Fentanyl versus Dexmedetomidine as an Adjuvant to Propofol for Fiberoptic Intubation in Patients with Temporomandibular Joint Ankylosis

Original Article

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ABSTRACT

Background: This study is done in Sohag University Hospitals, Faculty of medicine,sohag university as a collaboration between maxillofacial, head, and neck surgery unit in the general surgery department and anesthesia department.Fiberoptic intubation is the magic technique for difficult airway management in patients of difficult intubation especially in cases of temporomandibular joint ankylosis.

Objective: This study aimed to compare the clinical efficacy and safety of premedication with (dexmedetomidine versus fentanyl) added to propofol infusion for fiberoptic intubation.

Patients and Methods: 60 adult patients aged from 20 to 50 years with temporomandibular joint ankylosis, allocated for gap arthroplasty operation. They were enrolled for this prospective randomized clinical trial with two equal groups with 30 patients in each group. Group (D) patients received dexmedetomidine (1µg/kg infused over 10 min) followed by sedative propofol infusion and Group (F) patients were given fentanyl (2 mcg/kg over 10 min) infused followed by propofol infusion to achieve sedation. Condition achieved endoscopy, intubating conditions, and Stress response including (hemodynamic changes and cortisol level) postoperative complications were evaluated.

Results: The fiberoptic intubation was successful with good satisfaction with endoscopy and intubating conditions in both groups. Dexmedetomidine as premedication has provided satisfactory conditions for fiberoptic intubation more than fentanyl group and hemodynamic stability response of fiberoptic intubation than the fentanyl group.

Conclusion: Fiberoptic intubation was found to be easier with dexmedetomidine as premedication with a sedative infusion of propofol with complete amnesia of the procedure, with hemodynamic stability and good control of the patent airway.

Key Words: Dexmedetomidine, fiberoptic intubation, fentanyl, propofol, TMJ ankylosis.

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INTRODUCTION

The management of difficult airways is one of the most important jobs for the anesthesiologist. fiberoptic intubation is an important technique to manage the difficult airway. A suitable sedated patient, patent airway with blunting of airway reflexes, and spontaneous ventilation, particularly when the airway is difficult, are required for fiberoptic technique[1]. Temporomandibular joint ankylosis patients show difficult airway due to immobility of joint and restricted mouth opening so a fiberoptic bronchoscope should be a good solution for this problem. Awake fiberoptic intubation (AFOI) is recommended for patients with anticipated difficult airway as in cases of Temporomandibular joint ankylosis or failed intubation where optimum positioning for laryngoscopy is difficult to achieve.

Opioids such as fentanyl help control hemodynamic response and discomfort during the passage of the bronchoscope through vocal cords. However, all of them are respiratory depressants. although the combination of these drugs provides better intubation conditions, however, the hypoxemia incidence is high[3,4]. In difficult airway cases, which may lead to cannot intubate, cannot ventilate situation, we try to avoid hypoxemia as it can lead to fatal complications. Fentanyl is a synthetic opioid phenylpiperidine derivative that offers moderate sedation, hemodynamic stability analgesia, which is helpful for AFOI, although there is a chance of respiratory distress, nausea, and vomiting[11,12,13].

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The patients with difficult intubation may be benefited from dexmedetomidine[2]. Dexmedetomidine does not induce clinical respiratory depression and attenuates endotracheal intubation sympathoadrenal response[3]. For airway modulation, a sedation regimen using low-dose dexmedetomidine combined with titrated benzodiazepine doses and ultra-short-acting opioids with local airway anesthesia was used. A target-controlled infusion can, with a safe and predictable degree of sedation, have consistent pharmacodynamic results[4]. Dexmedetomidine is a highly selective, centrally acting alpha-2 agonist. It acts on presynaptic alpha-2 receptors to provide negative feedback that induces less accessible neurotransmitters (norepinephrine, epinephrine) at post-synaptic alpha-1 receptors. It produces the effects of hypnosis, amnesia, analgesia, anxiolysis, sympatholysis and antisialogue, all of which are beneficial during AFOI[14]. Dexmedetomidine induces sedation involving activation of endogenous sleep promoting pathway through the post-synaptic α-2 receptors in the locus ceruleus, which modulates wakefulness. The most important advantages of dexmedetomidine infusion during AFOI are a the form of sedation where patients remain sleepy, but are easily aroused, cooperative with minimum respiratory depression. The feasibility of dexmedetomidine has been recently studied either as a sole sedative agent or as an adjuvant during AFOI[15,16].

PATIENTS AND METHODS

This study is done in Sohag University Hospitals , Faculty of medicine, Sohag University as collaboration between maxillofacial, head and neck surgery unit in genral surgery department and anathesia department. A comparative prospective randomized study was conducted between 60 patients of either sex aimed to examine the efficacy, safety and suitability of addition of (dexmedetomidine versus fentanyl) as premedication with propofol infusion for fiberoptic intubation in spontaneously breathing patients of temporomandibular joint ankylosis who was scheduled for gap arthroplasty operation.

After seeing investigations and examination of patients we explained the indication, risks and benefits of fiberoptic intubation under sedation andhow we need their cooperation in our study .After obtaining institutional ethics committee approval and written informed consent from study patients .Fiberoptic nasal intubation under sedation was planned for all patients with difficult airway. Inclusion criteria included; sixty patients aged 20-50 years, belonging to American Society of Anesthesiologists physical status (ASA-PS) I and II and patients with restricted mouth opening and no jaw movement at the temporomandibular joint and anticipated difficult intubation by assessment by modified Malampatti grading (MP) and interincisor gap as aMP grade III and IV and interincisor gap below 2cm included in our study. Exclusion criteria included ; Patients with pregnancy, known alcoholic or drug abusers, allergy to the drugs involved in the study, bradycardia (baseline HR <60 beats/min), Any type of atrioventricular obstruction, heart failure, severe neurological, hepatic, renal and pulmonary disease, emergency surgery, any nasal intubation contraindication such as thrombocytopenia or coagulopathy.

Patients were pre-medicated with ondansetron 4 mg 2 h before surgery. On arrival the operating room, intravenous line (i.v.) was secured with wide bore cannula (18 G) and multichannel monitor was applied to record baseline Heart rate (HR), Mean arterial pressure (MAP), SpO_2 and electrocardiogram. Atropine 0.2 mg i.v. injection Has been given. Patency of both nostrils was checked, and for awake nasal fiberoptic intubation, the nostril with better patency was selected. Nebulization with 2 percent lidocaine 4 ml (80 mg) for 20 minutes was done by topicalization of both the upper and lower airways. Xylometazoline nasal drops and lidocaine jelly were applied to both the nostrils. Tongue and hypopharynx were sprayed with two puffs of 10% lidocaine (20 mg). After that patients divided to two equal groups with 30 patient in each group; group (D) dexmedetomidine (1 mcg/kg over 10 min) and group (F) fentanyl (2 mcg/kg over 10 min) was infused followed by (propofol infusion) in both group. After lubrication, the endotracheal tube was loaded with an acceptable size cuffed bronchoscope. Sedation was measured by the Ramsay sedation scale at the conclusion of the drug infusion analysis (RSS). After Score 2 was obtained, bronchoscopy was performed by nasal approach. General anaesthesia was induced after the correct positioning of the tube in the trachea and surgery was allowed to proceed.

The primary outcome measures were conditions achieved at bronchoscopy, intubation and post intubation. Intubation scores were assessed by vocal cord movement (1 open, 2 moving, 3 closing, 4 closed), cough score during bronchoscopy as Score 1 = no cough, 2 = slight cough (no more than two cough in sequence), 3 = moderate cough (3-5 cough in sequence), 4 = severe cough (>5 cough in sequence) [8.9] limb movement (1 = none, 2 = slight, 3=moderate, 4=severe) and success. satisfaction score assessment by comfort score (1=no reaction, 2=slight grimacing, 3=heavy grimacing, 4=verbal objection, 5=defensive movement of head or hands) ,success of technique. Intubation time (from insertion of the fiberoptic bronchoscopy in the nostril to visualization of the carina), After the positioning of the tube in the trachea, the post-intubation score assessed intubation tolerance as: 1 = cooperative, 2 = minimum resistance, 3 = extreme resistance and desaturation as $Spo_2 \leq 94$, The Ramsay sedation scale measured sedation (1 anxious, agitated or restless; 2 co-operative, oriented and tranquil; 3 respond to command; 4 asleep with brisk response to stimulus; 5 asleep with sluggish response to stimulus; and 6 asleep with no response).

Secondary outcome including

1- As a baseline and immediately after intubation,

stress response was reported as mean arterial pressure (MAP) and heart rate (HR). Hypotension (reduction of MAP >20% from baseline) was treated with i.v. fluid and/or phenylephrine 50 mcg i.v. bolus, repeat dose after 5 min. Atropine 0.6 mg i.v. was treated with Bradycardia (HR <60 beats/min). Desaturation of oxygen (SpO_2<95% for >10 s) was treated with oxygen and cortisol levels.

2- Complications as airway obstruction score ,temporary hemodynamic support and sore throat.

3- Demographic data as age, sex, weight,height and ASA classification.

RESULTS

Sixty adult consenting patients of temporomandibular joint ankylosis, scheduled for gap arthroplasty operation, were randomized patients into two groups of 30 patients each. There were no clinical significant differences in the patient demographic profiles between two groups (Table 1)

Table 1: Demographic data

	Group D	Group F	*P* value
Age	25.2±5.3	26.5±7.5	0.65
Sex	17;13	16;14	0.23
Weight	45.7±4.7	46.6±5.8	0.76
Height	150.5±6,5	151.8±6.4	0.67
ASA 1/ 11	22/8	24/6	0.45

Table 2: Comparison between two groups as regards intubation score, success, intubation time and satisfaction score.

	Group D	Group F	P value
Intubation score			
Vocal cord movement 1/2/3/4	21/9/0/0	15/8/7/0	0.03
Limb movement 1/2/3/4	17/6/4/3	13/8/5/4	
Cough	5	7	0.5
			0.6
Success	30	30	No significant
Intubation time	3.6±4.3	5.3±6.5	0.02
Satisfaction score (1-4)	25/5/3/2	20/4/3/3	0.32

As regard to intubation condition there was no statistically significant difference between 2 groups as regard limb movement or cough score but there was statistically significant difference between 2 groups as regards vocal cord movement as *p* value (0.03). In terms of success rate or satisfaction score, there was no statistically significant difference between two groups. There was a statistically significant difference between two groups in terms of intubation time as *p* value (0.02).

Table 3: Comparison between two groups as regard post intubation score, Ramsay sedation score and Spo_2

	Group D	Group F	*P* value
Post intubation score 1	25	5	0.006
Post intubation score ≥ 2	5	25	0.001
Ramsay sedation score (RSS)	3 ± 0.642	2.5± 0.547	0.0007
$Spo_2 \leq 94$	6	23	0.006
$Spo_2 \geq 95$	24	7	0.005

Better post-intubation score (Score 1) was found in 25 patients of Group (D) and only five patients in Group (F) This difference was also statistically significant ($P < 0.006$). At the end of study drug infusion, higher RSS was achieved in Group (D) (3 ± 0.642) than in Group (F) (2.5 ± 0.745) as (*P* value 0.0007). We observed that 24 patients of Group (D) and only seven patients in Group (F) were able to maintain SpO_2 (≥95%) ($P < 0.005$) during the procedure. 23 patients in Group (F) and six patients in Group (D) suffered from significant desaturation (SpO_2≤94%), which was managed by administration of oxygen through the port of the bronchoscope.

Table 4: Haemodynamic changes between two groups including (HR, MAP) at times in baseline, initiation of fiberoptic and one minute post-intubation.

Mean blood pressure(MBP)	Group D	Group F	*P* value
Base line	95.5±5.7	95.4±8.2	0.65
At the initiation of fiberoptic	96.4±7.6	97.4±5.4	0.74
One minute after intubation	97.7±6.2	117.6±4.3	0.003
Heart rate(HR)	Group D	Group F	P value
Base line	74.4±7.8	75.3±6.4	0.87
At the initiation of fiberoptic	73.4±6.8	77.5±4.3	0.34
One minute after intubation	72.4±5.4	114.4±4.3	0.008

The baseline MAP, HR was comparable between two groups (Table 4). There was a rise of MAP compared with baseline values in both groups. The increase of MAP was minimal in Group (D) . However, in Group (F) rise of MAP was statistically significant at one minute after intubation as (P<0.0003). There was no episode of hypotension in both groups. There was a significant increase in HR in one minute post-intubation period (117.6±4.3beats/min) in comparison with the baseline value (95.4±8.2 beats/min) in Group(F) as($P < 0.008$). in Group (D) one minute post-intubation HR (72.4±5.4 beats/min) decreased less significantly in comparison with baseline value (74.4±7.8beats/min) (*P* value 0.005). However, bradycardia (HR <60 beats/min) requiring atropine was not developed by any patient.

Table 5: Comparison between 2 groups as regards cortisol level

	Group D	Group F	*P* value
Cortisol level at time of induction Nano⁄ml	266.7±211.22	270.4±160.23	0.67
Cortisol level after 20 min	270.6±155.72	269.8± 150.4	0.85

There was no statistically significant difference between two groups as regard cortisol level

Table 6: Adverse events and satisfaction data between group (D)and group (F)during fiberoptic intubation. Data are expressed as median (IQR [range]) or number (proportion).

	Group D (n = 20)	Group F (n = 20)	*P* value
Airway obstruction score; 1/2/3	(20/5/5)	(15/8/7)	0.007
Hypoxia	0	1	0.31
Temporary hemodynamic support			
Atropine	2	0	0.15
Ephedrine	1	0	0.31
Hoarseness	4	4	1
Sore throat	2	5	0.21

There was statistically significant difference between two groups as regard to airway obstruction score as *p* value (0.007). There was no significant difference between two groups as regard to hypxia, soretroat, hoarseness. haemodynamic support did not differ significantly between the two groups.

DISCUSSION

The present study has evaluated dexmedetomidine versus fentanyl as premedication for sedation to facilitate the fiberoptic intubation with propofol infusion for gap arthroplasty in patients of temporomandibular joint ankylosis. The study showed that when dexmedetomidine was used as premedication, fiberoptic intubation was very easy, smooth and with less intubation time, adverse effects. All patients had been intubated successfully in the first attempt. Our primary outcome measures, bronchoscopy and intubation condition, were improved with dexmedetomidine sedation.

To promote fiberoptic intubation, agents such as opioid, midazolam, ketamine, propofol and remifentanil have been used, but dexmedetomidine has many properties to make it safe for use during fiberoptic intubation[8]. Abdelmalak *et al.* reported a series of successful awake fiberoptic intubations using dexmedetomidine for sedation in patients with difficult airway[9]. Chu *et al.* reported that a loading dose (1 µg/kg) of intravenous dexmedetomidine offered conscious sedation for fiberopticnasotracheal intubation without respiratory depression or upper airway obstruction[10]. In our research, the patients in the dexmedetomidine group demonstrated stronger intuition and hemodynamic stability conditions. Yavacaoglu *et al.* reported that dexmedetomidine prevented the hemodynamic responses to tracheal intubation more effectively than esmolol[11].

In patients with difficult airways due to subglottic mass, thyroid tumour causing tracheal compression, nasopharyngeal tumour causing obstructive sleep apnoea, and morbid obesity with sleep apnoea, Abdelmalak *et al.*[8]. reported a series of active awake fibreoptic intubations using dexmedetomidine for sedation. Dexmedetomidine can be used as either the sole agent or an adjuvant to facilitate awake intubation in patients with anticipated difficult airways[9,11, 14]. There are, however, few double-blind randomised controlled trials comparing the efficacy of the drug with other approaches.

Chu *et al.*[10] observed better tolerance to intubation without respiratory depression and upper airway obstruction in dexmedetomidine group (1 mcg/kg) compared with fentanyl group (1 mcg/kg). In our research, dexmedetomidine provided better intubating conditions than the dose of (2 mcg/kg) fentanyl used. In some challenging airway scenarios, dexmedetomidine has also been shown to be an effective agent for AFOI[17,18,19]. Bergese *et al.*[20] noted that 1 mcg/kg bolus dexmedetomidine was safe and beneficial for patients undergoing AFOI even without topical anaesthesia or airway nerve block.

Bergese *et al.*[20] found that dexmedetomidine is more effective for sedation in AFOI in combination with low dose midazolam than midazolam alone. However, a dosage of dexmedetomidine greater than 1 mcg/kg/h with midazolam resulted in airway obstruction that was regulated by easy chin lifting.

In our study, all patients achieved RSS ≥2, but patients of Group D achieved a higher score (3 ± 0.371) than Group F (2.07 ± 0.254) ($P < 0.0001$).

Ryu *et al.*[21] compared remifentanil with dexmedetomidine for conscious sedation during bronchoscopy. They found that there were no significant difference of sedation level, MAP, HR and patient satisfaction score ($P > 0.05$) but cough score and incidence of desaturation was significantly lower ($P < 0.01$) in dexmedetomidine group than remifentanil group.

Airway obstruction occurred more frequently in the fentanyl group than the dexmedetomidine group. During management of the difficult airway, it is safest to keep patients breathing spontaneously until an alternative artificial airway is established. Dexmedetomidine activates the postsynaptic α2-adrenergic receptors in the locus coeruleus, and induces sedation by activation of the endogenous sleep-promoting pathway. Moreover, it has sedative, analgesic, anxiolytic, and anti-sialagogue properties without predisposing to airway obstruction and respiratory depression[15, 16]. In our study, There was a rise of MAP compared with baseline values in both groups. The increase of MAP was minimal in Group (D) ($P = 0.347$). However, in Group (F) rise of MAP was statistically significant ($P < 0.0003$). There was no episode of hypotension in both groups. There was a significant increase in HR in the post-intubation period (117.6±4.3beats/min) in comparison with the baseline value (95.4±8.2 beats/min) in Group (F) ($P < 0.0001$). The post-intubation HR (72.4±5.4 beats/min) decreased significantly in comparison with baseline value (74.4±7.8 beats/min) in Group (D) (P value 0.005). However, no patient developed bradycardia (HR <60 beats/min) requiring atropine. Dexmedetomidine has been reported to prevent the haemodynamic responses to tracheal intubation more effectively than esmolol[17]. Its use was associated with a decrease in blood pressure and heart rate that may result from a decrease in release of noradrenaline, a decrease in sympathetic tone mediated centrally, and an increase in vagal activity[18, 19]. Adverse effects such as hypotension, hypertension, nausea, bradycardia, atrial fibrillation and hypoxia can result from dexmedetomidine infusion[20, 21].

Yavascaoglu *et al.*[23] reported that dexmedetomidine prevented the hemodynamic response to tracheal intubation more effectively than esmolol[24]. There are various reports of attenuation of stress response to

endotracheal intubation in patients scheduled for coronary artery bypass graft surgery[25,26]. In young volunteers following dexmedetomidine bolus and infusion, Peden *et al.* reported bradycardia and sinus arrest and recommended prevention with glycopyrrolate administration prior to dexmedetomidine infusion. Before the bronchoscopy procedure, we administered glycopyrrolate as an antisialogue, which may have prevented such side effects. In the dexmedetomidine group, there was no occurrence of hypotension, hypertension, bradycardia or arrhythmia.

Fentanyl suppresses the respiratory core, induces rigidity in the chest wall, and there is a chance of desaturation and hypoxia. The unique property of dexmedetomidine is that it produces sedation without airway obstruction and respiratory depression. We observed that the incidence of desaturation was less in Group D (six patients) than Group B (23 patients) ($P < 0.006$). These patients were managed by administration of oxygen through the port of the bronchoscope.

CONCLUSION

During AFOI, we concluded that dexmedetomidine is more efficient than fentanyl because it offers better intubation status, less intubation time, hemodynamic stability and sufficient desaturation-free sedation, so improved conditions were observed with dexmedetomidine as premedication due to its analgesic and sedative effects; therefore, the procedure was smoother and faster than the fentanyl community.

CONFLICT OF INEREST

There are no conflicts of interest.

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