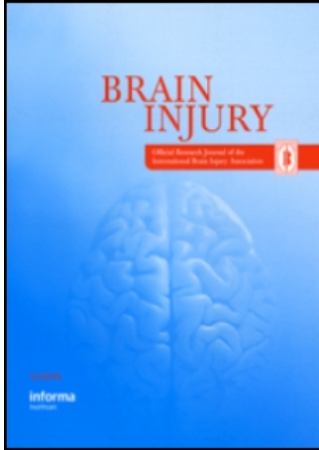


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Positive mood and sleep disturbance in acquired mania following temporal lobe damage

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CASE STUDY

Positive mood and sleep disturbance in acquired mania following temporal lobe damage

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Abstract

Primary objective: To determine the mood profile and sleep functioning of a patient with left anterior temporal region damage characterized by post-operative symptoms of mania.

Methods and procedures: In a structured clinical assessment, the patient's mood status, psychiatric diagnosis and sleep functioning—sleep onset latency, total sleep time, wake after sleep onset—were assessed. The sleep–wake cycle and daily mood was measured for 11 consecutive days.

Results: The patient met diagnostic criteria for bipolar disorder (excluding the requirement that the disturbance must not be due to a medical disorder) and delayed sleep-phase syndrome. Across 11 days, the patient exhibited elevated positive, but not negative, mood. Correlational analyses indicated a possible association between mood and sleep disturbance.

Conclusions: This pattern of findings implicates the temporal lobe in positive mood regulation and sleep-related impairments.

Keywords: *Mania, positive mood, sleep, temporal lobe, delayed phase*

Introduction

Following Papez [1], abnormalities in temporal lobe functioning have been linked to difficulties processing [2] and regulating [3] emotion in both human and non-human research [4, 5]. The temporal lobe and underlying amygdala are thought to direct attention to salient aspects of the emotional environment. Of recent interest has been the association of the temporal lobe to psychiatric disorders. Specifically, temporal lobe structures have been implicated in the pathophysiology of mania [6], i.e. bipolar disorder, a psychiatric disorder which involves difficulties in emotion regulation [7]. Bipolar disorder has been associated with significant reductions in the volume of temporal lobe structures (i.e. amygdala) manifested early in the course of the illness. Lesion studies, furthermore, suggest that right [5, 8–11], left [12] and bilateral [3] temporal lobe insults are associated with acquired symptoms of mania, involving elevated mood, grandiosity and

distractibility [8, 9, 13] as well as rapid-cycling between mania and depression [12].

Emotion regulation difficulty in patients diagnosed with bipolar disorder has also been highly linked to sleep disturbance [14]. Indeed, alteration in sleep pattern is the most common prodrome of mania, reported by 77% of patients with bipolar disorder [15]. Experimentally-induced sleep deprivation has also been linked to the onset of manic symptoms [16]. Few studies to date have examined the neurobiological basis of mania and its relation to mood and sleep disturbance despite the increasing interest in the association between sleep and mood [17, 18].

Primary objectives

The three aims were to examine (1) mood disturbance, (2) sleep patterns and (3) associations between mood and sleep in a patient with

postoperative symptoms of mania following left anterior temporal lobe damage.

Methods and procedures

The patient was a 55-year old woman examined for a 3-year history of manic symptoms following an intra-cerebral hemorrhage in her left anterior temporal lobe. At that time, she was admitted to intensive care following a sudden acute onset of headache, nausea, fainting, incontinence and vomiting. The CT scan identified a 41×22 mm intra-parenchymal hemorrhage in the left anterior temporal lobe with associated subarachnoid

hemorrhage and surrounding oedema, requiring emergent evacuation with a left temporal craniotomy. An MRI scan obtained ~ 1 year and 5 months after the surgery revealed extensive encephalomalacia in the anterior 3 cm of the left anterior temporal lobe extending into the amygdala, with dilatation of the left anterior temporal horn (Figure 1). Electroencephalography (EEG) was also obtained by her physician during an episode of increased mania and was normal with no evidence of seizure activity. No history of seizures pre- or post-operatively were reported.

Three years post-surgery, the patient continued to exhibit some mild difficulty in word-finding, distractibility and reported difficulty encoding

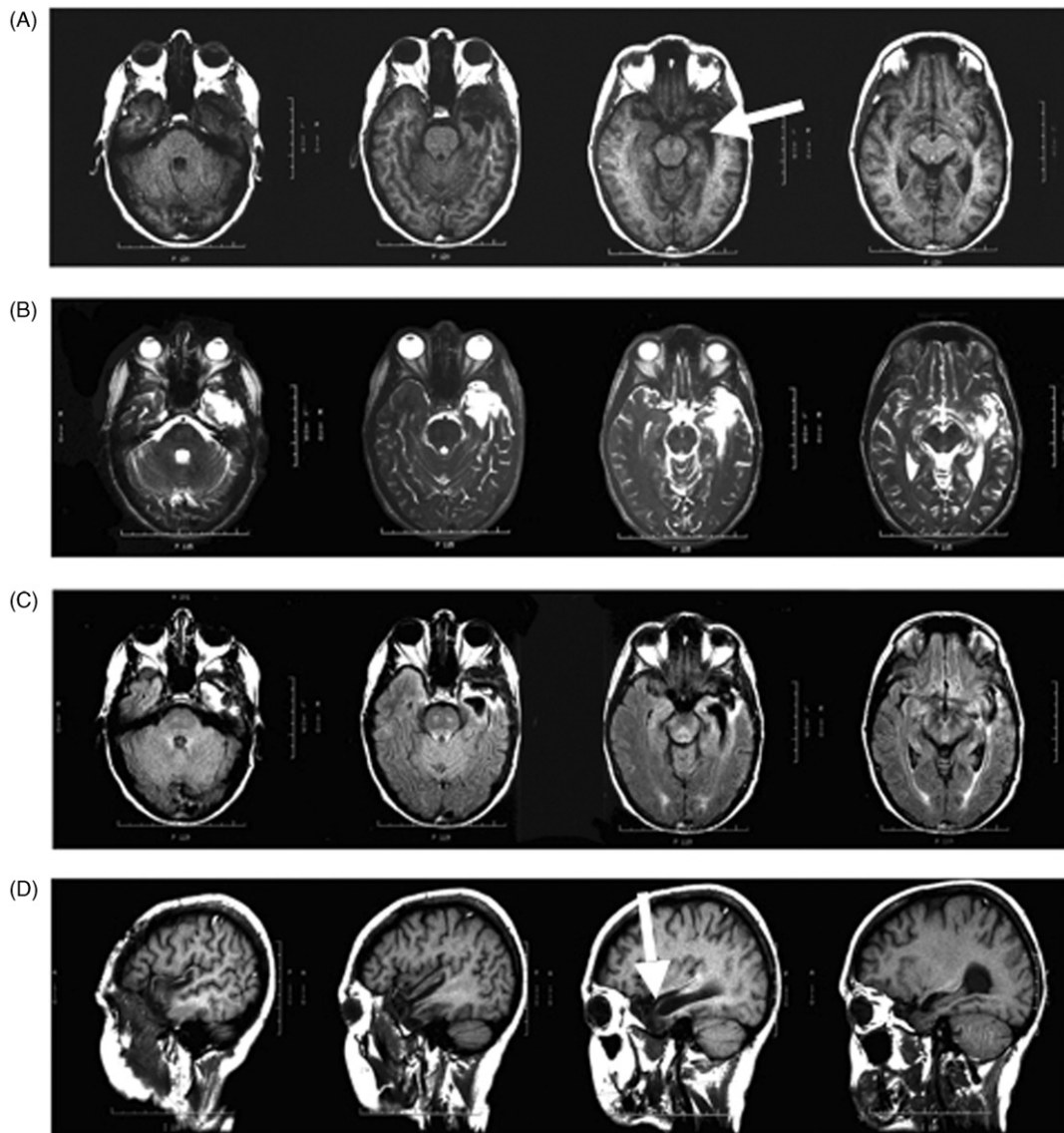


Figure 1. The patient has selective damage of the left anterior temporal lobe including the temporal pole and underlying amygdala. (A) T_1 -weighted, (B) T_2 -weighted, (C) FLAIR axial and (D) sagittal images show left the anterior temporal region. Arrows point to the lesion on the T_1 and axial and sagittal images.

auditory input in noisy settings. Her most notable post-operative change, however, is a persistently elevated, 'over-excited' mood, rapid speech and emotional lability, consistent with the clinical profile of mania. The patient reported taking 37.5 mg of venlafaxine, 25 mg of quetiapin, and an unspecified dosage of paroxetine in the past to stabilize her mood. No additional neuroleptics were attempted. The patient did not report any pre-operative psychiatric history. Her primary care physician for 20 years confirms no pre-surgical psychiatric disturbance and specifically no symptoms of mania.

Clinical assessment

The mood module of the Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR) [19] was employed to assess for the presence of bipolar disorder. Current symptom measures taken included the Altman Self-Rating Mania Index (ASRM) [20] and the Beck Depression Inventory (BDI) [21], as an index of self-reported symptoms of mania and depression, respectively. Clinician-rated current symptoms of mania and depression were measured using the Young Mania Rating Scale (YMRS) [22] and the Hamilton Rating Scale for depression (HAM-D) [23], respectively. An unpublished structured clinical interview, the Insomnia Diagnostic Interview (IDI; Harvey et al. 2003), was administered to identify the presence of insomnia. The IDI is comprised of five sections that carefully assess for the presence of each of the DSM-IV-TR [2] criteria for primary insomnia. The short form of the Positive and Negative Affect Scale (PANAS) [24] was used to assess baseline mood. The short form of the PANAS includes two 5-item scales, one that assesses positive affect (PA) and one assessing negative affect (NA). Finally, a sleep questionnaire battery was administered that the participant completed which included the Pittsburgh Sleep Quality Index [25], Dysfunctional Beliefs and Attitudes about Sleep (DBAS) [26] Questionnaire, the Sleep Disturbance Questionnaire (SDQ) [27] and the Morningness–Eveningness Questionnaire [28].

Mood assessment

Daytime positive and negative mood were also measured across the 11 consecutive days using an experience-sampling methodology (EMA) [29] by which the Actigraph watch beeped six times per day at quasi-random 2-hour intervals between the hours of 8:30 am and 9:30 pm. Immediately following the beep, the patient completed the current time and the short form of the PANAS.

Sleep assessment

For the next 11 consecutive days, both subjective and objective estimates of the patient's sleep–wake cycle were logged. Subjective estimates of the sleep–wake cycle included a sleep diary completed immediately upon waking which recorded the time the patient went to bed, how long it took her to fall asleep (SOL; sleep onset latency), the amount of time she was awake during the night (WASO; wake after sleep onset), the amount of sleep obtained in total (TST; total sleep time) as well as the time she woke up and the time she got out of bed. The patient also completed a pre-sleep diary each night before going to sleep which included the Pre-Sleep Arousal Scale (PSAS) [30] as a measure of cognitive and arousal level, the Stanford Sleepiness Scale (SSS) [31] as a measure of daytime sleepiness and the Fatigue Scale [32] as an index of state fatigue. The objective estimate of the sleep–wake cycle was measured using a Mini-Mitter AW64 Actigraph, a small wristwatch device that records continuously and is worn on the non-dominant wrist. The Actigraph contains a miniature piezoelectric acceleration sensor that detects and stores information about physical motion in 1-minute intervals which is then downloaded into a software program to generate an objective estimate of the sleep–wake cycle (i.e. SOL, WASO, TST). The high sensitivity algorithm of the Mini-Mitter AW64 produces reliable sleep estimates comparable to polysomnography [33].

Main outcomes and results

Clinical assessment

On the SCID [19], the patient met DSM-IV-TR diagnostic criteria for bipolar disorder, type I, excluding criterion E which states that the disorder must not be due to the direct effects of a medical disorder. The patient reported a persistently elevated mood, excessive talkativeness (often 'starting up conversations with complete strangers'), flight of ideas, heightened distractibility interfering with her ability to 'stay on track' during daily routines, hyper motor activity (feeling 'too hyped' and 'running around all the time') and increases in goal-directed behaviour. While meeting DSM-IV-TR criteria for a manic episode, the patient did not report other common features of mania, including grandiosity, irritability or decreased need for sleep. Endorsed symptoms of mania emerged post-operatively, were chronic and exhibited no period of remission. The symptoms caused significant functional impairment, as the patient was not able to sustain work at her previous employment. When assessing for evidence

of a depressed mood, she did not report any past or present depressed mood. On current measures of mania symptoms, the patient reported a score of 17 on the ASRM and 16 on the YMRS, indicative of clinically significant levels of current mania symptoms (i.e. ASRM ≥ 14 ; YMRS > 7) [20, 21]. The patient did not exhibit clinically significant levels of depression symptoms, scoring 16 on the BDI (cut-off ≥ 20) [34] and 0 (cut-off ≥ 7) on the HAM-D [23].

Mood assessment

From the initial questionnaire packet, the patient's reported trait PA was almost 2 standard deviations above individuals her sex and age [24]. Her trait NA, by contrast, closely approximated average age- and sex-matched norms.

The patient's response rate in completing the PANAS mood measures following the Actigraph watch beep six times per day across 11 days was 86.4%. Daytime PA and NA were each averaged across the six beeps to create three epochs per day, which will be referred to as the 'PA (or NA) morning', 'PA (or NA) daytime' and 'PA (or NA) evening'. This study also averaged PA and NA across the entire day, referred to as 'PA (or NA) across day'. Averaged values for PA and NA across day, morning, daytime and evening were comparable with age and sex-matched norms [24]. The patient's own level of reported PA across day, however, was significantly higher than her own reported NA across day, $t(55) = 9.13$, $p < 0.001$ (see Table I).

Sleep assessment

Subjective and objective sleep estimates are presented in Table II. Additional self-reported sleep-wake cycle characteristics obtained during the clinical assessment are presented in Table III.

On the IDI, the patient did not meet diagnostic criteria for primary insomnia. As evident in Table III, the patient fell within the cut-offs for 'normal sleep' according to Lichstein et al.'s [35] quantitative criteria for insomnia (i.e. SOL ≥ 31 min; occurring ≥ 3 nights a week; for ≥ 6 months). This was true for both objective (Actigraph) and subjective (sleep diary) sleep estimates recorded across 11 days. Her scores on both the SSS (> 3 cut-off for significant levels of sleepiness) [29] and the Fatigue scale indicated only a moderate degree of sleepiness and fatigue prior to bedtime. On the PSQI, the patient's total score was below the > 5 cut-off score for clinical significance of sleep disturbance [25]. The patient's score on the PSAS was also comparable to normal sleepers [28].

Table I. Positive and negative mood across 11 days.

	Positive affect; <i>M</i> (SD)	Negative affect; <i>M</i> (SD)
Across day	16.20 (4.46)	7.72 (2.05)
Morning	13.50 (5.59)	8.60 (3.67)
Daytime	17.80 (5.97)	7.00 (1.86)
Evening	16.60 (4.67)	7.50 (2.99)

Table II. Sleep estimates across 11 days.

Characteristic	Subjective estimate*	Objective estimate**
SOL (minutes)	17.28 (15.51)	24.50 (20.75)
WASO (minutes)	4.10 (9.28)	37.30 (11.60)
TST (minutes)	474.40 (83.40)	424.80 (67.68)
Time of sleep onset	1:20 am (41.11 min)	1:36 am (49.42 min)
Time of waking	9:51 am (52.92 min)	9:32 am (59.57 min)

SOL = Sleep onset latency; WASO = Wake after sleep onset; TSO = Total sleep time. * = obtained from self-report in diary. ** = obtained from Actigraph.

The patient did, however, meet criteria for delayed sleep-phase syndrome [36], defined as a condition by which the hour at which sleep normally occurs is moved back in time within a 24-hour sleep-wake cycle. Confirming this diagnosis, the patient scored in the 'evening type' range on the Morningness-Eveningness Questionnaire, indicating she tends to be most active late in the evening using both the original [28] scoring system and the newer scoring system that takes age into account [37].

The patient's score on the DBAS [26] was also high on sub-scales for dysfunctional beliefs about sleep promoting practices and causal attributions of insomnia. For example, the patient scored significantly higher than both patients with insomnia and non-neurologically acquired bipolar disorder [14]. The highest sub-scale score on the SDQ [27] was obtained on the mental anxiety sub-scale.

Mood and sleep associations

For the sleep estimates, subjective and objective estimates were calculated for TST, SOL and WASO. A series of two-tailed Pearson's correlations were conducted between daytime mood epochs and sleep the following night as well as between sleep and mood the following day. Correlations revealed a significant association between subjective estimates of sleep onset latency for PA morning ($r = 0.72$, $p < 0.05$) and PA across the day ($r = 0.66$, $p < 0.05$). Sleep onset latency was also positively associated with increased negative mood during the afternoon epoch ($r = 0.71$, $p < 0.05$). Objective sleep estimates of sleep onset latency were significantly correlated

Table III. Sleep-wake cycle characteristics.

Characteristic	Patient's score
Stanford sleepiness scale (SSS)	4.73 (1.85)
Fatigue scale	8.91 (3.99)
Pittsburgh sleep quality index score (PSQI)	3.0
Pre-sleep arousal scale (PSAS)	
Cognitive arousal	11.91 (4.25)
Somatic arousal	10.36 (3.80)
Morningness-eveningness questionnaire	
Horne & Ostberg scoring (1976)	36 (moderately evening type)
Taillard et al. scoring (2004)	36 (evening type)
Dysfunctional beliefs and attitudes about sleep (DBAS)	
Total score	164.1
Consequences of insomnia	3.33
Control and predictability of sleep	5.44
Sleep requirements	7.0
Sleep promoting practices	7.63
Sleep disturbance questionnaire (SDQ)	
Physical tension	2.0
Sleep pattern problem	3.3
Cognitive arousal	3.67
Sleep effort	2.67

Note: Mean values are reported. Standard deviations appear in parentheses for PSAS, Fatigue Scale and SSS, which were collected daily across 11 days.

with the evening negative mood ($r=0.84$, $p<0.01$). No other associations between daytime mood and subjective or objective total sleep time or wake after sleep onset were significant.

Associations between sleep estimates and mood the following day revealed negative associations between subjective total sleep time and morning negative mood ($r=-0.65$, $p<0.05$). Objective estimates of sleep onset latency were significantly associated with morning positive mood ($r=0.64$, $p<0.05$). No other associations between sleep estimates and mood the following day were significant.

Conclusions

This study examined whether the behavioural disorder in this patient with acquired temporal lobe damage met diagnostic criteria for mania. It confirmed that this patient exhibited clinically significant symptoms of mania, meeting criteria for bipolar disorder (excluding criterion E of the DSM-IV-TR criteria). These findings replicate previous literature associating post-traumatic brain injury in temporal lobe regions with acquired symptoms of mania [3, 8–13]. Dysfunction or damage to the temporal lobe region appears to play a crucial role in positive mood regulation and, potentially, the course of mood swings in bipolar disorder. This present study extends previous research by demonstrating positive emotional disturbances across multi-method assessments, including clinical interview and EMA over and extended 11 day period.

This study then examined whether this patient with acquired mania exhibited sleep disturbances. The patient did not meet criteria for insomnia but met criteria for delayed-phase syndrome. This finding is consistent with literature suggesting that sleep disturbance is a core symptom of patients with bipolar disorder [7, 14, 38, 39] and evidence associating sleep deprivation with the onset of mania [40]. The patient also exhibited some dysfunctional beliefs about sleep measured on the DBAS [26] and SDQ [27].

The authors then examined whether there were associations between mood and sleep in this patient. It was found that both positive and negative mood were significantly associated with increased sleep onset latency. This finding is consistent with the hypothesis that emotional activation during the day predicts difficulty getting to sleep the subsequent night. Significant associations between sleep disturbance (decreased TST and SOL) and elevated negative and positive mood were also observed. Together, the results of the correlational analyses are consistent with the hypothesis that disturbed sleep was associated with increased emotional arousal the following morning. These findings are consistent with literature suggesting associations between sleep and mood in normative samples [41] and in patients with bipolar disorder [40]. This case underscores the importance of the temporal lobes in mood regulation and the potential for a link between disturbed mood and sleep in patients with bipolar disorder.

In sum, this case study provides evidence suggesting the temporal lobe may have a role in mood regulation. Damage to the left anterior temporal lobe resulted in abnormally elevated mood both in the experimental session and naturalistically during the patients' day-to-day life. The current study also extended research on the function of the temporal lobe by linking it to sleep disturbances (i.e. delayed phase syndrome). Future research is needed to examine the inter-relationship between mood and sleep in patients with temporal lobe damage.

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