Zagazig University Medical Journal
www.zumj.journals.ekb.eg
https://doi.org/10.21608/zumj.2024.234154.2873 Volume 30, Issue 7, Oct. 2024
Manuscript ID ZUMJ-2407-3466 DOI . 10.21608/ZUMJ.2024.302548.3466

ORIGINAL ARTICLE

Sedation Using Dexmedetomidine with or without Different Methods of Airway Topical Anesthesia for Awake Fiberoptic Nasal Intubation in Patients Undergoing Elective Surgeries Under General Anesthesia

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Submit date: 08-07-2024
Revise Date : 16-07-2024
Accept date: 18-07-2024

ABSTRACT

Background: One challenge associated with awake fiberoptic intubation is providing adequate sedation with sufficient airway topicalization while maintaining the patient's cooperation.This study aimed to assess intubation condition during awake fiberoptic intubation (AFOI) using dexmedetomidine alone and compare it when combined with different methods of airway topicalization.

Methods: We included 56 patients who were undergoing elective surgery under general anesthesia in a prospective double-blind controlled clinical trial distributed into 4 equal groups (n=14 in each); Group C (Sedation / Control) received only dexmedetomidine as a sedativefor AFOI , Group N (Nebulization group):received dexmedetomidine + lidocaine 2% nebulization, Group A (Atomization): received dexmedetomidine + lidocaine 2% by atomization "modified McKenzie technique", Group S (SAYGo): received dexmedetomidine + lidocaine 2% by "Spray As You Go" technique. Achievement of good patients' intubation condition which was assessed by (Five - point fiberoptic intubation comfort score, three-point behavior score, and intubation time) were the primary outcome. Hemodynamic stability, patient satisfaction with minimal post-operative side effects were the secondary outcomes.

Results: The5-point fiberoptic intubation comfort score and 3-point behavior score were significantly better in atomization and SAYGo groups (p=0.011 and 0.002 respectively). Intubation time was statistically significantly shorter in Atomization group (1.85 mins) than SAYGo group (2.3 mins) followed by nebulization group (3.3 mins), while the sedation group recorded the longest intubation time (5.6 mins). Significantly higher total dose of dexmedetomidine was found in the sedation group (115.29±9.67 *u*g) compared to other groups ($p<0.05$). Regarding patient satisfaction, Atomization and SAYGo groups recorded the best scores, followed by Nebulization then Sedation groups.

Conclusion: Airway topicalization along with sedation using dexmedetomidine provides better intubation condition, hemodynamic stability, and patient satisfaction compared to sedation alone among patients undergone awake fiberoptic nasotracheal intubation for elective surgeries under general anesthesia. However, atomization and spray-as-you-go techniques are superior to nebulization.

Keywords: Dexmedetomidine; Airway Topical Anesthesia; Awake Fiberoptic Nasal Intubation; Elective Surgeries; General Anesthesia.

INTRODUCTION

General anesthesia includes airway management as one of its integral parts. It is a crucial skill and area of concern for anesthesiologists as failure in securing a patent airway could result in several life-threatening conditions[1]. Difficult airway management may lead to various adverse events such as airway trauma, hypertension, tachycardia, arrhythmias, unanticipated surgical airway, and anoxic brain injury up to cardiopulmonary arrest [2].

While awake fiberoptic intubation (AFOI) is the most effective method for managing problematic airways, particularly in cases where a difficult airway is expected, it can cause pain, discomfort and anxiety for the patient. Thus, it necessitates sufficientairway anesthesia for the patient's comfort and cooperation [3].

Another challenge to successful airway management is suppressing airway reflexes such as gagging,coughing, as well as laryngospasm.When patients are sedated, they are more likely to cooperate during these types of procedures. [4]. Sedation, anxiolysis, sparing with mild respiratory depression, as well as reduced salivary production are all advantages of dexmedetomidine, which is a selective alpha-2-adrenoceptor agonist that may be helpful for patients undergoing AFOI[5].

Severe hemodynamic reactions can be avoided by appropriately topicalizing the larynx and trachea prior to intubation. Topicalization methods preparation for AFOI includes nebulization, atomization (McKenzie technique), and Spray-As-You-Go (SAYGo) technique [6].

A three-way stopcock is used to connect oxygen tubing to a 20-gauge cannula in the McKenzie procedure. An oxygen source is connected to the oxygen tubing, and it delivers a flow rate of 2-4 L/min. An efficient way to topicalize the nasal and oral mucosa is by using a syringe to inject the local anesthetic, which creates a spray that resembles a jet [4].

In a Spray-As-You-Go (SAYGo) approach, local anesthetics can be applied to the airway using the fiberoptic bronchoscope. This technique is ideal for most awake intubations and allows for selective airway anesthesia [7].

So, we aimed this research to assess intubation conditions during AFOI using dexmedetomidine alone and compare it when combined with different methods of airway topicalization.

METHODS

We carried out this prospective randomized double-blind controlled clinical study at Zagazig University Hospitals for six months from June 2023 to November 2023 on 56 patients who were undergoing elective surgery under general anesthesia.

Sample size: Assuming the mean Modified Ramsay Sedation Scale score was 2.22+0.71 vs 1.6+0.66 in the nebulizer vs spray as-you-go group respectively [8]. At 80% power and 95% CI, the estimated sample size was 56 cases, 14 cases in each group. As calculated by OpenEpi.

70 patients were enrolled to undergo elective surgeries under general anesthesia, ten patients did not fulfill the inclusion criteria, and four patients voluntarily did not participate, leading to the exclusion of fourteen individuals. Four groups, each consisting of fourteen patients, were

randomly assigned to participate in the study (Figure 1).

After institutional review board approval of IRB (ZU-IRB#10528-1-3-2023), all participants were asked to sign an informed consent. Human subjects research adhered to the guidelines set in the Declaration of Helsinki, which is part of the World Medical Association's Code of Ethics.

Inclusion criteria: The study included 56 patients aged from 21 to 60 years old from both sexes with body mass index (BMI) of 18.5 – 24.9 kg/m^2, ASA physical status: class I & II, and EL-GANZOURI Risk Index score from 0:3 [9] and patients were scheduled to undergo elective surgery under general anesthesia.

Exclusion criteria: Patient refusal and patients with; known allergies to study drugs contraindications to nasal intubation, altered mental status, reactive airway disease, bleeding disorders, and patients who had a language barrier were excluded from the study.

Preoperative Preparation:

A general and airway examination was done to rule out any contraindications. All patients were investigated by complete blood count, liver function tests, kidney function tests, and coagulation profiles. All patients were kept fasting for a minimum of 2 hours for clear liquids and 6 hours for solid food before the operation, two 20-gauge cannulae were inserted, and premedicated with atropine 1 mg I.M. and metoclopramide 10 mg I.V. 1 hour before the technique. Xylometazoline hydrochloride decongestant nasal drops and lignocaine gel 2% were applied in both nasal passages. A gauze soaked in 10 ml lidocaine 2% was placed in the oral cavity for 10 minutes.

Intraoperative:

On arrival at the operating room, non-invasive blood pressure (NIBP), electrocardiogram (ECG), and pulse oximetry were attached. Baseline readings of mean arterial pressure (MAP), heart rate (HR), and oxygen saturation (SpO_2) were recorded. Supplemental oxygen was administered at 6-8 L/min via nasal prongs through the patients' mouth.

Randomization:

Fifty-six patients were randomized by computer-generated randomization table according to the technique used for AFOI into four equal groups (fourteen patients each): **Group C (Sedation / Control group) (n=14)** patients received only dexmedetomidine as a sedative for AFOI with placebo airway topicalization by nebulization, atomization and spray as you go using normal saline 0.9%. **Group N (Nebulization group) (n=14)** patients received dexmedetomidine as a sedative in addition to lidocaine 2% nebulization for airway topicalization and placebo airway topicalization by atomization and SAYGo using normal saline 0.9%. **Group A (Atomization group) (n=14)** patients received dexmedetomidine as a sedative in addition to lidocaine 2% by atomization "modified McKenzie technique" and placebo airway topicalization by nebulization and SAYGo using normal saline 0.9%. **Group S (SAYGo group) (n=14)** patients received dexmedetomidine as a sedative in addition to lidocaine 2% by "Spray As You Go" technique and placebo airway topicalization by atomization and nebulization using normal saline 0.9%.

The patient & anesthesiologist who performed AFOI and followed perioperative data were unaware of each preparation ensuring blindness of the study.

Sedation Technique:

All patients in all groups received procedural sedation by I.V. infusion of dexmedetomidine. It was prepared as 200 *u*g (2 ml) of dexmedetomidine added to 48 ml of 0.9% saline. A loading dose of 0.5 to 1 *u*g/kg was given over 10-20 minutes, followed by 0.2-0.7 *u*g/kg/hr as a continuous infusion. The total dose of dexmedetomidine used to reach a level of sedation to a point of semi-sleep but responds to commands (equivalent to Modified Ramsay Sedation Scale score of 3) was calculated and recorded.

Nebulization Technique:

During sedation, they had a nebulization session through a face mask nebulizer attached to an oxygen source with 10 ml of 2% lidocaine (200 mg) with a rate of 8-10 L/min for 10-15 minutes. (200 mg since 25% of it is typically absorbed = 50 mg) into the nasopharynx & oropharynx[10].

The patient was asked to take shallow breaths to topicalize the more proximal airway and to take slow deep breaths for the more distal airway.

Atomization technique:

During sedation, they were subjected to airway topicalization by atomization (through a modification of the McKenzie technique). A 10-Fr suction catheter was connected to the oxygen supply, which supplies 2-4 L/min, via oxygen tubing with a three-way stopcock. A 10-ml syringe filled with 10 ml of lidocaine 2% was attached to the top port of the three-way stopcock. In order to effectively topicalize the nasal and oral mucosa, a jet-like spray was formed as the local anesthetic was delivered via the syringe [4].

Spray as you go (SAYGo) Technique:

After sedation, under direct eyesight, a fiberoptic bronchoscope was introduced through the nose and into the mouth to administer the airway topicalization approach. The instrument was preloaded with a 6.5- or 7-mm endotracheal tube. Then a 10-ml syringe containing 10 ml Lidocaine 2%, was attached directly to the working channel, and thus the local anesthetic was sprayed as the fiberscope was advanced through the airway. At the epiglottis level around the vocal cords 2-4 ml of lidocaine 2% were sprayed as the patient takes a deep breath to achieve sufficient anesthesia to the laryngeal inlet and another deep breath as the scope was passed through the vocal cords and 2 ml of lidocaine 2% was sprayed to the trachea and the scope was advanced until the carina was visualized. On the final deep breath, a well-lubricated endotracheal tube at the entrance to the nose was rotated through the nose and into the trachea along the fiberoptic bronchoscope.

Awake Nasotracheal Fiberoptic Intubation Technique:

The fiberoptic bronchoscope was placed into the more patent nostril and guided via the nasal canal to reach the pharynx. The tip of the scope was then directed upward until it reached the midline, where it was able to observe the epiglottis. The patient was asked to take a deep breath so the scope could pass between the vocal cords observing the tracheal rings and reaching the carina. Then the patient was asked to take a deep breath, and the lubricated endotracheal tube "preloaded on the scope" at the entrance to the nose was rotated through the nose and into

the trachea along the fiberoptic bronchoscope. After the tube was successfully introduced into the trachea, its depth was measured, and the presence of the carina was used to confirm that the tube was in the trachea. Finally, the scope was removed.

In all groups, once the tube position was confirmed (using a stethoscope and capnography), the patient was anesthetized using propofol 2 mg/kg i.v., rocuronium 0.6-0.9 mg/kg i.v. and the cuff of the endotracheal tube was inflated. Anesthesia was maintained with inhalation of oxygen and isoflurane 1.5% MAC, rocuronium 0.15 mg/kg i.v. increments and the surgical procedure proceeded as planned.

The patient was transferred to the recovery room after the neuromuscular blockade was reversed with intravenous neostigmine (0.05 mg/kg) and atropine sulfate (0.01 mg/kg). Extubation was done according to the kind of surgery.

Primary Outcomes

Achievement of good patients' intubation condition which was assessed by: Five - point fiberoptic intubation comfort score during bronchoscope **[11]**, three-point behavior score immediately after intubation, intubation time.

Secondary Outcomes:

Included calculation of the total dexmedetomidine dose used for sedation, Peri-intubation measurement of vital parameters (MAP, HR), as well as oxygen saturation (SpO2%) were continuously checked and documented immediately after intubation, every 5 min during the 1st 15 min then every 15 min till 1 hour. Any changes in MAP, HR or any hypoxic episode (SPO2 <90%) were recorded. Evaluation of the post-operative patient satisfaction, complications of techniques and any side effect associated with the study drugs.

Statistical analysis

All statistical analyses were performed using SPSS version 27. Normality was tested using the Shapiro-wilk test and the Kolmogorov-Smirnov Normality Test. One-way ANOVA was used to normally distribute comparing the continuous data between groups. Not normally distributed data were represented as median, IQR. Kruskal-Walli's test followed by the Mann–Whitney test was used to compare the not normally distributed continuous data between groups. Comparing groups regarding categorical data was performed using the Chi-square test or Fisher Exact test. The general linear model was used for the assessment of repeated measurements.

RESULTS

Non statistically significant differences were found among the studied groups regarding baseline characteristics; age, sex, BMI, ASA grades, EL-GANZOURI Risk Index.The Modified Ramsay Sedation Score was achieved to 3 in all included patients (Table 1).

The 5-point fiberoptic intubation comfort score and 3-point behavior score were significantly better in Atomization (modified McKenzie) and SAYGo groups (p=0.011 and 0.002 respectively) (Table 2).

The intubation time was statistically significantly longer in the sedation group than all other groups (5.6 mins) (P1<0.05, P2&P3<0.001). Intubation time was also statistically significantly longer in the Nebulization (3.3 mins) than Atomization (1.85 mins) and SAYGo group (2.3 mins) (P4&P5<0.05). While it was significantly shorter in the Atomization group (1.85 mins) than the SAYGo group (2.3 mins) (P6<0.05) (Table 3).

The total dose of dexmedetomidine was statistically significantly higher in the Sedation group (115.29±9.67 *u*g) than all other groups (P1<0.05, P2&P3<0.001). The total dose of Dexmedetomidine was also statistically significantly higher in the Nebulization (106.36±9.09 *u*g) group than the Atomization group and SAYGo group (P<

0.001) (89.71±12.69 & 83.07±13.56 *u*g) (Table 4).

A significant increase was found in MAP in Sedation and Nebulization groups compared with Atomization or SAYGo groups at most times of measurements (P2,3,4,5<0.05). A significant increase was found also in HR in sedation and Nebulization groups compared with Atomization or SAYGo groups at most times of measurements (P2,3,5<0.05) (Figure 2).

A statistically significant difference was found among the studied groups as regards patient satisfaction (p=0.009). Atomization and SAYGo groups recorded the best scores, whereas 42.90% of the Atomization group and 28.6% of the SAYGo group had excellent results (score 0). While only 7.1% of the sedation group and 14.30% of the Nebulization group had excellent results. Regarding postoperative complications, Sore throat was significantly more recorded in the Sedation group (71%) than in Nebulization (28.6%), Atomization (14.30%), and SAYGo group (14.30%) (p=0.004), no cases of bradycardia, bronchoconstriction or seizures were recorded in all groups (Table 5)

Table (1): Patients' characteristics among the studied groups

Variable	Total number (n=56)	Groups				P value
		Sedation group (C) (n=14)	Nebulization group (N) (n=14)	Atomization group (A) (n=14)	SAYGo group (S) (n=14)	
	mean±SD	mean±SD	mean±SD	mean±SD	mean±SD	
Age (years)	40.8±11.27	40±11.99	40.07±10.65	42.07±12.02	41.07±11.54	0.96
Weight (Kg)	74.4±9.37	71.2±8.45	73.21±6.78	77.57±13.21	75.71±7.39	0.28
BMI (Kg/m^2)	23.25±1.48	23.1±1.81	22.9±1.89	23.5±1.134	23.3±.97	0.78
	n (%)	n(%)	n(%)	n(%)	n(%)	
Sex						
Female	25 (44.6%)	5(35.70%)	8(57.10%)	6(42.90%)	6(42.90%)	0.712
Male	31(55.40%)	9(64.30%)	6(42.90%)	8(57.10%)	8(57.10%)	
ASA						
I	37(66.10%)	11(78.60%)	9(64.30%)	9(64.30%)	8(57.10%)	
II	19(33.90%)	3(21.40%)	5(35.70%)	5(35.70%)	6(42.90%)	0.754
EL-GANZOURI Risk Index						
0	18(32.10%)	4 (28.6%)	6 (42.9)	3 (21.4)	5 (35.7%)	0.964
1	24(42.90%)	7(50%)	5(35.70%)	6(42.90%)	6(42.90%)	
2	11(19.60%)	3(21.40%)	2(14.30%)	4(28.60%)	2(14.30%)	
3	3(5.40%)	0(0.00%)	1(7.10%)	1(7.10%)	1(7.10%)	
Modified Ramsay Sedation Score (3)	56(100%)	14(100%)	14(100%)	14(100%)	14(100%)	---

Data were presented as numbers, percentage, mean and standard deviation.Oneway ANOVA, Exact fisher test,Chi-square test.P>0.05: non-significant n: number. ASA: American Society of Anesthesiologist.BMI: Body mass index

Table (2): 5-point Fiberoptic intubation comfort score and 3-point Behavior score among the studied groups

5-point Fiberoptic intubation comfort score	Total number (n=56)		Groups								Fisher's Exact Test	P value
			Sedation group (C) (n=14)		Nebulization group (N) (n=14)		Atomization group (A) (n=14)		SAYGo group (S) (n=14)			
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)		
0	17	30.40%	2	14.30%	2	14.30%	7	50.00%	6	42.90%	15.968	0.011*
1	18	32.10%	2	14.30%	5	35.70%	6	42.90%	5	35.70%		
2	21	37.50%	10	71.40%	7	50.00%	1	7.10%	3	21.40%		
3	0	0%	0	0%	0	0%	0	0%	0	0%		
4	0	0%	0	0%	0	0%	0	0%	0	0%		
3-point Behavior Score	Total number (n=56)		groups								Fisher's Exact Test	P value
			Sedation group (C) (n=14)		Nebulization group (N) (n=14)		Atomization group(A) (n=14)		SAYGo group (S) (n=14)			
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)		
0	16	28.60%	1	7.10%	1	7.10%	8	57.10%	6	42.90%	18.451	0.002*
1	31	55.40%	8	57.10%	9	64.30%	6	42.90%	8	57.10%		
2	9	16.10%	5	35.70%	4	28.60%	0	0.00%	0	0.00%		

For 5-point Fiberoptic intubation comfort score: Data were presented as numbers, percentage n: number %: percentage
0:noreaction1: slight grimacing2: heavygrimacing 3: verbal objection 4: defensive movements*Significant difference (**P<0.05).**For 3-point Behavior Score: ata were presented as numbers and percentage. n: number%: percentage 0: cooperative 1: restless/minimal resistance2: severe resistance.*Significant difference (P<0.05).

Table (3): Intubation time among the studied groups
Data were represented as median and IQR, K ruskal-Wallis test followed by Mannwhiteny test.

Intubation time (minutes)	Groups				P value
	Sedation group (C) (n=14)	Nebulization group (N) (n=14)	Atomization group (A) (n=14)	SAYGo group (S) (n=14)	
Median (IQR)	5.6 [3.65, 6.95]	3.3 [2.45, 4.85]	1.85 [1.47,2.55]	2.3 [2, 3.32]	**P1=0.018*** **P2,3=0.000*** **P4=0.01*** **P5=0.04*** **P6=0.035***

n: number IQR: Inter Quatrtile RangeP1: Sedation group vs Nebulization group. P2: Sedation group vs Atomization group. P3: Sedation group vs SAYGo group. P4: Nebulization group vs Atomization group. P5: Nebulization group vs SAYGo group. P6: Atomization group vs SAYGo group.
*Significant difference (**P<0.05).**

Table (4): Total dose of Dexmedetomidine among the studied groups

Total dose of Dexmedetomidine (*ug*)	Groups				P value
	Sedation group (C) (n=14)	Nebulization group (N) (n=14)	Atomization group (A) (n=14)	SAYGo group (S) (n=14)	
Mean ± SD	115.29±9.67	106.36±9.09	83.07±13.56	89.71±12.69	P1= **0.044*** P2,3,4,5= **0.000***P6=0.13

Data were presented as mean±SD. SD: standerd deviation n: number
P1: Sedation group vs Nebulization group. P2: Sedation group vs Atomization group.
P3: Sedation group vs SAYGo group. P4: Nebulization group vs Atomization group.
P5: Nebulization group vs SAYGo group. P6: Atomization group vs SAYGo group
*Significant difference (**P<0.05).**

Table (5): Patient satisfaction and postoperative complications among the studied groups

Patient Satisfaction	Total number (n=56)		Groups								Fisher's Exact Test	P value
			Sedation group (C) (n=14)		Nebulization group (N) (n=14)		Atomization group (A) (n=14)		SAYGo group (S) (n=14)			
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)		
0	13	23.20 %	1	7.10%	2	14.30%	6	42.90%	4	28.60%	20.070	**0.009***
1	20	35.70 %	2	14.30%	4	28.60%	6	42.90%	8	57.10%		
2	14	25.00 %	5	35.70%	5	35.70%	2	14.30%	2	14.30%		
3	9	16.10 %	6	42.90%	3	21.40%	0	0.00%	0	0.00%		

Complications	Groups								Fisher's Exact Test	P value
	Sedation group (C) (n=14)		Nebulization group (N) (n=14)		Atomization group (A) (n=14)		SAYGo group (S) (n=14)			
	n	(%)	n	(%)	n	(%)	n	(%)		
Sore Throat	10	71.40%	4	28.60%	2	14.30%	2	14.30%	12.84	**0.004***
Hoarseness	5	35.70%	6	42.90%	1	7.10%	2	14.30%	6.28	0.113
ECG Changes (Bradycardia)	0	0.00%	0	0.00%	0	0.00%	0	0.00%	…….	……
Bronchoconstriction	0	0.00%	0	0.00%	0	0.00%	0	0.00%	…….	……
Seizures	0	0.00%	0	0.00%	0	0.00%	0	0.00%	……	……

Data were presented as numbers, percentage. n: number %: percentage

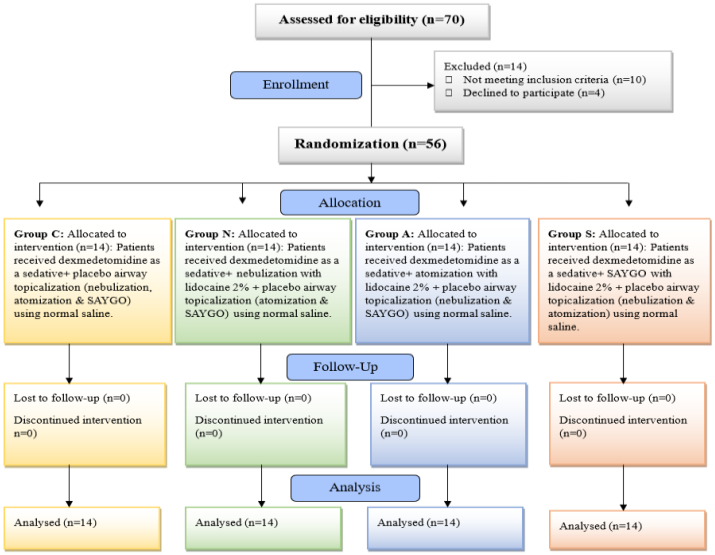

Figure 1: Consort Flow Chart

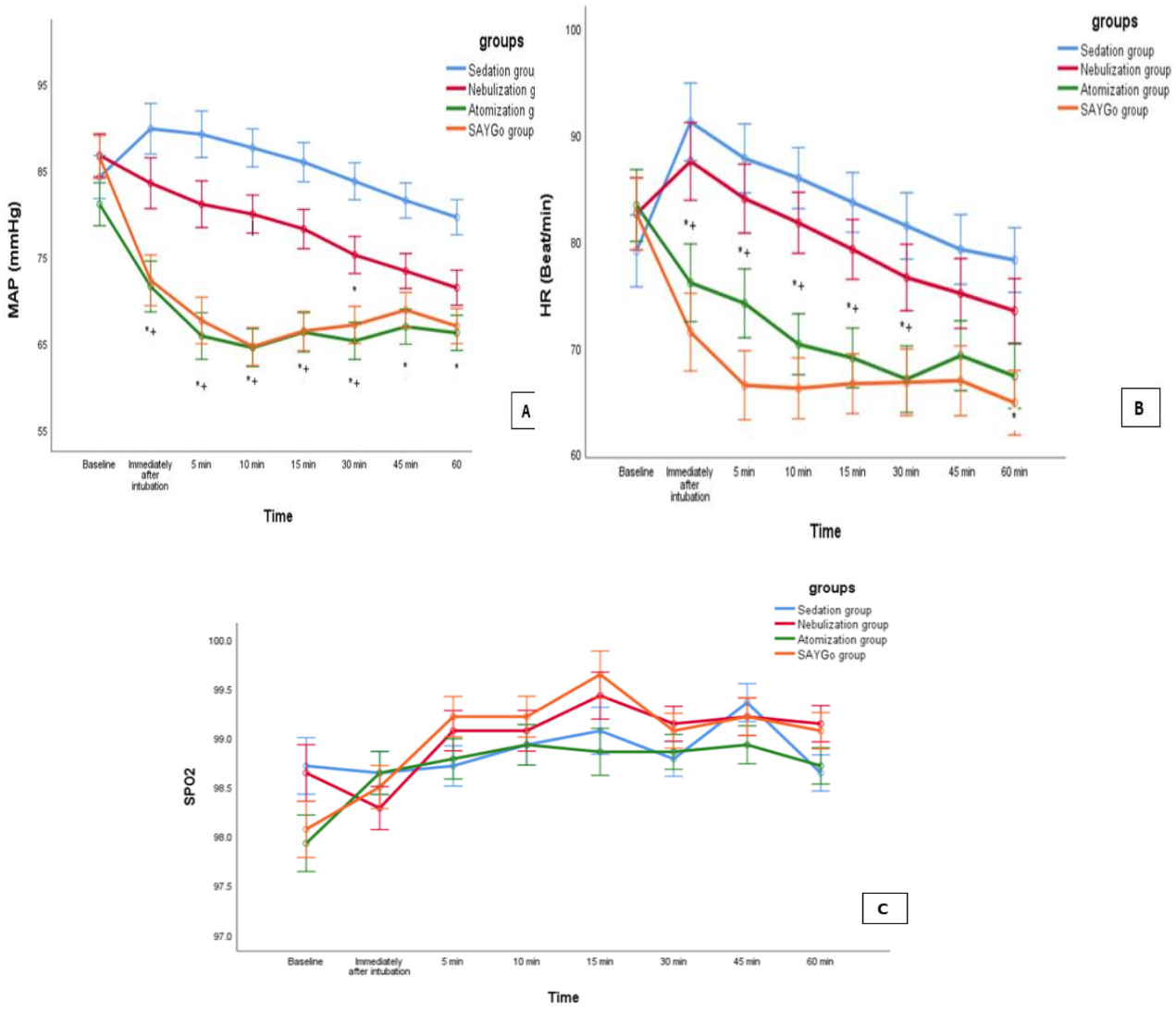

Figure 2: (A): Line chart of peri-intubation measurements of MAP, (B): Line chart of peri-intubation measurements of HR, (C): Line chart of peri-intubation measurements of SPO2

*indicate a statistically significant difference with sedation group.

+ indicate a statistically significant difference with nebulization group.

DISCUSSION

The results of the current study showed that; the intubation condition (which was assessed by 5-point fiberoptic intubation comfort score, 3-point behavior score, and intubation time) was best in Atomization and SAYGo groups. The intubation time was the shortest in the Atomization group, then SAYGo group followed by nebulization group, while the sedation group recorded the longest intubation time.

In line with the current study results Woodruff et al. [12] found that 2% lignocaine was better than 1% lignocaine for atomization during AFOI in patients with morbid obesity, and that airway anesthesia utilizing atomized lidocaine for this procedure was effective, quick, and safe.

The current study results were in accordance with those found by Sinha et al. [13], as they compared topical airway anesthesia by nebulization, airway nerve block, and atomization with lignocaine for AFOI. Patients in the atomization group reported better comfort scores (score: 2). than those in the nebulization group (score: 3). They concluded that the Atomization technique provides good intubating condition and a better comfort score with more hemodynamic stability than the nebulization technique. Also, intubation time was significantly longer in the nebulization group than atomization group.

Contrary to our results, Yadav et al. [14] concluded that, compared to topical anesthesia using (LMA MADgic) atomizer, for individuals who may have difficulty with their airway, airway nerve blocks allowed for faster intubation, sufficient airway anesthesia, and less anxiety during AFOI. According to their explanation, the local anesthetic was applied to the mucosa during atomization, and in airway nerve blocks, it was applied close to the nerves.

Regarding the intubation condition with the SAYGo group: In line with the results of the present study, the study results conducted by Shobha et al. [15] who compared three techniques of SAYGo for AFOI, also found that spraying lidocaine through the working channel of fiberoptic scope itself achieved better intubating condition with shorter intubation time.

Going with the results of the present study, are the study results of Kumar et al. [16] who assessed two methods for AFOI: intravenous dexmedetomidine and spray-as-you-go 4% lignocaine against intravenous fentanyl and 4% lignocaine transtracheal injection. Regarding the intubating condition and comfort during intubation, they found that injecting dexmedetomidine (1 ug/kg over 10 minutes) intravenously and SAYGo approach was more beneficial, this was in alignment with the current study results. However, its intubation time was longer. One possible explanation is that the SAYGo approach prolongs the time it takes for topical anesthetics to be absorbed. A topical anesthesia is produced in approximately one minute after lidocaine 2% or 4% is administered to the airway mucosa [17]. It is possible that the fact that all patients in the SAYGo group were premedicated with midazolam and dexmedetomidine and that nebulization with 2% lignocaine was administered to them before SAYGo contributed to the shorter intubation time in their research compared to the current study results.

The results of this study were not in line with the study conducted by Gupta et al. [18]who compared airway nerve blocks and nebulized lignocaine by ultrasonic nebulizer for AFOI.

The intubation condition was better in the nebulization group in their study compared to that of the present study. This may be due to the fine mist of vaporized local anesthetics delivered from the ultrasonic nebulizer which has been designed to deliver liquid medication in the form of droplets with an average diameter of just 3.5 mm to the airway. So, anesthetizes the trachea beyond the glottis. Moreover, the score used for grading the intubating condition in their study was different from that we used.

Regarding the intubation condition with the nebulization group: in agreement with the results of the current study, Mathur et al. [19]compared lignocaine nebulization and airway nerve block for AFOI. They revealed an intubation time of 3.5 minutes in nebulization group, which is comparable to that of our results. They also observed no case of failure of AFOI and no complications related to nebulization.

Contrary to our findings, Dhasmana et al. [8], considered two methods for administering topical anesthetic to the airway during AFOI in patients with temporomandibular joint (TMJ) ankylosis: 2% lignocaine nebulization and 2% lignocaine using the spray-as-you-go technique. Patients in the nebulization group reported better comfort during the procedure, which likely contributed to their greater cooperation compared to the SAYGo group. This may be attributed to the use of ultrasonic nebulizer in their study for about 10 - 15 minutes which delivers lidocaine in the form of fine mist anesthetizing the airway beyond the glottis.

Regarding the intubation condition in the sedation group in this study: patients in this group had the lowest comfort score, intubation condition, and longest intubation time using dexmedetomidine only for conscious sedation without airway topicalization for AFOI. However, procedural sedation using dexmedetomidine before airway topicalization, provides good intubating condition, comfort score and stable hemodynamics.

This agrees with the study of Chaudhary et al. [20] who compared the effects of nalbuphine and dexmedetomidine on the intubating state and hemodynamic responses during AFOI. The researchers found that patients who were calm and cooperative during intubation and had minimal negative effects on hemodynamics during AFOI were premedicated with the use of intravenous dexmedetomidine 1 μg/kg or nalbuphine 0.2 mg/kg administered over 10 minutes, in addition to sufficient topicalization of the airway.

Concerning the total dose of dexmedetomidine in the current study, it was significantly higher in the sedation group compared to other groups, because dexmedetomidine was used as a sole sedative for AFOI without airway topicalization. Compared to atomization and SAYGo groups, patients of the nebulization group required higher doses of dexmedetomidine. This may be explained by a larger volume of LA being wasted during the nebulization process compared to other methods of topicalization.

Concerning the hemodynamic variables (MAP & HR), the current study results recorded no statistically significant difference at baseline measurements among patients in all groups. It also demonstrated that MAP & HR readings were statistically significantly higher immediately, 5 minutes & 10 minutes after intubation in sedation and nebulization groups but without any clinical effect.

Consistent with the current study results, Kumar et al. [16] showed significant

attenuation of the post-intubation hemodynamic response in patients who received dexmedetomidine with SAYGo. Due to dexmedetomidine's effects on noradrenaline release, centrally mediated sympathetic tone, and vagal activity, this can be explained. It is also possible to achieve sufficient topical anesthesia of the airway using the SAYGo approach with 2% lignocaine [21].

Yadav et al. [14], also studied airway nerve blocks for oral AFOI versus atomized lidocaine using the Laryngo-Tracheal Mucosal Atomization Device (LMA MADgic). During and soon following intubation, they found that MAP and HR values increased in both groups. This is likely caused by sympathetic activation once the scope tip has passed beyond the vocal cord and the carina has been seen. This is inconsistent with the current study results, which may be attributed to the administration of fentanyl as a sedative in their study, unlike this study where dexmedetomidine was used as a sedative. Nevertheless, these alterations were only temporary, returning to their pre-intubation state within five minutes.

Concerning the postoperative side effects and complications in the present study, patients in the sedation group recorded the highest number of sore throat and hoarseness. This may be because, unlike the other groups, AFOI in this group was done without airway topicalization and the intubation condition was not optimal.

No ECG changes, bronchoconstriction, seizures, or any other signs of local anesthetic toxicity were recorded in any patient in all groups. This may be because the local anesthetic doses administered in the current study didn't exceed the maximum dose for airway topicalization as recommended by Langmarc et al. [22].

These results are in accordance withALsadik et al. [23] who aimed for comparing the effect of magnesium sulphate and two doses of dexmedetomidine on hemodynamic responses to laryngoscopy and tracheal intubation, they found that there was no statistical significant difference of adverse effects among the studied groups ($p>0.05$). Despite extensive research on dexmedetomidine doses, no one has yet determined the optimal amount for reducing the stress response with few unwanted side effects.

LIMITATIONS

The patients included having no anticipated airway difficulty, was one of the study limitations. Also, tolerance to intubation of each patient may differ, adding bias to the study.

CONCLUSION

Airway topicalization along with sedation using dexmedetomidine provides better intubation condition, hemodynamic stability, and patient satisfaction compared to sedation alone among patients undergoing awake fiberoptic nasotracheal intubation for elective surgeries under general anesthesia. However, atomization and spray-as-you-go techniques are superior to nebulization.

We recommend the administration of airway topicalization (atomization or spray as you go) along with sedation by dexmedetomidine in patients undergoing AFOI to provide better intubation condition and hemodynamic stability with patient satisfaction.

No potential conflict of interest was reported by the authors.

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Citation:

Mohamed, M., Mostafa, Z., Abdellatif, H., Soud, D., Nazmi, H. Sedation using Dexmedetomidine with or without Different Methods of Airway Topical Anesthesia for Awake Fiberoptic Nasal Intubation in Patients Undergoing Elective Surgeries under General Anesthesia. Zagazig University Medical Journal, 2024; (3240-2353): -. doi: 10.21608/zumj.2024.302548.3466