Clinical Investigation
ISSN (Print): 2394-6954
ISSN (Online) : 2394-9775
Karnataka Anaesthesia Journal Vol 17(3&4), July-December 2019, p. 71-79
DOI: 10.4103/kaj/2019/v17i3-4/158422

Comparison of Intubation Conditions between Dexmedetomidine and Propofol for Awake Fiberoptic Bronchoscopy: A Randomised Control Study

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Abstract

Introduction: Awake Fiberoptic Intubation (AFOI) is a valuable modality for airway management. Both optimal intubating condition and patient comfort are paramount for fiberoptic intubation. The challenges associated with the procedure are to provide adequate sedation while maintaining patent airway and ventilation. Both dexmedetomidine and propofol provide procedural sedation. Therefore, this study was taken to compare intubating conditions and haemodynamic stability between dexmedetomidine and propofol for Awake Fiberoptic Bronchoscopy. **Methods**: 60 patients of ASA physical status I or II undergoing elective surgery were enrolled for the study. They were randomly allocated into two groups, group D received dexmedetomidine (1 µg/kg over 10 min followed by infusion) and group P received propofol (1 mg/kg over 10 min followed by infusion). After achieving Ramsay sedation score of ≥2 bronchoscopy was performed. The following parameters were assessed and compared: Intubating conditions were evaluated by intubation score including vocal cord movement, coughing and limb movement. Post intubation condition was assessed by a subjective scale. Haemodynamic parameters were recorded at baseline, end of infusion and post intubation. Other parameters assessed were intubation time, sedation, number of attempts at intubation and any complications during the procedure. **Results**: Demographics were comparable. Intubating conditions and post intubation scores were comparable. Dexmedetomidine provided better haemodynamic stability at the end of infusion and post intubation (p = 0). Both provided a favorable sedation but propofol provided much deeper mean sedation score compared to dexmedetomidine. Intubation time was shorter in group D (p = 0). **Conclusion**: Both dexmedetomidine and propofol provide favorable intubation conditions, but dexmedetomidine in addition provides better haemodynamic stability and conscious sedation.

Keywords: Bronchoscopy, Dexmedetomidine, Intubating Conditions, Propofol

1. Introduction

Airway management is the core of safe anaesthetic practice. Management of the difficult airway remains one of the most relevant and challenging task for anaesthesia care providers. It is estimated that about one third of all anaesthetic deaths are due to failure to intubate and ventilate. The incidence of difficult tracheal intubation has been estimated at 3-18%[1, 2].

Most airway problems can be solved with relatively simple devices and techniques; however, experience and

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good clinical judgment are necessary for their successful application. Newer airway devices with the potential to improve patient outcomes are continually being developed. Anaesthesia providers must concurrently develop their skills and learn new techniques to be prepared when difficulty presents itself. The availability of fiberoptic bronchoscope represents a significant landmark in the search for a solution to difficult intubation[3].

Awake Fiberoptic Intubation (AFOI) is an effective technique for management of difficult airway. Fiberoptic Bronchoscope (FOB) guided intubation has helped many to secure the airway in patients with difficult airway. But achieving and maintaining a favorable condition for the ease of fiberoptic nasal intubation is another challenge by itself. A patient with difficult or compromised airway should either be awake or sedated with no or minimal respiratory depression. Both optimal intubating condition and patient comfort are paramount for fiberoptic intubation. The challenge associated with the procedure is to provide adequate sedation while maintaining patent airway and ventilation. Currently benzodiazepines, opioids, Propofol and α_2 adrenergic agonists are used alone or in combination[4–8]. Most of these agents are respiratory depressants except α_2 adrenergic agonists at clinically used doses. Hence there is a search of an ideal agent for conscious sedation. Propofol has been used as target controlled infusion in most of the studies and few studies have used loading dose followed by infusion[4,6,9–11]. Dexmedetomidine an α_2 adrenergic agonist has been enthusiastically advocated for AFOI on the grounds of its ability to produce sedation without respiratory depression associated with other anxiolytic-hypnotic and opioids[12]. Therefore this study was undertaken to compare intubating conditions and haemodynamic stability between dexmedetomidine and propofol for Awake Fiberoptic Bronchoscopy. Change in heart rate and blood pressure were the primary objective, where as intubating conditions was secondary objective.

2. Material and Methods

This prospective, randomised comparative study was undertaken after obtaining the approval of institutional ethical committee, to compare the intubating conditions and haemodynamic stability between dexmedetomidine and propofol for Awake Fiberoptic Bronchoscopy. A total of 60 patients were enrolled between January 2016 and December 2016 for the study with the following inclusion, age 18-60 years of gender, American Society of Anesthesiologists (ASA) class I-II and elective surgical procedures. The exclusion criteria were, any contraindication for nasal intubation like thrombocytopaenia or coagulopathies, bradycardia (baseline HR <60 beats/min), atrioventricular block, heart failure, emergency surgeries, significant neurological, hepatic, renal and pulmonary disease, known alcoholic or drug abusers, pregnant patients, anticipated difficult intubation. After obtaining the written participant informed consent from patients undergoing elective surgery in supine position under general anaesthesia with controlled ventilation fulfilling the above required criteria, a detailed pre-anaesthetic examination was done and the following parameters like demographic (age, gender), morphological (height, weight) and vital parameters were recorded. Patients were randomly allocated into two groups based on computer generated randomisation table. Group D: (n = 30) dexmedetomidine and Group P: (n = 30) propofol. On the day of surgery, the procedure of awake intubation was explained to the patient. An 18-gauge cannula was inserted and 500 ml of Ringer's lactate solution was infused. Electrocardiogram (ECG), Non Invasive Blood Pressure (NIBP), Pulseoximeter (SpO_2) monitors were connected and baseline readings noted. Injection midazolam 0.02 mg/kg, glycopyrrolate 0.005 mg/kg , ranitidine 50 mg and ondansetron 0.15 mg/kg intravenously was administered to all the patients. Patency of both nostrils was tested and the nostril with better patency was chosen for awake nasal fiberoptic intubation. Anaesthesia for the upper airway was accomplished by nebulisation with 2% lidocaine 4 ml (80 mg) for 20 min. Xylometazoline nasal drops and lidocaine jelly was applied to both the nostrils. Tongue and hypopharynx was sprayed with two puffs of 10% lidocaine (20 mg). After that dexmedetomidine (1 µg/kg over 10 min and a maintenance dose of 0.008 µg/kg/min) or propofol (1 mg/kg over 10 min and a maintenance dose of 50 µg/kg/min) was infused according to the subject's inclusion number[11,13]. The infusion of drug was given until the patient achieved the adequate sedation as evaluated by Ramsay Sedation Scale (RSS)[14]. Once sedation score of ≥2, bronchoscopy was performed through nasal approach. After lubricating the bronchoscope and the appropriate

size cuffed polyvinyl chloride endotracheal tube, the bronchoscope was loaded with the tube. The bronchoscope was held in the non-dominant hand with thumb over the control lever and index finger over the working channel valve. Dominant hand was used to steady and to hold the insertion cord as it is slowly advanced into the airway. The tip of FOB is gently guided through the nose, while advancing lignocaine was sprayed through the working channel as and when required. When bronchoscope was advanced closer to the larynx, 2 ml of lidocaine 2% was sprayed onto the glottis via the working channel of the fiberscope and another 2-ml lidocaine 2% was delivered between the vocal cords. The successful advancement was determined by the coordinated movements of the tip of the cord and rotation of FOB while advancing keeping the target in the center. Once in the trachea, tracheal rings are visualized and FOB is gently advanced further till carina is visualised. The endotracheal tube is gently advanced over the bronchoscope into the trachea. After proper placement of tube in trachea, intubation was confirmed by bilateral symmetrical chest expansion on manual ventilation and square waveform on capnography. During the procedure, if the patient developed prolonged coughing, discomfort and severe resistance during bronchoscopy or intubation, it was considered as study failure and patient was intubated under general anaesthesia. The primary outcome measurements were Intubation conditions, patient's tolerance to intubation and haemodynamic stability.

Intubating conditions were evaluated by intubation score[4,6,10]. Intubation score include

vocal cord movement (1 = open, 2 = moving, 3 = closing, 4 = closed),

coughing (1 = none, 2 = slight, 3 = moderate, 4 = severe) and

limb movement (1 = none, 2 = slight, 3 = moderate, 4 = severe);

Tolerance to intubation was evaluated subjectively by post-intubation score after placement of tube in the trachea as: 1 = co-operative, 2 = minimal resistance, 3 = severe resistance[4].

Vital parameters like Heart Rate (HR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP) and SpO_2 was noted before infusion (baseline), after end of infusion and immediately after intubation. Other parameters assessed in relation to fiberoptic intubation included intubation time, sedation at the time of intubation, number of attempts at intubation and any complications during the procedure. Intubation time was defined as the time in seconds from the insertion of the FOB to confirmation of nasotracheal intubation. Attempt was defined as the number of times the fiberoptic scope passed through the nares. More than two attempts were considered as failure and patient was intubated under general anaesthesia. Any complications like oxygen desaturation, bronchospasm, laryngospasm regurgitation of gastric contents and post-operative blood staining of the device and tongue, lip and dental trauma was noted. Bradycardia was defined as heart rate (HR) <60 beats/min and treated with intravenous atropine 20 μg/kg. Tachycardia response was defined as 20% increase in HR from the pre-intubation value. Hypertensive response was defined as 20% increase from pre-induction blood pressure. Hypotension was defined as BP <20% of pre-induction BP. Severe hypotension, defined as BP <40% of pre-induction value, was treated with intravenous fluids or small bolus dose of ephedrine as the rescue drug. Oxygen desaturation (SpO_2<95% for >10 s) was treated with oxygen supplementation.

The sample size of 23 in each group was calculated based on the study by Challam where the basal SBP reading was 132.04 ± 13.51, considering a minimum change in the SBP of 10%, the variance to be the same as basal readings, statistical power of 90% and α error cut off as 5% ($p<0.05$)[11]. Considering dropouts we included 30 patients in each group. Continuous variables were presented as mean for parametric data and median if the data is nonparametric or skewed. Student t test was applied for calculation of statistical significance whenever the data followed normative distribution. Mann Whitney test was applied whenever data followed non-normative distribution. Categorical variables were expressed as frequencies and percentages. Nominal categorical data between the groups was compared using Chi-square test or Fisher's exact test as appropriate. $P<0.05$ was taken to indicate a statistically significant difference. Minitab version 17 was used for computation of statistics. Mean and standard deviation were represented as bar graphs wherever appropriate.

3. Results

There was no significant difference in demographic profile between the two groups with respect to age, sex, weight, height (BMI) and type of surgery (Table 1). Two

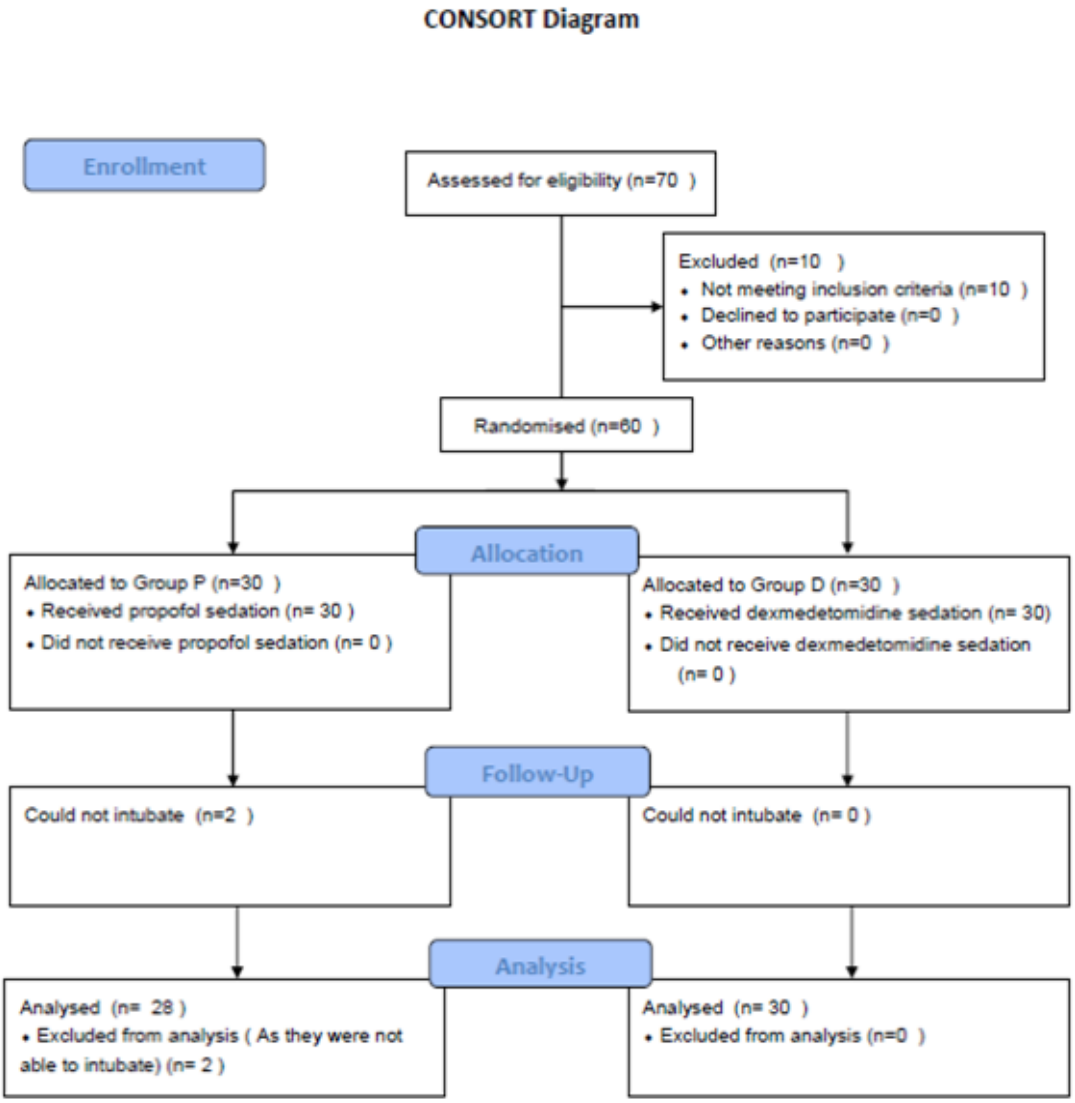


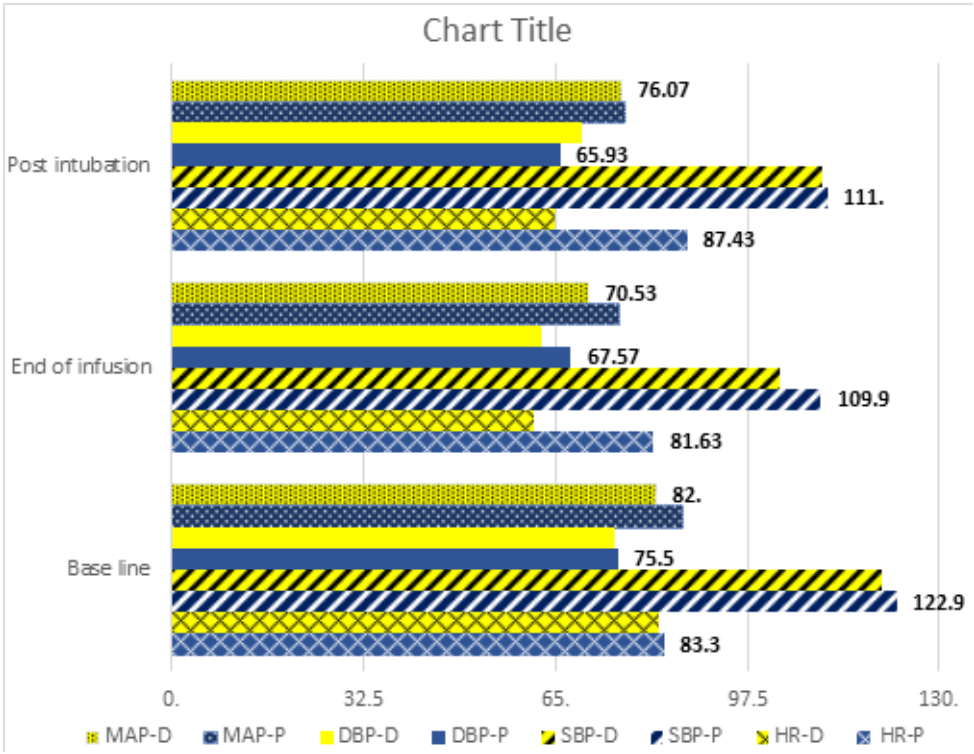
Figure 1. Consort diagram.

Table 1. Demographic parameters

Parameters	Group P (n = 28)	Group D (n = 30)	P value	Remarks
Mean age (in years)	32.8 ± 8.31	29.37 ± 6.98	0.09	NS
Gender (Male, Female)	14,16	15,15	0.8	NS
Body mass index (kg/m^2)	24.43 ± 2.99	25.3 ± 2.34	0.22	NS

Table 2. Intubation scores

Parameters	Group P (n = 28)	Group D (n = 30)	P value	Remarks
Number of patients with vocal Cord Movement score (4,3,2,1)	0,4,12,14	0,0,11,19	0.423	NS
Number of patients with Coughing score (4,3,2,1)	2,8,10,10	0,6,11,13	0.03	NS
Number of patients with Limb movement score (4,3,2,1)	2,5,14,9	2,5,9,14	0.537	NS
Number of patients with Post Intubation score (3,2,1)	6,16,8	5,11,14	0.448	NS



NS – Non significant; SS – Statistically significant

Figure 2. Haemodynamic parameters.

patients in group P could not be intubated and were excluded from the analysis (Figure 1). There was no statistically significant difference in the intubation score with regard to vocal cord movements, coughing and limb movements with p value more than 0.05. The number of patients having vocal cord movement score of 4, 3, 2, 1 where 0, 4, 12, 14 in group P and 0, 0, 11, 19 in group D respectively (p-0.423).The number of patients having cough score of 4, 3, 2, 1 where 2, 8, 10, 10 in group P and 0, 6, 11, 13 in group D respectively (p-0.03).The number of patients having limb movement score of 4, 3, 2, 1 where 2, 5, 14, 9 in group P and 2, 5, 9, 14 in group

Table 3. Sedation scores, intubation times and number of attempts

Parameters	Group P (n = 28)	Group D (n = 30)	P value	Remarks
Number of patients with Ramsay sedation score (1,2,3,4,5,6)	0,0,17,13,0,0	0,0,6,24,0,0	0.00	SS
Mean sedation score	3.57 ± 0.5	3.2 ± 0.41	0.00	SS
Intubation time (in seconds)	326.83 ± 52.07	275.33 ± 61.35	0.00	SS
Number of attempts (1 attempt, 2attempt, failure)	26,2,2	29,1,0	0.17	NS

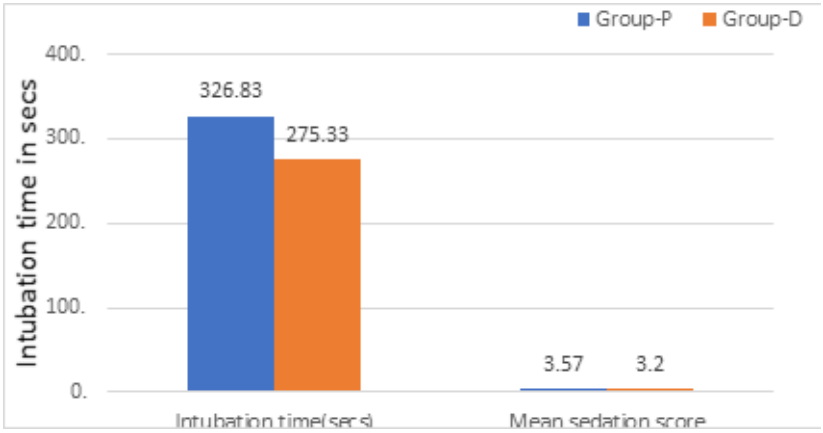


Figure 3. Intubation time and sedation scores.

D respectively (p-0.537). Patient's tolerance to intubation was evaluated by post intubation score. There was no significant statistical difference between the two groups with a p value of 0.448. The number of patients having post intubation score of 3, 2, 1 were 6, 16, 8 in group P and 5, 11, 14 in group D (Table 2). Haemodynamic parameters were comparable between two groups except for heart rate at the end of infusion and post intubation and mean SBP at the end of infusion. Mean heart rate after the end of infusion and post intubation were 81.63± 10.93, 87.431± 11.73 in group P and 61.43± 8.53, 64.77± 13.51 in group D ($p<0.001$) respectively. Mean SBP at the end of infusion were 109.93± 9.78 in group P and 102.9 ± 8.4 in group D ($p<0.001$) respectively (Figure 2). The sedation score was satisfactory in both groups (≥2). The number of patients having RSS score of 1, 2, 3, 4, 5, 6 were 0, 0, 17, 13, 0, 0 and 0, 0, 6, 24, 0. 0 in group P and group D respectively. There was significant difference in the mean sedation score between the two groups (group P= 3.57± 0.5 and group D = 3.2 ± 0.41, $p<0.001$). The intubation time was shorter in group D. The mean intubation time was 326.83± 52.07 seconds in group P and 275.33± 61.35 in group D, $p<0.001$ (Figure 3). All patients were successfully intubated under sedation except in two patients in group P who had severe coughing and desaturation and were intubated under general anaesthesia. 26 and 29 patients were intubated in first attempt, 2 and 1 patients were intubated in second attempt in group P and D respectively (Table 3).

4. Discussion

Awake Fiberoptic Intubation is a gold standard for the management of anticipated difficult airway. Fiberoptic intubation under local anaesthetics can be an unpleasant experience even with careful and meticulous approach. Conscious sedation is desirable not only to make the procedure more tolerable and also to ensure the optimal intubating conditions. The challenges associated with this procedure are to provide adequate sedation while maintaining patent airway and ventilation. Therefore, the ideal sedative for AFOI should provide anxiolysis and a degree of amnesia with low incidence of recall of the procedure while maintaining the airway.

In the last three decades, several class of drugs from benzodiazepines to opioids to α2 -adrenoreceptor agonists to IV induction agents like ketamine and propofol have been used alone or in combination[5,7,8,15]. All these agents are respiratory depressants, hence there is search for an ideal agent for conscious sedation. Propofol has been used in various studies as Target Control Infusions (TCI) to achieve plasma concentration of 1-3.6 μg/ml[4,6,9]. Few other studies have used propofol in the doses of 1 mg/kg as bolus followed by infusion of 25–75 μg/kg/min[10,11,13]. Propofol produces sedation with a less favorable condition for intubation with a higher degree of airway obstruction[16].

Dexmedetomidine, a α2-adrenoreceptor agonist which induces sedation and analgesia without respiratory depression is a valuable drug for fibreoptic intubation. Dexmedetomidine induces sedation involving activation of endogenous sleep promoting pathway through the post synaptic α2 receptors in locus coeruleus which modulates wakefulness. It produces a unique form of sedation where the patient remains sleepy, easily aroused and co-operative with minimal respiratory depression compared to propofol[17,18]. Dexmedetomidine has been used in various studies for AFOI in the dose of 1 μg/kg as bolus followed by infusion of 0.5 μg/kg/hr[4,18,19]. In our study we have compared propofol 1 mg/kg bolus followed by infusion and dexmedetomidine 1 μg/kg bolus followed by infusion, titrated to a Ramsay sedation score of ≥2 to facilitate AFOI.

The intubating conditions were assessed by vocal cord movement score, cough score and limb movement score in ours and in various studies. Studies done by Tsai *et al.,* and Gupta *et al.* have found that the vocal cord movement was significantly lesser in patients who received dexmedetomidine than those who receive propofol for sedation[4,10]. In study of Mondal *et al.,* the number of patients who had minimal cough during the procedure was higher with patients receiving dexmedetomidine compared to those who received fentanyl[19]. In our study we found similar results, the patients who received dexmedetomidine had lesser vocal cord movements even though the RSS was slightly lower. Various studies have compared post intubation score, between dexmedetomidine and propofol, with or without airway block. Chalam KS compared dexmedetomidine (1 mcg/kg over 10 min and a maintenance dose of 0.5 mcg/kg) and propofol (1 mg/kg over 5 min) along with airway blocks, observed that all the patients following intubation were cooperative and obeyed commands and there were no statistical or clinically significant changes in post intubation conditions in the two groups[11]. Tsai *et al.,* found the post intubation score were favorable in dexmedetomidine group when compared to propofol group ($p = 0.014$)[4]. In our study the post intubation score was comparable. The difference in the results in the various studies may be attributed to the airway block used along with the sedation and also the differences in the method of administration of airway blocks and also due to variation in the dose of the drugs.

Most studies have found the decrease in heart rate fall in MAP and DBP with the use of dexmedetomidine and better haemodynamic stability[4,10,11,19]. The haemodynamic effects of dexmedetomidine are due to decrease in noradrenaline release, decreased centrally mediated sympathetic drive and increased vagal activity[20,21].

In our study, the desired level of sedation ≥2 was achieved in a greater number of patients in dexmedetomidine group (24/30) than propofol group (13/30). But the mean sedation score was significantly higher in propofol group. Gupta *et al.* and Mondal et al found that the desired level of sedation was achieved in lesser time and more easily in dexmedetomidine group than in propofol group[10,19]. Mondal *et al.* found a significant higher mean sedation score in dexmedetomidine when compared to fentanyl[19]. The mechanism and level of sedation produced by each drug varies. It has been observed in various studies that propofol produces relatively deep sedation when compared to dexmedetomidine which produces conscious

sedation without respiratory depression[10,19]. Appropriate level of sedation for safe AFOI is difficult to standardise.

In our study, the mean intubation time was significantly shorter in dexmedetomidine group. Rai *et al.* found a statistically significant shorter time in remifentanil when compared to propofol[9]. Tsai *et al.* did not find a significant difference between dexmedetomidine and Propofol group[4]. Sinha *et al.* while comparing dexmedetomidine and ketamine with dexmedetomidine did not find statistically significant difference between two groups[15]. Variation in the mean intubation time in various studies may be due to the difference in the level of sedation, airway block used, anatomical and physiological state of airway and expertise of the endoscopies. The number of attempts to intubation is comparable between groups across various studies as in our study.

5. Conclusion

Dexmedetomidine and propofol have provided satisfactory intubating condition and post intubation scores in majority of patients undergoing Awake Fiberoptic Intubation. Dexmedetomidine has provided better haemodynamic stability when compared to propofol. Propofol has produced a much lower mean sedation score when compared to dexmedetomidine. Appropriate levels of sedation for a safe AFOI are difficult to standardise while comparing two drugs. Sedation scores and depth of anaesthesia monitoring may be the rationale in future. Further there is a need for large multicentric trials to prove conclusively the superiority of one over the other.

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