

Electroconvulsive therapy machine

HK Cheung, FRCPsych (UK), Hon FHKCPsych

Guest author, Education and Research Committee, Hong Kong Museum of Medical Sciences Society

<https://doi.org/10.12809/hkmj-hkms202106>

Electroconvulsive therapy (ECT) is a psychiatric treatment in which seizure is electrically induced in patients, typically with muscular convulsions subdued by muscle relaxant and anaesthesia. This ECT machine was generously donated to the Hong Kong Museum of Medical Sciences by Dr John Chung, son of the late Dr Cho-man Chung (Fig). The ECT machine is an Ectonus Mark 3 model manufactured by Ectron Ltd.

Convulsive therapy was first introduced in 1934 by Ladislav Joseph Meduna, a Hungarian neuropsychiatrist who believed that schizophrenia and epilepsy were antagonistic disorders. He induced seizures first with camphor and then metrazol. In 1938, Ugo Cerletti, an Italian neuropsychiatrist and his assistant Lucio Bini developed the idea of using electricity as a substitute for metrazol in convulsive therapy.¹ Soon, ECT replaced metrazol therapy worldwide, and Cerletti and his assistant Lucio Bini

were nominated for a Nobel Prize. Later, the two Italian inventors had a disagreement over the patent of the ECT device, damaging their relationship.

Since the original Cerletti–Bini ECT apparatus, there have been continuous modifications and refinements in the ECT machines. All modifications have had the same goal of maximising therapeutic effect while minimising adverse consequences (mainly confusion and amnesia). Many parameters have been considered, including waveform, pulse width, resistance (constant voltage or constant current), electric charge, electrodes (unilateral or bilateral), and dose (titration or fixed). In addition, modern machines have added capabilities to monitor physiological parameters such as electroencephalogram, electrocardiogram, blood oxygen level, and motion, as well as software that can provide the clinician with detailed monitoring and feedback.



FIG. Ectonus Mark 3 electroconvulsive therapy (ECT) machine manufactured in England by Ectron Ltd. (A) On/off switch, (B) treatment light (red), (C) mains power light (white), (D) output plug, (E) ECT treatment button (marked "Instant"), (F) waveform switch, (G) ECT treatment dial (marked "OFF", "increase", and "ON"), (H) scalp electrode, and (I) power lead and plug. This ECT machine was donated to the Hong Kong Museum of Medical Sciences by Dr John Chung

In the 1940s, ECT was given in “unmodified” form—without muscle relaxants—resulting in a full-scale convulsive seizure, and sometimes inflicting injury to the patient, including (rarely) fracture or dislocation of the long bones. In order to modify the convulsions, psychiatrists began to experiment with curare, a poison from South America. Unmodified ECT was introduced to Hong Kong in the 1940s. Known colloquially as “straight ECT”, it was performed by a psychiatrist without the use of anaesthesia, muscle relaxant, or any machine-provided physiological monitoring, and often without proper informed consent from the patient.

In 1951, the introduction of succinylcholine (succinylcholine), a safer synthetic alternative to curare, led to the more widespread use of modified ECT. Anaesthetics are unnecessary for ECT, as the electric shock is capable of immediately rendering the patient unconscious. Moreover, ECT can cause retrograde amnesia, so the patient also has no negative memory of the experience. Nevertheless, muscle relaxants can invoke a feeling of suffocation, so a short-acting anaesthetic was usually given in addition to the muscle relaxant in order to spare the patients this terrifying ordeal.

In the United States, ECT devices are manufactured by two companies, Somatics and MECTA. In the United Kingdom, the market for ECT devices was long monopolised by Ectron Ltd. In Hong Kong, following the British medical training and tradition, Ectron machines were the only ones in use for >50 years. It was not until the past 20 years that non-British models were introduced into Hong Kong.

The Ectonus Mark 3 ECT apparatus at the Hong Kong Museum of Medical Sciences was one of the first-generation models manufactured by Ectron Ltd. The apparatus was housed in a square wooden box with a lid that is hinged at the back, has two clasps on the left and right sides near the front and an attached leather handle on the front; the base houses the motor of the apparatus and is covered with a panel that with an on/off switch, an ECT treatment button, a waveform switch, and an ECT treatment dial, as well as various connectors and indicator lights (Fig). At the time the apparatus was manufactured and used, likely in the 1960s, current would have been delivered in sine-wave form, with a switch allowing the clinician to choose between unidirectional or bidirectional sine waves. At that time, it was believed that the unidirectional wave produced fewer adverse effects but the bidirectional

wave was more effective. A fixed dose of electricity predetermined by the manufacturer could be delivered by pressing a separate treatment button (labelled “instant”). Alternatively, the operator could choose to deliver a dose of variable strength and/or duration by using the treatment dial. No physiological monitoring or other software was provided by the machine.

Despite improvements in technique and equipment, the use of ECT declined from the 1950s owing to declining public acceptance influenced by negative depictions of ECT in the mass media, as well as the emergence of alternative treatments. Modern psychopharmacotherapy, including effective antidepressants, antipsychotics, mood stabilisers, tranquillisers, rendered ECT unnecessary in most cases. There are also less-invasive cerebral modulation interventions, such as repetitive transcranial magnetic stimulation, which, although not as effective as ECT, is acceptable to doctor and patient because it does not require general anaesthesia nor the induction of a seizure.

In Hong Kong, until the late 1970s, all ECT procedures (including the general anaesthesia) were carried out by psychiatrists. Typically, two psychiatrists worked as a team, treating tens of patients daily, with multiple ECT procedures each hour. After this, anaesthetists participated in the treatment. By the 2000s, taking the figures of Castle Peak Hospital as an illustration, ECT was performed in only two sessions per week, with one psychiatrist and one anaesthetist. Typically only one or two patients were treated per session, with no patients at all in some sessions.

A modern course of ECT usually consists of four to 12 treatments delivered 2 to 3 times per week. Neuroimaging studies in people who have had ECT, investigating differences between responders and non-responders, find that responders have decreased blood flow and metabolism in the frontal lobes, and increased perfusion and metabolism in the medial temporal lobe (such as the hippocampus).² The general physical risks (and mortality) of ECT are similar to those of a brief general anaesthesia. The most common adverse effects are confusion and transient memory loss. It is safe in pregnancy. Despite the decline in use, ECT remains an important backup treatment for patients with major depressive disorder and other mental disorders, including mania, catatonia, and treatment-resistant schizophrenia, in whom other therapies have proved ineffective.

References

1. Cerletti U. Electroshock therapy. In: Marti-Ibanez F, Sackler AM, Sackler MD, Sackler RR, editors. *The Great Physiodynamic Therapies in Psychiatry: an Historical Reappraisal*. New York: Hoeber-Harper; 1956: 91-120.
2. Abbott CC, Gallegos P, Rediske N, Lemke NT, Quinn DK. A review of longitudinal electroconvulsive therapy: neuroimaging investigations. *J Geriatr Psychiatry Neurol* 2014;27:33-46.