Original Research Article

Indian Journal of Anesthesia and Analgesia
November - December 2019; 6(6) (Part - II): 2163-2167
DOI: http://dx.doi.org/10.21088/ijaa.2349.8471.6619.45

Efficacy of Low-dose Succinylcholine and Low-dose Atracurium in Facilitating I-gel Insertion: A Randomised Comparative Study

Priya Mitali[1], Manjunath AC[2], Suresh G[3]

[1]Resident, [2]Associate Professor, [3]Assistant Professor, Department of Anesthesiology, MS Ramaiah Medical College and Hospitals, Bangalore, Karnataka 560054, India

Abstract

Background: I-gel is being commonly used for safe day care surgeries in today's fast pace world. Muscle relaxants even in low-doses are superior to other agents in facilitating smooth I-gel insertion. *Aims and Objectives:* The present study, aims to compare I-gel insertion conditions with low-dose succinylcholine and low-dose atracurium by assessing jaw relaxation, ease of insertion, hemodynamic changes and complications. *Materials and Methods:* Randomised comparative study conducted on 86 patients of ASA physical status I and II divided into 2 Groups of 43 each by random number tables. Group S received 0.2 *mg/kg* of succinylcholine and Group A received 0.1 *mg/kg* of atracurium. I-gel was inserted by a single investigator and jaw relaxation, insertion conditions and complications were observed. *Results:* Jaw relaxation was comparable in 2 Groups (93.0% had full jaw relaxation in Group A while 97.7% had full jaw relaxation in Group S) with no statistically significant difference. Group A had better ease of insertion than Group S, although difference was not statistically significant (p = 1.00). Hemodynamic response was similar in both the Groups. Post-operative myalgia was seen in 1 subject in Group S (2.3%), and sore throat in 1 subject in Group A (2.3%), statistically being insignificant. *Conclusion:* Both low-dose succinylcholine and low-dose atracurium provide good insertion conditions for I-gel. Low-dose atracurium (0.1 *mg/kg*) is equally effective as low-dose succinylcholine (0.2 *mg/kg*) for I-gel insertion.

Keywords: I-gel; Low-dose succinylcholine; Low-dose atracurium; Insertion conditions.

How to cite this article:

Priya Mitali, Manjunath AC, Suresh G. Efficacy of Low-dose Succinylcholine and Low-dose Atracurium in Facilitating I-gel Insertion: A Randomised Comparative Study. Indian J Anesth Analg. 2019;6(6 Part - II):2163-2167.

Introduction

Supraglottic Airway Devices (SAD) have changed the face of airway management and is now widely used in anesthesia across the globe. As ambulatory surgeries continue to grow over the world, the emphasis on day care anesthesia has increased which in turn has led to increasing use of SAD.[1]

Performing a successful smooth SAD insertion in first attempt may still be challenging at times.[2] Multiple insertion attempts may lead to insertion related morbidities including adverse hemodynamic changes, airway trauma and potential insertion associated reflexes such as coughing, gagging and laryngospasm.[3]

Propofol is considered as the induction agent of choice for SAD insertion as it obtunds oropharyngeal reflexes well.[1] Often though it

Corresponding Author: Manjunath AC, Associate Professor, Department of Anesthesiology, MS Ramaiah Medical College and Hospitals, Bangalore,Karnataka 560054, India.

E-mail: mac_acin@yahoo.co.in

Received on 09.09.2019, **Accepted on** 23.10.2019

has been seen that propofol as a sole agent is not sufficient to prevent patient movement, coughing, and gagging. Additional doses of propofol are required to prevent these undesirable movements and airway reflexes, hence, multiple insertion attempts may be needed.[4]

Using other agents like opioids, lignocaine, benzodiazepines and muscle relaxants facilitate ease of insertion and help in reducing the dose requirement of propofol and prevent some of its side effects like hypotension, and prolonged duration of apnea. Studies have shown that muscle relaxants even in low-doses are superior to other agents to facilitate I-gel insertion.

Existing data suggest that it may be possible to achieve a reasonable rapid onset time and shorter duration of action with small-dose of muscle relaxants as duration of action of muscle relaxant is dose dependent.[5] There are fewer studies comparing low-dose succinylcholine and low dose atracurium in facilitating I-gel insertion. Hence, in the present study we intend to compare low-dose succinylcholine and low-dose atracurium for facilitating I-gel insertion Aim of our study was to compare I-gel insertion conditions with low-dose succinylcholine and low-dose atracurium with objectives being to assess jaw relaxation and ease of insertion and also to assess hemodynamic changes and complications with low-dose succinylcholine and low-dose atracurium.

Materials and Methods

The institutional ethical committee clearance was obtained and study was registered with clinical trial registration of India. The study population consisted of *18–60 years*, ASA I and II patients of either sex who were scheduled for elective surgery under general anesthesia with I-gel at our hospital. Subjects with anticipated difficult airway, full stomach (pregnancy, hiatal hernia) and recent upper respiratory tract infections (within *4 weeks*) were excluded. Pre-anesthetic evaluation of patients satisfying inclusion criteria was done and informed written consent was taken. They were randomly allotted in two Groups by random number table: Group S (succinylcholine *0.2 mg/kg*) and Group A (atracurium *0.1 mg/kg*). On arrival in operating room, pulse oximetry, ECG monitor, NIBP monitor was instituted. Base line heart rate, systolic, diastolic and mean arterial blood pressure was recorded.

All patients were pre-oxygenated with 100% oxygen for *three minutes* and induced with fentanyl *2 mcg/kg* and propofol *2 mg/kg*. Relaxant was given according to the patient's group and ventilated by one of the investigator with 100% oxygen for *60 seconds* in Group S and 180 seconds in Group A. I-gel (according to patient's weight) was inserted with standard technique by another investigator (blind-unaware of the group) and also assessed the conditions during insertion. Successful insertion of I-gel was confirmed by chest rise, air entry and $EtCO_2$. Patients were ventilated with *6–8 ml/kg* of tidal volume and maintained on oxygen and air (1:1) and 2% sevoflurane.

In case of failed I-gel insertion during first attempt, additional dose of propofol (*0.5 mg/kg*) was given and another attempt was made after *60 seconds*. The same investigator inserted I-gel in all the patients and had assessed conditions during insertion. The parameters studied were jaw relaxation, ease of insertion, coughing and gagging and patient's movements. These were graded under 3 point scale based on Solanki *et al*.[6] study as follows;

Scores	3	2	1
Jaw relaxation	full	partial	nil
Ease of insertion	easy	difficult	impossible
Coughing and gagging	nil	mild	vigorous
Patient's movements	nil	moderate	vigorous

Ease of insertion was defined as no resistance to the insertion of device in the pharynx in single attempt.[7] Complications like post-operative myalgia and sore throat was scored according to severity from 1–4 based on Aghamohammadi *et al*.[1] study. Base line heart rate, systolic, diastolic and mean arterial blood pressure were noted down. These parameters were monitored and were recorded after induction and *5 minutes* after insertion. The number of attempts for successful I-gel insertion and additional doses of propofol used was also noted in all the patients.

Statistical Analysis

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance assessed at 5% level of significance. Student *t* - test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two Groups (Inter group analysis) on metric parameters. Chi-square/Fisher Exact test has been used to find the significance of study parameters on categorical scale between

two or more groups, non-parametric setting for Qualitative data analysis. The Statistical software namely SPSS 18.0, and R environment version, 3.2.2 were used for the analysis of the data.

Results

A total of 86 patients were included in data analysis. There were no dropouts. Majority of the subjects belonged to ASA 1 (62.8%) and I-gel size 4 (78%) was mostly used.

Table 1: Demographic data of the two studied groups

	Group A	Group S	Total	*p* - value
Age (*years*)	35.47 ± 12.93	37.28 ± 12.44	36.37 ± 12.64	0.509
Weight (*kg*)	66.93 ± 9.32	60.81 ± 8.47	60.87 ± 8.85	0.952
Height (*cm*)	156.60 ± 8.24	159.72 ± 7.08	159.66 ± 7.63	0.944
BMI (kg/m^2)	23.97 ± 3.46	25.04 ± 3.85	24.00 ± 3.63	0.930
Female	24 (55.8%)	25 (58.1%)	49 (57%)	1.00
Male	19 (44.2%)	18 (41.9%)	37 (43%)	1.00

The two Groups were comparable in regard to demographic data like age, weight, height, BMI and gender with p – value > 0.05 which is statistically insignificant, shown in Table 1.

Full jaw relaxation was seen in 40 subjects in Group A and 42 in Group S with p - value being 0.616. Ease of insertion was comparable between the two Groups. Complications were minimally noted when low-dose muscle relaxant was used. Coughing and gagging, patient movements, post-operative myalgia (POM) and sore throat were comparable in the two studied groups. Only 1 subject required second attempt for insertion in Group S with p value = 1.00 which is statistically insignificant, shown in Table 2.

Both the groups were comparable in terms of hemodynamic parameters like heart rate and MAP noted at baseline, post induction and post insertion with p - value of > 0.05, statistically insignificant. Results from our study shows that both the groups are comparable in terms of demographic data, hemodynamic parameters, insertion conditions and complications.

Discussion

Gentle and successful placement of SAD needs comfortable mouth opening, suppression of airway reflexes. I-gel being an innovative supraglottic airway device has advantages over other SAD.[9]

Sole use of propofol does not always guarantee the successful insertion of SAD. Propofol alone can lead to excessive patient's movements, coughing and gagging. 60% of patients had successful insertion in first attempt in Salem's study.[10] Stonheim found easy insertion of LMA in 62% of patients when only propofol was used.[11] In contrast, in our study 98.8% of patients had successful insertion as propofol was aided with low-dose muscle relaxant.

The use of low-dose neuromuscular blocking drugs is not new. Brain used thiopentone for induction and a small-dose of alcuronium (*0.2 mg/kg*) before LMA insertion.[12] Chui and Cheam found that low-dose mivacurium facilitated insertion of LMA after propofol induction.[13] There was lower incidence of swallowing, coughing, movement, laryngospasm and post-operative sore throat.

Table 2: Various parameters studied in two groups

	Grading	Group A	Group S	Total	*p* - value
Jaw relaxation	1 (nil)	0 (0%)	0 (0%)	0 (0%)	
	2 (partial)	3 (7.0%)	1 (2.3%)	4 (4.7%)	0.616
	3 (full)	40 (93.0%)	42 (97.7%)	82 (95.3%)	
Ease of insertion	1 (impossible)	0 (0%)	0 (0%)	0 (0%)	
	2 (difficult)	0 (0%)	1 (2.3%)	1 (1.2%)	1.000
	3 (easy)	43 (100%)	42 (97.7%)	85 (98.8%)	
Coughing and gagging	1 (vigorous)	0 (0%)	0 (0%)	0 (0%)	
	2 (mild)	1 (2.3%)	1 (2.3%)	2 (2.3%)	1.000
	3 (nil)	42 (97.7%)	42 (97.7%)	84 (97.7%)	
Patient's movements	1 (vigorous)	0 (0%)	0 (0%)	0 (0%)	
	2 (moderate)	7 (16.3%)	3 (7%)	10 (11.6%)	0.178
	3 (nil)	36 (83.7%)	40 (93%)	76 (88.4%)	
POM (Post Operative Myalgia)	1 (no)	43 (100%)	42 (97.7%)	85 (98.8%)	1.000
	2 (yes)	0 (0%)	1 (2.3%)	1 (1.2%)	
Sore throat	1 (no)	42 (97.7%)	43 (100%)	85 (98.8%)	
	2 (yes)	1 (2.3%)	0 (0%)	1 (1.2%)	1.000
No of attempts	1	43 (100%)	42 (97.7%)	85 (98.8%)	
	2	0 (0%)	1 (2.3%)	1 (1.2%)	1.000

Succinylchoiline, a depolarizing muscle relaxant has many advantages over NDMR like rapid onset of action, shorter duration of action. The Effective Dose (ED95) of succinylcholine is less than *0.3 mg/kg*.[14,15] A dose of *1 mg/kg* represents *3.5–4 times* the ED95.[16] Spontaneous recovery from the induced apnea with succinylcholine *1 mg/kg* may not develop fast enough to prevent hemoglobin desaturation in patients with unassisted ventilation in case of unanticipated difficult airway.[17] Smaller dose of succinylcholine may shorten this time of vulnerability.[18] Despite having many advantages succinylcholine is not devoid of side effects like bradycardia, hyperkalemia, masseter spasm, malignant hyperthermia, raised intraocular and itragastric pressure.

Atracurium's recovery time is long but is devoid of succinylcholine above mentioned side effects. A tracurium, particularly in high-doses, has been associated with histamine release, which can rarely lead to bronchospasm and cardiovascular collapse.[19]

Different studies have been conducted with different low-doses of muscle relaxants. Monem compared succinylcholine *0.35 mg/kg* with atracurium *0.06 mg/kg* under thiopentone induction.[20] Ho and Chui used *0.1 mg/kg* succinylcholine and found lesser insertion attempts and smoother insertion.[21] Similarly, Aghamohammadi used *0.1 mg/kg* succinylcholine and found smoother insertion conditions with this mini-dose of succinylcholine.[1]

From previous studies, we inferred that *0.1 mg/kg* of succinylcholine was adequate but higher-dose of propofol requirement was needed, although *0.1 mg/kg* of succinylcholine is effective in relieving laryngospasm. Keeping the day care setting in our mind, we compared $1/5^{th}$ of intubating dose of two muscle relaxants. We compared *0.2 mg/kg* of succinylcholine and *0.1 mg/kg* of atracurium in facilitating I-gel insertion.

Jaw relaxation in our study was similar to study conducted by Korula S., where it was found that jaw relaxation was better in succinylcholine Group (93.3% had good jaw relaxation) as compared to atracurium Group (90% had good jaw relaxation), though statistically being insignificant.[8] But, we observed less number of patients in Group A having partial jaw relaxation as compared to Korula S study. This could have resulted because they inserted the SAD after *1 minute* in both the groups however, we inserted after *1 min* in succinylcholine group and after *3 minutes* in atracurium group, giving time for muscle relaxant to act.

Insertion conditions depend not only on depth of neuromuscular blockade but also on premedication, depth of anesthesia, anatomical factors. It is well-recognized that inhalation agents potentiate the intensity of neuromuscular blockade, prolong the duration of block and may increase the speed of blockade.[22]

Aghamohammadi D. observed higher incidence of gagging in their study when *0.1 mg/kg* of succinylcholine was used.[1] Coughing and gagging are due to stimulation of posterior pharyngeal wall receptors. Low-dose relaxants not causing full muscle paralysis but causes suppression of upper airway reflexes and hence, can help in decreasing coughing and gagging.

In our study, 16.3% (7) subjects in atracurium group had moderate patient's movements while only 7% (3) had in succinylcholine group. This was similar to Solanki S study where moderate patient movements were seen in 13.33% (4 patients) who received *0.2 mg/kg* succinylcholine.[6] Muscle relaxants in low-dose does not cause full paralysis hence, moderate movements were noticed.

Complications like Post-operative Myalgia (POM) and sore throat were studied in both the groups on first post-operative day. In our study, one subject had POM on *day 1* in succinylcholine group. Korula S observed POM in 16.67% in succinylcholine group whereas, 3.3% had in atracurium group.[8] Lower number of POM seen in our study is attributable to lower-dose of Sch (*0.2 mg/kg*) used as compared to Korula S study where *0.35 mg/kg* of Sch was administered. It is possible that factors other than succinylcholine would have caused post-operative muscle pain like position of the patient during surgery as POM was also seen in atracurium group in Korula's study. Waters has hypothesized that post succinylcholine myalgia is due to shearing of soft tissues by asynchronous muscle contractions.[23] So, a lesser dose of the drug will cause less myalgia. Mild fasciculations were seen in 4 subjects in our study but POM was seen only in 1 subject.

Lower incidence of sore throat was observed in our study when compared to other studies, which could be accountable to use of I-gel in our study which is a cuffless SAD. The other reason might be reduced number of attempts and minimal manipulation of upper airway and pharynx.

Conclusion

The use of low-dose muscle relaxant helps in reducing upper airway reflexes and provides

adequate jaw relaxation, which help in easy and smooth insertion of I-gel. It also reduces propofol requirement and number of insertion attempts. From the results of our present study, we concluded that insertion conditions of I-gel were comparable with low-dose of succinylcholine (*0.2 mg/kg*) and low-dose of atracurium (*0.1 mg/kg*).

Low-dose atracurium is equally effective as low-dose succinylcholine and with fewer side effects. So, low-dose atracurium can be used as an alternative to low-dose succinylcholine in cases where succinylcholine is contraindicated. Low-dose muscle relaxant can be used in routine practice for I-gel insertion.

Prior publication: Nil

Support: Nil

Conflicts of interest: None to declare

Permissions: Nil

References

1. Aghamohammad D, Eydi M, Hosseinzadeh H, *et al*. Assessment of "mini-dose" succinylcholine effect on facilitating laryngeal mask airway insertion. J Cardiovasc Thorac Res. 2013;5(1):17–21.
2. Liao AH, Lin Y, Bai C, *et al*. Optimal dose of succinylcholine for laryngeal mask airway insertion: Systematic review, meta-analysis and metaregression of randomised control trials. BMJ Open. 2017;7:e014274.
3. Atalay YO, Kaya C, Aktas S, *et al*. A complication of the laryngeal mask airway. Eur J Anesthesiol. 2015;32(6):439–40.
4. George L, Sahajanandan R, Ninan S. Low-dose succinylcholine to facilitate laryngeal mask airway insertion: A comparison of two doses. Anesth Essays Res. 2017;11(4):1051–56.
5. Ved SA, Chen J, Reed M, *et al*. Intubation with Low-dose Atracurium in Children. Anesth Analg. 1989;68(5):609–13.
6. Solanki S, Solanki N. Comparison of propofol *vs* propofol with low-dose scoline to evaluate LMA insertion. Indian Journal of Clinical Anesthesia. 2015;2(2):97–101.
7. Jadhav P, Dalvi N, Tendolkar B. I-gel *vs* laryngeal mask airway-proseal: Comparison of two supraglottic airway devices in short surgical procedures. J Anesthesiol Clin Pharmacol. 2015;31(2):221.
8. Korula S, Abraham V, Afzal L. Evaluation of low dose succinylcholine for insertion of Laryngeal Mask Airway during thiopentone induction: A comparison with atracurium. J Anesthesiol Clin Pharmacol. 2010;26(3):355–59.
9. Atef H, El-Taher E, Henidak A, *et al*. Comparative study between I-gel, a new supraglottic airway device, and classical laryngeal mask airway in anesthetized spontaneously ventilated patients. Saudi J Anesth. 2010;4(3):131.
10. Salem WT. A comparison of midazolam and mini-dose succinylcholine to aid laryngeal mask airway insertion during propofol anesthesia. J Egypt Natl Canc Inst. 2000;12:65–69.
11. Stoneham M, Bree S, Sneyd J. Facilitation of laryngeal mask insertion. Anesthesia. 1995;50(5):464–66.
12. Brain AIJ. The laryngeal mask: A new concept in airway management. Br J Anesth 1983;55(8):801–05.
13. Cheam E, Chui P. Randomised double-blind comparison of fentanyl, mivacurium or placebo to facilitate laryngeal mask airway insertion. Anesthesia. 2000;55(4):323–26.
14. Smith C, Donati F, Bevan D. Dose-response Curves for Succinylcholine. Anesthesiology. 1988;69(3):338–42.
15. Kopman A, Klewicka M, Neuman G. An Alternate Method for Estimating the Dose-Response Relationships of Neuromuscular Blocking Drugs. Anesth Analg. 2000;90(5):1191–97.
16. Ezzat A, Fathi E, Zarour A, *et al*. The optimal succinylcholine dose for intubating emergency patients: Retrospective comparative study. Libyan J Med. 2011;6(1)7041.
17. Benumof J, Dagg R, Benumof R. Critical hemoglobin desaturation will occur before return to an unparalyzed state following *1 mg/kg* intravenous succinylcholine. Anesthesiology. 1997;87(4):979–82.
18. Heier T, Feiner J, Lin J, *et al*. Hemoglobin desaturation after succinylcholine-induced apnea. Anesthesiology. 2001;94(5):754–59.
19. Siler JN, Mager JG, Wyche MQ. Atracurium. Anesthesiology. 1985;62(5):645.
20. Monem A, Chohan U. Comparison of low-dose succinylcholine with low-dose atracurium to evaluate LMA insertion during thiopentone induction. J Anesthesiol Clin Pharmacol. 2004;20(1):39–44.
21. Ho K, Chui P. The use of mini-dose suxamethonium to facilitate the insertion of a laryngeal mask airway. Anesthesia. 1999;54(7):686–89.
22. Luyk NH, Weaver JM, Quinn C, *et al*. Comparative trial of succinylcholine *vs* low-dose atracurium-lidocaine combination for intubation in short outpatient procedures. Anesth Prog. 1990;37(5):238–43.
23. Waters D, Mapleson W. Suxamethonium pains: Hypothesis and observation. Anesthesia. 1971;26(2):127–41.