Effect of different doses of dexmedetomidine as an adjuvant to lignocaine nebulization: A comparative study during awake flexible fiberoptic bronchoscopy

Amarjeet Kumar, Poonam Kumari[1], Chandni Sinha[1], Ajeet Kumar[1], Saurabh Karmakar[2]

Departments of Trauma and Emergency, [1]Anaesthesia and [2]Pulmonary Medicine, AIIMS, Patna, Bihar, India

Abstract

Background and Aims: Mild to moderate sedation during bronchoscopy is essential for patient safety, comfort during and after the procedure, and to facilitate the performance of the bronchoscopist. Dexmedetomidine is a highly selective, centrally acting α-2 agonist used to provide conscious sedation during various procedures. The aim of this study was to compare the efficacy of three different doses of dexmedetomidine nebulization as an adjuvant to lignocaine during bronchoscopy.

Material and Methods: Ninety American Society of Anesthesiologists physical status I/II patients, aged from 18 to 60 years, scheduled for an elective bronchoscopy, were recruited. They were divided into three groups: 30 patients in each group. Group I: The patient was nebulized with a mixture of 4 ml of 4% lignocaine and dexmedetomidine 0.5 µg/kg. Group II: The patient was nebulized with a mixture of 4% lignocaine, 4 ml, and dexmedetomidine, 1 µg/kg. Group III: The patient was nebulized with 4% lignocaine 4 ml and dexmedetomidine 1.5 µg/kg.

Results: The mean cough score was (1.17 ± 0.37), (1.40 ± 0.49), and (1.70 ± 0.75) in group III, group II, and group I, respectively. A significant difference was found between the groups. Patients were more comfortable with a statistically significant difference in the comfort score in group III as compared to group II and group I.

Conclusion: Dexmedetomidine nebulization in a dose of 1.5 µg/kg (compared to 1 µg/kg or 0.5 µg/kg) as an adjuvant to lignocaine, provides better bronchoscopy conditions and patient satisfaction.

Keywords: Bronchoscopy, dexmedetomidine, lidocaine, nebulizer

Introduction

Flexible fiberoptic bronchoscopy (FFB) is a commonly done procedure for the diagnosis and treatment of various kinds of pulmonary diseases. However, it is an invasive procedure that can cause coughing, gagging, pain, dyspnea, and other adverse effects.[1,2] Airway preparation for FFB involves obtundation of airway reflexes, appropriate sedation, anxiolysis, patent airway, and adequate ventilation. Moderate sedation required during bronchoscopy is essential for patient safety, comfort during and after the procedure, and facilitating the performance of the bronchoscopist.[3] For ideal sedatives during bronchoscopy, on an outpatient basis, they should have properties like rapid onset, short duration of action, rapid recovery, and no respiratory depression. Currently, benzodiazepines, opioids, and propofol are used alone or in combination for induction during awake fiberoptic intubation (AFOI).[4] However, most of them cause respiratory depression and airway obstruction, leading to hypoxemia. Dexmedetomidine is a highly selective, centrally acting α-2 agonist. It produces desirable effects

Address for correspondence: Dr. Poonam Kumari,
Department of Anaesthesia, All India Institute of Medical Sciences,
Room No 506, Patna – 801507, Bihar, India.
E-mail: drpoonam1981@gmail.com

Access this article online

Quick Response Code:	
	Website: https://journals.lww.com/joacp
	DOI: 10.4103/joacp.joacp_60_22

like hypnosis, amnesia, analgesia, anxiolysis, sympatholysis, and antisialogogue effects useful during AFOI and FFB.[5] Administration of dexmedetomidine through the inhalational route is a new promising non-invasive method.[6] Nebulized dexmedetomidine administration may allow rapid drug absorption through nasal, respiratory, and buccal mucosa, with higher bioavailability. Dexmedetomidine nebulization as an adjuvant to lignocaine was used in various studies to provide sedation and improve bronchoscopic conditions.[6,7] The aim of this study was to compare the efficacy of three different doses of dexmedetomidine nebulization as an adjuvant to lignocaine to facilitate bronchoscopy in terms of reduction in episodes of cough, patient comfort, and satisfaction, hemodynamic stability, and requirements of additional sedatives.

Material and Methods

After clearance from the institutional ethical committee (AIIMS/Pat/IEC/2019/390 approved on 17/09/2019), the study was registered in the Clinical Trial Registry India (CTRI) vide CTRI/2019/10/021629. This randomized prospective double-blinded study was conducted from October 2019 to May 2021. Ninety (90) American Society of Anesthesiologists (ASA) physical status I/II patients, aged between 18 and 60 years scheduled for an elective bronchoscopy procedure [diagnostic and therapeutic airway inspection bronchoalveolar lavage (BAL) and brushing] were recruited. All patients were examined the day before bronchoscopy, and the procedure was explained.

The patients were randomized into three groups (30 patients) by computer-generated random numbers. The random allocation sequence was concealed in opaque, sealed envelopes until a group was assigned, as shown in Figure 1. Patients who refused to give consent, those having uncontrolled hypertension, diabetes, heart blocks, hemodynamic instability or on beta blockers, and those on positive-pressure ventilation were excluded from the study. All the patients were nebulized with 4 ml of 4% lignocaine, with dexmedetomidine as an adjuvant, in a dose of 0.5 μg/kg (Group I) or 1 μg/kg (Group II) or 1.5 μg/kg (Group III) The volume of 6 ml was kept constant in all three groups. After shifting the patient to the procedure room, intravenous (IV) access was secured. Standard monitors were attached, and the baseline vitals like electrocardiography, oxygen saturation, and non-invasive blood pressure were recorded. Glycopyrrolate 0.2 mg I.M. and intranasal xylometazoline 0.1% were given 20 min before nebulization in every patient. All patients were nebulized (Jet nebulizer, Dr. Morepen, India, CN06) over a period of 20 minutes, followed by FFB (Karl Storz Germany 11301 BNX 5.5 × 65 cm). All patients received

supplemental oxygen (2 lit/min) through the working channel of the bronchoscope. In case of cough and gag reflexes, an additional sedative in the form of midazolam, 2 ml, IV, was given. Parameters observed during bronchoscopy were the heart rate (HR), mean arterial pressure (MAP), and oxygen saturation (SpO2) at 0 min (baseline), 5 min, 10 min, 15 min, 20 min (during insertion of the bronchoscope), 25 min, 30 min, 45 min, and 60 min. The cough and gag episodes during the procedure and post-procedure were noted [1 = no cough, 2 = slight ≤2 coughs, 3 = moderate (3–5 coughs), 4 = severe (>5 coughs)].[8,9] The comfort of the patient during the procedure was assessed by the 3-point patient comfort score after 2 hours of the bronchoscopy (1 = cooperative, 2 = restless/minimal resistance, and 3 = severe resistance/ general anesthesia required immediately).[10,11]

Post-procedure patient satisfaction (excellent—1, good—2, fair—3, and poor—4) was noted. The patient satisfaction score was assessed after 2 hours of bronchoscopy; the patients were instructed to record their perception of their coughing which was associated with the procedure.[10,11] Requirements of additional sedatives like midazolam were noted. Side effects of lignocaine toxicity, over-sedation using Ramsay sedation score (RSS, score 1 = Anxious, agitated or restless, 2 = cooperative, oriented and tranquil, 3 = sedated, but responds to command, 4 = asleep, brisk glabellar reflex responds to loud noise, 5 = asleep, sluggish glabellar reflex or responds to loud noise, 6 = asleep with no response to a painful stimulus) were documented.[12] The study drug was prepared by a post-graduate student, who was not involved in the study. The patients were unaware of the drug nebulized to them. Bronchoscopies were done by a single experienced pulmonologist, who was not aware of the group allocated (drug nebulized). The anesthesia resident posted in the bronchoscopy suite was unaware of the group allocation. The resident administered intermittent midazolam and documented all parameters.

The primary outcome was the measurement of the mean cough score from the time of bronchoscope contact up to the patient leaving the room. Secondary outcomes included patient comfort, post-procedure patient satisfaction, HR, and MAP. The sample size was taken on the basis of a pilot study on 10 patients with 0.5 μg/kg dexmedetomidine nebulization; the mean cough score was 2.6 ± 0.66. Anticipating a 20% decrease in the mean cough score after nebulization with 1.5 μg/kg, the sample size came out to be 25 with an alpha error of 0.05 and a power of 80%. Considering a 10% dropout, we took a total of 60 patients, 30 in each group. Statistical analysis was performed using SPSS 22 software Continuous variables are expressed as means ± standard deviation and categorical variables as proportions (%).
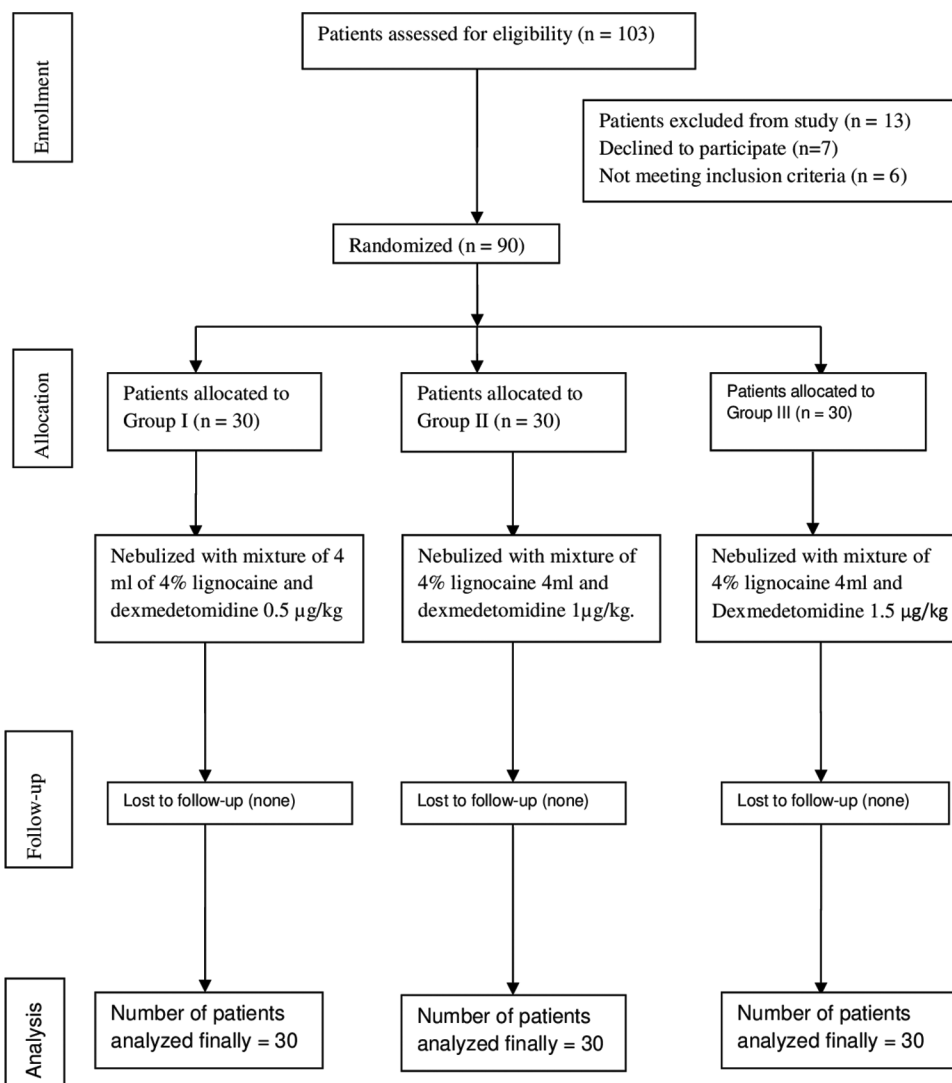
Figure 1: Consort flow chart

The analysis of variance (ANOVA) test was used for the comparison of patient characteristics and the differences in variables among the three groups. Tukey's post-hoc test was used for the statistical analysis of variables. P values < 0.05 were considered to be statistically significant.

Results

We assessed a consecutive series of 103 patients for eligibility posted for elective bronchoscopy, out of which 7 patients did not give consent. Six patients did not meet the inclusion criteria (two patients had uncontrolled hypertension, two had a history of coronary artery disease on B-blocker therapy, and two patients needed non-invasive positive-pressure ventilation). Figure 1 depicts the consort flow diagram of patient progress through the study. All enrolled patients were randomized (group I: $n = 30$; group II: $n = 30$; group III: $n = 30$) and completed the study, and their data were analyzed.

Table 1 presents the baseline demographic parameters and duration of bronchoscopy in all three groups. Parameters are comparable in all three groups, and there were no significant differences ($P > 0.05$) among the groups. Out of the 90 bronchoscopies, 35 patients (10 patients in group I, 13 patients in group II, and 12 patients in group III underwent therapeutic procedures [bronchoalveolar lavage (BAL) in 15 patients and brushing in 20 patients]. The decision of BAL and brushing was taken during the peri-bronchoscopy period.

In this study, we measured the episode of cough and gag reflexes, which was entirely operator-dependent and represented as the total number of coughs/gag episodes from the time the bronchoscope makes contact with the patient till the time the patient leaves the room.

The mean cough score was (1.17 ± 0.37), (1.40 ± 0.49), and (1.70 ± 0.75) in group III, group II, and group I,

Table 1: Demographic Parameters, duration of bronchoscopy (minutes), and type of procedure

S. no	Variant	Group I	Group II	Group III	*P*
1	Age	46.20±9.36	48.80±11.59	50.70±10.32	0.253
2	Weight	49.50±9.91	53.86±8.62	51.73±10.01	0.213
3	Duration of bronchoscopy (Minutes)	32.97±3.83	32.63±3.63	32.77±3.65	0.934
Types of procedure	**Patients in Group I**	**Patients in Group II**		**Patients in Group III**	
Diagnostic bronchoscopy	20	17		18	
BAL	4	6		5	
Brushing	6	7		7	

Age, weight, and duration of bronchoscopy in the above table are in terms of mean±SD

respectively. A significant difference was found between the groups (*P* value: 0.002) [Table 2]. However, post-hoc analysis showed a significant difference between group I and group III only (mean difference 0.533; CI: 0.19–0.88; *P* value: 0.0001) [Table 3].

The mean gag score was (1.10 ± 0.30), (1.30 ± 0.46), and (1.66 ± 0.77) in group III, group II, and group I, respectively. A significant difference was found between the groups (*P* value: 0.003) [Table 2]. However, post-hoc analysis showed a significant difference between group I and group III only (mean difference: 0.500; 95% CI: 0.16–0.84; *P* value: 0.001) [Table 3].

The comfort score was (1.23 ± 0.43), (1.63 ± 0.49), and (1.87 ± 0.34) in patients of group III, group II, and group I, respectively. This was statistically significant (*P* value: 0.001) [Table 2]. Patients were more comfortable with a statistically significant difference in the comfort score in group III as compared to group II (mean diff 0.400; 95% CI: 0.14–0.66; *P* value: 0.001) and group I (mean diff. 0.633; 95% CI: 0.37–0.90; *P* value: 0.001) [Table 3]. The mean satisfaction score was (1.47 ± 0.62), (2.03 ± 0.80), and (2.43 ± 0.56) in the patients of group III, group II and group I, respectively. This was statistically significant (*P* value: 0.0001) [Table 2]. Post-hoc analysis showed a statistically significant difference in group III as compared to group II (mean difference 0.567; 95% CI: 0.15–0.98; *P* value: 0.005) and group I (mean difference 0.967; 95% CI: 0.55–1.48; *P* value: 0.0001) [Table 3].

The mean additional doses of midazolam required and the means of RSS in all three groups were comparable. [Table 2]. The HR was comparable in all groups at different time intervals. However, 20 minutes after the start of the procedure, a significant difference in the HR was found among the groups (*P* < 0.01) [Figure 2]. MAP was comparable in all groups at different time intervals. However, 20 minutes after the start of the procedure, a significant difference in MAP was found among the groups (*P* < 0.01) [Figure 3]. Oxygen saturation (SpO2) was comparable in all groups at different

Table 2: Episode of cough, gag reflex, comfort, satisfaction, RSS, additional sedative, and lignocaine toxicity

Value	Mean±SD			ANOVA
	Group I	Group II	Group III	*P*
Episode of cough reflex	1.70±0.75	1.40±0.49	1.17±0.37	0.002*
Episode of gag reflex	1.6±0.77	1.30±0.46	1.10±0.30	0.003*
Comfort	1.87±0.34	1.63±0.49	1.23±0.43	0.0001*
Satisfaction	2.43±0.56	2.03±0.80	1.47±0.62	0.0001*
Additional sedative	0.43±0.62	0.27±0.45	0.13±0.54	0.06
RSS	1.50±0.57	1.67±0.47	1.77±0.43	0.117
Lignocaine toxicity	0.00±0.00	0.00±0.00	0.00±0.00	

*Values in the above table are in terms of mean±SD *P<0.01 highly significant*

time intervals. We did not encounter any drug toxicity and adverse events like over-sedation, sore throat, and hoarseness of voice in our study.

Discussion

Our study shows that nebulization with dexmedetomidine. 1.5 mcg/kg, as an adjuvant to lignocaine provides better bronchoscopy conditions than the other two doses of dexmedetomidine (1 mcg/kg or 0.5 mcg/kg). The patient who was nebulized with dexmedetomidine, 1.5 mcg/kg, as an adjuvant to lignocaine had better cough and satisfaction scores without any incidence of hemodynamic compromise. The use of dexmedetomidine through extravascular routes has been studied. Using the inhalational route allows rapid drug absorption through the nasal, respiratory, and buccal mucosa. The bioavailability through the nasal route is 65% whereas, through the buccal mucosa, it is up to 82%. Dexmedetomidine is a colorless and odorless liquid with a non-irritant property and high bioavailability.[13] Increasing the surface area of absorption through the inhalational route increases its clinical effectiveness.

Intravenous dexmedetomidine has been compared with nebulized dexmedetomidine. The incidence of moderate to severe cough reduced from 55% to 15% in patients receiving nebulization. This might be explained by the direct local action on alpha 2 receptors causing dilatation of the bronchi and suppression of cough reflex.[14] In our study also, increasing

Table 3: Intergroup comparison of statistically significant variables (post-hoc analysis)

Variables	Intergroup comparison	Mean difference	95% CI	*P*
Episode of cough reflex	Group I and Group II	0.30	−0.05 to 0.65	0.104
	Group I and Group III	0.533	0.19 to 0.88	0.001*
	Group II and Group III	0.233	−0.11 to 0.58	0.250
Episode of gag reflex	Group I and Group II	0.300	−0.04 to 0.64	0.092
	Group I and Group III	0.500	0.16 to 0.84	0.002*
	Group II and Group III	0.200	−0.14 to 0.54	0.339
Comfort	Group I and Group II	0.233	−0.03 to 0.50	0.09
	Group I and Group III	0.633	0.37 to 0.90	0.001*
	Group II and Group III	0.400	0.14 to 0.66	0.001*
Satisfaction	Group I and Group II	0.400	−0.02 to 0.82	0.62
	Group 1 and Group III	0.967	0.55 to 1.38	0.0001*
	Group II and Group III	0.567	0.15 to 0.98	0.005*
Additional sedative	Group I and Group II	0.167	−0.13 to 0.47	0.386
	Group I and Group III	0.300	0.00 to 0.60	0.05
	Group II and Group III	0.133	0.17 to0.43	0.542
RSS	Group I and Group II	−0.167	−0.47 to 0.14	0.400
	Group I and Group III	0.267	0.57 to 0.04	0.101
	Group II and Group III	0.100	0.41 to 0.21	0.717

CI: confidence interval; *P<0.05 is taken as statistically significant
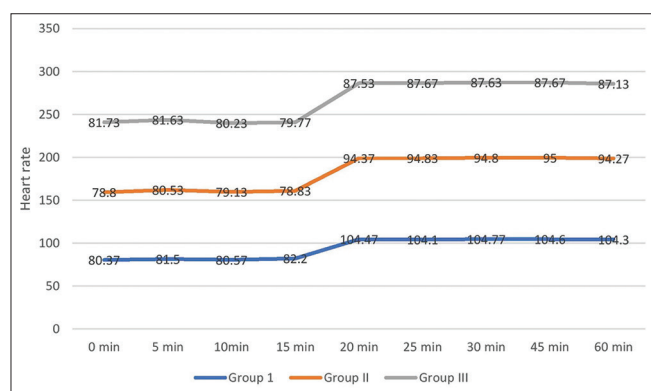

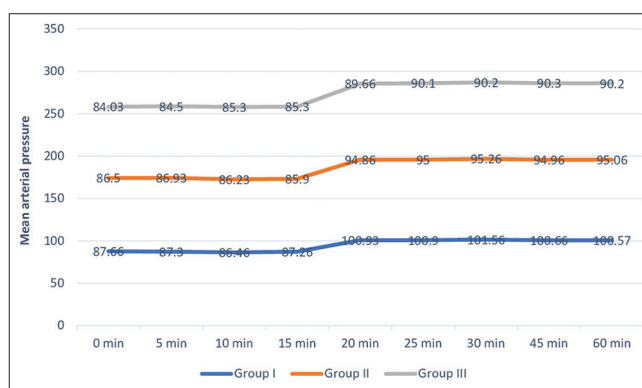**Figure 2:** HR variation with time during the bronchoscopy procedure

Figure 3: MAP variation with time during the bronchoscopy procedure

the dose decreased the cough reflex in patients. In our study, the mean cough score was statistically better in patients who received dexmedetomidine: 1.5 mcg/kg (1.17 ± 0.37) vs 1 mcg/kg (1.4 ± 0.49) or 0.5 mcg/kg (1.7 ± 0.75). The requirement of midazolam was also lower in this group, though the difference might not be clinically significant (0.13 ± 0.54) vs (0.27 ± 0.45) or (0.43 ± 0.62), respectively.

There are further trials on it establishing its role through this route as a pediatric premedicant, allowing parental separation, reduction of postoperative sore throat, and enabling fob-guided intubation, pain relief, etc. These studies have concentrated on its comparison with various drugs or its use as a combination drug. There is a dearth of data establishing the optimum dose of nebulized dexmedetomidine in bronchoscopy procedures. Anupriya *et al.*[15] compared two different doses 2 mcg/kg and 3 mcg/kg of nebulized dexmedetomidine as a pediatric premedicant. They found that 3 mcg/kg provides better

parental separation in younger children and better mask acceptance in both younger and older children and prolongs the duration of caudal analgesia. Lee *et al.*[16] compared intranasal dexmedetomidine 1 or 2 mcg/kg around half an hour before induction in pediatric patients. They concluded that a dose of 2 mic/kg intranasally could deliver better postoperative analgesia without prolonging recovery or increasing adverse effects.

The requirement of a higher dose of dexmedetomidine in this age group could be attributed to the larger volume of distribution. In our study, we used a lesser dose of 0.5/1/1.5 μg/kg for nebulization in adult patients with the best results in patients receiving a dose of 1.5 mcg/kg. A lower dose is associated with a lesser incidence of adverse effects such as hypotension and bradycardia. Nebulized dexmedetomidine at 1 μg/kg to 2 μg/kg effectively blunts the stress response to laryngoscopy and intubation, without any significant adverse effects.[17-19] Cheung's

research has shown that intranasal dexmedetomidine with doses of 1 and 1.5 μg/kg in surgical procedures produced significant sedation and less postoperative pain.[20] The British Thoracic Society guidelines[21] for diagnostic flexible bronchoscopy in adults recommend conscious sedation, in which the patient maintains airway patency and cardiorespiratory function, and verbal contact with the patient is possible at all times. Intravenous sedation in the form of midazolam with or without opioids should be offered to patients undergoing bronchoscopy, provided that there are no contraindications. Dexmedetomidine provides conscious sedation without respiratory depression, which is very much needed for the bronchoscopic procedure. Therefore, nebulized dexmedetomidine may represent a favorable alternative to the intravenous route in a short-duration procedure. Amir Safa[22] found that nebulized dexmedetomidine (2 μg/kg) provides better effects on the sedation level, and hemodynamic and anesthetic factors of children undergoing bronchoscopy and is also associated with fewer respiratory and hemodynamic complications. Kumari *et al.*[23] in their study compared fentanyl (2 μg/kg) nebulization with dexmedetomidine (1 μg/kg) as an adjuvant to lignocaine during FFB to provide better bronchoscopy conditions. They found that patients receiving nebulized dexmedetomidine 1 mcg/kg had better satisfaction and sedation scores. Dexmedetomidine's highly selective α_2 agonistic action causes a decrease in serum norepinephrine concentration, thus leading to a dose-dependent decrease in arterial blood pressure.[24] In our study, 1.5 mcg/kg dexmedetomidine nebulization maintained the HR and MAP throughout the procedure without any adverse effects.

The present study had the following limitations. Our study was underpowered to detect adverse effects in these patients. Different pulmonary pathologies create different frequencies and intensities of cough, which is an unavoidable confounder in our study. We did not measure the blood concentration of dexmedetomidine due to the unavailability of this facility at our institute. Further studies might be conducted to determine the blood concentration of the drug.

Conclusion

Dexmedetomidine added at a dose of 1.5 μg/kg to lignocaine for nebulization provides better bronchoscopy conditions (reduce cough and gag reflex, adequate sedation, and maintained hemodynamic responses) and patient satisfaction compared to the lower doses.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Poi PJH, Chuah SY, Srinivas P, Liam CK. Common fears of patients undergoing bronchoscopy. Eur Respir J 1998;11:1147–9.
2. Scheuermeyer FX, Andolfatto G, Qian H, Grafstein E. Does the sedation regimen affect adverse events during procedural sedation and analgesia in injection drug users? CJEM 2013;15:279–88.
3. Stefano P, Licia B, Lorenzo C, Lucio T, Alfredo P. Patient satisfaction with conscious sedation for bronchoscopy. Chest 1999;115:1437–40.
4. Worsley MH, MacLeod AD, Brodie MJ, Asbury AJ, Clark C. Inhaled fentanyl as a method of analgesia. Anaesthesia 1990;45:449–51.
5. Hall JE, Uhrich TD, Barney JA, Arain SR, Ebert TJ. Sedative, amnestic, and analgesic properties of small-dose dexmedetomidine infusions. Anesth Analg 2000;90:699–705.
6. Kumar A, Kumari P, Sinha C, Kumar A, Kumar R, Kumar A. Dexmedetomidine nebulization as adjuvant to lignocaine during awake flexible fiberoptic intubation. Saudi J Anaesth 2019;13:152-3.
7. Wei Gu, Meiying Xu, Huijie Lu, Qi Huang, Jingxiang Wu. Nebulized dexmedetomidine lidocaine inhalation as a premedication for flexible bronchoscopy: A randomized trial. J Thorac Dis 2019;11:4663–70.
8. Xue FS, He N, Liao X, Xu XZ, Xu YC, Yang QY, *et al.* Clinical assessment of awake endotracheal intubation using the lightwand technique alone in patients with difficult airways. Chin Med J (Engl) 2009;122:408–15.
9. Aouad MT, Sayyid SS, Zalaket MI, Baraka AS. Intravenous lidocaine as adjuvant to sevoflurane anesthesia for endotracheal intubation in children. Anesth Analg 2003;96:1325-7.
10. Mondal S, Ghosh S, Bhattacharya S, Choudhury B, Mallick S, Prasad A. Comparison between dexmedetomidine and fentanyl on intubation conditions during awake fiberoptic bronchoscopy: A randomized double-blind prospective study. J Anaesthesiol Clin Pharmacol 2015;31:212-6.
11. Niyogi S, Basak S, Acharjee A, Chakraborty I. Efficacy of intravenous dexmedetomidine on patient's satisfaction, comfort and sedation during awake fibre-optic intubation in patients with cervical spondylotic myelopathy posted for elective cervical fixation. Indian J Anaesth 2017;61:137-43.
12. Ramsay MA, Savege TM, Simpson BR, Goodwin R. Controlled sedation with alphaxolone-alphadalone. BMJ 1974;2:656-9.
13. Anttila M, Penttilä J, Helminen A, Vuorilehto L, Scheinin H. Bioavailability of dexmedetomidine after extravascular doses in healthy subjects. Br J Clin Pharmacol 2003;56:691-3.
14. Mason KP, Lerman J. Review article: Dexmedetomidine in children: Current knowledge and future applications. Anesth Analg 2011;113:1129-42.
15. Anupriya J, Kurhekar P. Randomised comparison between the efficacy of two doses of nebulised dexmedetomidine for

premedication in paediatric patients. Turk J Anaesthesiol Reanim 2020;48:314-20.

16. Lee S, Kim BH, Lim K, Stalker D, Wisemandle W, Shin SG, *et al*. Pharmacokinetics and pharmacodynamics of intravenous dexmedetomidine in healthy Korean subjects. J Clin Pharm Ther 2012;37:698-703.

17. Misra S, Behera BK, Mitra JK, Sahoo AK, Jena SS, Srinivasan A. Effect of preoperative dexmedetomidine nebulization on the hemodynamic response to laryngoscopy and intubation: A randomized control trial. Korean J Anesthesiol 2021;74:150-7.

18. Kumar NRR, Jonnavithula N, Padhy S, Sanapala V, Naik VV. Evaluation of nebulised dexmedetomidine in blunting haemodynamic response to intubation: A prospective randomised study. Indian J Anaesth 2020;64:874-9.

19. Zanaty OM, EI Metainy SA. Comparative evaluation of nebulized dexmedetomidine, nebulized ketamine, and their combination as premedication for outpatient pediatric dental surgery. Anesth Analg 2015;121:161-71.

20. Cheung CW, Qiu Q, Liu J, Chu KM, Irwin MG. Intranasal dexmedetomidine in combination with patient controlled sedation during upper gastrointestinal endoscopy: A randomised trial. Acta Anaesthesiol Scand2015;59:215–23.

21. Du Rand IA, Blaikley J, Booton R, Chaudhuri N, Gupta V, Khalid S, *et al*. British Thoracic Society Bronchoscopy Guideline Group. British Thoracic Society guideline for diagnostic flexible bronchoscopy in adults: Accredited by NICE. Thorax 2013;68(Suppl 1):i1-44.

22. Shafa A, Habibzade M, Shetabi H. Agil A. Comparing the hemodynamic dexmetomidine and nebulized lidocaine in children undergoing the fiberoptic bronchoscopy. J Adv Med Biomed Res 2019;27:14-9.

23. Kumari P, Kumar A, Sinha C, Kumar A, Kumar R, Rai DK. Fentanyl vs dexmedetomidine nebulization as adjuvant to lignocaine: A comparative study during awake flexible fiberoptic bronchoscopy. Trends Anaesth Crit Care 2021;37:18-22.

24. Grewal A. Dexmedetomidine: New avenues. J Anaesthesiol Clin Pharmacol 2011;27:297–302.