COMPARISON OF 0.3MG/KG, 0.6MG/KG AND 1.0MG/KG SUCCINYLCHOLINE IN PRODUCING ACCEPTABLE INTUBATING CONDITIONS AMONG ADULT PATIENTS AT THE JOS UNIVERSITY TEACHING HOSPITAL.

[1]Angashang L.A.I, [1]Isamade E.S, [2]Amanor-Boadu S.D.

[1]Department of Anaesthesia, Jos University Teaching Hospital, Jos, Nigeria.
[2]Department of Anaesthesia, College of Medicine, University College Hospital, Ibadan, Nigeria.

ABSTRACT

BACKGROUND: Succinylcholine at 1.0 mg/kg usually provides acceptable tracheal intubation condition within 60 seconds. The return of respiratory function following this dose is not quick enough to prevent oxyhaemoglobin desaturation when ventilation is not assisted. This randomized, double blind study was conducted to investigate if smaller doses of succinylcholine can provide acceptable intubating conditions.

METHODS: 180 patients, aged 18-65 years were randomly assigned to three groups A, B or C to receive 0.3, 0.6, or 1.0 mg/kg succinylcholine respectively. Anaesthesia was induced in all patients with 2µg/kg fentanyl and 2 mg/kg propofol. Following induction, they received the appropriate dose of succinylcholine according to allocated group. Tracheal intubation was performed 60 seconds later. A blinded investigator performed laryngoscopy and graded the intubating conditions.

RESULTS: Intubating conditions were acceptable in 91.7%, 96.7%, and 96.7% after in group A, B and C respectively. There was no significant difference between group A and B (p=0.235) and between group A and C (p=0.235). Group B and C equally showed no significant difference (p=1.00).

CONCLUSIONS: The use of 0.3mg/kg and 0.6 mg/kg succinylcholine can produce acceptable intubating conditions after 60 seconds following administration. We therefore recommend that 0.6mg/kg of succinylcholine may be administered to patients in order to achieve acceptable tracheal intubation.

KEYWORDS: succinylcholine, tracheal intubation,

NigerJmed2019: 232- 236
© 2019. Nigerian Journal of Medicine

INTRODUCTION

Succinylcholine is the muscle relaxant of choice when intense neuromuscular blockade of rapid onset and short duration is required.[1]It is not clear why the 1 mg/kg dose of succinylcholine has been traditionally used for tracheal intubation. Foldes and McNall[2] took note that doses less than 1 mg/kg allow only 60-90seconds for intubation when a single intravenous dose is administered. The effective dose of succinylcholine in 95% of the population (ED_{95}) is less than 0.3 mg/kg and 1mg/kg dose represents about 3.5 times the ED_{95} according to Kopman et al who demonstrated that anaesthetists use an unnecessarily large dose of succinylcholine.[3] Hunter JM in the 4th edition of Clinical Anesthesiology was also of the opinion that overdosing with neuromuscular drugs was a 'universal foible'.[4]

The question of the right dose to obtain adequate intubating conditions has not been addressed until recently. The intubating conditions depend on several factors, including the type of anaesthetic used, the depth of anaesthesia, the interval between drug administration and laryngoscopy, the dose of the muscle relaxant given, the anatomy of the airways, and the experience of the person performing the intubation.[5]

An earlier return of neuromuscular function following low dose succinylcholine is highly desirable, especially in instances where the anaesthetist is less certain of absolute control of the airway. Unfortunately, there is limited available studies documenting acceptable intubating

Correspondence to: Dr Lucky Awedek Ishaku Angashang
P.O.Box 8043, Anglo-Jos
Department of Anaesthesia, Jos University Teaching Hospital,Jos, Nigeria.
Tel: +234 803 317 5057
E mail: angashang@gmail.com

conditions when lower than 1 mg/kg doses of succinylcholine are used to achieve endotracheal intubation. This randomized, controlled double blind study aims to find out if lower doses of succinylcholine will provide acceptable intubating conditions.

PATIENTS AND METHODS

After institutional ethical committee approval, and written informed consent were obtained, we studied 180 ASA I or II adult patients, aged 18-65years and with no significant comorbidities, all scheduled for elective surgical procedures requiring general anaesthesia and tracheal intubation. Using a table of random numbers, the patients were randomly allocated to 3 groups of 0.3mg/kg, 0.6mg/kg and 1.0mg/kg with 60 patients in each group.

Patients with reactive airway, neuromuscular, renal or hepatic disease were excluded. Also excluded were those with a history of drug or alcohol abuse, delayed recovery from succinylcholine, hiatal hernia, moderate or significant cardiovascular disease as well as those that had received sedative or narcotic drugs in the preceding 24 hours and those with anticipated difficult airway.

No premedication was administered. An infusion of Ringer's Lactate and standard monitoring (using the DASH 4000 multi parameter monitor by GE Medical systems) were commenced before the induction of anaesthesia. After pre-oxygenation for 3minutes, anaesthesia was induced with 2ug/kg of fentanyl and 2mg/kg propofol (combined with 1ml of 1.0% lidocaine) intravenously.

Following loss of consciousness, one of the following doses of succinylcholine was administered as a bolus IV according to preoperative group allocation: 0.3mg/kg, 0.6mg/kg or 1.0mg/kg succinylcholine.

Tracheal intubation sequence was commenced 40-45 seconds after the administration of succinylcholine. The head was positioned in the sniffing position, laryngoscopy was started at 50seconds using a size 3 Macintosh blade and tracheal intubation performed at 60 seconds after succinylcholine administration. Cuffed endotracheal tubes of sizes 7mm and 8mm internal diameter were used respectively in female and male patients.

The criteria of good clinical research practice were used for grading tracheal intubation conditions.[6] Intubating conditions were scored excellent if all variables were excellent. If any variable was not excellent, intubating conditions were considered good. If one variable was poor, the intubating conditions were scored poor. Intubating conditions were grouped as 'Acceptable' if they were graded as excellent or good. Where they were graded as poor, they were classified as 'Unacceptable'. The investigator performing the intubation and grading intubation conditions was an experienced anaesthetist, who was blinded to which group the patients were assigned.

Where tracheal intubation proved difficult, an additional dose of succinylcholine 0.6mg/kg was given, preceded by IV atropine 0.01mg/kg and the patient was ventilated by face mask for 1 minute, after which tracheal intubation was re-attempted and these patients were recorded as 'failed intubation'.

After orotracheal intubation, ventilation was gently assisted manually to maintain end-tidal carbon-dioxide between 35 and 40mmHg. Anaesthesia was maintained with isoflurane 0.75% and oxygen 40% in nitrous oxide. Surgery was commenced at the end of the study period following which non-depolarizing neuromuscular blockers were administered as necessary. All patients were followed up for any adverse effects.

Data was collected on predesigned proforma and analyzed using epidemiological software, EPI info version 3.5. Data were analyzed with analysis of variance and chi-square or Kruskall-Wallis test where appropriate. Numerical data were expressed as mean ± SD. Categorical data were expressed as numbers and percentages. Statistical significance was established at $P<0.05$.

Assessment of Intubation Conditions[6]

	Intubation conditions*		
	Clinically acceptable		Unacceptable
Variable/criterion	Excellent	Good	Poor
Ease of laryngoscopy (jaw relaxation)	Easy	Fair	Difficult
Vocal cord position	Abducted	Intermediate	Closed
Vocal cord movement	None	Moving	Closing
Airway reaction/Coughing	None	Diaphragm	Sustained>10s
Movement of limbs	None	Slight	Vigorous

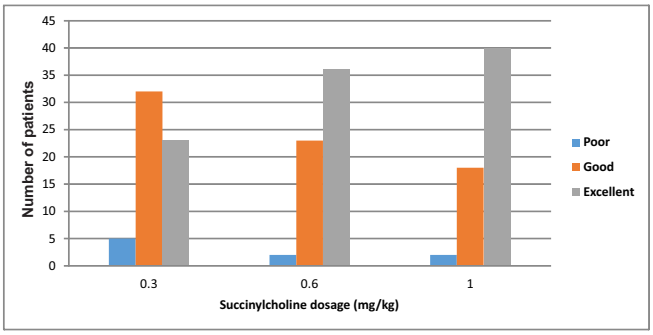
*Intubation conditions: Excellent = all variables are excellent; Good= all variables are either excellent or good; Poor= the presence of one or more variable graded as poor.

#Laryngoscopy: Easy= jaw relaxed, no resistance to blade during laryngoscopy; Fair= jaw not fully relaxed, slight resistance to blade; Difficult= poor jaw relaxation, active resistance by the patient.

RESULTS

A total of one hundred and eighty patients were recruited for the study with sixty in each group. There were no drop outs. A comparison of the demographic data, including age, sex, weight and height is shown in Table I. There were no significant differences in the age, sex, weight and height of the patients in the three groups (p >0.05). Figure 1 is a chart of intubating conditions amongst the three groups of patients. Table II compares the intubating conditions in the three groups of patients. Tracheal intubation was accomplished in all patients and none required an extra dose of succinylcholine. The incidence of acceptable (excellent plus good grade combined) intubating conditions was high in patients receiving all three doses of succinylcholine; 0.3 mg/kg, 0.6 mg/kg and 1.0 mg/kg (91.7%, 96.7% and 96.7% respectively, p=0.349). There was a significant difference in intubating conditions across all groups (p=0.025). There was a statistically significant difference in intubating conditions between Group A and B (p=0.041) and between Group A and Group C (p=0.005) while there was no difference between group B and group C (p=1.000).

Figure 1: Intubating conditions with different doses of succinylcholine; 0.3, 0.6 and 1.0mg/kg. (n=60 in each group).



P value= 0.025 (ANOVA across the 3 groups)
T-test – Group A vs Group B; p=0.041
Group A vs Group C; p=0.005
Group B vs Group C; p=1.000

Table 1: Comparison of Demographic data of patients receiving different doses of succinylcholine before Oro-tracheal Intubation.

	Succinylcholine dose (mg/kg)			Test statistic		p value
	Group A (0.3)	Group B(0.6)	Group C(1.0)			df
n	60	60	60			
Age (yrs)	35.9±8.7	38.8±14.8	36.7±11.5	F statistic	0.3788	2
Sex (M/F)	29/31	30/30	29/31	x^2=0.0445	0.9780	2
Weight (kg)	61.3±8.9	61.9±9.5	63.1±14.4	F statistic	0.6719	2
Height (cm)	169.5±3.9	170.1±5.6	170.4±6.4	F statistic	0.4087	2

Data appear as mean ±SD.

Table 2: Comparison of intubating conditions in patients receiving different doses of succinylcholine.

	Group A (0.3) n=60	Group B(0.6) n=60	Group C(1.0) n=60	X^2	df	P Value
Intubating Conditions.	n (%)					
Excellent	23(38.4)	36 (60.0)	40(66.7)	11.121	4	0.025
Good	32(53.3)	22(36.7)	18(30.0)			
Poor	5(8.3)	2(3.3)	2(3.3)			

Data appear as number (%) .
Group A vs Group B; p=0.041
Group A vs Group C; p=0.005
Group B vs Group C; p=1.000

Acceptable intubation (incidence)	91.7%	96.7%	96.7%	2.105	2	0.349

Group A vs Group B; p=0.235
Group A vs Group C; p=0.235
Group B vs Group C;p=1.000

DISCUSSION

The reported range of acceptable intubating conditions following administration of 1.0 mg/kg succinylcholine is between 91.8% to 97%.[7-11] Compared to the conventional intubating dose of 1.0 mg/kg succinylcholine, this study found that a reduction in succinylcholine dose to 0.6 mg/kg provided similar incidence of acceptable intubating conditions as 1 mg/kg within 60 seconds (p=1.000). The dose of 0.3 mg/kg succinylcholine achieved acceptable intubating conditions at 60 seconds in 91.7% of patients anaesthetized with 2 µg/kg fentanyl and 2 mg/kg propofol while 0.6 mg/kg succinylcholine achieved 96.7% acceptable intubating conditions, compared to 96.7% in the 1 mg/kg group. There was no significant difference between Group A and Group C and between the Group B and Group C. This demonstrates that 0.6 mg/kg succinylcholine is as effective as the 1.0 mg/kg dose in producing ideal intubating conditions.

There is ample evidence in the literature which suggests that acceptable intubating conditions may be achieved with lower doses of succinylcholine. This was probably not appreciated previously because the conventional dose of 1.0 mg/kg had a reliable effect and it was thought that lower doses might not be as reliable.

Succinylcholine will produce similar intubation conditions irrespective of the induction agent used. Following induction with thiopentone, propofol and etomidate in different group of patients, El-Orbany et al showed that there was no statistically significant difference in intubation conditions after succinylcholine administration.[12] Co-administration of opioids at induction can improve

intubating conditions.[13] Fentanyl was added in this study to attenuate the pressor response to laryngoscopy and intubation. This may have contributed to the high incidence of acceptable intubation conditions we observed with a small dose of succinylcholine.

Naguib et al in a study involving 200 patients in Saudi Arabia, reported that 0.3 mg/kg and 0.5 mg/kg succinylcholine equally provided as 1.0 mg/kg succinylcholine, acceptable intubating conditions within 60seconds.[5] In a randomized, double-blind study, following induction of anaesthesia with 2 μg/kg fentanyl and 2 mg/kg propofol, acceptable intubating conditions (excellent plus good) were observed in 92%, 94%, and 98% of patients who received 0.3, 0.5, and 1.0 mg/kg succinylcholine respectively ($P < 0.05$) compared with those in the control group who received a placebo. They concluded that the use of 1.0 mg/kg of succinylcholine may be excessive if the goal is to achieve acceptable intubating conditions within 60 seconds. They recommended the use of 0.5-0.6 mg/kg succinylcholine to facilitate tracheal intubation in rapid sequence induction. Comparing 2 different doses of succinylcholine (0.5 mg/kg and 1.5 mg/kg), Stewart et al demonstrated that the lower dose of succinylcholine provides clinically adequate intubating conditions for most elective cases.[14]

They had earlier studied the 0.5 mg/kg and 1.5 mg/kg doses of succinylcholine in 67 dental patients. They reported clinically adequate intubating conditions for the majority of elective cases, the incidence increasing from 56% to 85% respectively. A latter study by Naguib et alshowed that increasing the dose to 1.5 mg/kg and 2.0 mg/kg resulted in a marginally increased excellent intubating condition from 80% to 86.7%.[15] They observed that there is probably no advantage in exceeding the 1.5 mg/kg dose of succinylcholine. They concluded in consonance with most findings that a succinylcholine dose of 0.5 mg/kg is adequate for achieving clinically acceptable (excellent or good) condition for routine tracheal intubation within 60 seconds.

El-Orbany et al also reported that intubation conditions after 0.6 mg/kg succinylcholine were identical to those obtained using the traditional 1.0 mg/kg dose.[7] In a study involving 115 patients who were induced with fentanyl/propofol and randomly allocated to 5 groups, acceptable intubating conditions were achieved in all patients receiving 0.5, 0.6 and 1 mg/kg dose of succinylcholine.

In this study, 1.0 mg/kg succinylcholine was associated with a 66.7% incidence of excellent intubating conditions compared with 38.4% for 0.3 mg/kg and 60.0% for 0.6 mg/kg. Reported incidence of excellent intubating conditions varies between 63% to 74% following administration of 1.0 mg/kg succinylcholine.[9,11,16] Depending on the clinical situation, the dose of succinylcholine may need to be individualized, such as in laryngospasm where a lower dose will usually be adequate to relax the vocal cords. "Excellent", rather than "Acceptable" conditions for intubation may be ideal in cases of 'full stomach' to ensure a rapid airway control.

Smaller doses of succinylcholine have been shown to have a reduced duration of action. [5,13] This study observed that a dose of 0.6mg/kg provides similar intubation conditions as the conventional 1mg/kg. This will be beneficial in situations where the intubationist is unable to intubate the patient as the quick recovery from the block will likely prevent catastrophic desaturation in such patients.

This study did not assess the duration of action of the three doses.

CONCLUSION

The lower dose of 0.6 mg/kg succinylcholine produced clinically satisfactory intubation conditions 60 seconds following intravenous administration similar to the traditional 1.0 mg/kg. Though the dose of 0.3 mg/kg also produced a high incidence of acceptable intubation, there was a significant statistical difference between this dose and the 1 mg/kg dose.

The dose of 0.6 mg/kg may be thus considered as an alternative to a 1.0 mg/kg dose for tracheal intubation performed within 60seconds.

From this study, it is therefore recommended that in rapid sequence induction, 0.6 mg/kg intravenous succinylcholine can be administered to facilitate tracheal intubation in patients anaesthetized with 2 ug/kg fentanyl and 2 mg/kg propofol.

Further studies may need to be carried out to assess the duration of action of smaller doses of succinylcholine together with the extent of

desaturation. This may further strengthen the case for using lower doses of succinylcholine to achieve endotracheal intubation especially in situations where difficult intubation are anticipated.

Conflict of interest;

We declare that we have no financial or personal relationship(s) that may have inappropriately influenced us in writing this paper.

REFERENCES

1. Miller RD, Rupp SM, Fisher DM, Cronnelly R, Fahey MR, et al. Clinical Pharmacology of vecuronium and atracurium. Anesthesiology 1984;61:444-453
2. Foldes FF, McNall PG. The use of Succinylcholine for endotracheal intubation. Anesthesiology 1953;14:93-96
3. Kopman AF, Zhaku B, Lai KS. The intubating dose of Succinylcholine: The effect of decreasing doses on recovery time. Anesthesiology 2003;99:1050-1054
4. Hunter JM. Cholinesterase Inhibitors. In Morgan GE, Mikhail MS, Murray MJ. . 4th edn. Clinical Anesthesiology Lange Medical Books/ McGraw-Hill Medical Publishing Division, 2006: chapter 10; pg 232-233.
5. Naguib M, Samarkandi A, Riad W, Alharby SW. Optimal dose of Succinylcholine revisited. Anesthesiology 2003;99:1045-1049
6. Viby-Mogensen J, Engbaek J, Eriksson LI, Gramstad L, Jensen E, et al. Good clinical research practice (GCRP) in pharmacodynamic studies of neuromuscular blocking drugs. Acta Anaesthesiol Scand 1996;40:59-74.
7. El-Orbany MI, Joseph NJ, Salem MR, Klowden AJ. The neuromuscular effects and tracheal intubation conditions after small doses of Succinylcholine. Anesth Analg 2004;98:1680-1685
8. Kirkegaard-Nielsen H, Caldwell JE, Berry PD. Rapid tracheal intubation with rocuronium: a probability approach to determining dose. Anesthesiology 1999;91: 131-136.
9. Blobner M, Mirakhur RK, Wierda JM, Wright PM, Olkkola KT, et al. Rapacuronium 2.0 or 2.5mg/kg for rapid-sequence induction: comparison with succinylcholine 1.0mg/kg. Br J Anesthesiology 2000; 85: 724-731
10. McCourt KC, Salmela L, Mirakhur RK, Carroll M, Makinen MT, et al. Comparison of rocuronium and suxamethonium for use during rapid sequence induction of anaesthesia. Anesthesiology 1998; 53: 867-871
11. Sparr HJ, Mellinghoff H, Blobner M, Noldge-Schomburg G. Comparison of intubating conditions after rapacuronium (Org 9487) and succinylcholine following rapid sequence induction in adult patients. Br J Anaesth 1999; 82: 537-541
12. El-Orbany MI, Joseph NJ, Salem MR. Tracheal intubating conditions and apnoea time after small-dose succinylcholine are not modified by the choice of induction agent. Br J Anaesth 2005; 95: 710-714
13. Beck GN, Masterson GR, Richards J, Bunting P. Comparison of intubation following propofol and alfentanil with intubation following thiopentone and suxamethonium. Anaesthesia 1993; 48: 876-880.
14. Stewart KG, Hopkins PM, Dean SG. Comparison of high and low doses of suxamethonium. Anaesth 1991;46:833-836
15. Naguib M, Samarkandi AH, El-Din ME, Abdullah K, Khaled M, et al. The dose of succinylcholine required for excellent endotracheal intubating conditions. Anesth Analg 2006;102: 151-155.
16. Andrews JI, Kumar N, van den Brom RH, Olkkola KT, Roest GJ, et al. A large simple randomized trial of rocuronium versus succinylcholine in rapid-sequence induction of anaesthesia along with propofol. Acta Anaesthesiol Scand 1999;43: 4-8.