The Use of the Behavioral Pain Scale to Assess Pain in Conscious Sedated Patients

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BACKGROUND: Assessing pain in mechanically ventilated critically ill patients is a great challenge. There is a need for an adequate pain measurement tool for use in conscious sedated patients because of their questionable communicative abilities. In this study, we evaluated the use of the Behavioral Pain Scale (BPS) in conscious sedated patients in comparison with its use in deeply sedated patients, for whom the BPS was developed. Additionally, in conscious sedated patients, the combination of the BPS and the patient-rated Verbal Rating Scale (VRS-4) was evaluated.
METHODS: We performed a prospective evaluation study in 80 nonparalyzed critically ill adult intensive care unit patients. Over 2 mo, nurses performed 175 observation series: 126 in deeply sedated patients and 49 in conscious sedated patients. Each observation series consisted of BPS ratings (range 3–12) at 4 points: at rest, during a nonpainful procedure, at retest rest, and during a routine painful procedure. Patients in the conscious sedated state also self-reported their pain using the 4-point VRS-4.
RESULTS: BPS scores during painful procedures were significantly higher than those at rest, both in deeply sedated patients (5.1 [4.8–5.5] vs 3.4 [3.3–3.5], respectively) and conscious sedated patients (5.4 [4.9–5.9] vs 3.8 [3.5–4.1], respectively) (mean [95% confidence interval]). For both groups, scores obtained during the nonpainful procedure and at rest did not significantly differ. There was a strong correlation between nurses' BPS ratings and conscious sedated patients' VRS-4 ratings during the painful procedure ($r_s = 0.67$, $P < 0.001$). At rest and during nonpainful procedures, 98% of the observations were rated as acceptable pain (VRS 1 or 2) by both nurses and patients. During painful procedures, nurses rated the pain higher than patients did in 16% of the observations and lower in 12% of the observations.
CONCLUSION: The BPS is a valid tool for measuring pain in conscious sedated patients during painful procedures. Thus, for noncommunicative and mechanically ventilated patients, it may be regarded as a bridge between the observational scale used by nurses and the VRS-4 used by patients who are able to self-report pain.
(Anesth Analg 2010;110:127–33)

Many critically ill patients in the intensive care unit (ICU) suffer from pain,[1–3] notably those on mechanical ventilation.[4,5] From 35% to 55% of nurses have been reported to underrate patients' pain,[6,7] and a current practices study revealed that the observed rates of assessment during procedural pain in mechanically ventilated patients remain below 40%.[8] Researchers have recognized that pain and inadequate pain relief are major causes of physiological adversity and emotional stress.[9–11] Therefore, it would seem important to achieve effective management of analgesia, first by measuring pain in a valid and reliable manner.

Various pain scales are available, but there is insufficient evidence of their reliability in the diverse ICU population. The Society of Critical Care Medicine recommends self-reporting by communicative patients using the numerical rating scale (NRS, range 0–10).[7] This scale requires a certain level of comprehension, so one may opt for an alternative, the 4-point Verbal Rating Scale (VRS-4), which has shown good reliability and validity.[12] Postoperative patients even prefer the VRS-4 over the NRS because of its ease of use.[12]

The observational Behavioral Pain Scale (BPS, range 3–12), applied by nurses, has been validated in deeply sedated, mechanically ventilated patients.[13,14] It is composed of 3 subscales: facial expression,[1–4] movement of the upper limbs,[1–4] and compliance with mechanical ventilation.[1–4,13] The BPS reflects objective visible behavior at 1 specific time point, whereas the NRS represents a global impression of pain, including several contextual factors during a longer time period.[15] Gélinas et al.[16] developed the Critical Care Pain Observation Tool (range 0–8). Based on the BPS, the

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Accepted for publication September 14, 2009.

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DOI: 10.1213/ANE.0b013e3181c3119e

Critical Care Pain Observation Tool has not yet been tested among different critical care populations and requires additional validation.[17]

Apart from communicative and deeply sedated patients, a third group can be identified, i.e., conscious sedated mechanically ventilated patients. Current ICU practice strives to restrict sedation to a conscious level whenever possible, in agreement with the landmark report[18] that showed that ventilated patients benefit from daily interruption of sedative infusions. Ventilation could be stopped earlier in these patients, resulting in shorter ICU stays, and they showed no adverse psychosocial outcomes.[19]

Self-reporting using the NRS or VRS-4 may be complicated or unreliable in these patients because of their temporarily limited capacities of abstraction and concentration, and lack of comprehension.[7,11] Furthermore, the BPS has been validated only in deeply sedated and noncommunicative patients.

For this growing group of conscious sedated patients, an observational pain scale such as the BPS, which can be used by the nurse, can add value to VRS-4 scores, because patients' self-reporting may be complicated and/or unreliable. Therefore, we designed a study to compare use of the BPS_{nurse} in conscious sedated patients and in deeply sedated patients, for whom the BPS was developed. Additionally, in conscious sedated patients, the combination of the BPS_{nurse} and the patient-rated VRS-4 was evaluated.

METHODS

Design

A prospective, observational study was performed in a 30-bed surgical/medical ICU in a teaching hospital in Nieuwegein, The Netherlands. The Medical Ethical Committee of the St. Antonius Hospital approved the study protocol and waived the need for informed consent because the observational study design and pain measurements are considered as standard care.

Patients and Classifications

During the 2-mo study period, all patients admitted to the ICU were evaluated for inclusion in the study once a day (between 8:00 AM and 12 noon). ICU patients who were 18 yr and older, sedated irrespective of sedation depth, and ventilated for at least 8 h before assessment were eligible for inclusion. Patients who received neuromuscular blocking medications or muscle-paralyzing drugs, who were unconscious after resuscitation, quadriplegic, had a critical illness (poly) neuropathy, or had an epidural catheter, were excluded.

Included patients were classified as "sedated" or "conscious sedated" on the specific day. Sedated patients were defined as patients who were not able to communicate during all 4 consecutive assessments (at rest, during nonpainful procedures, at retest rest, and during painful procedures) on that particular day.

Table 1. The Behavioral Pain Scale[13]

Item	Description	Score
Facial expression	Relaxed	1
	Partially tightened	2
	Fully tightened	3
	Grimacing	4
Upper limbs	No movement	1
	Partially bent	2
	Fully bent with finger flexion	3
	Permanently retracted	4
Compliance with ventilation	Tolerating movement	1
	Coughing but tolerating ventilation for most of the time	2
	Fighting ventilator	3
	Unable to control ventilation	4

Conscious sedated patients were defined as patients who were able to communicate during at least part of the assessment. Patients could be included on multiple days, an approach also used in the first BPS validation study in nonresponsive critically ill patients.[13]

Eighty patients were included during the 2-mo study period. Fifty patients were classified as sedated on all study days, 17 as conscious sedated on all study days, and 13 as either sedated or conscious sedated on different days in the study period.

Pain Measurement Instruments

BPS

The BPS is an observational pain scale, preferably applied by the attending nurse. It has been validated for use in deeply sedated, mechanically ventilated patients.[13,20] Easy to use and well accepted by nurses, the BPS contains 3 subscales: facial expression, upper limb movements, and compliance with mechanical ventilation (Table 1). Each subscale is scored from 1 (no response) to 4 (full response). Therefore, BPS scores range from 3 (no pain) to 12 (maximal pain).[13] A BPS score of 6 or higher is considered to reflect unacceptable pain.[2]

VRS-4

The VRS-4 is a 4-point verbal rating scale (range 1–4) used for patient self-reporting. It was adapted from the Verbal Graphic Scale,[21] which includes 4 categories: 1) free of pain (NRS 0), 2) mild pain (NRS 1–3), 3) moderate pain (NRS 4–6), and 4) severe pain (NRS 7–10). This shorter version was used because conscious sedated patients may temporarily lack full comprehension of the more complex 11-point NRS. Unacceptable pain using the 11-point NRS is defined as NRS >3 (moderate pain and severe pain),[6,7] thus unacceptable pain using the 4-point VRS was defined as a score of 3 or 4.

In this study, the "BPS_{nurse}" is defined based on a BPS rating by the attending nurse. The "$VRS\text{-}4_{patient}$" is defined by the VRS-4 rating by the patient.

Study Procedures and Intervention

Pain was assessed during 2 routine nursing procedures. One was an arterial catheter dressing change, identified as a nonpainful procedure from a pilot study in our ICU. The second was turning, a procedure that patients have described as painful.[22,23] In addition, pain was assessed at rest, i.e., before the first of these procedures, and in between these procedures, at least 30 min after the first procedure.

At each of these 4 points, a nurse researcher (AV, critical care nurse and student in nursing sciences) and an attending nurse simultaneously observed the patient for about 1 min, with the observers' assessments made independently. The attending nurse then determined the Ramsay Score (RS). Next, the nurse researcher and the attending nurse independently determined the BPS_{nurse} score. Communicative patients were then asked to apply the $VRS\text{-}4_{patient}$. This order was decided upon to prevent the nurses' scores from being influenced by the patient's score.

Demographic data such as gender, age, intensive care indication, and the Sequential Organ Failure Assessment score[24] were collected.

Training

The 72 nurses who participated in the study all attended a 4-h training session, given by a BPS-trained ICU nurse. Attention was given to the essentials of pain and the difficulties of scoring pain in ventilated and sedated patients. The use of the BPS was explained by means of pictures of ICU patients. All received a protocol explaining the study and the BPS.

Depth of Sedation

Depth of sedation was assessed by the RS, which is a single-item, 6-level scale (scores range from 1 to 6).[25] The levels are: 1) patient anxious, agitated, restless; 2) patient cooperative, oriented, and tranquil; 3) patient drowsy or asleep, responds easily to commands; 4) patient asleep, brisk response to a light glabellar tap; 5) patient asleep, sluggish response to a light glabellar tap; and 6) patient asleep, no response to a light glabellar tap.[9] The RSs were rated in the morning (between 7:30 and 8:00 AM), whereas the pain assessments were completed between 8:00 AM and 12:00 noon. In 8 patients, the RS was different during sedation assessment and pain assessment. The RS for the conscious sedated patients (median 6, range 3–6) was significantly lower ($P < 0.001$) than that for the sedated patients (median 3, range 2–5).

Standard Pain and Sedative Medication in the ICU

All patients received pain medication by protocol, i.e., 4 times daily 1 g of acetaminophen rectally, plus either 4 times daily 10 mg morphine subcutaneously if in moderate pain or 30–50 mg morphine per day by continuous IV infusion when in severe pain. Pain severity was evaluated on a daily basis. For procedural pain, patients received either no morphine or a bolus of 5–10 mg morphine, depending on the attending nurse's judgment. Patients were sedated preferably with propofol or midazolam, according to local standard practice.

Data Analysis

Data were analyzed using the SPSS software (version 15.0, Chicago, IL). The statistical analysis was performed by calculation on all measurements of all patients, including 1 measurement per day per patient. This approach was used by Payen et al.[13] when they first validated the BPS in nonresponsive critically ill patients and can be justified because a critically ill patient's condition may rapidly change over 24 h, e.g., when taken off mechanical ventilation, with consequences in terms of organ failure, neurological or respiratory situation, sedation levels, pain levels, and communication abilities.

Kappa coefficients with quadratic weights were used to reflect agreement between the nurse researcher and the attending nurse regarding the BPS. Weighted kappa penalizes disagreement in proportion to its severity.[26] Theoretically, the value of kappa can range from 0 (no agreement) to 1.0 (perfect agreement). A value larger than 0.6 was regarded as satisfactory.[27] The 95% confidence intervals (CIs) for kappa coefficients were calculated.

Internal consistency, a measure of how the items within a scale are interrelated, was expressed in Cronbach's α. A high Cronbach's α value reflects high internal consistency. Generally, a value larger than 0.7 is regarded as satisfactory.[28]

The effect size is a standardized way to express the magnitude and meaning of an instrument's capacity to change, in this case, the BPS. The effect sizes of the BPS total and BPS items were calculated as the difference between the score at rest and the score during the painful procedure, divided by the standard deviation (SD) at rest.[29] An effect size of around 0.20 is generally considered to be small, 1 of 0.50 indicates moderate differences, and those of 0.80 or above indicate large differences.[30]

Values are expressed as mean and 95% CI. Spearman nonparametric rank correlation coefficients (r_s) were used to measure the degree of correlation for 2 ordinal variables. The unpaired *t*-test and the Mann-Whitney *U*-test served to compare differences in quantitative and nonparametric data, respectively. The test-retest procedure was analyzed by the paired Student's *t*-test. A P value of <0.05 was considered statistically significant.

RESULTS

Patients and Data

Table 2 shows the characteristics of the 80 enrolled patients, classified by state of sedation. The mean amount of propofol administered (±SD) was 130.4 ± 58.8 mg/h for conscious sedated patients vs 175.6 ± 72.6 mg/h for sedated patients ($P < 0.05$). The mean

Table 2. Baseline Patient Characteristics of All 80 Patients Participating in the Study, with Patients in Sedated State at All Study Days ($n = 50$), Patients in Conscious Sedated State At All Study Days ($n = 17$), and Patients in Either Sedated or Conscious Sedated State on Different Days ($n = 13$)

	Patients in sedated state on all days	Patients in conscious sedated state on all days	Patients in both states on different days
Number of patients	50	17	13
Age (yr) (range)	66 ± 12	61 ± 15	60 ± 11
Males/females (*n*)	30/20	12/5	7/6
SOFA score (range)	5 (1–14)	5 (1–10)	6 (2–9)
Diagnostic categories (*n*)			
Cardiac surgery	22	9	3
Abdominal surgery	9	6	4
TAAA	5	0	0
Nonsurgical	14	2	6

SOFA = Sequential Organ Failure Assessment; TAAA = thoracoabdominal aortic aneurysm.

Table 3. Interrater Reliability of the BPS Total and Separate BPS Items as Evaluated by Nurses in Sedated Patients (126 Observation Series) and Conscious Sedated Patients (49 Observation Series)

	Kappa	EA (%)	No. observation series
Sedated patients			
BPS total	0.83 (0.79–0.87)	67	126
BPS facial expression	0.80 (0.75–0.85)	82	126
BPS upper limb movement	0.72 (0.64–0.79)	82	126
BPS compliance ventilation	0.62 (0.52–0.72)	88	126
Conscious sedated patients			
BPS total	0.80 (0.72–0.88)	70	49
BPS facial expression	0.78 (0.69–0.87)	81	49
BPS upper limb movement	0.67 (0.52–0.82)	87	49
BPS compliance ventilation	0.61 (0.45–0.70)	89	49

EA = exact agreement; BPS = Behavioral Pain Score.

amount of midazolam administered in conscious sedated patients and sedated patients was 3.3 ± 1.2 vs 4.8 ± 2.5 mg/h ($P = 0.32$). The mean ICU stay at time of pain assessment (±SD) was 4.5 ± 3.6 for conscious sedated patients vs 5.4 ± 8.1 for sedated patients ($P = 0.43$). One hundred seventy-five observation series were completed: 126 in 63 sedated patients and 49 in 30 conscious sedated patients. The latter also included 49 VRS-$4_{patient}$ scores for 30 patients.

Interrater Reliability

Table 3 gives the quadratic weighted kappa and the exact agreement for the BPS_{nurse} in sedated patients (126 observation series) and conscious sedated patients (49 observation series) between the nurse researcher and the attending nurse. Kappa values were excellent (0.80–0.83). There was no difference in exact agreement for sedated and conscious sedated patients (0.83 [95% CI: 0.76–0.87] vs 0.80 [95% CI: 0.72–0.88]).

Pain Scores in Conscious Sedated Patients and Sedated Patients

BPS_{nurse}

BPS_{nurse} scores were significantly higher during painful procedures than at rest in both sedated patients (5.1 [95% CI: 4.8–5.5] vs 3.4 [95%: CI 3.3–3.5]) and conscious sedated patients (5.4 [95% CI: 4.9–5.9] vs 3.8 [95% CI: 3.5–4.1]) (Fig. 1). There was no difference in BPS_{nurse} scores between the nonpainful procedure and rest in sedated patients (3.4 [95% CI: 3.3–3.6] vs 3.3 [95% CI: 3.2–3.4]) and conscious sedated patients (3.7 [95% CI: 3.5–3.9] vs 3.6 [95% CI: 3.3–3.8]). BPS_{nurse} scores did not differ between sedated patients and conscious sedated patients at rest or during nonpainful or painful procedures.

Table 4 shows that the effect size for responsiveness of BPS total scores was large in sedated patients (126 observation series) and conscious sedated patients (49 observation series) (2.5 and 1.8, respectively). The effect size of the item "facial expression" was largest in both sedated patients (3.6) and conscious sedated patients (2.4). It was also large for "compliance with ventilation" (1.4 and 0.9) but moderate for "upper limbs" in both groups (0.7 and 0.5) (Table 4). During painful procedures, internal consistency was moderate in both sedated patients and conscious sedated patients (Cronbach's α 0.63 and 0.66, respectively).

VRS-$4_{patient}$

In conscious sedated patients, VRS-$4_{patient}$ scores were significantly higher during painful procedures

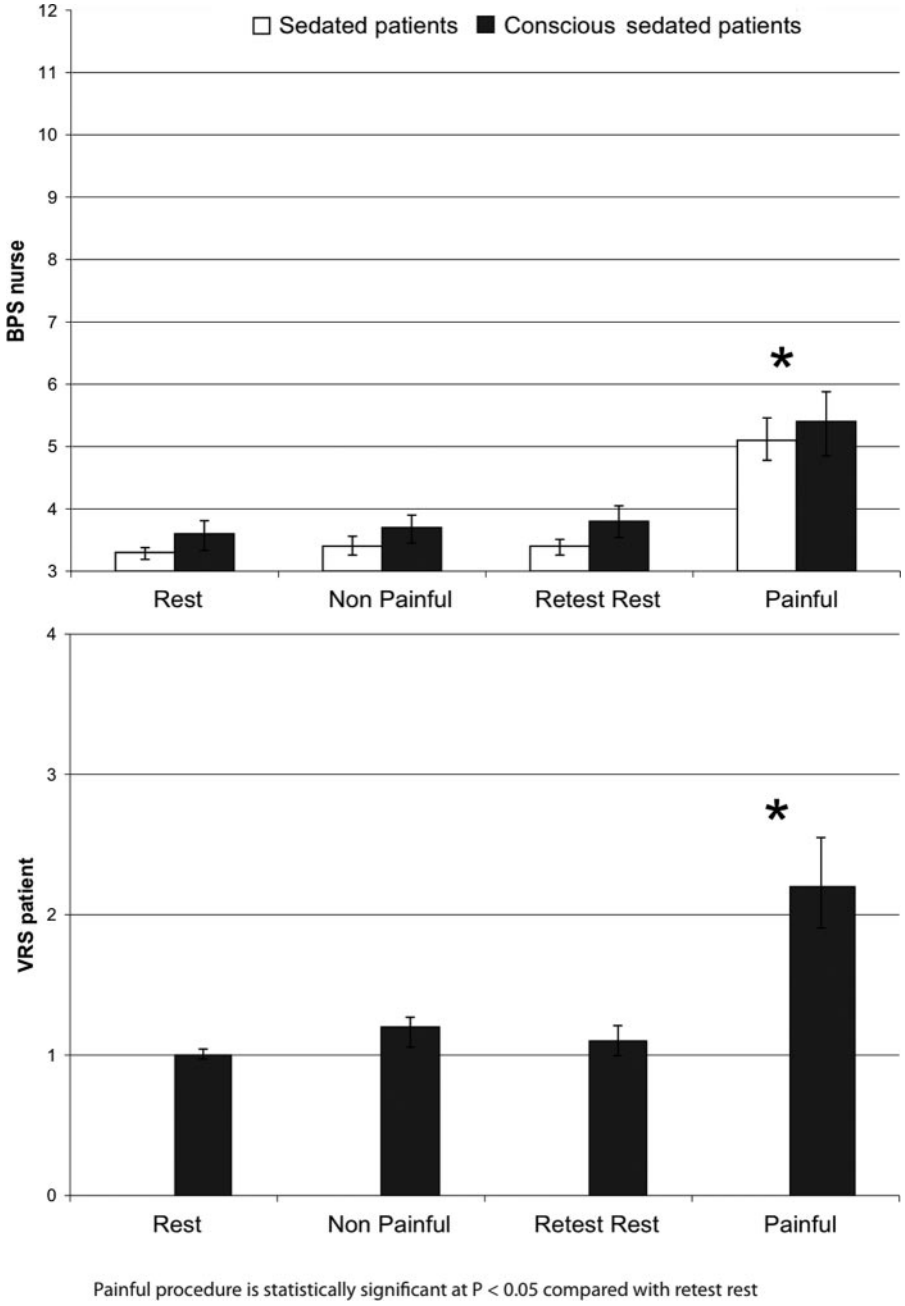

Figure 1. Change in Behavioral Pain Scale $(BPS)_{nurse}$ and Verbal Rating Scale $(VRS)\text{-}4_{patient}$ at rest, during nonpainful procedures, at retest rest, and during painful procedures (mean [95% confidence interval]) in sedated patients (126 observation series) and conscious sedated patients (49 observation series).

than at rest (2.2 [95% CI: 1.9–2.5] vs 1.1 [95% CI: 1.0–1.2]). Scores did not differ between the nonpainful procedure and rest (1.0 [95% CI: 1.0–1.0] vs 1.0 [95% CI: 1.0–1.0]).

Comparison Between BPS_{nurse} and $VRS\text{-}4_{patient}$ in Conscious Sedated Patients

During the painful procedure, there was a strong positive correlation between BPS_{nurse} and $VRS\text{-}4_{patient}$ ($r_s = 0.67$, $P < 0.001$, 49 observation series) (Fig. 2). The 4 boxes in Figure 2 each have been divided into 4 quadrants, separating acceptable pain and unacceptable pain scores (unacceptable pain VRS-4 >2 and BPS >5).

During painful procedures, in 16% of the observations, the patient rated pain as acceptable (VRS scores, 1 or 2), whereas the nurse rated it as unacceptable (BPS >5). Conversely, in 12% of the observations, the patient rated pain as unacceptable (scores VRS >2), whereas the nurse rated it as acceptable (BPS 3–5). At rest, during the nonpainful procedure, and at retest rest, 98% of the observations were in the quadrant with acceptable pain scores. In these cases, both the patient and the nurse assigned acceptable pain scores.

DISCUSSION

The findings from this study are consistent with the notion that the BPS is reliable for pain assessment in conscious sedated patients. This is of interest in that so far the BPS has been validated for deeply sedated patients only.[13] All ICU patients recovering from a deeply sedated state will pass through this conscious

Table 4. BPS Total Scores and BPS Items Scores (Mean ± SD) at Rest and During Painful Procedure, with Effect Size in Sedated Patients (126 Observation Series) and Conscious Sedated Patients (49 Observation Series)

	Retest rest	Painful procedure	*P*	Effect size
Sedated patients				
BPS total	3.4 ± 0.7	5.1 ± 1.0	<0.001	2.5
BPS facial expression	1.1 ± 0.3	2.1 ± 1.0	<0.001	3.6
BPS upper limb movement	1.2 ± 0.4	1.4 ± 0.7	<0.001	0.7
BPS compliance ventilation	1.1 ± 0.4	1.6 ± 0.7	<0.001	1.4
Conscious sedated patients				
BPS total	3.8 ± 0.9	5.4 ± 1.8	<0.001	1.8
BPS facial expression	1.1 ± 0.4	2.0 ± 1.0	<0.001	2.4
BPS upper limb movement	1.5 ± 0.6	1.8 ± 0.8	0.003	0.5
BPS compliance ventilation	1.2 ± 0.4	1.6 ± 0.5	<0.001	0.9

BPS = Behavioral Pain Score.

sedated state. Thereby, patients who experience agitation or delirium, in whom self-reporting will be complicated, benefit from this pain assessment in the conscious sedated state.

BPS_{nurse} scores during painful procedures were significantly higher than those at rest in both sedated patients and conscious sedated patients. Payen et al.[13] made a similar observation in deeply sedated patients, i.e., BPS scores were significantly higher for painful procedures such as turning or tracheal suctioning. Therefore, it would seem that the BPS can detect and discriminate pain and is a valid measure of pain in both sedated and conscious sedated patients. Furthermore, the internal consistency was comparable for observations in both groups, demonstrating similar homogeneity of the items. The fact that the effect size was large in both groups shows that the BPS is able to quantify change in clinical status and detect painful procedures. In both groups, the BPS subscale "facial expression" was the most sensitive to change, as in a previous study.[20] The value of facial expression has been proven for both acute and chronic pain not only in adults[31,32] but also in infants and children.[33]

Underestimation of patients' pain by nurses is a well-known problem.[5] Surprisingly, using the BPS, nurses also tend to overestimate patients' pain. On the other hand, conscious sedated patients' pain scores are not always reliable. Therefore, use of the BPS in combination with the VRS-4 during painful procedures may lead to a more reliable rating of patients' pain. A previous study from our group[34] also concluded that a combination of self-reporting and observational measures is recommended when credibility of self-reporting is doubted. Each method yields unique information. Self-reporting primarily reflects expressive pain behavior that is under control of higher mental processes. Observational measures capture behavior that is less subject to voluntary control and more automatic.[34]

The level of agreement between the research nurse and the attending nurse was high for both sedated patients and conscious sedated patients (kappa 0.83 and 0.80, respectively). The fact that the kappa values in this study pertained to 72 nurses and generally remained good shows that nurses can be trained to use the BPS in a reliable way in both sedated and conscious sedated patients.

In the ideal study design, nurses would be blinded to the nature of the procedure (painful or nonpainful) that is being performed at the point of assessment. This could be achieved by videotaping the scenes and having the nurses rate the scenes afterward. Care

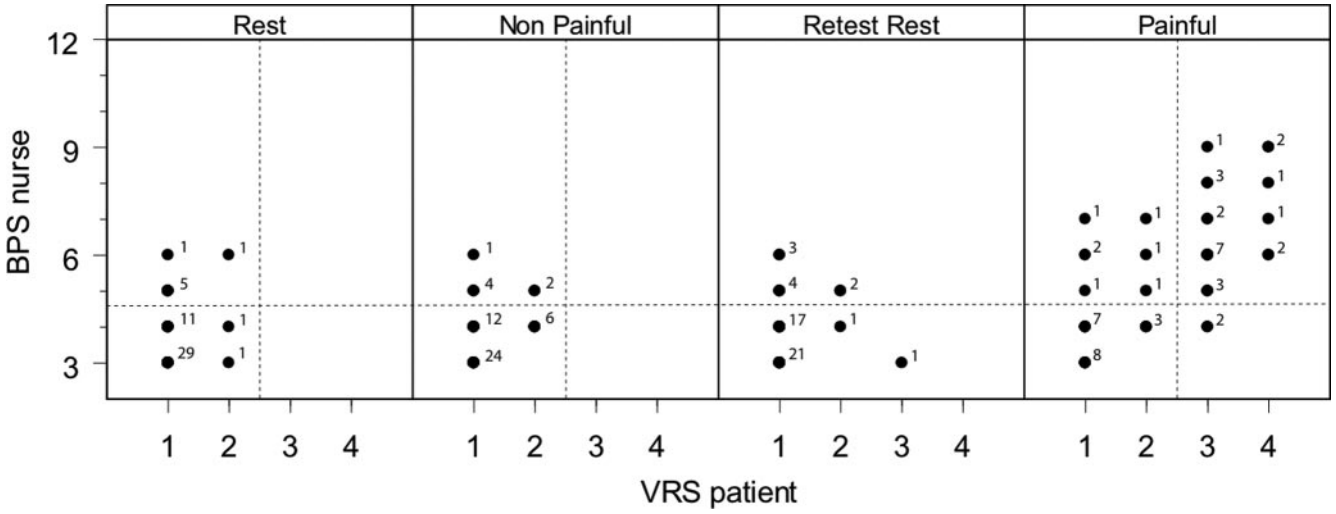

Figure 2. Correlation between Behavioral Pain Scale $(BPS)_{nurse}$ and Verbal Rating Scale (VRS)-$4_{patient}$ (49 observation series) at rest, during nonpainful procedures, at retest rest, and during painful procedures. The dotted line divides acceptable pain scores from unacceptable pain scores (VRS-4 >2 and BPS >5). Each number reflects how many similar results were observed per paired evaluation.

should be taken then to conceal the procedure. A limitation of video recordings is the likelihood that some aspects are missed because the general overview of the patients' situation is necessarily not provided.

In this study, we used the VRS-4 instead of the 11-point NRS because of the lack of capability in conscious sedated patients. This approach was inspired by a study from Briggs and Closs,[12] who showed that postoperative patients prefer the VRS. However, it would be of interest to test whether our assumption that conscious sedated patients are indeed incapable of using an 11-point scale is valid.

In this study, most patients were in a sedated state, although it is desirable for patients to be in a conscious sedated state. This suggests that the health staff should give more attention to the sedation state of the patients in our ICU.

Nevertheless, because the BPS may both overrate and underrate patients' pain, and the patient's self-report is not always reliable, a combination of the nurse-rated BPS and the patient-rated VRS-4 is perhaps ideal for estimating patients' pain. Within this context, patients' sedation levels must be frequently assessed as well, and conscious patients' own self-reported pain scores must be considered the "gold standard."

CONCLUSION

The BPS_{nurse} is valid for use in conscious sedated patients during painful procedures. Thus, the BPS can be regarded as a bridge between the observational scale for noncommunicative and mechanically ventilated patients and the VRS-4 used by patients who are able to self-report pain.

ACKNOWLEDGMENTS

The authors thank the staff and nurses of the intensive care unit of the St. Antonius Hospital for their contribution to this study. Ko Hagoort is thanked for editorial assistance.

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