Heart rate variability and “Antrieb” (drive, impulse)

Association between a psychopathological sign and the autonomic nervous system’s state in depressive patients

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Summary

German psychopathology uses a rather broad definition of the term “Antrieb” (drive, impulse). In our opinion, this psychopathological symptom should be subdivided into three more differentiated components. Of these three, the most bodily sign, “basal Antrieb”, is a very subjectively sensed variable, which hypothetically may influence, or be influenced by, the autonomic nervous system (ANS), particularly as measured by heart rate variability (HRV). In the present study we investigate a possible relationship using visual analogue scales and HRV measurements.

We recorded the HRV spectral analysis component “total power” in 93 psychiatric inpatients (50 women, 43 men) suffering from affective (N = 43) or schizophrenia (N = 50) spectrum disorders. The psychopathological sign “basal Antrieb” was investigated using a self-ratings and a clinician-rated visual analogue scale.

Clinicians’ ratings showed higher values for depressive patients, while patient ratings showed a tendency to feel lazy and lack energy. Self-ratings and clinicians’ ratings correlated only for the depressive patients.

For the depressive patients did a significant correlation exist between self-ratings and the HRV measurements. The clinicians’ ratings correlated on a 6% significance level with power, and the direction of the correlation was inverse.

The tendency in the clinicians’ ratings to assign higher VAS values to depressive patients than to the schizophrenics may be ascribed to a clinicians’ misjudgement caused by the influence of autistic aspects in schizophrenic patients. The missing correlation between self- and clinicians’ ratings in our schizophrenic patients may be due to the fact that insight into illness is much less pronounced in schizophrenic patients than in depressive patients.

For the first time we were able to depict our assumed association between ‘Antrieb’ as a state-dependent psychopathological sign and the ANS’s functional state as measured by HRV in a subgroup of depressive patients.

Key words: HRV; Antrieb; drive; impulse; psychopathology; ANS

Introduction

The term ‘Antrieb’ (drive, impulse) was introduced into German psychopathology in 1909 by Karl Kleist [1]. Examining soldiers with brain injuries in World War I, his subsequent work started out from the question whether a lack of ‘Antrieb’ caused by a frontal injury could be distinguished from a lack of ‘Antrieb’ based on disorders of the brainstem or disorders of the basal ganglia – a question that has regained topicality since the 1980s with the discovery of frontal-subcortical neuronal circuits [2].

In the middle of the last century the work of W. Klages was most important in the German discussion of ‘Antrieb’ [3]. He established the rather broad definition of ‘Antrieb’ as “the dynamic element, influencing all motoric, sensoric and associative abilities. This is a prerequisite for these accomplishments and contributes decisively to man’s individual personality pattern in its qualitative and quantitative diversity” [3, author’s translation].

At present the German psychopathological diagnostic tool “AMDP-System” defines ‘Antrieb’ as “the vitalising force, which, almost without reference to will, causes the motion of all mental functions with regard to speed, intensity and persistence. Thus, ‘Antrieb’ maintains vitality, verve, initiative, focus, attention, energy and enterprise …” [4, author’s translation]. Remarkably, an English or French psychopathological term that corresponds exactly to this very broad German approach to ‘Antrieb’ does not exist [5].

From a clinical point of view this broad definition causes a psychopathological blur. For instance, patients suffering from “inhibited depression” present decreased ‘Antrieb’ with regard to will and thought; at the same time they show increased “Antrieb” with regard to vegetative and affective parameters (restlessness, tenseess, increased impulsiveness with suicidal behaviour). Hence, in our opinion, to make it clinically useful, the psychopathological term ‘Antrieb’ should be subdivided into three components: “quantitative” and “qualitative disorders of higher Antrieb” and the most bodily component, “basal Antrieb” [6, see table 1].

To examine our psychopathological model under neurophysiological conditions, we started with “basal Antrieb”. Since “basal Antrieb” represents subjective inner feelings as well as describable psychopathological phenomena, it

Abbreviations

ANS: Autonomic nervous system
HRV: Heart rate variability. In our trial, we used HRV’s spectral analysis component “total power”.
VAS: Visual analogue scale
VASC: Visual analogue scale – clinicians’ ratings
VASS: Visual analogue scale – self-ratings

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Seemed an obvious move to test both the patients’ and the clinicians’ impressions [7].

“Basal Antrieb” is a very subjectively sensed variable that may influence the autonomic nervous system (ANS), particularly as measured by heart rate variability (HRV). The present study sets out to examine two questions concerning this component by an empirical approach:

- Do clinicians’ ratings and patients’ self-reported ratings correlate?
- Do these ratings correlate with the neurophysiological variable HRV?

To check whether the correlations are the same for the two groups of psychiatric patients for whom deficits with regard to ‘Antrieb’ are the most marked, we did our analyses for both a group of schizophrenic and a group of depressive patients. We expected to see a meaningful difference between schizophrenic and depressive patients, due to their variant insights into illness, or due to their different abilities to report on bodily perceptions.

**Methods**

**Subjects and setting**

93 psychiatric inpatients (50 women, 43 men) suffering from affective (N = 43) or schizophrenia (N = 50) spectrum disorders – according to ICD-10 categories F2 or F3 – were included in our trial. Patients gave informed consent and were recruited from our psychiatric unit. Our investigations were in accordance with common ethical standards and with the Helsinki Declaration.

We did not include patients with ECG abnormalities, with relevant cardio-vascular diseases, with neuropathy or with relevant sleep disorders. Patients in the study were treated neither with light therapy nor acupuncture, nor did we include patients with recent pathological laboratory blood findings. As HRV may further be influenced by disorders such as brain injury, brainstem disorders and coronary or other heart failure, or even by sleep disorders such as periodic leg movements in sleep syndrome, we did not include patients suffering from these disorders [8, 9, 10, 11]. Medication had remained stable during the previous three days.

**Measurements and course of examination**

The psychopathological sign “basal Antrieb” was investigated using a new self-rating (VASS) and a clinician-rated visual analogue scale (VASC). Visual analogue scales were formatted as a 10 cm line without any further scaling. The left pole (0 cm) was described as laziness and lack of inner energy, while the right pole (10 cm) represented a fidgety state in which the patient feels or seems impelled and strained (table 2).

As a neurophysiological measurement of the current state of a person’s autonomic nervous system, heart rate variability (HRV) was chosen [12]. We measured HRV online using Polar Precision Performance Software on a laptop via Polar Sport-Tester S810i and Polar infrared interface. In our statistical analyses we used the HRV spectral analysis parameter “total power” (total frequency power: this component includes all frequency spectra such as very low frequency, high frequency, etc.) as a robust component including both the ANS’s parasympathetic and sympathetic branches.

Because breathing frequency influences HRV and reaches the parasympathetic maximum in clock-pulse breathing 10/min [13], we used this breathing frequency to test HRV in our trial.

All examinations were done by two experienced clinicians (F.H.; C.L.).

**Table 1**

<table>
<thead>
<tr>
<th>Quantitative disorders of higher “Antrieb”:</th>
<th>Qualitative disorders of higher “Antrieb”:</th>
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<tbody>
<tr>
<td>increase or decrease of activity in the superordinated psychopathological divisions “thought”, “psychomotility” and “speech” as well as in the division “affect/emotion”.</td>
<td>qualitative disorders concerning will and spontaneity, skills in planning and goal-directed action, impulse-control and “executive control functions”.</td>
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</table>

**Table 2**

Visual analogue scales of “basal Antrieb”: English translations and German originals of self (VASS) and clinicians’ ratings (VASC).

<table>
<thead>
<tr>
<th>Left pole</th>
<th>Right pole</th>
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<tr>
<td><strong>VASS:</strong> At present, the patient inwardly appears very lazy, sluggish, feeble and lacking energy, his “inner motor” seems to be running extremely slowly, at low revs.</td>
<td><strong>VASS:</strong> At present, the patient inwardly appears very fidgety, impelled and strained. One feels as if his “inner motor” seems to be running extremely fast – although he may not be able to use this inner energy.</td>
</tr>
<tr>
<td>(German): Der Patient wirkt derzeit innerlich sehr träge, lahm, kraftlos und -energiearm, sein “innerer Motor” scheint extrem langsaml und -niedrigtourig zu laufen.</td>
<td>(German): Der Patient wirkt derzeitig innerlich sehr unruhig, getrieben und angespannt. Man hat das Gefühl, sein “innerer Motor” läuft »auf Hochtouren« – auch wenn er diese innere Energie vielleicht gar nicht nutzen kann.</td>
</tr>
<tr>
<td><strong>VASS:</strong> At present, I inwardly feel very lazy, sluggish, feeble and lacking energy, my “inner motor” seems to be running extremely slowly, at low revs.</td>
<td><strong>VASS:</strong> At present, I inwardly feel very fidgety, impelled and strained. I feel as if my “inner motor” seems to be running extremely fast – although I may not be able to use this inner energy.</td>
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</table>
Patients’ current psychopathological state was known from the ward round. The examiner filled in the VASC while the patient waited outside the examination room. After entering, the patient was instructed to put on the sport tester strap and was then asked to fill in the VASS. We measured HRV in a five-minute test while the patient was lying still. The sport tester’s wrist unit – connected with the infra-red interface – was placed on a table, at a distance of about 30 cm from the transmitter on the patient’s chest. Before starting the 5-minute trial the patient was instructed in clock-pulse breathing (10/min) using a digital metronome, and was asked to practise this technique for three minutes (lying still).

**Statistical analyses**

Normal distributions of variables were checked by Kolmogorov-Smirnov tests and graphic inspection. Independent and paired T-tests were used to compare scale differences between diagnoses and between self- and clinicians’ ratings. Correlations were calculated by Pearson product-moment correlation coefficients. Age was controlled in a first order partial correlation analysis between scale values and HRV power. All statistical analyses were performed with SPSS 14.0.

**Results**

**Patient characteristics**

N=93 patients were included in our study, of whom N = 50 (53.8%) had ICD10 F2 diagnoses of the schizophrenic spectrum and N = 43 (46.2%) an ICD10 F3 diagnosis of an affective disorder. N = 50 (53.8%) were women. The schizophrenia group was, with a mean age of 40.2 years (±10.8), clearly (T = –3.18, P = 0.002) younger than the patients with affective disorders (48.2, ± 13.2).

**Normal distributions of variables**

Values of the visual analogue scales showed normal distributions for both diagnostic groups, whereas the HRV component “total power” obtained was not normally distributed and hence had to be log-transformed to produce normal distributions.

**Self-ratings and clinicians’ ratings**

**Mean differences**

Table 3 shows that self-ratings in visual analogue scales for schizophrenia and affective patients did not differ significantly in their mean values (T = 0.37/P = 0.712). Clinicians’ ratings showed, with a statistical tendency (T = –1.75/P = 0.083), higher values for depressive patients (which means that the depressed patients appeared more fidgety, impelled and strained).

Highly significant differences were to be noted between self-ratings and clinicians’ ratings: all patients: T = –6.154/P = 0.000, schizophrenia patients: T = –3.449/P = 0.001, depressive patients: T = –5.428/P = 0.000. Patient ratings were always closer to the left pole of the scale – that is, feeling lazy and lacking energy.

**Correlations**

Table 4 shows that self-ratings and clinicians’ ratings correlated on a 9% significance level only for the depressive patients. For schizophrenia patients there was not even an approximately significant correlation between the two ratings.

**Correlations between rating scales and HRV measures**

Age as a control variable was controlled in partial correlations because of the significant connection which was to be noticed between age and power (r = –0.216/P = 0.037).

In table 5 it can be seen that for the depressive patients a significant correlation existed between self-ratings and the HRV measurements. For schizophrenia patients the relationship missed the 10% level. The clinicians’ ratings correlated on a 6% significance level with power, and the direction of the correlation was inverse.
Discussion

The aim of our study was to investigate aspects of our psychopathological construct ‘basal Antrieb’ [6]:
- the correlation of our psychometric measurements in self- and clinicians’ ratings
- and the correlation of these data with patients’ HRV.

We investigated values of the ‘basal Antrieb’ using a new 10-cm visual analogue scale (table 2). As the concept of ‘basal Antrieb’ is a new psychopathological construct, it was obvious that we should use a visual analogue scale as a relatively simple rating instrument for our first investigations. Other scales concerning ‘Antrieb’ did not consider any aspects of our concept of ‘basal Antrieb’ [14, 15]. Due to the fact that self-reported and observer-reported ratings may differ significantly [7], we noted down both impressions.

Since HRV represents aspects of the central autonomic system’s current state [12], we used this neurophysiological measurement to examine our thesis that ‘basal Antrieb’ may be one psychopathological correlate of the current state of a patient’s ANS.

Patients’ mean self-rating values did not differ significantly between those suffering from affective and those suffering from schizophrenia spectrum disorders. Clinicians’ ratings were significantly higher than the self-ratings. This may be due to patients’ underestimating themselves or to researchers overestimating what they observe with reference to the right pole of our VAS (fidgety, impelled, and strained).

In the clinicians’ ratings we found a statistically significant tendency to assign higher VAS values to depressive patients than to the schizophrenics. This may be ascribed to a clinicians’ misjudgement caused by the influence of autistic aspects in schizophrenic patients [16, 17]. The missing correlation between self- and clinicians’ ratings in our schizophrenic patients (unlike in the depressive patients) may be due to the fact that insight into illness is much less pronounced in schizophrenic patients than in depressive patients [18, 19].

The broad German term ‘Antrieb’, and especially our construct ‘basal Antrieb’, may have a certain overlap with anxiety syndromes. Berntson et al. described the influence of both the ANS’s sympathetic and parasympathetic branches and produced several hypotheses to explain the relationship between anxiety states and cardiovascular changes [20]. But in the “basal Antrieb VAS” we endeavoured to use only terms unrelated to anxiety symptoms (table 2). In our psychopathological understanding, following Kleist’s original theses on ‘Antrieb’ [1], “basal Antrieb” is more likely to be linked to psychomotor symptoms (such as “psychomotor tenseness”) whereas anxiety represents a complex affective state.

In our view a single psychopathological sign may represent a person’s current ANS state more precisely than a (rather trait-dependent) syndrome or a disease. This was the reason why we examined the correlation between the ‘basal Antrieb’ and HRV parameters. When searching the databases Medline and Pubmed we found no studies using a single psychopathological sign like ‘Antrieb’ to compare with HRV-changes.

As we did not know whether our construct of ‘basal Antrieb’ influences the HRV’s spectral analysis’s partial component, or one of the ANS’s branches, we used HRV total power as a robust parameter in our investigations.

HRV’s “low frequency” and “high frequency components”, which are often used to describe the ANS’s sympathetic or parasympathetic branches, represent only 5% of the total power [21].

Lower breathing frequencies influence HRV via its component “respiratory sinus arrhythmia” towards a more parasympathetic state. This influence reaches its maximum in clock-pulse breathing 10/min [22, 13]. Hence, to increase the ANS’s parasympathetic reaction and create standardised conditions, we used this breathing frequency in our trial. Because we expected HRV in psychiatric patients to be altered by more sympathetic conditions, this represents a good method of reaching HRV’s parasympathetic maximum.

Comparing our HRV values with the patients’ age, our results correspond to those of other investigators, who found low negative correspondences between the subjects’ age, sympathetic HRV components and heart rate [23, 24].

In our trial we found a significant correlation between log-transformed HRV total power and VAS self-rating values in depressive patients, whereas the clinicians’ ratings in depressive patients showed no correlation with HRV. The self-ratings and clinicians’ ratings in schizophrenic patients showed no correlation (possibly due to patients’ autism, see above). In some schizophrenic patients a disturbed ability to perceive bodily sensations such as pain [25] may be another explanation for these results.

We hypothesised that – from the clinicians’ viewpoint – lower levels of ‘basal Antrieb’ would correlate with vagotonic states and therefore with higher HRV total power levels [26], and vice versa. As expected, we found an inverse correlation between clinicians’ VAS values and log-transformed HRV total power.

As shown above, no studies on the correlation of single psychopathological symptoms and HRV were found. Some authors reported on the influence of affective syndromes such as mood and anxiety on HRV components, chiefly hf and lf/hf-ratio [27, 28]. De Jonge et al. [29] found that somatic depressive symptoms were associated with lower HRV (lf component more than hf component), although cognitive depressive symptoms were not.

All these authors reported on syndromes or on affective states; single psychopathological terms such as ‘Antrieb’ or psychomotor tenseness were not discussed.

Several studies reported the influence of psychiatric medication on HRV, involving changes based on its anti-cholinergic or antiadrenergic activity [30, 31].

In our opinion this medication will influence mood, components of ‘Antrieb’, anxiety and psychomotor tenseness, as well as HRV. Hence a specific medication may influence autonomic parameters, as well as the – subjective or observed – experience of a psychopathological symptom. This means that the influence of a specific medication may not affect our results in a meaningful way.

Thus, for the first time, we were able to illustrate our assumed association between ‘Antrieb’ as a state-dependent psychopathological sign and the ANS’s functional state as measured by HRV in a subgroup of depressive patients. Nevertheless, further investigations are needed. For ex-
ample, it would be interesting to ascertain whether ‘basal Antrieb’ and HRV are different in catatonic, paranoid and hebephrenic patients with regard to different disturbances of psychomotor and autonomous functions.

References


