Accelerated Long Term Forgetting in patients with focal seizures: Incidence rate and contributing factors

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Abstract

Background: Accelerated Long Term Forgetting (ALF) is usually defined as a memory impairment that is seen only at long delays (e.g., after days or weeks) and not at shorter delays (e.g., 30 min) typically used in clinical settings. Research indicates that ALF occurs in some patients with epilepsy, but the incidence rates and underlying causes have not been established. In this study, we considered these issues.
Methods: Forty-four patients with a history of focal seizures were tested at 30 min and 7 day delays for material from the Rey Auditory Verbal Learning Test (RAVLT) and Aggie Figures Test. Recently published norms from a matched group of 60 control subjects (Miller et al., 2015) were used to determine whether patients demonstrated ALF, impairment at 30 min or intact memory performance.
Results: The incidence of ALF in the epilepsy patients (18%) was N 3 times higher than normal on the RAVLT, but no different (7%) from the incidence in normal subjects on the Aggie Figures. A different, but again significantly high, proportion of patients (36%) showed shorter-term memory deficits on at least one task. ALF was found mainly in patients with temporal-lobe epilepsy, but also occurred in one patient with an extra temporal seizure focus. Presence of a hippocampal lesion was the main predicting factor of ALF.
Conclusions: Many patients with a focal seizure disorder show memory deficits after longer delays that are not evident on standard assessment. The present study explored the factors associated with this ALF memory profile. These new findings will enhance clinical practice, particularly the management of patients with memory complaints.

1. Introduction

Accelerated Long Term Forgetting (ALF) is a relatively newly de- scribed memory disorder in which a person shows good retention over a short period (e.g., up to 30 min), but then forgets at a rapid rate over the next few days or weeks [2,3]. This phenomenon has most often been reported in patients with temporal-lobe epilepsy [4,5] or transient epileptic amnesia [6,7]. Given the nature of standard memory testing, which typically involves shorter delays only, this type of longer- term memory disorder has gone largely undetected in clinical practice until recently. It is important to identify ALF, however, because it may be the first sign of a neurological problem [8] and because subjective memory complaints tend to correlate with long-term retention rather than with short-term scores [9,10]. It is not yet clear what proportion of patients with focal seizures have ALF, because research results have generally been presented for individual case studies or as an average for a group. Understanding the incidence of ALF in focal epilepsy and factors that predict its occurrence would improve clinical perspective and potentially offer new insights into longer term memory processes. Many studies of ALF have employed a learning-to-criterion technique to ensure equivalence of

encoding across subjects. Under these conditions, patients often show intact memory over the initial, 20– 30 min delay interval, but then demonstrate significant loss after days or weeks [4,9,11]. That is, as a group, their mean scores are indicative of ALF. This finding of relatively good memory at shorter delays, however, seems at odds with numerous previous reports of memory difficulties at these same, short delays in patients with temporal-lobe epilepsy [12–14], in particular when the hippocampus has been re- moved or is sclerotic [15–17]. It may be that this inconsistency in memory findings at 20–30 min delays is related to differences in learning condition (i.e., learned-to-criterion conditions of the more recent ALF studies versus limited exposure during learning in most of the earlier re- ports). We found support for this proposal when we compared these two learning conditions for stories; ALF was more evident when epilepsy patients had learned the material to criterion than when they heard the stories only once [18]. For the present study, we chose to use standardized memory measures that involve multiple (5) presentations during learning. Recall was then tested at 30 min and 7 day delays. A recent review paper [19] identified several clinical factors associated with ALF. Interictal discharges are common in patients with ALF, though there is less evidence that seizures during the delay interval [9,20], side of epileptic focus [21–25] or underlying etiology [19] are influential. Site of brain abnormality is probably also important. Most patients identified as showing ALF have had abnormalities in the temporal lobe, though a few recent studies have indicated that patients with an extra temporal focus (i.e., one outside the temporal lobe) can also demonstrate ALF [18,26,27].

It was also noted that patients who present with complaints consistent with ALF and are found to have an epileptic condition (usually TEA) tend to be middle aged or older [19]. It will be interesting to determine whether patients with focal seizures who show ALF are older than those without ALF and/or whether they had a later age of seizure onset.

Because patients with epilepsy can be treated with a number of different antiepileptic drugs (AEDs) alone or in combination, researchers have generally been able to consider only whether the number of AEDs predicts ALF and this has not been found to be the case [9,20,26]. Whether any particular medications are more likely than others to cause ALF has yet to be determined.

Structural hippocampal abnormality has been linked both with deficient memory at short delays (20–30 min) [15,21,22] and with memory decay over 24 h [11,18]. After intervals of days or weeks, however, impairments in memory have not been found to be limited to patients with hippocampal lesions [10,18,26,28,29]. A comparison of the impact of a hippocampal lesion at short vs long term retention intervals will help elucidate its contribution to memory over time.

Given that memory for different types of material decays at different rates [7,30,31], incidence of ALF might also be affected by the type of to- be-remembered material. Although most previous studies have detected steeper long-term forgetting rates in people with focal seizures compared to control subjects for both visual and verbal materials [19], visual and verbal tasks have often not been well-matched. With this in mind, the present investigation used 15-item lists consisting of verbal (words) and nonverbal (abstract drawings) material learned and recalled under similar conditions. Earlier work indicated that healthy subjects learn a similar number of items from the two lists [32] and subsequently show similar recall scores for words and drawings at 30 min and 7 day delays [1]. We will now discover whether patients with focal seizures show similar forgetting rates for the two types of material. By investigating memory task performance at short and long delays, we will determine what proportion of patients with focal seizures show ALF. The associated clinical and demographic characteristics will also be identified.

2. Methods

2.1. Ethics and consent

This study was approved by Royal Prince Alfred Hospital's Human Research Ethics Committee. All participants provided written informed consent.

2.2. Participants

2.2.1. Patients

Potential patients were approached to participate if they met the following inclusion criteria: (1) they were identified by A.N. (Clinical Neurologist) as having a focal seizure disorder on the basis of a full clinical work-up (i.e., EEG, neuroimaging, clinical history); (2) they spoke English; and (3) they had no neurological or psychiatric history other than epilepsy. After testing, any subjects with an estimated Full Scale IQ below the average range (i.e., b 80) were excluded.

Based on clinical interview, age of epilepsy onset, time since onset and frequency of seizures were established. Number and types of AEDs were also recorded. Fifty-one patients were tested initially but 6 failed to complete the testing after a 7-day delay. One additional subject was excluded because her estimated Full Scale IQ fell below 80. Twenty- two male and 22 female participants comprised the final group of 44. A.N. (blind to the neuropsychological results) determined the side and site of epileptic focus as well as the presence of a hippocampal lesion (n = 17).

One patient who had evidence of both left- and right-sided abnormalities was excluded from analyses comparing effects of lesion side. Three patients with temporal plus extra temporal abnormalities were not included in the analyses comparing effects of lesion site.

2.2.2. Normal control (NC) subjects

The group of 60 subjects (without neurological or psychiatric history) from our normative study served as a comparison group [1].

2.3. Neuropsychological test materials

2.3.1. Rey Auditory Verbal Learning Test (RAVLT) [33]

A 15-item word list (List A) is presented over 5 learning trials. In each trial, the list is read aloud to the subject and they are asked to recall as many words as possible. A distractor list of 15 new items (List B) is then read by the examiner and recalled by the subject in a similar fashion (but only once), and an unprompted ("immediate") recall of List A follows. Thirty minutes later, the delayed recall of List A is requested. For this study, subjects were also called 7 days later (without warning) and long term recall of List A was collected over the telephone. The number of words remembered after 30 min served as the 30 min Recall Score and the Percent Change Score was calculated as: [(number recalled at 30 min − number recalled at 7 days) / recall at 30 min] × 100.

2.3.2. Aggie Figures [32].

This test of memory for a set of 15 abstract line-drawings was created to be a visual analogue of the RAVLT and is presented in a similar fashion. Each line-drawing of List A is shown to the subject for a few seconds, one after another, using a ring-bound booklet. After seeing all 15 items, subjects are provided with a blank sheet of paper and asked to draw as many as possible. This is repeated for 5 learning trials, and then a distractor list (List B) of 15 new drawings is presented and recalled. Immediate and 30 min delayed recall of List A follows. At the time of the phone call seven days later, subjects were instructed to draw again all the figures they could remember and then post back the sheet. Subjects had not been forewarned that their recall would be retested. The number of figures remembered after 30 min served as the 30 min Recall Score and the Percent Change Score was calculated as: [(number recalled at 30 min − number recalled at 7 days) / recall at 30 min] × 100.

2.3.3. Test of Premorbid Functioning (TOPF) [34]

The TOPF is a measure of reading pronunciation ability for words that have irregular grapheme-to-phoneme translation. The number correct is converted to an estimate of Full Scale Intelligence Quotient (FSIQ) on the Wechsler Adult Intelligence Scale IV using age-adjusted norms.

2.3.4. Depression Anxiety Stress Scale (DASS-21) [35]

This is a 21-item self-report questionnaire measuring symptom frequency in the last week with regard to depression, anxiety and stress. Upon completion, scores are doubled to match the original 42-item version on which the norms are based. Only the score for the depression symptoms items (DASS-D) was used in this study. A score of 10 or higher suggests at least mild depression.

2.4. Procedure

Each patient was tested individually in the Neuropsychology Unit of Royal Prince Alfred Hospital. The four measures described above were administered in the context of a more complete neuropsychological assessment. Each 30 min delay interval was filled with other tests. One week later, subjects were contacted by telephone for the final delayed recalls of the RAVLT and Aggie Figures.

2.5. Statistical analyses

Contingency tables were used to compare groups in the proportion of memory profiles. Fisher exact tests were used to test significance because some of the expected cell sizes were b 5. Only results with p b .05 are reported as significant.

3. Results

3.1. Demographic and clinical characteristics of the groups

Patients did not differ on demographic or clinical variables when di- vided by either side or site of epileptic focus (see Table 1). With regard to seizure frequency, a little over half (55%) of the patients had active epilepsy (i.e., N 1 seizure per year). NC subjects did not differ from the patient group in sex distribution (29 male, 31 female), mean age (40.7, SD = 13.4) or mean estimated premorbid IQ score (105.2, SD = 10.9).

3.2. Incidence of memory deficits

Based on norms in Miller et al. [1], we divided the patients into three groups: 1) NORMAL MEMORY — those with memory scores within nor- mal limits at both the 30 min and 7 day delays (i.e., both 30 min Recall and Percent Change scores fell within 1.64 SD of the normal mean); 2) DEFICIT BY 30 MIN — those with a 30 min Recall score falling more than 1.64 SD below the normal mean; 3) ALF — those with a normal 30 min Recall score (i.e., within 1.64 SD of the normal mean), but a Per- cent Change in their memory 7 days later more than 1.64 SD above the normal mean (i.e., significantly greater than normal percentage lost).

The incidence rates for patients divided in this way are presented in Fig. 1. First, it is clear that with these fairly conservative cut-off scores (1.64 SD = less than the 5th percentile), many patients performed within normal limits (22/44 on RAVLT; 31/44 on Aggie Figures). Second, Task seemed to affect the incidence rate of a memory deficit; patients were more likely to show normal memory for the Aggie figures than the RAVLT word list, but this was not significant (two-tailed test, p =.08). When delayed memory performance on the two tasks was com- pared, patients showed

slightly higher rates of impairment on the words versus the figures by 30 min (14/44 vs 10/44) and in terms of ALF (8/44 vs 3/44), but neither of these differences reached significance.

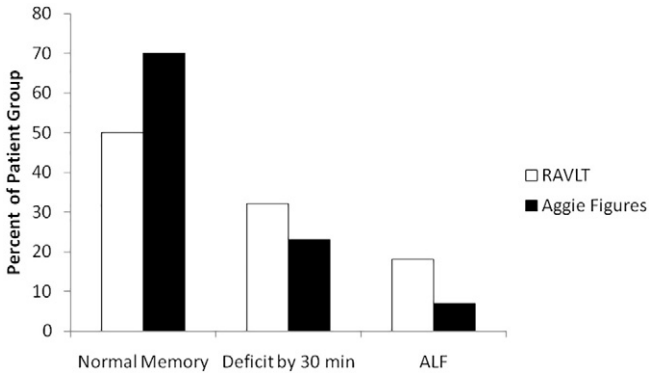

Fig. 1. Proportion of epilepsy patients falling into different memory groups.

The incidence of ALF for the patients differed from the incidence rate in the NC group only for the word list (one-tailed test, p b .05). In the NC group, 3/60 (5%) showed ALF on the words and 4/60 (7%) showed it for the figures. When the incidence of a deficit by 30 min on each task (middle bars of Fig. 1) was compared to the performance of the NC group, this was found to be significantly higher for the patient group for the RAVLT (one-tailed test, p b .01), but not on the Aggie Figures.

The proportion of subjects who showed ALF on either task was nearly double for the patients compared to the control group (10/44 [23%] vs 7/60 [12%], respectively), however this difference was not significant. Only one patient showed ALF on both tasks. There was a more marked difference between patients and NCs in the incidence of a memory deficit by 30 min on either task (16/44 [36%] vs 10/60 [17%], respectively) (one tailed test, p b .05).

When we divided patients into those with active (N 1 seizure per year) versus inactive (≤ 1 seizure per year) epilepsy, we found no significant differences in the proportion who showed memory deficits at either delay. Most of the patients with ALF had active epilepsy (7/10 [70%]), but this did not differ significantly from the proportion with active epilepsy who did not show ALF (17/34 [50%]).

3.3. Effect of hippocampal lesion

A higher proportion of patients with a hippocampal lesion showed memory deficits at both short and long delays, though this difference was more evident for ALF than for early memory deficits (Fig. 2). Of the individual comparisons (the two groups compared at each delay and on each task), only the comparison for ALF on Aggie Figures reached significance (one-tailed test, p b .05). There were not enough patients with hippocampal lesions to subdivide the group by side for analyses, but we noted that there were similar numbers with left- and right-sided hippocampal abnormalities showing ALF on both tasks.

Table 1
Characteristics of the patients divided by side and site of epileptic focus.[a]

Demographic or clinical variable	Side of epileptic focus		Site of epileptic focus	
	Left	Right	Temporal	Extra temporal
Sex: male/female (n)	12/10	10/11	13/14	9/5
Epilepsy condition: active/inactive (n)	13/9	10/11	15/12	6/8
Age Mean (SD)	42.5 (12.4)	42.7 (12.4)	43.9 (11.1)	42.0 (14.9)
Estimated IQ Mean (SD)	100.5 (13.1)	103.0 (14.0)	101.3 (9.5)	103.5 (18.0)
Age of epil onset (yrs) Mean (SD)	24.7 (13.6)	25.6 (10.8)	24.0 (12.9)	26.4 (12.2)
Time since onset (yrs.) Mean (SD)	17.8 (15.9)	17.0 (13.5)	19.9 (16.0)	15.6 (12.6)
Seizure frequency[b] Mean (SD)	20.5 (33.5)	54.7 (115.4)	29.3 (72.1)	35.1 (100.1)
Number of AEDs Mean (SD)	2.0 (1.0)	1.8 (.8)	1.9 (1.0)	1.8 (.9)

No significant differences were found between left and right or between temporal and extra temporal groups.
[a] Those with evidence of bilateral (n = 1) or temporal plus extra-temporal foci (n = 3) are not included in the statistics achieved when patients were divided by side and site, respectively.
[b] Frequency per year.

As can be seen in Fig. 3, if we consider whether deficits occurred on either task, then significant differences related to the presence of a hippocampal lesion were evident for both ALF and 30 min recall. Of the patients with a hippocampal lesion, 7/17 (41%) had ALF on at least one of the two measures, whereas only 3/27 (11%) patients without a hippocampal lesion showed ALF (two-tailed test, p b .05). The proportion of patients with a hippocampal lesion showing ALF was also significantly higher than the proportion of NC subjects showing ALF (two-tailed test, p b .05), but the proportion of patients without hippocampal lesions who showed ALF did not differ from the proportion of NCs with ALF (7/60 [12%]). With respect to differences in the proportion showing a deficit at 30 min, the comparison between patient groups (i.e., with and without hippocampal lesions) was not significant. There was a significant difference between NCs (10/60 [17%]) and patients with a hippocampal lesion (7/17 [41%]) in the proportion who showed a deficit on at least one task by 30 min (one-tailed test, p b .05). A similar comparison between NCs and patients without hippocampal lesions (9/27 [33%]) in incidence of deficits by 30 min recall did not reach significance.

3.4. Side and site of focus effects

With respect to frequency distributions, there were no significant differences when site and side of epileptic focus were considered (Table 2).

3.5. The impact of other clinical and demographic factors on ALF

T tests were used to compare patients with- to those without-ALF on a number of clinical and demographic measures (Table 3). No significant group differences were found, though mean age of onset was nearly 10 years higher in those with ALF and showed a medium effect size. This suggested that with a few more subjects, this difference would probably reach significance. With respect to AEDs, the two groups did not differ in the mean number taken. The 10 patients with ALF were taking a number of different medications, but the most common one was Lamotrigine (7 were taking this). The proportion of patients with ALF who were taking Lamotrigine (7/10 [70%]) was significantly higher than the proportion without ALF who were taking Lamotrigine (10/34 [29%]) (two-tailed test, p b .05). However, it is important to note that there were a high proportion of patients on Lamotrigine who did not show ALF (10/17 [59%]).

4. Discussion

This is one of the first studies to examine incidence rate of ALF in patients with focal epilepsy and to consider its underlying predicting factors. We applied recently established norms [1] to investigate this memory phenomenon for both visual and verbal materials.

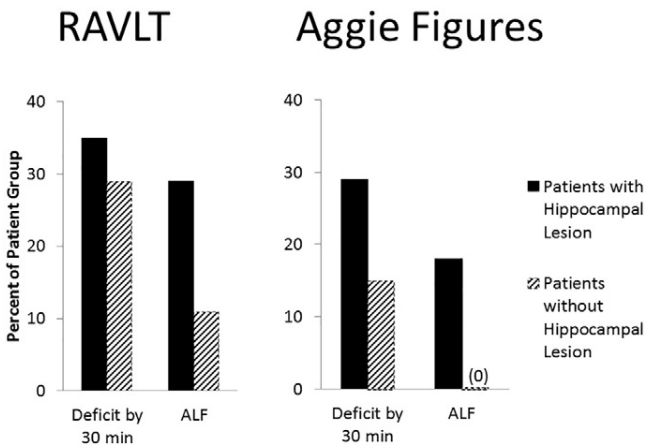

Fig. 2. Effect of a hippocampal lesion on individual task performance

We found that 23% of the patients with a history of focal seizures showed normal memory initially, but significant loss over a 7-day interval (ALF) on at least one of the two tasks compared to only 12% of controls. ALF was seen most often in patients with temporal-lobe epilepsy (33%), though it also occurred in 7% of patients with an extra temporal focus. Patients with hippocampal lesions were more likely to show ALF (41%) than those with no structural hippocampal abnormalities (11%). Consistent with earlier reports, memory deficits at the 30 min delay were also commonly found in patients with focal epilepsy (36% with a deficit on at least one of the two measures).

Although ALF was seen in some temporal lobe patients without hippocampal lesions and even in one patient with extra temporal epilepsy, our results indicated that ALF is most commonly present in patients with temporal-lobe epilepsy involving the hippocampus. This is consis- tent with the fact that most of the literature on ALF has focused on pa- tients with temporal-lobe epilepsy [19]. Because we collected data only at 30 min and 7 day delays, it was not possible to determine the pattern of decay within that week-long period, but previous work indi- cates that ALF as a consequence of a hippocampal lesion is most evident within 24 h [11,26]. The presence of a hippocampal lesion was also as- sociated with memory deficits at 30 min. Whether hippocampal lesions differ in extent or location in the group with memory impairments in the early stages (i.e., by 30 min) versus the group with ALF has yet to be determined.

Few other clinical or demographic factors were found to influence the incidence rate of ALF. Consistent with previous findings [9,20,26, 36], the number of anticonvulsant medications was not found to be re- lated to ALF. In our sample, a high proportion of the patients with ALF were found to be taking Lamotrigine, however, it must be acknowl- edged that this is a popularly used AED and many patients on Lamotrigine did not show ALF. Like others [22], we found no relation- ship between side of epileptic focus and the presence of ALF. In spite of a prediction raised in the introduction, there was no evidence of a re- lationship between the presence of ALF and a patient's current age, however, there was a trend to suggest that patients with ALF had a later age of epilepsy onset, which is consistent with some previous observa- tions [19]. As we did not assess whether patients experienced seizures within the 7-day delay period, we were unable to examine whether sei- zure activity during the delay period may have contributed to ALF. How- ever, we found no difference in yearly seizure frequency between patients with and without ALF.

Table 2
Percentage of patients who fell into each category, divided by side and site of seizure focus.

Category	Side		Site	
	Left	Right	Temporal	Extra temporal
Percent impaired at 30 min on RAVLT	41	19	37	29
Percent impaired at 30 min on Aggie Figures	18	29	26	21
Percent impaired at 30 min on either task	41	29	41	36
Percent with ALF on RAVLT	18	19	26	7
Percent with ALF on Aggie Figures	9	10	11	7
Percent showing ALF on either task	27	19	33	7

Table 3
Comparing patients with (n = 10) and without (n = 34) ALF on clinical, demographic and neuropsychological measures.

Variable	With ALF Mean (SD)	Without ALF Mean (SD)	T test result (with Cohen's d)
Age	48.1 (8.9)	41.2 (12.7)	$t = -1.6$, $p = .12$; $d = .63$
Estimated IQ	102.1 (9.0)	101.0 (14.5)	$t = -.10$, $p = .98$; $d = .06$
Age of onset	31.2 (16.5)	23.0 (10.1)	$t = -1.9$, $p = .06$; $d = .60$
Time since onset	16.9 (17.9)	18.2 (14.0)	$t = .24$, $p = .81$; $d = .08$
Number of AEDs	2.1 (1.2)	1.8 (.8)	$t = -1.0$, $p = .32$; $d = .29$
Seizure frequency (per year)	48.7 (112.9)	32.5 (73.4)	$t = .53$, $p = .60$; $d = .17$
DASS depression	12.6 (8.5)	8.1 (7.8)	$t = -1.6$, $p = .12$; $d = .55$

Rates of ALF differed on our two tasks (18% for RAVLT, 7% for Aggie Figures) and the percentage of patients showing ALF was significantly higher only for words. Similarly, Narayanan and colleagues [30] found ALF for verbal material (RAVLT) and not visual material (Rey Complex Figure) when mean memory scores for a group of patients with temporal-lobe epilepsy were contrasted to those of a NC group. There would seem to be a few possible reasons for these types of results. Word-list memory has been found to be more susceptible to disruption by focal epileptic discharges than memory for abstract drawings over a four day period [19]. Also, Davies et al. [37] linked impairments in word retrieval to hippocampal damage. Either of these clinical factors might have resulted in poorer long term retrieval of the RAVLT word list com- pared to the Aggie Figures. In addition, it is known that factors such as novelty, modality (verbal versus nonverbal) and style of presentation (seen vs heard) can affect learning and short term retention [38]. Whether all of these are important in determining longer term memory remains to be explored, but it was clear that task material affects the chances of ALF being demonstrated by patients with focal epilepsy.

The importance of considering the degree of early learning in studies of ALF was pointed out by Elliott et al. [39] as well as Butler and Zeman [40]. Indeed, it seems reasonable to propose that a task with a higher initial learning score (in this case, the RAVLT) is more likely to reveal a significant drop in memory than a task with a lower initial learning score. Arguing against this proposal, however, was the finding that per- cent retention between 30 min and 7 days was the same for NC subjects on the 2 tasks, irrespective of the 2-point difference in their learning by the 5th trial. Also, if anything, by 30 min delay, patients were scoring slightly higher on the Aggie Figures than the RAVLT, so when their ALF score is considered, according to this proposal, there should be more chance of showing ALF for the Aggie Figures. Hence, degree of initial learning does not seem to be the factor predicting which task will reveal ALF.

In contrast to the present results, Bell et al., [14,41] found no evidence of ALF for verbal material in patients with temporal-lobe epilepsy using similar stimuli and learning conditions to the ones employed here. Instead, Bell [14] found a high incidence of memory impairment (more than − 1 SD from the normal mean) in the patients at short delays. There are several possible differences that might explain the contrasting results. First, the percentage of patients in the Bell studies with active epilepsy (44%) was lower than that in ours. As it has previously been established that epileptiform activity is associated with ALF [9,19], the higher proportion of patients with active epilepsy in our sample might have resulted in higher levels of ALF. Consistent with this, we found that patients with ALF in our study tended to have active epilepsy. Second, it is possible that a smaller percentage of the patients in Bell's studies had significant hippocampal lesions. A substantial percentage of their patients (26%) had not had an MRI and although there was a significant difference between the scanned patients and the control group in mean hippocampal volume, patients were not classified as having (or not having) a significant hippocampal abnormality. We might have had a higher proportion of patients with significant hippocampal lesions in our sample to explain the higher level of ALF. Third, Bell and colleagues use a generous definition of "impairment" (i.e., more than −1 SD from the normal mean). With this definition, a much higher percentage of the epilepsy patients are found to be im- paired at 30 min and therefore will fail to meet the criteria for ALF. Using a cut-off at the 5th percentile (more than 1.64 SD from normal) we ensured that only patients who did quite poorly were classified as having an early or late memory deficit. Fourth, subtle differences in the material, learning paradigms or long-term delays might explain the different rates of ALF. Further investigation of these intriguing differences in rates of ALF could be used to elucidate long term memory processes.

In this study, we defined ALF as a deficit that showed up only after a 7-day delay. This was so that we could determine how many patients show only longer-term memory deficits, which would have been missed in standard clinical practice. In fact, when we broadened the definition of ALF to look for patients who showed excessively steep de- clines in memory from the 30 min to 7 day delays, irrespective of whether they showed a deficit at the standard delay interval, we found that ALF was almost twice as likely to be identified. Most patients who showed a deficit at the standard (30 min) delay also showed a significantly steep decline between 30 min and 7 days.

Overall, it is important to note that a patient with ALF on one task does not necessarily demonstrate it on others. In this study, only one patient showed ALF on both types of material. Further investigation of the impact of type of to-be-remembered material and other methodological factors is needed, as the current study employed only two measures of ALF. Conclusions from this study are also limited to those with partial epilepsy, as those with primary generalized epilepsy were excluded.

There seems to be an emerging consensus that consideration of ALF is an important part of the clinical profile of patients with epilepsy. Memory performance at very long delays correlates better with subjective complaints than memory performance at standard delays [9,10] and ALF may be the first presentation of a neurological problem [8]. The likelihood of finding ALF will be influenced by many factors, including the number of tasks used to detect it, definition of "impairment", type of to-be-remembered material and characteristics of the patient sample (e.g., especially proportion with hippocampal damage and pro- portion with active epilepsy). The results from the present study indicate that testing memory for a word list after a one-week interval is particularly useful in detecting ALF in patients with focal epilepsy.

Conflict of Interest

LAM has received funding from UCB Pharma in the form of an educational grant to run memory training programs and honoraria from this company to speak at neurological conferences. AN has received research funding from UCB Pharma and honoraria from EISAI and SciGen. There are no other conflicts of interest.

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