Original Article

Dexmedetomidine for reducing succinylcholine-induced myalgia in patients undergoing electroconvulsive therapy: A randomised controlled trial

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ABSTRACT

Background and Aim: Electroconvulsive therapy (ECT) is an effective intervention for psychiatric patients. Succinylcholine is considered the drug of choice for muscle relaxation for ECT. Significant adverse effects of succinylcholine include fasciculation and myalgia. Dexmedetomidine is a highly selective α-2 adrenergic agonist. This study aims to determine the efficacy of a low dose of dexmedetomidine in reducing succinylcholine-induced myalgia in patients receiving ECT. **Methods:** This randomised controlled trial was conducted on 100 patients, aged 18–65 years, undergoing ECT, who were randomly allocated into two groups with an allocation ratio of 1:1. Group D received intravenous (IV) dexmedetomidine 0.25 μg/kg, and Group C received IV normal saline (0.9%). Patients' self-reported myalgia scores were measured after 60 min of the procedure. Fasciculations were noted after IV succinylcholine administration. Heart rate (HR) and mean blood pressure (MBP) were measured at baseline, after infusion (5 min) and after ECT (0, 2.5, 5, 10, 15, 30 min). Continuous data were analysed using a Student's *t*-test for two-group comparisons, a mixed model analysis of variance for group comparisons and various time point analyses. Categorical data were analysed using the Chi-square/Fisher's exact test. **Results:** There were no differences between the groups regarding demographics. Myalgia and fasciculations were less in Group D than in Group C ($P < 0.001$). MBP and HR changes were comparable ($P > 0.05$). **Conclusion:** A low dose of dexmedetomidine (0.25 μg/kg) effectively reduces myalgia and fasciculations due to succinylcholine in patients undergoing electroconvulsive therapy.

Keywords: Dexmedetomidine, electroconvulsive therapy, fasciculation, myalgia, succinylcholine

INTRODUCTION

Electroconvulsive therapy (ECT) is a valuable non-pharmacological treatment for patients with persistent psychiatric illnesses, particularly for non-responders to pharmacotherapy.[1,2] In ECT, an external electrical device induces a generalised seizure with variable duration while the patient is under general anaesthesia (GA). This stimulates the autonomic nervous system, firstly the parasympathetic system, producing bradycardia, followed by a pronounced sympathetic spur, which results in transitory tachycardia and hypertension.[3,4] An anaesthetic agent that provides amnesia with minimal effects on haemodynamic stability and seizure duration is preferred. Muscle relaxation protects the musculoskeletal system from a generalised seizure's tonic and clonic actions.

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Succinylcholine has a very fast onset and short duration of action, making it an ideal drug for muscle relaxation for ECT. Some adverse effects of succinylcholine are fasciculation, postoperative myalgia and raised serum creatine kinase (CK).[5] Succinylcholine-induced myalgia has a prevalence of around 50%.[6]

Dexmedetomidine inhibits central sympathetic outflow at presynaptic receptors, reducing peripheral norepinephrine release due to its selective α-2 adrenergic agonist.[7] Intravenous (IV) dexmedetomidine helps decrease fasciculations and myalgia due to succinylcholine at 1 μg/kg.[5] We aim to use a minimal dose of dexmedetomidine in ECT as the dose of succinylcholine is also less (1 mg/kg) but can potentially cause fasciculations and myalgia. Therefore, our study aims to determine the efficacy of low-dose dexmedetomidine in reducing succinylcholine-induced myalgia in patients receiving ECT.

The study's primary objective is to compare the incidence of myalgia and fasciculations. The secondary objective is to find any changes in haemodynamics [heart rate (HR) and mean blood pressure (MBP)] in patients receiving and not receiving low-dose dexmedetomidine. We hypothesise that patients receiving dexmedetomidine are expected to have less myalgia and fasciculations.

METHODS

This study is a two-arm, double-blind, randomised controlled trial conducted in a tertiary care centre after approval was obtained from the institutional ethical committee (vide approval number DRI/IMS.SH/SOA/2021/101 dated 7 July 2021). The study was registered under the Clinical Trials Registry-India (CTRI/2021/10/037656, https://ctri.nic.in). It was conducted in accordance with the principles of the Declaration of Helsinki 2013 and good clinical practice. The study period was from November 2021 to January 2023.

A hundred patients of the American Society of Anesthesiologists (ASA) physical status I/II, aged 18–65 years, undergoing ECT, were selected to participate in the study after they gave informed and written consent for participation and use of data for research and educational purposes. Patients were excluded if they were blind, deaf or incapable of understanding the language, had second- or third-degree heart block or persistent bradycardia, were pregnant or nursing, were allergic to dexmedetomidine, were on drugs such as beta-blockers or other antiarrhythmic drugs. Data were collected from the procedure and post-procedure room.

Randomisation was done by computer-generated random sequence numbers, which were used to randomly allocate patients into two groups with an allocation ratio of 1:1. Allocation concealment was achieved by keeping the group allocation number in a sequentially numbered opaque envelope that was opened by the pharmacist at the time of preparation of the drug. Neither the patient nor the investigator was aware of the patient's group allocation. Group D received IV dexmedetomidine 0.25 μg/kg diluted in normal saline (0.9%) to make a volume of 10 ml administered over 10 min. Group C received a volume of 10 ml of IV normal saline (0.9%) over 10 min. Patients were directed to be nil per oral for 8 h before the procedure. Patients were shifted to the ECT room and received the drug according to the group allocation by the pharmacist, who was not involved in data collection. Patients had equal chances to go in either group to prevent selection bias. Patients were monitored for oxygen saturation, end-tidal carbon dioxide, blood pressure, HR and rhythm by electrocardiogram. The baseline values of all the parameters were noted. Demographic data (age, gender, ASA physical status, weight) and indications for ECT were noted. Patients were administered IV glycopyrrolate 0.005 mg/kg followed by propofol 1 mg/kg IV and succinylcholine 1 mg/kg IV. Through manual ventilation, 100% oxygen was administered. An electrical stimulus was applied after ensuring complete paralysis. Manual ventilation was initiated after cessation of seizure activity in electroencephalogram until the patient's spontaneous breathing was sufficient and the airway was patent.

The primary outcome measured was the patient's self-reported myalgia scores, as suggested by Harvey *et al*.,[8] which were graded as 0- no myalgia, 1- mild myalgia, 2- moderate myalgia and 3- severe myalgia after 60 min of the procedure. Fasciculations were noted on the Mingus scale as follows: 0- none, 1- mild, 2- moderate and 3- severe after administration of IV succinylcholine.[9] Those patients with myalgia scores ≥2 were given diclofenac 75 mg IV, which was repeated as required.

Secondary outcomes compared the haemodynamic responses in the two groups and the presence of

any adverse effects. Patients were examined for the presence of bradycardia and hypotension throughout the procedure. HR and MBP were measured at baseline, after infusion (5 min) and after ECT (0, 2.5, 5, 10, 15 and 30 min). Bradycardia (HR <45 beats/min) was treated with atropine 0.6 mg IV, and episodes of hypotension (MBP <65 mmHg) were treated with a phenylephrine 50 μg IV bolus every 5 min till MBP improved. Patients were transferred to the post-anaesthesia care unit and monitored.

The sample size was calculated using ClinCalc software (https://clincalc.com/stats/samplesize.aspx). Sample size calculation was based on the results of Celebi *et al*.[5] We aimed to detect a myalgia score of less than 10% with dexmedetomidine as it was found that the incidence of myalgia in control was 33% by Celebi *et al*. With a power of 80% and type 1 error of 5%, we calculated that 49 subjects were required per group. We included 100 total patients for the study, 50 in each group. Statistical analysis was performed using the International Business Machine Statistical Package for Social Sciences (IBM SPSS) version 26 for Windows (Chicago, IL, USA). Continuous data like age and weight were described as mean with standard deviation and analysed using Student's *t*-tests for two-group comparisons. Mixed model analysis of variance (ANOVA) was used to compare the effect of intervention on HR and MBP at various time points. Categorical data like gender, ASA physical status, myalgia and fasciculation were expressed as proportions and analysed using the Chi-square/Fisher's exact test.

RESULTS

The Consolidated Standards of Reporting Trials flow diagram is illustrated in Figure 1. The demographic profile of patients was similar in both groups [Table 1]. The incidence of myalgia was less in Group D than in Group C [8 (16%) versus 26 (52%)], with an odds ratio of 0.176 [95% confidence interval (CI) 0.690, 0.449, $P < 0.001$ with degrees of freedom (df) =1]. Similarly, the incidence of fasciculations was also less in Group D compared to Group C [12 (24%) versus 44 (88%)], with an odds ratio of 0.043 (95% CI 0.015, 0.126, $P < 0.001$ with df = 1) [Table 2]. Mixed model ANOVA suggested the HR and MBP variations were similar in both groups with no statistical difference [mean difference −3.020 (95% CI −7.126. 1.086) with *P* value 0.082 and mean difference −1.632 (95% CI −3.479, 0.214) with 0.182, respectively] [Figures 2 and 3] (mean with 95% CI) [Table 3]. Adverse effects like hypotension and bradycardia were not found in any patient of both groups.

Table 1: Demographic details of patients

Variable	Group D *n*=50	Group C *n*=50
Age (years)	33.18 (8.25)	34.04 (9.70)
Weight (kg)	61.54 (7.91)	59.88 (9.31)
Gender (male/female)	30/20	32/28
American Society of Anesthesiologists physical status (I/II)	36/14	40/10

Data expressed as mean (standard deviation) or numbers. *n*=number of patients

Table 2: Comparisons of variables between the groups

Variable	Group D *n*=50	Group C *n*=50	Odds ratio (95% CI)	*P*
Myalgia score: 0/1/2	42/8/0	24/20/6	0.176 (0.69–0.449)	<0.001
Fasciculations: 0/1/2/3	38/11/1/0	6/27/15/2	0.043 (0.015–0.126)	<0.001

Data expressed as numbers. CI=Confidence interval, *n*=number of patients

DISCUSSION

Our study established that administering 0.25 μg/kg IV dexmedetomidine effectively reduces succinylcholine-induced fasciculation and myalgia in patients receiving ECT.

Many drugs like benzodiazepines, diclofenac, lidocaine or vecuronium have been studied in the past. However, some were efficient in controlling myalgia, some in controlling fasciculations and some were associated with other adverse effects.[10] Therefore, the search for an ideal, efficient drug for controlling fasciculations and myalgia with minimal sedation in ECT is ongoing. Dexmedetomidine, a centrally active α-adrenergic agonist, causes inhibition of substance *P* release in the dorsal root neuron, exerting a powerful analgesic action. It is also an anti-inflammatory drug and is effective in fasciculation-induced pain.[11] The exact mechanism of dexmedetomidine's inhibitory effect on fasciculation is unclear, and it could be due to stimulation of α-2 adrenoreceptors in the spinal cord.[5] A recent study found that dexmedetomidine is also helpful in decreasing myoclonus severity.[12]

Our finding is concurrent with the study finding of Celebi *et al*.[5] They studied succinylcholine-induced postoperative myalgia in patients receiving GA. Succinylcholine and other anaesthetic agents were administered in full intubating doses, which might have played an essential role in reducing postoperative myalgia. They found dexmedetomidine

Table 3: Comparison of haemodynamic variables between the two groups

Variable	Time point	Group D	Group C	Pooled mean difference (95% CI)	*P*
Heart rate	At baseline	82.780 (14.016)	84.580 (14.814)	-3.020 (−7.126–1.086)	0.182
	5 min after the intervention	75.840 (10.458)	80.780 (10.680)		
	During ECT	78.260 (11.573)	82.000 (11.884)		
	2.5 min after ECT	90.280 (11.062)	93.520 (10.457)		
	5 min after ECT	83.120 (10.640)	84.560 (9.605)		
	10 min after ECT	80.300 (10.489)	83.380 (10.059)		
	20 min after ECT	78.820 (11.295)	81.700 (10.697)		
	30 min after ECT	78.980 (11.033)	82.020 (10.884)		
Mean blood pressure	At baseline	93.660 (4.292)	92.540 (5.853)	-1.632 (-3.479–0.214)	0.08
	5 min after the intervention	87.480 (5.411)	95.560 (5.859)		
	During ECT	92.600 (4.634)	91.600 (6.230)		
	2.5 min after ECT	101.720 (5.350)	104.000 (8.523)		
	5 min after ECT	101.720 (6.519)	102.640 (8.181)		
	10 min after ECT	93.000 (5.304)	92.980 (7.533)		
	20 min after ECT	94.000 (6.538)	96.260 (6.378)		
	30 min after ECT	93.540 (6.251)	95.200 (6.731)		

Data expressed as mean (standard deviation). ECT=Electroconvulsive therapy, CI=Confidence interval, *n*=number of patients. SD=Standard deviation

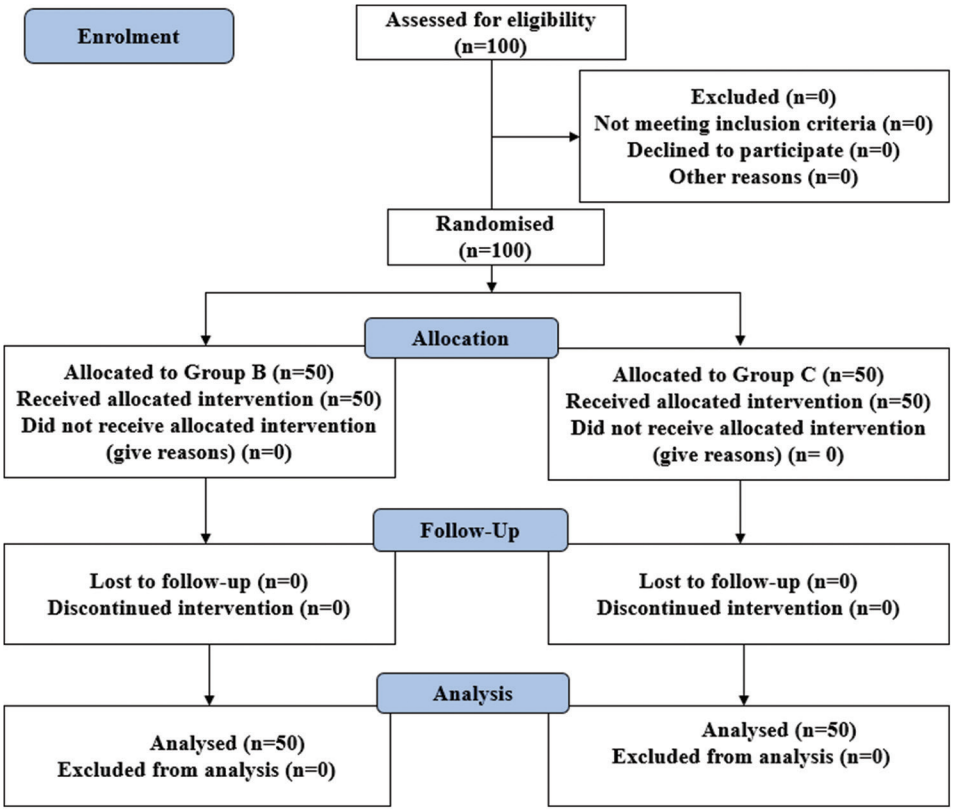

Figure 1: Consolidated Standards of Reporting Trials (CONSORT) diagram

to be very useful in decreasing fasciculations and myalgia due to succinylcholine.[5] We have used a minimal dose of dexmedetomidine in ECT as the dose of succinylcholine was also less (1 mg/kg) but can potentially cause fasciculations and myalgia. Low-dose dexmedetomidine was used in other studies for different indications and was found to be effective.[13,14]

Dexmedetomidine (1 μg/kg) is advantageous in ECT patients as it decreases the haemodynamic response during ECT without influencing recovery time. However, the length of motor seizures was marginally shorter with this dose, which could impact the effectiveness of ECT.[15] Some studies have found dexmedetomidine (0.5 μg/kg) effectively mitigates cardiovascular response to ECT without affecting

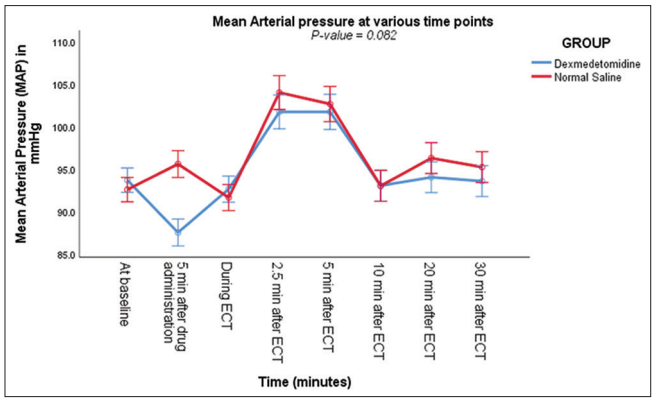

Figure 2: Plot for mean blood pressure at various time points of groups for comparison. ECT=Electroconvulsive therapy

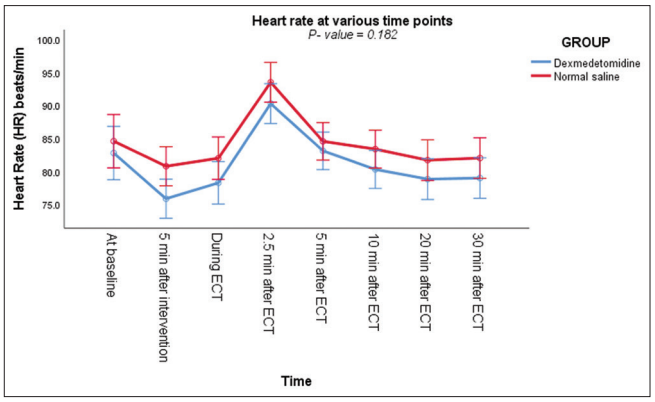

Figure 3: Plot for heart rate at various time points of groups for comparison. ECT=Electroconvulsive therapy

seizure duration.[4,15] Li *et al*.[16] used 0.2 μg/kg dexmedetomidine in ECT and found that it did not affect the duration of seizure or recovery. We did not see any benefit of dexmedetomidine 0.25 μg/kg in ameliorating cardiovascular responses of ECT.

Our study is of importance as this low-dose dexmedetomidine has never been tested in ECT patients for succinylcholine-induced myalgia, and this minimum dose has shown its efficacy in controlling myalgia and fasciculations without any adverse effects. However, this is a single-centric study, and further studies may be needed to validate our findings.

CONCLUSIONS

A low dose of dexmedetomidine (0.25 μg/kg) effectively reduces myalgia and fasciculations due to succinylcholine (1 mg/kg) in patients undergoing electroconvulsive therapy.

Study data availability

De-identified data may be requested with reasonable justification from the authors (email to the corresponding author) and shall be shared upon request.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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