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Care of Critically Ill Adults

Development of a pain management algorithm for intensive care units

Brita F. Olsen, RN, MNSc [a,b,*], Tone Rustøen, RN, PhD [b,c], Leiv Sandvik, MD, PhD [d], Christine Miaskowski, RN, PhD, FAAN [e], Morten Jacobsen, MD, PhD [a,c,f], Berit T. Valeberg, RN, PhD [g]

[a] Østfold Hospital Trust, Fredrikstad, Norway
[b] Oslo University Hospital, Division of Emergencies and Critical Care, Oslo, Norway
[c] Faculty of Medicine, University of Oslo, Norway
[d] Oslo Center for Biostatistics and Epidemiology, Oslo University Hospital, Oslo, Norway
[e] School of Nursing, University of California, San Francisco, CA, USA
[f] Norwegian University of Life Sciences, Aas, Norway
[g] Oslo and Akershus University College of Applied Sciences, Oslo, Norway

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ABSTRACT

Objectives: To develop a pain management algorithm for intensive care unit (ICU) patients and to evaluate the psychometric properties of the translated tools used in the algorithm.
Background: Many ICU patients experience pain. However, an evidence-based algorithm for pain management does not exist.
Methods: Literature review, expert panel, and pilot testing were used to develop the algorithm. The tools were evaluated for inter-rater reliability between two nurses. Discriminant validity was evaluated by comparing pain during turning and rest.
Results: An algorithm was developed. The Behavioral Pain Scale (BPS) and the Behavioral Pain Scale-Non Intubated (BPS-NI) discriminated between pain scores during turning and rest. Inter-rater reliability for the BPS varied from moderate (0.46) to very good (1.00). Inter-rater reliability for the BPS-NI varied from fair (0.21) to good (0.63).
Conclusions: The content of the pain management algorithm is consistent with the latest clinical practice guideline recommendations. It may be a useful tool to improve pain assessment and management in adult ICU patients.

Introduction

Pain is one of the most common traumatic memories for patients in the intensive care unit (ICU).[1,2] Unrelieved pain is a major source of stress[3,4] and can result in chronic pain, posttraumatic stress disorder symptoms, and lower health-related quality of life.[5] To provide optimal pain treatment to ICU patients, nurses need to perform routine pain assessments. While self-report is the gold standard for pain assessment,[6] many ICU patients cannot self-report pain because of intubation, altered levels of consciousness, and high doses of sedative agents.[7] In these cases, observation of patients' pain behaviors is recommended.[8–11]

Routine use of self-report[12] and behavioral[13] pain assessment tools for ICU patients is recommended in evidence-based guidelines.[6] The effects of using different pain assessment tools (e.g., Behavioral Pain Scale,[14] Harris Scale,[14] visual analog scale,[14] verbal descriptor scale,[14] numeric rating scale,[14] Critical-care Pain Observation Tool,[15,16] Adult Nonverbal Pain Scale[17]) in ICU patients have been evaluated. Better outcomes were found after the implementation of these tools including a reduction in the duration of mechanical ventilation and ICU stay[14]; decreased incidence of complications[16]; increased number of pain assessments[15,17]; and increases in nurses' confidence in pain assessment.[17] Even if all of these outcomes are positive, a pain assessment tool does not include guidelines for pain management.

Abbreviations: BPS, Behavioral Pain Scale; BPS-NI, Behavioral Pain Scale-Non Intubated; ICU, Intensive care unit; NRS, Numeric rating scale.

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* Corresponding author. Østfold Hospital Trust, P.O. Box 300, 1714 Graalum, Norway. Tel.: +47 99165586.
E-mail address: Brita.Fosser.Olsen@so-hf.no (B.F. Olsen).

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A pain management algorithm is a more comprehensive approach than an assessment tool because it can guide clinicians to manage the patient's pain based on the findings from the assessment. Only one pain management algorithm for ICU patients was found that included both pain assessment tools and pain management guidelines.[18] The Pain Assessment and Intervention Notation (PAIN) algorithm was developed in the 1990s and was based on the best available evidence. The algorithm contained lists of behavioral and physiological indicators of pain that nurses evaluated to make inferences about a patient's pain intensity. Then, the nurses evaluated for potential problems (e.g., hemodynamic and respiratory instability and/or oversedation) and made a decision about whether or not to administer an opioid analgesic. However, the PAIN algorithm was printed on several pages and the nurses commented that it was too long and too complex to use in a busy ICU. In addition, this algorithm was evaluated only in patients who were able to self-report their pain.[18] Because ICU patients often are not able to self-report pain,[7] nurses need to infer pain through the use of valid and reliable tools that assess pain behaviors. When behavioral pain assessment tools are translated, they require further validation testing.[6]

The format of an algorithm is important. An algorithm provides an opportunity to organize information from diverse sources into an easily accessible format[19] and provides clinicians with the most current information.[20] Several protocols for the evaluation of pain and sedation[21–23] and pain, sedation, and delirium[24,25] were identified. Except for one study,[22] findings from these studies suggest that the use of a protocol improves symptom management. However, none of these studies published their algorithm or protocol in an easily accessible format that could be used by ICU nurses to assess pain and make decisions about pain management. Therefore, an algorithm that was relatively brief and simple, easily accessible, and included valid pain assessment tools for patients who can and cannot self-report their pain is needed. The purposes of this study were to develop a pain management algorithm for ICU patients with these properties and to evaluate the psychometric properties of the translated pain assessment tools in this algorithm.

Methods

Ethical approval

The Regional Ethics Committee (2011/2582 D) and the leadership at the hospitals that participated in the study approved this study. The study was registered in ClinicalTrials.gov (NCT01599663).

Development of the pain management algorithm

In order to identify relevant literature, PubMed, Excerpta Medica Database (EMBASE), Cumulative Index to Nursing and Allied Health Literature (CINAHL), and Cochrane databases were searched using different combinations of the following terms: "critical care," "intensive," "intensive care," "acute care," "critical care nursing," "intensive care units," "critical illness," "critically ill patients," "respiration artificial," "artificial ventilation," "sedation," "deep sedation" or "conscious sedation" and combined with different combinations of the terms (i.e., "pain," "pain assessment," "pain measurement," "pain management," "pain experience" or "pain control"). The search was limited to papers that: were published between 1990 and 2012, included participants $\geq$18 years, and were written in English. This search generated 1340 articles. Abstracts from these articles were reviewed. The complete paper was reviewed if it addressed acute pain in the ICU. Studies that included a specific pain treatment (e.g., propofol versus midazolam), specific diagnoses (e.g., chest pain), or therapies (e.g., music therapy) were excluded. In total, 128 articles were selected and used to develop the pain management algorithm.

The pain management algorithm was developed for ICU patients over 18 years of age, because the assessment of pain in children requires different tools.[26] The pain management algorithm specified that pain assessments should be done at least once a shift (i.e., between 8 AM and 10 AM, between 3 PM and 5 PM, between 10 PM and 12 AM). In addition, nurses were instructed to assess patients' pain while at rest and during turning. Turning was chosen because it was reported to be the most painful procedure for adult ICU patients.[27] In addition, the algorithm instructed the nurses to reassess pain if they suspected changes in the patient's pain or after pain management interventions (see Fig. 1).

Pain assessment tools

Three tools (i.e., numeric rating scale (NRS), Behavioral Pain Scale (BPS), Behavioral Pain Scale-Non Intubated (BPS-NI)) were included in the pain management algorithm to assess pain in ICU patients who were (i.e., conscious) and were not (i.e., unconscious) able to self-report pain. The algorithm guided the nurses to choose the most appropriate pain assessment tool depending on the ICU patients' level of consciousness.

Pain assessment tools for ICU patients who are able to self-report

Several tools (e.g., visual analog scale, NRS, verbal rating scale) were evaluated for use in adults (for review see Ref. 28 and for comparison of pain assessment tools see Ref. 29). The NRS, where patients rated their pain intensity on a 0 (no pain) to 10 (worst possible pain) scale (Fig. 1), was chosen for the algorithm. ICU patients have described the NRS as the easiest, the most accurate, the preferred, and the most discriminative self-report tool.[12] In a study of 111 ICU patients,[12] negative predictive value, calculated from true or false negatives and defined by real and false absence of pain was 90% for the NRS. In addition, the success rate for the NRS was 91% when ratings of pain intensity at enrollment versus pain intensity after analgesic administration or pain intensity after a nociceptive procedure were compared.[12]

Pain assessment tools for ICU patients who are not able to self-report

A number of behavioral tools were developed to assess pain in ICU patients who are not able to self-report (e.g., Critical Care Pain Observation Tool,[30] BPS,[31] BPS-NI,[32] Nonverbal Pain Scale[33,34]). The BPS (Fig. 1) was included in the algorithm and can be used when ICU patients are on mechanical ventilation and are unable to report their pain. The BPS contains three domains (i.e., facial expressions, movements of upper limbs, compliance with ventilation). Each domain contains four descriptors rated on a 1 to 4 scale. The ratings for each domain are summed which results in a total score that can range from 3 (no pain) to 12 (worst possible pain). The BPS was used in studies of more than 500 medical, surgical, trauma, neurological, emergency patients[21,31,35–39] and in ICU patients with different levels of sedation.[40] In addition, compared to other behavioral assessment tools, the BPS had the best psychometric properties.[13,41,42] Cronbach's α coefficients for the BPS ranged from 0.63 to 0.72 in different samples of ICU patients.[35,36,38,40] Inter-rater reliability (kappa coefficient) for the BPS is satisfactory (i.e., range from 0.67 to 0.83[31,37,40]) with intraclass correlation coefficients (ICC) that ranged from 0.46 to 0.95.[35,38] Criterion validity was demonstrated by a Spearman correlation coefficient of 0.67 ($p > .001$) between BPS scores and the patient's self-report of pain intensity during a painful procedure.[40] Discriminant validity was supported by significant increases of 2–3 points in BPS scores