The study of the impact of ECT on memory begins with Janis’s studies (1950), when most ECT was given unmodified and with a sine wave stimulus. Sine wave ECT has not been used in the UK for the past 25 years, although it is still used around the world and, surprisingly, still used in the USA (Sackeim et al, 2007). Previous reviews have combined studies undertaken using different electrode placements (see Chapter 4) and different pulse widths, which has made the interpretation of the nature and severity of memory impairment difficult to assess. The recommendations in this chapter are based on studies that have used brief pulse and ultra-brief pulse stimuli carried out mainly from the mid-1980s onwards.

A couple of studies that do not quite fit into the mould are worthy of comment. Ottoson’s (1960) landmark research compared three groups with case-matched controls. The groups were high-dose bilateral ECT, a suprathreshold group and a group where the seizure was triggered with a suprathreshold stimulus and then aborted by intravenous lidocaine. The results led to the influential conclusion that it was the electricity rather than the seizure that caused memory impairment, because the high-dose stimulus caused more memory impairment than the suprathreshold and shortening the seizure length with lidocaine did not protect memory. These results have not entirely been borne out by more modern research and are difficult to interpret because Ottoson used a partial (quarter-wave) sine wave stimulus which lies somewhere between traditional sine wave and brief-pulse stimulus. Further research in this area has not clarified the situation. For example:

- Weiner et al (1986) found no relationship between stimulus dose and autobiographical memory using brief pulse unilateral and bilateral ECT
- Coffey et al (1990) found no relationship between electrical dose and Wechsler Memory Scale scores or time to orientation using brief pulse right unilateral ECT
- Miller et al (1985) found a significant relationship between memory impairment and seizure duration with brief pulse right unilateral ECT
• Sackeim et al (1986) found a significant correlation between seizure duration and post-ictal disorientation brief pulse right unilateral ECT
• Calev et al (1991) found a significant correlation between seizure duration and post-ictal disorientation using brief pulse bitemporal ECT.

Given the above studies, there is probably just sufficient evidence to continue measuring time to re-orientation after each treatment.

**Definitions of memory loss**

Some definitions of memory loss are given in Box 8.1. None of the types of memory described in Box 8.1 are discrete functions. Memory overlaps with and subsumes other cognitive functions such as learning, attention and overall intelligence.

**Does ECT cause cognitive impairment?**

The clear answer to this is yes, although the severity, permanence and spectrum of such deficits remain contentious. The most detailed, up-to-date and accurate evidence we have is from two meta-analyses (Semkovska & McLoughlin, 2010; Semkovska et al, 2011). The conclusions in this section rely heavily on these papers.

One area that is more difficult to address is the clear difference that has emerged between studies that have involved objective testing of memory and those that have recorded subjective findings, with the latter often reporting much more severe and persistent memory deficits. It is also the case that a small number of patients complain of extremely severe, ubiquitous memory impairment, cognitive changes and sometimes even personality change. There have been no such findings in carefully controlled follow-up studies.

**Box 8.1 Types of memory loss**

Anterograde amnesia: amnesia for the period after ECT.

Autobiographical memory: store of knowledge of past experiences and learning, sometimes rather confusingly referred to as personal remote memories.

Retrograde amnesia: amnesia for the period prior to ECT.

Working memory: the ability to store and access information in everyday life; often involves accessing both autobiographical memory and new memories that have been laid down after ECT.
What do other bodies say?

The current ECT guidelines from the American Psychiatric Association (2001) do not contain warnings about adverse effects on cognition but advise that most patients report that memory is actually improved by ECT. The American Psychiatric Association practice guidelines on major depressive disorder (2010) acknowledge that ECT may be associated with cognitive adverse effects, including anterograde amnesia.

In all types of information gathered for the review by Philpot et al (2004), it was evident that memory loss was a persistent side-effect for at least a third of recipients of ECT. For some, this memory loss profoundly affected their lives and sense of self. The NICE guidelines on ECT (2003) do conclude that cognitive impairment occurs and comment that evidence from users is that cognitive impairment after ECT often outweighed the perception of any benefit from it (p. 16, para. 4.3.8).

Does depression cause cognitive impairment?

Clearly it can and pseudodementia is the most dramatic illustration of this. Many patients show overall improvement after a course of ECT. This is because the balance between ECT caused deficits and relief of depression improving cognitive function is in favour of the latter. These are all pre-post ECT assessments, so markedly improved patients may still have significant cognitive impairment as their pre-ECT functioning may have been very poor.

Squire et al (1979) designed the Subjective Memory Questionnaire specifically to distinguish between cognitive impairments caused by depression and those caused by ECT. This is an 18-item self-report questionnaire where patients are asked to compare their memory pre- and post-ECT, rating each item on a 9-point scale (–4, much worse; through to 0, no change; to +4, much improved). The Subjective Memory Questionnaire has stood the test of time and has been shown to have adequate reliability and good construct validity. Van Bergen et al (2010) have shown that depression does have marked effects on attention and concentration and new learning, whereas ECT has more marked effect on retrograde amnesia and perhaps visuospatial tasks.

Unfortunately, patients with the most severe depression are usually unable to complete any cognitive tests and assessing their pre-ECT performance is almost impossible. It is worth remembering that most studies on memory and ECT and memory and depression have not included these patients. To state that to confuse the ‘temporary effects of depression on cognition (especially attention) and the long-lasting effects of ECT on a range of cognitive functions [...] is unnecessary and could be avoided’ somewhat over simplifies a complex clinical area (Robertson & Pryor, 2006: p. 230).
Recent systematic reviews

Semkovsa & McLoughlin (2010) reviewed objective cognitive performance associated with ECT in patients with depression. They included 84 studies (2981 patients) in their meta-analysis and analysed 24 different cognitive variables. One clear problem they had was that they could not identify any standardised retrograde amnesia tests (tests that would measure autobiographical memory). What they found was:

- over 70% of tests showed significant decreases in cognitive performance at 0–3 days after the last ECT
- improvement in test results occurred between 4 and 15 days post-ECT
- by 15 days after the last treatment, no negative effects on cognitive function were measurable
- nearly 60% of tests at 15 days showed improvement with the testing carried out before ECT.

They concluded: ‘After 15 days, processing speed, working memory, anterograde memory and some aspects of executive function improved beyond baseline levels’. This study combined patients who had received unilateral and bilateral ECT.

In a second study, Semkovsa et al (2011) tried to clarify the differential effects, if any, of unilateral v. bilateral ECT. They identified 39 studies, comprising 1415 patients and some 24 cognitive variables. The overall results were similar to the analysis described above but in addition they found:

- bitemporal ECT was associated with more deficits in verbal and visual episodic memory
- brief pulse ECT caused less impairment on visual episodic memory than sine wave ECT
- no relation was found between cognitive change and age
- no relation was found between total number of ECT treatments and cognitive change
- no relation was found between mean electrical dosage and cognitive change.

The authors caution against the premature conclusion that these latter factors may not be associated with increased cognitive impairment, pointing out that many of these factors interact with each other. The authors again come to the conclusion that it is not possible to make any clear statement about retrograde amnesia and comment that this is remarkable given the amount of research that has been done, that this is the area of cognitive function that patients complain about most and that it may be the memory impairment that persists the longest.

Fraser et al (2008) conducted a systematic review of autobiographical memory studies, covering papers from 1980 to 2007, yielding 15 studies of ECT and autobiographical memory. Their conclusions were as follows:
• Autobiographical memory impairment does occur as a result of ECT.
• Objective measures found memory loss to be relatively short term (less than 6 months post-treatment).
• Subjective accounts reported amnesia to be more persistent (longer than 6 months post-ECT).
• Electroconvulsive therapy predominantly affects memory of prior personal events that are near the treatment (the 6 months before).
• Autobiographical memory loss is reduced by using brief pulse ECT compared with sine wave ECT.
• Unilateral ECT causes less autobiographical memory loss than bilateral ECT.
• There is less autobiographical memory loss if the electrical current is titrated relative to the patient’s own seizure threshold.

There are clearly individual studies which contradict the findings of the three meta-analyses described but picking out individual studies can only be done on an ad hoc (and therefore potentially biased) basis.

Visuospatial memory

It is possible that the earlier-mentioned, very large studies underestimate the cognitive impact of ECT because they concentrate on verbal rather than visuospatial memory. Falconer et al (2010) showed more enduring effects, particularly on spatial recognition, using the Cambridge Neuropsychological Test Automated Battery (CANTAB). Although most deficits resolved between testing 1 week and 1 month after ECT, deficits in spatial recognition persisted at 1 month. They concluded that aspects of cognitive function dependant on the use of the right medial temporal lobe and perhaps frontal lobe were most affected. This fits with what patients say about getting lost in the supermarket and not recognising faces (prosopagnosia) after ECT. It clearly has implications for the use of non-dominant unilateral ECT and may mean we should alter our advice about driving after ECT.

What do patients complain of?

Typical complaints are of:
• not being able to hold on to information that has recently been acquired
• memory not being as good as it was before, or not as good as others of their age
• forgetting simple things, such as where they have left their keys
• having to make lists all the time
• not being able to recognise or remember faces or put names to them
• losing the thread of what they are saying as they are saying it
• getting lost in hospital corridors or supermarkets that they could previously easily navigate
• losing important or significant autobiographical memories of holidays, birthdays or important interpersonal events.

**What to tell patients and relatives**

Patients and their families should be informed in line with the earlier conclusions. They should be told that:

- ECT does cause memory problems
- difficulties with their everyday memory, learning and retaining new information will be relatively short-lived
- because these abilities are affected by both ECT and depression, their everyday memory may function better a few weeks after the end of a course of ECT.

They should be told separately about autobiographical memory, that the effects on this can be longer lasting and may continue for up to 6 months and that, even after that period, some patients complain of gaps or holes in their memory which last much longer.

In addition, they should be told that depression has very marked effects on a wide range of cognitive abilities and that the longer this goes on, the more persistent and enduring those memory problems will become, and therefore relieving depression is important.

**How and when to test**

Having reviewed all the literature, we have concluded that there are currently no valid, reliable and repeatable tests that can be easily used in routine clinical practice. We are aware that the MMSE (Folstein *et al.*, 1975) is now very widely used in the UK and that some clinics are using the Autobiographical Memory Interview (McIlney *et al.*, 2001). The MMSE was produced as a dementia screening scale. It is almost certainly the wrong test used in the wrong place at the wrong time but has retained its place because it is well known, and clinicians are familiar with using it in other settings. Surprisingly, it has picked up deficits, has shown change and has shown differences between unilateral and bilateral ECT in some studies (Prudic, 2008).

Robertson & Pryor (2006) have recommended a battery of tests which they say are suitable for use after ECT (Box 8.2). Interestingly, they too have no recommendation for autobiographical memory. Their battery is comprehensive and covers non-verbal and visuospatial memory and reasoning, working memory, executive function and reasoning. To carry out even a subset of these tests would take 30–40 min per patient. Although such test batteries might be applicable to research settings or to particular individual cases, they cannot be recommended for routine clinical practice.
The ethics of cognitive testing

The patient should not be exposed to detailed and repeated cognitive testing, unless part of an ethically approved research study, if that testing is not going to lead to any change of treatment or benefit for the patient. Clearly, testing after a course of ECT is not then going to alter what treatment has already been given. To test during a course of ECT leads to results that are difficult to interpret. Patients should also not be subjected to tests that are lengthy and/or that are not valid or standardised.

The problems of assessing autobiographical memory

This is exemplified by the Autobiographical Memory Test (Williams & Broadbent, 1986). This test has been widely used in research studies, particularly in the USA, and does detect retrograde amnesia at 2 and 6 months post-ECT. There are some problems with it, for example it has not been standardised on a general population and it is only possible to score negatively on it; in other words, it can only measure memories that have been lost. It concentrates on a great deal of overlearned and old information (e.g. grandparents’ names, telephone numbers of close relatives) and Robertson & Pryor (2006) have estimated that some 60%
of the 200–300 test items are of this type. Trying to capture unique and idiosyncratic memories that have been lost is clearly a difficult task – putting it simply, the patient does not know what they have forgotten until they are asked to retrieve it, and their assessment that previously they did know something which now they do not remember is a complex and possibly flawed judgement. Janis (1950) came closest to capturing this experience, but he interviewed patients for 1–2 h before treatment, which has no routine clinical utility. Attempts have been made to construct tests of impersonal remote memories (world events) such as the Amsterdam Short-Term Memory Test (Schagen et al., 1997) which are constantly kept up to date. Although these are fun to do, they are hugely influenced by culture, intelligence, employment status, etc., and need to be done before and after treatment. They are far too complex for pre-ECT patients with depression. The Kopelman Autobiographical Memory Test (Kopelman et al., 1989) is the best we have at present: it has been validated on normal samples and does allow for improvement; however, currently it remains a research rather than a clinical tool.

We currently have no valid, reliable test of remote memory, be it autobiographical or impersonal, that we can use clinically in routine ECT practice.

Key points

- Electroconvulsive therapy causes dysfunction in a wide variety of cognitive skills that is over and above that caused by the patient’s pre-existing depression.
- This is clearly and significantly present in the first few days after ECT but then begins to improve and usually remits within 2–3 weeks of the end of a course of ECT.
- After this time, patients function as well on all tests (and better on some) than they could before ECT was started, although patients may still have significant impairment.
- There is a difference in the amount and quality of evidence for deficits and improvement in anterograde amnesia and working memory as compared to retrograde amnesia/autobiographical memory.
- Given several caveats about the quality of the evidence, autobiographical memory is affected by ECT for up to 6 months after the end of an ECT course and then returns to pre-ECT levels.
- For autobiographical memory there are consistent reports of more severe and more persistent dysfunction when subjective and objective reports are compared.

Recommendations

- Measure time to re-orientation using a structured protocol so that this can be estimated to within a few minutes (Box 8.3).
• Reassess the stimulus dose and electrode position if this is markedly prolonged (see Chapter 4).
• Continue to use the MMSE until a more appropriate, reliable, valid and repeatable test is available but recognise that this is the least unacceptable of current tests which can be used in routine clinical practice.
• Make a careful and systematic enquiry of subjective memory complaints at the end of a course of treatment and at 3 and 6 months post-ECT.
• Take subjective complaints of memory impairments seriously and help patients with simple strategies to cope with and overcome these (Box 8.4).

Box 8.3  Protocol for time to re-orientation

1 Develop local protocol depending on clinical population
2 Measure time from stimulus to fully oriented time, place and person
3 Recovery nurse should be responsible for timing and recording
4 Ensure questioning is not too intrusive and not repeated too frequently (e.g. not every 5 mins; usually 15+ mins); timing will depend on how quickly your patients typically recover
5 Ensure information is readily available before next treatment session and available to ward team

Box 8.4 Ten points to help patients who complain of persistent memory impairment

1 Take the complaints seriously and enquire in detail
2 Explain again the nature of the memory impairment to the patient and family if appropriate
3 Explain things in everyday terms
4 Encourage the patient to practice specific memory tasks that they find difficult
5 Explain how to use compensation strategies such as lists and labelling, e.g. keeping keys, diary/notebook/wallet or purse in the same labelled drawer
6 Explain the relationship between low mood and memory and check level of depression
7 Consider appropriate accounts from patients; the paper by Donahue (2000) may be a good basis to adapt from
8 Help the patient rehearse strategies if caught out by memory failures, e.g. not recognising a neighbour
9 Consider referral for formal neuropsychological testing if the patient’s complaints are marked and very persistent
10 Consider forming links with other clinical services that may routinely be dealing with similar problems, e.g. epilepsy services
COGNITIVE ADVERSE EFFECTS OF ECT

References


