Nurse's Evaluation of a Pain Management Algorithm in Intensive Care Units

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ABSTRACT

Purpose: Many patients have memories of pain during intensive care unit stay. To improve pain management, practice guidelines recommend that pain management should be guided by routine pain assessment and suggest an assessment-driven, protocol-based, stepwise approach. This prompted a development of a pain-management algorithm. The purpose of the present study was to evaluate the feasibility and clinical utility of this algorithm.

Design: A descriptive survey.

Methods: A pain-management algorithm, including three pain assessment tools and a guide in pain assessment and pain management, was developed and implemented in three intensive care units. Nurses working at the three units (n=129) responded to a questionnaire regarding the feasibility and clinical utility of the algorithm used.

Results: Our results suggested that nurses considered the new pain-management algorithm to have relatively high feasibility, but somewhat lower clinical utility. Less than half of respondents thought that pain treatment in clinical practice had become more targeted using the tree pain-assessment tools (45 %) and the algorithm for pain assessment and pain management (24%).

Conclusions: Pain-management algorithms may be appropriate and useful in clinical practice. However, to increase clinical utility and to get a more targeted pain treatment, more focus on pain-treatment actions and reassessment of patients' pain is needed.

Clinical Implications: Further focus in clinical practice on how to implement an algorithm and more focus on pain-treatment action and reassessment of patients' pain is needed.

Key words: acute pain; pain management; critical care; intensive care units

Key Practice Points:

- Pain-management algorithms may be suitable for managing pain in intensive care unit patients.
- The new pain-management algorithm in the present study has relatively high feasibility, but somewhat lower clinical utility.
- In the future, more focus on pain-treatment action and reassessment of patients' pain is needed to increase clinical utility of pain-management algorithms and to get a more targeted pain treatment.

Introduction

Many patients in intensive care units (ICUs) have memories of pain during their ICU stay (Fink, Makic, Poteet, & Oman, 2015). In one study, 58% of ICU patients perceived pain as a problem (Alasad, Abu Tabar, & Ahmad, 2015). In another study, 71% of ICU patients reported that they constantly experienced pain during hospitalization (Demir, Korhan, Eser, & Khorshid, 2013). Therefore, the provision of adequate pain management for these patients is essential to promote comfort and rehabilitation during an ICU stay while avoiding any transition from acute to persistent pain (Puntillo & Naidu, 2016).

To improve pain management in ICU patients, clinical practice guidelines recommend that pain management should be guided by routine pain assessment, and suggest an assessment-driven, protocol-based, stepwise approach (Devlin et al., 2018). This method of assessing and managing pain is associated with decreased pain and agitation in ICU patients (Chanques et al., 2006). Several studies have implemented a single pain-assessment tool (Arbour, Caroline, Gelinas, Celine, & Cecile, 2011; Gelinas, Arbour, Michaud, Vaillant, & Desjardins, 2011; Topolovec-Vranic et al., 2010) or a set of assessment tools to assess pain, agitation, and delirium in ICU patients (Chanques et al., 2006; Skrobik et al., 2010; Williams et al., 2008). However, development of a tool that includes both pain assessment and pain management for use in clinical practice was warranted. Thus, a pain-management algorithm was developed (Olsen et al., 2015a). The algorithm guides clinicians to assess ICU patients' pain every eight hours both at rest and during turning, and guides nurses to choose pain-treatment actions based on cutoff points.

A wide range of factors can influence pain assessment and pain management in ICU patients, including nurse characteristics [e.g., nurses' level of knowledge, misconceptions about pain assessment, attitudes, and resistance to using valid tools (Bennetts et al., 2012; Berben, Meijs, van Grunsven, Schoonhoven, & van Achterberg, 2012; Horbury, Henderson,

& Bromley, 2005; Yildirim, Cicek, & Uyar, 2008)], patient characteristics [e.g., hemodynamic instability in critically ill patients, and a patient's inability to communicate (Rose et al., 2011)], and unit characteristics [e.g., the learning culture in the units (Bennetts et al., 2012), and nursing workload (Rose et al., 2011)].

To increase the use of available pain assessment tools in clinical practice, it is important that the tools have good feasibility (i.e., the ease with which nurses can apply the instrument in a clinical setting), and have satisfactory clinical utility (i.e., the ability to use the results of the instrument in a meaningful and useful way in a clinical setting). The aim of the present study was to evaluate the feasibility and clinical utility of a new pain-management algorithm, which included three pain-assessment tools and a guide in pain assessment and -management.

Materials and Methods

The Algorithm

The algorithm used in the present study was developed for use in ICU patients ≥ 18 years of age (Olsen et al., 2015a), and guides clinicians to assess the patients' pain at least every eight hours both at rest and during turning. Turning was chosen as an example of a painful procedure, as we assumed that pain scores would be higher during turning than at rest (Gelinas, 2007; Puntillo et al., 2001; Vazquez et al., 2011). A numeric rating scale (NRS) ranging from 0 to 10 points was used when patients were able to self-report pain (Chanques et al., 2010). The Behavioral Pain Scale (BPS) was used when patients were mechanically ventilated and not able to self-report pain (Payen et al., 2001), and the Behavioral Pain Scale-Non Intubated (BPS-NI) was used when non-intubated patients were unable to self-report pain (Chanques et al., 2009). Studies indicate that the expression of pain can be scored validly and reliably by using these tools in the present patient group (Payen et al., 2001; Chanques et al., 2009). Both the BPS and the BPS-NI scores range from 3 to 12 points, and require the clinicians to assess the patients' pain by observing their behavior. The algorithm guided nurses to choose pain-treatment actions based on cutoff points. An NRS score of >3 (Barr et al., 2013; Chanques et al., 2006; Gerbershagen, Rothaug, Kalkman, & Meissner, 2011), a BPS score of >5 (Chanques et al., 2006; Payen et al., 2001), or a BPS-NI score of >5 (Chanques et al., 2009) were defined as pain events. If a pain-intensity score was higher than the cutoff score (i.e., was defined as a pain event), the nurses were guided to consider increasing pain treatment. If a pain-intensity score was less than the cutoff score (not a pain event), the nurses were guided to consider either decreasing or continuing the same pain treatment. Pain-treatment actions could include analgesics prescribed individually to each patient or nonpharmacological interventions such as changing the patient's position.

Implementation

Nurses employed at two Norwegian hospitals (one medical/surgical ICU, one surgical ICU, and one postanesthesia care unit) received 1.5 hours of education in pain assessment and how to use the algorithm (Olsen et al., 2015b). The lecture focused on the occurrence of pain in ICU patients and how to assess pain. Information was provided to the nurses about the validity and reliability of the pain-assessment tools and how to use the algorithm. The nurses were educated about clinically meaningful cutoff points and how to make decisions about changing the patients' pain treatment. All temporary staff were given a summary of this education. The physicians were informed about the algorithm in a meeting prior to its implementation and received an email about the study.

After the education program, nurses practiced using the algorithm over a three-week period, during which time a resource person in pain assessment (i.e., an ICU nurse who was trained by the principal investigator in using the pain assessment tools and how to use the algorithm) were available on the units to answer questions and provide support. The resource person verified that the nurses performed the pain assessments and used the algorithm correctly.

Following this three-week period, ICU patients >18 years of age admitted to the three units were pain assessed and treated using the pain-management algorithm. Patients were included if they were able to self-report pain or express pain behaviors, and they were excluded if they could not self-report pain or express pain behaviors (e.g., if they were quadriplegic, receiving neuromuscular blockade or paralyzing drugs, or being investigated for brain death). The resource persons reminded the nurses to use the algorithm, and were available to answer questions and provide support if needed. Written information about the progress of the study (i.e., emails, the research unit's website) was provided to the nurses and written reminders on how to use the algorithm were placed at a number of sites on the three units. A written outline of the pain-management algorithm was placed at the bedside of every ICU patient. All these strategies were used to reinforce the use of the algorithm.

The algorithm was used over 22 weeks for patients in ICU. The nurses' level of adherence to the algorithm during this period was high, as nurses assessed pain during 75% of the shifts in which the algorithm suggested pain assessment (Olsen et al., 2015b). Several outcome variables, such as the number of pain assessments, duration of ventilation, and length of ICU stay, improved significantly after implementation of the pain-management algorithm, compared with a ICU patients control group where pain was not assessed using the algorithm (Olsen, Rustoen, Sandvik, Jacobsen, & Valeberg, 2016).

Data Collection

This study was a descriptive survey. No suitable questionnaire was available to evaluate the feasibility and clinical utility of the pain-management algorithm, and a questionnaire was developed by the research team based on the Critical-Care Pain Observation Tool (CPOT) Evaluation Form (Gelinas, 2010), and the definitions of feasibility and clinical utility defined by Duhn and Medves (2004). The questionnaire used in the present study consisted of 24 closed questions (see Table 1 and 2), and included questions on the feasibility and clinical utility of both the algorithm and the pain-assessment tools used. The time required for assessment and scoring, the clarity of the user instructions for the tool, the tool structure, and the scoring method determined the feasibility of the algorithm. The recommendation that the nurses use the tools routinely, how helpful the algorithm was in practice, and how it influenced their practice determined the clinical utility of the tools. All these items were scored using a five-point scale (i.e., not at all; to a small extent; to some extent; to a large extent; to a very large extent). The questionnaire also included questions about the nurses' estimates of how much time they spent using the tools, and questions about nurses' characteristics (i.e., gender, education level, age, percent employment, work experience).

A pilot test of the questionnaire was performed by five ICU nurses working with ICU patients in clinical practice. They were asked about the consistency, content, layout, and time spent completing the questionnaire. Only small changes in wording were made after the pilot test. In the present study, Cronbach's alpha of the dimensions of the questionnaire varied from 0.7 (clinical utility of the algorithm) to 0.9 (feasibility of the algorithm).

All nurses employed at the three units in which ICU patients were assessed and pain managed using the algorithm were invited to complete the questionnaire. The questionnaire was distributed to their personal mailbox, and email reminders were sent at the start of the survey and two and five weeks later.

Ethics

Approval and consent to participate were obtained from the directors of all the participating units. The Regional Ethics Committee (xxx) approved the study, and the ICU nurses provided informed consent to participate in the study. The study was registered in

ClinicalTrials.gov (xxx). Data were handled anonymously and confidentially, and were kept in a safe at the hospital trust.

Statistical Analysis

Descriptive statistics were used to describe the nurses' characteristics and to present the individual items of the questionnaire. Continuous variables were described by mean, standard deviation (SD), and range. Categorical data were presented as counts and percentages (%). For analytical purposes, the response categories of not at all/to a small extent/to some extent were merged into one category, and the response categories of to a large extent/to a very large extent were merged into another category. Cronbach's alpha analyses were performed to evaluate the internal consistency of the dimensions in the questionnaire. Values >0.7 are defined as acceptable, and values >0.8 are defined as preferable (Pallant, 2013). All statistical analyses were performed using Statistical Package for the Social Sciences (IBM SPSS Statistics for Windows, version 25.0; IBM Corp., Armonk, NY).

Results

Of 232 nurses employed at the three units, 129 completed the questionnaire, giving a response rate of 56%. The nurses were mainly women (96%) with a mean age of 44 years (Table 3). The majority of the nurses had intensive care education (85%). Their mean experience of working in ICU was 12 years, ranging from 1 to 30 years. Their mean percent employment was 90%, with 50% as the lowest percent. As many as 96% of the nurses reported that they had used the algorithm in clinical practice. Many nurses had used the NRS (35%) and the BPS (44%) more than 10 times during the 22 weeks of the study, but only 12% had used the BPS-NI more than 10 times.

More than half of the nurses (63%) responded that the 1.5 hours of education in pain assessment and how to use the algorithm was sufficient to use the algorithm, and the pain-assessment tools (57%) in clinical practice. Fewer nurses responded that the three-week training period where nurses practiced using the algorithm in clinical practice, was sufficient to use the algorithm (39%) and the tools (38%) in clinical practice.

Feasibility and Clinical Utility of the Algorithm

Between 72% and 81% of the nurses responded that the algorithm was easy to understand, quick to use, and that the directives about the use of the algorithm were clear. It provided clear descriptions about the types of patients on whom the algorithm should be used, the time at which the patients should be pain assessed, and which pain-assessment tool should be selected for each patient. However, fewer nurses responded that the algorithm was clear in terms of what action should be taken (59%), and the time at which the patient's pain should be reassessed (60%).

The clinical utility of the algorithm was somewhat lower as 53% of the nurses responded that they found the algorithm helpful in clinical practice, and 53% would recommend using it routinely. Only 24% of the nurses responded that pain treatment had become more targeted for each patient after the implementation of the algorithm.

Regarding whether the nurses followed the instructions in the algorithm, most nurses (74%) responded that they had considered *increasing* pain-treatment actions if NRS >3 or BPS or BPS-NI >5. However, only 55% responded that they always increased pain-treatment actions if the pain scores were above these cutoffs. Fewer nurses (38%) responded that they had considered *decreasing* pain treatment if NRS ≤3 or BPS or BPS-NI ≤5. Overall, 33% of the nurses responded that they always decreased pain treatment if pain scores were below these cutoffs, and 43% responded that they reassessed the pain after pain-treatment actions were increased or decreased.

The NRS was the tool that the fewest nurses felt was easy to understand compared with the BPS and the BPS-NI (43% vs. 76% and 61%, respectively) and was simple to use (36%

vs. 64% and 55%, respectively). However, when using the BPS and the BPS-NI in ICU patients, a number of nurses responded that facial expression (19% and 9%, respectively) and upper limb movement (17% and 14%, respectively) were difficult to assess.

Regarding the clinical utility of the pain assessment tools, the NRS was the tool that most nurses recommended using routinely in ICU patients (76%). However, only 45% thought that pain treatment in clinical practice had become more targeted using the three pain-assessment tools.

Discussion

Overall, the algorithm had good feasibility, given that more than 70% of the nurses responded that the algorithm was easy to understand, the instructions on how to use the algorithm were clear, and the algorithm was quick to use. It is important that implemented tools are feasible and have satisfactory clinical utility, as the literature reports that clinicians have barriers to and resistance toward using tools such as pain-assessment tools (Bennetts et al., 2012; Berben et al., 2012; Horbury et al., 2005; Rose et al., 2011; Yildirim et al., 2008). Such barriers can be explained by knowledge deficits, misconceptions about pain assessment, and attitudes and resistance to use valid tools (Berben et al., 2012; Horbury et al., 2005; Yildirim et al., 2008).

It is interesting that more than half of the nurses responded that the 1.5 hours of education in pain assessment and how to use the algorithm was sufficient, but that fewer nurses responded that the three-week training period where nurses used the algorithm in clinical practice was sufficient to use the algorithm and the tools in clinical practice. Use of local leaders or clinicians who assume a leadership role in championing best practices is shown to be effective for changing clinicians' behavior (Flodgren et al., 2011). Therefore, more use of these resource persons when new tools are implemented in clinical practice may increase the usefulness of such training periods.

However, the two items with the lowest feasibility score were those determining what pain-treatment action should be taken, and when patients' pain should be reassessed (Table 1). One reason for the low score on the item about treatment actions could be that when the nurses were guided to increase pain treatment, the algorithm did not have specific suggestions, (Strom, Martinussen, & Toft, 2010), but rather recommends a general pain-treatment action based on cutoff points. Using cutoff point to guide pain management actions is only a part of how to assess and manage patients' pain. Some nurses may have felt that the algorithm is one-dimensional and does not cover other dimensions of the pain experience, and further not take the nurse's critical thinking into account. It is worth noting that in Norway where the present study was performed, nurses adjust pain-treatment within wide prescribed limits. However, decisions about pain management in ICU patients are often complex. For example, if a patient who is able to self-report pain does not want more analgesics, the clinicians should respect the patient's wishes even if the patient's pain intensity scores are above the cutoffs, and it may be that the patient needs more information about the side effects of the medications. Alternatively, if a patient will be undergoing major surgery in the near future, their pain treatment should perhaps not be decreased even if their pain intensity scores are below the cutoffs, as it would be expected that their pain would increase after surgery. Therefore, even if an assessment-driven, protocol-based, stepwise approach is recommended (Devlin et al., 2018), a pain-management algorithm may be too simple in some situations and too restricted to guide pain management for all ICU patients in all types of situations. It is important that clinicians are aware of these limitations when using an algorithm.

Regarding assessment, this response should be viewed in combination with the clinical utility item where only 43% of the nurses reported that they reassessed pain if pain-treatment actions were changed (Table 1). Reassessment of pain in clinical practice is known to be a challenge, and it has been shown that the effectiveness of pain-treatment actions is not reassessed and documented (Ayasrah, O'Neill, Abdalrahim, Sutary, & Kharabsheh, 2014), even if clinical-practice guidelines recommend that clinicians should frequently reassess patients for pain (Devlin et al., 2018). A survey of critically ill burns patients found a considerable gap between current guidelines and clinical practice concerning the management of pain, anxiety, agitation, and delirium (Depetris, Raineri, Pantet, & Lavrentieva, 2018). Clinicians should frequently reassess patients for pain and carefully titrate analgesic interventions to prevent potential negative sequelae of either inadequate or excessive analgesic therapy. Therefore, efforts should be directed toward improving the implementation of algorithms and guidelines, especially those regarding reassessment and documentation of pain, because it is important to achieve an overview of their pain.

Overall, the clinical utility score of the algorithm was somewhat lower than its feasibility score, because the minority of the nurses thought that pain treatment had become more targeted to each patient after the implementation of the algorithm (45%), and the pain assessment tools (24%). One explanation for this finding could be that the nurses needed more training using the algorithm. Less than 40% of the nurses felt that the training period was sufficient to allow them to use the algorithm accurately. The present study included a three-week training period where resource persons were available in the units to answer questions and to provide support. It is worth highlighting that in clinical practice, it can be difficult for economic reasons to offer longer training periods. However, other techniques such as audit and feedback have been shown to lead to potentially important improvements in professional practice should maybe be prioritized when new tools are implemented in clinical practice in the future (Ivers et al., 2012).

The present study indicated that it appeared to be more difficult to decrease pain-treatment actions than to increase them. One explanation for the finding may be that pain in ICU patients is often undertreated and that many ICU patients still perceive pain as a problem during their ICU stay (Alasad et al., 2015). This knowledge may lead to more reluctance by staff to decrease pain-treatment actions. Another explanation could be that hospital staff nurses have only a moderate degree of autonomy (Mrayyan, 2004), and hence some nurses do not trust their own assessment of the patient’s pain. However, it is important that nurses consider decreasing medications if pain-intensity scores are low, to avoid overmedication. For example, with respect to sedation, it has been reported that 35% of the ICU patients in 45 Brazilian ICUs were deeply sedated (Tanaka et al., 2014), and another study reported that 27% of ICU patients in Germany were deeply sedated (Balzer et al., 2015), despite contrary recommendations from clinical practice guidelines (Barr et al., 2013).

Regarding the pain-assessment tools used in the algorithm, the NRS was reported to be more difficult to understand and use than the BPS and BPS-NI. One explanation for this surprising finding could be that nurses think that ICU patients are unable to cooperate sufficiently to use the NRS or understand how it works. If a patient describes their pain intensity as 8 on a scale of 0–10, the nurses may have concerns that the pain intensity is overstated. Others have noted that when high NRS values are reported by a patient, clinician assessments often underestimate that pain (Ahlers et al., 2008). However, a 0–10 visually enlarged horizontal NRS was found to be the most valid and feasible of five pain-intensity rating scales tested in over 100 ICU patients (Chanques et al., 2010). It is the patient themselves who decides the pain-intensity score when using the NRS, and it is important that nurses guide the patients how to use the scale. It is surprising that although over 75% of the nurses in the present study recommend using the NRS routinely in ICU patients able to self-report pain, but this was the pain assessment tool that the nurses though was most difficult to use. On the other hand, only half of the nurses recommend using the BPS and the BPS-NI, although the nurses reported that both the BPS and the BPS-NI were easy to use, easy to understand, and that the different items in the tools were not difficult to assess. One explanation for this finding may be that when this survey was done, BPS and BPS-NI was recently implemented in these units, while NRS had been used several years. The barriers and attitudes (Bennetts et al., 2012; Berben et al., 2012; Horbury et al., 2005; Rose et al., 2011; Yildirim et al., 2008) among the respondents may therefore be larger against BPS and BPS-NI than against NRS, even if the feasibility and clinical utility of the new tools were better than for the NRS. It is worth noting that the good feasibility of these two tools has been supported by another study in which behavioral pain-assessment tools were evaluated as highly satisfactory by the nurses (Payen et al., 2001).

Strength of our algorithm is that it includes specific tools for detecting pain in different patients groups, and can help clinicians discriminate between situations requiring sedation and those requiring analgesia, a task that remains a challenge for clinicians (Gerber, Thevoz, & Ramelet, 2015). In addition, the reported correlations between pain and anxiety (Oh et al., 2015), or pain, fear, and anxiety (Gelinas, Chanques, & Puntillo, 2014), indications of their coexistence in ICU patients emphasize the importance of using pain-assessment tools that are sensitive and specific for such patients. Furthermore, the inclusion of pain-assessment tools based on self-reporting of pain and observations of pain behaviors could improve the evidence base of pain assessment in ICU patients, as the patients' physiological stability is still used as a principal indicator for making decisions about pain management (Gerber et al., 2015).

Limitations and Strengths

The response rate of nurses in our study was rather low (56%), which may affect the generalizability of the results. Another weakness in the present study was that the questionnaire used to evaluate the pain-management algorithm was developed as part of this study, as no suitable validated questionnaire could be identified. However, our questionnaire was based on earlier research (Gelinas, 2010). It is strength of our study that compared with a similar study (Puntillo, Stannard, Miaskowski, Kehrle, & Gleeson, 2002), that a relatively high number of nurses were included in this evaluation. However, it is a limitation that the questionnaire does not investigate the reasons for the responses; for example, why did only 53% of nurses think the algorithm was helpful in clinical practice? Such knowledge could be helpful in the further development of the algorithm.

Conclusion

Our study suggests that nurses consider the new pain-management algorithm to have relatively high feasibility but somewhat lower clinical utility. Thus, the pain-management algorithm may be appropriate and useful in clinical practice. However, to increase clinical utility and to get a more targeted pain treatment in ICU patients, more focus on pain-treatment actions and reassessment of patients' pain is needed.

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