SEDATION IN ICU: ARE WE ACHIEVING GOALS?

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Abstract

Objective: The purpose of this study was to examine whether sedation goals, utilizing a validated sedation assessment scale, the Riker Sedation-Agitation Scale (SAS), and a standardized sedation protocol, were achieved in Intensive Care Unit (ICU) patients.

Design: This is a nested prospective cohort study

Setting: The study was conducted in a tertiary care medical-surgical ICU.

Patients: All mechanically ventilated adult patients who were judged by their treating intensivists to require intravenous sedation for more than 24 hours, were included in the study.

Interventions: A goal-directed protocol using the SAS was initiated following an educational program to the medical and nursing staff.

Measurements and Main Results: The following data was collected: patients' demographics, Acute Physiology and Chronic Health Evaluation (APACHE) II score, reason for admission, and outcome. For the first five ICU days, the bedside nurse documented ordered and average achieved SAS scores, every 4 hours. We compared the targeted versus achieved SAS scores using a paired Student's *t*-test. One hundred and five (105) patients were included in the study with mean age (±SD) of 47 (±23) and APACHE II (±SD) of 21 (±9). Achieved sedation scores were consistently lower than the requested goals during daytime and nighttime shifts throughout the study period. This did not change even after 3 months of implementing the protocol.

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Conclusion: Achieved levels of SAS score were consistently lower than what was requested by physicians despite an educational program and the use of a standardized protocol. Differences between targeted and achieved SAS scores persisted throughout the whole study period even three months after protocol implementation. These data suggest the need for alternative, more sensitive and precise approaches, to titrate sedation to targeted levels.

Introduction

Targeted sedation is central to the care, and outcome of critically ill patients. Both under- and oversedation of critically ill patients are undesirable and are associated with complications[1-5]. Inadequate sedation can result in anxiety, agitation and in recall

Table 1
Summary of the ICU Analgesia-Sedation Protocol

Document Analgesia and Sedation Scoring every 4 hours
DATE: TIME: This form is valid till 14:00 hours

Target: Sedation Score   ☐ **1**   ☐ **2**   ☐ **3**   ☐ **4**

ANALGESIA
☐ Morphine (Preferred in hemodynamically stable patients)
☐ 1-2 mg IV q 5-10 min until pain is controlled (maximum dose _____ mg)
☐ PRN doses _____ mg I.V. q _____ hourly
☐ Infusion _____ mg/hour
☐ Fentanyl (Preferred in hemodynamically unstable patients)
☐ 25-100 mcg IV q 5-10 minutes until pain is controlled (maximum dose _____ mcg)
☐ PRN doses _____ mcg I.V. q _____ hourly
☐ Infusion _____ mcg/hour

SEDATION
☐ If sedation is planned for ≤ 3 days
☐ Propofol Infusion: _____ mg/hour (check triglyceride level after two days)
☐ Dexmedetomidine Infusion: _____ mcg/kg/hour
☐ If sedation is planned for > 3 days
☐ Midazolam PRN doses _____ mg IV q _____ hourly
☐ Midazolam _____ mg IV q _____ hourly
☐ Midazolam infusion _____ mg/hour

IN PATIENTS WHO REACHED THE GOAL OF SEDATION AND ANALGESIA
Taper infusion by 20% every 4 hours until infusion is discontinued
☐ **Yes** (most patients)
☐ No (only in selected patients, such as patients on neuromuscular blockers, recent severe head injury, high ventilation settings)

of stressful experience following ICU discharge[1]. On the other hand, inappropriate and excessive sedation commonly occurs; and causes prolongation of mechanical ventilation and ICU and hospital length of stay (LOS), increased risk of pneumonia and sepsis, and increased mortality and costs[2-5]. Therefore, optimizing sedation is a universal goal for critical care practitioners.

To avoid under-and oversedation, the use of sedation protocol[6-8] and sedation scoring system[9], to regularly assess and document sedation level, have been recommended[10]. The establishment of endpoints of sedation[11] has been demonstrated to improve clinical practice of sedation[6-9,11].

The purpose of this study was to examine weather the ordered levels of sedation in the ICU, using a sedation scoring system (Riker Sedation-Agitation Scale: SAS)[12,13] with a sedation protocol which incorporates nurse-driven dose titration directives, were achieved. Our hypothesis was that the use of a sedation-score-based protocol, would not achieve the sedation goal. This would have implications on clinical practice of sedation in the ICU.

Materials and Methods

Setting: This is a nested prospective cohort study from a prospective observational study comparing protocolized versus non-protocolized sedation practice[14]. The study was conducted in a 21-bed, tertiary care medical-surgical ICU in an 800-bed teaching hospital in Riyadh, Saudi Arabia, between October 1, 2002 and March 31, 2003. The ICU, which admits more than a thousand patients per year, is run as a closed unit 24 hours a day, seven days a week by in-house, full-time critical care board-certified intensivists[15]. The study was approved by the institutional review board (IRB) of the hospital.

Patients: The study included all mechanically ventilated patients who were managed with protocolized sedation and met the following criteria: adult (≥18 years of age), and ascertained by the treating intensivist to require intravenous sedation for more than 24 hours. Exclusion criteria included: (a) sedation not expected to be beyond 24 hours, (b) admission following cardiac arrest, (c) ICU readmission, (d) "Do-Not-Resuscitate" (DNR) status, (e) epidural analgesia, and (f) brain death.

Sedation Protocol: Prior to and during the study period, the medical and nursing staff attended an educational program on ICU sedation consisting of lectures and in-services.

A standardized goal-directed protocol was

Table 2

Riker Sedation-Agitation Scale[12,13]

Score	Term	Descriptor
7	Dangerous agitation	Pulling at endotracheal tube (ETT), trying to remove catheters, climbing over bedrail, striking at staff, trashing side-to-side
6	Very Agitated	Does not calm despite frequent verbal reminding of limits, requires physical restraints, biting ETT
5	Agitated	Anxious or mildly agitated, attempting to sit up, calms down to verbal instructions
4	Calm and Cooperative	Calm, awakens easily, follows commands
3	Sedated	Difficult to arouse, awakens to verbal stimuli or gentle shaking but drifts off again, follows simple commands
2	Very sedated	Arouses to physical stimuli but does not communicate or follow commands, may move spontaneously
1	Unarousable	Minimal or no response to noxious stimuli, does or communicate or follow

established by a medical-nursing taskforce, based on published recommendations[10] and consisted of a daily physician order form (Table 1). Validated scoring systems were used to assess the level of pain and sedation-agitation. Whenever possible, the level of pain reported by the patient was graded using a Visual Analogue Scale (VAS). Patients who could not communicate were assessed through observation of pain-related behaviors (movement, facial expression, and posturing) and physiological indicators (heart rate, blood pressure, and respiratory rate)[10]. Sedation of agitated patients was started only after providing adequate analgesia and treating reversible physiological causes. A validated sedation assessment scale (SAS) was used to assess the level of sedation-agitation[12,13] (Table 2). The treating physician decided the sedation goal ranging from one to four, on a daily basis, depending on the patient's condition. The bed side nurse adjusted the dosage of analgesics and sedatives to reach the targeted level of sedation. To avoid over-sedation, when sedation goals were reached, doses of analgesics and sedatives were reduced by 20% every 4 hours until discontinued. Doses were not tapered in patients with increased intracranial pressure, patients with high ventilatory settings, and patients receiving neuromuscular blocking agents. The use of short-acting drugs such as fentanyl, propofol, and dexmedetomidine was recommended for patients anticipated to require sedation for less than 3 days. Long-acting drugs such as benzodiazepines and morphine were otherwise used. Order form was valid only for 24 hours and had to be rewritten on a daily basis.

Data Collection: The following data were collected: demographics including age, and gender; Acute Physiology and Chronic Health Evaluation (APACHE) II[16] scores; admission categories derived

Table 3 Baseline characteristics	
Variable	
Number, n	105
Age in years (mean ± SD)	47 ± 23
Male gender, n (%)	74 (71)
APACHE II (mean ± SD)	21 ± 9
Mechanical Ventilation, n (%)	105 (100)
Admission Category	
Medical, n (%)	52 (50)
Surgical, n (%)	16 (15)
Trauma, n (%)	37 (35)
Chronic Underlying Illnesses	
Chronic respiratory disease, n (%)	6(6)
Chronic renal disease, n (%)	6 (6)
Chronic immunosuppression, n (%)	7 (7)
Chronic cardiovascular disease, n (%)	1 (1)
Chronic liver disease, n (%)	7 (7)
Mortality	
ICU, n (%)	16 (16)
Hospital, n (%)	24 (23)

SD: Standard Deviation
APACHE: Acute Physiology and Chronic Health Evaluation
ICU: Intensive Care Unit

from the APACHE II system divided into the following groups: medical, surgical, and trauma[16]; severe chronic illnesses classified using APACHE II definitions[16] (chronic respiratory disease, chronic cardiovascular disease, chronic renal disease, chronic liver disease, and immune suppression); and ICU and hospital outcome. The average SAS score achieved for each 12-hour shift for the first 5 days (or for the ICU stay if less than 5 days) was calculated and compared to the targeted score. Differences between achieved and targeted scores were compared for the first and second three months intervals to discern whether sedation goals were better achieved after a period of protocol implementation.

Statistical Analysis: Minitab for windows (Minitab Inc., Release 12.1, State College, PA, U.S.A.) was used for statistical analysis. Descriptive statistics were used to describe patients' baseline characteristics.

Continuous variables were described as mean and standard deviation (±SD) and compared using a paired Student's *t*-test. Categorical variables were expressed as absolute and relative frequencies and compared using a Chi-Square test. A *P* value of ≤ 0.05 was considered significant.

Results:

Baseline Characteristics: One hundred and five (105) patients were included in the study. The mean (±SD) age of patients was 47 (±23) years. There were 74 (71%) male patients. The mean (±SD) APACHE II score was 21 (± 9). As per study inclusion criteria, all 105 (100%) patients received mechanical ventilation. The admission categories were as follows: medical

Table 4
Ordered versus achieved SAS scores (±SD) during the 1st and 2nd three months.

	First 3 months			Second 3 months		
	Ordered SAS	Achieved SAS	P Value	Ordered SAS	Achieved SAS	P Value
D1	2.85 ±1.13	2.66 ±1.65	0.75	2.50 ±1.24	2.10 ±1.28	0.02
N1	2.68 ±1.21	2.16 ±1.29	0.01	2.63 ±1.20	2.47 ±1.29	0.27
D2	2.69 ±1.33	2.16 ±1.26	0.02	2.87 ±1.22	2.59 ±1.35	0.05
N2	2.77 ±1.36	2.16 ±1.30	<0.001	2.86 ±1.22	2.47 ±1.38	0.04
D3	2.90 ±1.29	2.45 ±1.54	0.03	2.85 ±1.30	2.24 ±1.29	<0.001
N3	2.89 ±1.33	2.45 ±1.61	0.05	2.86 ±1.31	2.37 ±1.39	0.01
D4	2.88 ±1.32	2.62 ±1.69	0.29	3.07 ±1.22	2.64 ±1.37	0.01
N4	2.98 ±1.31	2.45 ±1.57	0.02	3.09 ±1.22	2.75 ±1.52	0.14
D5	3.20 ±1.19	2.48 ±1.63	0.05	3.24 ±1.22	2.60 ±1.56	0.01
N5	3.16 ±1.23	2. 45 ±1.57	0.01	3.24 ±1.19	2.75 ±1.52	0.01

SAS: Sedation - Agitation - Scale
D: Day (7:00 am - 6:59 pm)
N: Night (7:00 pm - 6:59 am)

Fig. 1
Ordered versus achieved SAS scores
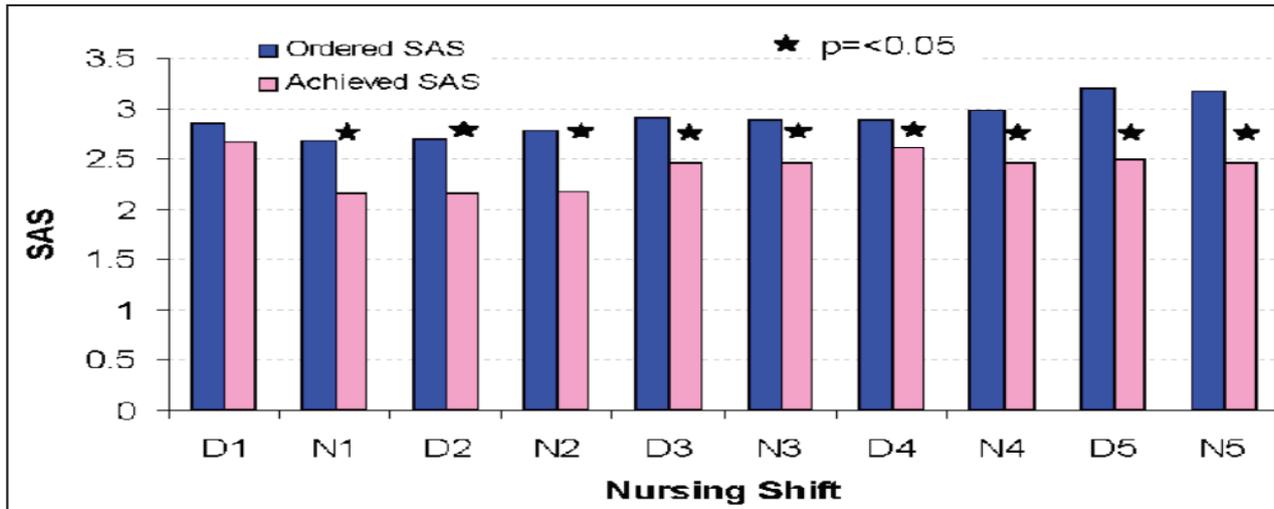
SAS: Sedation-Agitation-Scale
D: day (07:00 a.m. to 06:59 p.m.)
N: night (07:00 p.m. to 06:59 a.m.)

52 (50%), surgical 16 (15%), and trauma 37 (35%). Severe chronic illnesses were distributed as follows: respiratory 6 (6%), cardiovascular 1 (1%), renal 6 (6%), hepatic 7 (7%), and immune suppression 7 (7%). The ICU and hospital mortality were 16 (16%) and 24 (23%), respectively (Table 3).

Targeted versus achieved SAS scores: Achieved SAS scores were slightly but significantly and consistently lower than the targeted scores during both daytime (07:00 am to 06:59 pm) and nighttime (07:00 pm to 06:59 am) shifts throughout the study period (Fig.1). Differences between achieved and targeted scores remained significant in the second three months interval as compared to the first three months interval (Tables 4).

Discussion

This prospective study found that despite the use of a scoring system and a sedation protocol, achieved levels of sedation were lower than those targeted by the treating physician.

Our study is the first to demonstrate a significant difference between the ordered and the achieved level of sedation in critically ill patients. The discrepancy between the desired and achieved level of sedation persisted throughout the whole study period. One may expect sedation goals to be better achieved after

a period of protocol implementation. However, the achieved level of sedation remained significantly lower in the second three months interval as compared to the first three months interval.

Despite the implementation of guidelines and recommendations for continuous administration of analgesics and sedatives, critically ill patients are often more sedated than requested. Our study suggests that oversedation is not finally avoided by implementing these guidelines. We suggest that other factors may be responsible for oversedation including the lack of validated and objective methods for assessment of sedation and the difficulty in discriminating between degrees of sedation using only subjective clinical assessments. Oversedation may also be reduced by the use of ultra-short-acting analgesics and sedatives that can be tapered and titrated with immediate effects.

Sedation is an essential component of the management of patients who are critically ill and require mechanical ventilation. The goal for sedation is to provide environmental and nonpharmacologic interventions, as well as pharmacologic therapies to achieve and maintain an optimal level of comfort and safety for the critically ill patient. Deep sedation is necessary in only a selected group of ICU patients, such as those with elevated intracranial pressure, neuromuscular blockade, or high ventilatory settings,

or in patients requiring immobility due to unstable spinal fracture, open surgical wound, or invasive medical devices. Both undersedation and oversedation are undesirable and should be avoided in intensive care patients. Undersedation can result in anxiety, agitation, self-removal of medical devices, and in recall of stressful experiences in the post-ICU phase and posttraumatic stress disorder[1]. Oversedation can lead to hemodynamic compromise; prolonged ventilation and ICU and hospital length of stay (LOS); increased risk of pneumonia and sepsis; and increased mortality and costs[2-5]. Optimal sedation, while a universal goal for all critical care practitioners, remains a difficult task to accomplish. In 2002, the American Society of Health-System Pharmacists (ASHP) and the Society of Critical Care Medicine (SCCM) published "Clinical Practice Guidelines for the Sustained Use of Analgesics and Sedatives in the Critically Ill Adult"[11]. These guidelines are intended to standardize patient care and provide specific recommendations including: a) establishing and regularly redefining a patient-specific sedation goal or endpoint; b) documenting regular assessment and response to therapy; c) using a validated sedation assessment scale such as the Ramsay sedation scale (RSS)[17], Riker Sedation-Agitation Scale (SAS)[13], Motor Activity Assessment Scale (MAAS)[18], Richmond Sedation-Agitation Scale (RASS)[19]; and d) using a sedation protocol.

Reported data suggest that ICU sedation protocols used to prevent oversedation can significantly improve outcomes[6,20,21]. In a previous study[14], we have demonstrated that implementing a sedation protocol along with an educational program was effective in improving sedation practices and patients' outcomes in the ICU. Moreover, the educational and feedback program rather than the direct effect of the protocol itself appeared to be responsible for most of the observed effects. We concluded that such an educational program is critical for the success of ICU sedation protocol.

This study has a number of strengths including the prospective nature of data collection, the consecutive placement of all patients on a sedation protocol and, to the best of our knowledge; it is the first to examine the difference between the targeted and the achieved levels of sedation.

Our study has also several limitations. First, it was conducted in a single center with heterogeneous group of patients. Second, the lack of objective methods for assessment of sedation and the use of subjective clinical assessments may have made the measurement of achieved levels not as accurate as actual; however, this difference could have been in either direction. Third, more than nurse assessed the achieved level of sedation during the course of the study and there may have been some disparity in discriminating the levels of sedation among the nurses.

Conclusion

Achieved levels of sedation were consistently lower than what was requested by physicians despite the conduction of an educational program and the implementation of a standardized protocol and a validated scoring system for sedation of critically ill patients. More reliable and objective measures of sedation may help to overcome this difficulty and improve clinical practice of sedation. Further studies are required to confirm these findings and to explore methods that would more reliably allow the targeted level of sedation to be reached.

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