# Pain Assessment Scale for Patients With Disorders of Consciousness: A Preliminary Validation Study

CE 2.5 ANCC Contact Hours

*Ingrid Poulsen, Pia Brix, Sylvia Andersen, Lars Westergaard, Rikke Guldager*

## ABSTRACT

**Background:** Patients with acquired brain injury undergoing rehabilitation are often unable to verbalize pain because of disorders of consciousness. Hence, observational pain assessment instruments are warranted for these patients. **Aim:** The aim of this study was to study interrater agreement and sensitivity to change over time of an assessment scale developed for the evaluation of pain in severely brain-injured patients with disorders of consciousness. **Methods:** We developed a pain assessment scale based on scientific literature and clinical experience with severely brain-injured patients. It consists of four domains: physiological/autonomic, body language, verbal communication, and behavior. The domains consist of 27 items. Interrater reliability was tested through three experienced nurses who rated 26 patients with acquired brain injury. The patients were rated in two different situations: before and after repositioning in bed and before and after administration of analgesics. We used Cohen's kappa test for interrater reliability. Sensitivity to change was tested by Wilcoxon signed rank test. **Results:** Cohen's kappa for the presence or absence of each item was above 0.8 for 13 items, between 0.6 and 0.8 for eight items, and less than 0.6 for only three items. The sensitivity test showed a significant change from before to after repositioning ($p = .004$). **Conclusion:** It appeared that many of the pain assessment scale items held potential for inclusion in a new, more comprehensively developed and validated scale for the assessment of pain in patients with disorders of consciousness.

**Keywords:** acquired brain injury, disorders of consciousness, nociception, pain, pain assessment

It is clinically challenging to assess pain in patients in a coma, in a vegetative state/unresponsive wakefulness state (VS/UWS; preserved arousal but no signs of consciousness), or in a minimally conscious state (MCS; preserved arousal and reproducible but fluctuating behavioral signs of consciousness). Such patients are not in a position to express themselves verbally (Schnakers et al., 2010). Thus, scales such as the Visual Analog Scale (Fig 1), which is the most commonly used measure of pain, cannot be used because they require capacity to understand the task and to communicate about abstract ideas such as pain (Zwakhalen, Hamers, Abu-Saad, & Berger, 2006). Hospitals in Denmark must document pain assessment, information given, and treatment and its effectiveness; treatment must be evidence based (http://www.ikas.dk/DDKM.aspx). However, no pain assessment scale (PAS) has been validated for clinical use to measure pain in patients with reduced states of consciousness, for example, those with acquired brain injury (ABI).

ABI is used as an umbrella term that at least includes traumatic brain injury (TBI) or concussion, stroke, aneurysm, post cardiac arrest brain injury, "near drowning," and surgical complications resulting in anoxia. Pain in patients with ABI may be because of spasticity, contractures, fractures, pressure sores, soft tissue ischemia, peripheral nerve injuries, and numerous other possible causes (Schnakers & Zasler, 2007). However, self-reporting is not possible in noncommunicative patients, such as those recovering from coma, because pain is perceived and conceptualized as nociception and not as pain in this patient group (Schnakers et al., 2010). According to the International Association for the Study of Pain (IASP), pain is defined as "an unpleasant sensory and emotional

*Questions or comments about this article may be directed to Ingrid Poulsen, PhD, at ingrid.poulsen@regionh.dk. She is a Research Manager, RUBRIC (Research Unit on Brain Injury Rehabilitation Copenhagen), Clinic of Neurorehabilitation, Traumatic Brain Unit, Rigshospitalet, Denmark.*

*Pia Brix, RN, is a Clinician, Clinic of Neurointensive Care, Rigshospitalet, Denmark.*

*Sylvia Andersen, RN, is a Clinician, Clinic of Neurointensive Care, Rigshospitalet, Denmark.*

*Lars Westergaard, MD, is a Consultant, RUBRIC (Research Unit on Brain Injury Rehabilitation Copenhagen), Clinic of Neurorehabilitation, Traumatic Brain Unit, Rigshospitalet, Denmark.*

*Rikke Guldager, MSc, is a Clinical Nurse Specialist, RUBRIC (Research Unit on Brain Injury Rehabilitation Copenhagen), Clinic of Neurorehabilitation, Traumatic Brain Unit, Rigshospitalet, Denmark.*

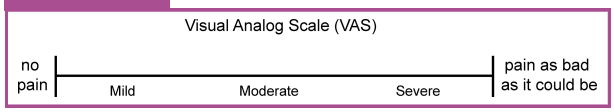
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**FIGURE 1 Visual Analog Scale (VAS)**




experience associated with real or potential tissue damage, or described in terms of such damage"(IASP, 2012). This definition implies that pain is a subjective experience and demands that the person in pain can express himself or herself in a conscious manner. In contrast, nociception is defined as "the neural process of encoding noxious stimuli," and a nociceptive stimulus is defined as "an actually or potentially tissue-damaging event transduced and encoded by nociceptors" (IASP, 2012). Thus, nociception refers to the basic processing of a noxious stimulus, for example, when a patient is turned or repositioned in bed. Nociceptive stimulus is necessary to pain perception, but for patients with disorders of consciousness (DOC), it will not always lead to a conscious experience (Chatelle et al., 2014). Neuroimaging studies show that brain processing linked to pain in those in a VS/UWS is incomplete and is carried out only at a primary, and not higher, secondary level (Schnakers et al., 2010). It is, however, important to stress that it is not evident that all patients in VS/UWS cannot feel pain (Chatelle et al., 2014). On the other hand, it has been shown that individuals who are in an MCS may have brain activation patterns to pain similar to normal controls. Thus, these patients may have sufficient cortical integration and access to afferent information to allow nociceptive stimuli to be consciously processed (Schnakers et al., 2010). Despite these definitions, we have chosen to use the word "pain" in relation to the phenomenon in this article.

Unrelieved acute pain can lead to negative physiological and psychological reactions, which in turn may affect the patient's outcome and may compromise rehabilitation and the longer term in hospital (Li, Puntillo, & Miaskowski, 2008). Furthermore, untreated pain may develop to a chronic stage. Therefore, it is important to identify and treat pain in the best possible way and to assess whether the treatment is effective (Herr, Bjoro, & Decker, 2006).

Schnakers et al. developed the first assessment scale for patients in VS/UWS and MCS, the Nociception Coma Scale (NCS; Schnakers et al., 2010; Table 1). NCS consists of four subscales—motor response, verbal response, visual response, and facial expression—and was developed from pain scales for noncommunicative patients with advanced dementia or for newborns to assess behaviors linked to nociceptive pain in the VS/UWS and MCS. The researchers found that the

> "It is interesting that the physiologic/autonomic part of our scale was the one with the best agreement…"

NCS could register response from noxious stimuli and that it was able to discriminate between patients in VS/UWS and MCS ($n$ = 48, 28 VS/UWS and 20 MCS; age range = 20–82 years; 17 with traumatic etiology). This ability to discriminate indicates that there is an overlap between the NCS and scales examining level of consciousness, for example, Coma Recovery Scale-Revised (Giacino, Kalmar, & Whyte, 2004). Furthermore, the scale was developed to address the question of whether the patient with DOC is able to feel pain rather than whether they are in pain. In 2012, the same research group published a study to further examine whether the scale was specific to noxious stimuli. They included 64 patients (27 VS/UWS and 37 MCS; age range = 20–82 years; 22 with traumatic

**TABLE 1. The Nociception Coma Scale**

| |
|---|
| Motor response |
| 3 = localization to noxious stimulation |
| 2 = flexion withdrawal |
| 1 = abnormal posturing |
| 0 = none/flaccid |
| Verbal response |
| 3 = verbalization (intelligible) |
| 2 = vocalization |
| 1 = groaning |
| 0 = none |
| Visual response |
| 3 = fixation |
| 2 = eye movements |
| 1 = startle |
| 0 = none |
| Facial expression |
| 3 = cry |
| 2 = grimace |
| 1 = oral reflexive movement/startle response |
| 0 = none |

The original Nociception Coma Scale (NCS) as developed by Schnakers et al. (2010). The NCS-Revised omits the visual response items (Chatelle, Majerus, Whyte, Laureys, & Schnakers, 2012).

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etiology). The results showed that, except for the visual scale, the scores from subscales as well as total scores were significantly higher in response to a noxious stimulus (pressure applied to the fingernail) than to a nonnoxious stimuli (tapping on the shoulder). Thus, the researchers decided to remove the visual subscale, and the revised scale was named NCS Revised (NCS-R; Chatelle et al., 2012). The authors recommend that this scale be tested in clinical practice (Chatelle et al., 2012), and those studies are ongoing (Chatelle et al., 2014).

In recent years, published studies have indicated that patients with TBI exhibit different behavioral signs or reactions to nociception or to pain from those exhibited by patients without such injury. Where 65%–69% of unconscious patients with trauma, medical or surgical diagnosis expressed frowning or grimacing and muscle rigidity, patients with TBI had mostly a relaxed face (70%) and no muscle rigidity (72%) during a procedure of turning in bed (Gélinas & Arbour, 2009). In 2014, Arbour and Gélinas conducted an integrative literature review concerning experts' opinions and empirical data on behavioral and physiological indicators of pain in nonverbal patients with TBI. These experts were, for example, certified physicians in medicine or rehabilitation, acute TBI specialists, neurologists, or certified neuropsychologists. The authors found that patients with TBI exhibit atypical signs on nociception or pain such as raising eyebrows, eye opening, weeping eyes, and absence of muscle tension. Furthermore, vital signs (blood pressure, heart rate, respiratory rate, $CO_2$, $SPO_2$) were identified as potential indicators of pain (Arbour & Gélinas, 2014). However, very little research has been done on those atypical signs on nociception in patients with brain injury in the early rehabilitation stage. Arbour et al. (2014) in a study including patients in intensive care with varying severity of TBI assessed them by 50 items from existing pain assessment tools. Those authors found that patients mostly exhibited atypical responses such as flushing, sudden eye opening, weeping eyes, and flexion of limbs. Patients were observed at baseline, during, and 15 minutes after a nociceptive procedure (turning in bed) and a nonnociceptive procedure (noninvasive blood pressure measurement). The atypical behaviors were observed in ≥25% of the patients during the turning procedure. No physiological signs, such as reaction on nociceptive stimulus or nonnociceptive stimulus, were included in that study.

On the basis of current knowledge and aiming to create a scale for use in clinical practice, our objective was to study interrater agreement and sensitivity to change over time of a PAS for severely brain-injured patients with DOC.

## Methods

An interdisciplinary project group (physician and nurses) developed a preliminary scale to assess pain, based on a literature review and on extensive clinical experience with patients with ABI. We searched the literature for measures of pain in populations where self-reporting is impossible or unreliable. Existing scales have been developed and validated for clinical use in care of preverbal infants and sedated and anesthetized patients and for people with developmental disabilities, advanced dementia, and DOC (Ambuel, Hamlett, Marx, & Blumer, 1992; Herr et al., 2006; Li et al., 2008; Merkel, Voepel-Lewis, Shayevitz, & Malviya, 1997; Zwakhalen et al., 2006). However, those patient groups were different from patients with ABI; for example, some were for patients with intact nervous systems but without a developed language and thus unable to communicate, and others were for conscious but confused patients. Finally, the NCS and NCS-R were not validated for clinical use (Chatelle et al., 2012; Schnakers et al., 2010). As discussed above, patients with TBI seem to present a wider range of behavioral reactions to pain than do adult patients without TBI. Grimacing, agitation, both increase and absence of muscle tension, raising eyebrows, opening eyes, and weeping eyes were seen as reactions when exposed to nociception (Arbour & Gélinas, 2014).

Three experienced neuroscience nurses, a research nurse, and a neurological consultant physician discussed and reflected on the most significant signs of nociception or pain in patients with DOC. They agreed on 27 signs, of which some but not all were similar to those found in the literature. These signs were divided into four domains (subscales): (a) physiological/autonomic signs ($n$ = 10), (b) body language ($n$ = 7), (c) verbal communication ($n$ = 4), and (d) behavior ($n$ = 6; Table 2). Our underlying line of thought was that patients' signs of pain would depend on level of consciousness in the sense that those at the lowest level of consciousness would be able to show only physiological/autonomic signs of pain whereas those at the highest level would be able show behavioral signs.

### *Participants*

Patients admitted to five different neurointensive care units, as well as to subacute neurorehabilitation units, in Denmark were included. Inclusion criteria were as follows: Danish speaking, aged ≥15 years, diagnosed with ABI in the acute or subacute phase (within the first 3 months after injury), and not able to express themselves verbally. The nurses who were responsible for the daily care of the patients were asked if they judged the patient capable of expressing pain by mean of a Visual Analog Scale. If a patient was judged unable to do so, the relatives were asked for permission

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**TABLE 2.** Domains and Items of PAS and Cohen's Kappa Between Three Raters in 27 Items Before and After Repositioning in Bed or Before and After Administration of Analgesic

| | Domains and Items of PAS | Rater, 1+2 Before | Rater, 1+3 Before | Rater, 2+3 Before | Rater, 1+2 After | Rater, 1+3 After | Rater, 2+3 After | Mean |
|---|---|---|---|---|---|---|---|---|
| | Physiological/autonomic signs | | | | | | | |
| 1 | Blood pressure | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 2 | Heart rate | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 3 | Respiratory rate | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 4 | Pupillary dilatation | 0.76 | 0.73 | 0.82 | 0.88 | 0.91 | 0.91 | 0.835 |
| 5 | Tear production | 1.00 | 1.00 | 1.00 | 1.00 | 0.79 | 0.79 | 0.93 |
| 6 | Pale skin | 0.55 | 0.55 | 0.61 | 0.38 | 0.45 | 0.63 | 0.528 |
| 7 | Cold skin | – | – | 0.64 | – | – | 0.66 | 0.65 |
| 8 | Cold sweating | 0.83 | 0.83 | 1.00 | 0.48 | 0.66 | 0.79 | 0.77 |
| 9 | Sweat production | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 10 | Goose pimples | 1.00 | 1.00 | 1.00 | 0.66 | 0.66 | 1.00 | 0.886 |
| | Body language signs | | | | | | | |
| 11 | Grimacing | 0.45 | 0.45 | 0.29 | 0.86 | 0.72 | 0.74 | 0.585 |
| 12 | Wrinkles forehead | 0.79 | 1.00 | 0.79 | 0.87 | 0.80 | 0.80 | 0.841 |
| 13 | Squinting | – | – | −0.23 | 0.66 | 0.66 | 0.79 | 0.703 |
| 14 | Clenched teeth | – | – | 0.66 | 0.91 | 0.91 | 1.00 | 0.87 |
| 15 | Eyes wide open | 1.00 | 0.48 | 0.48 | 0.76 | 0.69 | 0.83 | 0.706 |
| 16 | Increased tonus | 0.76 | 0.76 | 1.00 | 0.64 | 0.86 | 0.78 | 0.82 |
| 17 | Twitches | 1.00 | 1.00 | 1.00 | 0.29 | 0.48 | 0.65 | 0.736 |
| | Verbal communication signs | | | | | | | |
| 18 | Sigh | 0.66 | 0.66 | 1.00 | −0.48 | −0.31 | 0.66 | 0.745 |
| 19 | Moan | – | – | – | 0.48 | 0.48 | 0.48 | 0.48 |
| 20 | Complain | 0.66 | 1.00 | 0.66 | 0.93 | 0.93 | 1.00 | 0.86 |
| 21 | Cry (with voice) | – | – | – | 0.66 | 0.66 | 1.00 | 0.773 |
| | Behavioral signs | | | | | | | |
| 22 | Weeps | – | – | – | – | – | – | |
| 23 | Irritable | – | – | – | – | – | – | |
| 24 | Motor restlessness | 1.00 | 1.00 | 1.00 | 0.79 | 0.85 | 0.65 | 0.88 |
| 25 | Confused | 0.85 | 0.85 | 1.00 | 1.00 | 0.79 | 0.79 | 0.88 |
| 26 | Restlessness | – | – | – | – | – | – | |
| 27 | Takes hand to the aching place | 1.00 | 0.66 | 0.66 | – | – | – | 0.773 |

*Note.* An en dash (–) indicates that the rater(s) did not observe this sign on nociception or pain in any of the patients.

to include them. Exclusion criteria were patients whose relatives would not allow participation.

## *Ethical Considerations*

The study was registered with the Danish Data Protection Agency, File number 2011-41-5772. According to the Danish National Committee on Health Research Ethics, only studies defined as biomedical research studies must be approved. Therefore, this study was not registered under the committee act. The ethical principles of the Declaration of Helsinki were followed. The patients' relatives were informed and asked for their consent to use the patient ratings for research purposes.

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### Procedure

The following patient characteristics were retrieved from their records: age, gender, diagnosis, tracheostomy (yes/no), and able to verbalize (yes/no). The nurses assessed patients' state of consciousness by Glasgow Coma Scale score (Teasdale & Jennett, 1974), immediately before the ratings.

Patients were rated during one of two regular clinical procedures, namely, (a) before and after repositioning in bed and (b) before and after administration of analgesics. Both procedures were chosen because we assumed them to be pain relieving. In the first procedure, patients were repositioned when needed, for example, after up to 2 hours in the same position. Three nurses rated patients before, and within 5 minutes after, the repositioning. In the second procedure, the patient's own nurse administrated the analgesics either in a regular basis or "as needed." The nurses first searched for data on the kind of analgesic and thus the predicted time for effect of the medicament. The "after rating" was done, on average, 30 minutes after medication. The 27 items were rated as "present" or "not present." Blood pressure and heart rate were measured electronically only once in each range of measures; thus, the agreement between the nurses was based on one measure. The ratings were done individually with the nurses documenting results on separate forms and not sharing or discussing them with each other before completion of the ratings.

### Statistics

Patient characteristics are described by mean and percent values. Cohen's kappa was used to test interrater reliability (Altman, 1991). This was done by first testing the agreement between nurses 1 and 2, then nurses 2 and 3, and finally, nurses 1 and 3. Finally, a mean value of all three kappa values was calculated. We used the Wilcoxon signed rank test to test sensitivity to change over time between the before and after ratings. SPSS version 19 was used for analysis, and $p < .05$ was set as statistically significant.

## Results

We included 26 patients; 44 ratings were conducted. More men (61.5%) than women were included, and most patients (57.7%) had a non-TBI including the following diagnoses: stroke, hydrocephalus, aneurysm, subarachnoid hemorrhage, subdural hemorrhage, cerebral paresis, epilepsy, post cardiac arrest brain injury, and cerebral abscess (Table 3).

The reliability test showed very good agreement for 13 items: blood pressure, pulse, respiratory rate, pupillary dilatation, tear production, sweat production, goose pimples, forehead wrinkles, clenched teeth, increased tonus, complain, motor restlessness, and confusion (Cohen's kappa = 0.80–1.00). Good agreement was found for eight items (Cohen's kappa = 0.60–0.79), and moderate agreement was found for three items (Cohen's kappa = 0.40–0.59; Altman, 1991). The remaining three items were not observed by any of the nurses in any of the patients and thus could not be tested for agreement (Table 2).

When testing the difference from before to after repositioning (sensitivity to change), we found that patients scored higher after repositioning than before ($p = .004$). There was no difference between before and after administration of analgesics.

**TABLE 3. Characteristics of Patients Participating in the Study ($N = 26$).**

| Variable | Values |
|---|---|
| Age in years, mean (range) | 56.5 (15–74) |
| Gender: men, n (%) | 16 (61.5) |
| Traumatic/nontraumatic brain injury, *n* (%) | 11/15 (42.3) |
| GCS, mean (range) | 10 (6–14) |
| Verbalizing (yes) | 11 (42.3%) |
| Tracheostomy (yes) | 7 (26.9%) |

## Discussion

Our study showed that nearly 50% of the items we had chosen for the assessment scale showed very good interrater agreement and that a substantial number of the remaining ones showed good or moderate agreement. Furthermore, we found that the scale may be capable of measuring change over time, which is a very important property when the aim is to develop a scale for use in clinical practice.

It is interesting that the physiological/autonomic part of our scale was the one with the best agreement; 7 of 10 items showed very good agreement. Those reaching this highest level of agreement were blood pressure, heart rate, respiratory rate, pupillary dilatation, tear production, sweat production, and goose pimples. The integrative review of pain indicators by Arbour and Gélinas (2014) suggested that nonverbal patients with TBI in intensive care or in acute rehabilitation units may have an autonomic response to pain characterized by an increase in blood pressure, heart rate, and respiratory rate. Furthermore, in that analysis, it was shown that such patients in acute rehabilitation units may react physiologically to pain by an increase in blood pressure and heart rate. Last but not least, in acute/subacute rehabilitation units,

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they may have an autonomic response to nociceptive stimulation shown by tachycardia, tachypnea, and diaphoresis. The opinions outlined in the Arbour and Gélinas (2014) review were followed by an analysis of empirical studies. Those studies found significant changes in vital signs such as blood pressure and heart rate during a nociceptive procedure. Furthermore, most patients with TBI and ventilated patients with trauma showed an increase in blood pressure, heart rate, respiratory rate, and $CO_2$ and a decrease in $SPO_2$ (Arbour & Gélinas, 2014). Most patients in the studies included in the integrative review were patients with medical or surgical diagnosis in intensive care units, but two studies (Gélinas & Arbour, 2009; Gélinas & Johnston, 2007) included patients with TBI within a month of their injury. Nevertheless, in 2010, Schnakers et al. describe their earliest development of the NCS for patients in VS/UWS and MCS, stating that previous studies had shown that autonomic changes such as respiration and heart rate are not reliable indicators of nociception. However, this statement was based on the assessments of postoperative analgesic demand for newborns, infants, and young children and on awareness during anesthesia (Schnakers et al., 2010) and not on patients with ABI. Gélinas and Johnston (2007) also found that physiological signs of pain were not reliable, but because this was based on correlation of observed signs and patient self-report, the individuals were conscious. Although it is known that stress, medication, medical complications, and the brain lesion itself affect autonomic functions (Chatelle et al., 2014), it is not clear whether physiological/autonomic signs of pain in patients in a reduced state of consciousness can be used in pain assessment.

There are three dimensions in the behavioral section of our scale: body language, verbal communication, and behavior. Wrinkling of forehead, clenching of teeth, and increased tonus reached kappa > 0.8. None of the verbal communication items reached this level, but for the last of our dimensions behavior, motor restlessness and confusion did reach it. While we have developed our scale, other researchers have tested some of the same items for measuring pain in patients with TBI. Some found that such patients showed atypical signs of pain, for example, Arbour et al. (2014) who aimed to validate the use of behaviors for assessing pain in adults in an intensive care unit within the first month after TBI and with a Glasgow Coma Scale score > 3. The authors tested a checklist with 44 items from validated behavioral pain scales in critical care and added a further six items. Pain behaviors were tested before, and 15 minutes after, a turning procedure and while measuring blood pressure noninvasively. For the initial data collection (a second one was carried out for patients with changing level of consciousness), the pain behaviors most frequently observed were frowning, flushing, sudden eye opening, eye weeping, flexion of an upper or lower limb, and moaning, independent of the level of consciousness.

Of the six items most observed by Arbour et al. (2014), we chose only two in our scale. The item "eyes wide open" in our scale may be similar to their item "sudden eye opening." Moaning was observed in both scales, however, with a moderate interrater reliability in our scale (.48). We did not have items related frowning, flushing, and flexion of upper or lower limbs. However, we observed motor restlessness, which may effectively be the same as flexion. We consider that flushing belongs to physiological/autonomic sign of pain, as suggested by Arbour et al. in their discussion.

These authors also tested intrarater and interrater agreement and found mostly very good agreement (mean = 95.5%) between two raters. However, low interrater agreement was found for eye weeping and flushing (48.6% and 35.9%, respectively). In our scale, tear production could be similar to eye weeping; however, we have categorized the latter as a physiological/autonomic sign. Weeping was not observed in any of the rated patients.

We also tested our scale for sensitivity to change over time and found that, when using the repositioning procedure, there was a significant difference from before to after the assessment. The results showed more signs of pain after the repositioning procedure than before. This can be explained by the fact that the ratings were conducted within 5 minutes of the repositioning procedure. We believe that it would have been more appropriate if we had rated the patients after, for example, 15 minutes, giving an opportunity to relax after the repositioning, as in the study by Arbour et al. (2014). We did, however, not find a difference when rating signs of pain before and after administration of analgesics. Analgesics were administered either regularly or "as needed." In the latter case, administration was based on the nurse's experience and understanding of the patient. In the preparation of a new PAS, nurses caring for patients with DOC were interviewed. They reported that physicians ordering analgesics on an "as needed" basis had very little guidance, particularly when they did not know the patient (Chatelle et al., 2014).

## Limitations of the Study

We found that 7 of 10 items in the physiological/autonomic domain fall in the "very good agreement" category. However, blood pressure and heart rate were

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measured only once in each rating, and one could argue that, by necessity, those two items would fall in this category. On the other hand, there is always a risk of reading an electronic measurement in different ways. Our study included only a small sample of patients with ABI, and the sample consisted of patients with both TBI and non-TBI. We do not know whether illness etiology has an impact on the results; thus, we suggest the need for larger samples in future studies with the possibility of assigning patients to TBI and non-TBI categories. Furthermore, we did not have a clear description for interpreting whether the signs were present, which could of course limit the strength of the study. However, the nurses who conducted the ratings had chosen and discussed the signs, based on their own experience, and thus, we believe that their assessments were done similarly. In future studies and in clinical practice, defining the scale consistently will enhance its value.

## Conclusion and Future Studies

In this preliminary study of development and validation of a scale for assessment of pain in patients with ABI in the acute and subacute rehabilitation stage, we found that nearly 50% of the PAS items held potential for inclusion in a new, more comprehensively developed and validated scale for the assessment of pain in patients with DOC. Because we have not found any convincing evidence for not using physiological/autonomic signs of pain, we will include those signs in our further work.

In an ongoing study between the authors of this article and the Moss Rehabilitation Research Institute in the United States, we aim to develop and validate a unidimensional quantitative observational scale to detect the severity of nociceptive conditions for clinical use in patients who are not able to communicate because of DOC and who are admitted to subacute rehabilitation after TBI (Chatelle et al., 2014).

This new scale consists of both physiological/autonomic and behavioral signs based on literature studies and the experience with our PAS. Signs of pain are described with increasing intensity, assuming that, for example, a frown is of lower intensity than a scream. Data are collected in various situations and on different doses of analgesia. We are collecting data on a large number of patients on both sites and expect, among other things, to determine whether physiological/autonomic signs of pain are valid and reliable in a PAS for patients with TBI in DOC.

## Implications for Nursing Practice

Although the PAS is not fully validated, our experience is that it is an important and useful tool for bedside nursing practice. The PAS is fast and easy to learn. By means of this assessment tool, nurses can play a pivotal role in systematically assessing pain in patients not able to express themselves.

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