

ECT: I. Patients' Experiences and Attitudes

By C. P. L. FREEMAN and R. E. KENDELL

SUMMARY One hundred and sixty-six patients who had ECT in either 1971 or 1976 were interviewed. The 1976 sample represented 89 per cent of those available for interview. Their experiences of ECT and their attitudes to it are described. They found ECT a helpful treatment and not particularly frightening, but side-effects, especially memory impairment, were frequent.

We have not found any systematic attempts in the literature to assess patients' experience or views of ECT. Gomez (1975) looked at side-effects but confined questioning to a period 24 hours after the treatment. A number of other studies which compared the effects of unilateral and bilateral ECT on cognitive function included questions on side-effects. There have been some anecdotal reports in the general press, usually along the lines that ECT was a terrifying or damaging treatment. Following a *Panorama* (BBC TV) programme on ECT in 1977 Julian Mounter wrote in *The Listener* "I spoke to more than 50 ECT patients, and almost all of them said they dreaded it more than anything else they had ever experienced". Bird (1979) attempted to assess the effect this programme had on patients' attitudes.

In view of the increasing number of adverse anecdotal reports we felt it would be useful to interview a representative sample of patients who had had a course of ECT and find out what they thought.

Methods

Sample—We attempted to interview all the patients under the age of 70 who had had ECT during one year (1976) in the Royal Edinburgh Hospital. We tried to interview people approximately one year after their last ECT, but some had had a second course of treatment during the year and were interviewed within six months while others, being difficult to contact, were not interviewed until 18 months after their

last course. The interviewing took place between February 1977 and October 1978.

Because the study was conducted alongside another investigation concerned with epilepsy following ECT, a number of patients were interviewed who had had ECT in 1971, i.e. six years earlier. No attempt was made to contact everyone who had had ECT in 1971 but it was felt useful to include this group to see if attitudes changed with the passage of time.

Each patient of the sample was sent a letter explaining the nature of the study and asking them to come for an out-patient interview. Those who did not respond were sent a second appointment enclosing a small questionnaire and a stamped addressed envelope. The few who still did not come were visited at home, where possible with prior telephone contact.

Interview schedule—Patients were given a semi-structured interview based on a questionnaire. They were allowed to talk spontaneously about their views and experience of ECT for about five minutes and then asked for specific details about the number and timing of their treatments, why they were given ECT, their psychiatric symptoms at the time, why the treatment was stopped, their experience of the treatment sessions themselves, the side-effects that they experienced, whether the treatment helped them, whether they would have it again, and whether they gave consent to the treatment. Finally, they were asked to respond to a number of statements by either agreeing, disagreeing or saying 'don't know'. Further

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details of specific questions are given in the results section.

Details about number and timing of treatments, psychiatric diagnosis and type of ECT were also obtained from case-notes and ECT records.

Background Information

The Royal Edinburgh Hospital admits approximately 2,500 patients per annum. In 1976 714 had a diagnosis of some type of depression or of puerperal psychosis. Almost all fell into three ICD-8 categories, (296.2 manic-depression depressed type, 300.4 depressive neurosis, or 296.1 manic-depression manic type). One hundred and eighty three patients had a course of ECT. These figures would indicate that approximately one in fifteen inpatients, and one in five depressed in-patients receive a course of ECT. ECT is little used as a treatment for other psychiatric conditions. Bilateral ECT is routinely given unless the consultant specifically requests unilateral treatment. Very little out-patient ECT is given, though in a few cases ECT which has been started as an in-patient is continued on an out-patient basis.

At the time of the study ECT was given in two places in the hospital. In the main hospital a separate ECT suite was used and patients were fasted overnight in their wards, given atropine premedication at 40 minutes and then brought down to the ECT suite by a ward nurse at approximately 15 to 30 minutes before each treatment. There were separate waiting, treatment and recovery rooms. In the other area (Craig House) ECT was given in the patient's ward. This usually involved clearing a side room or four-bedded ward. The ECT was given by the ward doctor and a visiting anaesthetist. In both areas ECT was routinely given twice-weekly but could be given three times weekly if this was specifically requested.

Results

One hundred and eighty three patients received one or more courses of ECT during 1976 and constituted the main sample. At enquiry in 1977-8, 12 were dead (see below), 25 were over 70 and 27 had left the Edinburgh

area. This left 119 people available for interview, of whom we interviewed 106 (89 per cent). Sixty patients who had had ECT in 1971 formed a subsidiary sample. The two samples were analysed separately but are reported here together as no differences were found between the two. The combined sample was thus 166.

Of the 13 patients who were not interviewed three were still in treatment at the hospital but refused to be interviewed for research purposes. All three were said by the doctors treating them to be somewhat hostile to doctors in general, but they had not made any specific comments about ECT. The remaining 10 patients could not be traced.

The treatments

Many subjects had little idea how many treatments or how many courses of ECT they had had, and the information they gave was quite unreliable when checked against case-note records. The details of background variables and actual experience of ECT are summarized in Table I. It can be seen that there was a wide range of experience. A few people had had only a single ECT treatment and one lady had had as many as 93 treatments in her lifetime, spread over 14 courses. The average number of treatments of those interviewed were 16 for the 1976 group and 18 for the 1971 group. The distribution about the mean was skewed. Over half those interviewed had had only a single course of ECT, usually of five to eight treatments. Details of the diagnoses obtained from the case-notes are given in Table II. The main difference between the two years is that fewer schizophrenic patients were given ECT in 1976.

The reasons given in the case-notes for treatment being stopped are given in Table III. In 74 per cent this was because improvement was felt to be satisfactory or sufficient.

Causes of death

Twelve patients had died before they could be interviewed. Four had committed suicide. In two there was a good response to ECT and the suicide occurred during another illness, and in two there was only a partial response, the depression continued and suicide occurred nine months and eleven months later.

ECT: I. PATIENTS' EXPERIENCES AND ATTITUDES

TABLE I
*Background details of the two samples
 (N = 183 for 1976, but only 106 interviewed; N = 60
 for 1971)*

	1976	1971
Mean age	50	54
Sex ratio: M:F	1.46:1	1.4:1
Marital status:		
Single	24%	21%
Married	57%	67%
Widowed	15%	8%
Divorced	4%	3%
Social class		
1	4%	16%
2	21%	23%
3	35%	23%
4	24%	25%
5	16%	13%
Bilateral ECT	81%	96.7%
Unilateral ECT	19%	3.3%
Experience of ECT during lifetime		
6 or less treatments	31%	25%
7-24 ,,	52%	49%
25-50 ,,	12%	21%
51 or more ,,	5%	5%
Range of experience	1-75	1-93
Mean total of treatments ever received	16	18

In 6 cases death appeared to have been from causes entirely unrelated to ECT. They all occurred 6 months or more after treatment. In the remaining two cases death may have been related to ECT. A 69 year old woman died 24 hours after her thirteenth treatment. Post-mortem showed a myocardial infarction. She had had one previous infarct. A 76 year old woman also died 48 hours after her thirteenth ECT. Post-mortem showed a myocardial infarction 24-48 hours old. Both patients were taking a tricyclic drug at the time.

Patients' experience of the treatment

Details of this are given in Table IV. Only 21 per cent of patients felt they had been given an adequate explanation of the treatment before it began. Forty-nine per cent were sure they had been given no explanation at all and stuck to this view even when it was suggested to them

TABLE II
*Percentage distribution of diagnoses for 1st course of ECT
 (N = 243 for 1976; N = 60 for 1971)*

	Year	1976	1971
Unipolar depression		67.6	62.3
Bipolar illness depressed		14.5	16.4
Bipolar illness manic or hypomanic		3.9	1.6
Schizophrenic		5.0	16.4
Puerperal psychosis		3.4	0
Miscellaneous or unspecified psychosis		1.1	1.6
Other diagnoses		3.9	1.6

TABLE III
*Reason in case-notes for ECT ending
 (N = 183 + 60)*

Sufficient or satisfactory improvement	73.7%
Not sufficient improvement to justify continued treatment	13.6%
Hypomanic reaction	3.7%
Side effects	2.9%
Patient refused further treatment and/or took own discharge	1.6%
Death	0.4%
Major complication	Nil
Other reason or not specified	3.3%

that they might have forgotten. Twelve per cent said they couldn't remember being given any explanation but one might have been given.

When asked how they felt before their first ECT treatment 16 per cent described feeling very anxious or frightened and a further 23.5 per cent feeling slightly anxious. Forty-six per cent said that they either had no particular feelings one way or the other or felt reassured that some new action was being taken, or an effective treatment instigated. Most found it difficult to say why they had been afraid, though a few

TABLE IV
Patients' experience of ECT

- (a) Adequacy of explanation given before treatment (N = 166)
- (b) Do you remember how you felt before your first treatment? (N = 166)

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3.7%	
2.9%	
1.6%	
0.4%	
Nil	
3.3%	

TABLE IV
Patients' experience of ECT

(a) Adequacy of explanation given before treatment (N = 166)		(b) Do you remember how you felt before your first treatment? (N = 166)	
Adequate	20.6%	Very anxious and frightened	16.3%
No explanation	49.1%	Slightly anxious and frightened	23.5%
Inadequate	8.5%	No particular feelings	22.9%
Misleading	—	Pleased treatment starting	22.9%
Can't remember if explanation given	12.1%	Can't remember	5.4%
Other	3%	Other	5.4%
Don't know	6.6%		

(c) Experience of various parts of the treatment (N = 166)		(d) Response to statements about experience of ECT			
Aspect of treatment	Pleasant	Neutral	Unpleasant	Don't know	Percentage answering
Premedication	2.4%	77.1%	15.7%	4.8%	
Waiting for treatment	1.2	74.7	19.9	4.2	Statement
ECT staff	26.5	65.7	3.0	4.8	1 I was so upset by the treatment I'd be reluctant to have it again
Anaesthetic injections	5.4	83.7	6.6	4.2	2 If necessary I'd readily have the treatment again
Falling asleep	31.9	54.8	8.4	4.8	3 More explanation should be given to patients about the treatment
Walking up	10.8	63.9	20.5	4.8	4 ECT is a frightening treatment to have
Recovery period for few hours after each treatment	6.0	69.9	17.5	6.6	5 How did ECT compare with going to the dentist?
					6 How frightening or upsetting was ECT compared with what you expected?

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said spontaneously they were afraid of the unknown or afraid of the anaesthetic.

The responses to specific questions about brain damage, fear of epilepsy, worry about electricity, worry about being made unconscious etc. are listed in Table V. It can be seen that worry about possible brain damage was the commonest fear, but even then 77 per cent of patients had not thought about this at all. We did not come across anybody who had bizarre ideas about what happened during ECT and our general impression was that patients did not find it particularly frightening. When asked to compare it with a trip to the dentist, (see Table IVd), 50 per cent of subjects felt that going to the dentist was more upsetting or frightening.

Specific parts of the treatment procedure, listed in Table IVc, seemed to arouse little feeling in subjects, and most found them neutral. We optimistically asked whether any of the aspect of treatment was pleasant. Thirty-two per cent of subjects thought that the sensation of falling asleep was a pleasant one and 27 per cent commented on the staff being pleasant. No aspect of the treatment was rated as unpleasant by more than 30 per cent of the subjects.

Side-effects

Details of these are given in Table VI. It should be noted that these are side-effects remembered approximately a year afterwards.

Twenty per cent reported remembering no side-effects whatsoever. Memory impairment was clearly the most troublesome with 50 per

cent of the total sample mentioning this as the worst side-effect. Forty-one per cent mentioned memory impairment spontaneously when asked about side-effects and a further 23 per cent when prompted, making 74 per cent of the whole sample who reported some memory disturbance.

The only other side-effect commonly reported was headache occurring at the time of treatment. This was reported by 48 per cent of subjects. Fifteen per cent of the total sample thought it was the most troublesome unwanted effect.

When asked to respond to a series of statements about ECT, 30 per cent agreed with the statement that their memory had never returned to normal afterwards though 12 per cent felt their memory was better now than it had ever been. Twenty-eight percent felt that ECT caused permanent change to memory and 22 per cent that ECT had no effect on memory at all.

There were single complaints of neck stiffness, skin burns, increased sleepiness, increased sweating and muscle aches. One man complained of choking and said he had been too lightly anaesthetized on one occasion.

Did patients find the treatment helpful?

Details are given in Table IX. Altogether 78 per cent of subjects thought that ECT had helped them either a little or a lot. Only one person thought that ECT had made him much worse. He was a young electrical engineer who had developed a schizophrenic illness. Because of his trade he had considerable respect for electricity and had found the whole experience

TABLE V
Fears and worries about ECT
(N = 166)

Worry or fear	Not at all	A little	A lot
About being made unconscious	80.6%	11.9%	7.5%
About losing control of bladder, or embarrassing things happening whilst unconscious	83.7	9.4	6.9
That electricity was used in the treatment	76.9	13.1	10.0
About having a fit or a turn	90.9	4.2	3.8
Of possible brain damage as a result of the treatment	76.9	13.1	10.0

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quite upsetting and blamed his present state on ECT.

Although 78 per cent of people said it had helped them, only 65 per cent were willing to say that they would have ECT again. This discrepancy appeared to be due to two factors. A number could not imagine themselves getting depressed again and therefore could not believe that they would ever need more ECT. Others had clearly been put off by the side-effects and

13 per cent said so. When asked if they would recommend it to a friend if a psychiatrist advised the friend to have it 65 per cent said yes, but 24 per cent didn't know, and 11.4 per cent said definitely no.

Few people believed that the effect of ECT had been permanent. Thirty-five per cent believed the beneficial effects had lasted for a year or more, 15 per cent that they had lasted from 6 months to a year, 13 per cent less than 6 months and 2.4 per cent thought they had relapsed immediately.

Did patients understand the treatment?

Fifteen per cent of those interviewed appeared to have a full understanding of what the treatment involved. They knew about the anaesthetic, that electrodes were applied to the head and that the object was to produce an epileptic fit. Thirty per cent had a partial understanding. They knew about the anaesthetic, they knew that electricity was used and that it was applied somewhere around the head. They said they were put to sleep but then had no idea of what happened to them whilst they were asleep. Only four patients described false ideas. One believed that patients were naked when they had the treatment and another that some sort of metal electrode was implanted in the head during the treatment.

TABLE VII
Patients' estimate of severity

	Total percentage reporting symptom	Percentage who reported symptom spontaneously	Percentage who reported when prompted	Percentage who thought symptom severe	Percentage who thought symptom mild
Memory impairment	63.9%	41%	22.9%	25.3%	38.6%
Headache	47.6	24.7	22.9	19.2	28.4
Confusion	26.5	4.8	21.7	9.0	17.5
Clumsiness	9.0	2.4	6.6	3.6	5.4
Nausea or vomiting	4.2	2.4	1.8	2.8	1.4
Eyesight problems	4.2	2.2	2.0	2.2	2.0
Other side effects	12.0	10.8	1.2	3.6	8.4

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TABLE VIII
Opinions on memory impairment

Statement	Percentage responses		
	Agree	Dis-agree	Don't know
My memory has never returned to normal after ECT	30%	63.1%	6.9%
My memory now is better than ever it has been	11.9	84.4	3.7
ECT is helpful but the side effects are severe	15.6	77.5	6.9
ECT has no effect on memory at all	21.9	73.7	4.3
ECT causes permanent changes to memory	28.1	63.7	8.1

Patients' consent to ECT

From the medical case-notes we determined that 76 per cent of patients had signed the consent form themselves (Table XI). We tried to determine whether patients felt they had been coerced into having ECT, persuaded against their judgement, or compelled to have ECT when they definitely did not want it. 7.8 per cent felt that they shouldn't have been given ECT but in most of these this was because they felt the treatment did them little or no good. Only two patients said that they clearly remembered being given ECT against their specific wishes. One of these had been helped by the treatment and was now glad she had received it. We also asked everyone whether they felt that if they had not wanted ECT they could have refused it at the time, and whether they thought their decision would have been respected by their doctors. A third said they could have said no and they felt they would have been obeyed. Twenty-three per cent said that they wouldn't have been able to say no, either because they couldn't imagine themselves saying no to a doctor or because they were in no fit state at the time to make a decision. Forty per cent said that they didn't know what would have happened or didn't understand the question. We then asked an open-ended

TABLE IX
How helpful was the treatment? (N = 166)

How much did ECT help you?	A lot	57.2%	1. What doe
	A little	20.5	No u
	No change	18.7	Parti
	A little worse	2.4	Full
	Much worse	0.6	False
			Wou
In what way did it help?	Less depressed	50.6%	2. Why is th
	Less anxious	6.0	No ic
	Made me forget	1.2	For c
	Gave me a jolt	0.6	For a
	Other explanation	19.3	Other
	Didn't help	21.1	Wou
Has the effect lasted?	Don't know	1.2	
ECT is a helpful and useful procedure	Permanently	9%	3. How does
	1 year or more	34.9	No ic
	6-12 months	15.1	Give
	<6 months	12.7	Mak
	Immediate relapse	2.4	Other
ECT works for a short while but the effects don't last	Not applicable	24.7	Does
	Don't know	1.2	Wou
ECT gets you better quicker than drugs	Agree	65.6%	1. Who signed
	Disagree	14.4	(N = 266)
	Don't know	20	No for:n could

question about whether in general they felt the consent procedures for ECT were adequate. In 90 per cent of cases the reply was yes or that it wasn't really the patient's decision, i.e. that it was up to the doctor to decide and for the patient to do as the doctor recommended.

Two people said they had been pressurized into signing the consent form. One man said he was 'conned'. "They said I wouldn't get out if I didn't have it!" The other, a woman, said she felt that the doctors had already decided she was going to get ECT and it was futile her resisting.

We found this area of the questionnaire the most unsatisfactory and we were left with the clear impression that patients would agree to almost anything a doctor suggested. Many people could not remember ever having signed

consent form important an people, such behalf.

Factors affecting

More women were very frightened. Slightly their memory (41 per cent

TABLE X
Patients' understanding of treatment
(N = 166)

57.2%	1. What does the treatment involve?	30.1%
20.5	No understanding	43.4
18.7	Partial understanding	22.9
2.4	Full understanding	2.4
0.6	False ideas	1.2
	Wouldn't answer	
50.6%	2. Why is the treatment given?	16.4%
6.0	No idea	61.2
1.2	For depression	5.5
0.6	For anxiety	14.5
19.3	Other reasons	2.4
21.1	Wouldn't answer	
9%	3. How does the treatment work?	38.8%
34.9	No idea	32.7
15.1	Gives you a jolt or a shock	7.3
12.7	Makes you forget	14.5
2.4	Other explanation	5.5
24.7	Doesn't work	1.2
1.2	Wouldn't answer	

TABLE XI
Consent procedure

65.6%	1. Who signed the consent form? (N = 266)	Information on whole sample from notes.
14.4	Patient alone	76.1%
20	Relative alone	11.9%
65.6%	Both relative and patient	11.5%
14.4	No form could be found in notes for one patient.	
19.4	2. Do you think you could have refused to have ECT if you had wanted to?	
	Yes	33.7%
	No	23.1%
	Don't know	40.0%
	Other replies	3.1%

consent form, didn't regard it as particularly important and seemed quite happy to have other people, such as relatives, give consent on their behalf.

Factors affecting attitudes

More women than men found the treatment very frightening, 20 per cent as against 8 per cent. Slightly more men than women said that their memory had not been impaired at all (41 per cent as against 32 per cent), otherwise

there were no sex differences. The amount of previous experience of ECT did not appear to alter attitudes, nor did attitudes either mellow or harden with time. The 1971 group did not complain either more or less than the 1976 group and they did not report that ECT had been any more or less helpful.

The number of people who had unilateral ECT was small and some of them had had bilateral treatment on other occasions. Their views differed markedly from the bilateral group. Fifty per cent said they wouldn't have ECT again (26 per cent in bilateral group), 33 per cent said it helped them a lot (61 per cent in bilateral group), 28 per cent thought they shouldn't have been given ECT (9 per cent bilateral group). We think that the most likely explanation for this negative view is not that unilateral ECT is a more unpleasant treatment but that these patients already had adverse views and were therefore selected by their consultants for unilateral treatment although in this hospital bilateral ECT is the usual procedure.

An alternative explanation is that unilateral ECT doesn't work as well, and therefore more people complained; however the numbers of treatments given and the therapeutic outcome recorded in the notes did not differ between unilateral and bilateral groups.

Finally, patients were asked the following: ECT is dangerous and shouldn't be used: agree 6.9 per cent, disagree 76.9 per cent, don't know 16.2 per cent. ECT is given to too many people: agree 6.2 per cent, disagree 30.6 per cent, don't know 63.1 per cent. ECT is often given to people who don't need it: agree 8.7 per cent, disagree 29.4 per cent, don't know 61.9 per cent. The commonest reply to the second and third questions was in fact that it was "up to the doctors, and I'm not qualified to say".

Discussion

We are aware that the main criticism of this study is that it was carried out by psychiatrists in a psychiatric hospital. It is obviously going to be difficult to come back to a hospital where you have been treated and criticize the treatment that you were given in a face-to-face meeting

with a doctor. It is not easy to see a way round this. It would clearly not be possible to release details of a group of patients' treatments to lay persons so that they could undertake such a study. Even if this were possible we imagine that the response rate to a questionnaire administered by strangers would be much lower. It was our impression that those patients who had strong views spoke out with little inhibition. What is less certain is whether there were a significant number of people in the mid-ground who felt more upset by ECT than they were prepared to tell us.

Given these reservations a number of definite results are apparent. The majority of patients did not find the treatment unduly upsetting or frightening, nor was it a painful or unpleasant experience. Most felt it helped them and hardly any felt it had made them worse. In general then, most patients had very positive views about ECT.

We were surprised by the large number who complained of memory impairment. Many of them did so spontaneously without being prompted, and a striking 30 per cent felt that their memory had been permanently affected, although the majority meant by this that they had permanent gaps in their memory around the time of treatment, not that their ability to learn new material was impaired. It may be that this high level of memory complaint is due to most people having had bilateral ECT.

It is clear that patients wish to be told more about the treatment. It so happened that one of us had interviewed a number of these patients before they started ECT in 1976 in connection with another study (Freeman *et al.*, 1978) and given them quite detailed explanations of what the treatment involved, yet several of these were adamant that they had never been given any

explanation. It might, therefore, be beneficial to patients to give them a second explanation of the treatment after they have completed the course and are symptomatically improved.

It is worrying that two patients from the 1976 sample died during a course of ECT. Both were elderly females, had pre-existing cardiac disease, were taking tricyclic antidepressants, had longer than usual courses of ECT and died of myocardial infarctions which were clinically silent until death. It is not possible to draw firm conclusions from two cases but they raise the question whether in such 'at risk' patients ECT and tricyclics should be given together.

Finally, we would like to emphasize the great trust that patients put in doctors. The majority of subjects in this study were more than happy to leave all decisions about their treatment to a doctor. There was hardly any concern about consent procedures being inadequate. This is perhaps best illustrated by two patients who misunderstood the initial appointment letter and came fully prepared to commence a course of ECT. Neither had been near the hospital for nine months and both were quite symptom-free.

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The addresses of the authors are given at the end of Paper III.

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ECT: II: Patients who Complain

By C. P. L. FREEMAN, D. WEEKS and R. E. KENDELL

SUMMARY Twenty-six subjects who complained of permanent unwanted effects following ECT were compared with two groups of control subjects on a battery of 19 cognitive tests. Many statistically significant differences were found in cognitive functioning, mostly attributable to the level of depression or medication in the complainers. However, after analysis of variance/co-variance some differences still remained, indicating impaired cognitive functioning in the ECT complaining group.

The aim of the study was to identify a group of people who had specific complaints about electroconvulsive therapy (ECT), to catalogue their complaints and to assess their cognitive function. Results on a battery of cognitive tests were compared with results from a group of matched normal volunteers.

Methods

With the cooperation of the local evening newspaper (circulation 140,000 approx.), an article was written entitled "Is there any harm in shock treatment?". At the end of the article readers who thought that ECT had had an adverse effect on them were asked to contact one of the authors:

So if YOU have had ECT, no matter how recently or how long ago, and reckon it has had an adverse effect on you, the group would be grateful if you would help by allowing them to test your memory and ability to think quickly, and see how you compare with other people. It would only take about an hour or so one afternoon . . . and there are no shocks in store. That's a promise!

We also asked consultants in the hospital to let us know of any patient who had complained about ECT.

Each complainer was given an unstructured interview by either C.P.F. or R.E.K. A note was made of their complaints, time and number of treatments, and whether they would willingly have ECT again. An attempt was made to

assess their mental state at interview to see if they were clinically depressed or otherwise ill and a note was made of their drug treatment, if any. This rough assessment was supplemented by completion of the Wakefield depression self-rating scale (Snaith *et al.*, 1971) and the Middlesex Hospital questionnaire (Crown and Crisp, 1966). (All references are at the end of Paper III).

Subjects were tested for cognitive function by D.W. who did not know the nature of their complaints. A battery of 19 tests was used, as described with literature references at the end of Paper III. They covered visual design, verbal and spatial positional learning, verbal and visual memory, and there were two tests of remote memory, tests of delayed recall and recognition, a test of the ability to link faces with names, and tests of perceptual aptitude and concentration.

The subjects also filled in the Broadbent cognitive failures questionnaire which gives a self-rating of the subject's memory and concentration difficulties.

Controls—A group of volunteers who had not had ECT, and most of whom had not been psychiatric patients, were tested in exactly the same way. These were group-matched with the ECT complainers for age, sex, social class, educational level and intelligence. These volunteers were also obtained via an article in the same evening newspaper which asked for people

who would be prepared to help out with research projects at the Royal Edinburgh Hospital.

The samples—Twenty-eight people replied to the newspaper article, 10 men and 18 women. One woman had Alzheimer's disease and was attending the hospital as a day patient. She had insisted on coming when her husband brought the article to her attention. She was interviewed but was not testable.

Of the remaining 27, 14 had specific complaints about ECT (newspaper complainers), and 13 had misunderstood the article (newspaper non-complainers) and attended because they thought we wanted to have any views on ECT. They had either good or neutral things to say about the treatment. On closer questioning most had one or two very minor complaints about the treatment.

Twelve patients were identified via psychiatrists in the area, (hospital complainers), as they had told their doctors that ECT had produced enduring unwanted effects.

Results

The majority of complainers were women: 22 to 5 men (see Table I). There were only minor differences between the groups, except that the hospital complainers had last had ECT much more recently than either of the newspaper groups.

Nature of complaints

Case summaries are given in the Appendix. The commonest complaint by far was about some type of memory impairment. There were two main types of memory complaint: everyday forgetfulness such as forgetting faces or names, forgetting phone numbers or messages, forgetting things when going shopping; and secondly, holes or gaps in past memories.

Most subjects accepted that there might be poor memory for the time of their illness and course of ECT. Their complaints were of long periods, usually some months before ECT but occasionally afterwards. One subject complained he could not remember an annual summer holiday, another a wedding which occurred six months after ECT. The amount of distress this memory impairment caused varied considerably, but most found it irritating rather than incapacitating.

Other complaints were of epilepsy (patient 7), severe episodic pain (patients 7 and 21), personality change (patients 9 and 16), difficulty in knitting and fine hand function (patient 12), poor concentration (patients 22, 24 and 26). Many subjects had more than one complaint.

In all these cases the subjects definitely related the onset of the complaint to a course of ECT.

Only one complainant was against ECT in principle (No. 4). She felt it was a senseless and

illogical thing to peoples' brains

Of the total would have E never have it and 9 said they depend on the depressed they had failed. All would have EC

Thus we did politically motivated inquiries or, if we but one of the a reasonable genuinely concerned often relieved scores. We did were exaggerated bad' on the co

Wakefield self-rated

Middlesex Hospital

Total symptom score

Sub scales

Free floating
Phobic fears
Obsessive-compulsive
Somatization
Depression
Hysterical
Broadbent et al.

TABLE I
Means of personal variables for the groups

	Newspaper non-complainers N = 13	Newspaper complainers N = 14	Hospital complainers N = 12	Normal volunteers N = 53
Male:Female	7:6	3:12*	2:10	1:2.3
Age (years)	56.8	50.6	52.7	52.9
Social class	3.1	2.9	2.8	2.7
Education in years of schooling	10.3	11.5	11.3	11.2
Total no of ECT	10.1	13.9	9.9	Not applicable
Time in years since ECT	12.8	9.3	2.6	Not applicable
IQ	104	104	102	108

* One woman untestable (Alzheimer).

Wakefield

Middlesex Hospital

Medication

illogical thing to pass an electric current across peoples' brains when they were depressed.

Of the total of 26 complainers 4 said they would have ECT again, 13 said they would never have it again under any circumstances and 9 said they were doubtful and it would depend on the circumstances, such as how depressed they were or whether antidepressants had failed. All the non-complainers said they would have ECT again.

Thus we did not attract any cranks or politically motivated complainers by our enquiries or, if we did, we didn't detect them. All but one of the subjects put their complaints in a reasonable balanced way, they seemed genuinely concerned by their difficulties and often relieved when told the results of their test scores. We did not get the impression that people were exaggerating their complaints or 'faking bad' on the cognitive test results.

Comparisons on non-cognitive tests

The subjects as a whole rated themselves as more depressed than the matched volunteer controls on the Wakefield scale. They also scored more highly than the volunteers on the Middlesex Hospital questionnaire (MHQ) on both total score and all subscales except hysterical personality. They rated themselves as having more cognitive failures on the Broadbent questionnaire. (See Table II). ECT complainers ($n = 26$) scored as more distressed on the same tests than ECT non-complainers ($n = 13$). (See Table III).

As drug taking varied greatly from subject to subject both in amount and type of drug, each subject was crudely rated on a score of 0-4 on the amount of psychotropic drugs taken. (Example: nitrazepam 5 mg taken the night before would score 1; diazepam 5 mg t.d.s. would score 2; amitriptyline 150 mg daily would

TABLE II
Comparison of ECT subjects with normal volunteers by mean scores

	All ECT subjects N = 39	Normals N = 53	Significance
<i>Wakefield self-rating scale</i>	17.2	7.9	P < 0.001
<i>Middlesex Hospital questionnaire</i>			
Total symptom score	42.3	24.2	P < 0.001
<i>Sub scales</i>			
Free floating anxiety	10.1	5.5	P < 0.001
Phobic fear	6.3	3.3	P < 0.001
Obsessive symptoms and personality	9.7	6.8	P < 0.001
Somatization complaints	7.7	5.0	P < 0.001
Depression	8.5	4.6	P < 0.001
Hysterical extravert personality	4.4	3.9	NS
<i>Broadbent cognitive failures questionnaire</i>	73.9	63.9	P < 0.01

TABLE III
Relative illness of ECT complainers vs non-complainers

	ECT complainers (N = 26)	ECT non-complainers (N = 13)	Significance
Wakefield	19.1	13.2	P < 0.005
Middlesex Hospital questionnaire	43.3	40.4	P < 0.001
Medication	2.3	0.8	P < 0.005

score 3; diazepam 30 mg daily, barbiturates in doses of 200 mg daily, major tranquillizers if more than 100 mg daily of chlorpromazine or its equivalent would all score 4. Using this measure the complainers were taking more drugs than the non-complainers.

Thus on all measures of symptoms and medication the complainers scored more than the non-complainers and the subjects as a whole scored more than the normal volunteer controls. The non-complainers' scores were closer to the normal volunteers than to the complainers.

Comparisons on cognitive tests

When all ECT subjects were compared with the normal controls they were significantly impaired on eight tests, (See Table IV) and not impaired on eleven. They were slower than controls and their retention was poor; they couldn't remember a spoken paragraph of text as well; they couldn't put names to faces as well. They scored poorly on memories of their own past and on remembering personalities since the 1950s. In general, the test results appeared to match the subjects' complaints.

Despite rating themselves as more depressed, more anxious etc., and being on drugs, they

did as well as the matched volunteers on the majority of tests. Their new learning, (visual, spatial and verbal), was not impaired and they remembered personalities from the 1930's-1950's as well as controls.

Removing the 13 non-complainers from the ECT group and then comparing the complainers with normal controls alters the picture very little. The difference on personal remote memory becomes non-significant because the N is smaller and the means remain the same. Complainants were significantly better than non-complainers on one test and worse on two (Table V).

Summary of group comparisons

The picture emerges of a group of patients who have had ECT, who rate themselves as more depressed, having more symptoms in general and currently receiving more medication, and who perform significantly worse on a number of cognitive tests than a group of volunteer controls. They also tend to be more impaired than a small group of non-complaining subjects who have also had ECT (See also Table VI).

A crucial question therefore arises: How

TABLE IV
All ECT subjects vs normal volunteers on cognitive tests

Test	ECT subjects N = 39	Volunteers N = 53	Significance
Personal remote memory	38.8	40.5	P < .05
Logical memory	9.5	12.5	P < .001
Famous personalities from past 1960's 1970's	11.6 13.9	14.4 15.8	P < .001 P < .001
Verbal memory sensitivity	2.7	4.0	P < .001
Face-name connection	5.7	7.1	P < .02
Decision time (m/secs)	445.6	353.7	P < .001
Movement time (m/secs)	365.9	258.3	P < .001

(t test independent)

There were non-significant differences on:

Delayed recall, Delayed recognition, Famous personalities from past 1930's, 40's and 50's, Verbal learning, Spatial positional learning, Visual design learning, Anomalous sentence repetition, Perceptual aptitude, Incidental visual memory.

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TABLE V
Comparison of ECT complainers vs ECT non-complainers

Test	ECT complainers (N = 26)	ECT non-complainers (N = 13)	Significance
Verbal learning	26.9	21.4	P < 0.005
Famous personalities of 1960's	11.4	12.3	P < 0.05
Logical memory	9.1	10.2	P < 0.05

TABLE VI
Comparison of ECT non-complainers with normal volunteer controls

Test	ECT non-complainers	Volunteer controls	Significance
Movement time (m/sec)	304	267	P < 0.005
Verbal learning	21.4	23.9	P < 0.005*

* ECT non-complainers less impaired

much of the poor performance of the complainers is due to their level of depression, and medication?

Analysis of variance

To try to answer this question the test results on all tests by all subjects and controls were put into an analysis of variance/covariance matrix with level of medication, level of depression, total symptom score on MHQ, age and social class as covariants. The object was to determine how much of the variance in test scores could be accounted for by these five variables, and whether having allowed for this the test results which had discriminated between subjects and controls still did so. We examine the previously significant differences test by test.

(a) Decision time and Movement time:

These are measures of speed. Level of medication had a very large effect on results and level of depression a significant effect. There were smaller contributions from age and MHQ scores. When these factors were allowed for there was no significant difference between complainers and controls on either test.

(b) Famous personalities of 60's and 70's:

All five covariates had an effect and when they were allowed for the significant difference between controls and complainers disappeared.

(c) Logical memory test:

The level of significance increases, so some of the covariates must have been operating in the direction of reducing any difference. In other words, the difference between complainers and controls becomes greater when the five covariates are allowed for.

(d) Face-name test:

Social class was a significant covariate. All the other covariates had little effect and the difference between the complainers and controls remained significant, $P < .05$.

(e) Verbal learning:

Medication had little effect on this test. The Wakefield score and total symptom score of the MHQ both had large effects and age had some effect. When all five covariates were allowed for the difference between complainers and controls remained significant, $P < .05$.

(f) Personal remote memory:

All covariates had some effect on this test and when they were all allowed for the

difference between complainers and controls just missed significance at $P < .05$.

Individual test results

So far we have only considered group comparisons on cognitive testing. Although there were a number of statistically significant differences between the means of the groups, when translated into clinical terms these differences are all small.

When the scores of individual subjects are examined there are some large deficits on some tests. A few patients scored well into the organic range on some measures. Sometimes there was a probable explanation for these deficits. For instance in patient 1, and possibly in patient 5, alcohol could be implicated. Patient 20 was taking large amounts of psychotropic medication. Patient 10 was on a considerable amount of medication and was very anxious. Patients 24, 26 and 27 were clinically depressed. However in a number of patients, particularly numbers 2, 14, 16 and 25, there seemed to be no ready explanation for their poor test results. They were virtually symptom-free, not taking drugs and as far as we could tell had no history of brain damage or excessive alcohol consumption.

The most convincing complainers who had no obvious explanation for their poor memory appeared to have nothing in common. They had not had excessive amounts of ECT, nor had their ECT been more recent than the other complainers, nor, as far as we knew were there any complications during their treatment. There were no comments in the case-notes about things going wrong such as prolonged hypoxia, missed fits, stuns, or excessive applications of electricity.

Discussion

The findings of this study must be interpreted with caution. We have not shown that ECT causes permanent memory impairment, though our results are compatible with this possibility. The study was designed as a descriptive one. What we have done is to describe in some detail a self-selected group of patients who complained about enduring unwanted effects of ECT. We have found that members of this

group do have some areas of impaired cognitive function, but on the majority of tests they performed as well as control subjects. On the tests where they were impaired, much of the impairment could be accounted for by other factors such as their level of depression and their level of medication. However, even when these factors and three other variables were taken into account not all the difference could be explained.

We are left with the fact that on three of a large battery of tests the ECT complainers performed significantly worse than the controls. Although these results are statistically significant their practical significance is less certain. The differences on test scores were not great when the groups as a whole were compared, and it is not possible to say whether the differences are certainly due to the ECT, or to something else which had happened in the period since the end of treatment. The length of time since the last course of ECT varied from nine months to thirty years and in the group that answered the newspaper advertisement the mean time since their last ECT was ten years.

There are two possible explanations for our findings. The first is that ECT does indeed cause some lasting impairment of memory in a small proportion of the people who receive it. The second is that our ECT complainers were simply people whose memories came in the lower half of the normal range, or had some mild impairment of memory for other reasons, and mistakenly attributed these failings to the treatment they had received years before. One man, for example, had a history of heavy drinking and had fallen down stairs and concussed himself on four occasions.

In our study on patients' attitudes to ECT (see Paper I, p. 12), we found that 12 per cent of patients agreed with the statement that "My memory now is better than ever". Had our newspaper article been worded differently it is conceivable that we could have attracted a group of people who had had ECT but whose memory was better than average.

What is clear is that the present subjects themselves clearly linked their memory impairment with having had ECT. Some were quite emphatic that their memory had been

average or a number of c become appa ECT and ha years. It may degree of peri small proport but we cons comparisons patients rece indicate fairly normally pro memory, thou does so. It large scale, an study to dete say, one patie

All references found after Paper

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1. *Male. Age* for severe de sistent difficult Cognitiv functi particularly rei

Impression—T seen. Past hist to 50 pints of cussion requir Diastolic BP 1 underestimat

2. *Male. Age treatments for names, gets e: was going to d Can't rememb ago, 6 years : personal remo recall impaire*

Impression—T pressed. Corre there is no obv

3. *Male. Age in 1972. Com memory. One months after E Sure that men whether to att*

average or above average beforehand. In a number of cases the memory disability had become apparent shortly after the course of ECT and had remained constant over many years. It may be that ECT does cause some degree of permanent memory impairment in a small proportion of the patients who receive it, but we consider that our own and other comparisons of carefully matched groups of patients receiving ECT and drug treatment indicate fairly convincingly that ECT does not normally produce such enduring effects on memory, though they do not prove that it never does so. It would, however, require a very large scale, and probably multicentre, prospective study to detect impairments that only affected, say, one patient in a hundred.

All references and the address of the authors will be found after Paper III.

APPENDIX: Case Histories of Complainers

Numbers 1-14 were obtained through the newspapers, the rest from consultant psychiatrists.

1. *Male, Age 48: I.Q. 98.* ECT 2 courses 1960-1972 for severe depression. *Complaints*—Slight but persistent difficulty in remembering numbers and names. *Cognitive function*—Impaired on nearly all tests, particularly remote memories, face-name test.

Impression—Not depressed or otherwise ill when seen. Past history of alcohol consumption amounting to 50 pints of beer per week. Four episodes of concussion requiring overnight admission to hospital. Diastolic BP 120 mm Hg. Seems to be considerably underestimating his deficits.

2. *Male, Age 53: I.Q. 116.* ECT 1 course 1973, 6 treatments for depression. *Complaints*—Forgetful of names, gets easily sidetracked and forgets what he was going to do. One particular hole in his memory. Can't remember going to a wedding a few months ago, 6 years after ECT. *Cognitive function*—Poor on personal remote memory and on face-name, delayed recall impaired.

Impression—Slightly anxious but not now depressed. Correct assessment of his deficits, for which there is no obvious reason.

3. *Male, Age 48: I.Q. 125.* ECT 1 course of 27 ECT in 1972. *Complaints*—Two particular holes in his memory. One a few months before, the other a few months after ECT. Now has generally poor memory. Sure that memory was good before but doesn't know whether to attribute loss to ECT or illness. Wouldn't

have ECT again. *Cognitive function*—Good. Verbal learning somewhat impaired.

Impression—Severe obsessional neurosis of 20 years standing. Takes 30 mg diazepam daily plus L. tryptophan. Scored highly on Wakefield depression inventory. Holes in memory probably would not be picked up on our tests, otherwise did better on tests than his complaints would suggest.

4. *Female, Age 19: I.Q. 90.* ECT 1 course of 5-8 treatments when aged 16. Would never agree to have ECT again. *Complaints*—Very against ECT. No complaints about her own experience of treatments, but feels that it is a senseless and illogical thing to give people shocks across their brain. No memory complaints. Not anti-psychiatry in general. *Cognitive function*—Within normal range except for mild impairment of verbal memory.

Impression—From her history she clearly had considerable adolescent problems. In the past she had cut her wrists and taken overdoses. ECT may well have been an inappropriate treatment. We were puzzled by her strength of feeling about ECT.

5. *Female, Age 57: I.Q. 96.* ECT 1 course 1962. Would have ECT again if doctor recommended it. *Complaints*—Indaequate separation from other patients at time of treatment. Poor memory; has to write things down more than she used to. Not distressed by this. *Cognitive function*—Moderate impairment on a number of tests. Face-name, verbal memory, mental set shifting. Also slow on reaction time, cube analysis and card dealing.

Impression—Main complaint was that her GP had made her alcoholic by suggesting she take a sherry at night to help her sleep. Claims she has now been abstinent for four years, and is a stalwart A.A. member. Her memory complaints and cognitive function were congruent.

6. *Female, Age 58: I.Q. 123.* ECT 2 courses in 1967 and 1974. Would have ECT again if very depressed. *Complaints*—Gaps in memory going back 20 years, prior to last ECT. Not a serious problem. Not sure if it was her age. Otherwise no memory complaints. *Cognitive function*—Entirely within normal range except for personal remote memory which was 1. SD below mean.

Impression—Intelligent veterinary surgeon. Entirely well at present. Complaints and test results congruent.

7. *Female, Age 48: I.Q. 100.* ECT 18 treatments in 1962 following puerperal depressive illness. Doesn't know if would agree to ECT again. *Complaints*—2 grand mal fits 3 months after ECT followed by a large number of what were probably temporal lobe attacks. All fits stopped when her tricyclic medication was stopped. Intermittent severe pain radiating from

her left temporo-mandibular joint to whole of left side. Told by neurologist 14 years ago that ECT may have damaged trigeminal nerve. *Cognitive function*—Delayed recall and decision time mildly impaired. Otherwise entirely normal.

Impression—Epilepsy seems definitely temporally related to ECT and antidepressant treatment. Current neurological opinion is that her unusual facial radiating pain could be temporomandibular arthrosis. Patient says that she wouldn't have associated pain with ECT unless neurologist had suggested it.

8. Female. Age 60: I.Q. 114. ECT 12 treatments in 1970. Would readily have ECT again. *Complaints*—Memory impairment. Says she was known in her bridge club as the 'computer' because of her good memory. Now has to write things down, and misplaces her keys and jewellery. *Cognitive function*—In middle of normal range for age and intelligence.

Impression—She takes at least 60 mg chlordiazepoxide, imipramine 75 mg, thioridazine 50 mg and nitrazepam 10 mg daily out of habit. She was entirely well, leading a full and active social life but would seem to be dependent on her many drugs.

9. Female. Age 63: I.Q. 106. ECT 63 treatments in Canada in 1950. Wouldn't have ECT again. *Complaints*—Regards all current and past troubles as due to ECT including need for flupenthixol injections. Convinced that ECT has changed her personality and made her miserable. *Cognitive function*—Gross impairment of ability to learn visual designs. Decision and movement time both slow.

Impression—Fairly typical chronic schizophrenic who accepts that she had a mental illness before ECT but blames the chronicity of her illness and personality change on ECT.

10. Female. Age 35: I.Q. 88. ECT 6 bilateral treatments in 1969. Would have ECT again if drugs didn't work. *Complaints*—Difficult to remember phone messages. Gets mixed up when people tell her things. Dates this from ECT. Still has a good memory for faces. *Cognitive function*—Sentence repetition, and verbal memory impaired. Slow decision time, Porteus maze tests poor in both speed and errors.

Impression—Pleasant, very anxious women with mild phobic illness. Takes diazepam 10 mg daily. Cognitive test results compatible with complaints.

11. Female. Age 33: I.Q. 89. ECT 6 bilateral treatments in 1977. Wouldn't have it again. *Complaints*—Multiple complaints about almost everyone who had tried to help her; psychiatrists, social workers, housing department etc. She felt ECT had generally made her worse but couldn't elaborate. Her memory was worse. She couldn't remember what her children told her. *Cognitive function*—Definite impairment on face-name test. Spatial learning and sentence

repetition mildly impaired. Decision and movement time slow.

Impression—A rather dramatic lady dressed all in white. Was tearful throughout the interview. Said she was completely crippled by her anxiety symptoms. In comparison with all her other complaints those about ECT were trivial.

12. Female. Age 57: I.Q. 110. ECT 1 course of 6 ECT in 1969. Wouldn't have ECT again. *Complaints*—Difficulty knitting. She keeps making mistakes and has to knit slowly. Cannot retain things that her daughter and friends tell her. She feels her memory is progressively getting worse and that this can't be her age. *Cognitive function*—Moderate impairment of logical memory and decision time.

Impression—Manic depressive well maintained on lithium and tranylcypromine. Completely well when interviewed. Marked tremor, presumably from lithium, which may account for her knitting difficulty. Cognitive function objectively less impaired than her complaints would suggest.

13. Female. Age 67: I.Q. 118. ECT 7 bilateral ECT four years before testing. *Complaints*—Memory impaired since ECT. *Cognitive function*—Gross impairment of visual design learning. Decision and movement time slowed.

Impression—Moderately depressed and anxious when seen. Diagnosed as schizophrenic in past. She appears to have some residual symptoms.

14. Female. Age 52: I.Q. 102. ECT 1 course of 6 ECT 18 years before testing. *Complaints*—Terrible memory since. At present wonders if it might be due to her age but has always blamed ECT. *Cognitive function*—Poor personal remote memory. Poor on face-name test. Modest impairment on spatial/positional learning and verbal learning.

Impression—Not ill or depressed when tested. Does seem to have some definite impairment which is not accountable for by drugs or depression.

15. Female. Age 40: I.Q. 96. ECT 1 course of 6 treatments 14 months before testing. *Complaints*—Poor memory since ECT. Couldn't give examples. *Cognitive function*—Only very mild impairment on decision time and delayed recall.

Impression—Anxious, rather obsessional lady. Still attends day hospital. Not obviously ill. Rated herself as moderately depressed.

16. Female. Age 63: I.Q. 102. 30 ECT 8 years before testing, for depressive illness. *Complaints*—Permanently damaged by ECT. Not very specific about how she was damaged, gave impression that her personality was changed. Denies any memory impairment. *Cognitive function*—Grossly impaired verbal learning. Face-name, sentence repetition and perceptual aptitude impaired.

Impression—woman who personality di results not exp

17. Female. months and 2 ECT. *Complain* was permaner her memory h Gross impairn ing. Verbal n mental set shi Decision time:

Impression—Surprising de depressed ran so poor at one

18. Female. months before plaints—Mem things, can't Very slow on delayed recall

Impression—fluoperazine v slurred speech well,

19. Female. . 2 years before Complaints—M function—Defir and visuallear

Impression—Wakefield and

20. Male. A before testing and gets conf jobs. Muscle a definitely due impulsive errc impaire, mei memory impai

Impression—prone to bouts mg daily. Not,

21. Female. . 8 months pric

Impression—Not psychiatrically ill now. The sort of woman who might attract the label hysterical personality disorder from some psychiatrists. Test results not explained by drugs or symptoms.

17. *Female, Age 65:* I.Q. 95. ECT 2 courses 9 months and 2 years before testing. Approximately 15 ECT. *Complaints*—Had thought memory impairment was permanent but now beginning to doubt this as her memory has recently improved. *Cognitive function*—Gross impairment of verbal and visual design learning. Verbal memory impaired. Face-name test and mental set shifting, sentence repetition all impaired. Decision time and movement time both very slow.

Impression—Only mildly depressed when tested. Surprising degree of impairment. In normal/mildly depressed range on Wakefield. Memory functioning so poor at one stage thought to be dementing.

18. *Female, Age 45:* I.Q. 115. ECT 1 course nine months before testing. Would have it again. *Complaints*—Memory still affected. Forgets where she puts things, can't remember names. *Cognitive function*—Very slow on card dealing; sentence repetition and delayed recall impaired.

Impression—On lithium, amitriptyline and trifluoperazine with marked side effects of drowsiness, slurred speech. Considering this she did remarkably well.

19. *Female, Age 62:* I.Q. 118. ECT 4 bilateral ECT 2 years before testing and 1 course many years ago. *Complaints*—Memory permanently affected. *Cognitive function*—Definite impairment on face-name, spatial and visual learning decision and movement time slow.

Impression—Still depressed, rates herself highly on Wakefield and analogue scales.

20. *Male, Age 55:* I.Q. 101. ECT 2 courses 5 years before testing. *Complaints*—Multiple. Memory poor and gets confused, to such an extent that he loses jobs. Muscle aches and pains across chest. Believes all definitely due to ECT. *Cognitive function*—Careless impulsive errors on some tests. Face-name test very impaired, mental set shifting and visual incidental memory impaired.

Impression—A withdrawn, isolated and lonely man prone to bouts of depression. Takes amitriptyline 150 mg daily. Not depressed when tested.

21. *Female, Age 39:* I.Q. 94. ECT 6 unilateral ECT 8 months prior to testing. Wouldn't have it again.

complaints—Slight but definite memory impairment. Can't concentrate as well. *Cognitive function*—Verbal learning and verbal memory impaired. Mental set shifting very impaired.

Impression—Mildly depressed when tested. Chronically depressed and rather disillusioned with all psychiatric treatment.

22. *Female, Age 44:* I.Q. 96. ECT 6 bilateral treatments 20 months prior to testing. *Complaints*—Mild but definite memory impairment. Agrees it fluctuates with her mood. *Cognitive tests*—Verbal learning mildly impaired. Otherwise normal.

Impression—Not depressed when tested.

23. *Male, Age 47:* I.Q. 89. ECT 4 bilateral ECT 2½ years previously. Wouldn't have it again. *Complaints*—Poor memory, can't concentrate. *Cognitive function*—Impaired logical memory, spatial learning and mental set shifting.

Impression—Chronically depressed and anxious man. Still quite severely depressed when tested.

24. *Female, Age 68:* I.Q. 112. ECT 3 courses 1958, 1971 and 1972 (13 treatments). *Complaints*—Memory poor for everyday events: messages, faces. *Cognitive function*—Impaired on sentence repetition, face-name, verbal learning and memory, mental set shifting and positional learning.

Impression—Not depressed or otherwise ill when tested. Poor results not obviously explained.

25. *Female, Age 55:* I.Q. 116. ECT 16 bilateral ECT 3 years previously. *Complaints*—All aspects of memory, learning and retention. Can't do her job as well because of it. *Cognitive function*—Very impaired on sentence repetition and verbal memory. Verbal learning impaired. Decision and movement time slow.

Impression—Chronically depressed. Scored 27 on Wakefield.

26. *Female, Age 49:* I.Q. 95. ECT 1 course of 6 bilateral ECT 19 months before testing. *Complaints*—All aspects of memory. Holes in memory from past. Can't retain things, has to make lists. *Cognitive function*—General poor performance. Face-name, delayed recall, personal remote memory. Mental set shifting and logical memory all impaired.

Impression—Unhappy lady with chronic marital problems. Scored highly (28) on Wakefield.

ECT: III: Enduring Cognitive Deficits?

By D. WEEKS, C. P. L. FREEMAN and R. E. KENDELL

SUMMARY Cognitive function was compared in carefully matched groups of ECT and non-ECT treated depressives and in matched normal volunteer controls on admission, at 4 months and at 7 months. ECT caused little impairment at 4 months and no impairment at 7 months on a comprehensive cognitive test battery. Severity of depression had a marked effect on cognitive function. Within the ECT group bilateral ECT caused more impairment than unilateral ECT one week after a course but 3 months later the differences had disappeared. They were equally antidepressant.

The purpose of the study was to examine whether ECT has any enduring effects on cognitive function when it is used to treat depressed patients.

ECT is the most effective treatment for seriously depressed patients. It is also a controversial treatment, and much of the concern over its use centres on the effect it has on memory. It is known that ECT produces a brief retrograde amnesia in a rather unpredictable patchy fashion. It also produces a certain degree of anterograde amnesia and difficulty in learning new material. It is widely accepted by psychiatrists that this post-treatment memory impairment is temporary and reversible, but critics dispute this and claim that ECT produces permanent impairment.

The published studies to date support the former view but many of them are inadequate on methodological grounds. The early work mixed various types of schizophrenic and depressed patients and it is known that some forms of schizophrenia are associated with intellectual deterioration. The cognitive tests used have rarely been comprehensive and sometimes not sensitive enough to detect small changes in cognitive function. Tests of cerebral dominance have often been inadequate. Some studies have taken little or no account of how depressed the patients were when tested, and it is known that depression can markedly affect test performance.

Wilcox (1954) studying 23 psychotic females who had been given ten bilateral ECT showed that they had returned to their pre-ECT level of memory within two weeks of ECT and that when followed up at twelve weeks they had shown further slight improvement. Korin *et al* (1956) found that ability to learn common words had returned to pre-treatment levels three weeks after a course of ECT. Cronholm and Molander (1964) concluded that one month after a course of ECT there were no ECT-related deficits on tests of non-verbal, verbal or personal remote memory, and that scores on tests requiring immediate reproduction of newly presented material had improved. Kendrick and Post (1967), in a study on elderly depressed patients which compared ECT with imipramine, found that there were no learning deficits in the ECT group either 24 hours or several months after treatment.

Halliday *et al* (1968) compared bilateral ECT with unilateral non-dominant and unilateral dominant ECT. They used a battery of six tests and tested their subjects after four ECT and at three months. After four ECT they found the dominant unilateral group to be most impaired on tests of verbal learning, both immediate and delayed. The non-dominant group were most impaired on tests of non-verbal learning. The bilateral group were mid-way between the two. When they re-examined some of the patients at three months the non-dominant unilateral group were no longer impaired on any of the tests, the dominant unilateral group were still significantly impaired on the two tests of verbal learning, and the bilateral group remained impaired on one test of delayed non-verbal learning. The bilateral group had also developed slight but statistically significant impairment on the digit span test.

Miller (1970) looked specifically at verbal learning after ECT and found no deficits at either five days or nine days post-treatment. Turek and Block (1974), in an exemplary study in which patients were given no concurrent medication, found that scores on the Wechsler memory scale

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Subjects

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became progressively impaired during a course of treatment, but then rose to pre-treatment levels within one week of the course finishing. Squire and Chase (1975) in a retrospective study using six different tests of delayed retention and memory could find no persisting deficits six to nine months later. Summarizing the above work and including studies by Stone (1946); Hemsley *et al.* (1968); Brower and Oppenheim (1951); Jackson (1978) and Hesle *et al.* (1978) there is a mean recovery time to pre-ECT cognitive function or better of 72 days, with a range of from 7 to 270 days. The wide range is probably due to different types of cognitive function being tested.

These findings parallel results of animal experimentation. There have been 18 studies into the possible permanence of an ECS-induced cognitive deficit. Fifteen showed that for courses averaging 9 shocks memory function recovered completely in an average of 7 days (range 8 hours to 23 days). (Braun *et al.*, 1957; Broadhurst *et al.*, 1952; Brown and Simpson, 1956; De Vietti and Bucy, 1975; Horowitz and Stone, 1947; McGinnies and Schlossberg, 1945; Murphree and Peters, 1956; Nielson, 1968; Russell, 1949; Siegel, 1943; Siegel *et al.*, 1949; Stern, 1956; Stone, 1946a; Williams, 1959; Zinkin and Miller, 1967). Three unfavourable reports involved between 18 and 25 shocks given once daily. Brown and De La Garza's (1953) results were inconclusive as follow-up was broken off after fifteen days. Brown and Wilbanks (1952) found that spatial learning was impaired post-ECS but again follow-up was not extended. Braun *et al.* (1949) found that there was a diminishing learning impairment after 30 days but that impairment of retention was still present at 60 days.

Thus the indications are that ECT does not cause enduring effects on memory. Many studies have used return to pre-ECT level of memory functioning as evidence of lack of impairment. As ECT is given for severe depression and severe depression impairs memory we think that using such a criterion is misleading. Before ECT, patients may have very poor cognitive function because they are depressed. Few studies have used normal or non-depressed controls. It is therefore not possible to conclude from previous work that patients who have had ECT and whose depression has been treated do not have memory impairment.

Methods

Subjects

All patients admitted to the Royal Edinburgh Hospital with an admission diagnosis of depressive illness were screened to see if they fulfilled the following seven inclusion criteria: age between 18 and 70; clinical diagnosis of de-

pressive illness; minimum score of 15 on the Hamilton rating scale; no evidence on clinical examination of organic brain disease, epilepsy, previous neurosurgery, alcoholism, or schizophrenia (in doubtful or borderline cases the Present State Examination (PSE) was used to screen individuals for depressive illness and exclude schizophrenia or atypical psychoses); no history of head injury requiring admission to hospital (in Edinburgh all patients presenting at hospital with a history of loss of consciousness, however short, are admitted overnight); no ECT in the previous six months; not taking major tranquillizers regularly.

Accepted patients were dropped from the study because of the development of a major physical illness during the study (e.g. myocardial infarction or carcinoma); major tranquillizers being prescribed; any self-poisoning that resulted in loss of consciousness; receiving a second course of ECT during the follow-up period. (Most patients received a single course of ECT, but a few received further treatments. If these were separated by less than two weeks from the original course the course was regarded as continuous).

Matching of subjects

Of the patients who fulfilled all the trial criteria 51 subsequently went on to receive a course of ECT, 15 unilateral ECT to the non-dominant hemisphere and 36 bilateral treatment. From those depressed patients who did not receive ECT and who fulfilled all the trial criteria, 51 patients were matched to the ECT group on age, sex, social class, educational attainment, and severity of depression. (See Table I).

From a larger group ($n = 130$) of community volunteers, 51 subjects were matched to the ECT group on age, sex, social class, educational attainment and verbal intelligence. (See also Table II). None of these subjects suffered from a formal psychiatric illness and none was receiving regular psychotropic medication. The purpose of this normal control group was to ascertain baseline levels on each of the psychometric tests when given by the same tester in the same manner. There were no significant differ-

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TABLE I
Matched variables of patient groups

	ECT group (n = 51)		Non-ECT group (n = 51)		Non-patient controls (n = 51)	
	Mean	SD	Mean	SD	Mean	SD
Age (years)	52.4	12.5	49	14.8	51.0	14.2
Education (years)	10.8	3	10.6	2.5	10.5	2.0
Social class (numbers of people)						
I	6	-	7	-	9	-
II	10	-	5	-	2	-
III	16	-	19	-	26	-
IV	12	-	10	-	9	-
V	7	-	10	-	5	-
Initial level of depression (by Hamilton)	26.6	7.5	26.4	7.7	Not applicable	
(by Wakefield)	25	7	24.5	5.6	Not applicable	
Sex distribution						
Females N =	34	-	30		34	
Males N =	17		21		17	

TABLE II
Resemblances between patient groups

	ECT group		Non-ECT group		Non-patient controls	
	Mean	SD	Mean	SD	Mean	SD
Verbal intelligence	99.5	12.8	98.2	9.4	101.9	10.6
Non-verbal intelligence	95.9	14.0	94.4	13.5	96.9	13.3
Number of prior episodes of depression	2.6	2.9	2.04	2.4	-	-
mania	0.04	0.28	0.12	0.38	-	-
physical illness	0.73	0.85	0.82	1.09	-	-
Cerebral dominance (laterality) in 51 cases						
Left	44		44		49	
Right	3		4		1	
Mixed	4		3		1	
Middlesex H.Q.						
total symptom score	49	12.4	49	10.8	25.8	5.4
free floating anxiety	11.2	3.2	11.3	2.8	5.8	3.5
phobic fear	7.4	4.2	7.3	3.7	3.8	2.7
obsessionality	9.5	3.7	9.9	2.9	6.7	3.4
somatisation	9.7	3.6	10	3	5.2	2.8
depression	11.2	3.2	10.8	3	4.3	3.3
hysterical personality	3.8	3.2	4.4	2.9	4.6	3.2
Broadbent cognitive F.Q.						
total score	71.8	19.7	69.2	15	69	13.8

Presentation
Friskum capsules
Uses
Mild tranquilizer
and hypnotic
Dose & Admin
Adult dose 20 to 30
mg given at night
the elderly. Child
recommended ac-

ences between the three groups in matched variables and the patient groups, whether ECT or non-ECT received the same mean doses of tricyclic antidepressants and lithium. The two patient groups had one important difference, however; on the Newcastle scale (Carney *et al.*) the ECT group scored a mean of 6, the non-ECT 4.75 ($P < .01$) and therefore the ECT group was slightly more 'endogenous'.

Shortly after admission each subject was interviewed, by C.P.F., who collected background information and rated the subject's type and severity of depression. Cognitive assessment was conducted (by D.J.W.) within 24 hours of the first interview. Each rater was blind to the other's assessment and at this stage it was usually not known for certain whether the subject would receive ECT or chemotherapy, this being decided independently by the patient's consultant.

The ECT group were tested before ECT, one week after the course was completed and then at three months and six months after the course was completed. The non-ECT group were re-tested at four months and seven months after initial testing, thus allowing one month for an average course of ECT.

The tests were administered in a random order and there were four completely parallel and equivalent test batteries which were administered in a counterbalanced order. The selection of a particular order was by use of a random numbers table. This was to avoid sub-test interaction effects wherever possible.

Details of the 19 tests used to measure a wide range of cognitive functions are given in the Appendix. Ratings of depression were made independently on each testing occasion using the Hamilton scale (Hamilton, 1960), Wakefield self rating scale (Snaith *et al.*, 1971) and a number of visual analogue scales.

ECT

ECT was given twice-weekly using an Ectron Mark IV machine. All patients received a bi-directional modified sine wave current with a stimulus duration of 1.5 seconds. The actual amount of current delivered depends on the inter-electrode resistance viz. the resistance of

the subject's head. This may vary greatly from subject to subject but for a typical resistance of 470 ohms the Ectron Mark IV delivers 36 joules of current. For bilateral ECT the standard temporal electrode placement was used (4 cms perpendicularly above the mid-point of an imaginary line drawn from the external auditory meatus to the lateral angle of the eye). For unilateral ECT Lancaster's position was used (Lancaster *et al.*, 1958). All ECT patients were premedicated with atropine sulphate 0.6 mg, 30 to 40 minutes before ECT and received suxamethonium chloride 20 to 40 mg as muscle relaxant and sodium thiopentone 150 to 300 mg as anaesthetic. Laterality was assessed on a 12 point scale which ranged from simple measures of preferred hand for writing to speed of card dealing with either hand.

Other variables

Careful note was kept of all types and dosages of medication. Dosages were converted into simple five-point scales using amitriptyline equivalents for antidepressant regimes. Subjective side-effects were recorded on each testing occasion using a four-point scale from absent to severe.

Number of subjects tested at each occasion

Of the 51 subjects in the ECT group all 51 were tested post ECT, 45 at four months and 41 at 7 months. In the non-ECT group 47 were tested at 4 months and 46 at seven months. Four subjects, two in each group, committed suicide. Other subjects were excluded because of drug overdoses (2), development of physical illness (3), and non-attendance (6). There were no significant differences between the groups with respect to these variables.

Note on statistics

Dependent *t* tests were used only on comparisons within groups. For all comparisons between groups independent *t* tests were used. Because of the large number of tests used results are only reported when the difference in results produced a *P* value of $P < 0.1$. It can therefore be assumed that all scores on tests not reported did not even approach significance. As measured by



the Hamilton and the Wakefield scales both the ECT and non-ECT groups improved significantly. All the ECT group's improvement occurred over the course of their ECT and this improvement was maintained at 4 and 7 months. We did not test the non-ECT group again until 4 months and by that time their depression had improved as much as that of the ECT groups. There was no difference in depression scores between the two groups at 4 months or at 7 months.

Results

ECT group one week after treatment

Much to our surprise the ECT group did not perform worse on any test after treatment than they had beforehand. In fact they improved significantly on visual design learning, on measures of psychomotor speed, on immediate repetition of anomalous sentences, and on the cube analysis test. Their verbal memory was also significantly more accurate in that they committed themselves to fewer semantic false

positives. The improvement on visual design learning and verbal memory semantic false positives brought the ECT group into the normal range for these particular tests. On several of the other tests there were changes in the direction of improvement but these did not reach significance. Details are given in Table IV.

Details of the first (pre-treatment) testing are given in Table III. The group went on to receive ECT started the study significantly more impaired on 9 out of the 19 cognitive tests. There was no test where the ECT group began the study with a better score than the non-ECT group.

Thus ECT had not produced any further impairment in cognitive function; on a simple three-point side effects scale there was a small rise from a mean of 1.4 to 1.65 indicating that the patients felt their memory to be slightly but not significantly more impaired after ECT than before.

TABLE III
Initial differences (pre-treatment) between two patient groups

Test	Normal level		ECT group		Non-ECT group		Significance (difference between ECT and non-ECT groups)
	Mean	SD	Mean	SD	Mean	SD	
Famous personalities of 1970s	15	2.8	12.3	4.7	15.2	3.8	P < .001
Delayed recall	5.5	1.6	4.4	1.9	5.5	1.4	P < .001
Delayed recognition	8.5	0.9	7.3	1.9	8.2	1	P < .01
Verbal memory—semantic false positives	0.94	1	1.23	1	0.75	0.7	P < .02
Auditory verbal learning	26	7	38	18.6	31	12.9	P < .05
Decision time (internal information processing speed)	387 msec.	128	599 msec.	337	483 msec.	183	P < .05
Personal remote memories	21.5	2.5	20.1	4.1	21.7	2.6	P < .05
Movement time	295 msec.	114	593 msec.	552	425 msec.	213	P < .05
Fluid movement (card dealing)	13.8 sec.	3.8	20.4 sec.	9.4	16.8 sec.	8.5	P < .05
Visual memory structural false positives	0.33	0.6	0.61	0.85	0.33	0.5	P < .10
Anomalous sentences repetition (errors)	8.7	6	14.7	9.7	11.35	7.8	P < .10
Visual design learning	21.8	11.2	33.2	18	27.5	14.8	P < .10
Famous personalities of 1960s	13.2	3.2	10.4	4.6	11.9	4.7	P < .10

Variable
Visual design learning
Decision time
Movement time
Verbal memory's semantic false positives
Anomalous sentence repetition
Cube analysis (error rate)
Positional learning
On all other cognition

Famous personalities of 1970s
Mental set-shifts, alternations
Anomalous sentence repetition (error rate)
Personal remote memories

* ECT group significantly different from non-ECT group
On all other cognition

Testing at four months
When the ECT group compared at this time nearly all the cognitive tests were significantly different from the non-ECT group. Only two tests came close to significance. The ECT group was significantly impaired on the names of famous people in the 1970-79 as well as on personal remote memories. They did significantly worse on movement time, shifting. This is probably due to the short-term attentional difficulties they have. They also had difficulty with fluid movement (card dealing). On this they did not differ from the controls, and the

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Significance
up between ECT
and non-ECT
groups)

TABLE IV
ECT group—comparison of measures before and 1 week after treatment

Variable	Before ECT		After ECT		Significance (2-tailed)	Normal level	
	Mean	SD	Mean	SD		Mean	SD
Visual design learning	33.2	18	26	11.3	P < .005	21.8	11.2
Decision time	599 msec.	337	455 msec.	161	P < .005	387 msec.	128
Movement time	593 msec.	552	404 msec.	205	P < .005	295 msec.	114
Verbal memory semantic false positives	1.24	1	0.71	1	P < .01	0.94	1
Anomalous sentences repetition	14.7	9.7	12.1	8.2	P < .05	8.7	6
Cube analysis (errors)	18.3	16.1	13.8	13	P < .05	16	14.7
Positional learning	25	13.6	20.7	10.9	P < .05	20.8	13.8

On all other cognitive tests the ECT group did not change significantly.

TABLE V
ECT vs non-ECT at four months

	ECT group		Non-ECT group		Significance	Normal level	
	Mean	SD	Mean	SD		Mean	SD
Famous personalities of 1970s	12.9	5.2	15.4	3.7	P < .01	15	2.8
Mental set-shifts, correct alternations	1.53	0.6	1.2	0.7	P < .05*	1.4	0.6
Anomalous sentences repetition (errors)	13.8	8	10.8	6.9	P < .10	8.7	6
Personal remote memories	20.1	3.6	21.35	2.8	P < .10	21.5	2.5

* ECT group significantly less impaired.

On all other cognitive tests there were no significant differences.

Testing at four months

When the ECT and non-ECT groups were compared at this stage (Table V) their scores on nearly all the cognitive tests were very similar. Only two tests distinguished between the groups at a significance level of 5 per cent or less. The ECT group were not able to remember the names of famous personalities from the decade 1970–79 as well as the non-ECT group, but they did significantly better on the test of mental set shifting. This is a test which gives a measure of short-term attention and concentration, and ability to plan ahead what you are going to say. On this they did slightly better than the normal controls, and the non-ECT group slightly worse.

Testing at seven months

Only one test differentiated the two groups at a statistically significant level (see Table VI).

There was, however, a tendency for both groups to obtain slightly impaired scores on a number of tests when compared with the normal controls. In other words, both patient groups were still performing less well than normal people on no psychotropic medication and with, presumably, few symptoms of depression.

Unilateral vs bilateral ECT

It is tempting to conclude that ECT is causing no cognitive impairment at all, even in the short-term, but this is not so, as can be seen

ECT: III. ENDURING COGNITIVE DEFICITS?

TABLE VI
ECT vs non-ECT at seven months

Test	ECT group		Non-ECT group		Significance	Normal level	
	Mean	SD	Mean	SD		Mean	SD
Logical memory	14.3	4.6	12.2	3.4	P < .05 (In favour of ECT group)	13.4	3.6

On all other cognitive tests there were no differences between the two groups and none even approached significance.

TABLE VII
Matching of bilateral ECT group with unilateral non-dominant group

	Unilateral ECT group (N = 15)		Bilateral ECT group (N = 15)		Non-ECT group
	Mean	SD	Mean	SD	
Age	50.3	14.4	52.3	13.2	
Social class	2.9	1.3	3.1	1.3	
Educational level	11.7	3.4	11.2	3.4	
Verbal intelligence	101.1	12.6	101.7	15.4	
Sex distribution	10 females: 5 males		10 females: 5 males		
Number of ECT	7.4		7.2		

There were also no significant differences on smoking and drinking habits, physical illnesses, ECT complications, number of shocks per patient, Newcastle diagnostic index, laterality, non-verbal intelligence, severity of depression, neurotic symptoms, or drug regimes.

TABLE VIII
Comparison between scores of bilateral and unilateral ECT groups

	Bilateral ECT group		Unilateral ECT group		Significance	Occasion
	Mean	SD	Mean	SD		
Verbal memory—structural false positives (change)	+0.6		-0.7		P < .01	1 week post-ECT
Visual design paired-associate learning	31.5	12	23.5	9.6	P < .05	1 week post-ECT
Delayed recall	3.9	2	5.5	1.7	P < .05	1 week post-ECT
Auditory verbal paired-associate learning	35.7	16.7	28.4	10	P < .01	1 week post-ECT

All differences favour the unilateral non-dominant ECT group. Comparisons on all other tests showed no significant differences.

when patients receiving unilateral and bilateral ECT are compared. From the 36 patients receiving bilateral ECT 15 were blindly matched individually to the 15 patients who had received unilateral ECT (Table VII). It was found that unilateral ECT was equally effective in relieving depressive symptoms at one week, four months and seven months follow-up testings.

However, when the results on cognitive testings were compared, the unilateral ECT group were significantly less impaired at the one week post-ECT testing (Table VIII). In fact the unilateral ECT group were scoring close to the normal control levels on many tests within one week of treatment. By four months the bilateral group had caught up and were no longer more

Pre-test
ECT group

impaired. Th effective as a appeared to c cognitive func

Amount of ECT

The ECT g treatments. A person receivin many as twen 5-8 treatment ween degree c ber of ECT. during treatm though three vulsive stimul they had a sati

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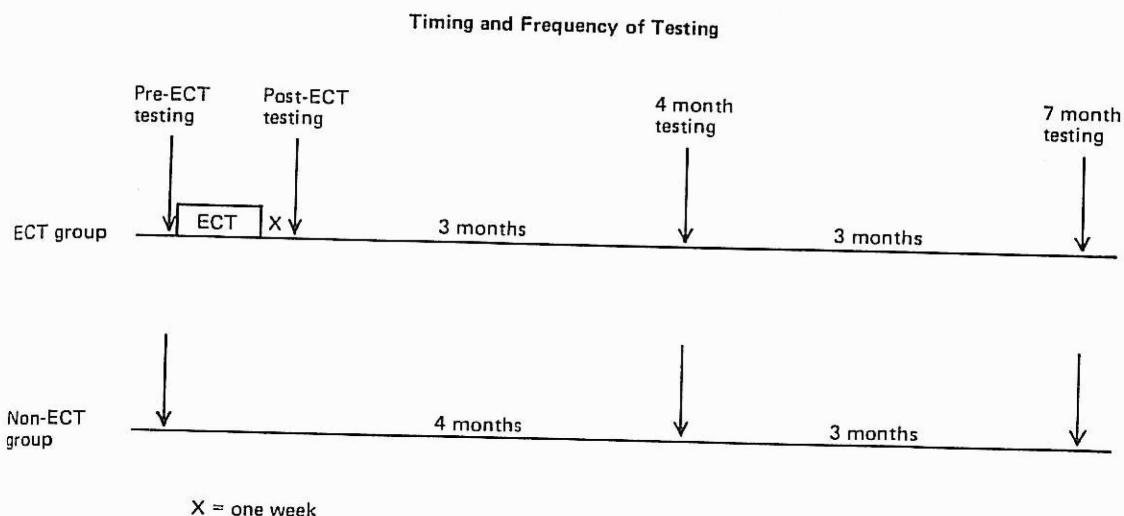


FIG. 1

impaired. Thus, unilateral ECT was just as effective as an antidepressant treatment and appeared to cause virtually no impairment in cognitive functioning.

Amount of ECT given

The ECT group received a mean course of 7.2 treatments. Although the range was wide, one person receiving only two treatments and one as many as twenty, most patients received between 5-8 treatments. We found no correlation between degree of cognitive impairment and number of ECT. There were no complications during treatment involving the study patients, though three patients required a second convulsive stimulus on one occasion each before they had a satisfactory fit.

There were no significant differences between groups in amount of medication taken at any stage. There was a tendency for the ECT group to be on slightly more lithium at four months. At this time the ECT group complained of fewer side effects, particularly headache and dizziness, but the differences were not significant.

Discussion

This study supports the view that ECT when used in everyday clinical circumstances to treat depressed patients does not cause lasting cogni-

tive impairment. None of the very wide ranging battery of tests used to examine all relevant areas of cognitive function showed lasting impairment in the ECT-treated group. The test battery used was more comprehensive than that in any other study to date. Memory functions tested included recall, relearning rate, and recognition, both in the auditory-verbal and visual-spatial modalities. Tests of both immediate and delayed retrieval were used. Both short-term and long-term memory were assessed. Long-term or remote memory was tested for both personal and impersonal facts.

A number of related areas were also tested, such as perceptual aptitude, concentration, short-term predictive planning, choice reaction time (internal information processing speed), discrete peripheral movement speed and fluid movement speed, verbal fluency, speech comprehension, processing and expression, vocabulary and non-verbal problem solving.

We did not use a design involving random allocation to an ECT and non-ECT group. There is good evidence that where accurate matching is required matched group designs are more precise because variance due to random errors is reduced (Ray, 1960). In our opinion it would not have been ethically justifiable to allocate patients randomly to ECT or non-ECT.

Had we insisted, subjects would have had only a 50–50 chance of receiving ECT and we would probably only have been referred mild to moderately depressed patients. Random allocation to ECT and simulated ECT would have had the advantage that the psychologist testing cognitive function might have been blind to the treatment given. It would have had the disadvantage that any cognitive impairment due to the anaesthetic or to hypoxia could not have been assessed as this would have been controlled for in the design. We did ensure that cognitive function and level of depression were assessed completely separately. For the first testing neither rater knew which patients were going to receive ECT.

Patients fell into the moderate to severely depressed category with a mean initial Hamilton score of 28 (undoubled). We were able to match initial Hamilton scores closely but it is clear that the ECT group had a slightly different symptom pattern. All the differences that did exist between the two groups at the start of the study were in favour of the non-ECT group.

If no permanent deficit in memory is caused by ECT, why do so many patients complain of both temporary and lasting memory impairment? (Squire and Chase, 1975; Paper I, p. 12). That ECT produces a short-term memory deficit has been shown in many studies, and is also confirmed by the differences between the unilateral and bilateral ECT groups in this report. When the ECT and drug treated groups are compared with the normal control group, both show deficits at both four and seven months on some tests.

Thus patients who complain of memory impairment after treatment for depression are not imagining their disabilities. They are slightly impaired. This may be related to the medication they are taking or to some residual depressive symptoms. The replies to the Broadbent failures questionnaire showed that at follow-up both ECT and non-ECT patient groups complained to an equal extent about memory impairment. It is clear that severe depression profoundly impairs cognitive function and that antidepressant treatments, whether ECT or drug, act in two opposing ways. Their major effect is to reduce impairment by re-

ducing the level of depression. But both also produce a less striking effect in the opposite direction (causing cognitive impairment) although this impairment appears to be reversible.

Finally the results add weight to the view that unilateral ECT to the non-dominant hemisphere causes very little cognitive impairment even in the short-term.

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APPENDIX

Brief Description of Tests Used

1. *Delayed recall (Williams)* (Graham White et al, 1969)
A test of short-term memory in which nine common objects are presented pictorially for 30 seconds and the subject asked to recall them after a period of 10 minutes, during which time questions are asked concerning their personal remote memories.
2. *Personal remote memories* (after Bidder et al, 1970)
An interview schedule with 28 items sampling memories from various times in the subject's life, from early childhood to the present.
3. *Famous personalities test 1930's to 1970's* (Stevens, 1979)
A test of impersonal remote memory in which the subject is asked to state how familiar each of 50 names of famous or obscure personalities are to him. Personalities who were particularly famous in one decade only, from the early 1930's onwards have been chosen. Ten fictional names are also randomly presented as a control for 'faking good'.
4. *Logical memory* (Wechsler, 1945)
Immediate reproduction of a brief story read to the subject. The story is divided into 22 word units. The test is a measure of concentration and registration.
5. *Choice reaction time: Decision time and movement time* (Byrne, 1976)
A three-choice reaction timer with two electronically sequenced timers accurate to one millisecond organized so as to separate internal information processing speed (decision time) from physical speed (movement time).
6. *Auditory verbal learning*
A paired associate verbal learning test in which the subject is required to learn six pairs of nouns that vary along dimensions of associative value, imagery, concreteness, meaningfulness and frequency of usage.
7. *Spatial/Positional learning*
A task in which the subject is required to learn the specific locations of four differing solid objects in relation to four different pictures exposed simultaneously, each learning trial lasting 30 seconds.
8. *Visual design learning* (Meyer, 1959)
A paired associate learning test in which five pairs of geometric figures, of varying levels of ease of

verbalization and random associativeness, have to be learned.

9. *Cube analysis (Ratcliffe, 1970)*

A test of perceptual ability in which the subject is required to count the number of cubes in displays varying from simple to complex. Time and error scores are derived.

10. *Anomalous sentence repetition* (Newcombe, 1969)

Presentation of six increasingly meaningless sentences which have to be immediately reproduced by the subject. The test is particularly sensitive to difficulties in processing speech and differentiates left cerebral hemisphere from right cerebral hemisphere impairment.

11. *Incidental memory*

Specific questions are asked about the picture/coloured block array which has been presented 45 minutes previously in the Spatial/positional learning test. No prior warning is given. The object is to assess what other information was retained incidental to the original learning task.

12. *Memory sensitivity and response bias*

The subject is presented with 18 cards, on six of which are the responses learned 50 minutes previously in the Verbal learning task. The other 12 cards are 'noise'. By scoring true and false positive and negative scores for verbal memory sensitivity and response bias can be calculated.

13. *Mill Hill vocabulary scale (Raven, 1962)—verbal intelligence*

14. *Advanced progressive matrices (Raven, 1958)—non-verbal intelligence*

15. *Broadbent cognitive failures questionnaire (Broadbent, 1979)*

16. *Mental set shifting (letter, number sequencing)* (Bendefeldt et al, 1976)

A test of short-term concentration in which the subject is required to complete three increasingly difficult letter/number sequences until arriving at the end of the alphabet.
e.g. A1-B2-C3 . . . ; A2-B4-C6 . . . ; B3-D6-F9 . . . etc.

Time and error scores are derived. Presented only at the four month follow-up.

17. *Face-name test (Weeks, 1979)*

Designed to test complaints from post-ECT patients that they can't put names to faces. The subject is shown 12 pictures of six males and six females for three seconds each. The person's name is read by the experimenter. Each face and name are exposed three times. Ten minutes later, during which time the subject has been actively occupied, the subject is asked to match 12 out of