ELECTROCONVULSIVE THERAPY NO-RELAXANT ANAESTHESIA

BY

A. E. DELILKAN

SUMMARY

General anaesthesia was given to 63 in-patients for electroconvulsive therapy. The relaxant-modified method, using thiopentone and suxamethonium, was used on 134 occasions. For 220 treatments methohexitone, without suxamethonium, was used, a graded potential stimulus being applied instead of an instantaneous maximal electrical stimulus. Comparing the two methods it was found that there were significantly fewer increases in blood pressure and an absence of dental or oral trauma with the methohexitone technique. The results of arterial blood-gas analysis of 15 patients treated by this technique showed that there was neither a dangerous fall in arterial oxygen tension nor a marked rise in arterial carbon dioxide tension.

Electroconvulsive therapy has passed through various phases since it was first used (without anaesthesia) by Cerletti and Bini (1938). Problems arose because of the associated trauma (crush injuries and dislocations, especially of the spine) and the introduction of neuromuscular blocking agents in the 1940s, and their subsequent wide adoption brought about a considerable lessening in the incidence and severity of trauma. Associated with the use of muscle relaxants for the modification of electroconvulsive therapy respiratory maintenance problems occasionally arise.

If, instead of applying an instantaneous maximal electrical stimulus, a graded potential stimulus is applied, then a graded muscle or convulsion response ensues. In this case previous injection of a muscle relaxant is unnecessary. The author refers to this technique as the ENORA technique* and the Ectonus apparatus† provides such a graded potential stimulus. The radial control knob is rotated through 120 degrees reaching a maximum of 150V in 3–5 sec, during which period the word Ectonus is spelt out by the psychiatrist.

Trials were undertaken to ascertain whether the omission of muscle relaxants would be advantageous when providing anaesthesia for electroconvulsive therapy by this method. The procedure to be described differs from the usual technique, wherein thiopentone induction of anaesthesia is followed by suxamethonium and a maximal single electrical stimulus, in four ways. These are that methohexitone is used, a muscle relaxant is omitted, a gradually increasing electrical stimulus is employed, and no mouth props, gags or airways are used, the lower jaw being kept apposed to the upper throughout the procedure.

MATERIAL AND METHOD

During the period July 1967 to July 1968, 6 in-patients (32 males) underwent anaesthesia for e.c.t. on 354 occasions in the Psychiatric Unit of the University Hospital, Kuala Lumpur.

Electroconvulsive therapy was given by the conventional method (Series I) or the ENORA method (Series II). All patients were treated on the first and third occasions by the conventional method, and on the second, fourth and subsequent treatments by the ENORA method. This order was chosen to enable a comparison to be made of the two methods in the same patient.

Series I (conventional method).

Thiopentone 2.5 per cent was injected in a dose of 3 mg/kg, the quantity being adjusted to the nearest 25 mg. The maximum dose was 200 mg. Atropine 0.6 mg was drawn into the same...
syringe. Suxamethonium 25–50 mg was then injected. After brief ventilation of the lungs, with oxygen, using a facepiece, a mouth prop, gag or airway was inserted while the electrical stimulus was given (the “instantaneous” or “one-shot” electrical stimulus; 90–150V). The patient was turned into the lateral position for recovery and ventilation continued if apnoea still persisted. This method was used in 134 administrations.

**Series II (ENORA technique).**

Methohexitone 1 per cent was injected at a dose of 1 mg/kg, the dose being adjusted to the nearest 10 mg. The maximum dose was 100 mg. Atropine 0.6 mg was added to the methohexitone. Suxamethonium was not used. Following injection, the stimulus was administered from the Ectonus apparatus. The graded stimulus resulted in a graded response in the patient who was easily controlled by a nurse who noted the blood pressure readings, and prevented the hands from coming into contact with the headband electrodes. This method was used in 220 administrations.

The patient was anaesthetized supine, without pillows, on his bed in the treatment room of the ward. Besides the Ectonus machine, the CIG Midget 2 anaesthetic machine mounted on an anaesthetic trolley, a suction apparatus and a cardio-resuscitation trolley were in the room.

Anaesthesia was induced and when the eyelash reflex disappeared the lower jaw was held up with one hand (fig. 1) so that the lower teeth were held in apposition just behind the upper teeth, according to the normal occlusion, taking care to ensure that the tongue and lips were not caught between the upper and lower teeth. Apposition of the jaws was forcibly maintained throughout until cessation of the convulsion; mouth props, bite-pieces or airways were not used.

The technique of maintaining sustained apposition of the lower and upper jaws was modified in cases where loose teeth were detected in the preanaesthetic assessment. In these cases deliberate prevention of the upper and lower teeth coming together during the electrical stimulus was carried out by hooking up the angles of the mandible with both index fingers and simultaneously depressing the body of the mandible with the thumbs. This position was maintained throughout the convulsion (fig. 2).
When these preparations were completed, the electrical stimulus was administered via the Ectonus machine with the patient breathing air. At the end of the convulsion oral suction was carried out and on return of the eyelash reflex the patient was turned into the right lateral position and taken from the treatment room on the bed.

Data on the 63 patients who were anaesthetized by both methods were as follows:

- **Age.** These ranged from 13 to 66 years (mean 31.14; SD 14.2).
- **Weight.** This ranged from 30.2 to 91.0 kg (mean 56.6; SD 13.3).

**Blood pressure** readings were recorded at all treatments (using a mercury sphygmomanometer and the auscultatory method) just before induction, just before e.c.t. and immediately following cessation of the convulsion.

The **time interval** between induction (termination of injection) and return of the eyelash reflex was noted with a stopwatch. During anaesthesia the incidence of trauma, hiccough and coughing was noted. The time taken before the patient had breakfast after leaving the treatment room was noted. All patients were personally interviewed by the author on the same evening following the morning e.c.t. anaesthesia sessions. The following questions in sequence were put to them:

1. "How do you feel?"
2. "Do you have any complaints?"
3. "Do you have any pain or aches anywhere?"

The answers obtained were used to assess the incidence of post-treatment headaches and muscle pains.

**Arterial blood-gas analysis pilot study.**

Arterial blood-gas analysis was undertaken in 15 cases in Series II. Consent for arterial puncture was obtained from the patient's relatives and from the patient (if and when judged by the psychiatrist to be mentally capable of doing so); permission was also obtained from the Professor of Psychological Medicine to carry out any arterial puncture on his patients. $P_{O_2}$ was measured by using the Radiometer, Clarke-type, Type E5046, $P_O_2$ electrode; pH, $P_{A_CO_2}$ and base excess were measured by the technique described by Astrup (Astrup et al., 1960) using the Sigggaard-Andersen curve nomogram (Sigggaard-Andersen, 1961). Arterial samples were taken at the pre anaesthetic assessment and used as the baseline values and the second arterial sample was taken immediately following cessation of the convulsion; all the second samples were taken within 30 sec of the cessation of the convulsion (if a sample was not obtained within 30 sec, the procedure was abandoned). All samples were placed in an ice-box and analyses were carried out within 1 hour of sampling.

**RESULTS**

**Blood pressure variations.**

The resting arterial pressures of all 63 patients anaesthetized according to Series I and Series II were as follows: systolic range (mm Hg) 100–200; diastolic range (mm Hg) 52–120.

**Series I.** After all 134 administrations there was an increase in pressure: systolic increase range (mm Hg) 24–84; diastolic increase range (mm Hg) 12–48.

**Series II.** Of the 220 administrations no change in pressure followed therapy in 119. In 74 there was an increase in blood pressure: systolic increase range (mm Hg) 24–84; diastolic increase range (mm Hg) 12–48.

A rise in blood pressure of short duration following electroconvulsive therapy (with or without anaesthesia) is a recognized accompaniment (Adderley and Hamilton, 1953). Table I shows that in Series II there were significantly fewer increases in pressure.

### Table I

<table>
<thead>
<tr>
<th>No. of patients</th>
<th>Series I</th>
<th>Series II</th>
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<tbody>
<tr>
<td>No change</td>
<td>0</td>
<td>119</td>
</tr>
<tr>
<td>Fall</td>
<td>0</td>
<td>27</td>
</tr>
<tr>
<td>Rise</td>
<td>134 (100)</td>
<td>74 (33.6)</td>
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$X^2 = 148.621; P<0.001.$

**Complications during anaesthesia.**

Data on the incidences of trauma (dental or oral), hiccoughing, and coughing in Series I and...
Series II during the procedures, and the incidence of headaches and muscle pains following the procedures are shown in table II. Trauma was not noted on any occasion in Series II. Hiccough and cough occurred infrequently in either series and differences were not statistically significant.

### Complications following e.c.t.

The incidences of headache and muscle pain following therapy are listed in table II. There was no significant difference in the headaches and the low incidence of muscle pains shows a barely significant difference between the two techniques. However, the questions were asked of psychiatric patients, the veracity of whose answers is not always reliable.

#### The induction-recovery interval.

The point of immediate recovery was taken to be the return of the eyelash reflex. The results are shown in tables III and IV and demonstrate that the induction-recovery interval was significantly shorter in Series II than in Series I. Ninety-five per cent of the patients in Series II had breakfast within 10 minutes of leaving the treatment room.

#### Arterial blood-gases.

Evidence of hypoxia, hypercarbia and metabolic acidosis associated with e.c.t. was not seen in this pilot study (table V). In some cases there was a fall in $P_{aO_2}$ and, bearing in mind the margin of experimental error the author attributes the fall to the hyperventilation which was commonly seen to follow the termination of the electrically induced fit. The hyperventilation could also possibly have occurred in response to the metabolic acidosis arising during the convulsion. This pilot study was carried out to show that the technique of using methohexitone alone as anaesthesia for treatment with the Ectonus apparatus was associated with only minor disturbances of $P_{aO_2}$ and $P_{aCO_2}$.

### DISCUSSION AND CONCLUSIONS

The use of anaesthesia during electroconvulsive therapy was mooted during the late 1930s and 1940s to remove the unpleasantness and fears associated with the initial stages leading to the convulsion, and the lessening of the incidence of trauma was mainly controlled by the use of muscle relaxants (Hocking, 1963).

The procedure (Series II) using intravenous methohexitone with the Ectonus apparatus can be questioned as unnecessary, as the step-like build-up of the potential of the electrical stimulus removes the need for muscle relaxants. The author maintains that on the basis of being
TABLE V
Showing results of arterial blood-gas analysis on pilot study (15 cases) in Series II.

<table>
<thead>
<tr>
<th>Pre-e.c.t.</th>
<th>Post-e.c.t. (samples taken within 30 sec of cessation of convulsion)</th>
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<tr>
<td></td>
<td>( P_{aO_2} ) (mm Hg)</td>
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<td>1</td>
<td>98</td>
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<td>2</td>
<td>99</td>
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humane and consequently making subsequent treatments easily acceptable to the patients an
inducing agent must be used and has a definite place.

Methohexitone was chosen as the induction
agent in preference to thiopentone on the basis
of its advantages. Coleman and Green (1960),
Green and Jolly (1960), Dundee and Moore
(1961) and other workers have shown that, com-
pared to thiopentone, methohexitone has a shorter
recovery time which is in accordance with the
recent results. Respiration is depressed to a
similar extent with the two agents. Methohexi-
tone is less irritant and there is minimal danger
of venous thrombosis or tissue damage following
perivenous injection. Methohexitone is said to
have a more pleasant induction compared to
thiopentone, in that the associated taste and
smell of the latter is not found (Hocking, 1963).

The dosage of methohexitone used by the
author has been found adequate and compatible
with the technique. Bourne (personal communi-
cation and 1967) advocates a greater dosage for
methohexitone as an agent by itself for dental
out-patient extraction anaesthesia on a basis of
age groups and weight, but the dosage used in
this series has been found adequate for anaes-
thesia for electroconvulsive therapy.

The method of holding the jaw in Series II
is simple and safe. In Series I where mouth bites,
props, gags and airways were used, the possibility
of dental and oral trauma was a constant worry.
With the modified technique described the risk
of this complication was removed. The fact that
oral and dental trauma occurred despite the use
of muscle relaxants (Series I) when mouth bites,
etc., were used is important. The simple jaw-
holding technique currently practised is, in the
author's opinion, a significant contribution to the
absence of dental or oral trauma associated with
e.c.t. anaesthesia.

The practice of using atropine to prevent the
brief period of bradycardia and asystole associated
with e.c.t. has been followed. The recommended
dose of 1–2 mg (Dobkin, 1958) advocated by
most workers was not followed. In this series 0.6
mg was injected intravenously, but the heart-beat
and peripheral pulse were not monitored. Radi-
ographs of the vertebrae to check for crush
fractures have not been taken.

Initially satisfactory therapeutic results were
not obtained using the Ectonus apparatus (graded
stimulus). On checking, it was found that the
output was less than the expected voltage. New
apparatus was used; the voltage was checked
while in use and found to be within the expected
range (lowest value 95 V and highest value
138 V). Since then the therapeutic results have
been satisfactory.

Electroconvulsive therapy no-relaxant anaes-
thesia using methohexitone (with atropine) in
combination with an apparatus providing gradu-
ally increasing potential electrical stimulus is recommended as a simple, safe, economical and time-saving procedure. It can be used for both in-patient and out-patient treatment. The only apparatus required, other than the e.c.t. apparatus, is a needle and a syringe; cardiorespiratory resuscitation apparatus should, of course, be available as in all situations where general anaesthesia is given.

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REFERENCES


ANESTHESIE SANS RELACHANTS POUR L'ELECTROCHOC-THERAPIE

SUMMAIRE

Une anesthesie generale a ete administree pour l'électrochoc-therapie chez soixante trois patients hospitalises. La methode modifiee avec relaxant, utilisant thiopentone et suxamethonium, a ete appliquee 134 fois. Methohexitone sans suxamethonium a ete administre pour 220 traitements, avec application d'un stimulus a potentiel graduel au lieu du stimulus electrique maximal instantané. La comparaison des deux methodes a montre qu'avec la technique au methohexitone les augmentations de la pression sanguine etaient significativement moins frequentes, et les traumatismes dentaires ou oraux absents. Les resultats de l'analyse des gaz sanguins arteriels chez quinze malades, traites selon cette methode, demontre l'absence d'une reduction dangereuse de la pression arterielle d'oxygene, ainsi que d'une augmentation marquee de la pression arterielle de gaz carbonique.

ELEKTROSCHOCK-THERAPIE OHNE ANWENDUNG VON MUSKEL-RELAXANTEN BEI DER NARKOSE

ZUSAMMENFASSUNG