Sedation and analgesia are important components of the management of intubated, mechanically ventilated patients. Patient comfort is a central goal, but is especially challenging after severe injury. In addition, pain and anxiety may be associated with intubation, invasive bedside procedures performed for monitoring or management, and the intensive care environment. In the trauma patient, these issues are complicated by pain associated with operative incisions, fractures, and soft tissue injury. The prior use of excessive alcohol or illicit drugs in the trauma population adds additional complexity to management. Head injury management often requires a very meticulous balancing of medication to enable patient comfort without clouding neurologic assessment. Patient comfort may be further complicated by delirium. This is a syndrome of fluctuating consciousness, with reduced attention and impaired cognitive function. Its multifactorial origins may include the metabolic and physiologic derangements of critical illness as well as acute brain injury. Delirium is associated with prolongation of hospital stay and increased mortality.

Overuse of medication for sedation and analgesia may have adverse effects, including hemodynamic instability, prolongation of mechanical ventilation, other complications associated with sustained bed rest and immobility, and may facilitate the development of later posttraumatic stress disorder. Thus, appropriate use of drugs for the management of sedation and analgesia has implications that extend beyond patient comfort.

The recognition of pain, anxiety, and delirium as independent contributors to patient distress enables a more appropriately focused management strategy that targets these symptoms individually with appropriate medication. Symptoms should be rapidly controlled, to avoid a cycle of inadequate dosing and escalating need. Pharmacotherapeutic intervention should be directed to minimize adverse effects while accomplishing this goal. It is also important to recognize that sedation and analgesia are closely related; that is, anxiety reduces the pain threshold, and pain control may reduce anxiety. This concept justifies the use of multiple

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V. Guidelines for Sedation and Analgesia During Mechanical Ventilation General Overview

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Controversy exists over whether continuous or intermittent sedation is best for critically ill patients. In one prospec-
tive observational study, the use of continuous intravenous sedation was associated with significantly longer duration of mechanical ventilation, ICU stay, and hospital stay. The same authors affirmed the relationship of continuous sedation and duration of ventilation in a subsequent randomized, controlled trial, although this was not the primary purpose of the trial. This evidence must be balanced against concerns that intermittent dosing may undermedicate patients in the short term and lead to greater cumulative dosing in the long term. A recent, open-label, randomized trial compared length of mechanical ventilation in patients receiving continuous propofol versus intermittent lorazepam, incorporating a daily sedation interruption. Median ventilator days were significantly reduced in patients receiving continuous propofol, suggesting that the choice of sedating drug may be as important as the mode of delivery. Similar consensus pain management guidelines have not entirely resolved this issue, with recommendations that analgesia should be administered either continuously or on a scheduled intermittent basis, with supplemental bolus doses as needed. Acknowledging the lack of definitive data to direct practice clearly, but with focus on the principle of prompt symptom control, we propose the initial approach to sedation and analgesia management should include an intermittent dose strategy. Continuous infusions should be reserved for those patients in whom the target sedation level cannot be achieved within a timely manner.

**Interruption of Sedation and Analgesia**

Because “adequate” sedation is often equated with unresponsiveness, the possibility that sedation itself contributes to prolonged mechanical ventilation and its attendant complications must be considered. A randomized, controlled trial of daily interruption of continuous sedation has been performed to assess the effect on length of mechanical ventilation. Continuous sedative and analgesic infusions were stopped until the patient was awake or uncomfortable and in need of resumed medication. In the cohort in which sedation was interrupted on a daily basis, the duration of mechanical ventilation was significantly reduced (median duration 2.4 days less than standard care), as were the length of ICU stay and total drug used. The rate of unplanned extubation was not increased. Interrupting medication may be inappropriate for patients who require sustained deep sedation for medical management (e.g., adult respiratory distress syndrome [ARDS], shock, or open chest or abdomen). For other patients, however, the guideline presented here incorporates the concept of the daily sedation interruption by setting the target sedation level to a RASS of 0 to -2, which approximates the criteria for “awake” described in the trial above.

**Protocol Summary**

A. The responsible physician should make an initial determination of the goal level of sedation for each patient, defined by the RASS score. This goal should be reassessed as often as clinically appropriate, but no less than daily.

B. The patient should be assessed regularly for signs or symptoms of pain, anxiety, or delirium. The patient’s RASS score should be assessed every 15 minutes until symptoms are controlled within the target range, and then every 4 hours thereafter.

C. Fentanyl is the drug of choice for pain, chosen for its relative lack of histamine release and greater hemodynamic stability. (Morphine is also widely used for analgesia. Its use has been associated with histamine-related hemodynamic change and impaired clearance in patients with renal failure. Nevertheless, provider familiarity and experience may, in some centers, be grounds for its preferential use.) Propofol may be used for anxiety if the expected duration of sedation is less than 48 hours and if frequent neurologic assessments are necessary. Alternatively, or if the duration of sedation will exceed 48 hours, lorazepam should be used to control anxiety. Lorazepam offers significant cost savings over propofol and avoids potential complications of hyperlipidemia and, rarely, cardiac decompensation. Because of the speed with which propofol is cleared when discontinued, and the potential for faster weaning and extubation, it may be cost effective to use propofol when the anticipated duration of ventilation is short. Haloperidol is used when pharmacologic control of agitation from delirium is required. This guideline does not attempt to prevent, minimize, or diagnose delirium but rather to control the agitation that established delirium may produce. Part of delirium management should be to identify and control the inciting cause, and in some cases, sedation and analgesia may contribute to this problem. Delirium severity scales have been described to help in this assessment. A recent retrospective, observational analysis in patients mechanically ventilated for more than 48 hours found a significant reduction in hospital mortality in those patients who received haloperidol within 2 days of initiation of mechanical ventilation. The explanation of this finding remains speculative, and these results have not been reassessed in a randomized, prospective, placebo-controlled trial.

D. Initial dosing should be intermittent. If adequate symptom control cannot be achieved with the described regimen of bolus dosing, a continuous infusion may be used for pain and anxiety control, titrated to the lowest dose necessary to achieve the target RASS score.

**Guideline Details**

1. A target level of sedation will be established based on the patient’s condition and expected duration of mechanical ventilation (Fig. 1). Unless medically contraindicated, the optimal level is that at which the patient is alert, not agitated, and able to maintain...
brief contact and follow simple instructions (RASS 0 to −2; Fig. 2).

2. Assess pain and sedation level every 15 minutes until the patient reaches the desired level of sedation. Thereafter, assess every 4 hours unless otherwise indicated.

3. Analgesia for pain: bolus fentanyl, 25 μg to 100 μg intravenously every 5 minutes to achieve the specified goal. If the goal is met, continue bolus dosing every 30 minutes to 60 minutes. If the sedation goal is not met after 3 hours, begin an infusion at 50 μg/hr. If the goal is not met in 1 hour, give a bolus with the amount of current infusion rate and increase infusion by 25 μg/hr.

4. Sedation for anxiety:
   a. Anticipated duration of mechanical ventilation exceeds 48 hours: Lorazepam: bolus 1 mg to 2 mg intravenously every 15 minutes to achieve the specified goal. If the goal is met, continue bolus doses every 2 hours to 4 hours as needed. If the goal is not met within 3 hours, begin scheduled doses of 4 mg intravenously every 6 hours and continue bolus doses. If the goal is not met in 24 hours, begin an infusion at 2 mg/hr and continue bolus doses as needed. If the goal is not met after 1 hour, increase the infusion rate by 1 mg/hr and continue bolus dosing as needed. Consider the possible contribution of pain and delirium to the appearance of agitation.

   b. Anticipated duration of mechanical ventilation less than 48 hours, or need for frequent assessment of neurologic status: Propofol bolus 0.5 mg/kg intravenously, then infuse 20 μg/kg/min (consider use if expected duration of mechanical ventilation will be less than 48 hours, or for patients [e.g., neurosurgical or head-injured] in whom frequent neurologic checks are necessary). If the goal is not met in 15 minutes, bolus with 0.5 mg/kg during a period of 2 minutes and increase

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Fig. 1. Sedation or analgesia protocol for mechanical ventilation.
the infusion by 10 μg/kg/min every 15 minutes to a maximum of 100 μg/kg/min. Consider the possible contribution of pain and delirium to the appearance of agitation.

5. Antipsychotic for delirium: Bolus haloperidol, 2 mg to 10 mg intravenously every 1 hour as needed. If the goal is not met in 6 hours, begin scheduled doses of 5 mg intravenously every 6 hours and continue bolus doses.

6. Unless medically contraindicated in patients sedated to a RASS score of −3 to −5, sedation should be interrupted daily until the patient is awake (establishes brief eye contact or follows simple instructions) or until the patient becomes agitated or uncomfortable.

REFERENCES


