Journal of Cardiovascular Disease Research

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 01, 2023

Original research article

Comparison of hemodynamic and respiratory effects of dexmedetomidine combined with propofol versus fentanyl propofol with propofol being control for insertion of laryngeal mask airway

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Abstract

Aim and Objectives: Comparison of Hemodynamic and Respiratory Effects of Dexmedetomidine Combined with Propofol Versus Fentanyl Propofol with Propofol as Control for Insertion of Laryngeal Mask Airway. To evaluate and compare hemodynamic parameters including heart rate (HR), mean arterial pressure (MAP) and oxygen saturation (spo2), in Dexmedotimidine propofol group, Fentanyl Popofol group and only propofol group. To evaluate and compare respiratoy parameters mainly Respiratory Rate (RR) in Dexmedotimidine propofol group, Fentanyl Popofol group and only propofol group**.**

Methods: This was a prospective randomized study that was conducted in the Department of Anaesthesia, Andhra Medical College, Visakhapatnam, Andhra Pradesh, India, during the period of June 2022 to November 2022. The study was approved by the hospital ethics committee.

Results: The Mean Age of patients who had Dexmedetomidine and Propofol is 30±7 Years, Fentanyl and Propofol is 31±7 Years, and Propofol alone is 30±6 Years, which is not statistically significant. Fentanyl plus Propofol patients weigh 53±8 Kgs, whereas those who received just Propofol weigh 52±7 Kgs. This difference is insignificant. Dexmedetomidine and Propofol pre-operatively had a greater mean arterial pressure during LMA insertion, but after 1 min, 3 min, 5 min, and 10 min, their mean arterial pressure was lower than Fentanyl and Propofol. This difference was statistically significant throughout.

Conclusion: In contrast to group F, which used fentanyl and propofol, and group P, which used propofol alone, our study demonstrated that the effects on hemodynamic and respiratory parameters are more stable in Group D, which used dexmedetomidine with propofol. When used separately for co-induction with propofol to insert an LMA, dexmedetomidine and fentanyl produce excellent overall insertion conditions with haemodynamic stability. Additionally, the need for an induction dose of propofol for LMA insertion is significantly reduced by dexmedetomidine. When inserting a LMA, propofol is the ideal induction agent. Haemodynamic instability may result when used alone.

Keywords: Dexmedetomidine, fentanyl, propofol, mean arterial pressure.

Introduction

Endotracheal intubation is the most commonly used anaesthetic technique for all major surgical procedures. The laryngeal mask airway is a novel concept in airway management [1]. In a meta- analysis study Brimacombe J [2], LMA is proved to be more advantageous over the Face Mask is less hand fatigue in prolonged surgeries. The advantages of LMA over endotracheal tube include increased speed and ease of placement by inexperienced personnel; improved hemodynamic stability during induction and emergence; and reduced anaesthetic requirements for airway tolerance. It is also used in routine anesthetic practice, primarily for short surgical procedures where muscle relaxants are not required [3].

LMA insertion necessitates a lower plane of anaesthesia than endotracheal intubation [4, 5]. LMA insertion necessitates sufficient mouth opening and the absence of upper airway reflexes such as coughing, gagging, or laryngospasm [6]. Because inhalational anesthetics required more time for LMA insertion, intravenous agents were preferred. Propofol has been chosen as the most preferred intravenous agent due to its potential suppressor effects on upper airway reflexes [5-7]. Propofol, when used alone without

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 01, 2023

premedication, creates conditions for LMA insertion [8,9] and causes cardiorespiratory depression [9, 10]. To reduce the adverse effects of propofol, opioids or muscle relaxants were added to reduce the propofol dose requirement [11-13]. Muscle relaxants were found to be ineffective [14, 15-18], and they even increase the risk of aspiration.
The sedative and analgesic properties of dexmedetomidine, a highly selective adrenoceptor agonist, have been demonstrated [19-21]. Dexmedetomidine has been shown to be clinically safe for respiration even at supramaximal plasma levels [22]. It has also been demonstrated to reduce airway and circulatory responses during intubation and extubation [23-25].

Material and Methods
This was a prospective randomized study that was conducted in the Department of Anaesthesia, Andhra Medical College, Visakhapatnam, Andhra Pradesh, India, during the period of June 2022 to November 2022. The study was approved by the hospital ethics committee.

Design of Study
After ethics committee approval, patients were thoroughly informed about the nature of the study, and all patients provided written informed consent. The study included 90 patients classified as American Society of Anesthesiologists (ASA) grade I or II (25). Patients were randomly assigned to one of three groups: propofol with dexmedetomidine (group D; n = 30), propofol with fentanyl (group F; n = 30), or propofol only during laryngeal mask airway insertion (group P; n = 30).

Inclusion criteria: Patients with ASA physical status 1 and 2, aged 18-60 years posted for elective short term surgical procedures.

Exclusion criteria
- Patient refusal to participate in study; allergic to drugs, and patients ASA physical status 3 and 4.
- Age below 18 years and above 60 years;
- Patients with significant cardiopulmonary, respiratory, endocrine, hepatic, renal, and metabolic disorders
- A pregnant woman who is breast-feeding,
- Patients who have recently had surgery (within 7 days),

Groups: Patients were randomly divided into 3 groups of 30 each
Group I (D): Anaesthesia was induced using propofol with dexmedetomidine.
Group II (f): Anaesthesia was induced using propofol with fentanyl.
Group III (p): Anaesthesia was induced using propofol only.

Results

Table 1: Age distribution among study participants

	N	Mean	Std. Deviation	P Value
Dexmedtomidine and Propofol	30	29.6667	6.92488	>0.05 (N.S)
Fentanyl and Propofol	30	30.9667	6.83542	
Propofol	30	30.4333	6.20169	

The Mean Age of Patients Receiving Dexmedetomidine and Propofol is 30±7 Years, the Mean Age of Patients Receiving Fentanyl and Propofol is 31±7 Years, and the Mean Age of Patients Receiving Only Propofol is 30±6 Years. This Difference Is Not Statistically Significant.

Table 2: Gender distribution among study participants

		Group			Total	P Value
		Dexmedtomidine and Propofol	Fentanyl and Propofol	Propofol		
Gender	Female	14	17	17	48	>0.05 (N.S)
	Male	16	13	13	42	
Total		30	30	30	90	

Out of 90 study participant's males constitute 42 in number of which 16 were administered with Dexmedtomidine and Propofol, 13 with Fentanyl and Propofol, 13 with only Propofol. Females constitute 48 of which 14 were administered with Dexmedtomidine and Propofol, 17 with Fentanyl and Propofol, 17 with only Propofol.

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Table 3: Weight distribution among study participants

	N	Mean	Std. Deviation	P value
Dexmedtomidine and Propofol	30	55.37	8.130	>0.05 (N.S)
Fentanyl and Propofol	30	53.47	8.291	
Propofol	30	51.87	6.827	

The mean weight of patients who received Fentanyl and Propofol was 53±8 kg, the mean weight of patients who received only Propofol was 52±7 kg, and there was no statistically significant difference between the mean weights of these groups of patients. Patients who received Dexmedetomidine and Propofol had a mean weight of 55±8 kg.

Table 4: Heart rate at different time intervals

		N	Mean	Std. Deviation	P Value
Hr preop	Dexmedtomidine and Propofol	30	96.13	16.964	>0.05 (N.S)
	Fentanyl and Propofol	30	91.77	18.152	
	Propofol	30	88.93	17.575	
At induction	Dexmedtomidine and Propofol	30	88.10	16.865	>0.05 (N.S)
	Fentanyl and Propofol	30	92.20	16.618	
	Propofol	30	94.20	14.291	
LMA insertion	Dexmedtomidine and Propofol	30	90.90	17.625	>0.05 (N.S)
	Fentanyl and Propofol	30	95.93	12.556	
	Propofol	30	96.93	11.985	
1 min	Dexmedtomidine and Propofol	30	92.73	12.323	>0.05 (N.S)
	Fentanyl and Propofol	30	93.53	10.328	
	Propofol	30	97.33	11.842	
3 min	Dexmedtomidine and Propofol	30	87.90	12.234	<0.001 (V. Significant)
	Fentanyl and Propofol	30	92.53	10.020	
	Propofol	30	99.53	11.175	
5 min	Dexmedtomidine and Propofol	30	89.60	10.506	< 0.05 (Significant)
	Fentanyl and Propofol	30	91.47	8.709	
	Propofol	30	98.40	10.627	
10 min	Dexmedtomidine and Propofol	30	91.07	10.194	< 0.05 (Significant)
	Fentanyl and Propofol	30	92.87	9.709	
	Propofol	30	99.27	10.178	

In comparison to patients who received Fentanyl and Propofol and patients who received only Propofol, patients who received a combination of Dexmedetomidine and Propofol had better control over their mean heart rates. This difference was statistically significant at the 3min, 5min, and 10min marks, though it was not at the start.

Table 5: Mean arterial pressure at different time intervals

		N	Mean	Std. Deviation	P Value
MAP Preop	Dexmedtomidine and Propofol	30	93.13	9.051	>0.05 (N.S)
	Fentanyl and Propofol	30	91.10	9.102	
	Propofol	30	86.90	13.278	
AT Induction	Dexmedtomidine and Propofol	30	93.50	12.467	<0.001 (V. Significant)
	Fentanyl and Propofol	30	85.67	9.282	
	Propofol	30	80.33	11.848	
LMA Insertion	Dexmedtomidine and Propofol	30	89.73	15.913	<0.001 (V. Significant)
	Fentanyl and Propofol	30	95.50	10.415	
	Propofol	30	81.83	10.815	
1 min	Dexmedtomidine and Propofol	30	87.93	12.379	< 0.05 (Significant)
	Fentanyl and Propofol	30	90.60	11.416	
	Propofol	30	82.33	10.752	
3 min	Dexmedtomidine and Propofol	30	86.30	13.220	< 0.05 (Significant)
	Fentanyl and Propofol	30	90.00	8.80	
	Propofol	30	93.93	9.16	
5 min	Dexmedtomidine and Propofol	30	87.57	7.610	< 0.05 (Significant)
	Fentanyl and Propofol	30	90.47	10.641	
	Propofol	30	93.53	7.673	
10 min	Dexmedtomidine and Propofol	30	90.63	9.743	< 0.05 (Significant)
	Fentanyl and Propofol	30	96.40	8.42	
	Propofol	30	99.33	9.94	

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 01, 2023

The Mean Arterial Pressure is initially high in the group that received the combination of Dexmedetomidine and Propofol drugs at pre-operatively later on dip at LMA insertion and later on during 1min, 3min, 5min, and 10min time frame this group has lower Mean Arterial Pressure compared to that of the group that received Fentanyl and Propofol, and this difference is statistically significant at all time intervals.

Table 6: Spo2 levels at different time intervals

		N	Mean	Std. Deviation	P Value
SPO2 Preop	Dexmedtomidine and Propofol	30	99.80	.484	>0.05 (N.S)
	Fentanyl and Propofol	30	99.70	.535	
	Propofol	30	99.93	.365	
AT Induction	Dexmedtomidine and Propofol	30	100.00	.000	>0.05 (N.S)
	Fentanyl and Propofol	30	99.97	.183	
	Propofol	30	99.97	.183	
LMA Insertion	Dexmedtomidine and Propofol	30	100.00	.000	---
	Fentanyl and Propofol	30	100.00	.000	
	Propofol	30	100.00	.000	
1 min	Dexmedtomidine and Propofol	30	100.00	.000	---
	Fentanyl and Propofol	30	100.00	.000	
	Propofol	30	100.00	.000	
3 min	Dexmedtomidine and Propofol	30	100.00	.000	---
	Fentanyl and Propofol	30	100.00	.000	
	Propofol	30	100.00	.000	
5 min	Dexmedtomidine and Propofol	30	99.97	.183	>0.05 (N.S)
	Fentanyl and Propofol	30	100.00	.000	
	Propofol	30	100.00	.000	
10 min	Dexmedtomidine and Propofol	30	99.97	.183	>0.05 (N.S)
	Fentanyl and Propofol	30	100.00	.000	
	Propofol	30	100.00	.000	

With the Dexmedetomidine and Propofol group, the Fentanyl and Propofol group, and the patients who received only Propofol, the saturation remained essentially constant over all time intervals.

Table 7: Respiratory Rate

Respiratory Rate		N	Mean	Std. Deviation	P Value
PRE OP	Dexmedtomidine and Propofol	30	17.77	1.073	< 0.05 (Significant)
	Fentanyl and Propofol	30	17.67	1.184	
	Propofol	30	16.93	1.143	
Induction	Dexmedtomidine and Propofol	30	13.63	1.129	>0.05 (N.S)
	Fentanyl and Propofol	30	13.57	1.073	
	Propofol	30	13.20	1.215	
LMA Insertion	Dexmedtomidine and Propofol	30	15.33	.994	<0.001 (V. Significant)
	Fentanyl and Propofol	30	14.70	.750	
	Propofol	30	13.90	1.296	
1 min	Dexmedtomidine and Propofol	30	15.70	.915	<0.001 (V. Significant)
	Fentanyl and Propofol	30	15.83	.747	
	Propofol	30	14.20	1.324	
3 min	Dexmedtomidine and Propofol	30	16.77	.898	<0.001 (V. Significant)
	Fentanyl and Propofol	30	16.87	.900	
	Propofol	30	15.20	1.126	
5 min	Dexmedtomidine and Propofol	30	17.47	.900	<0.001 (V. Significant)
	Fentanyl and Propofol	30	17.43	.817	
	Propofol	30	16.47	1.137	
10 min	Dexmedtomidine and Propofol	30	18.03	.089	<0.05 (Significant)
	Fentanyl and Propofol	30	18.17	1.085	
	Propofol	30	18.03	.809	

Discussion

A of an anaesthesiologist reminds him of its most responsible work of providing a secure and adequate A and B of cardiopulmonary resuscitation. A is for airway B is for breathing.

Although endotracheal intubation is the most commonly used general anesthesia technique, there are some complications that result from the need to see and penetrate the laryngeal opening. The importance of daycare anesthesia has increased the use of laryngeal mask airways rather than facemasks and endotracheal intubation during anesthesia.

In 1981, Dr. ARCHIE BRAIN (1) started studying the anatomy of the upper airway and started working

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 01, 2023

on the laryngeal mask airway. In order to avoid damaging or visualizing the vocal cords, it was primarily created to offer some advantages over endotracheal intubation. Airway reflexes must be suppressed for successful laryngeal mask airway insertion.

The use of IV propofol, which has the advantages of quickly inducing anesthesia and of depressing upper airway reflexes, is a common technique for administering anesthesia for LMA insertion.

A device with a lumen that creates a seal around the laryngeal inlet is the laryngeal mask airway. With an airway pressure of approximately 15 cm of water, it permits both spontaneous ventilation and positive pressure ventilation. In situations where spontaneous ventilation is permitted, a LMA can be used safely in place of a facemask. For LMA insertion, there should be little upper airway reflex activity, such as coughing, gagging, or laryngospasm.

Inhaled anesthetics take longer to work, so IV anesthetics are preferred for LMA insertion. Because of its potential to suppress upper airway reflexes, propofol has been the most popular IV anesthetic. Propofol offers favorable LMA insertion conditions when used by itself without premedication [5, 6].

Since propofol does not naturally possess any analgesic properties, opioids are added to lower the effective concentration (EC50LMA) for LMA insertion of propofol for a variety of painful stimuli with little respiratory depression and without a significant increase in BIS [12]. The preferred opioid in this case is fentanyl. While small doses of fentanyl do not effectively prevent laryngospasm when normocapnia is maintained, incremental doses generally do so in a dose-related manner [16].

It exhibits specific and selective 2 adrenoceptor agonism and is a pharmacologically active dextro isomer of medetomidine. Analgesia, bradycardia, hypotension, and sedation are all brought on by the activation of receptors in the brain and spinal cord [21]. In addition to its sedative effects, dexmedetomidine also has anaesthetic and analgesic effects, which start to manifest at dose intervals of 0.5-2 mcg/kg. Propofol dosages for induction and maintenance were significantly decreased when dexmedetomidine was used postoperatively for BIS 40-50 [26]. The reduction of airway and circulatory reactions during intubation and extubation by dexmedetomidine has also been observed [22].

This study aims to establish favorable LMA insertion conditions using dexmedetomidine and propofol and compares the results to those obtained using fentanyl and propofol as a control.

In present study, 90 patients with ASA physical status grade I & II, undergoing short surgeries were selected and divided into 3 groups.

Group D:(n=30), is Dexmedetomidine propofol with patients received loading dose of inj. Dexmedetomidine 1 µg/kg i.v over 2 minutes followed by propofol2mg/kg iv given. Nintey seconds after propofol injection lma is inserted and monitored.

Group F:(n=30), patients received inj. Fentanyl propofol, patients received loading dose of fentanyl 1 µg/kg i.v over 2 minutes followed by propofol2mg/kg iv given., Nintey seconds after propofol injection lma is inserted and monitored.

Group P:(n=30), patients receiving propofol 2mg/kg iv and Lma is inserted and monitored.

In the present study Out of 90 study participant's males constitute 42 in number of which 16 were administered with Dexmedtomidine and Propofol, 13 with Fentanyl and Propofol, 13 with only Propofol. Females constitute 48 of which 14 were administered with Dexmedtomidine and Propofol, 17 with Fentanyl and Propofol, 17 with only Propofol.

In the present study, The Mean Weight of Patients Receiving Fentanyl and Propofol is 53.8 Kg, and the Mean Weight of Patients Receiving Only Propofol is 52.7 Kg, and This Difference Is Not Statistically Significant. The Mean Weight of Patients Receiving Dexmedetomidine and Propofol is 55.8 Kg, and the Mean Weight of Patients Receiving Only Propofol is 52.7 Kg.

In the present study regarding saturation, it is almost similar in all the three groups, with a slight decrease in propofol group only. This has been later stabilised by 10 min due at addition of 2nd dose propofol0.5mg/kg. This has been observed in only three patients of group P taking only propofol.

Propofol is better suited for this purpose because it has a greater depressant effect on airway reflexes than thiopentone, which is associated with a higher incidence of unwanted response whether used alone or in combination with an opioid. This allows for the smooth insertion of LMA without complications like coughing, gagging, or laryngospasm. In the current study, this was noted by Blake *et al.* [27] in their dose response study to determine the ideal propofol dosage for inserting LMA. When it came to successful LMA insertion, keeping the induction bolus of propofol at 2 mg/kg was associated with a lower incidence of laryngospasm.

Previous studies showed by Blake DW, Dawson *et al*., [27], the effects on the respiratory system were minimal, but MAP started to fall 90 seconds after the laryngeal mask airway was inserted. The cardiovascular effects did not significantly vary between dosage groups or when more propofol was used. Propofol alone does not significantly suppress the airway reflexes during anesthesia, but incremental doses of fentanyl do so in a dose-related manner [4, 14].

Following an induction dose of propofol, heart rate does not significantly change. The tachycardic response to hypotension is decreased by propofol, which either inhibits or resets the baroreflex.

When compared to propofol dexmedetomidine and propofol fentanyl in the current study with Blake *et al*., [27], propofol significantly increased heart rate, which increased from the third to the tenth minute.

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 01, 2023

Dexmedetomidine, on the other hand, decreased heart rate by 25% after induction and returned to normal by the tenth minute.

The current study's findings lend support to the research by A H Ramaswamy [28] *et al*. by showing a slight decrease in HR in three groups. This may be the case because inserting a large device like the LMA may have increased the sympathetic response, which in turn increased the effects of dexmedetomidine's (bradycardia) effects on the heart rate (HR).

In the current study, it was found that patients who received a combination of Dexmedetomidine and Propofol had better control over their mean heart rates than patients who received only Propofol or patients who received Fentanyl and Propofol. The difference between these groups was statistically significant at the 3min, 5min, and 10min marks, though it was not at the beginning.

Bradycardia is observed in only three patients receiving dexmedotimidine, which got stabilised by 10minute. Due to agonizing the postsynaptic membrane 2 receptor, dexmedetomidine inhibits sympathetic activity [29].

According to expectations, the current study shows an increase in RR in the dexmedetomidine group when compared to the fentanyl group and the propofol group from the Ramaswamy and *et al*. study.

Wong *et al*.'searlierresearch [16] showed that dexmedetomidine infusions increased RR and decreased apnea episodes. According to studies by Venn *et al*. and Arian *et al*. [19, 20], which demonstrated that Dexmedetomidine did not affect the hypercapnic arousal phenomenon, the present study did not record any episodes of apnea. As a result, its sedation closely resembled that of a natural sleep cycle. The locus caerulus, which is known to play a role in both respiratory control and sleep modulation, is the main site of action for Dexmedetomidine that causes its respiratory effects. Natural sleep does cause a change in ventilation, but dexmedetomidine uses the same pathway to exert its sedative effects [22, 29].

In contrast to a prior study on respiratory rate by F. Uzümcügil *et al*. [33], Group D's respiratory rates increased (P 0.001). Fentanyl was found to cause similar adverse events when inserting a laryngeal mask. Prior to propofol induction, dexmedetomidine offers successful laryngeal mask insertion comparable to that of fentanyl while preserving respiratory functions more than fentanyl [33].

The mean basal respiratory rate (RR) was comparable in the current study with minimal variation (p 0.05). After the laryngeal mask airway was inserted, group D (dexmedetomidine-propofol) experienced a statically significant (p 0.001) increase in respiratory rate that stabilized at 10 minutes.

In group F (propofol fentanyl) there was no increase in respiratory rate compared to group D it got stabilised at 10 minutes.

In group P (propofol) there is slight decrease in respiratory rate compared to group D and group F. There are only three of them received additional dose of propofol 0.5mg/ kg intra venously given which got stabilised by 10 minutes.

The respiratory rates in both groups were found to be similar in the earlier study by Sowmya Jayaram *et al*. When the number of patients who developed apnea was compared between Groups F and D, it was discovered that Group F had more respiratory depression.

Dexmedetomidine stands out among sedatives because it is clinically safe for the respiratory system even at doses high enough to render a patient unresponsive to vigorous stimulation and exhibit hypercarbic arousal phenomena resembling those seen during restorative sleep [22].

The effects on haemodynamic parameters with regard to blood pressure were better, or more stable, in group D than in groups F and P, as compared to the earlier study by Sowmya Jaya Ram *et al*. in the present study. All of the measured pressures, especially the mean arterial pressure, showed a statistically significant decrease from the baseline.

In the current study, patients with high initial mean arterial pressure who received a combination of dexmedetomidine and propofol medications prior to surgery showed a decrease in mean arterial pressure upon LMA insertion. When compared to those who received propofol, fentanyl, and propofol, the dexmedetomidine propofol group has lower mean arterial pressure during the 1 minute, 3 minute, 5 minute, and 10 minute time frames. Every time interval that this difference is present is statistically significant.

The findings of earlier studies by Blor BC *et al*, Scheinin B *et al*, Aantaa R, *et al*, were similar to those of the current study. Dexmedetomidine use was linked to a reduction in MAP and HR, which may be due to reduced noradrenaline release, reduced centrally mediated sympathetic tone, and increased vagal activity [30-32].

Severe bradycardia, hypotension, hypertension, and arrhythmias are all side effects of dexmedetomidine, according to reports. In our research, we never saw cases of severe hypertension or arrhythmias. By giving IV fluids, moderate hypotension was treated.

The dose of dexmedetomidine used for intraoperative sedation was 1 g/kg given over 2 minutes in accordance with the studies by Belleville *et al*. and Uzümcügil *et al*. [33-35]. The goal was to quickly sedate patients while avoiding adverse alpha-1 effects like hypertension and tachycardia. Such doses are likely associated with deep sedation as well as the patient's anatomical characteristics, which can be seen in the obstructive respiration pattern and irregular breathing [36]. Since the focus of our study was the insertion conditions of laryngeal masks, we did not encounter this issue to a significant degree.

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 01, 2023

Conclusion

Our research revealed that Group D, which used Dexmedetomidine along with Propofol, had more stable effects on hemodynamic and respiratory parameters than Group F, which used Fentanyl along with Propofol, and Group P, which used only Propofol. When dexmedetomidine and fentanyl are used separately for co-induction with propofol for LMA insertion, the insertion conditions are excellent overall with haemodynamic stability. Additionally, the need for an induction dose of propofol for LMA insertion is significantly reduced by dexmedetomidine. When inserting a LMA, propofol is the ideal induction agent. Haemodynamic instability may result when used alone.

Funding source: None

Conflict of Interest: None

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