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A Comparative Study of Intubating Condition and Hemodynamic Responses Using Propofol or Thiopentone without Muscle Relaxants

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Abstract

Introduction: Muscle relaxants are frequently used to facilitate endotracheal intubation during the induction of anesthesia. However, the administration of short-acting depolarizing muscle relaxants is associated with postoperative myalgias, malignant hyperthermia, hyperkalemia and increased intracranial or intraocular pressure. *Aim:* To compare the intubating condition and haemodynamic response to induction, laryngoscopy and intubation in patients induced with lignocaine, fentanyl and propofol or lignocaine, fentanyl and thiopentone and intubated without muscle relaxants. *Methods:* 40 patients were randomly allotted in P group [Propofol group] and T group [Thiopentone group]. Patients with the predicted difficulty of intubation, history of hypertension, history of asthma, drug or alcohol abuse, significant cerebrovascular disease and cardiovascular disease, BMI more than 30 kgm^{-2} were excluded from the study. The results were compared between both the groups. Jaw relaxation, vocal cord position, patient's response to laryngoscopy and intubation were assessed and graded as excellent, good, and poor. *Results:* In this study higher incidence of ideal and acceptable intubating conditions were observed in 95% of patients in P group when compared with T group in which the acceptable intubating conditions were observed in 30% of the patients which is statistically significant ($p < 0.05$). The mean heart rate was decreased in both the groups after induction, but immediately after intubation, mean heart rate was high in group T, when compared with group P. *Conclusion:* We conclude that induction with Propofol, Fentanyl and Lignocaine provides better intubating conditions with less haemodynamic response to laryngoscopy and intubation than induction with Thiopentone, Fentanyl and Lignocaine.

Keywords: Propofol; Thiopentone; Intubation without muscle relaxants.

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Introduction

Induction of anaesthesia is now commonly facilitated by the administration of a combination of short-acting hypnotic drugs, depolarizing or non-depolarizing muscle relaxant drugs. Nevertheless muscle relaxants have their limitations. The use of succinylcholine is controversial because of its side effects which include hyperkalemia, muscle rigidity, malignant hyperthermia, myoglobinuria increased intracranial pressure, increased intraocular pressure, the prolonged neuromuscular blockade in patients with plasma choline esterase deficiency, anaphylaxis, etc. They may cause

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serious complications and even death in patients with concurrent diseases.

And the use of long-acting muscle relaxants is disadvantageous in intubating the patients with unpredicted airway difficulty where there is a dangerous possibility of getting into a cannot ventilate, cannot intubate situation. The other complications of non-depolarizing neuromuscular blocking agents include Histamine release, vagolytic, Ganglion blockade, anaphylaxis, nephrotoxicity etc.

So, there is a need for an optimal technique that provides acceptable intubating conditions with reasonable haemodynamic stability without using muscle relaxants particularly in patients with severe burns, hyperkalemia, spinal cord injury where the muscle relaxants are contraindicated or in cases where tracheal intubation is necessary but not prolonged muscle relaxation, such as short ENT and Gynaecological procedures.

The commonly used hypnotic drugs are propofol, thiopentone and etomidate etc. Thiopentone an ultrashort-acting barbiturate was introduced into clinical practice in 1934 became a gold standard induction agent.

However thiopentone produced side effects in some patients like bronchospasm, analgesia etc [1,2]. Etomidate first described by *Paul Janssen* came into clinical practice in 1974 was often used as a drug of choice for anesthetizing hemodynamically unstable patients. Nevertheless it produced pain on injection, myoclonus, and inhibition of Steroidogenesis etc. Propofol is the recent addition which was first synthesized and clinically tested in 1977. It was found that it produces hypnosis quickly and prompt recovery when the drug was discontinued, suppresses pharyngeal reflexes without a need for either muscle relaxants or potent inhaled anaesthetics [3].

To obtain better haemodynamic stability while intubating the trachea without using muscle relaxants the untoward cardiovascular responses during laryngoscopy and intubation itself has to be prevented. For this intravenous lignocaine [4], narcotics, β Blockers, calcium channel blockers, ACE inhibitors, vasodilators, clonidine etc have been used.

Since the advent of short-acting opioids [5], intubating trachea without muscle relaxants has been successful when they are used in combination with the induction agents. In this study propofol and thiopentone were used as induction agents to intubate the trachea without using muscle relaxants [6].

In this study the intubating condition and haemodynamic response of both the drugs were compared. Fentanyl and lignocaine were used as adjuvants to blunt the pressor response to laryngoscopy and intubation [7,8].

Aim

To compare the intubating condition and haemodynamic response to induction, laryngoscopy and intubation in patients induced with lignocaine, fentanyl and propofol or lignocaine, fentanyl and thiopentone and intubated without muscle relaxants.

Materials and Methods

After approval of the study by our institutional Ethics Committee, the study was undertaken in a total of 40 ASA grade I patients of age between 16-65 years, undergoing elective surgery under general anaesthesia. Informed written consent was obtained from all the patients. In all patients weight, pulse rate, blood pressure were recorded. The preoperative investigation included blood hemoglobin, blood sugar, urea, creatinine, urine albumin and sugar, ECG and chest X-ray. All the patients were on overnight fasting. Patients with the predicted difficulty of intubation, history of hypertension, history of asthma, drug or alcohol abuse, significant cerebrovascular disease and cardiovascular disease, BMI more than 30 kg m-2 were excluded from the study. All patients were premedicated with, Tab. Diazepam 5 mg and Tab. Ranitidine 150 mg the previous day night and morning of the surgery and were prehydrated using 0.9% saline 5 ml per kilogram. Out of the total of 40 patients 20 were randomly included in the P group [Propofol group] and the other 20 were included in the T group [Thiopentone group]. In the operating room intravenous access was established by inserting 18 gauge cannula. Patients were connected to NIBP, ECG, Pulse oximetry monitors and preoperative baseline values of heart rate, blood pressure, and SpO_2 were recorded. The patients were preoxygenated with 100% O_2 for 3 min and were administered Inj.Glycopyrollate 0.2 mg intravenously. All the patients received Inj.Fentanyl 2.5 microgram per kilogram intravenously, 2 minutes after the administration of fentanyl, Inj lignocaine 1.5 milligrams per kilogram was administered. One minute after administration of lignocaine, patients in the Propofol (P) group was induced with 3 mg per kilogram of propofol

intravenously and with thiopentone 6mg per kilogram intravenously in the Thiopentone (T) group. When the patient became unconscious, his or her respiration was assisted through a mask with 100% O_2. Ninety seconds after propofol or thiopentone administration, laryngoscopy and tracheal intubation was attempted using appropriate size Macintosh laryngoscope blade and appropriate size endotracheal tubes. Intubation was performed by another experienced anaesthesiologist who was blinded to the drugs used. Measurements of heart rate, mean arterial pressure, and SpO_2. 40 sec after induction (Post Induction), immediately after laryngoscopy (Post Laryngoscopy) and placement of endotracheal tube (Post Intubation) were recorded. The results were compared between both the groups. Jaw relaxation, vocal cord position, patient's response to laryngoscopy and intubation were assessed and graded as excellent, good, and poor. This scoring is assessed by the intubating anaesthesiologist. Patients who could not be intubated at the first attempt were given succinylcholine 1.5 milligrams per kilogram and intubation was completed.

Results

The present study was undertaken in 40 ASA grade I Patients of both genders between the age group of 16-65 years scheduled for elective surgeries under general anaesthesia. The patients were categorized into 2 groups (Propofol (P) group and Thiopentone (T) group). 17 patients [85%] showed complete jaw relaxation in P group when compared with the T group in which 15 patients (75%) showed complete jaw relaxation. 14 patients (70%) had fully opened vocal cord in P group in comparison with T group where only 2 patients (10%) had fully opened vocal cords. There was no response to laryngoscopy and intubation in 8 patients (40%) and less than 2 bucking was observed in 11 patients (55%) in P group when compared with T group where only 6 patients had less than 2 bucking (30%). In this study higher incidence of ideal and acceptable intubating conditions were observed in 95% of patients in P group when compared with T group in which the acceptable intubating conditions were observed in 30% of the patients which is statistically significant ($p < 0.05$). Not even a single patient in the T group had an excellent intubating condition. Considering the haemodynamic response it is observed that the mean heart rate was decreased in both the groups after induction, but immediately after intubation, mean heart rate was high in group T, when compared with group P. Both groups showed a decrease in mean arterial pressure after induction. Whereas the increase in mean arterial pressure was observed in group T immediately after laryngoscopy and intubation ($p < 0.0001$).

Table 1: Patient characteristics

Variables	Group P (n=20)	Group T (n=20)	p value
Mean age (yr)	42.95 ± 14.48	36.80 ± 11.86	0.15
Mean weight (kg)	57.35 ± 6.71	52.70 ± 8.04	0.054
Mean HR (min)	78.50 ± 8.05	80.00 ± 7.57	0.752
Mean MAP (mmHg)	91.88 ± 3.98	89.97 ± 5.18	0.547

Table 2: Jaw Relaxation

Group	Fully relaxed	Slight tone	Stiff
P group	85%	15%	0%
T group	75%	15%	10%

Table 3: Position of vocal cords

Group	Open	Moving	Closed
P group	70%	25%	5%
T group	10%	65%	25%

Table 4: Response to laryngoscopy

Group	No response	Less than 2 Bucking	Persistent bucking or Peripheral limb movement or Use of succinylcholine
P group	40%	55%	5%
T group	0	30%	70%

Table 5: Overall intubating condition

Group	Ideal		Acceptable		Poor	
	No of patients	%	No of patients	%	No of patients	%
P group	6	30%	13	65%	1	5%
T group	0	0	6	30%	14	70%

Table 6: Percentage deviation from the baseline level

Heart Rate	Group P (n=20) (Mean ± SD)	Group T (n=20) (Mean ± SD)	p value
Post induction	-16.60 ± 6.56	-6.59 ± 6.90	0.000*
Post laryngoscopy	-6.27 ± 16.28	0.81 ± 8.60	0.094
Post intubation	-3.21 ± 17.11	8.83 ± 8.46	0.008*

Table 7: Percentage deviation from the baseline level.

MAP	Group P (n=20) (Mean ± SD)	Group T (n=20) (Mean ± SD)	p value
Post induction	-12.00 ± 6.23	-4.91 ± 4.76	0.000*
Post laryngoscopy	-10.84 ± 4.48	2.49 ± 6.96	0.000*
Post intubation	-7.81 ± 4.62	6.97 ± 7.77	0.000*

Discussion

Various other methods to intubate the trachea without the use of muscle relaxants include high dose opioids, and using thiopentone and propofol as sole agents. The technique of intubation without using muscle relaxants offers a useful alternative when neuromuscular blocking drugs are undesirable. The example in patients with hyperkalemia, burns, renal failure or in an anticipated difficult airway. Although intubation without muscle relaxants is considered safe in some patients, this technique is not without complications.

While attempting tracheal intubation without using muscle relaxants, it is mandatory to prevent pressor response, coughing, and laryngospasm produced by laryngoscopy and intubation itself as these unwanted side effects place the anaesthesiologist in a critical situation like an increase in intracranial pressure, cardiac events due to an increase in heart rate and mean arterial pressure in susceptible patients.

Our study is aimed at comparing the intubating conditions and the associated haemodynamic changes following induction and tracheal intubation in the propofol group and thiopentone group without using muscle relaxants in adult patients.

In our study the complete jaw relaxation was observed in 17 patients (85%) in the Propofol group when compared with Thiopentone group in which it was observed in 15 patients (75%).

In a study done by Andel H *et al.* in which he used 3 micrograms per kilogram of fentanyl in combination with Propofol observed complete jaw relaxation in 93% of the patients [9].

The lower incidence of complete jaw relaxation observed in our study when compared with that of Herald Andel et al is probably due to the lower dose of fentanyl used in our study.

Baker P *et al.* assessed the vocal cord movement after induction of anaesthesia with either propofol and thiopentone and observed that the vocal cords adducted to a greater extent with thiopentone than propofol [10].

In our study 14 patients (70%) had fully opened vocal cord in the Propofol group in comparison with Thiopentone group where only 2 patients (10%) had fully opened vocal cords.

McKeating *et al.* investigated the depressant effect of induction doses of thiopentone and propofol on airway integrity and reactivity. They found that when no muscle relaxant was given laryngoscopy was easier to perform after propofol than after an equipotent dose of thiopentone, and that pharyngeal and laryngeal reactivity during laryngoscopy without attempting intubation was more depressed after propofol than after thiopentone [11].

Moreover Eames WO *et al.* found that respiratory resistance after tracheal intubation was lower after induction with propofol than after induction with thiopentone [12]. In our study there was no response to laryngoscopy and intubation in 8 patients (40%) and less than 2 bucks were observed in 11 patients (55%) in p group when compared with T group where only 6 patients had less than 2 bucking (30%).

The results of this study suggests that propofol 3 milligram per kilogram administered with lignocaine 1.5 milligram per kilogram and fentanyl 2.5 microgram per kilogram provides ideal and acceptable intubating conditions in 95% of premedicated patients with favorable airway anatomy whereas thiopentone 6 milligram per kilogram provides acceptable intubating conditions in only 30% of patients which is statistically significant ($p < 0.05$).

In a similar study done by Samar Taha *et al.*, who compared propofol (2 milligram per kilogram) and thiopentone (5 milligram per kilogram) in combination with remifentanil (2 microgram per kilogram) and lignocaine (1.5 milligram per kilogram), observed ideal intubating condition in 50% of patients induced with thiopentone and in 84% of patients induced with propofol [13].

The decreased incidence of ideal intubating condition with propofol group in Samar taha study may be due to the reduced dose of propofol used in that study [13].

In our study none of the patients in the thiopentone group showed ideal intubating condition when compared with Samar taha study which may be due to the fact that fentanyl is less potent when compared with remifentanil [13].

The decreased incidence of severity of bucking and decreased vocal cord movement, but not complete jaw relaxation contributed much to the high percentage of the patients with the ideal and acceptable intubating conditions in the propofol group.

This is attributed to the fact that propofol itself and the synergism with lignocaine in decreasing the muscle tone and abolishing the laryngeal response to tracheal intubation.

When laryngoscopy, intubation and skin incision are considered, tracheal intubation is the strong stimulus. It is important to produce adequate conditions for laryngoscopy, but preventing subsequent coughing or haemodynamic response after tracheal intubation may be even more important.

Addition of lignocaine at induction of anaesthesia has been shown to be beneficial in improving the intubating conditions. This may be attributed to a decrease in the incidence and severity of coughing following insertion of the tracheal tube. It is likely the antitussive effect of lignocaine is caused by at least partially by an increase in the depth of anaesthesia.

Woods AW *et al.* suggested that the combination of lignocaine and propofol may have a synergistic effect [14].

In our study all patients were prehydrated with 0.9% saline before induction of anaesthesia and were premedicated with an anticholinergic agent (Glycopyrollate 0.2 mg intravenously).

Considering haemodynamic response both Propofol and Thiopentone produced a decrease in mean arterial pressure and heart rate immediately after induction. (Mean ± SD -16.60 ± 6.56 and -6.59 ± 6.90) respectively. While doing laryngoscopy and intubation, propofol had blunted the pressor response effectively by maintaining the decrease in mean arterial pressure and heart rate below the baseline values when compared with thiopentone group where an increase in mean arterial pressure and heart rate above the baseline values was observed.

The cardiovascular depressant effects of propofol may be attributed to direct myocardial depression and decreased systemic vascular resistance. Also propofol alters the baroreflex mechanism, resulting in a smaller increase in heart rate for a given decrease in arterial blood pressure as described by Cullen *et al.* in 1987 [15].

The decrease in mean arterial pressure and heart rate following propofol may be well tolerated in healthy, well-hydrated patients, but can be hazardous in elderly patients and in patients with clinically significant cardiovascular disease.

In our study no patient was treated with vasopressor, a decrease in mean arterial pressure was not less than 70 mmHg in both the groups. No patient had a fall in heart rate of fewer than 60 beats per minute.

Peripheral oxygen saturation remained at the preinduction level, 97-99%, in all groups throughout the procedure.

Conclusion

We conclude that induction with Propofol, Fentanyl and Lignocaine provides better intubating conditions with less haemodynamic response to laryngoscopy and intubation than induction with Thiopentone, Fentanyl and Lignocaine. So when intubation is to be done without the use of muscle relaxants propofol will be a better drug than thiopentone for induction.

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