

Comparison of Safety and Efficacy of Dexmedetomidine versus Propofol Sedation for Elective Awake Fiber-optic Intubation

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Abstract

Objective: To evaluate the safety and efficacy of dexmedetomidine versus propofol as a sedative modality for awake fiber-optic intubation (AFOI) in elective patients with anticipated difficult intubation. **Materials and Methods:** This randomized prospective study was conducted on 90 patients (Group D and Group P; $n = 45$) who had undergone AFOI for anticipated difficult airway. Group D received intravenous (IV) dexmedetomidine and Group P patients received IV propofol, until they were adequately sedated. Sedation was measured by Bispectral index[®] and Ramsay Sedation Scale. Airway blocks were given to all patients undergoing awake fiber-optic intubation. Intubation comfort scores, airway obstruction scores, and hemodynamics were recorded in all patients. **Results:** Sedation level was comparable in both the groups. Intubation time was less in Group D than Group P (119.06 ± 16.51 s vs. 126.67 ± 18.19 s; $P < 0.05$). The intubation score for both cough and vocal cord opening was better in the dexmedetomidine group than the propofol group ($P = 0.6$). There were significant incidences of airway obstruction and hypoxia in Group P compared to Group D ($P < 0.05$). Significant fall in mean arterial pressure (MAP) was seen in Group P during drug infusion which continued till fiber-optic bronchoscopy ($P < 0.05$). MAP changes during intubation were similar during intubation in both the groups ($P = 0.18$). **Conclusion:** Dexmedetomidine is a better alternative for achieving optimal sedation during AFOI.

Keywords: Dexmedetomidine, intubation, propofol

INTRODUCTION

Airway management is a major skill of an anesthesiologist.^[1] Difficulties with tracheal intubation significantly contribute to the morbidity and mortality associated with anesthesia.^[1] Identifying situations and patients at frequent risk for airway management problems is key to optimal care and has been the focus of numerous studies.^[1] The difficulty of achieving a patent airway varies with anatomic and other individual patient factors, and identification of the patient with a difficult airway is vital in planning and anesthetic management, so that endotracheal intubation and positive pressure ventilation can be achieved safely.^[2]

Fiber-optic oral/nasal intubation is an effective technique for the management of patients with difficult airways.^[3,4] Both optimal intubating conditions and patient comfort are paramount while preparing the patient for fiber-optic intubation.^[3,4] One challenge associated with this procedure was to provide adequate sedation while maintaining a patent airway and ensuring ventilation.^[3,4]

An ideal sedation regimen would provide patient comfort, blunting of airway reflexes, patient cooperation, hemodynamic stability, amnesia, and the maintenance of a patent airway with spontaneous ventilation.^[3,4]

Dexmedetomidine is a novel sedative agent which can be used for awake fiber-optic intubation (AFOI).^[5] It is a highly selective α_2 -adrenoceptor agonist that acts as a sedative, analgesic, and a moderate antisialagogue without respiratory depression, making it suitable for facilitating AFOI.^[6,7] Efficacy of dexmedetomidine has been demonstrated in previous studies as compared to midazolam,^[6] fentanyl,^[7] propofol,^[8] and sufentanil^[9] in AFOI. There are a few studies on the

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efficacy of dexmedetomidine for AFOI; there is a paucity of data comparing the safety and efficacy of dexmedetomidine as compared to propofol in AFOI.^[8,10,11] Hence, the current prospective comparative study was aimed to compare the safety and efficacy of dexmedetomidine and propofol as a sedative modality for AFOI in elective patients with anticipated difficult intubation.

MATERIALS AND METHODS

After approval from the Institute Ethics Committee and written informed consent, 90 adult patients posted for elective surgery under general anesthesia requiring intubation were selected for this randomized prospective study in NEIGRIHMS, Shillong, from September 2016 to October 2017. They were randomly allocated to one of the two groups of 45 each: group D (dexmedetomidine) and Group P (propofol) based on computer-generated list of random numbers by an independent observer, who was blinded to both the groups. The numbers generated were then concealed in envelopes and provided to the anesthesiologists, thus concealing the allocation. The American Society of Anesthesiologists (ASA) I and II patients between 18 and 60 years having Mallampati grading III or IV posted for elective surgery were included in the study. Patients not giving consent, ASA grade III/IV patients, patients with higher degree atrioventricular block, obstructive sleep apnea, and morbid obesity and those who are treated with angiotensin-converting enzyme inhibitors, α_2 antagonist, and long-term use of benzodiazepines or tricyclic antidepressants were excluded from the study.

Before shifting the patient to the OT table, 0.1% oxymetazoline nasal drops were instilled in both the nasal passages in case of nasotracheal intubation. In OT, all standard monitoring devices (SpO_2 , electrocardiography, and noninvasive blood pressure) were attached. Wide bore intravenous (IV) line was established before the procedure. Bispectral Index (BIS) monitor (Aspect Medical System, Norwood, USA) was also attached for a continuous monitoring of depth and sedation. Sensors were placed diagonally on the forehead after wiping skin with alcohol and drying. Sensors were placed as follows: first one at the center of forehead approximately 2 inches above the bridge of nose, second one directly above the forehead, and third one on temple between the corner of the eye and hairline.

All patients received IV glycopyrrolate 0.2 mg premedication to reduce salivary, tracheobronchial and pharyngeal secretions inside the OT. Supplemental oxygen was given by nasal cannula. Nasal pledgets with 2% topical lignocaine were kept in both the nostrils for 5–10 min while preparing for the airway blocks. Adequate oropharyngeal anesthesia was achieved with superior laryngeal nerve block, intratracheal block, and glossopharyngeal nerve block. For superior laryngeal and glossopharyngeal nerve block, 2% lignocaine 2 ml/nerve was injected on each side. For intratracheal block, 2% topical lignocaine 5 ml was injected. Patients were allowed to cough after the intratracheal drug was

injected. Additional airway anesthesia was achieved with 2% lignocaine sprayed from the working channel of fiber-optic bronchoscope whenever required. Baseline hemodynamic data were recorded before the procedure. Depth of sedation was evaluated by monitoring intraoperative hemodynamic values, BIS value (target BIS 60–70), and Ramsay Sedation Scale (≥ 2). In Group D, patients were given dexmedetomidine 1 $\mu\text{g/kg}$ bolus infusion over 15 min, followed by an infusion of 0.2 $\mu\text{g/kg/h}$, which was then titrated up to 0.7 $\mu\text{g/kg/h}$ until they were adequately sedated as defined by BIS (60–70) and Ramsay Sedation Scale (RSS ≥ 2). Group P patients received IV propofol, which was given 0.1 mg/kg/min bolus infusion, followed by an infusion of propofol 0.025 mg/kg/min, which was then titrated up to 0.075 mg/kg/min until they were adequately sedated. The fiber-optic scope (KARL STORZ SE and Co. KG, Tuttlingen, Germany) was loaded with a 7.0-mm tracheal tube for male patients or 6.5-mm tube for females. Once the glottic structures were identified, 2 ml lidocaine 2% was sprayed directly onto the glottis through the working channel of the fiber-optic scope. Another 2 ml lidocaine 2% was then sprayed below the vocal cords. Comfort Score^[10] values, hemodynamic parameters, including heart rate (HR), systolic blood pressure, and diastolic blood pressure, as well as oxygen saturation at 1 min, and then at 5 min were recorded and compared between the two groups during drug infusion, during fiberoptic scopy, endotracheal intubation.

Primary outcomes measured included the intubation scores, as assessed by coughing (1 – none, 2 – slight, 3 – moderate, and 4 – severe) and vocal cord movement (1 – open, 2 – moving, 3 – closing, and 4 – closed). One of the independent, study-blinded observers assessed patient's reaction to placement of the fiber-optic scope and the endotracheal tube on a scale (patients' tolerance and intubation comfort scores) of 1–6 (1 – no reaction; 2 – slight grimacing; 3 – severe grimacing; 4 – verbal objection; 5 – defensive movement of head, hands, or feet; and 6 – uncooperative).^[7]

In addition, we recorded the consciousness level (BIS value and RSS level), airway obstruction score (1 – patent airway, 2 – airway obstruction relieved by neck extension, and 3 – airway obstruction requiring jaw retraction), the intubation time (time period between fiber-optic bronchoscopy [FOB] insertion and the confirmation of tracheal intubation), any hypoxic episodes (SpO_2 of $<90\%$), any adverse effects, and the use of any rescue doses for maintaining the RSS ≥ 2 were also recorded. Hemodynamic changes (HR and mean arterial blood pressure) were compared between the two groups at five time points during the modified AFOI procedure, including at the baseline (preanesthetic preparation), at infusion (immediately before fiber-optic intubation), at intubation, and at 1 and 5 min after tracheal intubation.

General anesthesia was then induced by propofol 1–2 mg/kg intravenously and vecuronium 0.1 mg/kg. The surgical procedure then proceeded as planned. On the 1st postoperative day, an independent observer evaluated the patients' recall during

fiber-optic intubation. Amnesia (memory of bronchoscopy and intubation) and incidence of adverse events (hoarseness and sore throat) were also assessed.

Statistical analysis

Data were entered into a Microsoft Excel spreadsheet and analyzed using SPSS Statistics version 17 (SPSS Inc., 2008, Chicago, Illinois, USA) and Graph Prism version 5 (Graph Pad Software Inc., 2005, San Diego, California, USA) software. Continuous variables are expressed as mean $\pm$ standard deviation and were compared within groups using the paired *t*-test and between groups using the independent *t*-test. The following variables were treated as continuous variables and evaluated using parametric tests as mentioned above: age (years), weight (kg), time taken to intubate, Ramsay Sedation Scale, BIS, heart rate, and mean arterial pressure (MAP). The following were treated as categorical variables and evaluated using nonparametric test (Mann–Whitney U-test) for the comparison between two groups: intubation scores, cough and vocal cord movement, airway obstruction score, and intubation comfort score. The following binomial variables were compared using the Chi-square test or Fisher's exact test as appropriate: gender, ASA grade, recall of bronchoscopy and intubation, hypoxia, sore throat, and hoarseness. $P \leq 0.05$ was considered statistically significant.

Sample size calculation

Based on a previous study,^[8] taking airway obstruction score into consideration, we calculated a sample size of 45 patients in each group to give the power of 0.8 and significance level of 0.05.

RESULTS

A total of 90 patients were included in this study. They were divided into two groups of 45 patients each who were similar in terms of age, gender, weight, and ASA physical status [Table 1]. AFOI was successful in all the patients.

The intubation score for both cough and vocal cord opening was better in the dexmedetomidine group than the propofol group; however, it was statistically not significant. Cough was absent in 27 (60%) patients in case of dexmedetomidine as compared to 18 (40%) patients with propofol. Dexmedetomidine facilitated vocal cord opening in 32 (71%) patients as compared to 26 (58%) patients with propofol [Table 2].

The time taken to intubate the trachea was less ($P < 0.05$) in case of dexmedetomidine (119.06 ± 16.51 s) as compared to propofol (126.67 ± 18.19 s). The patients were also similarly sedated in both the groups as shown by comparable average Ramsay Sedation Scale (2.46 ± 0.50 vs. 2.33 ± 0.47) and BIS (81.66 ± 3.78 vs. 80.56 ± 3.92) scores during bronchoscopy and intubation [Table 2].

Airway obstruction was slightly more in the propofol group ($P \geq 0.05$). Only five patients had slight airway obstruction in dexmedetomidine group, which was relieved by neck extension; however, jaw retraction was required in five

Table 1: Demographic variables

Variable	Mean $\pm$ SD		P
	Group D (n=45)	Group P (n=45)	
Gender (male/female)	30/15	35/10	NS
Age (years)	39.37 $\pm$ 9.91	37.2 $\pm$ 8.68	0.27 (NS)
Weight (kg)	60.51 $\pm$ 6.1	62.13 $\pm$ 5.93	0.20 (NS)
ASA (I/II)	25/20	26/19	NS

$P \leq 0.05$ is considered statistically significant. ASA=American Society of Anesthesiologists, n=Number of patients, NS=Nonsignificant, SD=Standard deviation

Table 2: Anesthetic data during the modified awake fiber-optic intubation procedure

Intubation scores	Group D (n=45)	Group P (n=45)	P
Cough (1/2/3/4), n	27/10/7/1	18/12/13/2	0.68 (NS)
VCM (1/2/3/4), n	32/12/1/0	26/10/9/0	0.62 (NS)
Intubation time (s)	119.06 $\pm$ 16.51	126.67 $\pm$ 18.19	0.04 (S)
RSS at intubation	2.46 $\pm$ 0.50	2.33 $\pm$ 0.47	0.2 (NS)
BIS at intubation	81.66 $\pm$ 3.78	80.56 $\pm$ 3.92	0.17 (NS)

VCM=Vocal cord movement, S=Significant, NS=Nonsignificant, n=Number of patients, RSS=Ramsay Sedation Scale, BIS=Bispectral index

patients in the propofol group to relieve the obstructed airway. Ten patients in the propofol group had hypoxia as compared to three patients in the dexmedetomidine group ($P \leq 0.05$). The incidence of other postoperative complications such as sore throat and hoarseness of voice was comparable between the groups [Table 3].

The recall of bronchoscopy and intubation was comparable between the dexmedetomidine group (55.56% and 26.67%, respectively) and the propofol group (48.89% and 22.23%, respectively) [Table 3].

Patients in both the groups were statistically similar ($P \geq 0.05$) in terms of baseline HR and MAP. Statistically significant fall in MAP was seen in the propofol group during drug infusion which continued till FOB ($P < 0.05$). MAP changes during intubation were similar in both the groups ($P = 0.18$). However, the fall in MAP in the propofol group was slightly more than the dexmedetomidine group ($P \leq 0.05$) at one time point (1 min) after intubation [Table 4]. The rise in HR was also significantly more in the propofol group at different time points during FOB and intubation [Table 5]. Two episodes of bradycardia (HR < 60 /min.) were noted in the dexmedetomidine group.

With regard to the intubation comfort score, 27 (60%) patients in the dexmedetomidine group and 20 (44.45%) patients in the propofol group showed no reaction to intubation [Table 6]. Defensive movement of head, hands, or feet was seen in one patient in the propofol group. The Mann–Whitney test (independent samples) was used for the comparison to analyze the difference in intubation comfort score (1–6) during bronchoscopy and intubation between the two groups [Figure 1]. Although Group D showed lower intubation

Table 3: Adverse effects and postoperative satisfaction data

Adverse effects/satisfaction data	Group D (n=45), n (%)	Group P (n=45), n (%)	P
Airway obstruction score (1/2/3)	40/5/0	30/10/5	0.01 (S)
Hypoxia (SpO ₂ <90%)	3	10	≤0.05 (S)
Sore throat	6	8	0.56 (NS)
Hoarseness	3	3	0.99 (NS)
Recall of bronchoscopy	25 (55.56)	22 (48.89)	0.53 (NS)
Recall of intubation	12 (26.67)	10 (22.23)	0.62 (NS)

S=Significant, NS=Nonsignificant

Table 4: Mean arterial pressure during awake fiber-optic intubation

MAP	Group D (n=45)	Group P (n=45)	P
Baseline	95.37±2.90	96.34±3.21	0.13 (NS)
Infusion	92.50±4.4	79.17±3.45	<0.05
FOS	88.81±3.64	93.76±5.18	<0.05
Intubation	91.5±3.51	92.65±4.53	0.18 (NS)
After 1 min	91.73±4.88	86.62±5.24	<0.05
After 5 min	85.44±3.95	86.22±3.81	0.34 (NS)

FOS=Fiber-optic scope, S=Significant, NS=Nonsignificant, MAP=Mean arterial pressure

Table 5: Heart rate changes during awake fiber-optic intubation

HR	Group D (n=45)	Group P (n=45)	P
Baseline	78.91±6.32	79.2±6.13	0.82 (NS)
Infusion	78.51±6.47	79.04±6.54	0.69 (NS)
FOS	60.62±2.74	79.6±4.68	<0.05
Intubation	80±6.11	78.67±6.7	0.32 (NS)
After 1 min	62.77±2.33	82.42±3.8	<0.05 (S)
After 5 min	71.06±1.64	89.65±2.09	<0.05 (S)

FOS=Fiber-optic scope, S=Significant, NS=Nonsignificant, HR=Heart rate

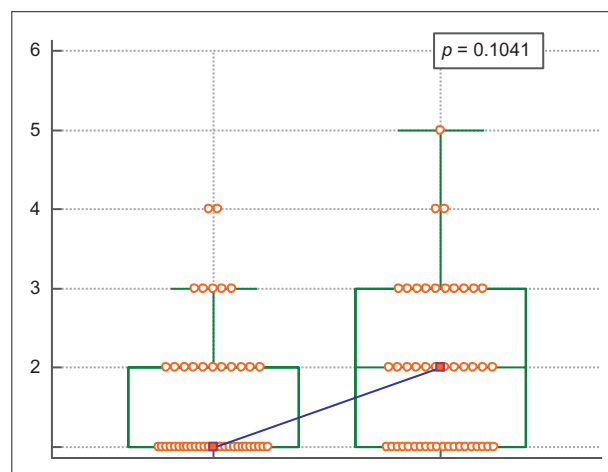
Table 6: Intubation comfort score (1-6) during bronchoscopy and intubation

Intubation comfort score (1-6)	Group D (n=45), n (%)	Group P (n=45), n (%)	P
1. No reaction	27 (60)	20 (44.45)	0.1041
2. Slight grimacing	11 (24.45)	12 (26.67)	
3. Severe grimacing	5 (11.11)	10 (22.23)	
4. Verbal objection	2 (4.45)	2 (4.45)	
5. Defensive movement of head, hands, or feet	0	1 (2.23)	
6. Uncooperative	0	0	

comfort score (ICS) when compared to Group P, the difference was not statistically significant ($P = 0.1046$).

DISCUSSION

The selection of an ideal agent that can efficiently sedate the patient without compromising airway patency is paramount for AFOI.^[12] Dexmedetomidine has been successfully used as

**Figure 1:** Box and Whisker plot comparing the intubation comfort score (1–6) during bronchoscopy and intubation between two groups

a single agent for conscious sedation during AFOI.^[8,12-15] The optimum sedation dose for dexmedetomidine for AFOI has not been established, although a loading dose of 0.4 µg/kg to 1 µg/kg over 10 min and beyond has been used to attain sedation.^[8,9,13-16] Dhasmana *et al.* compared two different doses of dexmedetomidine: 1 µg/kg and 1.5 µg/kg, and he found that both doses can produce effective sedation with protection of airway reflexes.^[13] In this study, the patients were given dexmedetomidine 1 µg/kg bolus infusion over 15 min, followed by an infusion of 0.2 µg/kg/h, which was then titrated up to 0.7 µg/kg/h until they were adequately sedated.

Our study showed that both dexmedetomidine and propofol are effective for awake FOB and intubation. In terms of MAP, less fall was seen in case of dexmedetomidine than propofol both after drug infusion as well as intubation. Attenuation of HR elevation during bronchoscopy and intubation was also better in case of dexmedetomidine. Slightly more fall in the HR was seen in case of dexmedetomidine after the infusion which can be attributed to its α₂-adrenoceptor agonist activity. Our findings were similar to Tsai *et al.* who also found dexmedetomidine to be more hemodynamically stable as well as to reduce the hemodynamic response to intubation than propofol.^[8] Only two episodes of bradycardia were noted in the dexmedetomidine group which could be attributed to a potential side effect of α₂-adrenergic agonist administration. Glycopyrrolate premedication might have decreased the frequency of bradycardia in these patients.^[14]

Airway obstruction was also less in the dexmedetomidine group than the propofol group. The incidence of transient hypoxia ($\text{SPO}_2 < 90\%$) was marginally lower in the dexmedetomidine group. Dexmedetomidine was used successfully by Abdelmalak *et al.*^[14] for sedation in AFOI in patients with difficult airways caused by subglottic mass and a thyroid tumor without any respiratory compromise. However, our findings are supported by Tsai *et al.*^[8] who also reported more episodes of airway obstruction and transient hypoxia with propofol than dexmedetomidine.

The intubation scores for both cough and vocal cord movement were similar between the groups. Tsai *et al.*,^[8] in their study, found that dexmedetomidine group had more favorable intubation score for vocal cord movement than the propofol group, but there was no significant difference in intubation scores for coughing among the two groups. The incidence of recall of bronchoscopy and intubation was comparable between the groups ($P \geq 0.05$). Our findings differed from Tsai *et al.* who compared dexmedetomidine and propofol target-controlled infusion for AFOI and found dexmedetomidine patients to have a higher incidence of recall compared to propofol. Our findings were also in contrast to other studies where dexmedetomidine was found to have less incidence of recall than remifentanyl due to its strong amnestic effect.^[13,17]

Intubation comfort scores, although statistically insignificant, were slightly better in the dexmedetomidine group. Our results were comparable to a study by Bergese *et al.* who also found the overall comfort to be more in dexmedetomidine-midazolam group as compared to midazolam.^[6] Sedation level was monitored using the Ramsay Sedation Scale (RSS) and BIS. The mean sedation scores were comparable between the two groups in our study. Effectiveness of dexmedetomidine in allowing adequate levels of sedation for fiber-optic intubation has been documented before.^[6,18-20] Our observations varied from Tsai *et al.*^[8] who found deeper levels of sedation with propofol than that with dexmedetomidine.

Limitation of our study was that we could not blind the drugs, as propofol is white and dexmedetomidine is colorless. Moreover, the small sample size is another limitation of the present study.

CONCLUSION

IV dexmedetomidine can help in achieving better patient tolerance and comfort for an anticipated difficult airway where fiber-optic intubation is indicated. IV dexmedetomidine resulted in optimum level of sedation comparable to propofol, without hemodynamic instability and airway complications.

Thus, dexmedetomidine is a better alternative for achieving optimal sedation during AFOI.

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Conflicts of interest

There are no conflicts of interest.

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