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Routine delirium monitoring is independently associated with a reduction of hospital mortality in critically ill surgical patients: A prospective, observational cohort study

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ABSTRACT

Purpose: Although delirium monitoring is recommended in international guidelines, there is lacking evidence for improved outcome due to it. We hypothesized that adherence to routine delirium monitoring would improve clinical outcome in adult critically ill patients.
Material and methods: We present the results of a prospective, noninterventional, observational cohort study that was conducted on 2 intensive care units (ICUs) of a tertiary care medical center between July and October 2007 (International Standard Registered Clinical Trial Record identifier: 76100795). We assessed delirium-monitoring and outcome parameters on a daily basis. Besides multivariate logistic and robust linear regression to analyze the relationship between delirium monitoring and outcome, we used the doubly robust augmented inverse probability weighting method for observational data to estimate effect sizes.
Results: Of 355 screened patients, we included 185 surgical ICU patients into our final analysis, of which 87 were mechanically ventilated. We found an independent association between delirium-monitoring adherence and in-hospital mortality for ventilated patients (odds ratio, 0.973; $P = .041$). Estimating the effect size, delirium monitoring indicated a reduction of 22% of in-hospital mortality if conducted 50% or more of ICU days per patient. The average ICU length of stay of 46 days was estimated to be reduced by 19 days ($P = .031$) if patients were sufficiently monitored.
Conclusion: Our data suggest an improved outcome for mechanically ventilated patients being screened for delirium in clinical routine.

1. Introduction

Delirium is defined as a disturbance in attention accompanied by a change in either cognition or consciousness that fluctuates over the course of the day and results from an underlying medical condition [1]. The incidence of delirium in critically ill patients has a wide variability depending on the mode of diagnosis, screening, and the patients under observation [2–5]. Various studies have shown that delirious patients have an increased length of hospitalization [6], as well as a higher risk for long-term cognitive impairment [7] and functional impairments [8]. There are also studies stating a higher risk for mortality, which is a matter of current discussion [2]. The practice guideline of the Society of Critical Care Medicine [9] and national societies [10] recommend a frequent screening for delirium with particular assessment tools. These tools have been developed to allow a valid and reliable screening for delirium in clinical routine [3]. In comparison to a subjective, clinical evaluation, the use of validated scores improves the physician's and nurse's ability to detect delirium [11].

Delirium monitoring is part of the evidence-based organizational approach referred to as the "ABCDEF bundle" (Awakening and Breathing Coordination, Choice of sedatives, Delirium monitoring, Early mobility, Fast sleep) [12]. In this respect, feasibility and effectiveness have been shown for the implementation of parts of this bundle [13]: Considering the single features of the bundle, there is a body of literature favoring protocol-based sedation and showing negative effects of a continuous benzodiazepine-driven sedation [14], compared with a regime favoring nonbenzodiazepine sedation [15] and favoring less sedation [16]. In addition, early mobility has proven benefits for the patient [17]. In contrast, the distinct value of delirium monitoring in clinical routine has

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not been addressed so far and remains hypothetical. This might be one potential cause for the low implementation of delirium screening in clinical practice [18].

We set up a prospective cohort study to address this issue. We hypothesized that adherence to delirium monitoring, as an additional level of care, would result in a reduction of mortality in ventilated and nonventilated patients.

2. Materials and methods

In this prospective, observational, clinical trial (International Standard Registered Clinical Trial Record: 76100795) patients were included between July 2007 and October 2007. The data acquisition was performed on 2 intensive care units (ICUs) of a tertiary care medical center in Germany. The local ethics committee of the Charité–Universitätsmedizin Berlin, Berlin, Germany, approved the study and waived informed consent (ethical vote no. EA1/132/07, protocol no. 1.0, date of approval January 8, 2007).

We included patients aged 18 years or more, being newly admitted between 7:00 AM and 10:00 PM, with at least 1 surgical procedure. Exclusion criteria included inability to communicate due to severe hearing loss or brain injury and non–German-speaking patients. We only included patients to our analysis with a minimum ICU length of stay (LOS) of 24 hours.

2.1. Main predictor variable

The main predictor variable was the adherence to delirium monitoring. Delirium, analgesia, and sedation monitoring were aligned in an algorithm: starting with the sedation monitoring, all patients with a Richmond Agitation Sedation Scale (RASS) [19] of −2 or greater were scheduled for delirium monitoring. In case of a negative score, patients were assessed for pain using the Numerical Rating Scale (NRS) [20]. In case of a positive score, or if screening of sedation revealed a RASS of −3 or less, patients were screened for pain using the Behavioral Pain Scale (BPS) [21]. For moderately and deeply sedated patients (RASS, ≤−3), the algorithm suggested the reduction of sedation and assessment for delirium within the following 8 hours (Fig. 1).

At the beginning of the study, implementation rates for daily sedation and pain monitoring on both ICUs were 100%, because they have been implemented before the delirium monitoring and are mandatory fields in the electronic medical record (EMR) [22].

Before the study, we consecutively trained a delirium screening using the Delirium Detection Score (DDS) [23], on top of a preexisting analgesia and sedation monitoring. The confusion assessment method for the ICU (CAM-ICU) [24] was introduced to the ICU staff at the end of the study period. The training method used included on-the-job-training periods provided by a multiprofessional team of nurses and physicians [25].

Adherence to delirium monitoring was assessed prospectively on a daily basis. Study staff (nurses and residents who where supervised by an intensive care specialist) observed actual practice at the patients' bedside. Evaluation of delirium scoring adherence for a specific patient on a specific day was made by combining the results of the bedside observation and the screening of the patient record. Study staff was present between 7:00 AM and 10:00 PM.

The adherence to delirium monitoring for a patient was calculated as follows: the number of "adhered days" was divided by the total number of days the patient was treated on the ICU (adherence of 0% to 100%). A patient's ICU day was rated as "adhered" if the patient received at least 1 delirium monitoring on that specific day. If the patient received no delirium monitoring, this specific day was only rated as adhered if the RASS remained −3 or less during all RASS assessments of that day (at least every 8 hours).

2.2. Outcome variables

The main outcome variable was the in-hospital mortality. Secondary outcome variables included the duration of mechanical ventilation (MV), ICU LOS, hospital LOS, and discharge from our hospital to home (yes/no). These data were extracted from the EMR.

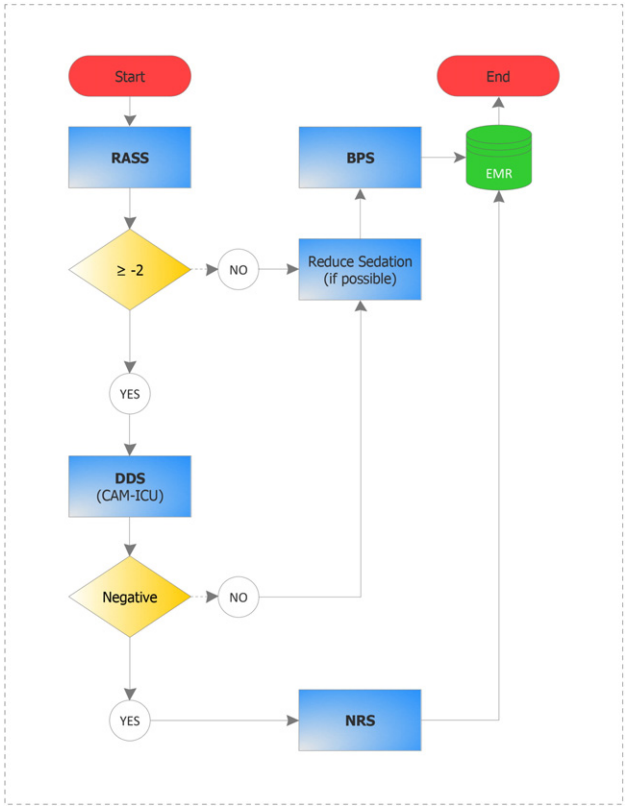

Fig. 1. Algorithm for sedation, delirium, and pain monitoring. Delirium, analgesia, and sedation monitoring was aligned in an algorithm. At the beginning of the study, implementation rates for daily sedation and pain monitoring on both ICUs were 100%. Before the study, we trained a delirium screening using the Delirium Detection Score (DDS). The Confusion Assessment Method for the ICU (CAM-ICU) was introduced to the ICU staff at the end of the study period. EMR, Electronic Medical Record.

2.3. Covariates

The control variables for the regression models were determined a priori based on available literature and clinical experience: They include age, sex, the delirium screening result (using DDS and/or CAM-ICU), the Simplified Acute Physiology Score II (SAPS II) [26] on admission, RASS [19], BPS [21], and/or NRS [20], as well as the amount of administered haloperidol, midazolam, lorazepam, and clonidine per ICU day. Midazolam and clonidine were delivered by continuous intravenous (IV) infusion, whereas haloperidol and lorazepam were delivered by bolus injection. We chose these IV agents because they were used for treatment of delirium-associated symptoms: haloperidol for hallucinations, clonidine and midazolam for agitation, and lorazepam in the presence of anxiety. Covariates were assessed daily by reviewing the electronic medical record.

2.4. Statistical analysis

We separately analyzed ventilated (MV) and nonventilated (not mechanically ventilated [NMV]) patients.

Results are expressed as medians with interquartile ranges (IQR) in case of continuous variables; absolute and relative frequencies were used for categorical and dichotomous variables. Due to limited sample sizes and/or nonsymmetrically distributed observations, we applied nonparametric statistics. The impact of adherence to delirium monitoring on time of ventilation, as well as ICU and hospital LOS, was investigated by means of multiple robust linear regression analyses; multiple