

Group H had more favourable Observer's Assessment of Alertness/Sedation Score (OAA/S) than Group L ($p < 0.05$). The intubation scores for vocal cord movement, coughing or limb movement did not differ significantly between the groups though poor scores were seen in Group L (Table 3). Eighteen patients in Group L had moderate to severe movements during the procedure while none in Group H. Four patients in each group required neck extension to relieve airway obstruction, while jaw retraction was also required in one patient in Group L (Table 3). None of the patients in both groups had oxygen desaturation requiring face mask ventilation.

With respect to fiberoptic intubation comfort score, severe grimacing was observed in 4 and 1 patients in Group L and Group H respectively, during the procedure. One patient also had defensive movements of head and hands in Group L. This illustrates that the awake fiberoptic nasotracheal intubation was better tolerated using dexmedetomidine 1.5 μg/kg (Group H). Global evaluation of the sedation by the patients was fair to good in 19 and 15 patients respectively, in Group L and Group H. However, 5 patients graded their sedation excellent in Group H (Table 3).

**Table 2** Patient characteristics

| Characteristics | Group L (n = 20) | Group H (n = 20) |
|---|---|---|
| Age (in years) | | |
| Mean ± SD | 28.15 ± 9.40 | 27.10 ± 8.64 |
| Range (min–max) | (17–45) | (15–42) |
| Gender n (%) | | |
| Males | 16 (80.0 %) | 16 (80.0 %) |
| Females | 4 (20.0 %) | 4 (20.0 %) |
| Weight (in kg) | | |
| Mean ± SD | 55.25 ± 10.77 | 54.10 ± 7.30 |
| Range (min–max) | (40–75) | (44–70) |
| ASA class n (%) | | |
| I | 13 (65.0 %) | 15 (75.0 %) |
| II | 7 (35.0 %) | 5 (25.0 %) |

Hemodynamic parameters (heart rate and mean arterial pressure) did not differ significantly between the groups at all time intervals and these variables did not differ significantly from baseline values (Fig. 1, 2).

The recall of topical anesthesia, endoscopy and intubation were higher in Group L (80, 60 and 15 %, respectively) compared with Group H (70, 40 and 10 %, respectively). Increased recall was not associated with increased limb movement or fiberoptic intubation comfort

**Table 3** Secondary outcome measurements

| Characteristics | Group L (n = 20) | Group H (n = 20) |
|---|---|---|
| Observer's assessment of alertness/sedation score (mean ± SD) | 15.00 ± 0.79 | 11.35 ± 0.59* |
| Vocal cord movement n (%) | | |
| Open | 1 (5.0 %) | 1 (5.0 %) |
| Moving | 18 (90.0 %) | 17 (85.0 %) |
| Closing | 1 (5.0 %) | 2 (10.0 %) |
| Closed | 0 (0.0 %) | 0 (0.0 %) |
| Coughing n (%) | | |
| None | 2 (10.0 %) | 1 (5.0 %) |
| Slight | 15 (75.0 %) | 18 (90.0 %) |
| Moderate | 2 (10.0 %) | 1 (5.0 %) |
| Severe | 1 (5.0 %) | 0 (0.0 %) |
| Limb movement n (%) | | |
| None | 0 (0.0 %) | 8 (40.0 %) |
| Slight | 2 (10.0 %) | 12 (60.0 %) |
| Moderate | 15 (75.0 %) | 0 (0.0 %) |
| Severe | 3 (15.0 %) | 0 (0.0 %) |
| Fiberoptic intubation comfort score n (%) | | |
| No reaction | 0 (0.0 %) | 8 (40.0 %) |
| Slight grimacing | 14 (70.0 %) | 10 (50.0 %) |
| Heavy grimacing | 4 (20.0 %) | 1 (5.0 %) |
| Verbal objection | 0 (0.0 %) | 1 (5.0 %) |
| Defensive movement of head and hands | 2 (10.0 %) | 0 (0.0 %) |
| Nasotracheal intubation score n (%) | | |
| No reaction | 0 (0.0 %) | 8 (40.0 %) |
| Slight grimacing | 14 (70.0 %) | 10 (50.0 %) |
| Heavy grimacing | 4 (20.0 %) | 1 (5.0 %) |
| Verbal objection | 0 (0.0 %) | 1 (5.0 %) |
| Defensive movement of head and hands | 2 (10.0 %) | 0 (0.0 %) |
| Airway obstruction n (%) | | |
| Patent airway | 15 (75.0 %) | 16 (80.0 %) |
| Airway obstruction relived by neck extension | 4 (20.0 %) | 4 (20.0 %) |
| Airway obstruction requiring jaw retraction | (0.0 %) | 1 (5.0 %) |
| Global evaluation n (%) | | |
| Excellent | 0 (0.0 %) | 5 (25.0 %) |
| Good | 15 (75.0 %) | 13 (65.0 %) |
| Fair | 4 (20.0 %) | 2 (10.0 %) |
| Poor | 1 (5.0 %) | 0 (0.0 %) |

* $p$ value $< 0.05$

score. Adverse events related to the sedation regimen or the procedure did not differ between the two groups (Table 4).

## Discussion

Anesthesiologists may find it difficult to provide enough sedation for patients to be comfortable and cooperative to perform awake fiberoptic intubation (AFOI), while at the same time avoiding airway compromise from too much sedation. The ideal sedation regimen should provide patient comfort and maintenance of spontaneous respiration without altering airway function. In our study, both doses of dexmedetomidine provided adequate and satisfactory sedation for awake fiberoptic intubation as shown by the secondary outcomes but 1.5 μg/kg dexmedetomidine was found to be better. There were no significant complications recorded in either patient group, and none of the 40 patients experienced any untoward effects. These findings have been documented in other studies also [21, 22]. However, airway obstruction in spontaneously breathing patients has been reported with

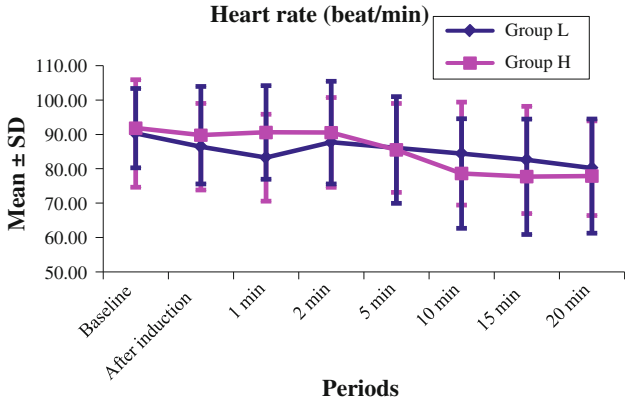


**Fig. 1** Heart rate in the groups

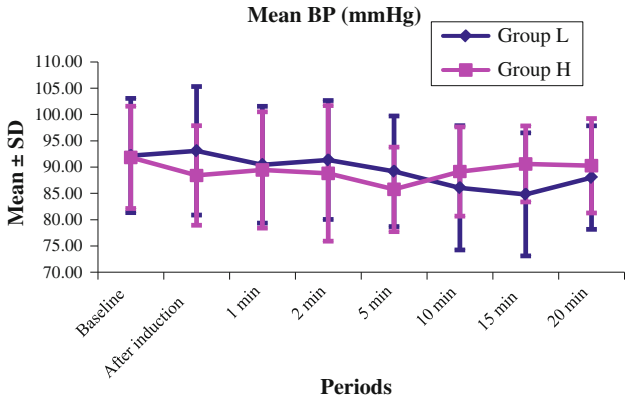


**Fig. 2** Mean arterial pressure in the groups

**Table 4** Adverse effects

| | Group L (n = 20) n (%) | Group H (n = 20) n (%) |
|---|---|---|
| Bradycardia | 0 (0.0 %) | 2 (10.0 %) |
| Dry mouth | 10 (50.0 %) | 13 (65.0 %) |
| Hypotension | 0 (0.0 %) | 1 (5.0 %) |
| Fainting | 0 (0.0 %) | 0 (0.0 %) |
| Atrial fibrilation | 0 (0.0 %) | 0 (0.0 %) |
| Ventricular tachycardia | 0 (0.0 %) | 0 (0.0 %) |
| Myocardial infarction | 0 (0.0 %) | 0 (0.0 %) |
| Cardiac arrest | 0 (0.0 %) | 0 (0.0 %) |
| Transient hypertension | 2 (10.0 %) | 3 (15.0 %) |

dexmedetomidine infusion rate of 10 μg/kg/h and the lost airway was maintained with a chin lift [23]. One such patient was seen in our study also with 1.5 μg/kg dexmedetomidine.

Dexmedetomidine is an effective sedative and analgesic agent widely used for patients requiring post-operative ventilation in the intensive care unit [24]. Dexmedetomidine sedation does not cause respiratory depression. Furthermore xerostomia is reported by some patients. These two factors make dexmedetomidine highly desirable for awake fiberoptic intubation. Dexmedetomidine has been shown to offer adequate conscious sedation for fiberoptic intubation in patients with anticipated difficult airways [9, 10, 18, 25]. It can be used as either sole agent or an adjuvant to facilitate awake fiberoptic intubation. The characteristics of dexmedetomidine sedation have been compared to propofol target controlled infusion (TCI) and dexmedetomidine offered better patient tolerance, better preservation of a patent airway and spontaneous ventilation and a reduced hemodynamic response to intubation with a drawback of greater incidence of recall [17]. Dexmedetomidine and low-dose ketamine provided excellent conditions for awake fiberoptic intubation, including satisfactory sedation, patient cooperation and a dry airway [4]. The dexmedetomidine midazolam combination has been compared for awake fiberoptic intubation with midazolam alone and the patients who received combination were calmer [3].

With respect to hemodynamics, alteration in blood pressure with dexmedetomidine is typically biphasic and dose-dependent [26]. High doses cause hypertension due to vasoconstriction caused by direct stimulation of α2 receptors on blood vessels and low doses inhibit the release of norepinephrine from sympathetic terminals resulting in hypotension [27]. The decrease in HR with dexmedetomidine occur most commonly during a bolus or within 10 min of the start of an infusion [28]. The potential causes of low HR are lower basal HR from increased vagal tone, the baroreceptor response of high vascular tone that occurs with the bolus, or high doses and decreased circulating levels of norepinephrine [29]. In our study, 2 patients in high dose group had bradycardia and it did not decrease to an expected level because all the patients were pretreated with midazolam and glycopyrrolate which resulted in less sympathetic discharge and it was easily managed with atropine. Anticholinergics are recommended in dexmedetomidine package insert (Precedex; Hospira, Inc., Lake Forest, IL, USA) to reduce the potential for asystole and frequency of bradycardia in patients with high vagal tone [28]. More important, antisialagogues are furthermore beneficial and recommended for patients undergoing awake fiberoptic intubation. There was no recall in our study as all the patients were premedicated with midazolam.

Hence, we conclude that dexmedetomidine appears to be a particularly useful pharmacologic agent for sedation during awake fiberoptic intubation. The sedative, analgesic, anxiolytic, reversible anterograde amnestic and antisialagogue properties without impairment of protective reflexes or respiratory depression can add to the comfort of patients, enabling tolerance to the procedure. The preservation of arousability and respiratory-sparing properties allows for

safer conduct of awake fiberoptic intubation in difficult airway cases. IV administration of 1.5 μg/kg dexmedetomidine is better for awake fiberoptic intubation as delineated by fiberoptic intubation comfort score.

We suggest further larger clinical trials to elucidate its potential role as the sole agent for awake fiberoptic intubation and also to find the optimal and effective lowest dose of dexmedetomidine in combination with topical spray/nebulisation of the airway with or without local blocks and other pharmacological agents to minimize the hemodynamic side effects, during awake fiberoptic intubation.

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