AMJ
ISSN: 0005-2523

ISSN: 0005-2523
Volume 63, Issue 01, January, 2023

Comparing the probable complications and hemodynamic changes in Electro Convulsive Therapy under anesthesia with two 0.3 and 0.6 doses of Succinylcholine

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Keywords:
Electroconvulsive therapy, Succinylcholine, hemodynamic changes

ABSTRACT

Electroconvulsive therapy (ECT) is one of the oldest and most effective methods to treat many psychiatric disorders. Succinylcholine is a short-acting depolarizing skeletal muscle relaxant used to relax muscles and facilitate patient control during intubation, mechanical ventilation, and surgical procedures. The aim of this study was to compare the probable complications and hemodynamic changes created as a result of applying 0.3 and 0.6 doses of Succinylcholine in candidates of ECT. In this clinical trial at Isfahan university hospital, 40 ECT candidate patients were randomly divided into two groups of 20 patients receiving 0.3 and 0.6 Milligrams per Kilogram dose of Succinylcholine. The age, sex, height, weight, and body mass index (BMI) of patients were recorded. Before induction of anesthesia (baseline) and 1, 5, 10, and 20 minutes later, symptoms like systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), heart rate (HR) and oxygen saturation (SPO2) measured and compared between two groups. There were no significant differences between the two groups regarding primary data and symptom values (P> 0.05). In patients that received 0.6 mg/kg of Succinylcholine, the prevalence of hypoxia and duration of apnea were significantly higher and the seizure duration was considerably shorter. Administration of Succinylcholine with 0.3 mg/kg lead to fewer complications including frequency and duration of apnea.

1. Introduction

Electroconvulsive therapy (ECT) is one of the oldest and most effective methods to treat many psychiatric disorders, especially when there is no adequate response to other remedy methods or in life-threatening cases [1]. Severe depression, acute schizophrenia, acute mania, and catatonia are the common uses of ECT. It also in patients who need a quick treatment response is the order of choice [2], [3].

The initial stimulation produced by ECT and the resulting seizure, lead to cardiovascular motivation through parasympathetic and then sympathetic stimulation. A considerable increase in heart rate and blood pressure, in this situation, could gain the risk of ischemia and coronary artery diseases. This is where screening before treatment becomes important [4], [5].

To reduce the intensity of muscle contractions caused by convulsive attacks in ECT, Succinylcholine is the muscle relaxant of choice [7], [9].

Succinylcholine is a short-acting depolarizing skeletal muscle relaxant that competes with acetylcholine in binding to the cholinergic receptors of the terminal drive plate [10].

The high affinity of succinylcholine to cholinergic receptors makes it resistant to the effects of cholinesterase, and thus the depolarization of succinylcholine is longer than that of acetylcholine. This effect first causes muscle contraction and fasciculation and then inhibits neuromuscular transmission [11], [12].

This depolarization process raises the potassium level which may cause arrhythmia or cardiovascular collapse and increase the ECT complications [14].

Spontaneous improvement of apnea and hemoglobin saturating may not occur rapidly enough with a 1mg/kg dose of succinylcholine in unassisted ventilation. This can lead to a life-threatening decrease in hemoglobin saturation, especially in patients with an unpredicted difficult airway, and the use of lower doses of succinylcholine may reduce this risk [15], [16].

References have introduced a dose of 1 to 1.5 mg/kg of Succinylcholine as a standard dose in general anesthesia, although new studies have considered a dose of 0.6 mg/kg to be effective for this purpose as well. On the other hand, the dose of muscle relaxant used for ECT is half the dose used in general anesthesia. So, the Succinylcholine dose required in ECT can vary from 0.3 [half of the minimum dose) to 0.75 (half of the maximum dose). The aim of this study was to compare the probable complications and hemodynamic changes created as a result of applying 0.3 and 0.6 doses of Succinylcholine in candidates of ECT.

2. Methods

General information

This prospective and cross-sectional clinical trial was conducted on 40 ECT treated patients at Isfahan university hospital, Iran 2022 - 2022. Sampling was done after informing the patients and obtaining written consent. Adherence to the principles of the Helsinki Declaration and keeping the confidentiality of patient information were also considered in all stages. Covering the costs by the researchers prevented any extra burden imposition on the patients.

The project was approved by the Research Ethics Committee (IR.MUI.MED.REC.1401.07) and registered in the clinical trial registration center (IRCT20160307026950N40).

Inclusion and exclusion criteria

Inclusion criteria: (1) patients with 18 to 25 years old; (2) ASA I and II According to ASA (American Society of Anesthesia) criteria; (3) Candidate for electroconvulsive therapy (ECT) according to

ISSN: 0005-2523
Volume 63, Issue 01, January, 2023

psychiatrist's diagnosis; (4) Informed consent to participate in the study.

Exclusion criteria: (1) patients with a BMI over 30;(2) patients had a history of cardiovascular diseases and hemodynamic disorders; (3) patients used psychoactive or sedative drugs, or addicted to alcohol, opioid and non-opioid drugs; [4patients with any previous history of seizure or epilepsy.

It is necessary to mention that patients with no seizures or seizures less than 20 seconds after receiving a 20% energy shock and also patients who were allergic to anesthetic or required cardiopulmonary resuscitation (CPR) were excluded from the study.

Method

Patients were subjected to electroconvulsive therapy with an energy of 20% and Anesthesia was induced with a 5mg/kg dose of Thiopental sodium and 0.3 and 0.6 of Succinylcholine in the first and second groups (randomized by Random Allocation Software), respectively.

Two electrodes were installed on the mastoid ridge and the time between seizure onset (appearance of epileptiform waves) till the end of that (disappearance of epileptiform waves) on a two-channel electroencephalogram (EEG) was measured to determine the duration of a brain seizure.

Before induction of anesthesia, we tied the sphygmomanometer cuff above the ankle and inflated that 50 mmHg more than the base systolic pressure to evaluate the clonic movements. We considered the duration of motor seizure from the start of tonic movements to the end of clonic movements.

Blood pressure, heart rate, and, O2 saturation, were evaluated before the administration of the anesthetic (baseline) and then 1, 5, 10, and 20 minutes after the seizure.

It should be noted that if the motor seizure lasted more than 60 seconds, it was treated with sodium thiopental sodium 2 mg/kg, and if lasted more than 90 seconds, the patient was excluded from the study with prescribed a dose of 0.1 mg/kg thiopental sodium. On top of that, patients without complete respiratory recovery after 10 minutes of induction were reversed with a combination of Neostigmine and Atropine if they did not have three or four responses to stimuli of the neurostimulator nor had no specific clinical symptoms of neuromuscular function.

Statistical method

All data were entered into SPSS software version 23 and analyzed by appropriate descriptive and analytical statistical tests as follows:

2.1 Descriptive: report of mean value and frequency distribution.

2.2 Analytical: Pearson's test was used to determine the relationship between quantitative variables, and Spearman's test was used if the data did not follow normal distribution. The independent t-test was used to compare quantitative variables between study groups (Mann-Whitney test if data distribution was not normal) and a Chi-Square test was used to compare qualitative variables. In order to compare each group before and after treatment, the variance test was used in repeating the observations (if the data distribution is not normal, Friedman's test). A statistically significant level of $p>0.05$ was considered.

3. Results

16 females (40%) and 24 males (60%) with an average age of 39.26 ± 12.5 years were examined. the primary analysis of data showed no significant difference between the two groups in terms of gender (P=0.519), age (P=0.665), weight (P=0.704), height (P=0.450), and BMI (P=0.525).

Table I. Distribution of demographic and general variables in two groups

Variable		A Group B		P value
		0.3 N=20	0.6 N=20	
gender	Female	9 (45)	7 (35)	0.519
	Male	11 (55)	13 (65)	
age		38.70±12.09	39.75±12.82	0.665
BMI		26.35±4.13	25.23±4.89	0.525
weight		75.30±13.02	73.95±15.41	0.704
height		169.05±9.28	171.15±8.09	0.450

Comparing the SBP, DBP, MAP, and HR data demonstrated no significant difference between the two groups at baseline, one, 5, 10, and 20 minutes after drug injection (P>0.05).

Table 2. Comparison of SBP, DBP, MAP and, HR in two groups.

Variable			A Group B		P value
	Time		0.3 N=20	0.6 N=20	
Systolic Blood Pressure	Basal		119.25±14.89	112±6.56	0.057
	1 min		160.15±22.38	148.85±16.14	0.075
	5 min		142.9±18.23	136.15±13.26	0.189
	10 min		122.95±11.59	118.65±6.57	0.157
	20 min		116.45±9.33	114.45±5.04	0.405
Diastolic Blood Pressure	Basal		76.75±12.3	71±6.80	0.077
	1 min		104.45±14.16	98.85±16.50	0.257
	5 min		92.9±12.58	87.3±11.84	0.155
	10 min		78.3±7.22	79.4±7.65	0.643
	20 min		76.15±6.99	75.55±5.3	0.762
Mean Arterial Pressure	Basal		90.91±13.0	84.66±6.34	0.065
	1 min		123.01±16.35	115.51±15.90	0.150
	5 min		109.56±13.83	103.58±11.53	0.146
	10 min		93.18±8.09	92.48±6.56	0.766
	20 min		89.58±7.41	88.51±4.57	0.587
Heart Rate	Basal		83.05±9.24	79.7±9.73	0.272
	1 min		97.45±17.02	95.5±19.14	0.735
	5 min		92.1±12.98	91.2±15.84	0.845
	10 min		82.8±8.30	84.05±9.63	0.663
	20 min		77.8±7.79	79.7±7.67	0.442

The prevalence of hypoxia and O2sat drop in patients who received succinylcholine 0.6 mg/kg (100%) was significantly higher compared to that of those who received succinylcholine 0.3 mg/kg (30%). (P<0.001)

There were no notable differences in other parameters (frequency of tachycardia, bradycardia, hypertension,

ISSN: 0005-2523
Volume 63, Issue 01, January, 2023

and hypotension).

Table 3. Comparison of Tachycardia, Bradycardia, Hypertension and, Hypotension in two groups.

Variable		A Group B		P value
	Time	0.3 N=20	0.6 N=20	
Tachycardia	1 min	12 (60)	13 (65)	0.744
	5 min	5 (25)	7 (35)	0.490
	10 min	1 (5)	5 (25)	0.182
	20 min	0 (0)	1 (5)	1.000
Bradycardia	1 min	1 (5)	2 (10)	1.000
	5 min	1 (5)	2 (10)	1.000
	10 min	1 (5)	1 (5)	1.000
	20 min	1 (5)	1 (5)	1.000
Hypertension	1 min	17 (85)	16 (80)	1.000
	5 min	8 (40)	11 (55)	0.342
	10 min	0 (0)	0 (0)	-
	20 min	0 (0)	0 (0)	-
Hypotension	1 min	0 (0)	0 (0)	-
	5 min	0 (0)	0 (0)	-
	10 min	1 (5)	0 (0)	1.000
	20 min	1 (5)	0 (0)	1.000
Hypoxia	1 min	19 (95)	20 (100)	1.000
	5 min	6 (30)	20 (100)	0.000
	10 min	0 (0)	2 (10)	0.487
	20 min	0 (0)	0 (0)	-

In patients who received dose of 0.6 mg/kg succinylcholine, the duration of apnea was significantly longer (P=0.005) and the duration of seizures was significantly shorter than the other group (P=0.001).

Table 4. Comparison of Apnea duration and, Seizure duration in two groups.

Variable	A Group B		P value
	0.3 N=20	0.6 N=20	
Apnea duration	1.55±0.58	2.1±0.59	0.005
Seizure duration	20.05±2.52	17.4±1.84	0.001

4. Discussion

In the present study, we compared the effects of two 0.3 and 0.6 doses of succinylcholine in ECT candidates and perceived that both doses had similar effects on the hemodynamic status. We observed that the prevalence of hypoxia and the duration of apnea were significantly longer and seizure duration was significantly shorter in patients who received 0.6 mg/kg succinylcholine.

In 2018, [17] evaluated a wide range of succinylcholine doses used for muscle relaxation in ECT on 500 candidates. they found that in those patients requiring adjusted doses of 2 SD either more or less than the mean dose (0.9mg/kg) of succinylcholine (29 patients, 5.8%), adequate neuromuscular block was achieved

only by increasing the dose to a maximum of 2.10 mg/kg or decreasing the dose to a minimum of 0.29 mg/kg.

Another study by [18] evaluated the minimum effective dose of succinylcholine during ECT. They stated that the initial dose of ECT succinylcholine should be selected between 0.77-1.27 mg/kg based on each patient's preoperative condition to produce acceptable muscle relaxation in 50% to 90% of patients although the side effects may be more at higher doses.

[19] compared the effects and complications of using Atracurium and succinylcholine in 905 patients in 2020. Succinylcholine application is associated with a longer duration of apnea, and anesthesiologists should be more aware of the side effects of this drug in this regard, they found. On the other hand, some studies have supported the use of succinylcholine as a muscle relaxant, stating that lower doses can have higher effectiveness and fewer side effects [20], [21].

Research by [22] identified apnea as one of the most important side effects of succinylcholine and showed considerable muscle relaxant effects with using a 0.6 mg/kg dose. These data support our findings.

We compared two different doses of succinylcholine, whereas most previous studies have evaluated specific doses of succinylcholine with other types of medications.

Limitations

The study population was limited and this survey was conducted in just one of our centers. We recommend that multicenter studies whit be conducted on larger populations.

5. Conclusion

Administering a dose of 0.3 mg/kg of succinylcholine leads to less side effects such as hypoxia and apnea. These findings were consistent with previous studies and empress prescribing lower doses.

6. References

[1] Kellner CH, Obbels J, Sienaert P. When to consider electroconvulsive therapy (ECT). Acta Psychiatr Scand. 2020;141(4):304-315. doi:10.1111/acps.13134

[2] Hermida AP, Glass OM, Shafi H, McDonald WM. Electroconvulsive Therapy in Depression: Current Practice and Future Direction. Psychiatr Clin North Am. 2018;41(3):341-353. doi: 10.1016/j.psc.2018.04.001

[3] Sienaert P, Lambrichts S, Popleu L, Van Gerven E, Buggenhout S, Bouckaert F. Electroconvulsive Therapy During COVID-19-Times: Our Patients Cannot Wait. Am J Geriatr Psychiatry. 2020;28(7):772-775. doi: 10.1016/j.jagp.2020.04.013

[4] Weiss A, Hussain S, Ng B, et al. Royal Australian and New Zealand College of Psychiatrists professional practice guidelines for the administration of electroconvulsive therapy. Aust N Z J Psychiatry. 2019;53(7):609-623. doi:10.1177/0004867419839139

[5] Hermida AP, Mohsin M, Marques Pinheiro AP, McCord E, Lisko JC, Head LW. The Cardiovascular Side Effects of Electroconvulsive Therapy and Their Management. J ECT. 2022;38(1):2-9. doi:10.1097/YCT.0000000000000802

ISSN: 0005-2523
Volume 63, Issue 01, January, 2023

[6] Plaud B, Baillard C, Bourgain JL, et al. Guidelines on muscle relaxants and reversal in anaesthesia. Anaesth Crit Care Pain Med. 2020;39(1):125-142. doi:10.1016/j.accpm.2020.01.005.

[7] Fernández-Candil J, Castelltort Mascó L, Fàbregas Julià N, Urretavizcaya Sarachaga M, Bernardo Arroyo M, Valero Castell R. Anaesthesia in electroconvulsive therapy. Special conditions. Rev Psiquiatr Salud Ment (Engl Ed). 2020;13(1):36-46. doi:10.1016/j.rpsm.2018.05.002

[8] Putzu A, Tramèr MR, Giffa M, Czarnetzki C. The optimal dose of succinylcholine for rapid sequence induction: a systematic review and meta-analysis of randomized trials. BMC Anesthesiol. 2020;20(1):54. Published 2020 Mar 2. doi:10.1186/s12871-020-00968-1

[9] Sane S, Aghdashi MM, Haki BK, Gholamveisi B, Rajabzadeh M, Golabi P. The Effect of Pregabalin on the Prevention of Succinylcholine-Induced Fasciculation and Myalgia [published correction appears in J Perianesth Nurs. 2021 Jun;36(3):319-320]. J Perianesth Nurs. 2020;35(3):255-259. doi: 10.1016/j.jopan.2019.11.005

[10] Schaefer MS, Hammer M, Santer P, et al. Succinylcholine and postoperative pulmonary complications: a retrospective cohort study using registry data from two hospital networks. Br J Anaesth. 2020;125(4):629-636. doi: 10.1016/j.bja.2020.05.059.

[11] Plane A-F, Marsan P-E, du Cheyron D, Valette X. Rapidly changing ECG in hyperkalaemia after succinylcholine. The Lancet. 2019;393(10184):1983.

[12] Schmartz D, Chénard L, Baumann C, Fuchs-Buder T. A modified train-of-four ratio to assess recovery from depolarizing neuromuscular blockade after succinylcholine, a prospective observational study. J Clin Monit Comput. 2021;35(5):1133-1138. doi:10.1007/s10877-020-00560-5

[13] Aragón-Benedí C, Visiedo-Sánchez S, Pascual-Bellosta A, et al. Study of Rocuronium-Sugammadex as an Alternative to Succinylcholine-Cisatracurium in Microlaryngeal Surgery. Laryngoscope. 2021;131(1): E212-E218. doi:10.1002/lary.28649

[14] Kothari D, Tripathi S, Upadhyay R. Effect of pre-treatment with rocuronium and vecuronium on post succinylcholine fasciculations, serum potassium, and postoperative myalgia: A prospective, randomized, double-blind study. Asian Journal of Medical Sciences. 2022;13(6):51-6.

[15] Aghamohamadi D, Gol MK. An investigation into the effects of magnesium sulfate on the complications of succinylcholine administration in nulliparous women undergoing elective cesarean section: A double-blind clinical trial. International Journal of Women's Health and Reproduction Sciences. 2019;7(4):520-5.

[16]. Larach MG, Klumpner TT, Brandom BW, et al. Succinylcholine Use and Dantrolene Availability for Malignant Hyperthermia Treatment: Database Analyses and Systematic Review. Anesthesiology. 2019;130(1):41-54. doi:10.1097/ALN.0000000000002490

[17] Bryson EO, Kellner CH, Li EH, Aloysi AS, Majeske M. Extreme variability in succinylcholine dose for muscle relaxation in electroconvulsive therapy. Australas Psychiatry. 2018;26(4):391-393. doi:10.1177/1039856218761301.

[18] Mirzakhani H, Guchelaar HJ, Welch CA, et al. Minimum Effective Doses of Succinylcholine and Rocuronium During Electroconvulsive Therapy: A Prospective, Randomized, Crossover Trial. Anesth Analg. 2016;123(3):587-596. doi:10.1213/ANE.0000000000001218.

[19] Ciobotaru oR, Stoleriu G, Ciobotaru OC, Grigorovici A, Voinescu DC, Matei MN, et al. Postanesthetic skin erythema due to succinylcholine versus atracurium. Experimental and Therapeutic Medicine. 2020;20(3):2368-72.

[20] Sedighinejad A, Khoshrang H, Soltanipour S, Rezvani SM, Soleimani R, Haghighi M, et al. Atracurium as an Alternative to Succinylcholine in Electroconvulsive Therapy: A Randomized Clinical Trial. Caspian Journal of Neurological Sciences. 2022;8(3):163-70.

[21] Takazawa T, Suto T, Aihara M, et al. Comparison between succinylcholine and rocuronium as neuromuscular blocking agents for electroconvulsive therapy in a patient with pseudocholinesterase deficiency. JA Clin Rep. 2015;1(1):7. doi:10.1186/s40981-015-0009-2

[22] Shabanian G, Shabanian M, Shabanian A, Heidari-Soureshjani S. Comparison of atracurium and methocarbamol for preventing succinylcholine-induced muscle fasciculation: A randomized controlled trial. J Adv Pharm Technol Res. 2017;8(2):59-62. doi: 10.4103/japtr.JAPTR_172_16