Original Article:

Comparison of intubating conditions and haemodynamic responses during rapid tracheal intubation using either suxamethonium or rocuronium with ephedrine pretreatment

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ABSTRACT

Background: Suxamethonium is considered as the "gold standard" for tracheal intubation. Because of innumerable contraindications for the use of this drug, there is a continuous search for other alternatives.

Methods: In a prospective, randomized and double-blind study, we compared the intubating conditions and haemodynamic responses during rapid tracheal intubation using either suxamethonium or rocuronium with ephedrine pretreatment. We recruited 50 patients and allocated them into 2 groups (n= 25 each); Group S: received suxamethonium 1.5 mg/kg and Group R: received rocuronium 0.6 mg/ kg with ephedrine 100 µg/kg pretreatment. All patients were induced with 2 mg/kg propofol and intubation was attempted at 60 seconds. Haemodynamic responses and quality of intubating conditions were assessed.

Results: Both groups were comparable in respect to age, sex, weight, Mallampati grade, Cormack Lehane grade and duration of laryngoscopy. Although both groups had clinically acceptable intubating conditions (good and excellent), there were more number of patients with better intubation score in Group S compared to Group R ($p = 0.014$).

Conclusion: Suxamethonium still continues to be the "gold standard" for providing ideal tracheal intubation conditions. However, in conditions where suxamethonium is contraindicated, rocuronium-ephedrine combination can be used as an alternative to intubate the trachea at 60 seconds.

Key words: *Suxamethonium, Rocuronium, Ephedrine, Propofol, Tracheal intubation.*

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INTRODUCTION

The goal of rapid sequence induction and intubation is to secure the patients' airway smoothly and quickly minimizing the chances of regurgitation and aspiration of gastric contents. Traditionally suxamethonium has been the neuromuscular blocking drug of choice and the "gold standard" in rapid sequence induction and intubation. However, its use is not without adverse effects[1] like hyperkalemia, cardiac rhythm abnormalities, raised intracranial, intra ocular and intragastric pressure, myalgias, among others. The potential problems associated with suxamethonium have prompted the search for alternative drugs. Amongst the currently available non-depolarising muscle relaxant rocuronium has the most rapid onset of action and may provide an alternative to suxamethonium. Previous studies[2,3] compared the intubating conditions by using suxamethonium and rocuronium and the observations from these studies suggest that rocuronium in a dose of greater than 0.9 mg/kg

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has acceptable intubating conditions similar to suxamethonium but has prolonged duration of action. If cardiac output and tissue perfusion are increased during induction by using either vasopressor or inotropic drugs, these may enhance the onset of action of non-depolarizing muscle relaxants.[4,5] In this respect, ephedrine[6,7] has been shown to reduce the hypotension following induction of anaesthesia. Hence the present study was undertaken to compare the intubating conditions and haemodynamic responses during rapid tracheal intubation using either suxamethonium or rocuronium with ephedrine pretreatment.

MATERIAL AND METHODS

We conducted a prospective, randomized double-blind study after obtaining approval from Institutional Ethics Committee. Written informed consent was obtained from all the patients. The study included 50 American Society of Anesthesiologists[8] (ASA) Grade I patients aged between 18-65 years scheduled to undergo elective surgery under general anaesthesia requiring oral endotracheal intubation (OETI). The sample size calculation was based on previous studies published on the subject.[9,10] Patients with morbid obesity, Mallampati grade[11] (MPG) III and IV, neuromuscular, thyroid, hepatic and renal diseases, post-burns, known allergy to study drugs and pregnant women were excluded from the study.

Patients were randomized into two groups of 25 each by computer generated random numbers generated before the start of the study and sealed opaque envelope technique was used. Group S patients received suxamethonium 1.5 mg/kg with saline pretreatment and Group R patients received rocuronium 0.6 mg/kg with pretreatment of ephedrine 100 mcg/kg. Equivolume syringes of 2.5 mL and 5 mL for saline/ephedrine or muscle relaxant respectively were loaded by an anaesthesiologist blinded to the study.

After thorough preoperative evaluation all the patients were pre-medicated with oral tablet alprazolam 0.5 mg night before surgery and 2 hours. prior to surgery. All patients were pre-oxygenated with 100% oxygen for 3 minutes. Fentanyl 1 µg/kg, the study drug comprising of either 0.9% saline for the Group S (or) ephedrine 100 µg/kg for the Group R and propofol 2 mg/kg was given one, two and third minutes after starting of pre-oxygenation respectively. This was followed by muscle relaxant rocuronium 0.6 mg/kg for Group R patients and suxamethonium 1.5 mg/kg for Group S patients was administered as per randomization. Blinding was done by completely draping the patient and keeping the patient out of view of the anaesthesiologist responsible for assessing intubation conditions. Draping was done to mask the fasciculations produced by suxamethonium, which might have hampered the blinding procedure. The anaesthesiologist assessing the intubating conditions was blinded to the study drug and if any adverse reactions because of the study drug administered then the study drug was decoded and treated accordingly.

Sixty seconds after the muscle relaxant administration, OETI was done with appropriate size endotracheal tube. The difference in assessment of the quality of intubating conditions makes comparison among studies difficult and sometimes impossible. So the Copenhagen Consensus Conference in 1994 established a set of internationally acceptable guidelines for good clinical research practice in studies of neuromuscular blocking agents, including intubating conditions.[12] Intubating conditions were assessed as per the intubation scoring system of consensus conference on good clinical research practice in pharmacodynamics studies of neuromuscular blocking agents, Copenhagen Consensus Conference.[12]

The haemodynamic variables like systolic blood pressure (SBP, mm Hg); diastolic blood pressure (DBP, mm Hg); mean arterial pressure (MAP, mm Hg); were measured using an invasive arterial line. Heart rate (HR, beats/min) and oxygen saturation (SPO_2) were monitored continuously by using electrocardiogram (ECG) electrodes and pulse oximeter respectively, and were recorded at seven - time intervals for analysis: namely, baseline [5 minutes after arterial cannulation (T1)], after induction and just before intubation (T2), one (T3), two (T4), three (T5), four (T6) and five (T7) minutes after OETI. Duration of laryngoscopy (DOL) and response of the patient during OETI[12] were observed at the time of intubation. Neuromuscular monitoring, an important in assessing the depth of block produced by neuromuscular muscle relaxants was not used in the present study due to its non-availability. Anaesthesia was maintained with 50% Oxygen, 50% nitrous oxide and halothane 0.5% after intubation for 5 minutes with positive pressure ventilation. No noxious stimulus was allowed during the study period of 5 minutes after intubation.

Statistical analysis

Categorical values like sex, MPG,[11] Cormack-Lehane grade (CL grade)[13] were analyzed using chi-square test. Comparison between two groups with respect to continuous variables such as age, heart rate, blood pressure and DOL were compared with student t-test. Intra-group comparison was done with repeated measures analysis of variance (ANOVA) with baseline value as control and post-hoc Bonferroni test. A p-value of less than 0.05 was considered as statistically significant. Statistical analysis was done by using Statistical Packages for Social Sciences (SPSS), version 11.5 software (SPSS Inc; Chicago).

RESULTS

Both groups were comparable demographically and we did not[11] find any difference in MPG,[11] CL grade[13] and duration of laryngoscopy (Tables 1 and 2). In group S, 20 patients had excellent intubating conditions, 5 patients had good intubating conditions and none of the patients had poor intubating conditions. In group R, 10 patients had excellent intubating

Table 1: Comparison of demographic data

Variables	Group S (n=25)	Group R (n = 25)	p-value
Age (Years)*	37.6 (11.8)	41.3 (11.6)	0.273
Weight (Kg)*	57.6 (12.0)	56.6 (10.8)	0.768
Sex (Males:Females)	12:13	13:12	>0.99
Mallampati Grade[11] (No.)			
I	21	22	>0.99
II	04	03	
Cormack Lehane Grade [13](No.)			
I	14	15	>0.99
II	11	10	
III	00	00	
IV	00	00	

*Data are presented as mean ± standard deviation

Group S = suxamethonium + saline; Group R = rocuronium + ephedrine

Table 2: Intubating conditions and duration of laryngoscopy

Variables	Group S (n = 25)	Group R (n = 25)	p-value
Intubation conditions*			
0	0	01	0.014
1	5	14	
2	20	10	
Duration of laryngoscopy (sec)†	18.7 (6.8)	19.3 (8.4)	0.768

*as per the intubation scoring system (reference 11)
† = data are presented as mean ± standard deviation
Group S = suxamethonium + saline; Group R = rocuronium + ephedrine; 0 = poor intubating conditions; 1 = good intubating conditions; 2 = excellent intubating conditions

conditions, 14 patients had good intubating conditions and one patient had poor intubating conditions. Although both groups had clinically acceptable intubating conditions (good and excellent) (Table 2), a significantly higher number of patients in Group S had a better intubation score (p=0.014).

In both the groups there is a significant variability in the heart rate (HR) across the group (Figure 1). In group S the raise in the HR was significant at one minute after intubation but return to baseline value at the end of study period (T7). In group R, the raise in HR was significant in comparison to baseline value from one minute after intubation (T3) to fifth minute after intubation (T7). But the final HR (T7) is well within the predefined clinical limits (30% of the baseline value).

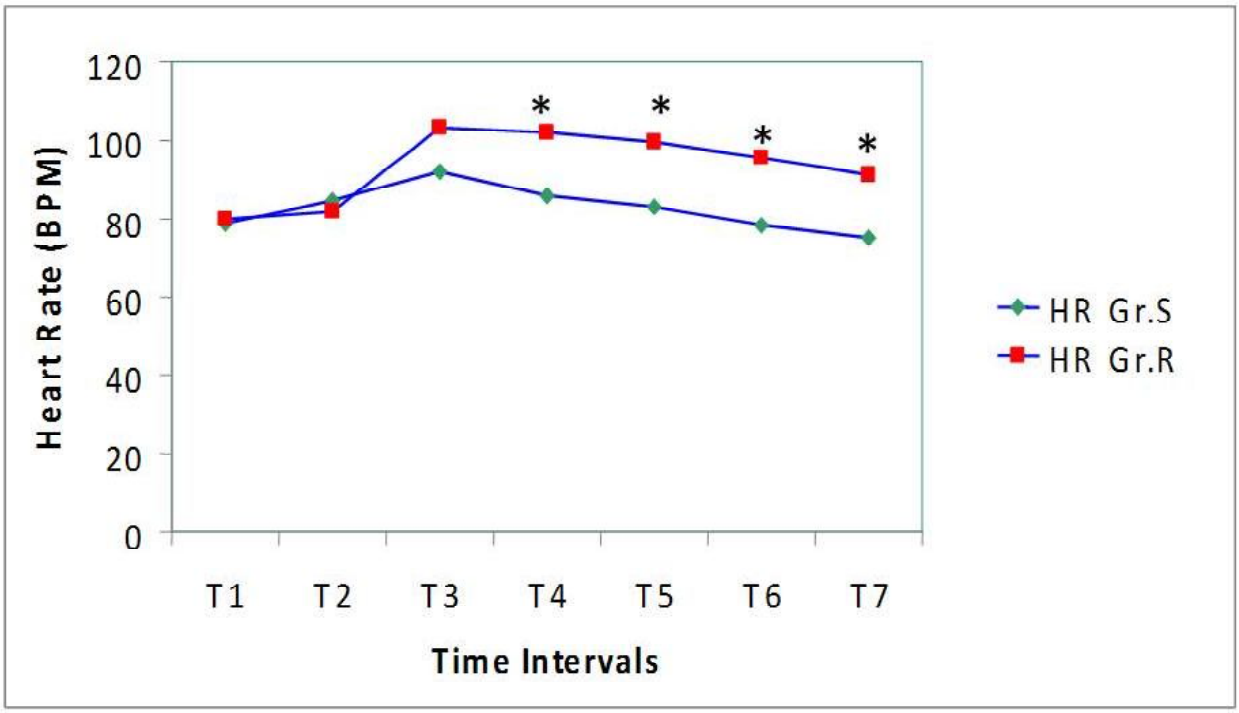

Figure 1: Changes in heart rate

*p <0.05
T1 = baseline; T2 = before intubation; T3 = one minute after intubation; T4 = two minutes after intubation; T5 = three minutes after intubation; T6 = four minutes after intubation; T7 = five minutes after intubation; Gr.S = suxamethonium + saline; Gr.R = rocuronium + ephedrine; BPM = beats per minute; HR = heart rate

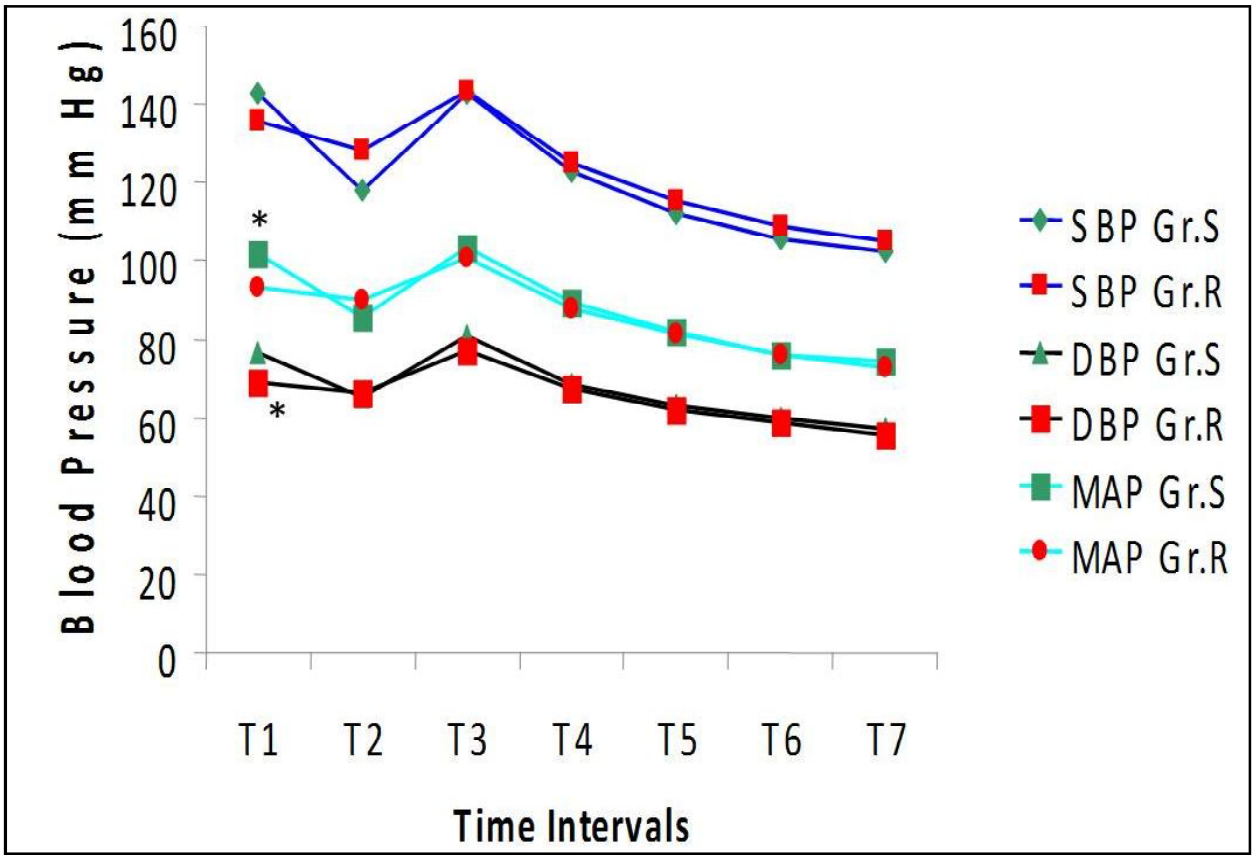

Figure 2: Changes in blood pressure

*p < 0.05

T1 = baseline; T2 = before intubation; T3 = one minute after intubation; T4 = two minutes after intubation; T5 = three minutes after intubation; T6 = four minutes after intubation; T7 = five minutes after intubation; Gr.S = suxamethonium + saline; Gr.R = rocuronium + ephedrine; BPM = beats per minute; HR = heart rate; SBP = system blood pressure; DBP = diastolic blood pressure; MAP = mean arterial pressure

In group S, the fall in SBP), DBP and MAP (Figure 2) was significant at T2, T4, T5, T6 and T7 time intervals. In group R, the fall in SBP and MAP was significant at T5, T6 and T7 value in comparison to baseline value, whereas the fall in DBP was significant only at T5 and T7 in comparison to baseline value but the changes in SBP, DBP and MAP from the baseline after study drug administration is well within the predefined clinical limits (30% of the baseline value) (Figure 2).

DISCUSSION

In this study we tried to find out whether ephedrine pretreatment improved the intubating conditions with conventional dose of rocuronium 0.6 mg/kg. Both groups had clinically acceptable intubating conditions (good and excellent) (Table 2), but in group S, there was statistically significant number of patients had better quality of intubation score (p=0.014) compared to group R. When compared clinically HR, SBP, DBP, and MAP values are within 30% from the baseline value in both groups.

In the literature various techniques have been described to improve the intubating conditions with rocuronium like, priming technique,[14] by using high dose of rocuronium,[2,3] by combinations of neuromuscular blockers,[14] by using different induction agents[8,16-19] and some other studies[4-7,10,20-23] also described that ephedrine pre-treatment to counteract the hypotension which follows after induction of anaesthesia. The hypothesis that manipulation

of cardiac output with esmolol or ephedrine affects the onset time of rocuronium was addressed in one study.[5] Pre-treatment with ephedrone or esmolol appeared to affect the onset time of rocuronium by altering cardiac output as measured with the non-invasive cardiac output monitor. In a study[23] assign the effects of ephedrine on intubating conditions following priming with rocuronium it was observed that ephedrine in combination with propofol significantly improved clinical intubating conditions at 30 seconds following priming with rocuronium compared with priming with ephedrine without priming. In a study[10] to evaluating the effect of ephedrine administered prior to induction of anaesthesia on the onset time of suxamethonium for endotracheal intubation concluded that the onset time of succinylcholine can be shortened with ephedrine pre-treatment. Based on observation from the earlier studies[5,10,23] we decided to use ephedrine pre-treatment in our study to improve the rocuronium intubating conditions. One study[7] compared the effect of pre-treatment with ephedrine 75, 100, 150 µg/kg and saline on intubating conditions and haemodynamics during rapid tracheal intubation using propofol and rocuronium. The authors[7] concluded that ephedrine either 75 or 100 µg/kg given before rapid tracheal intubation using propofol and rocuronium improved the intubating conditions but was not effective in preventing the hypotension which follows induction of anaesthesia with propofol. The authors[7] also said that increasing the dosage of ephedrine from 100 to150 µg/kg did not improve the intubating conditions. Probably, ephedrine in the excess dosages may produce vasoconstriction of blood vessels supplying laryngeal muscles, thus limiting the access of the relaxant to its site of action. That is why we chose to administer a dose of 100 µg/kg of ephedrine. But we wanted to compare the intubating conditions of rocuronium with ephedrine pre-treatment with that of suxamethonium which is considered as "gold standard". Both groups had clinically acceptable intubating conditions and only one patient had poor intubating condition in Group R. However, in terms of intubation scores, suxamethonium group had better intubation scores confirming that suxamethonium is still the "gold standard" for tracheal intubation. However, rocuronium with ephedrine pre-treatment can be used as an alternative to suxamethonium. The two main limitations of this study are: first though important, we have not monitored cardiac output during study period. Secondly, though neuromuscular monitoring is important in assessing the depth of block produced by neuromuscular blocking drugs we have not used neuromuscular monitoring in our study, cardiac output monitoring and neuromuscular monitoring could not be done due to non-availability of equipment needs for the same.

In cases where suxamethonium is contraindicated, rocuronium with ephedrine pre-treatment may be used for intubation, though the quality of intubation is slightly poor but still clinically acceptable. However caution need to be exercised while using this (rocuronium with ephedrine pre-treatment) technique in patients in whom raising HR and blood pressure is not desirable such as patients with ischaemic heart disease.

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