Can mobile skin conductance assessments be helpful in signalling imminent inpatient aggression?

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Introduction

General medicine has a long tradition in developing tools and equipment that support the diagnostic process and treatment of patients. Not surprisingly, the costs of such equipment nowadays make up a substantial proportion of the budget of hospitals. The costs of medical equipment according to Cascarino (2008) represent 10 to 40% of current healthcare budgets, and the growing complexity of current technology and equipment is likely to increase that percentage even further.

In (clinical) psychiatry the use of objective measurement devices, let alone high tech equipment, is still rare. Psychiatric diagnostic processes are still depending heavily on the observations, experience, and skills of a diagnosing psychiatrist or psychologist, which are sometimes backed up by the uses of (paper-and-pencil) tests. Of course, the rise of neuroimaging techniques such as EEG, CAT, MRI and fMRI have enormously increased the possibilities to objectively study brain anomalies in psychiatric patients, but nevertheless, establishing a psychiatric diagnosis is still mainly based on the (behavioural) criteria described in DSM-IV, which have to be observed and assessed by a human diagnostician. Many of the major challenges of mental health care, however, are not dealing with the specific diagnostic categories presented in the DSM-IV, but with the behavioural manifestations and problem behaviours that stem from these mental illnesses. Aggressive and disruptive behaviour, for instance, are the main causes for involuntary psychiatric admissions, even though aggressive behaviour is not a specific diagnostic category in the DSM-IV. Nevertheless, psychiatric professionals are expected to be able to ‘predict’ dangerousness and violence risks of individual psychiatric patients, for instance when having to judge the necessity of forced pharmacological treatment, involuntary admissions, or whether it is safe enough to discharge a patient. In other words, they have to make assessments about risks of aggressive behavior, without it being an official psychiatric illness in terms of the DSM-IV, and without having access to measurement tools or equipment that can assess a state of physiological hyper arousal, let alone an assessment that can objectively ‘predict’ imminent aggression.

A well-know technique to assess psychological arousal (for a review see Critchley, 2002) is to measure Skin Conductance Levels (SCLs), and to evaluate rapid changes in skin conductance in response to triggers (Skin Conductance Responses; SCRs). Although widely used in experimental psychological research, for instance in patient samples suffering from phobia (e.g., Jong, Merckelbach, Arntz & Nijman, 1992), this technique has relatively seldom
been used in (locked) psychiatric admission settings (but see Campo et al., 2000). One of the obvious reasons for this is that measuring skin conductance, until recently, required a substantial amount of equipment to which a patient had to be attached to obtain these assessments. Clearly, this will have hampered the use of skin conductance measurements in severely agitated and aggressive patients, who are forced to reside at a locked psychiatric ward. As technology progressed, however, it became possible to develop small wearable devices in the form of regular watches or wrist bands (e.g., Picard, 2010; Westerink et al., 2009) to measure SCLs and SCRs. In fact such new high tech devices can be used to assess various psycho physiological parameters, among which the SCL, without the patient being restricted (i.e., having to sit in one place) or being bothered by these measurements in any way. This provides opportunities to measure psycho physiological changes in psychiatric patients during their regular ward life, and even when they are in a state of acute psychiatric crisis.

To illustrate the potential this development may have for research on the treatment of severely agitated and aggressive psychiatric patients, we provide a brief case description of a patient in crisis with whom we piloted a wearable psycho physiological skin conductance measurement device in the form of a watch, which was developed by Philips Research (see photo 1). The aim of our pilot study was to investigate whether continuous assessments of SCL in the daily clinical reality of a locked psychiatric admissions ward are feasible, and to explore whether SCL may be able to capture increases in arousal of psychiatric patients, even before actual observable agitation and aggressive behavior are visible. The device also assessed the amount of activity and motions made by the patient during the day, as increased physical activity in general is associated with increases of the SCL.

*Figure 1.*

*The wearable devices used to assess SCL and activity of psychiatric patients*
A pilot study

Between April 21th and May 12th, 2010 a pilot study was performed at one of the locked intensive care wards of a psychiatric hospital in Eindhoven, the Netherlands. An open experiment with a limited number of patients was conducted in which their arousal, in terms of their SCL, was assessed for longer periods during regular ward life. This pilot study was authorized by the medical ethical committee for research with psychiatric patients in the Netherlands (i.e., the Metigg), as well as by the technical and ethical committee of Philips Research. Potential participants were informed about the study, and were asked for written informed consent if they were willing to participate. Patients who consented wore a mobile skin conductance device from 4 PM till 10 PM. This period was chosen as experiences shows that during these hours a lot of interaction takes places on the ward (e.g. during diner time) and the likelihood of aggressive behaviour is somewhat increased. The personal caregivers of patients wearing a skin conductance watch were instructed to log any event or behavior that struck them in a little diary made for this purpose. Apart from that, agitation, or even hostile or violent behavior was documented each half hour, using a brief 11 item checklist called the Social Dysfunction and Aggression Scale (SDAS; Wistedt et al., 1990). It is important to note that the caregivers providing these assessments of the condition and behavior of the patient, had no knowledge off, or access to, the SCLs of the patients while they were making their observations. The skin conductance data were only retrieved from the mobile wrist devices after the measurement session had ended.

One of the first pilot cases is presented below. Clearly, it concerns a selected case, in which the behaviour of the monitored patient escalated into aggressive behaviour, which is
meant to illustrate the potential usefulness of assessments like this for crisis intervention research. This case description, yet anecdotal, is representative in our opinion as similar results were seen in other patients who went from a relatively calm to a more agitated and even hostile condition.

The case of Mrs. A

On March 29\(^{th}\), 2010, Mrs. A., a young woman in her early twenties, suffering from schizophrenia, agreed to participate in the study. She was feeling relatively well when asked to participate, rating her own tension level to a “6” on a scale from 1 to 10. Her behaviour throughout the day indeed showed no signs of hostile or agitated behaviour till 8 PM. That is to say, no observations on agitated or disruptive behavior whatsoever were noted by her personal caregiver in the diary. Likewise, all SDAS ratings performed twice per hour were zero, until 8 PM. From 8 PM till 8.30 PM., however, changes in the behavior of Mrs. A. were noted by her personal caregiver, and her behaviour seemed to deteriorate after that. For the period between 8 PM till 8.30 PM her personal caregiver noted that the patient showed signs of “both anger and desperation”. On the SDAS this expressed in elevated scores on the items assessing “Verbal aggression not directed towards specific persons”, “Irritability”, “Negativism”, “Anger”, and “Socially disruptive behavior”. Yet, still no physical aggressive behavior was recorded on the SDAS for that time frame, and the personal care giver of Mrs. A tried to verbally deescalate and calm the patient. Between 8.30 and 9 PM, however, Mrs. A’s behaviour got worse. On the SDAS pertaining to that time frame, physical aggression, apart from verbal aggression, was reported.

Interestingly, when studying the SCL of Mrs. A. in retrospect, it became clear that her skin conductance had already been rising before 8 PM (see Figure 2), although no reports on agitation or aggression were made in the Diary or with the SDAS for the time frame 7.30 to 8 PM.

\textit{Figure 2.}
\textit{SCL (in microSiemens; upper half of the screen) of and the amount of activity of Mrs. A (lower half of the screen) on March 29\(^{th}\), 2010.}
As can be seen in Figure 2, the SCL of Mrs. A. had been starting to rise at about 7.20 p.m. already, and eventually rose to over 5 microSiemens between 8 and 8.30 PM, whereas the baseline had been around 0.5 microSiemens throughout the day. In the period between 8.30 and 9 PM in which the physical aggression was reported, the patient was encouraged and observed to make attempts to contain herself (i.e., at about 8.15, for instance; the assessment of physical motion also shows this period of reduced physical activity), but in the end Mrs. A. was smashing and throwing plates and glassware in the kitchen of the ward and pulled off the skin conductance watch (i.e., just past 8.30 PM; see Figure 2).

**Discussion**

The fact that the patient’s SCL increased markedly during the period of the visible aggressive behaviour, in our opinion, is not what makes this case report of particular interest. It is a well-established fact that increased arousal and physical activity go along with increases in SCL. The finding that the tension in Mrs. A., as detected by the skin conductance watch, appears to already have been building before the first behavioural signs of aggression were noticeable, however, may have important implications for aggression prevention. This observation fits well with the experience of psychiatric caregivers that aggressive outbursts of
psychiatric inpatients sometimes seem to be preceded by a long period of tension building and agitation (e.g., see Nijman et al., 1997), but this first rise in arousal may hardly translate itself in observable disruptive behaviour.

Possibly, by measuring SCLs on a continuous basis in patients who are at a high risk of becoming violent, without this procedure having to interfere with the patients’ life, may help to make the very first stages of tension building visible and quantifiable. This may open new avenues for intervening at an earlier stage than currently is the case, and to evaluate the effects of such interventions and treatment. Apart from that, one could consider to give patients real time access to their own current stress levels, so that patient may learn to recognize, and possibly cope with, building tension themselves at an earlier stage. These techniques, of course, have been used earlier in various biofeedback therapies. Wearable devices, however, make it possible to receive the feedback on a continuous basis, in real life, and even in the hectic situation of a locked ward environment. In other words, the fact that the device is in the form of a watch allows assessments around the clock with the most difficult patients.

The use of real time psycho physiological assessments, in our opinion, may give an enormous boost to research on understanding and preventing inpatient aggression. It has proven difficult in the past to take aggressive patients who are in acute psychiatric crisis to the laboratory, but we now can take the laboratory to the patients in a portable form. The wearable device may also prove useful in helping patients to learn how to calm down more effectively. The use of real time assessments of the SCL of psychiatric patients in a state of (near) crisis may mean a new chapter of research on psycho physiological phenomena that are associated with human aggression.

References


