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Research Article

COMPARATIVE EVALUATION OF THE EFFECTS OF DEXMEDETOMIDINE-PROPOFOL AND FENTANYL-PROPOFOL ON VARIOUS PARAMETERS DURING I-GEL INSERTION

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ABSTRACT

Objectives: Supraglottic airway devices (SGAD) have become inevitable for routine and difficult airway management and various induction agents are used for SGAD insertion. The present study compares the insertion conditions for I-gel, using Dexmedetomidine and Fentanyl with Propofol.

Methods: Sixty patients were included in the study and randomly divided into two groups. Group D received 1 mcg/kg Dexmedetomidine and Group F received 1 mcg/kg Fentanyl. The mean arterial blood pressure (MAP) and heart rate (HR) were recorded at baseline and after 1', 3' 5', and 10' after insertion.

Results: A significant decrease in HR was seen in Group D at 3', 5', and 10' after insertion when compared to its respective time intervals in Group F. However, when MAP was observed, the 5' after insertion showed a decrease in blood pressure within the groups but when MAP between groups were compared, there was no significant variation between Group F and Group D at their respective time intervals after insertion. HR was significantly reduced with Dexmedetomidine compared to that with Fentanyl.

Conclusion: Co-induction of Propofol with Fentanyl or Dexmedetomidine 1 mcg/kg provides satisfactory hemodynamic stability and comparable insertion condition for I-Gel.

Keywords: I-Gel, Fentanyl, Propofol, Dexmedetomidine, Heart rate, Arterial blood pressure.

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INTRODUCTION

During surgeries, proper airway management is a predominant factor of consideration to anesthesiologists in an elective as well as critical situation. These days endotracheal intubation is rapidly been replaced by supraglottic airway device (SGAD) in difficult air way management. I-Gel is an SGAD with the highest first-pass success rate of any SGAD. This technique has been shown to be quick, dependable, and simple to protect the airway due to the high seal pressure, which may reduce trauma during the procedure [1]. It also includes a gastric channel to provide additional protection against aspiration. The non-inflatable cuff of I-Gel is made of a soft gel-like thermoplastic elastomer and makes a non-traumatic tight seal over the laryngeal, pharyngeal, and parapharyngeal structures. This could reduce tissue compression, provide stability after insertion, and eliminate the need to insert a finger into the patient's mouth, unlike during an laryngeal mask airway (LMA) insertion. Due to its simple design, the I-Gel requires little technical skill to insert.

Various induction agents are used during SGAD insertion to achieve the best conditions. Propofol is a popular induction agent. It lowers arterial blood pressure (ABP) by lowering systemic vascular resistance. When propofol is used alone for induction, it can cause dose-dependent cardiorespiratory depression. Co-induction with other drugs usually helps reduce the dose of Propofol and its associated side effects [2]. Typically, opioids are used to improve I-Gel insertion conditions. Fentanyl is a highly potent synthetic opioid that stimulates μ receptors and is one of the most commonly used anesthetic adjuncts in ambulatory surgery. However, opioids are associated with anesthetic recovery delays, muscular rigidity, and post-operative apnea [3]. Dexmedetomidine is a highly selective alpha-2 adrenergic agonist. It has sedative, analgesic, and anxiolytic effects. It is also proven as a safe adjunct in various applications of clinical anesthesia.

In the present study, we aimed to the effect of Dexmedetomidine versus Fentanyl with Propofol co-induction on insertion conditions of I-gel SGAD.

METHODS

The study was carried out after the Institutional Ethical Committee approved it and the study participants provided written informed consent. (IRB No. 51/2021) From May 2021 to April 2022, this study was carried out in the General Surgery Operation Theatre of Government Medical College, Kottayam. The study group included 60 adult female patients aged 18 to 60 who required breast lump excision surgery under the American Society of Anesthesiologists (ASA-I) or ASA-II. The study excluded patients with difficult airways, obese patients (Body Mass Index >30), prolonged procedures (duration of surgery >1 h), emergency procedures, unwilling patients, and patients allergic to the drugs being studied.

The patients were randomly divided into two: Group D and Group F. Group D subjects received the Dexmedetomidine-propofol combination and Group F subjects received Fentanyl-Propofol combination.

Following the patient's transfer to the operating table, baseline parameters such as heart rate (HR), electrocardiogram, SpO_2, non-invasive blood pressure, and respiratory rate were recorded and continuously monitored throughout the procedure. Midazolam injection 0.02 mg/kg, Ondansetron injection 0.08 mg/kg, and Glycopyrrolate injection 0.004 mg/kg were used as pre-medication. The study drug (1 mcg/kg Dexmedetomidine in Group D and 1 mcg/kg Fentanyl in Group F) was administered intravenously over 10 min through infusion pump. Anaesthesia was induced 30 s after the infusion of the study drugs with a 2 mg/kg injection of Propofol. I-Gel insertion was attempted after the Propofol injection was completed. The size of I-gel was determined based on the manufacturer's recommendation and the weight of the patients. I-Gel was inserted in the' sniffing-morning-air' position. The position of I-Gel was confirmed by bilateral air entry, chest movements, and square wave of capnogram. The absence of any of these meant a failed attempt.

If bradypnea (12 breaths/min) occurs during induction, it was recorded. When apnea occurred, the ventilation was manually assisted until normal, spontaneous respiration was restored. Following that, anesthesia was maintained with a mixture of oxygen, nitrous oxide (50:50), and sevoflurane (1.5–2%). During the study, no muscle relaxants were used. HR and ABP were also measured at baseline, after study drug infusion, and at 1, 3, 5, and 10 min of I-Gel insertion. No additional hemodynamic parameter data were collected. When the patient was able to open her mouth on command, the I-Gel was removed at the end of the procedure. Adverse effects such as bradycardia (40 beats/min), hypotension, coughing, laryngospasm, bronchospasm, or desaturation were recorded and treated as needed.

The degree of jaw relaxation achieved using Young's criteria [4] was used to assess the ease of I-Gel insertion. Absolutely relaxed jaw -I, Moderately relaxed jaw-II, poorly relaxed jaw-III. While the overall I-Gel insertion condition was assessed using the Modified Scheme of Lund and Stovener [5]. Excellent-No gagging or coughing, no laryngospasm, no patient movement; Good - Mild-to-moderate gagging or coughing, no laryngospasm, mild-to-moderate patient movement; Poor - Moderate-to-severe gagging or coughing, no laryngospasm, moderate-to-severe patient movement; Unacceptable - severe gagging or coughing, laryngospasm, severe patient movement. If the condition is assessed as "Unacceptable," then, a further bolus of 0.5 mg/kg of Propofol was administered.

After three failed attempts at I-Gel insertion, the patient's study was terminated, and the case was treated with general anesthesia and endotracheal intubation.

Changes in HR and blood pressure were measured at baseline, 1 min, 3 min, 5 min, and 10 min after successful I-Gel insertion. Further measurements of hemodynamic parameters were not taken. Adverse effects such as bradycardia, hypotension, coughing, bronchospasm, laryngospasm, or desaturation were recorded and treated as needed.

All data are presented in the form of mean standard deviation. Mann–Whitney and Fisher's exact tests were used to analyze the demographic data. For intergroup analysis, the analysis of variance was used, and the Bonferroni *post hoc* test was used for multiple comparisons. The level of significance was set at p=0.05.

RESULTS

A total of 60 patients were included for statistical analysis. The demographic parameters of patients including age, weight, gender distribution, and ASA grade were compared. Group F and Group D and showed no significant variation (Table 1).

When compared to Baseline HR (80.93±3.98), there was a significant increase in the HR (p<0.01) at 3' after insertion (84.03±2.87) in Group F.

Table 1: Demographic variables

Variable	Group F	Group D	p-value
Age	48.03±6.83	46.90±6.95	0.526
Weight	61.23±4.33	61.70±4.63	0.467
Gender	30[F]	30[F]	0.602
ASA grade	15[1], 15[2]	16[1], 14[2]	0.500

Table 2: Comparison of overall insertion condition by modified Scheme of Lund and Stovener between Group D and Group F

Insertion condition	Group D	Group F
Excellent	36	34
Good	24	26
Poor	0	0

However, HR at 5' after insertion (81.97±3.25) have no change from baseline HR but showed a significant decrease in HR compared to 1' (82.77±4.38) and 3' (84.03±2.87) after insertion in Group F. When HR in Group D was observed, 5' after insertion (77.90±4.11) and 10' after insertion (74.40±4.08) showed a significant decrease in HR compared to baseline HR (81.37±4.12), 1'after insertion HR (81.63±4.03) and 3' after insertion HR (81.43±3.95). In addition, a significant decrease in HR was seen in Group D at 3' (p<0.05), 5' (p<0.001), and 10' (p<0.001) after insertion when compared to its respective time intervals in Group F.

In Group F, there was a significant decrease in mean arterial blood pressure (MAP) at 1' (90.57±3.24), 3' (84.23±3.28), 5' (81.13±3.91), and 10' (79.00±3.22) after insertion from the baseline MAP (98.50±3.42) (Table 4). When compared to 1' after insertion, 3' 5' and 10' showed a significant decrease (p<0.001) in MAP. MAP values were showing a steady decrease after the baseline MAP and 10' after insertion showed significantly decreased MAP compared to all other times intervals (1,' 3'and 5') after insertion in Group F. Similar result was also observed in Group D. However, when Group F and Group D were compared, there was no significant change in MAP at their respective time intervals after insertion.

DISCUSSION

Different types of induction agents can be used to induce general anesthesia for I-Gel insertion. Propofol alone requires a very high dose to achieve satisfactory insertion conditions. High doses result in cardiorespiratory depression. In this study, 60 patients were put under general anesthesia and had I-Gel inserted. Fentanyl was used to induce 30 patients, and Dexmedetomidine was used to induce 30 patients.

We compared Fentanyl and Dexmedetomidine as co-induction agents with Propofol for I-Gel insertion in this study. The Dexmedetomidine (D) group was given 1 mcg/kg Dexmedetomidine with 2 mg/kg Propofol, while the Fentanyl (F) group was given 1 mcg/kg Fentanyl with 2 mg/kg Propofol. When the effect of Dexmedetomidine and Fentanyl on Propofol anesthesia for LMA insertion was evaluated in previous studies, comparable insertion conditions were observed [6-8].

The overall insertion condition, as summarized by Lund and Stovener's modified scheme [5], was comparable in both groups (Tables 2 and 3). Our findings are consistent with the findings of Lande *et al*. [9], who compared Dexmedetomidine and Fentanyl for LMA insertion and found that Dexmedetomidine resulted in an absolutely relaxed jaw in 96.6% of patients.

Inadequate depth of anesthesia can cause regurgitation or aspiration during I-Gel insertion. However, no signs of regurgitation or trauma were observed during I-Gel insertion in any of the cases [10,11]. Previous research [12] suggested a Dexmedetomidine dose of 1 mcg/kg infusion over 10 min. Rapid injection of Dexmedetomidine can have a biphasic effect on blood pressure, with a temporary increase in blood pressure caused by a direct alpha-2 adrenoceptor-induced vasoconstriction in the peripheral vasculature, bradycardia, and a low mean arterial pressure caused by decreased sympathetic outflow [13]. Slow infusion of the drug over 10 min or more causes long-term stabilization of HR and blood pressure at slightly lower values than baseline, most likely due to activation of central pre-synaptic alpha2 adrenergic receptors, resulting in sympatholysis [13,14].

It has been reported that fentanyl at 1 mcg/kg provides optimal SGAD insertion conditions as well as significantly improved hemodynamic stability [2]. Fentanyl is a synthetic opioid phenylpiperidine derivative. It is 100 times stronger than Morphine. Fentanyl has been approved by the FDA for the treatment of pain associated with surgery or complex pain syndrome. It is also used during general anesthesia to reduce stress response during endotracheal intubation. It acts quickly but has a short duration of action. The faster onset of action and higher potency are due to its higher lipid solubility, which allows it to cross

Table 3: Heart rate

Group	Baseline HR	1'after insertion HR	3'after insertion HR	5'after insertion HR	10'after insertion HR
F	80.93±3.98	82.77±4.38	84.03±2.87	81.97±3.25	79.97±3.16
D	81.37±4.12	81.63±4.03	81.43±3.95	77.90±4.11	74.40±4.08

Table 4: Mean arterial pressure

Group	Baseline MAP	1'after insertion MAP	3'after insertion MAP	5'after insertion MAP	10'after insertion MAP
F	98.50±3.42	90.57±3.24	84.23±3.28	81.13±3.91	79.00±3.22
D	96.60±3.00	88.37±3.29	82.73±3.49	81.37±5.76	78.90±5.49

MAP: Mean arterial blood pressure

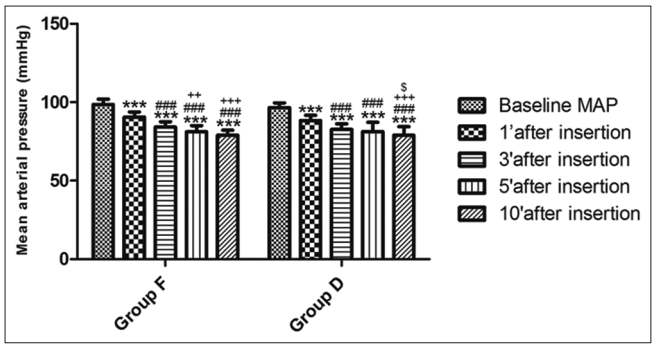

Fig. 1: Effect of Fentanyl-Propofol combination and Dexmedetomidine-Propofol combination on mean arterial pressure. The values are represented as Mean±SD. the significant difference within the experimental groups are indicated by asterisks, at the rate of, hashtag and plus (*, @, p<0.05; **, ##, p<0.01; *, ###, +++, $$$, @@@ p<0.0001). "*" denotes the significant changes from baseline HR and "#" denotes the significant changes from 1' after insertion, "+" denotes the significant change from 3' after insertion, "$" denotes the significant change from 5' after insertion with in the group. @ denotes the significant change between group F versus group D at the respective time intervals**

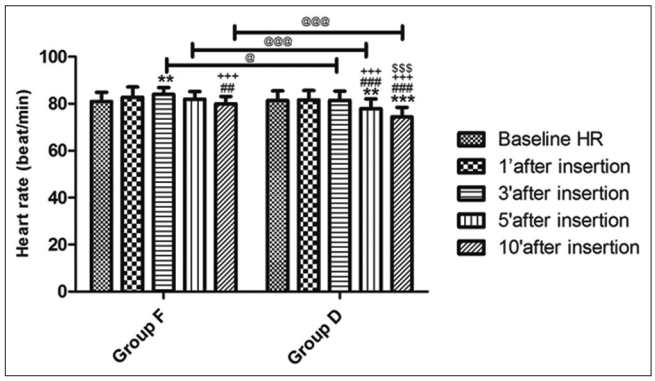

Fig. 2: Effect of Fentanyl-propofol combination and Dexmedetomidine-propofol combination on heart rate. The values are represented as Mean±SD. the significant difference within the experimental groups are indicated by asterisks, at the rate of, hashtag and plus (*, @p<0.05; **, ##p<0.01; *###, +++, $$$, @@@ p<0.0001). "*" denotes the significant changes from baseline HR and "#" denotes the significant changes from 1' after insertion, "+" denotes the significant change from 3' after insertion, "$" denotes the significant change from 5' after insertion within the group. @ denotes the significant change between group F versus group D at the respective time intervals**

the blood-brain barrier more easily. Similarly, the short duration is due to Fentanyl's rapid redistribution into inactive tissues such as fat and skeletal muscle [15]. When high doses of Fentanyl were administered, prolonged apnea was observed [16,17]. It has been reported that fentanyl at 1 mcg/kg provides optimal SGAD insertion conditions as well as significantly improved hemodynamic stability.

Both Fentanyl and Dexmedetomidine have been shown to reduce the need for Propofol during SGAD insertion [7,18]. In this study, the Fentanyl group required higher Propofol doses. As a result, the mean total dose of Propofol was significantly higher when compared to Dexmeditomidine. Moreover, Dexmedetomidine pre-treatment reduced half-maximal effective concentration (EC 50) of Propofol for SGAD insertion without muscle relaxant, thereby decreasing the total requirement of Propofol [7,19]. In this study, both the Fentanyl and Dexmedetomidine groups produced nearly identical jaw relaxation.

Both the study drugs resulted in a reduction of MAP. Propofol, at a dose of 2–2.5 mg/kg for induction, decreased MAP due to its vasodilatory and myocardial depressive effects [20] (Fig. 1). During the 1st and 3rd min of I-Gel insertion, the Fentanyl group has greater hemodynamic stability. However, in the Dexmedetomidine group, HR and blood pressure increased slightly in the 1st and 3rd min of I-Gel insertion. However, after 5 and 10 min, the HR and blood pressure were lower than the baseline values. But this reduction in MAP was well tolerated by hydration.

With Dexmedetomidine, we observed a decrease in HR from baseline (Fig. 2). The sympatholytic and preserved baroreflex effect of Dexmedetomidine caused a dose-dependent decrease in HR during anesthesia [16]. A loading dose of 1 mcg/kg Dexmedetomidine was associated with bradycardia from 5 min after Dexmedetomidine administration to the I-Gel insertion period in a previous study [19]. In this study, no patients experienced clinically significant bradycardia that required pharmacological intervention. In the current study, the Fentanyl group had 5/30 apnea, while the Dexmedetomidine group had 1/30. The incidence and mean duration of apnea were significantly higher ($p<0.01$) in the Fentanyl group than in the Dexmedetomidine group. A higher incidence of apnea may also be due to the additional Propofol doses required in the Fentanyl group. The incidence and duration of apnea after Propofol induction are dose, injection speed, and concomitant premedications dependent, and opioids are known to potentiate it [21]. Dexmedetomidine's sedative mechanism is similar to that of natural sleep, with minimal effects on respiration and ventilation [13]. Propofol-induced respiratory depression is not exacerbated by Dexmedetomidine. This could explain the shorter mean duration of apnea observed with Dexmedetomidine versus Fentanyl. However, a few authors have reported statistically significant increases in respiratory rates and apneic episodes after a 2-min Dexmedetomidine infusion [6,13]. In human volunteers, rapid infusion of Dexmedetomidine increased plasma concentrations to levels that caused irregular breathing and mild hypercapnia [13]. When 1 mcg/kg Dexmedetomidine was infused over 10 min, there was no significant change in respiratory rate. The respiratory rate did decrease after Fentanyl infusion, but it was not clinically significant, and no patients developed desaturation.

Various studies have used varying doses and rates of Dexmedetomidine and Fentanyl as a pre-treatment for Propofol induction for SGAD insertion in the literature. In this study, we discovered that both HR and blood pressure rise from baseline in the 1st and 3rd min of induction, with the Dexmedetomidine group rising more than the Fentanyl group, but in the 5th and 10th min, HR and blood pressure both fell significantly from baseline in the Dexmedetomidine group.

There are some limitations to this study. Propofol alone was not used as a control group because it has previously been shown to be insufficient for SGAD insertion. Propofol control group was thought to be unethical when used alone or in higher doses can be dangerous for respiration and hemodynamics. Another limitation was that the depth of anesthesia at the time of I-Gel insertion was only clinically assessed, and no specific monitor was used due to a lack of availability. BIS/entropy would have been a more clinically appropriate measure of awareness during airway manipulation. This study included patients with Mallampati scores of 1 and 2. More research is needed to determine the effects of these drugs' pre-treatment on I-Gel insertion conditions in patients with higher Mallampati scores or difficult airway.

CONCLUSION

Propofol is the preferred induction agent for I-Gel insertion. When used alone, a higher dose is required, which can cause hemodynamic instability. As a result, co-induction with Fentanyl or Dexmedetomidine 1 mcg/kg provides adequate hemodynamic stability and insertion conditions for I-Gel. However, when Dexmedetomidine was combined with Propofol, the hemodynamic stability was found to be better than when Fentanyl was combined with Propofol.

AUTHORS' CONTRIBUTION

All authors contributed to the preparation of the manuscript.

CONFLICT OF INTEREST

There is no conflict of interest.

AUTHORS' FUNDING

Nil.

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