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Measuring motor activity in major depression: The association between the Hamilton Depression Rating Scale and actigraphy

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ABSTRACT

Despite the use of actigraphy in depression research, the association of depression ratings and quantitative motor activity remains controversial. In addition, the impact of recurring episodes on motor activity is uncertain. In 76 medicated inpatients with major depression (27 with a first episode, 49 with recurrent episodes), continuous wrist actigraphy for 24 h and scores on the Hamilton Depression Rating Scale (HAMD) were obtained. In addition, 10 subjects of the sample wore the actigraph over a period of 5 days, in order to assess the reliability of a 1-day measurement. Activity levels were stable over 5 consecutive days. Actigraphic parameters did not differ between patients with a first or a recurrent episode, and quantitative motor activity failed to correlate with the HAMD total score. However, of the motor-related single items of the HAMD, the item *activities* was associated with motor activity parameters, while the items *agitation* and *retardation* were not. Actigraphy is consistent with clinical observation for the item *activities*. Expert raters may not correctly rate the motor aspects of retardation and agitation in major depression.

1. Introduction

Psychomotor disturbances are essential features of major depressive disorders, have discriminative value, and have been reported to predict response to some antidepressants (Sobin and Sackeim, 1997; Dantchev and Widlöcher, 1998; Caligiuri et al., 2003; Leventhal et al., 2008; Schrijvers et al., 2008). Other studies have used fine motor tasks such as drawing and video analyses to study motor symptoms in depression (Lemke et al., 1999a; Sabbe et al., 1999; Mergl et al., 2004; Pier et al., 2004). Especially, hand-motor tasks proved to be an interesting tool to investigate the impact of psychopharmacological effects on motor function in depression (Hindmarch, 1997; Tucha et al., 2002; Hegerl et al., 2005; Mergl et al., 2007). However, these methods are limited to laboratory settings. Conversely, acquisition of motor activity using wrist actigraphy allows continuous recording in naturalistic and clinical settings (Teicher, 1995; Volkers et al., 2002, 2003; Stanley, 2003; Todder et al., 2009; Walther et al., 2009a,b,c, 2010b).

An increasing body of literature reports on actigraphy in major depression. The earliest evidence demonstrated reduced motor activity in bipolar depressed patients as compared to unipolar depressed patients and controls (Kupfer et al., 1974; Wehr et al., 1980; Wolff et al., 1985; Stanley, 2003). Reduced activity in comparison to controls has also been consistently reported for major depression (Teicher, 1995; Volkers et al., 2003). Indeed, results from health surveys corroborated the actigraphic findings of reduced motor activity in major depression (Patten et al., 2009; de Wit et al., 2011). In melancholic depression, motor activity is negatively correlated with subjectively experienced symptom severity (Lemke et al., 1997). Actigraphy has also been employed to measure treatment outcomes in major depression (Royant-Parola et al., 1986; Raoux et al., 1994; Teicher, 1995; Volkers et al., 2002, 2003; Stanley, 2003; Baune et al., 2007; Todder et al., 2009). One study suggested that during treatment the change in quantity of movements as measured by actigraphy reflects the change in psychopathology in major depression (Todder et al., 2009). Over the last three decades temporal resolution of actigraphs has immensely increased, and a variety of parameters and analyses are available today.

Despite its increasing application little is known about the association of actigraphic parameters with particular symptoms, especially with those rated by an expert observer. One study in major depression failed to find associations between depression rating scales and the objective level of diurnal activity (Raoux et al., 1994), while another demonstrated *motor retardation* of the Brief Psychiatric Rating Scale to correlate inversely with the level of activity (Joffe et al., 1987). Further, the validity of expert rating of motor symptoms has been challenged by ultrasonic gait analysis and actigraphy in schizophrenia (Putzhammer et al., 2005; Walther et al., 2009c). Since motor activity is an important outcome variable in depression, actigraphy may be a useful instrument to provide

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objective parameters and to test the external validity of expert ratings. Therefore, the primary aim of this study was to test whether expert ratings of single motor items of the Hamilton Depression Rating Scale (HAMD)(Hamilton, 1960) were reflected by actigraphic measures. The items *retardation* and *agitation* describe motor behavior directly, whereas the items *activities* and *diurnal variation* should be linked to motor behavior. Moreover, depression severity may be associated with actigraphic measures.

Recurring depressive episodes appear to be somewhat different from single depressive episodes. In fact, patients with remitted recurrent depression have been reported to have higher cortisol levels, more frequent negative perception of social interaction, impaired executive function, and psychomotor retardation (Lampe et al., 2004; Bos et al., 2005). Furthermore, recurrent depression was shown to be associated with residual symptoms, which have been reported to lead to impaired long-term social functioning (Kennedy and Paykel, 2004). Likewise, a study in young adults demonstrated that the agitated-retarded depression subtype was associated with recurrent episodes, poor social functioning and increased severity (Leventhal et al., 2008). Findings from structural brain imaging suggest a reduction of bilateral hippocampal and amygdala volumes to be associated with recurring episodes and symptom severity (Sheline, 2000; Videbech and Ravnkilde, 2004). Taken together, recurrent depression seems to be different from single episode depression in physiological and psychological aspects, including psychomotor function. As psychomotor retardation has been shown in patients with recurrent depression during remission (Lampe et al., 2004), we hypothesize that we will find reduced objectively measured motor activity in patients with recurrent depressive episodes compared to those with a first episode; even if some of the first episode patients later go on to suffer from recurrent depression.

The first aim of the study was to elucidate the association of quantitative motor activity and the ratings of motor items of the HAMD in a clinical setting. We hypothesized that the items retardation, agitation, activities, diurnal variation and the HAMD total score would correlate with actigraphic data. The second aim was to determine whether patients with recurring depressive episodes differ from those in a first depressive episode in terms of quantitative motor activity. We assumed that patients with recurrent depression would have reduced motor activity levels and increased periods of immobility.

2. Methods

2.1. Subjects

In total, 76 patients were included in the study within the first 3 weeks after admission to the University Hospital of Psychiatry in Bern, Switzerland. All patients suffered from major depression according to DSM-IV and were inpatients at the time of study participation. Exclusion criteria were history of or concomitant neurological or medical disorders that could interfere with normal motion, substance abuse other than nicotine, and comorbid psychiatric disorders. Especially, patients with bipolar affective disorder were excluded, as it has been shown previously that they differ from unipolar depression in terms of motor activity (Wolff et al., 1985; Kuhs and Reschke, 1992; Teicher, 1995). Diagnoses were given by experienced psychiatrists after thorough clinical interview and review of the case files. Participation was unpaid. Patients were categorized into two groups: those with a first depressive episode ($N=27$) and those with recurrent depression ($N=49$). Most patients received psychopharmacological treatment, except five (6.6%) who were treated primarily with psychotherapy and had received on demand benzodiazepines, but not during the recording day. Eighteen patients (23.6%) were also treated with antipsychotics: 3 with typical and 15 with atypical antipsychotics. No difference in antipsychotic prescription was detected between depressive subgroups ($\chi^2=0.49$, $P=0.30$). The duration of illness as well as the number of episodes was obtained from the case files and information given by the patient. Participants were between 21 and 64 years of age. Demographic characteristics and clinical variables are given in Table 1.

After complete explanation of the aims and procedures of the study, patients provided written consent. Procedures were in accordance with the declaration of Helsinki and had been approved by the local ethics committee (KEK no. 208/06).

2.2. Procedures

Severity of depression was assessed by S.W. using the Hamilton Depression Rating Scale (21-item version) (HAMD)(Hamilton, 1960). The rating referred to the last week, except for the two items that rely on direct observation during the interview (retardation and agitation). The rater was trained in the use of the HAMD. He was aware of the diagnosis of major depression, but not aware of the specific history of each patient nor whether it was the first or a recurrent episode. The interview of 30–60 min was conducted immediately after the actigraphy was initiated. Patients wore an actigraph (Actiwatch®, Type AW4, Cambridge Neurotechnology Inc., UK) at the wrist of the nondominant arm for 24 consecutive hours for the continuous recording of motor activity. Ten patients of the sample additionally agreed to wear the actigraph over a period of 5 consecutive days. The actigraph was read out after 24 h and handed back to the patients immediately afterward. As such, it was possible to test for the approximate variation of the motor behavior during a longer time of measurement. The device contains an accelerometer that produces voltage whenever the actigraph is moved. The

Table 1
Demographic and clinical characteristics of the sample population ($n=76$). [a]Fisher's exact test: Exact significance (two-tailed, Bonferroni corrected): $P<0.02$; [b]independent samples Mann–Whitney *U*-tests: significance (two-tailed, Bonferroni corrected): $P<0.01$; SSRI: Selective Serotonin Reuptake Inhibitor; SSNRI: Selective Serotonin and Norepinephrine Reuptake Inhibitor; TCA: Tricyclic antidepressants; HAMD: Hamilton Depression Rating Scale. Duration of hospitalization is given in days from admission.

	Total sample ($N=76$)		First episode ($N=27$)		Recurrent depression ($N=49$)		Analysis[a]		
Sample characteristics	*N*	*(%)*	*N*	*(%)*	*N*	*(%)*	χ^2	d.f.	*P*
Gender (men)	38	50.0	15	55.6	23	46.9	0.52	1	0.630
Antidepressants							4.89	4	0.300
No antidepressants	7	9.2	1	3.7	6	12.2			
SSRI	19	25.0	8	29.6	11	22.4			
SSNRI	22	28.9	8	29.6	14	28.6			
TCA	24	31.6	7	25.9	17	34.7			
Mirtazapine	4	5.3	3	11.1	1	2.0			
Antipsychotics							0.67	2	0.720
No antipsychotics	58	76.3	22	81.5	36	73.5			
Typical	3	3.9	1	3.7	2	4.1			
Atypical	15	19.7	4	14.8	11	22.4			
							Analysis[b]		
	Mean	S.D.	Mean	S.D.	Mean	S.D.	*Z*	d.f.	*P*
Age (years)	44.8	11.5	43.9	12.0	45.3	11.2	−0.60	74	0.554
Number of episodes	2.7	2.4	1.0	0.0	3.6	2.6	−7.46	74	<0.001
Duration of illness (years)	6.0	7.8	1.0	2.0	8.6	8.6	−5.89	74	<0.001
Duration of hospitalization	21.9	37.9	15.5	15.8	25.5	45.7	−0.43	74	0.671
Total HAMD score	19.0	6.4	17.0	6.4	20.0	6.2	−1.95	74	0.052