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EFFECT OF END-TIDAL CARBON DIOXIDE IN MODIFIED ELECTROCONVULSIVE THERAPY

Anaesthesiology

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ABSTRACT

Background: Seizure duration is clinical marker of effectiveness of Electro Convulsive Therapy. Hypocarbia may lowers seizure threshold and increase seizure duration. Hypocabia can be monitored by end-tidal carbon dioxide ($ETCO_2$) which is a part of anesthesia management.
Aim: To compare the effect of two levels of $ETCO_2$ as 40 and 30 mmHg in Modified-ECT
Materials and Methods: 60 patients of 18 to 45 years of either sex were divided in two groups as 30 in each by random sampling. In Group A; ECT was given at 40 mm Hg of $ETCO_2$ and in Group B; ECT was given at 30 mm Hg of $ETCO_2$.
Conclusion: 30 mm Hg end-tidal CO_2 is safe and effective in increasing seizure duration in Modified-ECT.

KEYWORDS

$ETCO_2$, Modified-ECT, Anesthesia

INTRODUCTION

Electroconvulsive Therapy (ECT) is safe and effective mode of treatment for many psychiatric disorders[1]. Modified electroconvulsive therapy (Modified-ECT) was started under short acting intravenous general anesthesia and muscle relaxant[2]. Seizure is monitored using electroencephalogram (E.E.G.) or the "cuff method". In cuff-method distribution of a muscle relaxant is blocked to the hand or foot via a tourniquet to maintain the potential for muscle contraction[2]. Routine monitoring is done for pulse, blood pressure and SpO_2 during ETC.

For adequate therapeutic response seizure produced after ECT should last for more than 15-20 seconds[2]. Sometimes adequate seizures are not produced and higher intensity of electric stimulation is used for these patients. But, higher intensity of electric stimulation may increase chance of post ECT delirium and may increase impact on memory. So there is a need for alternative methods to increase the seizure duration in ECT particularly in patients refractory to seizure at usual intensity of electric stimulus.

Many augmentation approaches used for enhancing seizure production like hyperventilation, pretreatment with xanthines, and use of remifentanil or ketamine in ECT anesthesia[3]. Pretreatment with caffeine, theophylline or aminophylline (xanthines) prolongs the duration of ECT seizures but has not been clearly shown in controlled trials to increase efficacy[3]. Caution is also warranted because their use may be associated with significant adverse effects. However moderate hyperventilation is safe and may be useful for seizure augmentation before restimulation with higher intensities[4].

Routine monitoring for carbon dioxide (CO_2) is not done during ECT. Since hypocarbia lowers the seizure threshold and also may increase the duration of seizure, this can be useful in patients refractory to seizures with usual intensity of electric stimulus. Monitoring of hypocarbia is done by End Tidal Carbon dioxide ($ETCO_2$) level. ETCO2 is the partial pressure or maximal concentration of CO_2 at the end of an exhaled breath, which is expressed as a percentage of CO_2 or mmHg. The normal values are 5% to 6% CO_2, which is equivalent to 35-45 mmHg. When CO_2 diffuses out of the lungs into the exhaled air, a device called capnometer measures the partial pressure or maximal concentration of CO_2 at the end of exhalation. To prove it scientifically we took two levels of $ETCO_2$ as 30 mmHg and 40 mmHg in this study. Since there is very less work done on this topic as searched in Pubmed, Medline and others and only one relevant small study of 19 patients was found from Japan[4] and no studies from India, we took this study to explore the results.

METHOD

Approval of this study was taken from institution ethical committee. In pre-anesthetic evaluation 60 patients in the age group of 15 to 60 years of either sex, ASA grade I or II who were scheduled for Modified-ECTs enrolled for the study.

Inclusion criteria-

1. Patients who are receiving first ECT after hospitalization.
2. Patient who show adequate seizure by stimulation of constant current from Brief Pulse ECT Machine for 1 second.

Exclusion criteria-

1. Patients who had received any anesthetic drugs in last 1 month.
2. Patient who had received ECT in last 6 months.
3. Patients having any history of drug dependence or abuse or taking benzodiazepines.
4. Patients with major medical illness, history of drug allergy and epilepsy were excluded.
5. Patient who did not show any sign of seizure or adequate seizure duration by stimulation of constant current from Brief Pulse ECT Machine for 1 second.

Informed consent was obtained from the patients and care takers in the prescribed form. Patients were divided into 2 groups of 30 each by simple random sampling.

Group A (Control group) = ECT was given at 40 mm Hg of $ETCO_2$.
Group B (Study group) = ECT was given at 30 mm Hg of $ETCO_2$.

After starting IV line on one arm of patient, injection Glycopyrrolate 0.2 mg given as it decreases secretions and prevents vagal stimulation. Then Propofol was given in dose of 1.5 to 2.5 mg/ Kg body weight. Induction of anesthesia was done by titration method till loss of eyelid reflex. B.P. cuff is tied on other arm of patient and B.P. raised up to 250 mm Hg to block the circulation of succinyl-choline (muscle relaxant) to observe the seizure in that hand. Succinyl-choline was administered in the dose of 0.5 mg/kg body weight by IV line and patients were ventilated with 100% Oxygen with face mask using Bain's circuit till succinyl-choline fasciculation subsided. Monitoring of Systolic BP (SBP), Diastolic BP (DBP), Pulse rate (PR), Hb Oxygen saturation (SpO2) and CO2 was done by Multipara throughout the procedure. When $ETCO_2$ level reached 40 mm Hg in Group A and 30 mm Hg in Group B patients, a rubber mouth gag was inserted into the oral cavity separating tongue and buccal mucosa and supporting chin; ECT applied bi-temporally after applying ECT gel on to the electrodes. ECT was given using a constant current from Brief Pulse ECT Machine for 1 second. If there were no signs of seizures out of the stimulus, then that patient excluded from study.

Duration of seizure was recorded in seconds by clinical method from start of electrical impulse to the end of the clonic contraction in hand with BP cuff tied on arm. Duration of recovery (cognitive, orientation and neuromuscular co-ordination) was recorded from injection intravenous anesthetic agent to time taken to obey verbal commands like opening of eyes, protrude tongue and move limbs.

Collected data represented as mean and standard deviation for quantitative data. Homogeneity of quantitative data of both the samples was tested by variance ratio test (F test referring F-distribution in F-table at $F_{0.05}$). Student's t-test of unpaired type was used for test of significance in quantitative data. P value at 0.05 is taken as level of significance.

RESULTS

The demographic characteristics as shown in Table 1 were comparable in both groups. Maximum numbers of patient were males in both groups.

Mean Induction and recovery time (Table 2) were showing no significant difference indicating that momentary change in $ETCO_2$ level did not affect these parameters. Seizure duration was significantly higher in Group B.

As per table 3, most common side effect was seen as headache in both the groups. Post ECT delirium was seen only in one patient of Group A. Incidence of headache, nausea and vomiting was seen less in Group B but the difference between two groups was statically insignificant.

DISCUSSION

Nowadays application of end-tidal CO_2($ETCO_2$) monitoring is considered for safe and effective anesthesia management of patients. Siato et al[5] considered this monitoring as beneficial for patients undergoing ECT, especially patients with an intracranial disorder or ischemic heart disease. Hyperventilation or low CO_2 in the brain "leads to spontaneous and asynchronous firing of neurons". Hence, when we hyperventilate, CO_2 level in cells becomes abnormally low. As a result, accidental or weak electrical signals can be strengthened and relayed through some parts of the brain interfering with the normal signals. This causes a reduction in the seizure threshold.

Seizure threshold and its duration may be altered by type of anesthetic drug used in Modified ECT. So we used single anesthetic agent as Propofol for all patients in both groups. Seizure threshold may increases in successive ECT, so we studied the effect of $ETCO_2$ in first ECT only. Successive stimulation in case of no seizure or inadequate seizure, threshold for seizure may increase, so such patient excluded from the study.

Patients of both groups in our study were matched for age, sex and body weight. Patients with major medical illness, drug abuse and epilepsy were excluded from the study. Level of 40 mm Hg $ETCO_2$ taken was normal level (normal range 35 to 45 mm Hg) in patients of Group A (control group) and 30 mm Hg $ETCO_2$ taken in Group B to test whether it has any effect on seizure threshold or duration of seizure. Similar level of $ETCO_2$was compared in other study also[5].

In our study, seizure duration was significantly higher in Group B and this was also observed by Sawayamaet al[6] while another study did not report the effects of lower $ETCO_2$ on seizure quality[5].

The level of 30 mm Hg of $ETCO_2$ was found to effective in increasing seizure duration and it is safe in Modified-ECT as the two levels of $ETCO_2$ did not affect mean induction and recovery time of patients and side effects like delirium, headache, nausea and vomiting in post ECT period were less in both Groups. However the recovery time in hyperventilation has been found to be shorter in a study of Mayur et al[7]. and in another study of De Arriba-Arnau et al[8].

The limitation of our study was that the sample size was not large. So more larger sample size studies are needed to explore the results of effect of $ETCO_2$ on seizure quality of ECT.

In conclusion the level of 30 mm Hg of $ETCO_2$ was found to effective in increasing seizure duration and it is safe in Modified-ECT as the two levels of $ETCO_2$ did not affect mean induction and recovery time of patients and side effects like delirium, headache, nausea and vomiting in post ECT period were less in both Groups. The recovery time in hyperventilation has been found to be shorter in a study of Mayur et al[7]. and in another study of De Arriba-Arnau et al[8].

Table No1 Demographic profile

Parameters	Group A	Group B
Age (in Yrs)	29.1 ± 11.6	28.9 ± 9.3
Weight (in Kg)	58.5 ± 9.4	59.6 ± 8.9
Sex (as M/F)	20/10	18/12

Table No. 2 ECT and Anesthesia Parameters

Parameters	Group A	Group B	Significance*
Induction Time (in Seconds)	52.6 ± 4.1	51.8 ± 4.8	NS**
Seizure duration (in Seconds)	26.6 ± 2.5	29.5 ± 3.4	P<0.05
Recovery Time (in Minutes)	28.4 ± 2.4	28.3 ± 2.5	NS

*Student's t-test of unpaired type is used. **Non Significant

Table No. 3 Side effects after ECT

Parameters	Group A	Group B
Delirium	0	1
Headache	2	1
Nausea / vomiting	2	0
Others	3	2

Source of support: Nil
Conflict of interest: None

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