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Timing Principle and Rapid Sequence Intubation: A Preliminary Study

KEYWORDS: Vecuronium, Non-depolarizing muscle relaxant, Timing principle, Rapid tracheal intubation

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ABSTRACT **Background and objectives:** *Rapid sequence induction-intubation(RSI) is very important in general anesthesia(GA) for safety of the patients. The Timing principle uses a single intravenous (IV) bolus dose of non-depolarizing muscle relaxant followed by induction drug at the onset of clinical weakness. This method can be used for RSI.*

Methodology: *40 patients were equally divided into two groups, group S and group V. Group S received succinylcholine 1.5mgkg-1 and group V vecuronium 0.1 mgkg-1. Intubating conditions were assessed in both the groups according to a grading scale and hemodynamic response to intubation was compared at 1, 3 and 5 min after intubation.*

Results: *Using timing principle intubating conditions with vecuronium were excellent in 75% and good in 25% patients. There was statistically significant increase in pulse rate and blood pressure at one minute after intubation but these parameters rapidly decreased at 3 and 5 minute after intubation. These observations were comparable to those seen with succinylcholine.*

INTRODUCTION

Tracheal intubation becomes easy, smooth and non-traumatic if there is profound muscle relaxation with adequate jaw opening, fully abducted vocal cords and adequate depth of anesthesia. The skill of anesthesiologist is also important[1]. For rapid sequence induction-intubation(RSI) we need a muscle relaxant with rapid onset and short duration of action. Succinylcholine, a depolarizing muscle relaxant has been extensively used for this purpose as it produces ideal intubating conditions within 60 seconds of its administration. However its use is associated with serious side effects and it is contraindicated in certain patients[2]. Non-depolarizing muscle relaxants (NDMRs) can also be used for intubation but their onset of action is 2-3 minutes and therefore these are not suitable for RSI. Various techniques used to decrease effective onset time of NDMRs include priming[3] and administration of a large dose[4]. A technique of "Timing principle" has also been used to produce good intubating conditions rapidly. In this technique a single bolus dose of a NDMR is administered intravenously(IV) and general anesthesia(GA) is induced at the onset of clinical weakness. Thus time from induction of GA to full muscle relaxation is reduced and the peak effect of the relaxant and IV induction drug may more closely coincide[5]. Vecuronium is a NDMR having onset of action 3 min and intermediate duration of action. In this preliminary, prospective randomized clinical study we have evaluated intubating conditions 45-60 sec after induction of GA using vecuronium with timing principle and compared them with succinylcholine. We also compared pulse rate(PR) and blood pressure changes at 1, 3 and 5 min after intubation.

METHODOLOGY

Following approval from medical ethics committee of our institute and an informed patients' consent we studied 40 ASA I and II (American Society of Anesthesiologists) patients of either sex ranging from 21 to 75 years of age. Patients having difficult airway problem were excluded from the study. All the patients were posted for major occuloplasty surgeries of approximately 60-75 min duration. These patients were subjected to thorough pre-anesthetic evaluation including essential investigations prior to surgery. Patients were then randomized into two equal groups by computer generated random numbers; Group S (n=20) and Group V (n=20) according to IV administration of succinylcholine and vecuronium for tracheal intubation.

All the patients of both the groups were uniformly pre medicated with glycopyrrolate 0.2mg, pentazocine 0.3mg/kg and midazolam 0.02mg/kg body weight (maximum 1mg.) IV 5 min prior to induction of GA. Base line vital parameters, namely, electrocardiogram (ECG), pulse rate(PR), systolic and diastolic blood pressure(SBP, DBP) and peripheral arterial oxygen saturation(SPO_2) were noted prior to premedication. The same parameters were recorded prior to induction of GA. In group S patients, following induction of GA with IV propofol 2.5 mg/kg body weight, succinylcholine 1.5mg/kg (maximum 100mg) was injected IV to facilitate tracheal intubation. Laryngoscopy was initiated at 45 sec of administration of succinylcholine with conventional laryngoscope in order to complete intubation within

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60 sec from the time of completion of succinylcholine injection. Intubating conditions were assessed using a grading scale as given by International Consensus Conference 1994[6]. Changes in hemodynamic parameters (PR, SBP, DBP) were also recorded at 1, 3 and 5 min after intubation.

In group V patients, a calculated dose of vecuronium ($0.1mgkg^{-1}$) was given IV and they were closely observed for onset of ptosis which was taken as onset of clinical weakness. At this point of time fall in SPO_2 if any was also noted. In all patients oxygenation was started with face mask using 100% oxygen and GA was induced with propofol 2.5mg/kg followed by intubation in a similar fashion as in group S. Intubating conditions and hemodynamic changes were also noted as in group S.

Subsequently surgery was allowed to proceed under conventional balanced GA and monitoring of PR, SBP, DBP, ECG and SPO_2. Dextrose Normal Saline (DNS) was used as maintenance fluid during surgery. At the end of surgery residual effect of vecuronium was reversed with combination of neostigmine with glycopyrrolate in a usual dose. The patients were then shifted to Post Anesthesia Care Unit (PACU) for further management.

RESULTS

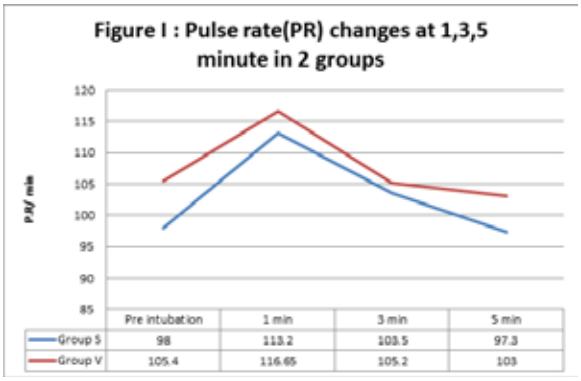
Both the groups were comparable with regard to age, body weight and sex distribution . Intubating conditions were graded as excellent in 16 (80%) patients and good in 4 (20%) patients of succinylcholine group (Table I) .

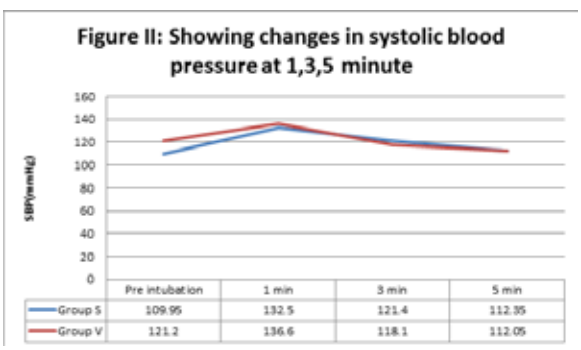
Table I: Intubation Conditions

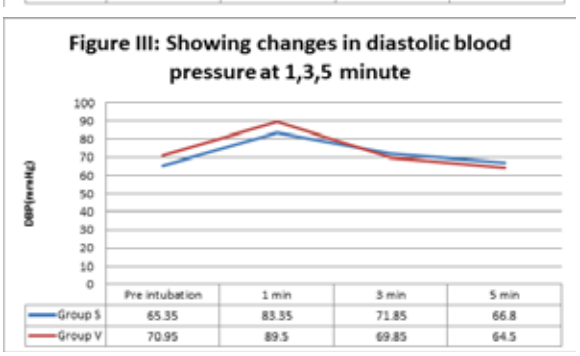
Group	Excellent	Good	Poor
S (Succinylcholine)	16(80 %)	4 (20 %)	0
V (Vecuronium)	15(75%)	5(25%)	0
P value < 0.05			

Out of these 4 patients one patient reacted to laryngoscopy with limb movements, in one patient external pressure had to be applied by the assistant to facilitate visualization of vocal cords, one patient had coughing on intubation and in one patient vocal cords were in intermediate position and not fully abducted though intubation was possible. In vecuronium group (Table I) Intubating conditions were excellent in 15 patients (75%) and good in 5 patients (25%) Out of these 5 patients three patients reacted to intubation with movements of upper limbs and in one of these patients vocal cords were partially abducted, one patient had moving vocal cords visualized at laryngoscopy and one patient had bucking on intubation. In all these patients intubation was possible without any difficulty. Intubating conditions were comparable in both the groups with no statistically significant difference.

Pulse rate, systolic and diastolic blood pressure were significantly more in both the groups at 1 minute after tracheal intubation($P<0.05$) as compared to pre intubation values. However there were no statistically significant changes in these parameters at 3 and 5 min following intubation ($P>o.o5$) and these hemodynamic variables had reached near the base values by 5 min post intubation in both the groups.







DISCUSSION

Neuromuscular blocking drugs are used to facilitate intubation following induction of GA and to provide adequate relaxation during surgery[6]. The ideal muscle relaxant should have a rapid onset and short duration of action and devoid of adverse hemodynamic effects. Succinylcholine has been used since the time of its introduction in clinical practice as it produces ideal intubating conditions within 60 sec of its IV administration but it can produce serious side effects and is contraindicated in certain patients[2]. So we need a drug to substitute succinylcholine which can produce similar intubating conditions as fast as succinylcholine but without any side effects. With this objective in mind this small preliminary study was conducted using vecuronium in terms of intubating conditions and hemodynamic changes compared to that of succinylcholine.

The time interval between loss of consciousness of patient at induction of GA and intubation is a critical period as there is a risk of regurgitation and pulmonary aspiration of gastric contents due to attenuation of protective reflexes[7]. The techniques like priming principle[3] and administration of large dose of non-depolarizing muscle relaxant[4] have been used to reduce the effective onset time of these relaxants for intubation. A technique of "timing principle" has been used with atracurium[7] and rocuronium[5] to rapidly produce good intubating conditions.

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In the present study we have administered vecuronium 0.1 $mgkg^{-1}$ body wt. using timing principle and intubation was done within 60 sec after induction with propofol. We observed excellent to good intubating conditions in all the patients which were comparable to succinylcholine. The difference between the two groups was statistically not significant. None of the patients under study had poor intubating conditions.Chatrath V and Singh I et al[8] also compared intubating conditions with rocuronium and vecuronium using timing principle and compared the same with succinylcholine and observed that intubating conditions with vecuronium 0.12 $mg.kg^{-1}$were excellent in 48% and good in 48% of patients. Thus total 96% patients showed good to excellent intubating conditions. They used a higher dose of vecuronium as compared to the dose used in our study. They also used nerve stimulator to assess "Train Of Four" (TOF) count at adductor policis muscle. Their results are comparable to those observed in our study.

We have used ptosis as the first clinical sign of muscle weakness after administration of intubating dose of vecuronium as we did not have " Train of four " facility in our set up for monitoring neuron- muscular blockade. Koh and Chen[7] also used ptosis as the marker for onset of clinical weakness postulating that onset time for neuromuscular block at levator palpebrae superioris would be similar to that in orbicularis oculi and therefore that in the diaphragm.

In our study PR, SBP and DBP all increased at one minute after intubation in both the groups due to stress response of intubation but all these parameters returned to near base line values from 3 min onwards and remained within normal range thereafter indicating hemodynamic stability following intubation in both the groups. Observations made by Chatrath V and Singh I et al are also consistent with our results

It may be concluded that using "Timing Principle" vecuronium 0.1$mgkg^{-1}$ produces intubating conditions within 60 sec and hemodynamic stability comparable to succinylcholine. So vecuronium can be used as a suitable alternative to succinylcholine for rapid tracheal intubation especially in patients in whom it is contraindicated. The limitations of this study were that, this study was conducted on small number of cases and we did not have neuromuscular monitoring device with us. We plan to do more number of cases in future to confirm our results.

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