The Effect of Electroconvulsive Therapy on Autobiographical Memory: A Systematic Review

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Objectives: In the last 20 years, an increasing number of articles have been published about effects of electroconvulsive therapy (ECT) on memory. Here, we review autobiographical memory studies in particular because there have been conflicting reports about the extent and persistence of ECT effects and the period before treatment from which memories are most likely to be affected.

Methods: Five psychological and medical databases (MEDLINE, PubMed, PsychINFO, ScienceDirect, and Web of Knowledge) were searched from 1980 to 2007, yielding 15 studies of ECT and autobiographical memory.

Results: Evidence suggests that autobiographical memory impairment does occur as a result of ECT. Objective measures found memory loss to be relatively short term (<6 months posttreatment), whereas subjective accounts reported amnesia to be more persistent (>6 months post-ECT). Electroconvulsive therapy predominantly affects memory of prior personal events that are near the treatment (within 6 months). Autobiographical memory loss is reduced by using brief pulse ECT rather than sine wave—unilateral positioning of electrodes rather than bilateral—and by titrating electrical current relative to the patient's own seizure threshold.

Conclusions: Further research is required to determine memory loss associated with ECT, controlling for the direct effects of the depressive state.

Key Words: cognitive impairment, autobiographical memory, depression, ECT effects

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Electroconvulsive therapy (ECT) is widely acknowledged as effective in the treatment of psychiatric disorders, in particular depressive illness.[1] It has been used with medication-resistant patients for more than 60 years, despite a number of reported adverse cognitive effects, which include postictal disorientation and neuropsychological impairments. Perceived memory impairment is now the major concern surrounding the use of ECT. In particular, there is controversy regarding the long-term rather than the immediate consequences of the treatment.[2] Acute effects include amnesia for events occurring before the treatment (retrograde) and the acquisition of new memories after the treatment (anterograde). Retrograde amnesia is mostly marked for events occurring in the weeks or months before ECT, although in some cases, loss of memories from years before treatment have been reported. Anterograde amnesia is generally confined to the time of treatment itself or shortly afterward.[3]

The extent of memory problems has been shown to be dependent upon techniques used in the administration of ECT. Earlier treatment used sine wave stimuli, which produced more severe cognitive side effects in comparison with brief pulse ECT that is now more commonly used.[4] Electrode placement and stimulus dosage can influence the severity of memory deficits. Right unilateral (RUL) ECT has been reported to result in less severe cognitive side effects, in comparison with bilateral (BL) ECT, although it seems to be characterized by a reduction in therapeutic efficacy using comparable dose relative to seizure threshold.[2]

Generally, memory problems resulting from ECT steadily improve in the weeks and months after treatment, although some patients report more persistent memory loss.[5,6] A systematic review conducted by Rose et al[7] showed that between 29% and 55% of people who had undergone ECT reported persistent memory loss, suggesting that the degree of perceived memory deficit varies greatly between different individuals. The reported period for lasting effects on memory differs, depending on the type of assessment. Memory impairment reported subjectively lasts longer than that observed from objective measures.[8] A relationship between mood and subjective impairment is frequently reported (eg, Prudic et al[9]).

Research has focused on retrograde amnesia because of claims that there are more enduring deficits in past memories as a result of ECT than in anterograde memory.[10] Retrograde memory deficits seem to be characterized by an amnestic time gradient: the distant past is remembered better than more recent events.[11,12] Furthermore, events related to the period closest to receiving ECT are least well remembered or permanently lost.[12] Studies have frequently highlighted deficits specifically in personal or autobiographical memories[13–15]; however, more recent results have raised the question whether it is memories of public events that are more likely to be affected.[16]

As yet, relatively few studies have been conducted to examine autobiographical memory specifically. This is surprising, as autobiographical memory deficit is clinically the most concerning to patients. Whereas other memory performance deficits often require specific tests to be

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performed and may as such be inaccessible to the patient, loosing whole autobiographic episodes, such as family events, will be obvious to the patient and his or her environment and cause alarm. The experience of such side effects will affect concordance with ECT, not only of the patient concerned but also of other patients and relatives who are aware of this effect. The aim of this review is therefore to evaluate the existing literature to estimate the degree of autobiographical memory loss after ECT and to consider the persistence in memory deficits of its nature. We will focus on research considering the time to recovery and the temporal gradient of autobiographical memory impairment after ECT administration, as well as considering other possible confounding factors. Additionally, subjective and objective accounts of autobiographical memory loss will also be compared.

MATERIALS AND METHODS

Only studies published since 1980 were reviewed. The severity of memory problems had been reduced by then because of the more common use of brief pulse wave ECT as an alternative to sine wave ECT. Five search engines were used to identify publications from 1980 to 2007. These included MEDLINE, PubMed, PsychINFO, ScienceDirect, and Web of Knowledge. The following key words were used in this search: (*a*) "autobiographical" (or "personal memories"), (*b*) "amnesia" (or "memory loss"), and (*c*) "electroconvulsive" (or "ECT"). The author then read each abstract to determine its relevance to the current review. All articles that considered autobiographical memory loss as a result of ECT, regardless of memory measures used or techniques used in the administration of ECT, were extracted for review. These articles then underwent cross-referencing, yielding a total of 15 published studies (Table 1). We listed relevant information, such as subject characteristics (diagnosis and numbers), study design (nature of ECT and number of treatments in total and per week), memory measures used, and outcome data. These should be considered together with the following results and discussion to assess the comparability and power of the studies included. Whereas some obvious confounders have been listed, other differences between studies that may affect outcome, such as detailed medication status, type of anesthesia, and so on, have been omitted for simplicity's sake. There were clearly not enough data to conduct a meta-analysis or even a metaregression with potential confounders, so we are, at the moment, limited to interpreting the outcome data, taking account of potential confounders on an individual basis.

RESULTS

Autobiographical Memory and ECT

Autobiographical memory refers to the memory of an event from a person's own history. A number of measures have been used to assess autobiographical memory loss. These include the "The Squire Subjective Memory Questionnaire" (SSMQ)[17] and "The Autobiographical Memory Interview" (AMI)[18], which was adapted from "The Personal Memory Questionnaire" (PMQ).[19] The SSMQ assesses patients' own views about the extent of memory loss after ECT, whereas the AMI is an objective measure that investigates memory for past events ranging from childhood to just before treatment.

Electroconvulsive therapy can have a detrimental effect particularly on personal memories, although conflicting findings have been reported.[20] Kho et al[14] assessed a group of patients who had received ECT and pharmacotherapy and a group who had received pharmacotherapy only. The ECT and pharmacotherapy group showed significantly greater problems in recalling personal memories than those who had received pharmacotherapy alone. However, this study was cross-sectional and does not therefore address the time course of memory impairment. Furthermore, patients were not randomized to treatment group, which may have resulted in bias associated with preexisting differences between samples. For example, patients who received ECT may have been more severely depressed and medication resistant.

Studies have shown that autobiographical memory complaints can persist up to 3 years after treatment.[8,21] Weiner et al[19] reported one of the few studies that show persistence in autobiographical memory deficits, assessed by objective measures, up to at least 6 months after ECT. This was a randomized controlled trial of unilateral (UL) versus BL ECT, and both participant and researcher were kept blind to treatment allocation. However, the findings were not replicated by Calev et al[13] in a similar trial also using the Personal Memory Questionnaire pre-ECT and at different times after ECT. Although Calev et al[13] found a significant impairment in autobiographical memory immediately after treatment, performance in the recall of personal memories was found to improve to pre-ECT levels at 1 month posttreatment and exceed these by 6 months of follow-up. Similarly, Sackeim et al[22] found no decrement in performance on the AMI relative to baseline at a 2-month post-ECT follow-up examination, and this was supported by a later study conducted by the same research group.

Lisanby et al[16] conducted a randomized double-blind study of UL and BL ECT, testing the differential effects of ECT on autobiographical memory versus impersonal memory. Shortly after ECT, patients recalled fewer events and event details than controls, and these deficits were most apparent for impersonal events compared with personal events. At 2 months of follow-up, patients continued to show deficits in recalling memories of impersonal events, whereas recall of autobiographical memories had improved and was equivalent to that recorded at baseline. The results of this study are in contrast with the general view generated by research in this area (ie, that personal autobiographical memory problems are more likely to persist in comparison with other types of memory after ECT). This result suggests that deficits in retrograde memory for public events are more prominent and more persistent than autobiographical events. Lisanby et al[16] argue that this effect could be due to autobiographical events being more memorable as a result of greater affective and personal significance, deeper encoding, more extensive elaboration, and more frequent retrieval. However, public memory performance at 2 months of follow-up did not differ significantly from pre-ECT baseline ($P > 0.05$), and therefore, further research needs to be conducted to test for differential effects.

TABLE 1. Studies Examining Autobiographical Memory Loss and ECT

Study	Subjects (ECT Type)	Design	Autobiographical Memory Measures	Outcome
Calev et al (1991)[13]	27 RDC Dep MF (BL BP ECT, 2 or 3 treatments per wk, NECT = 8.9 ± 2.0) No C.	Prospective (pre-ECT, post-ECT, 1 mo, 6 mo) RDB (2 or 3 treatments per wk).	PMQ	Amnesia at end of treatment course. Improved to pre-ECT levels at 1 mo + exceeded these at 6 mo.
Coleman et al (1996)[30]	70 RDC MD MF (lorazepam) (BL/UL and HD/LD BP ECT, NECT = 9.4 ± 2.5) 18 matched Cs	Prospective (prior, during, 1 wk, 2 mo)	SSMQ, Structured Personal Memory Interview	Relation between subjective and objective memory impairment at 2 mo.
Kho et al (2006)[14]	20 *DSM-IV*-Dep (UL/BL ECT, NECT = 27 ± 23 + pharmacotherapy	Cross-sectional Nonrandomized. Test time—mean 1.8 yr posttreatment), 30 pharmacotherapy only (2.5 yr posttreatment)	AMI, SSMQ, ERAPS. 50 proxies' ratings	No correlation between subjective and objective score. ECT + pharmacotherapy group = lower AMQ scores—supported by proxy scores.
Lisanby et al (2000)[16]	55 RDC MD MF (lorazepam) (BL/UL and HD/LD BP ECT, NECT = 9.3 ± 2.5) 36 normal Cs.	Prospective (pre-ECT, within 1 wk after, 2 mo). RDB	PIMT, AMI	Impairment for impersonal memories greater than personal at 2 mo. More persistent twith BL than RUL.
McCall et al (2000)[16]	72 *DSM-III-R* MD (titrated RUL ECT 2.25 × initial seizure threshold or fixed dose of 403 mCi, NECT = 5.9 [fixed dose] to 7.4 [titrated] ± 1.9 to 2.8).	Prospective (pre-ECT, within couple of d after course). RDB	DPMQ	Fixed-dose group more impaired than titrated-dose group. However, fixed-dose group more likely to have fewer treatments and greater antidepressant response.
McElhiney et al (1995)[15]	75 RDC MD MF (lorazepam) (16 = LD UL, 18 = HD UL, 18 = LD BL, 20 = HD BL, NECT = 9.6 ± 2.4) 16 nondepressed Cs.	Prospective (pre-ECT, 1 wk post-ECT, 2 mo post-ECT). RDB.	AMI	BL ECT = lower AMI score (1 wk + 2 mo) than UL ECT group. Temporal gradient (more recent events). Lower scores if received second ECT course since.
Ng et al (2000)[31]	32 *DSM-III-R* MD (RUL ECT, NECT = 9.4 ± 4.4) No Cs.	Prospective (baseline, during, 1 mo).	PMT, Self-Rating Scale of Memory.	Performance on PMT decreased from baseline by 32.5% after 6 sessions—significantly improved at 1 mo. Subjective scores correlated with HDRS score.
Peretti et al (1996)[23]	12 *DSM-III-R* MD (12 BL SW ECT) + antidepressants, benzodiazepines, 9 *DSM-III-R* MD antidepressants, benzodiazepines	Prospective—baseline, 1 wk (ECT), 4-6 wk (med only group). Not randomized—selected by previous ECT efficacy + medication resistance.	SIGH-D. Derived from HDRS.	Subjective memory loss associated with events related to depressive episode.
Sackeim et al (1993)[18]	96 RDC MD (23 = LD UL, 23 = HD UL, 23 = LD BL, 27 = HD BL: NECT = 9.0 [UL LD] to 10.6 [BL LD] ± 2.0 to 2.9). No Cs.	Prospective (pre-ECT, during (does not specify), 1 wk after completion, 2 mo later). RDB	AMI, SSMQ	Main effect of electrode placement: BL resulted in more retrograde autobiographical amnesia than UL in wk posttreatment. No differences at 2 mo follow-up.
Sackeim et al (2000)[27]	59 RDC MD (BL ECT or RUL ECT at low or high stimulus intensity, NECT = 9.4 ± 2.2). No Cs	Prospective (pre-ECT, during, within a wk of completion). RDB.	AMI	Increased theta activity associated with greater amnesia. BL more likely to induce this pattern than RUL.
Sackeim et al (2000)[22]	80 RDC MD (RUL ECT [50% {NECT = 9.9 ± 4.0}, 150% {NECT = 9.2 ± 1.8} or 500% {NECT = 8.3 ± 2.0 over seizure threshold}, or BL ECT [NECT = 8.3 ± 2.0] [150% above threshold]). No Cs.	Prospective (pre-ECT, during, immediately after + 2 mo). RDB.	AMI, SSMQ	BL greater impairment than UL immediately after + 2 mo after, regardless of dose relative to seizure threshold.

TABLE 1. *(Continued)*

Study	Subjects (ECT Type)	Design	Autobiographical Memory Measures	Outcome
Sackeim et al (2007)[28]	347 *DSM-IV* MD or schizoaffective (12 = BF ECT, 75 = mixture of BL, RUL and/or BF ECT, 2 = RUL SW. 258 uniform treatment (either RUL or BL BP or BL SW but does not specify no. in each group). 24 healthy Cs.	Prospective (pre-ECT, d post ECT course, 6 mo post). Naturalistic. Not randomized.	AMI-SF	BL ECT more persistent amnesia than RUL ECT. SW stimulation resulted in more severe and persistent deficits. Correlation between number of treatments and autobiographical amnesia.
Sobin et al (1995)[33]	71 inpatients with RDC MD NECT = 9.5 ± 2.4 (RUL or BL and either HD or LD ECT (does not give specific no.); 28 patients received only 1 ECT course (of these, 19 = BL). No Cs.	Prospective (pre-ECT, within 1 wk after course, 2 mo post). RDB.	AMI, PMQ	Pretreatment cognitive status and postictal reorientation time predicted extent of amnesia—regardless of technical parameters.
Squire and Slater (1983)[8]	31 depressed patients BL ECT (NECT = 10.9—does not give SD) (27 sine, 4 BP), 28 RUL ECT (NECT = 9.2—does not give SD (all sine), NECT = 19 depressed Cs.	Prospective (ECT—prior, 1 wk, 7 mo, 3 yr, Cs—initial hospitalization, 7 mo). Not randomized.	SSMQ	Amnesia reported at 3-yr follow-up for events occurring 6 mo before treatment and up to 2 mo after.
Weiner et al (1986)[19]	53 depressed—BL or UL, sine or brief (39 at 6 mo), NECT = does not mention mean treatment no. 21 similarly diagnosed Cs (13 at 6 mo).	Prospective (pre-ECT, 2–3 d after course, 6 mo) RDB.	SSMQ, PMQ	All but BP UL impairment. 2–3 d + 6 mo post BL greater impairment than UL.

AMI,[18] AMI-SF,[23] ERAPS,[14] PMQ,[19] SSMQ.[17]

BP indicates brief pulse; C(s), control(s); DPMQ, Duke Personal Memory Questionnaire[27]; *DSM-III-R/IV, Diagnostic and Statistical Manual Third Edition-Revised/Fourth Edition*; HD, high dose; HDRS, Hamilton Depression Rating Scale; LD, low dose; MD, major depression; med, medication; MF, medication-free; NECT, mean total number of ECT; PIMT, The Personal and Impersonal Memory Test[16]; RDB, randomized double-blind; RDC, Research Diagnostic Criteria; SIGH-D, Structured Interview Guide for the HDRS (SIGH-D[32]); SW, sine wave.

Past autobiographical memories that are disrupted by ECT may show a temporal gradient. Squire[21] found that 7 months after ECT treatment, recollection of remote events (those occurring more than 2 years before treatment) had been completely recovered, whereas events that had occurred in the 2 years previous to ECT were only partially recovered. At 3 years of follow-up, however, memory loss for personal events was limited to those occurring 6 months before ECT treatment.[8] This suggests that memory loss for events that are near ECT treatment is more likely to occur than persistent amnesia for more temporally remote memories. However, similar levels of memory impairment for personal events were reported before treatment. At baseline, participants described memory problems for 5 months before treatment, thus implying that amnesia at 3-year follow-up may possibly be partially attributed to poor encoding of memories because of depressive illness rather than ECT.

A key confounder affecting memory assessments comparing pre-ECT memory performance with post-ECT performance is that memory may be significantly impaired because of depressive symptoms at both time points.[20,23] Studies using a healthy control group can measure this to a certain extent, but it cannot be assumed that depressed patients have entirely normal functioning preepisode.[24,25] That is, although a comparison could be made to distinguish differences in performance between healthy participants and depressed patients at baseline, difficulties would still remain in determining whether poor memory performance in the depressed group pre-ECT was as a result of the depressive state in that particular sample or whether their memory was already poor before the episode. Therefore, to be confident that memories before ECT have been lost as a result of poor encoding at the time of the depressive episode, research must demonstrate an improvement in autobiographical memory after treatment.[20]

Calev et al[13] reported that recall of personal memories at 6 months after treatment exceeded that before ECT, thus implying that the depressive state independently affected memory and that recovery from depression was not a result of the amnestic action of the treatment. However, because of the small number of participants (n = 27), the study would have benefited from a depressed comparison to examine the (lack of) specificity of the ECT effect on depression and a healthy control group to assess the maximum possible practice effect over the follow-up period to support this result. In line with this, Lisanby et al[16] question the view that memory for remote personal events are less disrupted by ECT than more recent autobiographical memories. Although participants in their study had difficulty in recalling personal events closer to treatment, these were dated as having occurred, on average, 6 months earlier in comparison with the personal memories forgotten by controls. The reverse would be expected if recency effects were predominant. If ECT affected memories closest to the time of treatment, then recall of events should be more impaired for the treatment group compared with controls for this period rather than for events occurring 6 months previously.

Although these studies demonstrate the conflicting findings of the extent of autobiographical memory loss that can occur after ECT, most research shows that recall deficits of personal memories are relatively short term, lasting for months,[13,18,22] although a few have reported more persistent deficits.[8,19,21] Furthermore, there is also controversy regarding the view that events occurring closest to ECT are most disrupted.[8,16,21] Such memory problems may represent a partial consequence of depression before treatment.

Effects of ECT Technique on Autobiographical Memory

Considerable research has been conducted on the effect that different techniques in administering ECT have on autobiographical memory.[15,16,18,19,26–28] Weiner et al[19] compared the effects of electrode placement and waveform on different types of retrograde memory including autobiographical memories. Patients were randomly assigned to either sine wave or brief pulse ECT, with electrodes placed either bilaterally or unilaterally. Two to 3 days after finishing a course of ECT, all groups except the brief pulse UL ECT group showed significant impairment in the recall of personal memories. Additionally, at 6 months of follow-up, significant differences between scores on the personal memory test for UL and BL groups were observed, with poorer performance in the BL group. Furthermore, when considering recall of personal memories and waveform, there was a significant difference between controls and the sine wave group in the number of memories recalled, but such a difference was not evident when comparing the sine wave group's scores with those of the brief pulse group.[19] This study demonstrates the detrimental immediate and long-term effects of BL ECT in comparison with UL ECT on autobiographical memory and also implies that less memory impairment is induced by brief pulse ECT than sine wave ECT, albeit more prominently in the short term.

This result is supported by more recent research reporting greater autobiographical memory deficits in sine wave ECT compared with brief pulse ECT immediately after treatment. However, at 6 months of follow-up, BL sine wave ECT produced similar scores on the AMI–Short Form (AMI-SF) compared with BL brief pulse ECT, with RUL ECT resulting in significantly less autobiographical memory impairment. In addition, the extent of amnesia associated with BL ECT was directly related to the number of treatments received, with a greater number of ECT sessions resulting in greater impairment.[28] However, because the 2007 study by Sackeim et al[28] was naturalistic and therefore type of treatment was not randomly allocated, the sample may be biased. As more severely depressed individuals may require a larger number of ECT trials and may also be prescribed BL rather than RUL ECT, increased memory impairment could possibly reflect illness severity.

Consistent with the findings by Sackeim et al,[28] McElhiney et al[15] conducted a randomized double-blind trial showing that BL ECT produced more impairment in autobiographical memories at 1 week and 2 months after ECT, with more recent events being affected more by the treatment. At 2 months of follow-up, more persistent amnesic deficits were related to having received a second course of ECT rather than associated with electrode placement.[15]

This is further explained by Sackeim et al[27] who looked at the adverse cognitive effects of ECT and how they relate to functional brain activity as a result of electrode placement. The results showed that increased theta activity in left frontotemporal regions was associated with greater amnesia for autobiographical information. Furthermore, this pattern of increased theta activity was more likely to be found with BL ECT compared with RUL ECT, possibly explaining the mechanism of effect for BL ECT producing more profound amnesia for autobiographical information.[27]

When considering electrical dosage, Sackeim et al[18] showed that BL ECT resulted in 3 times more retrograde amnesia for autobiographical memories immediately posttreatment compared with UL ECT, and this result was independent of electrical dosage. Similarly, at 2 months of follow-up, although high-stimulus dosage was effective in relieving depression in both UL and BL ECTs, it did not significantly influence memory impairment.[18] This is consistent with recent research that also demonstrates that BL ECT causes more marked amnesia for personal events than RUL ECT at initial follow-up, irrespective of electrical dosage.[16] Sackeim et al[22] did report more long-term effects (2 months of follow-up) of BL ECT in comparison with RUL; this was still independent of electrical dosage. Electrical dosage did have a detrimental effect on other types of retrograde memory (complex figure and story recall) immediately after assessment, but autobiographical memory remained unaffected.[22]

Furthermore, research conducted by McCall et al[26] highlighted the importance of determining the patient's seizure threshold to reduce the likelihood of deficits in autobiographical memory. They showed that the group of patients who received a fixed high dose (403 mC) recalled a smaller percentage of autobiographical items after ECT compared with those who received the titrated dose, which was at 2.25 times (mean dose, 136 mC) the initial seizure threshold.[26] However, an increase in electrical dose was also associated with an increase in the likelihood of an antidepressant effect.

The research therefore suggests that, although BL ECT is superior to RUL in terms of efficacy, a greater risk of adverse effects on autobiographical memory recall is incurred, and this risk increases with the number of treatments received.[28] Furthermore, research demonstrates that effects on autobiographical memory can be reduced by delivering an electrical dosage titrated to the patient's seizure threshold. Additionally, sine wave ECT has been shown to have a more detrimental effect on autobiographical memory compared with brief pulse ECT. When considering the long-term effects of this and of electrode placement, memory problems have been generally transient, although conflicting findings have been reported.[15,19]

Objective Versus Subjective Measures of Autobiographical Memory

When the effects of ECT on autobiographical memories were assessed by objective and subjective measures, conflicting results have emerged. Studies investigating memory deficits after ECT have generally failed to observe significant associations between subjective memory assessments and objective measures.[8,13,18,19,29] It has been suggested that this is due to subjective memory complaints being more closely related to mood state. That is, patients will report greater impairment in their memory when they feel more depressed, although this may be in contrast with objective findings.[9,30]

Recently, Ng et al[31] failed to find a relationship between memory loss reported subjectively and that assessed objectively. Subjective accounts of memory impairment were correlated with depression scores. This confirms the inconsistency between subjective and objective measures of autobiographical memory loss and suggests that self-reported memory loss is a consequence of negative self-evaluation secondary to mood disorder. Coleman et al[30] also found that reports of memory dysfunction were found to be strongly associated with severity of depressive symptoms at all times. Consequently, this raises doubts about the accuracy of the SSMQ in measuring actual memory impairment in individuals with mood disturbance. However, the study also provided evidence supporting a relationship between subjective and objective measures 2 months after ECT treatment. It was demonstrated that greater inconsistency in the recall of personal memories at follow-up relative to baseline was significantly associated with poorer scores on the SSMQ. The result, however, did not reach significance when scores were compared at 1 week posttreatment, suggesting that at least 2 months are required for individuals to establish an idea of the extent of their memory impairment.[30] This study highlights the problems associated with the effects of depression on self-ratings of memory functioning and mood.

Kho et al[14] failed to find a relationship between scores on 2 measures of subjective memory (SSMQ and the ECT Retrograde Amnesia and Perception Scale [ERAPS[14]]) and scores on the AMI. They compared 2 groups—those receiving ECT and pharmacotherapy and those receiving pharmacotherapy only. Ratings of subjective memory measures were also obtained from proxies (friends or relatives of the patient). The results showed a significant difference in proxies' scores on the ERAPS (which assesses aspects of retrograde amnesia, including loss of personal memories) between the 2 groups with and without ECT, with greater retrograde memory deficits observed in the ECT group.[14] The discrepancy between the patient and the proxy raters highlight the problem of establishing valid subjective memory tests. The assessments were conducted within the hospital, which, as the researchers suggested, would mean that patients had not yet had the opportunity to be exposed to environmental cues that required past memories to be accessed and thus would perhaps not have had time to recognize any existing impairment.[32]

Peretti et al[23] investigated the effects of ECT on autobiographical memory of past subjective experiences related to depression in melancholic patients. The findings showed a consistent trend of autobiographical memory loss of subjective experiences related to the depressive episode. Such results are in contrast with those found from objective autobiographical memory measures, where memory loss is demonstrated to be independent of the affective valence of the memory.[15] Therefore, ECT induces not only objectively assessed autobiographical memory loss as indicated by other research but also subjective autobiographical memory

complaints, although only the latter seem to be related to the state of depression. This highlights the issue that memory loss reported subjectively is not necessarily indicative of a treatment side effect but may be more a consequence of affective state.

In summary, objective measures of autobiographical memory often do not correlate with subjective accounts. This accentuates the problems associated with subjective measures and emphasizes the influence that mood has on autobiographical memory self-reports.[30,31] Subjective measures of autobiographical memory can, additionally, be influenced by the affective valence of the memory.[15,23] That is, memories associated with the patient's depressive state before treatment are more likely to be impaired by ECT. This highlights the potential effect of mood on subjective assessments of memory.

Individual Differences and Autobiographical Memory Loss

Sackeim et al[28] showed that sex was an important factor in the extent of autobiographical memory loss. Scores of female subjects on the AMI-SF showed greater deficits than those of the male subjects, which could be due to women having a lower seizure threshold than men and that electrical dosage was not adjusted in most patients in the study relative to the individual's seizure threshold. Age and premorbid IQ did not affect autobiographical memory, whereas older age and lower IQ did result in an increase in impairment in other cognitive measures.[28]

Sobin et al[33] have shown that the extent of short-term and persistent retrograde amnesia for autobiographical memories is related to both global cognitive functioning before ECT and postictal reorientation time. That is, the lower the pretreatment score on the Mini-Mental State Examination and also the longer the period of recovery, the more likely were deficits in recall of autobiographical memories.[33] Despite greater persisting amnesia for autobiographical events, patients with lower cognitive functioning at baseline or longer postictal disorientation showed greater improvement in the Mini-Mental State Examination at follow-up. This dissociation suggests that deficits occurred specifically in retrograde amnesia for personal events and not because of a change in global cognitive mental state.

DISCUSSION

The research discussed in this review illustrates the problems associated with subjective measures of autobiographical amnesia. Memory may improve as a result of improved mood,[30,31] and memories associated with affective valence are more impaired.[15,23]

The sensitivity of objective autobiographical memory measures, such as the AMI, has been questioned. This test may be insensitive to ECT-induced amnesia because of a large number of items within the assessment, focusing primarily on very old events, rather than on events occurring closer to ECT, which are more likely to be affected. Furthermore, most questions are associated with information that is well rehearsed and is therefore less likely to be impaired by ECT.[32] We therefore suggest a preferential research focus on memories that are within the temporal proximity of ECT treatment because these memories are most likely to be affected. Overlearned materials may be repeated for some individuals and not for others. Specifically, some patients may have lived at the same address for their whole life; others may have moved frequently. Thus, scoring the former on the AMI as having accurately recalled their address over different time points may give the inaccurate conclusion of little treatment-related memory impairment compared with the latter patients, who are required to remember multiple addresses.[32] Furthermore, patients may (unknown to the researcher) be consistently reporting incorrect information, again resulting in a difficulty obtaining an exact measure of their memory impairments.[15] Practice effects can, of course, confound the effects of treatment; however, they are likely to reduce any observed memory impairment. Practice effects are also likely to be confounded by the relative severity of depressive symptoms before and after treatment.

Other routine neuropsychological assessments have been suggested to be impractical in assessing retrograde amnesia.[7] Squire and Slater[8] used a timeline procedure, where individuals recalled events occurring over their life span and the "amount of life lost." The outcome of this task, however, is dependent upon the degree of memory impairment and therefore does not give an accurate account of the extent of retrograde amnesia. That is, individuals with poorer memory may actually report a shorter amount of life lost. This could perhaps be overcome by allowing the patient to talk at length about general topics and prompt at follow-up for previously mentioned past events.[34]

Another issue associated with studies of autobiographical memory loss after ECT is the lack of research considering predepression cognitive status.[20] Much of the research conducted compares assessment scores before ECT, when the patient's level of depression is at its highest, to performance after ECT, where depression is often improved. Such assessments give no indication of "normal" premorbid memory functioning before ECT, and therefore, improvements in performance on retrograde memory measures observed at follow-up could be attributed to improvement of mood. Therefore, further research needs to be conducted to obtain information about the individual's memory performance before depression onset to control for this confounding variable, although we acknowledge that this represents a formidable research challenge. A step in the right direction would be to routinely control for premorbid intellectual ability (because this is highly correlated with memory function[35] using reading-based estimates, for example, the National Adult Reading Test[36] or the Wechsler Test of Adult Reading[37]).

It is further important to assess memory at different times after ECT. Tests of autobiographical memory conducted immediately after treatment could paradoxically result in an overestimate of the patient's ability. This is because memory problems may only become apparent to the individual at a later date, once they have left hospital and are attempting to function in everyday life.[32] This indicates the value of follow-up, particularly after longer periods after ECT.

Levels of autobiographical memory loss after ECT are related to the administration of the treatment. Accordingly, to

minimize memory impairment, future ECT treatments should implement RUL rather than BL ECT where possible and should use brief pulse rather than sine wave ECT.[16,18,19,22,28] Additionally, the patient's seizure threshold needs to be established, and the level of electrical dosage applied should be relative to this to reduce the likelihood of autobiographical memory problems.[26] The number of ECT treatments given should be limited to minimize impairment,[15,28] and individual differences, such as sex, cognitive performance pre-ECT, and length of time for recover after ECT, must be taken into consideration when administering the treatment.[28,33]

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