# Assessing pain in critically ill sedated patients by using a behavioral pain scale

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***Objective:*** **To establish the validity and reliability of a new behavioral pain scale (BPS) for critically ill sedated adult patients.**

***Design:*** **Prospective evaluation.**

***Setting:*** **Ten-bed trauma and surgical intensive care unit in a university teaching hospital.**

***Patients:*** **Thirty mechanically ventilated patients who were receiving analgesia and sedation.**

***Intervention:*** **Assessments with the BPS were completed consecutively at standardized times (morning, afternoon, night) by pairs of evaluators (nurse and nurse's aide). They collected physiologic parameters and BPS results before and during care procedures: nonnociceptive (group 1, compression stockings application and central venous catheter dressing change), nociceptive (group 2, endotracheal suctioning and mobilization), and retested nociceptive (group 3). The BPS score was the sum of three items that had a range score of 1–4: facial expression, movements of upper limbs, and compliance with mechanical ventilation.**

***Measurements and Main Results:*** **Two hundred and sixty nine assessments were completed, including 104, 134, and 31 measurements in groups 1, 2 and 3, respectively. There was no difference in Ramsay scale scores between the three groups (Ramsay 4–6). Nociceptive stimulations (group 2) resulted in significantly higher BPS values than nonnociceptive ones (group 1, 4.9 vs. 3.5, $p < .01$), whereas the two groups had comparable BPS values before stimulation (3.1 vs. 3.0). A trend was found in group 2 between the dosage of sedation/analgesia and BPS: the higher the dosage, the lower BPS values and BPS changes to nociceptive stimulation. Group 3 had BPS values similar to group 2 at rest (3.2 vs. 3.2) and during the procedure (4.4 vs. 4.5), with good interrater correlations ($r^2 = .71$ and .50, respectively).**

***Conclusions:*** **These results indicate that the expression of pain can be scored validly and reliably by using the BPS in sedated, mechanically ventilated patients. Further studies are warranted regarding the utility of the BPS in making clinical decisions about the use of analgesic drugs in the intensive care unit. (Crit Care Med 2001; 29:2258–2263)**

**KEY WORDS: pain; pain behavioral scale; physiological pain indicators; pain assessment; sedation; analgesia; intensive care unit**

It has long been established that critically ill patients may experience pain during their intensive care unit (ICU) stay. Interviews within 5 days of discharge from ICU showed that 63% of surgical patients rated their ICU pain as being moderate to severe in intensity (1). Pain from chest tubes or surgical incisions was the worst memory for 42% of cardiac surgical patients (2). Arterial blood sampling and endotracheal suctioning were the most important factors that worried patients during their ICU stay (3). From the Study to Understand Prognoses and Preferences for Outcomes and Risks of Treatment (SUPPORT), pain was reported to occur in nearly 50% of seriously ill patients interviewed and was described as severe in 15% of patients (4). As a result of such findings, the use of analgesic as well as sedative drugs for critically ill patients has increased and frequently is ordered on an "as-needed" basis regardless of the patient's specific requirements (5). Surprisingly, the appropriate depth of analgesia and its efficacy scarcely have been addressed, although it has been suggested that optimizing pain control could affect, in part, patients' clinical outcome (6, 7). The lack of adequate assessment of pain in sedated critically ill patients interferes with optimum pain management.

When critical care patients are unable to self-report their pain intensity, comprehensive pain assessments should require an objective evaluation through the observation of pain indicators. However, there is no perfect tool for evaluating pain. Changes in physiologic variables (e.g., heart rate, blood pressure, respiration rate, perspiration, pupil size) in response to a nociceptive action are nonspecific in the ICU and may be affected largely by medications. When critical care nurses were asked to assess pain intensity by using a visual analog scale, 35% to 55% of nurses underrated the patient's pain (8). Family members were found to assess the presence or absence of pain in nonintubated patients only 53% of the time (9), and they are not permanently in contact with the patient. Recently, the use of sedation-agitation scales for mechanically ventilated patients has been proposed (10–12), and these scales have stratified agitation into more categories than did the Ramsay scale (13). Although pain and anxiety are linked, these sedation scales are not useful for evaluating pain level in sedated patients or for guiding analgesia treatment decisions. A number of behavioral pain scales that are based on observation of the patient body's posture and its response to a nociceptive stimulation have been developed for the neonatal and pediatric populations (14). To date, however, no objective behavioral pain scale has been reported to be optimal for ICU adult patients.

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The aim of the present study was to establish the validity and reliability of a new objective pain scale in sedated adult patients undergoing mechanical ventilation. Puntillo et al. (15) reported that behavioral indicators (movements, facial expressions, and posturing) in surgical patients could be rated correctly by nurses. They found moderate to strong correlations between the number of behavioral items observed by the patients' nurse and the patients' self-report of pain intensity. To expand on those study findings, we developed a new, easy-to-use behavioral pain scale (BPS) for critically ill patients. As stated previously, no criterion reference method exists for assessing pain in sedated, mechanically ventilated patients. Therefore, we tested the validity of this scale by comparing the BPS scores obtained during both nociceptive and nonnociceptive procedures. We hypothesized that if the BPS really measures what it proposes, a large difference in BPS results should occur between these two stimulations. To get standardized evaluation of the BPS, we selected painful procedures as the nociceptive stimulation according to previous studies (3, 16) as well as their routine part of a patient's care. BPS scores then were compared with procedures expected to be painless. BPS measurements also were performed before any stimulation, to establish baseline conditions, and were recorded and evaluated according to the dosage of sedation/analgesia each patient was receiving. Finally, reliability of the BPS was assessed by measuring interrater agreement between independent observers during nociceptive procedures.

## MATERIALS AND METHODS

This study was conducted over a 6-month period in a 10-bed trauma and postoperative ICU. Patients were included if they were ≥15 yrs of age, were admitted to ICU after trauma or thoracic or abdominal surgery, had undergone mechanical ventilation, were hemodynamically stabilized, and needed analgesia and sedation. Three types of sedative and analgesic regimens were used: a light regimen (intermittent administration of clorazepate and morphine), a mild regimen (continuous infusion of midazolam and fentanyl, or midazolam and sufentanil), and a heavy regimen (continuous infusion of thiopental, midazolam, and fentanyl or sufentanil). Regimens were prescribed by the patient's primary physician, according to the patient's requirements. Patients were excluded if they were quadriplegic, were receiving neuromuscular blockade, or were allowed to be assessed by an autoevaluation pain scale or if their sedative and analgesic regimen changed during the procedure.

*Measurements.* Two groups of standardized stimulations were identified as nonnociceptive (group 1) and nociceptive (group 2) procedures. In group 1, compression stocking applications and central venous catheter dressing changes were chosen as nonnociceptive procedures. In group 2, patients were endotracheal suctioned (ETS) and were mobilized (i.e., rolled to one side from their initial position) during standard care for surgical incision or traumatic injury. Both were considered nociceptive procedures.

Forty-six registered nurses and nurse's aides participated in the study. Each patient was assessed at three predefined times (morning, afternoon, night), starting usually 12–24 hrs since ICU admission, during a maximum 72-hr period by a pair of evaluators (nurse and nurse's aide). Pairs of evaluators were not assigned or randomized but were established on a convenience basis. They were asked to assess the patient at rest and during one procedure in each group (group 1 and group 2), with at least a 30-min interval between the two procedures. The choice and the moment of procedure were made according to the patient's requirements. For reliability, another assessment was done independently by two assigned evaluators (physical therapist and physician) during a nociceptive procedure (group 3, retested group). There was no communication with the first evaluators. Results then were recorded on a data collection form and included BPS scores, Ramsay scale scores, and two hemodynamic parameters (blood pressure, heart rate) previously noted as the most frequent physiologic indicators of pain (15).

The BPS was based on a sum score of three items: facial expression, movements of upper limbs, and compliance with mechanical ventilation. These behavioral items were selected based on a survey of our ICU nurses and a literature review of pain scales for infants and children (14) and of pain-related behaviors (8, 15). Facial expression was derived from the study of Prkachin (17). In that study, the bulk of pain information was divided into four facial expressions, reflecting a graded increase in pain intensity: brow lowering, orbit tightening, eyelids closing, and upper lip raising. We adapted these facial expressions into a coarser classification to avoid disagreements within the paired evaluators. Movements of upper limbs and compliance with mechanical ventilation were adapted from the COMFORT scale assessing distress in pediatric ICUs (18) and from the Harris scale (discussed in Ref. 10). We also chose to score each pain indicator from 1 (no response) to 4 (full response), assuming that a relationship should exist between each score and the intensity of pain. Therefore, the possible range score of BPS was 3–12 (Table 1).

Before the study, a referent group (two nurses, one physical therapist, one physician) taught evaluators how to appropriately assess patients by using the BPS. At the end of the study, all evaluators were asked to fill out a questionnaire for satisfaction and remarks. Other routine procedures used for the patient's care were not affected by the study. The Grenoble Institutional Ethical Committee approved the design of the study, and, considering that each study procedure was part of standard care, waived the requirements for informed consent from the patients.

*Statistical Analysis.* Data were expressed as mean and 95% confidence intervals, unless specifically indicated. Analysis for statistical significance was performed by using one-way or two-way (group × measurement) repeated-measures analysis of variance (StatView SE program, SAS Institute, Cary, NC). When a significant interaction was detected between the groups and the measurements, the following were done: a) intergroup analysis that used a factorial analysis of variance; and b) intragroup analysis that used a one-way analysis of variance for repeated measurements. Each value was compared to that obtained at the rest period by using the Scheffé test. When no significant interaction was detected between the groups and the measurements,pooled data were subjected to a one-way analysis of variance for repeated measurements. The chi-square test was used to com

**Table 1.** Behavioral pain scale

| Item | Description | Score |
|---|---|---|
| Facial expression | Relaxed | 1 |
| | Partially tightened (e.g., brow lowering) | 2 |
| | Fully tightened (e.g., eyelid closing) | 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 |

pare qualitative variables. The test-retest procedure was analyzed by using the paired Student's *t*-test. The weighted kappa test was calculated to estimate the magnitude of agreement between observers (group 2 and group 3). Relationships between variables were tested by using linear correlation. Principal component factor analysis was used to determine the contribution of each item (facial expression, movements of upper members, compliance with mechanical ventilation) on the BPS. Statistical significance was established at $p < .05$.

## RESULTS

Thirty consecutive mechanically ventilated patients were assessed a median of three times (one to eight) during their ICU stay, resulting in 301 observations. There were 32 excluded observations because of incomplete forms (n = 25) or changes in the sedation/analgesia regimen during the procedures (n = 7). The remaining 269 observations included 78 compression stocking applications and 26 central venous catheter dressing changes in group 1 (nonnociceptive procedures, n = 104), 96 ETS and 38 mobilizations in group 2 (nociceptive procedures, n = 134), and 31 ETS in group 3 (retested nociceptive procedures, n = 31). An average of ten assessments thus was completed by each evaluator in groups 1 and 2. The baseline demographic variables are described in Table 2. Among the population, there were 16 trauma patients with head injury (Glasgow Coma Scale score, 5.6, 4.5–6.5), who had 75 and 62 assessments during nociceptive and nonnociceptive procedures, respectively. The 134 nociceptive procedures were assessed under various analgesia/sedation regimens: 32, 80, and 22 for light, mild, and heavy regimens, respectively. Fentanyl was mostly used for mild and heavy regimens, whereas sufentanil was used for 11 procedures only.

*Painless and Painful Procedures (Group 1 vs. Group 2).* Assessments completed at rest had a high percentage of no response (i.e., score of 3) on the BPS, without a significant difference between group 1 and group 2: 97% (94% to 100%) vs. 88% (83% to 94%), respectively. By contrast, painless or painful procedures resulted in significant changes in the BPS; that is, the percentage of no response dropped to 69% (60% to 78%) in group 1 and to 31% (23% to 39%) in group 2, with a significant difference between the two groups ($p < .01$). A significant interaction between groups and measurements was found concerning the BPS ($F$-test = 49.0, $p < .01$). This was attributable to significantly higher BPS values in group 2 (4.9, 4.6–5.2) than in group 1 (3.5, 3.3–3.7) during the procedure ($p < .01$; Fig. 1), whereas the two groups had comparable BPS values at rest: 3.0 (3.0–3.1) in group 1 vs. 3.2 (3.1–3.3) in group 2. Therefore, the nociceptive procedure resulted in a four-fold increase in the BPS score compared with the nonnociceptive procedure. No difference in the BPS values was found between ETS and mobilization nociceptive procedures. The BPS values during the painless procedures also were significantly increased compared with the rest period. This was attributable to an increase in the BPS during compression stocking procedure (3.6, 3.4–3.8, $p < .05$), whereas the central venous catheter dressing change procedure did not result in significant BPS changes (3.2, 3.0–3.3; Fig. 2). No difference in the BPS values was found according to the time period of the assessments (morning, afternoon, night). Similar findings also were noted in the subgroup of head-injured patients, because a significant increase in BPS was found during nociceptive procedures (4.4, 4.1–4.8 vs. 3.1, 3.0–3.1 at rest) and, to a lesser extent, during nonnociceptive procedures (3.3, 3.1–3.4 vs. 3.0 at rest, both $p < .01$).

Principal component factor analysis was used to ascertain how the separate pain-related expressions interrelate empirically. The analyses revealed a large first factor, accounting for 55% of the variance in pain expressions, with coefficients of .789 for facial expression, .794 for the movements of upper members, and .632 for the compliance with the mechanical ventilation. These findings imply that each item reflects a pain expression factor, with a smaller weight for compliance with ventilation. We found no significant difference between ETS and mobilization procedures in scoring compliance with the mechanical ventilation: 1.4 (1.2–1.5) during ETS vs. 1.3 (1.2–1.5) during mobilization.

**Table 2.** Demographic data for the 30 patients

| | |
|---|---|
| Age, yrs | 44.4 (38.0–50.8) |
| Gender: male/female, *n* | 17/13 |
| Simplified Acute Physiology Score II | 40.8 (36.0–45.6) |
| Origin: trauma/surgical, *n* | 23/7 |

Data are presented as mean (95% confidence interval).

Changes in hemodynamics are shown in Table 3. A significant interaction between the two groups of procedures and measurements was found concerning the blood pressure ($F$-test = 15.4, $p < .01$) and the heart rate ($F$-test = 6.7, $p < .05$). This interaction was attributable to significant increases in these hemodynamic parameters during nociceptive procedures (group 2), whereas neither changes in blood pressure nor changes in heart rate were found during nonnociceptive procedures (group 1). The hemodynamic changes in group 2 were, however, unrelated to those in the BPS ($r^2 < .10$ for both hemodynamic variables). No difference in the Ramsay scale was found between the two groups of procedures (5.3, 5.1–5.5 in group 1 vs. 5.2, 5.0–5.4 in group 2). Finally, there was a trend between the type of analgesia/sedation regimen (light, mild, or heavy) given to the patient and the value of BPS as well as the BPS changes induced by nociceptive procedures: The higher the dosage of mida-

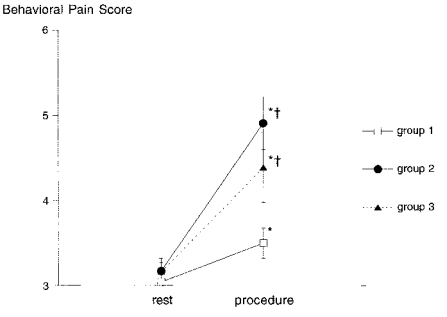


**Figure 1.** Scores of the behavioral pain scale at rest and during procedures: nonnociceptive (group 1, n = 104), nociceptive (group 2, n = 134), and retested nociceptive (group 3, n = 31) procedures. Values are expressed as mean and 95% confidence interval. *$p < .05$ vs. rest period. †$p < .05$ vs. group 1.

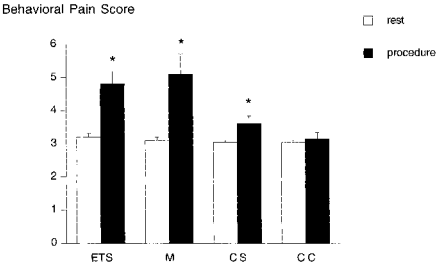


**Figure 2.** Scores of the behavioral pain scale at rest and according to each procedure: endotracheal suctioning (*ETS*, n = 96), mobilization (*M*, n = 38), compression stockings application (*CS*, n = 78), and central venous catheter dressing change (*CC*, n = 26). Values are expressed as mean and 95% confidence interval. *$p < .05$ vs. rest period.

zolam and fentanyl, the lower the values of BPS (Table 4).

*Test-Retest Procedure (Group 2 vs. Group 3).* Nociceptive procedures were independently retested in 31 cases (group 3; Fig. 1). No significant interaction was found between the two groups (group 2 and group 3) and measurements (*F*-test = .04). The BPS values in the group 3 were 3.2 (3.0–3.3) at rest and 4.4 (4.0–4.8) during procedure. These values were comparable with the paired BPS values in group 2: 3.2 (3.0–3.5) at rest and 4.5 (4.0–5.0) during the procedure. Among the 31 paired assessments during a nociceptive procedure, 17 had similar BPS scores from the pair of raters; 12 differed by one mark on the BPS, and two assessments disagreed by more than one mark (Fig. 3). Within an error of one mark, interrater agreement was .94 for BPS. The correlation of the BPS values between the two groups was moderate to strong, with $r^2 = .71$ at rest and $r^2 = .50$ during procedure (both $p < .01$). When magnitude of difference between evaluators and chance agreement was considered, the weighted kappa test for agreement was .74 ($p < .01$). The Ramsay value scored in group 3 was 5.5 (5.3–5.7), comparable with that in group 2 (5.3, 5.0–5.7).

*Satisfaction.* Twenty-eight of 34 questionnaires sent to the evaluators at the end of the study were complete. Most of the evaluators (24 of 28) were satisfied or very satisfied by the ease of use of the BPS, although seven evaluators expressed some concerns regarding its relative complexity. All of them agreed that each patient assessment took minimal time (2–5 mins). Twenty-five evaluators considered that effective pain reactions during routine procedures had been assessed by using the BPS. Twenty-six evaluators said they expected changes in pain assessment and in pain relief within the ICU as a result of the BPS.

## DISCUSSION

Making accurate pain assessment for uncommunicative critically ill patients is of great interest with regard to the various and frequent sources of pain (3, 4) and the potential effect of pain (or analgesia) on the patient's outcome (6, 7). In an attempt to give ICU caregivers an easy-to-use tool for assessing pain in sedated (Ramsay 4–6), mechanically ventilated patients, we designed and tested a behavioral pain scale based on three indicators. Movements during procedures usually are considered as behavioral pain indicators (8, 15) and are included in many behavioral pain scales for children (14). Facial expressions associated with various nociceptive stimulations were studied extensively by Prkachin (17) in volunteers, providing evidence for a unique universal facial expression of pain. Our data support the use of facial expression as a pain indicator in critically ill patients, as previously suggested by Puntillo et al. (15) in surgical patients. Compliance with mechanical ventilation in response to nociceptive stimulation has received little attention. The routine observation from our ICU nurses that an intubated patient's response to a nociceptive stimulus is associated with a change in compliance with ventilator (cough, fight) prompted us to include this item on the BPS. The principal component factor analysis demonstrated that this item was as relevant a pain-related expression as the two others.

Testing the validity of a new pain scale should require comparison with a standard criterion. However, no scale that quantifies pain in adult ICU patients has been tested previously for validity or reliability. An interview of the patients after their discharge from ICU reflects an overall, retrospective pain rate (minimal, moderate, or severe) (1, 4) and cannot assess the temporal nature of pain. We therefore evaluated validity of the BPS by gathering indirect arguments assessing whether the BPS really measured level of pain. First of all, we submitted each BPS evaluation to two different care procedures that were suspected to be nonnociceptive (group 1) or nociceptive (group 2). If a significant difference in BPS response between the two procedures should be found, this could argue for the discriminating value of the BPS in measuring painful aspects of a procedure. It is established that endotracheal suctioning is a painful procedure. In postoperative

**Table 3.** Hemodynamic data at rest and during nonnociceptive (group 1) and nociceptive (group 2) procedures

| | Rest | Procedure |
|---|---|---|
| Mean arterial blood pressure, mm Hg | | |
| Group 1 | 85 (82–89) | 86 (82–89) |
| Group 2 | 84 (82–87) | 89 (86–92)[a] |
| Heart rate, $min^{-1}$ | | |
| Group 1 | 88 (84–92) | 89 (85–93) |
| Group 2 | 89 (85–92) | 93 (89–97)[a] |

[a] $p < .05$ vs. rest period. Data are presented as mean (95% confidence interval).

**Table 4.** Influence of the sedation/analgesia regimen (light, mild, or heavy) on the values of behavioral pain scale (BPS) during nociceptive procedures (group 2, $n = 134$ measurements)

| | Light ($n = 32$) | Mild ($n = 80$) | Heavy ($n = 22$) |
|---|---|---|---|
| Midazolam, mg/hr | 0 | 8.7 (8.0–9.4) | 12.8 (11.3–14.2)[b] |
| Fentanyl, μg/hr | 0 | 381 (355–407) | 511 (453–569)[b] |
| Thiopenthal, mg/hr | 0 | 0 | 75 (59–91) |
| Ramsay scale | 4.1 (3.6–4.7) | 5.4 (5.2–5.6)[a] | 6.0 (6.0–6.0)[a] |
| BPS score | 6.0 (5.3–6.7) | 4.8 (4.4–5.2)[a] | 3.7 (3.3–4.1)[a,b] |
| BPS changes during procedure | 2.7 (2.0–3.4) | 1.7 (1.3–2.0)[a] | 0.7 (0.2–1.1)[a,b] |

[a] $p < .05$ vs. light; [b] $p < .05$ vs. mild. Data are presented as mean (95% confidence interval). During sedation/analgesia light regimen, patients received intermittent administration of clorazepate and morphine.

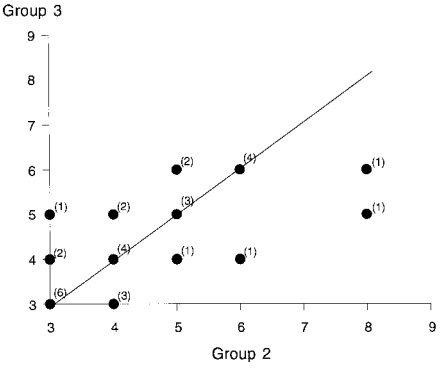


**Figure 3.** Paired evaluation of behavioral pain scale in group 2 (tested group) and in group 3 (retested group). Each number reflects how many similar results were observed per paired evaluation.

*We have shown that responses to nonnoxious and noxious stimuli can be differentiated accurately in sedated, mechanically ventilated patients by using behavioral indicators.*



cardiovascular surgery patients, the mean pain intensity with endotracheal suctioning was 4.9 cm on a 0–10 numerical rating scale (16). Mobilization often results in pain, and it is a factor in neonatal and pediatric behavioral pain scales (14). The painful character of these procedures was retrospectively attested to by the significantly increased heart rate and blood pressure during ETS and mobilization in the present study. However, other events can alter hemodynamics in critically ill patients in addition to nociceptive responses, preventing the use of such changes to assess the pain intensity (8). By using these two painful procedures, we found significant increases in BPS scores, indicating that BPS changes may be induced by nociceptive procedures. We found, however, that BPS was increased to a lesser extent during nonnociceptive procedures. As seen in Figure 2, the BPS increase was attributable to the compression stockings application, which may yield pain through mobilization of lower limbs in trauma patients. Conversely, no significant changes were found during catheter dressing change, as expected. This indicates that BPS is a sensitive scale because it can discriminate between different procedures according to their painfulness in sedated, mechanically ventilated patients.

Another indirect argument in favor of the validity of BPS in measuring pain is the trend found between the sedation/analgesia regimen and the BPS score: The higher the sedation/analgesia, the lower the BPS value as well as the BPS changes induced by painful procedures (see Table 4). However, because patients were receiving different sedative regimens resulting in different Ramsay scores, one could speculate that BPS should reflect level of sedation rather than pain. Although pain and anxiety are linked, it must be kept in mind that all BPS evaluations were assessed when sedation levels were high (Ramsay 4–6). These levels of sedation correspond to patients being unarousable, very sedated, or sedated by using the sedation-agitation scale (10). In addition, sedation usually is assessed by observing the patient's wakefulness (e.g., opening eyes) in response to verbal or physical stimuli, not necessarily noxious stimuli (10–12). Therefore, BPS could provide dimensions of procedural pain in sedated patients, the range of BPS changes being dependent on the sedation/analgesia regimen. This suggests that BPS is also a specific scale.

Based on the paired patient assessments completed in this study, the BPS was found to be a reliable measure of pain. The correlations and weighted kappa scores compare favorably with other studies validating pain or sedation scales (10, 12, 18). Although the sample was small, we found that most of the paired evaluations were in close agreement. Accepting a difference by one mark between two independent evaluators is reasonable, considering that the mean value of all painful procedure-induced changes in BPS was higher, that is, 1.7 (1.4–2.0). To minimize the risk of communication between evaluators, a significant delay was observed in the assessments between group 2 and group 3. However, this could lead to possible changes in the patient's status during that time interval and could threaten test-retest reliability.

Although BPS could be a useful scale for assessing pain in sedated patients, there are other methodologic considerations regarding the present study. First, to minimize the inclusion of patients with compromised neurologic status, we excluded quadriplegic patients as well as those receiving neuromuscular blockers. However, the results found in the subgroup of head-injured patients indicate that the BPS could be useful for assessing pain reactions in such patients. Second, although continuous scales (e.g., visual analog scale) are considered to be more relevant than categorical scales (e.g., BPS) to assess pain, we designed a scale ranging from 3 to 12 based on pain-related expressions. We empirically chose to score BPS by scoring each item from 1 to 4, in order to avoid the "median value effect." Nevertheless, the linearity of BPS in recording pain intensity is unknown (e.g., whether a change in BPS from score 3 to 5 is twice as painful as that from score 3 to 4). The main interest of this pain scale is to quantify the patient's response to a nociceptive, standardized procedure to adjust analgesia for further nociceptive interventions. Third, although BPS score theoretically can range from 3 to 12, it is not surprising that most of our evaluations (82%) were clustered around BPS 3–6 because all patients were receiving sedative and analgesic drugs. Thus, we were unable to assess the validity of the BPS at the far end (BPS $> 8$) of the pain scale due to few evaluations ($n = 7$). However, adding more categories into the lowest values of BPS to stretch dimensions of BPS might result either in confused description of end points or in disagreement between evaluators.

The results of this study led us to implement the BPS as a tool for pain assessment in sedated, mechanically ventilated patients. The BPS was easy to use and well accepted by our nurses, as the evaluator's satisfaction showed. We have decided to develop a pain algorithm in which analgesic drug is prescribed according to the BPS change induced by ETS, because it is a frequently performed painful procedure in ICU. It also should be possible to use BPS in decision-making, to measure the efficacy of analgesia, and to determine the impact of an analgesic titration on patient outcomes, such as length of mechanical ventilation and length of stay in ICU. This approach has been reported previously with optimized sedation protocol (19).

## CONCLUSION

We have shown that responses to nonnoxious and noxious stimuli can be differentiated accurately in sedated, mechanically ventilated patients by using behavioral indicators. The BPS could offer caregivers a simple, objective tool to titrate analgesia therapy in the ICU.

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