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COMPARATIVE STUDY TO FIND THE OPTIMAL DOSE OF SUCCINYLCHOLINE FOR ELECTROCONVULSIVE THERAPY

Anaesthesiology

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ABSTRACT

Electroconvulsive therapy is a commonly performed procedure for psychiatric conditions such as intractable depression, bipolar disorder and schizophrenia to mention a few. The procedure involves the delivery of small electrical stimuli transcutaneously with an aim to produce generalized seizures. The therapy aims to produce a state of unconsciousness where the patient has generalized convulsions. The procedure requires that the patient be given general anaesthesia and have neuromuscular paralysis to avoid pain and any excessive muscle contraction when the seizures are induced. The patient is therefore given general anaesthesia and then neuromuscular blocking drugs are administered to produce a state of muscle paralysis. But the dose of the neuromuscular blocking drug to produce this state of muscle paralysis remains debatable. The minimum required dose to attain this state of muscle paralysis is desired to ensure minimum side effects. The aim of our study is to compare two doses of a drug commonly used for electroconvulsive therapy, succinylcholine, in order to ensure a state of muscle paralysis while keeping ensuring the side effects are minimum.

KEYWORDS

Succinylcholine, Electroconvulsive Therapy, Fasciculations, General Anaesthesia

MATERIALS AND METHODS

A prospective study of 27 patients who were scheduled to undergo elective electroconvulsive therapy from 1st January 2022 to 31st July 2022 was undertaken.

Description

A prospective study of 27 patients who were scheduled to undergo elective electroconvulsive therapy from 1st January 2022 to 31st July 2022 was undertaken Electroconvulsive therapy is commonly performed as a day-care procedure on an elective basis. Participants for the study will be undergoing a preanaesthetic evaluation. Participants who satisfy the inclusion and exclusion criteria will be selected for the study. Those selected for the procedure will be prepared for the procedure as per standard protocols for elective procedures. They will be nil per oral for fatty meals for eight hours, for solids for 6 hours and for liquids for 4 hours prior to the procedure.

Monitoring of the patient for the procedure will be done using standard American Society of Anaesthesiologists criteria using non-invasive blood pressure monitoring, peripheral oxygen saturation, electrocardiography, temperature monitoring, electroencephalogram and neuromuscular monitoring.

A nerve stimulator will be used to monitor the effect of succinylcholine. Succinylcholine is a short acting depolarizing muscle blocking agent which is used to produce a state of neuromuscular paralysis for the procedure. A non-invasive blood pressure cuff on one of the patients arms is used as an alternative to electromyography. This non-invasive blood pressure cuff is placed on the upper limb on which the patient does not have a peripheral intravenous access. A peripheral intravenous access is secured on the upper limb on which the non-invasive blood pressure cuff for neuromuscular monitoring is not placed. This non-invasive blood pressure cuff for neuromuscular monitoring is inflated to a pressure above approximately two hundred millimetres of mercury after the patient has been administered general anaesthesia and before the administration of succinylcholine. This cuff prevents the depolarizing muscle relaxant from entering this upper limb and thus seizure activity can be observed in this limb during the procedure.

Preoxygenation with hundred percent oxygen will be done for three minutes prior to the induction of general anaesthesia. General anaesthesia is administered using methohexital as the induction agent. Propofol and thiopental reduce seizure seizure duration and are therefore avoided. Etomidate has a correlation with increased seizure duration and is thus avoided. Following induction of general anaesthesia, an oral airway or bite block is placed in the patient's mouth to protect his or her teeth and tongue. The patients airway and ventilation are secured with bag and mask ventilation for the entire duration of the procedure. The participants will receive either succinylcholine 15 milligram or 30 milligram. Patients will be assessed as having either conditions with acceptable muscle relaxation or unacceptable conditions.

The duration of the cerebral seizure induced therapeutically for the electroconvulsive therapy will be monitored using electroen cephalography which will be recorded from left and right frontal and mastoid positions. The induction of seizure will be performed via two electrodes which will be placed bitemporally. The electroconvulsive therapy stimulus will be a brief pulse waveform. During the course of the therapy over which electroconvulsive therapy is administered to the patient, the seizure threshold may be expected to increase as tolerance will be developed by the patient.

Monitoring of neuromuscular transmission for the therapy will be done using electromyography and a non-invasive blood pressure cuff. Train-of-four (TOF) stimulation will be performed every 15 seconds and this will be maintained until a recovery of T1 to 100% baseline can be ensured.

Time taken for recovery of spontaneous breathing will be measured during the procedure. The time taken for the entire procedure from the time the patient was taken into the operation theatre, the time that the patient was administered general anaesthesia, time taken to initiate electroconvulsive therapy and the duration of the seizure will be measured.

After the termination of the seizure and after ensuring that the patient has adequately recovered from general anaesthesia, the patient will be shifted out from the operation theatre and observed the post anaesthesia care unit until the patient satisfies Modified Aldrete score for discharge from the post anaesthesia care unit. Adequate reversal of neuromuscular blocking agents will be ensured using electro myography and a train-of-four ratio of more than or equal to nine will be sought before discharge and will be documented.

Study Type :

Interventional Clinical Trail

Primary Outcome :
To find the optimum dose of succinylcholine required for electroconvulsive therapy

Secondary Outcome :
Document differences in time taken to recover from varying doses of succinylcholine used for electroconvulsive therapy

Number of Participants :27

Allocation :
Randomization

Study Start Date :
1st January 2022

Study End Date :
31st July 2022

Inclusion Criteria :
Consenting adults between the ages of 18-48 years of either gender who have been advised electroconvulsive therapy.

Exclusion criteria
- Non-consenting participants
- Pregnancy
- Neuromuscular diseases including paralysis
- Cardiovascular diseases including abnormal
- Malnourished patients
- Contraindications to the use of neuromuscular blocking drugs such as history of malignant hyperthermia, allergy to succinylcholine
- Hyperkalemia
- Patients on medications which can affect the seizure threshold
- Renal disease with estimated glomerular filtration rate less than 60 milliliter per minute

Equipment
- Blood presssure monitor
- Electrocardiography monitor
- Pulse oximeter
- Suction apparatus
- Temperature monitor
- Additional non-invasive blood pressure cuff
- Larngoscope blades and handles
- Bougie
- Endotracheal tubes of appropriate sizes
- Syringes
- Intravenous fluids
- Induction agents
- Reversal agents
- Intravenous cannulae
- Intravenous lines
- Facemasks
- Artificial Manual Breathing Unit
- Ventilator
- Oral airways

RESULTS

The study had an enrollment of twenty-seven participants. There were eleven male participants and sixteen female participants. Twenty of the participants belonged to ASA physical class I while the remaining seven belonged to ASA physical class II.

The patients were randomized to receive either 15 mg or 30 mg of succinylcholine for the electroconvulsive therapy. Intractable depression was the most common indication for electroconvulsive therapy.

Table 1 : Patients' demographic characteristics (n=27)

Variables	Mean (SD)
Age (years)	34.9 (11.3)
Weight (kg)	58.2 (11.6)
Height (m)	1.6 (0.8)
BMI (kg/m2)	22.2 (3.7)

The table shows the time taken for the onset of apnoea, duration of apnoea after the administration of succinylcholine and the duration of convulsions.

Table 2 : Comparison of onset of apnoea, duration of apnoea, and duration of convulsion between 15 mg and 30 mg suxamethonium

Variable	15 mg (n=27) mean (SD)	30 mg (n=27) mean (SD)	P
Onset of apnoea (s)	62.15 (13.14)	61.41 (12.02)	0.785†
Duration of apnoea (s)	112.44 (31.24)	125.74 (35.40)	0.112†
Duration of convulsion (s)	30.26 (5.95	29.00 (7.83)	0.498†

†Not Significant

The table below shows the quality of convulsions. An acceptable convulsion was seen in sixteen (59%) of the twenty-seven participants with the administration of 15 mg succinylcholine while twenty-three (85%) participants had an adequate convulsion with 30 mg succinylcholine. Poor convulsion modification was seen in eleven participants (41%) as opposed to four participants (15%) with 30 mg succinylcholine. The differences were statistically significant (P = 0.016).

Table 3 : Quality of convulsion with the two doses of suxamethonium

Convulsion modification	Dose of suxamethonium		P
	15 mg (n=27)	30 mg (n=27)	
Poor	11 (41%)	4 (15%)	*0.016††
Acceptable	16 (59%)	23 (85%)	

††Significant. *Fisher's Exact Test

The table below shows the mean value of serum potassium measured in the participants before and after the electroconvulsive therapy with the two doses of succinylcholine compared in the study. The table shows a significant increase in the mean potassium level post electroconvulsive therapy than before it (P < 0.001).

Table 4 : Showing comparison of pre-ECT and post-ECT serum potassium with the two doses of suxamethonium

Suxamethonium dose (mg)	Serum Potassium (mmol/L)		Change Mean (SD)	P
	Pre-ECT Mean (SD)	Post-ECT Mean (SD)		
15 (n=27)	3.52 (0.32)	3.72 (0.32)	0.20 (0.11)	<0.001††
30 (n=27)	3.67 (0.27)	3.92 (0.32)	0.25 (0.15)	<0.001††

††Significant

The participants were followed up for a twelve hour period after the electroconvulsive therapy with the two doses of succinylcholine and the incidence of side effects was noted. The most commonly reported side effect was muscle pain which was recorded in 5 patients (19%) with 15 mg succinylcholine and 4 patients with 30 mg succinylcholine (P = 0.353). There was a comparable incidence of headache and muscle pain between the two doses.

DISCUSSION

The quality of the generalized convulsion activity determines the effectiveness of the electroconvulsive therapy. Therefore, adequate and well-controlled seizure activity is desirable for the electroconvulsive therapy. This seizure activity is accompanied by some untoward side effects such as muscle pain, injury to soft tissues, bones and teeth and these adverse events should be prevented through the practise of appropriate preventive measures such as the use of oral airway devices and appropriate monitoring and early intervention.

This study advocates that 30 mg of succinylcholine is more effective than 15 mg of succinylcholine as a neuromuscular blocking drug for electroconvulsive therapy. The time of onset of apnoea, duration of apnoea, and incidence of adverse effects was similar when either of the doses of succinylcholine was used for the electroconvulsive therapy.

With the advancement in the technique of electroconvulsive therapy, today there is a decreased need for physical restraints during the

electroconvulsive therapy procedure. The duration of the seizure activity, time for onset of apnoea and duration of apnoea were comparable between the groups receiving 15 mg and 30 mg of succinylcholine (P values of 0.498, 0.785 and 0.112, respectively).

Important hemodynamic changes are seen associated with electroconvulsive therapy including an initial parasympathetic response resulting in bradycardia and rarely asystole which on most occasions is brief and may go unnoticed. This stage is followed by a state of sympathetic activity characterized by hypertension, tachycardia and arrhythmias. These hemodynamic changes are self-limited and these were observed following 15 mg as well as 30 mg doses of succinylcholine.

CONCLUSION

This study concludes that the 30 mg dose of succinylcholine is more effective than the 15 mg dose when used as a muscle relaxant for the treatment of electroconvulsive therapy.

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