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Results of implementing a pain management algorithm in intensive care unit patients: The impact on pain assessment, length of stay, and duration of ventilation☆

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ABSTRACT

Purpose: This study aimed to measure the impact of implementing a pain management algorithm in adult intensive care unit (ICU) patients able to express pain. No controlled study has previously evaluated the impact of a pain management algorithm both at rest and during procedures, including both patients able to self-report and express pain behavior, intubated and nonintubated patients, throughout their ICU stay.
Materials and methods: The algorithm instructed nurses to assess pain, guided them in pain treatment, and was implemented in 3 units. A time period after implementing the algorithm (intervention group) was compared with a time period the previous year (control group) on the outcome variables: pain assessments, duration of ventilation, length of ICU stay, length of hospital stay, use of analgesic and sedative medications, and the incidence of agitation events.
Results: Totally, 650 patients were included. The number of pain assessments was higher in the intervention group compared with the control group. In addition, duration of ventilation and length of ICU stay decreased significantly in the intervention group compared with the control group. This difference remained significant after adjusting for patient characteristics.
Conclusion: Several outcome variables were significantly improved after implementation of the algorithm compared with the control group.

1. Introduction

Many patients in intensive care units (ICUs) experience pain [1,2]. Pain should be assessed routinely and repetitively [3] but is not always done [4]. Valid pain assessment tools are available and recommended [3], but a substantial proportion of ICU nurses do not use them [5]. When implementing these tools in clinical practice, knowledge deficits, resistance, and barriers against changing practice have been documented among clinicians [6-9].

Clinical evidence-based algorithms are suitable for implementing pain management in clinical practice [10]. However, because an appropriate algorithm for adult ICU patients that included both pain assessment and pain management was not available, a comprehensive new algorithm was developed [11]. This algorithm was implemented in 3 units [12]. To our knowledge, no controlled studies have previously evaluated the impact of a pain management algorithm both at rest and during procedures [13], including both patients able to self-report and express pain behavior, intubated and nonintubated patients, throughout their ICU stay.

However, the implementation of a single pain assessment tool has been evaluated in several studies [14-17]. Of note, not all ICU patients able to express pain were included in these studies. Other studies have evaluated the implementation of several assessment tools, including tools to assess pain, agitation, and delirium [18-21]. When introducing several tools targeting different variables, it is difficult to

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evaluate the effect of implementing the pain assessment tools. Despite these limitations, these studies found a decrease in pain and agitation [17,20], decreased duration of ventilation [15,18-20], decreased length of ICU stay [14,15,18,19], decreased length of hospital stay [18], a decrease in complications [15], nosocomial infections [20], decreased mortality [18,19], more frequently charted pain assessments in the medical records [14-17,20], and better and more dedicated analgesia [14-16,18,20,21].

Based on earlier research, the objective of the present study was to evaluate the use of a pain assessment and pain management algorithm in all groups of ICU patients able to express pain on pain assessments, duration of ventilation, length of ICU stay, length of hospital stay, use of analgesic and sedative medications, and the incidence of agitation events.

2. Materials and methods

2.1. Development of the algorithm

A short, evidence-based algorithm was developed [11]. The algorithm instructed ICU nurses to assess patients' pain at least once a shift, both at rest and during turning [22,23]. A numeric rating scale (NRS) was used when patients could self-report pain [24]. The behavioral pain scale (BPS) was used when patients were receiving mechanical ventilation and unable to self-report pain [25]. Finally, the BPS-NonIntubated (BPS-NI) was used when patients were not intubated but unable to self-report pain [26]. Pain treatment actions were chosen based on cutoff points that defined a pain event. Pain events were defined as NRS scores >3 [20,27], or BPS and BPS-NI scores >5 [20,25,26]. If the pain score was higher than the prespecified cutoff, the nurses were guided to consider increasing pain treatment. If the pain score was less than the cutoff, the nurses were guided to consider either decreasing or continuing the present pain treatment. Pain treatments included analgesics within each patient's prescription or nonpharmacological interventions such as changing the patient's position.

2.2. Implementation and evaluation of the algorithm

The algorithm was implemented in 3 units (1 medical/surgical ICU, 1 surgical ICU, and 1 postanesthesia care unit) at 2 Norwegian hospitals. Before the implementation, these units had no protocols or guidelines for pain assessment or management, but the nurses were able to titrate doses of prescribed analgesics. Nurses at the 3 units were educated in pain assessment and management for a 3-week period [12].

The algorithm was used for a 22-week period for all ICU patients ≥18 years old admitted to the 3 units [12]. Patients were included in the study if they were able to self-report pain or express pain behaviors and were excluded if they could not self-report pain or express pain behaviors (having quadriplegia, receiving neuromuscular blockade or paralyzing drugs, and being investigated for brain death). During these 22 weeks, the nurses' level of adherence with the algorithm was 74.6% [12].

To evaluate the impact of the algorithm in ICU patients, we used a pre-post intervention design. To cover the same time period of the year, we compared a period (from May to November 2012) after implementing the algorithm (intervention group) with a similar time period (from May to November 2011) the previous year (control group).

2.3. Ethics approval

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

2.4. Data collection

Demographic and clinical data including sex, age, ventilation status (yes/no), diagnosis using the International Classification of Diseases-10 codes, total ventilation time during ICU stay (for patients receiving mechanical ventilation or noninvasive ventilation), length of ICU stay, length of hospital stay, severity of disease, and nurses' workload were collected from the medical records. In addition, the use of analgesic and sedative medications (yes/no), daily dosages of analgesic or sedative medications, sedation level (day/evening/night), and pain assessments (day/evening/night, at rest and during turning) during the first 6 days of each patient's ICU stay were collected from medical records.

Sedation level was measured by the Motor Activity Assessment Scale (MAAS) [28] or the Richmond Agitation-Sedation Scale (RASS) [29], depending on which scale the units used. MAAS ranges from 0 (unresponsive) to 6 (dangerous agitation), and a score of 3 denotes a calm and cooperative patient. RASS ranges from −5 (unarousable) to 4 (combative), and 0 denotes an alert and calm patient. Severity of disease was measured with the Simplified Acute Physiology Score (SAPS II) [30]. SAPS is calculated during the first 24 hours of ICU stay, ranges from 0 to 163, with higher scores indicating high disease severity and high risk of hospital mortality. Nurses' workload was measured by the Nine Equivalents of Nursing Manpower Score (NEMS) [31]. The NEMS includes 9 variables. Scoring range is from 0 (low workload) to 66 (high workload).

Pain assessments were measured using 3 different tools. The NRS is a scale that ranges from 0 (no pain) to 10 (worst possible pain). The BPS contains 3 domains (facial expressions, movements of upper limbs, and compliance with ventilation). In the BPS-NI, the domain compliance with ventilation is replaced with vocalization. Each domain contains descriptors rated on a 1-to-4 scale. The ratings for each domain are summed, with a total score from 3 (no pain) to 12 (worst possible pain).

2.5. Statistical analysis

A sample size calculation was performed, using ventilation time as the variable. In a study by Chanques and colleagues [20], median ventilation times were 120 and 65 hours for the control group and the intervention group, respectively, and the interquartile ranges were 264 and 168 hours, respectively. In normally distributed data, the standard deviation (SD) is 0.694*interquartile range; the SDs of the ventilation times were 183 and 117 hours, respectively. Based on these data, we assumed that, in the present study, the difference in mean ventilation time between the groups would be at least 55 hours and that the SD would be 150 hours for each group. To achieve 80% test power, we needed to include at least 117 mechanically ventilated patients in each group. Because we included both mechanically ventilated and nonmechanically ventilated patients, data from all patients enrolled were collected until at least 117 of the included patients in each group were mechanically ventilated. In that way, we could also include ventilation time as an outcome measure in the group of ICU patients that were mechanically ventilated.

Diagnostic groups including <5% of the patients were merged into 1 category named “other diagnoses”. Mean daily NEMS was calculated for each patient. Ventilator time was calculated for patients receiving mechanical ventilation or noninvasive ventilation. Analgesic and sedative medications used in >5% of patients are analyzed [32]. Median daily dosages of each medication were calculated for each patient. Doses of ketobemidone [33], morphine [33], oxycodone [33], fentanyl [34], remifentanil [34], and alfentanil [34] were converted into intravenous morphine equianalgesic dosages. Sedation level was divided into no agitation events (RASS ≤1 or MAAS ≤4) and agitation events (RASS >1 or MAAS >4) [20,28,29]. The total number of pain assessments that were recorded during the first 6 days of the patients' ICU stay was divided by the total number of pain assessments that should have been recorded