Eversince its discovery by Gerletti and Bini (1938), electro-convulsive therapy (E.C.T.) has continued to occupy a central place in the therapeutic armamentarium of psychiatrists. Despite abhorrence from some quarters, it is still being practiced as one of the cheapest and safest, and yet one of the most effective therapeutic techniques in the whole of medical science (Kalinowsky, 1975; Royal College of Psychiatrists, 1977; Shukla et al., 1979; Shukla, 1981; DeSousa and DeSousa, 1984; Abhyankar, 1985 and Slater and Roth, 1986).

These statements are particularly true of developing countries like India where, due to lack of adequate indoor treatment facilities, trained psychiatric personnel and funds, it is imperative that patients are treated quickly and effectively (DeSousa and DeSousa, 1984). This is possible only with the help of E.C.T. used in conjunction with psychopharmacological agents. It is therefore hardly surprising that, in contrast to the developed countries, where E.C.T. is used rather sparingly and almost exclusively in depression, in India it forms the main stay of treatment for all the functional psychoses, particularly schizophrenia and post partum psychosis (Vahia et al., 1974; Shukla, 1981; DeSousa and DeSousa, 1984 and Abhyankar, 1985).

E.C.T. has recently become controversial through misrepresentation by the mass media under the unfortunate name of “shock” treatment and has been projected as punitive, noxious and old fashioned in total disregard of its merits (Frederiksen and d’Elia, 1979 and Weiner, 1979). After fifty years of its discovery, it would be worthwhile to assess the present status of this therapeutic modality and to put it in a proper perspective, particularly in the Indian setting.

The term convulsive therapy is virtually synonymous with electro-convulsive treatment for, now-a-days, convulsions are almost always electrically induced (Kiloh et al., 1988). I would not therefore go into the historical details since it is only too well known that, to start with convulsions were induced pharmacologically and electricity came to be used for this purpose solely because of convenience, safety and almost certain efficacy. Further, since this review is addressed mainly to the practising psychiatrists, it will limit itself to some very practical and clinical aspects of E.C.T. viz. indications and efficacy in some important psychiatric conditions, contra indications, current parameters and electrode placement, use of anaesthesia and muscle relaxants, and untoward effects alongwith ways to avoid/overcome them. I shall try to fulfil these objectives without delving deeply into theoretical details.

INDICATIONS AND EFFICACY:

Depression:

When E.C.T. was introduced, it was tried out in virtually every psychotic
condition—schizophrenic, depressive, manic and even organic. It soon became apparent, however, that the most spectacular improvements occurred in patients with endogenous depression. E.C.T. has been found to be equally effective in all types of endogenous depression viz., manic depressive depression, involutional depression and old age depression (Kalinowsky et al., 1982). The efficacy of E.C.T. in such cases has been repeatedly confirmed by several studies including those involving comparison with simulated E.C.T. (Freeman et al., 1978; Johnstone et al., 1980; West, 1981; Bagadia et al., 1983; Brandon et al., 1984 and Gregory et al., 1985). The classical symptoms of endogenous depression (severe depression of acute onset, diurnal variation of mood, retardation, early morning awakening and loss of weight, appetite and libido) predict a good response (Carney et al., 1965). On the other hand, in patients with neurotic depression, the results are unpredictable. Rather, in such cases, E.C.T. is likely to exaggerate some of the neurotic symptoms (Freeman, 1979 and Slater and Roth, 1986).

Although ever since they became available, tricyclic and tetracyclic antidepressants constitute the mainstay of treatment for depression, numerous studies have shown E.C.T. to be still the more effective, and more rapidly so, in the treatment of endogenous depression (Medical Research Council, 1965 and Avery and Windor, 1977). Further, E.C.T. is usually effective even in those patients who have not shown any response to antidepressants (Kalinowsky et al., 1982 and Linington and Harris, 1988). However, the main role of E.C.T., nowadays, is in the treatment of patients who have failed to respond to an adequate dose/duration of antidepressant pharmacotherapy (Kendell, 1981).

There are, nevertheless, a number of circumstances in which it would be appropriate to use E.C.T. as the initial treatment. In some patients with recurrent episodes of depression, it is clear from their history that they have never responded to drugs but have always responded to E.C.T. Hence it would be quite sensible to give E.C.T. straightway rather than prolong the patient's misery for several weeks by administering a drug which is unlikely to be of help. Secondly, severe melancholia, particularly one with marked retardation or accompanied by nihilistic or paranoid delusions, responds poorly to drugs but dramatically to E.C.T. (Brockington et al. 1978 and Rao and Coppen, 1979). Further, it has been found by Quitkin et al. (1978) that deluded depressives respond only to very high doses of imipramine and such a high dose may not be tolerated by the patients, particularly the elderly. It is often advisable therefore to give E.C.T. straightway to patients with nihilistic or paranoid delusions. Finally, there are situations in which it is vital to remove the patient's symptoms as quickly as possible either because they are not taking food or water, or because there is a grave risk of suicide or simply because there is too much suffering. E.C.T. acts much faster than drugs (Medical Research Council, 1965 and Coryell, 1978) and, in situations such as these, one should have no hesitation in giving it immediately for that reason alone.

Mania:

While lithium and neuroleptics constitute the treatment of choice in most of the manic states, there are still some indications for E.C.T. in this condition (McCabe, 1976; Thomas and Reddy, 1982 and Small et al., 1985). The American Psychiatric Association's
task force (1978) found that 42% of American Psychiatrists considered that E. C. T. was an appropriate treatment for mania. In these patients, E. C. T. has to be given more frequently, i.e., daily or even many times in a day (Kalinowsky and Hippius, 1969 and Kiloh et al., 1988). In severely disturbed manic patients, lithium may be started and, at the same time, a few E. C. Ts given to eliminate the most disturbing symptoms (Kalinowsky et al., 1982). However, it has been reported that the combination of lithium and E. C. T. carries a risk of provoking delirious reactions and of giving rise to rather more memory impairment than E. C. T. alone (Hoenig and Chaulk, 1977; Mandel et al., 1980; Small et al., 1980 and Weiner et al., 1980). How commonly this occurs has not been established but, as nowadays any patient with mania who is considered for E. C. T. is very likely to have received lithium, the possibility of this complication needs to be borne in mind.

**Schizophrenia:**

For a number of years after its introduction, E. C. T. was used as an effective treatment for schizophrenia—at least in a proportion of cases. However, following the advent of neuroleptic drugs, interest in E. C. T. for the treatment of schizophrenia decreased substantially and its role vis-a-vis neuroleptics has become uncertain and doubtful. Only 25% of American psychiatrists considered E. C. T. to be an appropriate treatment for schizophrenia while 59% regard its use as inappropriate. Merely 8% consider E. C. T. to be the treatment of first choice (American Psychiatric Association, 1978).

However, in view of the long and often downhill albeit fluctuating natural course of schizophrenia, it would not be fair to expect the same efficacy of E. C. T. as in depression since the latter is, by definition, an episodic and a relatively benign condition. Keeping this fact in mind, E. C. T. is found to be useful in many schizophrenic situations. In acute schizophrenia, E. C. T. is definitely useful in that it quickens the recovery and shortens the hospital stay (Smith et al., 1967; Wells, 1973; May, 1975 and Shukla, 1981), makes the patients more easily manageable (Shukla, 1974 and Kalinowsky, 1975) and helps in treating the patients with smaller doses of neuroleptics and thus avoids the side effects and dangers that go with their high doses. All these make it possible to manage even the most disturbed and excited patients in the open wards of general hospitals, thus avoiding admission to a mental hospital and all the legal and social problems that it entails. Not only that, in some cases e.g., those with the so-called malignant catatonia, E. C. T. is often a life saving measure (Kalinowsky et al., 1982).

In acute stage, E. C. T. has been found to be better than neuroleptics (Childers, 1964 and May et al., 1976) and many patients refractory to neuroleptics make an excellent response to E. C. T. (Weinstein and Fischer, 1971 and May, 1975). Further, several workers have found a combination of E. C. T. and neuroleptics to be much more effective than either of these used alone (Childers, 1964; Smith et al., 1967; Wells, 1973; Shukla, 1981 and Slater and Roth, 1986). The combination ensured improvement in 80% of the cases as against 55% by E. C. T. and 45% by chlorpromazine (Childers, 1964). These observations have been confirmed by several simulated trials (Turek and Hanlon, 1977; Taylor and Fleminger, 1980; Taylor, 1981 and Brandon et al., 1984, 1985).
On the other hand, almost all these workers have observed that although E. C. T. quickens the recovery in the acute stage and has therefore an edge over neuroleptics in the initial few weeks, in the long run—say after 12 weeks—drugs catch-up and then there is no difference between the patients treated with E. C. T. and those treated with neuroleptics (Smith et al., 1967; Janakiramaiah and Subbakrishna, 1981; Brandon et al., 1984, 1985 and Abraham and Kulhara, 1987). Nevertheless, the rapid recovery and quick restoration of the patient’s earning capacity is, in itself, a great advantage in our set up (Vahia et al., 1974; Shukla 1981 and DeSousa and DeSousa, 1984).

As against this, in chronic schizophrenics, maintenance E. C. T., has been found to be inferior to maintenance neuroleptic treatment and is no substitute to it (Naidoo, 1956 and Goldner, 1960). In such cases, E. C. T. is however indicated to control the acute exacerbations and to make it possible to rehabilitate the patient in the community. Thus, Stinson et al. (1972) found that it was possible to discharge 75% of the chronic patients treated with E. C. T. as against 50% of those treated with drugs. Similarly, using “regressive technique”, Exner and Murillo (1973, 1977) reported improvement in 91% of the chronic schizophrenics subjected to E. C. T. as against in 70% of those treated with chlorpromazine and/or haloperidol. Further, the relapse rate was lower with E. C. T.—a finding that has been corroborated by Smith et al. (1967) and Wells (1973). Exner and Murillo (1973, 1977) concluded that “E. C. T. appeared to promote sound and reasonably long lasting gains which were better than those obtained by drugs”. May et al. (1976) noted that E. C. T. treated patients fared about as well or, in fact (non-significantly) better than those who received drug treatment.

Thus it is not possible to be as emphatic about the value of E. C. T. in patients with schizophrenia as in those with endogenous depression. Nevertheless, there is sufficient clinical evidence to show that E. C. T. has a definite and important place in the treatment of schizophrenia when used in judiciously selected patients in various stages of their illness. Neuroleptics will usually be more helpful in vast number of chronic patients while in acute patients, E. C. T. still has an important indication. An unprejudiced use of both types of treatment will improve the results in schizophrenia and will help in the rehabilitation of many of these patients. Sargant and Slater (1972) and Kalinowsky et al. (1982) have suggested that every schizophrenic patient should be given the opportunity to receive combined (neuroleptic and convulsive) therapy during the most favourable period of the first year of his illness.

**Other indications:**

**Epilepsy**: In epileptics with seizures at regular intervals, an artificial convulsion may offer some protection against a spontaneous fit which, occurring under uncontrolled conditions, might endanger the patient or jeopardize his social position. Continued epileptic twilight states and repeated incomplete seizures constitute other indications where the patient can be made normal with just one or two E. C. Ts. Lastly, schizophrenic and affective psychoses associated with temporal lobe epilepsy can be treated with E. C. T if they do not improve with psychopharmacotherapy (Slater and Roth, 1986 and Kiloh et al., 1988).

**Delirium**: There are patients with delirium due to typhoid and encephalitis who, even after the infection has been adequately treated, continue to be con-
fused, disoriented and uncooperative with medication feeding and care. These cases are often extremely difficult to manage and cause desperation to their relatives and the nursing staff. Such cases usually make a dramatic recovery with a short course of E. C. T's. However, C. S. F. and blood picture must have returned to normal before E. C. T is started and it should be stopped on the first indication of a deterioration in the patient's general condition or in his cognitive functions (Breakey and Kala, 1977 and Shukla, 1989).

**CONTRAINDICATIONS:**

Since E. C. T produces a considerable albeit transient increase in cerebral blood flow (Kenell, 1981), it should not be given to patients having raised intracranial tension. Many clinicians therefore regard the presence of brain tumour to be an absolute contraindication (Kiloh et al., 1988). Apart from this, there is no absolute medical contraindication to E. C. T. Nevertheless, there are obvious cases in whom serious consideration has to be given whether or not to proceed with E. C. T. With modified E. C. T, the final decision about giving the treatment to a patient with a significant physical illness lies primarily with the anaesthetist. However, it is for the psychiatrist to evaluate the dangers of the mental condition, so that these could be set against the hazards of the treatment. For example, in severe depression, the risk of death by suicide may very well be greater than any hazard the treatment may pose.

Recent myocardial infarction and cerebral thrombosis and haemorrhage are some of the more frequently encountered problems and it would be advisable to allow the acute features to subside before starting E. C. T because E. C. T may provoke brief periods of tachycardia and hyper-tension (Perrin, 1961). In view of a series of general anaesthesia involved, E. C. T should generally be postponed in a patient with an acute respiratory infection. Similarly, liver and renal failures should be corrected as far as possible before subjecting the patient to E. C. T. A raised intraocular pressure should be brought under control since E. C. T as well as suxamethonium cause a rise in the pressure and can therefore worsen glaucoma (Kalinowsky, 1975 and Shukla et al., 1980).

Spinal disease and recent limb fractures used to be contraindications but matter little now since limb and spinal movements can be abolished by the muscle relaxants. However, the suxamethonium and E. C. T induced rise in serum potassium (Bali, 1975 and Shukla et al., 1982) may be particularly pronounced in cases with pre-existing tissue damage e.g., those with fracture, crush injuries and burns. This may cause arrhythmias including ventricular fibrillation. One has therefore to be very cautious and vigilant in these cases throughout the procedure. Indwelling cardiac pacemakers do not constitute a contraindication since the passage of current across the head does not interfere with the pacemaker. However, the trolley should be totally insulated and no one should touch the patient while the stimulus is being applied (Jauher et al., 1979 and Kendell, 1981). Atropine should not be given in these cases (Alexopoulos and Frances, 1980). It has also been suggested that a demand pacemaker should be converted into a fixed-mode pacemaker, during E. C. T., by placing a magnet over the pulse generator (Kiloh et al., 1988).

Pregnancy presents no problem; there is no particular danger to the mother or to the foetus (Impastato et al, 1964 and Kalinowsky and Hippius, 1969). In early pregnancy, E. C. T may be
preferable to antidepressants or other drugs (Kendell, 1981). Similarly, old age in itself is not a contraindication. Indeed, there is evidence that E.C.T. might be safer than antidepressants in view of the propensity these have for provoking glaucoma, cardiac arrhythmias and in males, urinary obstruction (Kiloh et al., 1988). Even frail people in their 80s usually tolerate the treatment well and its efficacy is at least as good, or possibly better, in old age than it is in the earlier decades (Kendell, 1981).

E.C.T. MACHINERY: WAVE FORMS AND ELECTRODE PLACEMENTS:

Once it was clear that convulsions rather than electricity constituted the therapeutic agent, it was only in the fitness of the things to try to develop techniques which required the least electricity for inducing a convulsion so as to lessen the risk of undesirable sequelae. This led to the investigations of different forms of electrical stimulus and electrode placements.

Stimulus wave form:

Cerletti and Bini induced seizures with an alternating current of 110 volts for half a second and most E.C.T. machines have been based ever since on some modification of the mains alternating current (i.e., a biphasic sinusoidal wave form with a frequency of 50 or 60 cycles per second), though some have used a discharging condenser. Some machines deliver a fixed quantity of electricity, or would do so if head resistance were constant; in others the quantity can be varied either by increasing or decreasing the duration of stimulation or by altering the capacity of the condenser (Kendell, 1981).

It is now an accepted fact that a supra-liminal stimulus increases the post-ictal confusion and memory disturbance without any matching in the therapeutic efficacy and that the minimal electrical stimulus capable of inducing a convolution should therefore be used (Ottosson, 1960). Although most of the E.C.T. machines assume a skull resistance of 300 Ohms, it may actually vary from 200 to 500 ohms and since these machines are set to produce a convolution in the great majority of the patients without any adjustment, it follows that many patients are receiving a considerably larger current than they require. Further, much of this biphasic sinusoidal current is not contributing to the neuronal discharges provoking the seizure because it is delivered while the concerned neurones are in a refractory period.

Friedman and Wilcox (1942) indicated that the quantity of electricity required could be substantially reduced by replacing the alternating sinusoidal current by unidirectional pulses. These observations have subsequently been confirmed by several workers who have found the use of pulsed stimulus to reduce the required electricity to the tune of one-fourth to one-twentieth of the sinusoidal stimulus technique of Cerletti and Bini (Weaver et al., 1977; 1978, 1982 and Gordon, 1982). Further, pulsed current is as effective in producing convulsions as the original sinusoidal stimulus (Valentine et al., 1968 and Weaver et al., 1977). Rather, pulsed current appears to be more reliable in inducing convulsions with a very low failure rate (Weaver et al., 1977; 1978) and it has a shorter latency between the end of stimulus and the onset of convulsions (usually less than one second and never more than two seconds) as compared to the standard Cerletti and Bini technique where the latency can be up to 50 seconds (Weiner, 1980). The reason for all these is that brief pulses lasting no longer than a milli second and coming at intervals of 10-40
milli-seconds avoid the problem of neuronal refractory period and enable a seizure to be produced with a much smaller quantity of electrical energy spread over a longer period (Kendell, 1981).

Post-E. C. T. confusion and memory impairment are very much less marked when pulsed current is used. Valentine et al. (1988) compared brief bidirectional pulses and standard biphasic sinusoidal current in two groups of patients using bilateral electrodes in half of each group and unilateral electrodes in the other half. Recovery of consciousness was fastest and the post-ictal confusion and memory impairment least in the group receiving unilateral brief pulse E. C. T. and recovery slowest and confusion and memory impairment most pronounced in the group receiving bilateral sinusoidal E. G. T. These observations get further support from Weiner (1980) who found that post-E. G. T. electro-encephalographic abnormalities were less marked with the brief stimulus technique.

Direction and shape of the pulses have also received attention. It has been proved that direction is not important-positive, negative and bi-directional-all the waves are equally effective (Weaver et al., 1982). Shape-wise, exponentially rising waves were the most efficient, whilst square (rectangular) waves required 22% more power. Exponentially falling waves needed 85% more power and sinusoidal waves several times as many as any other. The ease with which square waves could be produced justified their use rather than the exponentially rising waves.

The optimum pulsed stimulus has not yet been precisely defined and-within limits of course—this may not be all that important. Weaver et al. (1977, 1978) have advocated the use of square pulses of 1 milli-second duration, at 91 cycles per second, for a stimulus duration of 1.65 seconds so as to deliver precisely 150 pulses.

However, in spite of the fact that it has been demonstrated clearly that from a clinical point of view, brief pulsed current is at least as effective as the sinusoidal current and that it is greatly to be preferred in regards to its side effects, the task force of American Psychiatric Association (1978) found that 62% of American Psychiatrists were still using sinusoidal current while in Great Britain, Pippard and Ellam (1981) found that in very few clinics was pulsed current being used exclusively. In India, norms for E. G. T. machines are yet to be introduced. Work should therefore be directed to develop and recommend standard for E. C. T. instrument which can be formally implemented at the national level for clinical practice and research. Similarly, the importance of electrical dose measurement (“dosimetry”) during E. C. T. has just started gaining recognition. There is a need to explicitly provide full details of electrical stimulus. The NIMHANS group is at work in this direction (Andrade et al., 1988 and Gangadhar et al., 1988).

Electrode placements:

When E. C. T. was first introduced, it was given with one electrode each placed over either of the temples—the so called standard or bilateral electrode placement. Although several alternatives, viz., bifrontal (Inglish, 1969 and Abrams and Taylor, 1973), biparietal (Friedman and Wilcox, 1942) and multiple electrode placements (Friedman, 1952) have been described, the original bitemporal placement is still more widely used than any other because of its easy applicability and perhaps because other bilateral placements offer no advantage in terms of efficacy or side-
effects (Kendell, 1981).

The idea of putting both the electrodes on the same side was mooted and tried out in 1940s (Friedman and Wilcox, 1942). They observed that by placing the positive electrode just above and in front of the pinna and the negative one over the mid obHon, i.e., the junction of frontal and parietal bones, the amount of electricity required to produce a seizure was reduced. They preferred a left sided placement because “some symptoms of mental derangement may originate in such areas”. It was also noticed that unilateral E. C.T. produced less post-ictal confusion and memory disturbance—a finding that has since been confirmed over and over again (McAndrew et al., 1967; Wilson and Gottlieb, 1967; Halliday et al., 1968; Sutherland et al., 1968; Costello et al., 1970 and Chatterjee and Mohammed, 1980). Not only that, return of consciousness and respiration were faster with unilateral E.C.T. (Valentine et al., 1968). All these differences have been attributed to the reduction in the current required and to a difference in the routing of the current (Kiloh et al., 1988).

Although there might be subtle differences in form of memory disturbances, its degree has been found to be very much less if E. C. T. is given unilaterally, whether on dominant or non-dominant side, than with bilateral E.C.T. (Shah et al., 1974 and Chatterjee and Mohammed, 1980). Thus while Kendall (1981), over-impressed with the importance of the dominat hemisphere, advocated giving bilateral E. C. T. if in doubt about the handedness, Kiloh et al. (1988) found it inappropriate to give bilateral E. C. T. even in such cases since they felt that either variety of unilateral E. C. T. was preferable to bilateral E. C. T. Weiner (1979) suggests that if laterality is unknown, it is worth giving right and left sided treatments alternately followed, as soon as consciousness is regained, by the administration of a simple verbal performance test; treatment should be continued on the side associated with better results.

Several unilateral electrode placements have been described, viz., temporo-parietal (Lancaster et al., 1958 and d'Elia, 1970), temporo-frontal (Muller, 1971), temporo-occipital (Impastato and Karliner, 1966; McAndrew et al., 1967 and Halliday et al., 1968) and purely frontal (d'Elia et al., 1977). In the technique of Lancaster et al. (1958), which is most commonly used, the positive electrode is placed 3-6 cms. perpendicularly above the mid-point of a line joining the external auditory meatus to the outer canthus of the eye and the negative electrode is placed 6-7 cms. above and posterior to it, the line joining the electrodes making an angle of 70° with the perpendicular. To ensure efficacy, the electrodes should be at least 4 cms in diameter in order to avoid focal stimulation and their mid-points should be at least 12-13 cms. apart so as to stimulate a sufficiently large area to induce a generalized seizure (d'Elia and Raouma, 1975). Gordon (1982) has pointed out that closer the electrodes smaller the proportion of electricity entering the cranial cavity. If very close, the current may be shunted past the brain (d'Elia et al., 1983).

Many comparative studies of the therapeutic efficacy of unilateral and bilateral E.C.T. have been reported. However, they can be collated only with difficulty because of technical differences in the procedures, the form of stimulation, the precise electrode placement and the design of study. It is therefore hardly surprising that while some authors have found unilateral E.C.T. to be more effective than the bilateral method (Martin et al.,
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1965 and Zinkin and Birchnell, 1968), just opposite observations have been made by others (Cronin et al., 1970; Small et al., 1970 and Abrams et al., 1973). Reichert et al. (1976), Fink (1979) and Weeks et al. (1980), on the other hand, have found unilateral and bilateral treatments to be equally effective. From India, Doongaji et al. (1973) and Chatterjee and Mohammed (1980) have found no difference in the efficacy of unilateral and bilateral treatments. d'Elia and Raotma (1975) reviewed 29 comparative studies; in 60% the two techniques were equally effective while in the remaining unilateral E. C. T. was found to be less effective although the difference was significant in just one of these (Abrams et al., 1973).

Although it is now an accepted fact that unilateral E. C. T. produces less confusion and memory disturbance, its efficacy has been criticized on the following grounds: (1) A slightly higher number (0.5—1) of sessions are needed with unilateral E. C. T. (Stromgren, 1973; Valentine et al., 1968 and d'Elia, 1970) although Bidder et al. (1970; have made just opposite observations, (2) Relapse rate has been found to be higher with unilateral E. C. T. (Abrams et al., 1973; Kalinowsky and Hippius, 1969; Levy, 1968 and Strain et al., 1968). However, d'Elia and Raotma's (1975) review did not confirm this observation. Rather, it disclosed a trend favouring unilateral E. C. T. (3) Impastato and Karliner (1966) found unilateral E.C.T. to be less effective in severe depression. On the other hand, Stromgren (1973) and d'Elia and Raotma (1975) found no support for this contention. (4) Heshe et al. (1978) have reported that there are patients who respond only to bilateral E.C.T.

Some of the reasons for some clinicians considering unilateral E.C.T. to be less effective have been outlined by Kiloh et al. (1988). With unilateral E.C.T., particularly in inexperienced hands, it is easy to give submaximal stimulus, resulting in unduly brief convulsions that are relatively ineffective. Further, unilateral E.C.T. given with inadequate current may provide a unilateral seizure that might be mistaken as a generalized convulsion under the obscuring effects of muscle relaxants. Another possible factor could be that the greater degree of confusion and memory impairment with bilateral E.C.T. masks the residual depressive symptoms so that the degree of improvement is judged to be better than it really is (Reichert et al., 1976).

Thus none of the criticisms against unilateral E.C.T. seem to hold good. Further, dominant and non-dominant unilateral E.C.T. have been found to have equal therapeutic efficacy (McAndrew et al., 1976; Halliday et al., 1968 and Sutherland et al., 1968). Lastly, the patients who have had both types of treatment prefer unilateral to bilateral E.C.T. and dislike the latter very much less (Kiloh et al., 1988).

In view of almost equal efficacy and very much less side effects, unilateral E.C.T.—particularly utilizing brief pulse stimulus—should have replaced bilateral sinusoidal E.C.T. altogether. However, it is still very rarely used. The task force of American Psychiatric Association (1978) found that 90% of the treatments in the U.S.A. are given using bilateral placement. Similarly, in Great Britain, 79% of the psychiatric facilities surveyed rarely used unilateral E.C.T. (Pippard and Ellam, 1981 and Kiloh et al., 1988). Almost similar practice obtains in most of the psychiatric centres in our country. There is therefore a need to popularize this technique by training more and more psychiatrists in properly administer-
ing it because E.C.T. minus confusion and memory disturbances would certainly be a boon for psychiatric patients and would make the treatment more acceptable by removing perhaps the most important objection against its use.

Modified E.C.T. (Anaesthesia and Muscle Relaxant):

It is now customary to give atropine, an anaesthetic and a muscle relaxant before applying the current. If the latter two are not given, the treatment is referred to as 'unmodified' or 'direct' E.C.T.

Atropine:

Atropine is given to reduce the bronchial secretions and to inhibit the vagus nerve so as to minimise the chances of arrhythmias and cardiac arrest. It should be given, intravenously, along-with or just before the anaesthetic, rather than subcutaneously 30-60 minutes before hand, to spare the patient the discomfort of a dry mouth with the attendant risk of surreptitious drinking (Kendell, 1981). Atropine should not be given if the patient is hypertensive (Bodley and Fenwick, 1966) or if he has a cardiac pacemaker (Alexopoulos and Frances, 1980). The usual dose is 0.6 mg although Arneson and Butler (1961), Cropper and Hughes (1964) and Allen et al. (1982) advocate a substantially higher dose (2 mg), as a smaller dose does not fully protect against arrhythmias and perhaps cardiac arrest due to vagal stimulation that could be caused by E.C.T. As atropine has cerebral as well as systemic effects, the American Psychiatric Association's task force (1973) recommended the use of a quaternary anticholinergic drug like methylscopolamine which does not cross the blood-brain-barrier. However, there is no evidence that atropine contributes to the post-E.C.T. confusion.

Anaesthesia:

Of the two anaesthetic agents most widely used for E.C.T. viz., thiopentone sodium (Pentothal) and methohexitone sodium (Brevital), only the former is available in India. Methohexitone is probably preferable as it produces fewer E.C.G. abnormalities (Pitts, 1972) but its very short duration of action may be a disadvantage if the patient wakes while still in a state of post-ictal confusion. Same is the problem with propanidid (Shukla and Sharma, 1979). On the other hand, diazepam advocated by some workers (Chatterjee et al., 1977) has slow and uncertain anaesthetic effect and the patients continue to feel drowsy for several hours after E.C.T. (Shukla and Sharma, 1979 and Kalinowsky, 1982*). Hence in our set-up, thiopentone continues to be the anaesthetic agent of choice. A minimum dose should be used as barbiturates raise the convulsive threshold. On the other hand, it is vital to give enough to render the patient unconscious. The experience of being paralysed with succinmethonium while still conscious is terrifying and patients to whom this has happened are reluctant to have E.C.T. ever again.

Muscle relaxant:

Succinyl choline chloride (succinmethonium), a persistent depolarizer introduced by Holmberg and Thesleff (1951), is the most preferred muscle relaxant. The immediate effect of its injection therefore is fasciculations, followed by paralysis. The action is shorter than that of the non-depolarizing drugs such as D-tubocurarine, the effect coming on in 30 seconds and lasting about 5 minutes. Succinylcholine should not be mixed with the anaesthetic but given from a separate syringe albeit through
the same needle. The dose is 0.5—1 mg/kg of body weight. Electrical stimulus should be applied only after the fasciculations have stopped. Once the muscle relaxant has been given, it is essential to administer oxygen, using a positive pressure technique, both before and immediately after the convulsions, continuing until natural respiration has returned. This will avoid anoxia and hypercapnia and will thus certainly reduce the confusion, memory impairment and some form of cardiac arrhythmias.

It is obvious that the use of anaesthetics and muscle relaxants, which can produce dramatic and sometimes lethal sequelae, requires considerable knowledge and skill on the part of the clinician. Few psychiatrists possess these abilities and it is therefore necessary to have the services of an anaesthetist although his presence is not a *conditio sine qua non* (Kalinowsky et al., 1982) and the incidence of complication have been found to be the same whether anaesthesia is given by a psychiatrist or by an anaesthetist (Heshe and Roeder, 1976). It is vital, however, for whoever gives the anaesthesia, to be able to pass an endotracheal tube and to carry out resuscitation if the need arises (Kendell, 1981). It is also essential to have available all the equipments and drugs required to carry out resuscitative measures (see Kiloh et al., 1988 for a complete list). In absence of these facilities and skills, it may be safer to give unmodified E.C.T. (Abramezuk and Rose, 1979; Pond, 1980; Shukla, 1981; Kalinowsky et al., 1982). In fact, this, is still the usual practice in many centres in the developing countries, which cannot afford the expenses and lack the skilled manpower which the use of anaesthetic and relaxant requires (DeSouza and DeSouza, 1984). Although it involves a risk of injuries and is often followed by troublesome restlessness, unmodified E.C.T. virtually never endangers patient’s life and is usually no more frightening to the patient than the modified treatment (Huggins et al., 1964 and Kalinowsky et al., 1982). Therefore, unmodified E.C.T. may, in many cases, be better than not giving E.C.T. to the patients who genuinely need it.

**Risks and Adverse effects:**

These are being described in the order of their seriousness rather than the frequency of their occurrence.

**Death:**

E.C.T. is regarded as a highly safe procedure since although several thousands treatments are given annually world over, the occurrence of serious complications is rather rare (Sargant and Slater, 1972; Royal College of Psychiatrists, 1977; Shukla, 1981; Kalinowsky et al., 1982 and Kiloh et al., 1988). Nevertheless, complications do occur and are at times fatal (Barker and Baker, 1959; Arneson and Butler, 1961; Heggteit, 1963; Gomez, 1974 and Shukla and Mishra, 1985). Its rarity itself makes this complication even more important because an unexpected death creates more problems than an expected one. Further, the statistical rarity of death following E.C.T. is no consolation to patient’s relatives. For them it becomes 100%. Therefore this complication deserves the utmost attention and is being dealt with in some detail.

The exact frequency of death vis-a-vis the total number of patients treated and the total number of treatments administered is not known. In the earlier literature, the case fatality rate was estimated to range from 0.5% to 0.8% and the treatment fatality rate from 0.007% to 0.04% (Barker and Baker,
More recently Heise and Roeder (1976), in their study of the use of E.C.T. in Denmark, found the case and treatment fatality rates to be 0.03% and 0.005% respectively. Kalinowsky and Hippius (1969) feel that the earlier rather high figures could have been due to the inclusion of many deaths unrelated to but occurring in temporal proximity to E.C.T. and due to the fact that curare was used as relaxant in those days. Kalinowsky (1975) has given a very low treatment fatality rate (0.002 -0.003%). He and Holden (1985) have asserted that this figure is in no way higher than that associated with the use of short acting barbiturate anaesthetics. However, it must be accepted that fatalities are not always reported and this is particularly true in India where there have been just one documented death following E.C.T. (Shukla and Mishra, 1985) while, in fact, most of the psychiatrists would admit to having had such cases.

The cause of death is predominantly cardio-vascular, in form of cardiac arrest or coronary occlusion (Barker and Baker, 1959; Arneson and Butler, 1961; Heggtevit, 1963; Gropper and Hughes, 1964 and Kalinowsky and Hippius, 1969), followed by cerebral and respiratory (Arneson and Butler, 1961; Gomez, 1974 and Shukla and Mishra, 1985). There is hardly any way of predicting the possibility of a fatality occurring following E.C.T. and a patient’s apparently good physical health is no guarantee against it (Arneson and Butler, 1961 and Gomez 1974). Even autopsy, in most of the cases, is not much informative (Kalinowsky et al., 1982).

Heggtevit (1963) pointed out that although death following the first E.C.T. was common, the majority of the fatalities occurred after subsequent treatments. It could therefore be concluded that though the risk of death following E.C.T. is small it is not an entirely innocuous procedure and must never be given without a careful consideration of the patient’s physical state. Further, in the absence of any fool-proof way of predicting or preventing such an eventuality (Arneson and Butler, 1961 and Abramzuk and Rose, 1979), all the treatments must be taken as potentially fatal and one has to be continuously on guard. It is therefore axiomatic that the medical and nursing staff should be aware of the possibilities and have the knowledge, skills and equipments to deal with them (Shukla, 1981; Shukla and Mishra, 1985 and Kiloh et al., 1988).

Injuries:

In the past, fractures—mainly of mid-thoracic vertebrae—and dislocations, particularly of the jaw were a common complication, affecting upto 30 percent of patients in some series. Since suxamethonium came into routine use, however, complications of this kind have virtually ceased to occur and even patients with serious spinal or other orthopaedic disorders can be given E.C.T. with relative impunity (Kendell, 1981). Since muscle relaxation may be inadequate in an individual case, all the precautions in holding the patient, gently but firmly, must be observed to prevent injuries (Kalinowsky et al., 1982).

Confusion and memory disturbance:

The common immediate side effects of E.C.T. are headache, confusion and memory disturbance (Freeman and Kendell, 1980). Most of the patients have a period of confusion following E.C.T. Its duration varies from patient to patient, tending to be longer in older patients. An occasional patient may become fearful, euphoric, excited or even aggressive. All these changes are more marked with bilateral E.C.T., using
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sinusoidal current and become more and more marked with successive convulsions so that after 5 or 6 treatments they fail to disappear before the next session is due. With unilateral electrodes and pulsed current, the period of confusion is remarkably brief, lasting no more than a few minutes (Daniel et al., 1983).

There is a short-term impairment of memory, after a course of E.C.T.s., in virtually every case though most of the patients remain unaware of it. This pertains mostly to recent events and there is some difficulty in retaining newly acquired information (Squire et al., 1981). This memory impairment, like confusion is less severe and more short lived with unilateral than with bilateral E.C.T. (Squire and Chace, 1975 and Hesle et al., 1978). Further, non-dominant unilateral E.C.T. causes a selective impairment of non-verbal learning while a dominant unilateral E.C.T. produces a selective impairment of verbal learning (Halliday et al., 1968 and Squire and Slater, 1978). These disturbances wane rapidly after the end of the course of E.C.T. Full restitution of memory occurs within a month after bilateral and within a week after unilateral treatment (d’Elia et al., 1976). Squire and Chace (1975) found no evidence of memory impairment 6-9 months after even bilateral E.C.T. The number of E.C.T.s. given had no influence on the recovery from the memory impairment. It is interesting to note that Bagadia et al. (1981) did not observe any psychometric evidence of cognitive defect 48 hours after the last treatment even though some patients did complain of forgetfulness.

As regards long term effects of E.C.T. upon memory, psychological and psychometric investigations have proved convincingly that no lasting intellectual, cognitive or memory impairment occurs with E.C.T. (American Psychiatric Association, 1978; Johnstone et al., 1980 and Kalinowsky et al., 1982). Freeman and Kendell (1980) and Weeks et al. (1980) studied the memory functions of patients treated in 1971 and 1976. Those who complained, found their memory difficulties to be limited to events around the time of treatment; their ability to learn new material was not impaired. Some patients, on the other hand, stated that their memory was better than what it was before E.C.T. On tests of memory, E.C.T. treated patients performed as well as did the controls. The authors concluded that E.C.T. did not produce any enduring effects on memory.

Therefore, it is apparent that the question of a permanent memory impairment has received undue attention in the lay press and from those objecting to organic treatments on theoretical grounds. They overlook the fact that we are treating mental disorders which imply a much greater damage to the personality than the treatments employed for their cure. It should not be forgotten that in many of these cases the disease progresses towards deterioration in spite of treatment and not because of it. Cronholm and Molander (1964) pointed out that the patients who are freed from their emotional distress, after E.C.T., seldom complain of memory disturbances. In fact, their memory and learning may get even better because of improvements in attention and social responsiveness.

Concluding Remarks:

Fifty years on, E.C.T. survives whereas most of the physical treatments common to the pre-war psychiatry have been discarded. It is a safe and effective treatment for carefully selected patients (Rollin, 1981 and Lepingto and Harris, 1988). The introduction of muscle relaxants and short-acting anaesthetic agents
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has made it dignified too. Post (1978) has recalled its miraculous effect on melancholic patients who previously had to be tube fed twice a day for years on end. He considers the arrival of E.C.T. to be a turning point in the history of psychiatric treatment. It is therefore hardly surprising that, despite a substantial decline in its popularity (Morrissey et al., 1979), E.C.T. continues to be used in 3 to 5% of all the psychiatric cases in the United States and Sweden (Aperia et al., 1976; American Psychiatric Association, 1978 and Frederiksen and d'Elia, 1979) and in 10% of cases in Denmark (Hesle and Roeder, 1976). In these countries, the indications for E.C.T. were, in order of frequency, severe depression, manic excitement and schizophrenia.

While E.C.T. is going out of vogue in the West, it continues to be important in the Indian setting. Vahia et al. (1974) reported that over 20% of their patients received it. After 17 years, 14.3% of the cases attending the psychiatric services of a teaching general hospital received E.C.T (Shukla, 1981).

Further, as against the practice in the West, three quarters of the cases treated with E.C.T. were schizophrenics and only one-fifth depressives. Although the response was best in depression, other psychotic conditions—schizophrenia and post partum psychosis—had substantial improvement despite a previous failure to respond to drug therapy. These findings lend support to the assertion of Slater and Roth (1986) that many schizophrenics fail to respond to drugs but make an excellent recovery when these are combined with E.C.T. Thus, while the effect of E.C.T. is "substantial and incontrovertible" in depression (Royal College of Psychiatrists, 1977 and Kendell, 1981), it has no disadvantage compared with other treatments in the non-depressive functional psychoses (Weiner, 1979 and Shukla, 1981).

On the positive side, E.C.T. promotes rapid recovery when it is effective, and it quickly restores the patient’s earning capacity—a great advantage in the country like India where his or her day to day earnings may be the only source of subsistence for a whole family (Vahia et al., 1974; Shukla, 1981 and DeSouza and DeSouza, 1984). The therapy is inexpensive, simple and convenient, and our patients, by and large, prefer a short course of E.C.T. to long-term regular medication with drugs which may be uncertain in their effect (Vahia et al., 1974).

To conclude, E.C.T. continues to be a very useful and reasonably safe form of treatment in all functional psychoses, particularly in the developing countries. Very strong evidence against it would therefore be required before fifty years of useful experience were to be thrown away just for emotional reasons.

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