CHAPTER

5

Comfort and Sedation

Mamoona Arif Rahu, PhD, RN, CCRN

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INTRODUCTION

Maintaining an optimal level of comfort for the critically ill patient is a universal goal for physicians and nurses.[50] Patients in the critical care unit experience pain from preexisting diseases, invasive procedures, or trauma. Pain can also be caused by monitoring devices (catheters, drains), noninvasive ventilating devices, endotracheal tubes, routine nursing care (airway suctioning, dressing changes, and patient positioning), and prolonged immobility. It has been reported that 64% of patients recall having pain as a stressful experience during their critical care unit stay.[38]

Unrelieved pain may contribute to inadequate sleep, which may lead to exhaustion, anxiety, disorientation, and agitation. Patients who have recollections of their stay in the critical care unit cite pain (46%) and noise (40%) most frequently as concerns, and 22% complained of not getting enough pain medication. In addition, patients complain of sleeping problems (48%) related to noise (54%), fear (5%), and pain (21%).[46] Furthermore, 26% of critically ill patients experienced delusional memories such as dreams, hallucinations, nightmares, and the illusion that people were trying to hurt them.[100] Patients with memory of the critical care experience report development of posttraumatic stress disorder (PTSD) related to delusions, pain, and anxiety,[52] delirium,[103] sleep disturbance,[46] and uninterrupted sedative infusions.[59]

The patient's perception, expression, and tolerance of pain and anxiety may vary because of different psychological and social influences.[78] Evidence of ethnic differences in pain perception has also been reported.[73,95] Therefore it is important for healthcare providers to assess and manage pain and anxiety appropriately. Hospitals and healthcare accrediting agencies have recognized that pain and anxiety are major contributors to patient morbidity and length of stay. According to a National Patient Safety Goals Survey, pain assessment remains one of the top standards of noncompliance among hospitals (19%).[51] The Joint Commission requires that pain be assessed in "all patients" and that it be considered the "fifth vital sign." The Joint Commission also recommends that tools to evaluate pain should be specific to the age and disease state of the patient and to the site of pain.[51]

Promoting rest, comfort, and frequent reorientation are important nursing interventions to reduce pain and anxiety for a critically ill patient. The treatment of pain and anxiety should be individualized to the patient's needs for analgesia and sedation. Many critically ill patients have underlying chronic pain, thus making assessment and management more challenging. This chapter focuses on the assessment and management strategies for the critically ill patient experiencing acute pain, anxiety, or both.

DEFINITIONS OF PAIN AND ANXIETY

The International Association for the Study of Pain defines pain as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.[48,76] McCartney[70] defines pain as "whatever the experiencing person says it is, existing whenever he says it does." Applying this definition, the patient becomes the true authority on the pain that is being experienced, and the patient's pain should be managed accordingly.

BOX 5-1 GATE CONTROL THEORY OF PAIN

Innocuous (nonpainful) stimuli transmitted by large afferent nerve fibers may prevent the transmission of painful stimuli. Stimulation of larger nerve fibers causes synapses in the dorsal horn of the spinal cord to cease firing, thus creating a "closed gate." A closed gate decreases the stimulation of trigger cells, decreases transmission of impulses, and diminishes pain perception. Persistent stimulation of the large fibers may allow for adaptation, allowing pain signals to reach the spinal cord and brain.

Modified from Huether SE. Pain, temperature regulation, sleep, and sensory function. In McCance KL & Huether SE, eds. *Pathophysiology: The Pathologic Basis for Disease in Adults and Children.* 6th ed. 481-521. St. Louis: Mosby; 2010.

Many theoretical bases for the development of pain have been proposed. The gate control theory is the most widely used in research and therapy (Box 5-1).[47]

Anxiety is a state marked by apprehension, agitation, autonomic arousal, fearful withdrawal, or any combination of these.[70] It is a prolonged state of apprehension in response to a real or perceived fear. Anxiety must be assessed in the same way used to assess pain: the patient's level of anxiety is whatever the patient reports.

Pain and anxiety are often interrelated and may be difficult to differentiate because the physiological and behavioral findings are similar for each. The relationship between pain and anxiety is cyclical (Figure 5-1), with each exacerbating the other.[20] Inadequately treated pain leads to greater anxiety, and anxiety is associated with higher pain intensity. Anxiety may contribute to pain perception by activating pain pathways, altering the cognitive evaluation of pain, increasing aversion to pain, and increasing the report of pain.[20] If pain and anxiety are unresolved and escalate, the patient may experience feelings of powerlessness, suffering, and psychological changes, such as agitation and delirium. Anxiety is not a benign state, and unrelieved anxiety may lead to greater morbidity and mortality, especially in patients with cardiovascular disease. PTSD may occur after discharge from the critical care unit.[21,52,53]

Because interventions to manage pain may differ from those used to manage anxiety, the nurse must be astute about the patient's precipitating problem. If pain is being treated in a patient who is experiencing anxiety only, the anxiety may worsen while potentially ineffective management strategies are used. For example, the pharmacological agents used to treat pain have very different properties compared with those used to treat anxiety. Pain is managed with antiinflammatory and analgesic medications, whereas anxiety is treated with sedative medications.

PREDISPOSING FACTORS TO PAIN AND ANXIETY

Many factors inherent to the critical care environment place patients at risk of developing pain and anxiety. Pain perception

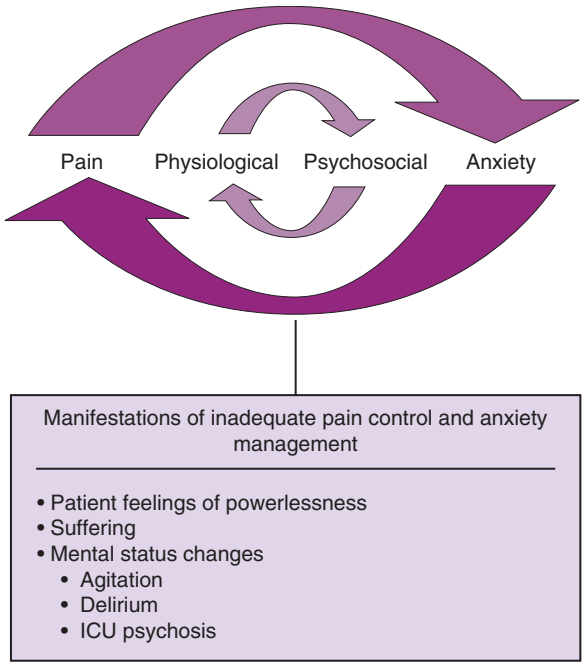


FIGURE 5-1 The anxiety-pain cycle. (From Cullen L, Greiner J, Titler MG. Pain management in the culture of critical care. *Critical Care Nursing Clinics of North America.* 2001;13[2]: 151-166.)

may occur as a result of preexisting diseases, invasive procedures, monitoring devices, nursing care, or trauma. The perception of pain is also influenced by the expectation of pain, prior pain experiences, a patient's emotional state, and the cognitive processes of the patient.[14] Although pain perception involves conscious experience, new evidence shows a higher prevalence of pain in adult patients with impaired cortical function or cortical immaturity during early development in children.[12,75] Yet, these vulnerable populations receive fewer analgesics as compared with patients with intact cognitive function.[17,58]

Anxiety is likely to result from the inability to communicate; the continuous noise of alarms, equipment, and personnel; bright ambient lighting; and excessive stimulation from inadequate analgesia, frequent assessments, repositioning, lack of mobility, and uncomfortable room temperature. Sleep deprivation and the circumstances that resulted in an admission to the critical care unit may also increase patient anxiety. Intubated patients receiving mechanical ventilation experience moderate levels of anxiety.[16]

PHYSIOLOGY OF PAIN AND ANXIETY

Pain

All pain results from a signal cascade within the body's neurological network. Pain is initiated by signals that travel through the peripheral nervous system to the central nervous system for processing.[23] Pain can be classified as acute or chronic, malignant or nonmalignant, and nociceptive or neuropathic. In all forms of acute pain, the sympathetic nervous

BOX 5-2 PHYSIOLOGICAL RESPONSES TO PAIN AND ANXIETY

- Tachycardia
- Tachypnea
- Hypertension
- Increased cardiac output
- Pallor and/or flushing
- Cool extremities
- Mydriasis (pupillary dilation)
- Diaphoresis
- Increased glucose production (gluconeogenesis)
- Nausea
- Urinary retention
- Constipation
- Sleep disturbance

system (SNS) is usually activated quickly, and several physiological responses typically occur (Box 5-2). In contrast, some forms of chronic pain may result in less activation of the SNS and a different clinical presentation.

The sensation of pain is carried to the central nervous system by activation of two separate pathways (Figure 5-2). The fast (sharp) pain signals are transmitted to the spinal cord by slowly conducting, thinly myelinated A-delta afferent fibers. A-delta fibers are activated by high-intensity physical (hot and cold) stimuli that are important in initiating rapid reactions. Conversely, slow (burning; chronic) pain is transmitted by the unmyelinated, polymodal C fibers, which are activated by a variety of high-intensity mechanical, chemical, hot, and cold stimuli.[56]

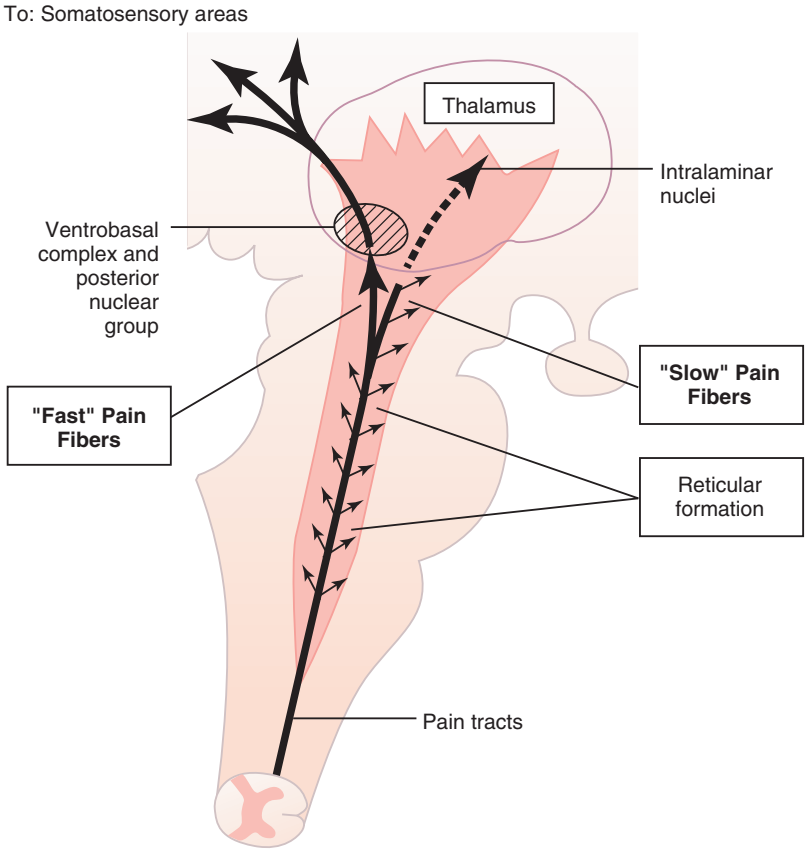


FIGURE 5-2 Transmission of pain signals into the brainstem, thalamus, and cerebral cortex by way of the "fast" pain pathway and "slow" pain pathway. (From Guyton A, Hall J. *Textbook of Medical Physiology.* 12th ed. Philadelphia: Saunders; 2011.)

The most abundant receptors in the nervous system for pain recognition are nociceptors whose cell bodies are located in the dorsal root ganglia.[56] The sensation of pain received by peripheral endings of sensory neurons is called *nociception.* The nociceptive pain is divided into somatic and visceral. Nociceptive pain is detected by specialized transducers attached to A-delta and C fibers. *Somatic pain* results from irritation or damage to the nervous system. *Visceral pain* is diffuse, poorly localized, and often referred.[56]

Mechanical, chemical, and thermal stimuli activate nociceptors to produce a painful sensation. Examples of mechanical stimuli include a crushing injury or a surgical wound. A chemical stimulus is any substance that produces skin irritation, and burn injury is a thermal stimulus for pain. Identifying the correct pain-inducing stimulus is important in the effective management of pain. Removal of the stimulus should always precede other treatment measures in managing pain.[41]

Nociceptors differ from other nerve receptors in the body in that they adapt very little to the pain response. If the stimulus for pain is not removed, the body continues to experience pain until the stimulus is discontinued, or other interventions (e.g., analgesic agents) are initiated. This is a protective mechanism so the body tissues being damaged will be removed from harm.

Nociceptors usually lie near capillary beds and mast cells. When tissue injury occurs, the nociceptor initiates an inflammatory response near the injured capillary.[32,72,79] The mast cells in the damaged tissues degranulate, releasing histamine and chemotactic agents that promote infiltration of injured tissues with neutrophils and eosinophils. As neutrophils move into the site of injury, more neurotransmitter-like substances (acetylcholine, bradykinins, substance P, and enkephalins) are released from the neutrophils into the surrounding tissue. These substances act as mediators and may induce or suppress pain. Endogenous cytokines that suppress pain induction are commonly referred to as the *endorphins*.

Advances in neuroimaging studies have identified a more complex level of processing of pain in the human cerebral cortex. The neuroimaging studies have identified multiple nociceptive pathways that deliver parallel inputs to somatosensory, limbic, and associative structures.[4,63] These techniques (Table 5-1) allow noninvasive examination of brain mechanisms involved in acute and chronic pain processing.

Anxiety

The physiology of anxiety is less clearly understood in comparison with pain and is a more complex process because no actual tissue injury is thought to occur. Anxiety stimulates the SNS response.

Anxiety has been linked to the reward and punishment centers within the limbic system of the brain. Stimulation in the punishment centers frequently inhibits the reward centers completely.[41] The punishment center is also responsible for helping a person escape from potentially harmful situations. The punishment center has dominance over the reward center for the person to escape harm.

POSITIVE EFFECTS OF PAIN AND ANXIETY

In the healthy person, pain and anxiety are adaptive mechanisms used to increase mental and physical performance levels to allow a person to move away from potential harm. When the SNS is activated, the person usually becomes more vigilant of the environment, especially to potential dangers. Once dangers are recognized, the person makes a choice whether to flee the situation or combat the possible threat. For this reason, SNS activation is known as the "fight-or-flight" response.

TABLE 5-1 NEUROIMAGING STUDIES

METHOD	APPLICATION IN PAIN STUDIES
Functional magnetic resonance imaging (fMRI)	Localizing brain activity
Electroencephalography (EEG); Magnetoencephalography (MEG)	Detecting temporal sequences and measuring neuronal activity
Single photon emission computed tomography (SPECT) Positron emission tomography (PET)	Identifying neurotransmitter systems and drug uptake
Magnetic resonance (MR) spectroscopy	Detecting long-term changes in brain chemistry

Data from Apkarian AV, Bushnell MC, Treede RD, et al. Human brain mechanisms of pain perception and regulation in health and disease. *European Journal of Pain.* 2005;9:463-484.

NEGATIVE EFFECTS OF PAIN AND ANXIETY

Physical Effects

Both pain and anxiety activate the SNS. Catecholamine levels increase, which may place a significant burden on the cardiovascular system, especially in a critically ill patient. Activation of the SNS results in tachycardia and hypertension, which leads to increased myocardial oxygen demand. In patients with a history of cardiovascular disease, anxiety is associated with recurrent cardiac events and increased mortality. Patients with silent myocardial infarction do not experience chest pain and therefore do not seek immediate medical treatment.[39] These patients are also at high risk for increased morbidity and mortality.

The physiological response to stress also interferes with the healing process and impairs perfusion and oxygen delivery to tissue.[10] Hemodynamic instability, immunosuppression, and tissue catabolism may also occur.[117] Any large organ that experiences an increase in oxygen consumption places the critically ill patient at risk of increased rates of complications related to end organ ischemia.[67]

Hyperventilation (tachypnea) secondary to pain and anxiety can be stressful to the patient because rapid breathing requires significant effort with the use of accessory muscles. Hyperventilation may cause respiratory alkalosis. Respiratory alkalosis may result in impaired tissue perfusion, and many vasoactive medications become less effective.

If the patient is mechanically ventilated, an increased respiratory rate leads to feelings of breathlessness. As the patient "fights" the mechanical ventilator (dyssynchrony), further alveolar damage ensues, and the endotracheal or tracheostomy tube creates a "choking" sensation and increased anxiety. Anxiety has been linked to dyspnea and delayed ventilator weaning.[105]

Psychological Effects

Many patients in the critical care unit report feelings of panic and fear. Pain and anxiety exacerbate reports of lack of sleep, nightmares, and feelings of bewilderment, isolation, and loneliness. The effects of a critical care unit stay may persist long after discharge, and many patients develop PTSD as a result of their critical care unit experience.[52]

Extreme anxiety, pain, and adverse effects of medications can also lead to agitation, which is commonly seen in the critically ill patient. Agitation is associated with inappropriate verbal behavior, physical aggression, increased movement (head or extremities), and ventilator dyssynchrony, any of which may harm the patient or caregiver.[30,49,113] The failure to manage agitation may have severe consequences, such as a higher rate of self-extubation and self-removal of catheters and invasive lines, a higher rate of nosocomial infections, and a longer duration of stay; agitated patients also require extra resources for their care.[49]

ASSESSMENT

Quality pain management begins with a thorough assessment, ongoing reassessment, and documentation to facilitate treatment and communication among health care providers.[37] The American Pain Society guidelines recommend a five-step hierarchy approach to pain measures[37,88]:

- Pain should be assessed and treated promptly in all patients. Pain assessment and documentation should be clearly communicated with other healthcare providers.
- The patient should be actively engaged in the pain management plan.
- Healthcare providers need to preemptively treat patients with analgesics to safely, effectively, and equitably manage pain.
- Pain should be reassessed and treatment adjusted to meet the patient's needs.
- Healthcare facilities need to establish a comprehensive quality improvement program that monitors both healthcare provider practice and patient outcomes.

Pain assessment is challenging in patients who cannot communicate; these patients represent the majority of critically ill patients. Factors that alter verbal communication in critically ill patients include endotracheal intubation, altered level of consciousness, restraints, sedation, and therapeutic paralysis[6] (see box, "Evidence-Based Practice").

The American Pain Society guidelines mandate evaluation of both physiological and behavioral response to pain in patients who are unable to communicate.[45] At present, no universally accepted pain scale for use in the noncommunicative (cognitively impaired, sedated, paralyzed, or mechanically ventilated) patient exists.[50] Optimal pain assessment in adult critical care settings is essential because it has been reported that nurses underrate the patient's pain.[1,2,43,92] Nurses often undermedicate the critically ill patient as well. One study reported that more than 60% of critically ill patients did not receive any medications before and/or during painful procedures such as central line insertions, wound dressing changes, and suctioning.[94] Inaccurate pain assessments and resulting inadequate treatment of pain in critically ill adults can lead to significant physiological consequences.

Assessment involves the collection of the patient's self-report of the pain experience as well as behavioral markers. If a patient is able to respond, nurses can ask the patient to describe the pain or anxiety being experienced, or to provide a numerical score to indicate the level of pain or anxiety. In addition, behavioral or physiological cues of pain can be observed. For example, increased blood pressure or a facial grimace or frown may indicate pain or anxiety. Typical physiological responses related to pain are detailed in Box 5-2. In the healthy person, these responses are adaptive mechanisms and result from activation of the SNS to prepare the individual for the fight-or-flight response. In the critically ill patient, these changes may induce further stress in an already compromised individual.

EVIDENCE-BASED PRACTICE

Are Facial Expressions a Reliable Indicator of Pain?

Problem

Assessing pain in critically ill patients who are unable to communicate is challenging. Nurses rely on objective assessment of the patient's expressions, responses to painful stimuli, and physiological parameters, such as heart rate and blood pressure.

Clinical Question

Does nursing assessment of facial expressions in patients who are unable to communicate provide a reliable indicator of pain?

Evidence

The authors conducted an extensive review of the literature to examine the study of facial expression and its application as a pain assessment tool in critically ill patients who are unable to communicate. They summarized the reliability and validity of various pain assessment tools that incorporate assessment of facial expression. The tools include a variety of facial behaviors—wincing, frowning, and grimacing—but scoring of these behaviors varies widely. The Facial Action Coding System (FACS) identifies facial muscle movement during a response, such as pain. It is a reliable method for assessing pain in adults, but its utility has not been tested in critically ill patients. No single tool was identified as a superior method of assessing pain responses.

Implications for Nursing

Many critically ill patients are unable to communicate because of intubation, a decreased level of consciousness, or both. Assessment of pain in these individuals is an important yet challenging component of nursing care. Evaluating facial expressions that may indicate pain is one component of a comprehensive pain assessment, but cannot be used as the sole indicator of presence or absence of pain. Assessment of wincing, frowning, and grimacing are included in many critical care pain assessment tools. Additional knowledge gained by studying FACS in critically ill patients who are unable to communicate is needed.

Level of Evidence

C—Descriptive studies

Reference

Arif-Rahu M, Grap MJ. Facial expression and pain in the critically ill non-communicative patient: state of science review. *Intensive and Critical Care Nursing.* 2010;26:343-352.

As part of the assessment of pain and anxiety, the nurse must be aware of what procedures may cause pain, and evaluate the effectiveness of interventions to prevent or relieve pain and anxiety.[93] When patients exhibit signs of anxiety or agitation, the assessment also includes identification and treatment of the potential cause, such as hypoxemia, hypoglycemia, hypotension, pain, and withdrawal from alcohol and drugs. When possible, patients should be asked about any herbal remedies used as complementary and alternative medical therapies and whether they take them along with prescription or over-the-counter medications.[13,112] These products may lead to adverse herb-drug interactions, especially in the elderly who are more likely to be taking multiple drugs.[13,68,125]

Pain Measurement Tools

In the assessment of pain, the nurse asks the patient to identify several characteristics associated with the pain. These characteristics include the precipitating cause, severity, location (including radiation to other sites), duration, and any alleviating or aggravating factors. Any pain assessment should address these pain characteristics or the assessment is incomplete. Patients with chronic pain conditions, such as arthritis, may be able to provide a detailed list of effective pain remedies that may be useful to implement.

Several tools are available to ensure that the appropriate pain assessment questions are asked. One tool used in assessing the patient with chest pain is the PQRST method. The PQRST method is a mnemonic the nurse can use to ensure that all chest pain characteristics are documented.

P—*Provocation or position.* What precipitated the chest pain symptoms, and where in the chest area is the pain located?

Q—*Quality.* Is the pain sharp, dull, crushing?

R—*Radiation.* Does the pain travel to other parts of the body?

S—*Severity or symptoms associated with the pain.* The patient is asked to rate the pain on a numerical scale and to describe what other symptoms are present.

T—*Timing or triggers* for the pain. Is the pain constant or intermittent, and does it occur with certain activities?

One of the most common methods to determine pain severity is to ask for a pain score. Patients are asked to rate their pain on a numbered scale such as 0 to 10. A score of 0 indicates no pain, and a score of 10 indicates the worst pain the patient could possibly imagine. The pain score is reassessed after medications or other pain-relieving measures have been provided. Institutional policy provides guidelines for the method and frequency of pain assessment. Some institutions require nurses to intervene for a pain score greater than a predesignated number. The pain score method should be used only with patients who are cognitively aware of their surroundings and are able to follow simple commands. It is possible for patients with mild to moderate dementia to self-report pain, but this ability decreases with progression of the disease.[45] Numeric rating is not an appropriate method to assess pain in patients who are disoriented or have severe cognitive impairment.

FIGURE 5-3 A version of the FACES scale. (From Hockenberry M, Wilson D. *Wong's Essentials of Pediatric Nursing.* 8th ed. St. Louis: Mosby; 2009.)

A second tool is known as the FACES Pain Scale. Patients are asked to describe how they feel by pointing to a series of faces ranging from happy to distressed (Figure 5-3). The FACES method involves a higher level of emotional intellect because the patient must be able to accurately process different yet similar visual stimuli.[64] The most common versions of the FACES scale use between five and seven different images.

Another widely used subjective pain measurement tool is the visual analog scale (VAS). The VAS is a 10-cm line that looks similar to a timeline. The scale may be drawn horizontally or vertically, and it may or may not be numbered. If numbered, 0 indicates no pain, whereas 10 indicate the most pain (Figure 5-4). When using the VAS, the nurse holds up the scale, and the patient points to the level of pain on the line. If the patient is able to communicate in writing, the patient can place an "X" on the VAS with a pencil. The VAS can also be used to evaluate a patient's level of anxiety, with 0 representing no anxiety and 10 the most anxiety. The VAS must only be used with patients who are alert and able to follow directions.

Pain Measurement Tools for Nonverbal Patients

Identification of the optimal pain scales for noncommunicative patients has been the focus of several studies. To date, no one tool is universally accepted for use in this patient population.[44] Assessment of pain intensity may be quantified by using the behavioral-physiological scales.

Several behavioral pain tools are available to assess critically ill adult patients. Widely used and validated, the behavioral pain scale was developed to assess pain in the critically ill adult who is nonverbal and unable to communicate (Table 5-2).[90] The Behavioral Pain Scale provides critical care nurses with an objective and reliable pain measurement tool.[90,91] It is designed to be used for the mechanically ventilated patient and therefore may not be appropriate in other patients.

Another behavioral pain tool is the Critical-Care Pain Observation Tool (Table 5-3). It was initially validated in cardiac surgery patients and most recently in other critically ill patients.[33-35,126] The Critical-Care Pain Observation Tool is appropriate for the assessment of patients with or without an endotracheal tube.

The Checklist of Nonverbal Pain Indicators[27,29,84] provides a good indicator of the patient's distress by looking for pain-related behaviors. The tool was initially developed because of concerns that some of the cognitively impaired patients are not able to respond reliably to the yes/no questions about pain. This tool showed no significant differences in observed pain behaviors between the cognitively impaired group and the cognitively intact group. The Checklist of Nonverbal Pain Indicators has been tested in acute and long-term care settings to assess acute and chronic pain in elderly patients.[29,84]

The Faces, Legs, Activity, Cry, Consolability (FLACC) Behavioral Scale has been widely used in the pediatric setting. Researchers have recently tested the applicability of the FLACC in the adult population and suggest that it may be useful in the critically ill patient[127] (see box, "QSEN Exemplar").

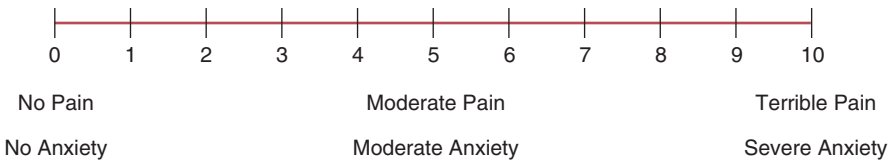


FIGURE 5-4 The visual analog scale.

TABLE 5-2 THE BEHAVIORAL PAIN SCALE*

ITEM	DESCRIPTION	SCORE
Facial expression	Relaxed	1
	Partially tightened (e.g., brow lowering)	2
	Fully tightened (e.g., eyelid closing)	3
	Grimacing	4
Upper limbs	No movement	1
	Partially bent	2
	Fully bent with finger flexion	3
	Permanently retracted	4
Compliance with ventilation	Tolerating movement	1
	Coughing but tolerating ventilation most of the time	2
	Fighting ventilator	3
	Unable to control ventilation	4

*Each of the categories—facial expression, upper limbs, and compliance with ventilation—is scored from 1 to 4. The values are added together for a total score between 3 and 12.

From Payen JF, Bru O, Bosson JL, et al. Assessing pain in critically ill sedated patients by using a behavioral pain scale. *Critical Care Medicine.* 2001;29(12):2258-2263.

TABLE 5-3 CRITICAL-CARE PAIN OBSERVATION TOOL

INDICATOR	SCORE
Facial Expression	
• Relaxed, no muscle tension	0
• Tense facial muscles (brow lowering, orbit tightening, and levator contraction)	1
• Grimacing with tense facial muscles	2
Body Movements	
• Absence of movements	0
• Protection	1
• Restlessness	2
Muscle Tension in Upper Extremities	
• Relaxed	0
• Tense, rigid	1
• Very tense or rigid	2
Compliance with the Ventilator	
• Tolerating ventilator or movement	0
• Coughing but tolerating ventilator	1
• Fighting ventilator	2
Nonventilator, Vocalization	
• No sound	0
• Sighing, moaning	1
• Crying out, sobbing	2
Total Score	—

Data from Gelinas C, Fillion L, Puntillo KA, et al. Validation of the critical-care pain observation tool in adult patients. *American Journal of Critical Care.* 2006;15:420-427.

QSEN EXEMPLAR

Patient Centered Care, Evidence-Based Practice

Pain assessment is challenging in the critical care setting because of the physical and cognitive impairments of many critically ill patients, and impediments to communication such as intubation.[1] Critical care nurses commonly use behavioral observations and vital signs as primary assessment data when developing pain relief strategies and comfort-promoting interventions. The Face, Legs, Activity, Cry, Consolability (FLACC) behavioral scale is a five-item instrument that may be useful for assessing pain in critically ill patients. The tool is simple to score and provides a pain rating on a traditional 0 to 10 scale. The instrument includes items that have been previously validated as pain indicators in children, cognitively impaired adults, and critically ill adults. A prospective, observational study was conducted to evaluate the validity and reliability of the FLACC scale in a sample of critically ill adults and children. Criterion validity, construct validity, internal consistency reliability, and interrater reliability were reported. The authors suggest that the FLACC scale may be useful in a variety of patient populations, and it generates an easy-to-use pain assessment score. Further study of easy-to-use pain assessment instruments remains a priority in critical care nursing.

Reference

Voepel-Lewis T, Zanotti J, Dammeyer JA, et al. Reliability and validity of the Face, Legs, Activity, Cry, Consolability (FLACC) behavioral tool in assessing acute pain in critically ill patients. *American Journal of Critical Care.* 2010;19:55-61.

Anxiety and Sedation Measurement Tools

Sedation Scales

No objective tool is considered the gold standard for determining a patient's level of anxiety. Anxiety typically produces hyperactive psychomotor functions including tachycardia, hypertension, and movement. Patients are typically sedated to limit this hyperactivity. The level of sedation can be measured by using objective tools or scales. An ideal sedation scale provides data that are simple to compute and record, accurately describe the degree of sedation or agitation within well-defined categories, guide the titration of therapy, and are valid and reliable in critically ill patients.[50]

When administering medications to sedate a patient, the goal is to achieve a level of sedation with the lowest dose. By using lower doses of medications, the patient is less likely to experience drug accumulation or adverse effects. These adverse effects include increased hospital stay, delayed ventilator weaning, immobility, and increased rates of ventilator-associated pneumonia. Conversely, not enough sedation may lead to agitation, inappropriate use of paralytics, increased metabolic demand, and an increased risk of myocardial ischemia.[71] Sedation scales assist in the accurate identification and communication of sedation level. The most frequently used sedation scales are the Richmond Agitation-Sedation Scale (RASS),[108] the Ramsay Sedation Scale,[96] and the Sedation-Agitation Scale.[99]

The RASS is a 10-point scale, from 4 (combative) through 0 (calm, alert) to −5 (unarousable). The patient is assessed for 30 to 60 seconds in three steps, using discreet criteria (Table 5-4). The RASS has strong interrater reliability, is useful in detecting changes in sedation status over consecutive days of critical care unit care, and correlates with the administered dose of sedative and analgesic medications.[26,109]

The Ramsay Sedation Scale was developed for evaluation of postoperative patients emerging from general anesthesia.[96] The scale includes three levels of wakefulness and three levels of sedation (Table 5-5). The nurse makes a visual and cognitive assessment of the patient. Scores range from 1 (awake) to 6 (asleep/unarousable).

The Sedation-Agitation Scale (Table 5-6) describes patient behaviors seen in the continuum of sedation to agitation.[99] Scores range from 1 (unarousable) to 7 (dangerously agitated).

The appropriate target level of sedation depends on the patient's disease process and therapeutic or support interventions required. A common target level of sedation is a calm patient who is easily aroused; however, deeper levels of sedation may be needed to facilitate mechanical ventilation. To optimize patient comfort and minimize distress, a structured approach to sedation management includes: frequent assessments for pain, anxiety, and agitation using a reproducible scale; combination therapy coupling opioids and sedatives that is best suited to patient characteristics, including the presence of organ dysfunction that may influence drug metabolism or excessive risk for side effects; and careful communication between multiprofessional team members, including physician, nurse, and pharmacist, with a particular recognition that the bedside nurse must be empowered to pair assessments with drug manipulation.[106,110,111]

TABLE 5-4 RICHMOND AGITATION-SEDATION SCALE (RASS)

TERM	SCORE
Combative	+4
Very agitated	+3
Agitated	+2
Restless	+1
Alert and calm	0
Drowsy—sustains (>10 sec) awakening, with eye contact to voice*	−1
Light sedation—sustains (<10 sec) awakening with eye contact to voice*	−2
Moderate sedation—any movement (but no eye contact) to voice*	−3
Deep sedation—no response to voice, but any movement to physical stimulation*	−4
Unarousable	−5

*In a loud voice, state patient's name and direct patient to open eyes and look at speaker.

From Sessler CN, Gosnell MS, Grap MJ, et al. The Richmond Agitation-Sedation Scale: Validity and reliability in adult intensive care unit patients. *American Journal of Respiratory and Critical Care Medicine.* 2002;166:1338-1344.

TABLE 5-5 THE RAMSAY SEDATION SCALE

LEVEL	SCALE
1	Patient awake, anxious and agitated or restless, or both
2	Patient awake, cooperative, oriented, and tranquil
3	Patient awake; response to commands only
4	Patient asleep; brisk response to light glabellar tap or loud auditory stimulus
5	Patient asleep; sluggish response to light glabellar tap or loud auditory stimulus
6	Patient asleep; no response to light glabellar tap or loud auditory stimulus

From Ramsay MA, Savege TM, Simpson BR, et al. Controlled sedation with alphaxalone-alphadolone. *British Medical Journal.* 1974;2(90):656-659.

TABLE 5-6 SEDATION-AGITATION SCALE

SCORE	CHARACTERISTIC	EXAMPLES OF PATIENT'S BEHAVIOR
7	Dangerously agitated	Pulls at endotracheal tube, tries to remove catheters, climbs over bed rail, strikes at staff, thrashes from side to side
6	Very agitated	Does not calm despite frequent verbal reminding of limits, requires physical restraints, bites endotracheal tube
5	Agitated	Anxious or mildly agitated, attempts to sit up, calms down in response 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 not communicate or follow commands

From Riker RR, Fraser GL, Simmons LE, et al. Validating the Sedation-Agitation Scale with the Bispectral Index and Visual Analog Scale in adult ICU patients after cardiac surgery. *Intensive Care Medicine*. 2001;27(5):853-858.

FIGURE 5-5 The Bispectral Index (BIS) monitor and electrode. (Image used by permission of Nellcor Puritan Bennett LLC, Boulder, Colorado, doing business as Covidien.)

Continuous Monitoring of Sedation

No technological device provides the bedside nurse with an absolute measurement of the patient's pain or anxiety. Various devices may be used to measure a patient's level of consciousness by assessing the patient's brain activity.

The electroencephalogram (EEG) records spontaneous brain activity that originates from the cortical pyramidal cells on the surface of the brain by placing electrodes on patient's head. Any major brain activity produces a peak in activity on the EEG monitor. In the critical care unit, the EEG is used infrequently to assess levels of sedation because it takes significant time (up to 60 minutes) to properly place electrodes, and a high level of skill is required to interpret the EEG recording.

However, devices that monitor continuous EEG signals without using the traditional 21-electrode system are frequently used to assess levels of sedation in the critically ill patient. These devices digitize the raw EEG signal and apply a complex algorithm that results in a numeric score ranging from 0 (isoelectric EEG) to 100 (fully awake).[31] The EEG generally changes from a low-amplitude, high-frequency signal while the patient is awake to a high-amplitude, low-frequency signal when the patient is deeply anesthetized.[7] Examples of such devices are the Bispectral Index Score (BIS) monitor (Aspect Medical Systems, Newton, MA) and the Patient State Index (PSI) Analyzer (Physiometrix, North Billerica, MA). The resulting score provides an objective analysis of the level of wakefulness resulting from agitation or pain.[35,60]

To obtain a signal, an electrode is placed across the patient's forehead and is attached to a monitor. The monitor displays the raw EEG and the BIS or PSI value. The BIS monitor and electrode are shown in Figure 5-5. A value

greater than 90 typically indicates full consciousness, a score of 40 to 60 represents deep sedation, and a score of 0 represents complete EEG suppression. A BIS value of greater than 60 is associated with patient awareness and recollection. A BIS value of less than 60 should be the goal in critically ill patients who require sedation.[31,55] Several studies have found strong correlation with BIS in assessment of sedation level and the RASS in the ICU.[55,121] For adequate sedation (RASS value of 0 to −3), the median BIS value was found to be 56.[55,121]

A score is usually documented with each set of vital signs. When using BIS or PSI monitoring, results must be correlated with the patient's clinical assessment and correct electrode placement. All muscle activity may not be completely filtered, which may affect the value. These devices are especially useful for critically ill patients who are treated with medications that produce deep sedation or neuromuscular blockade. They provide a continuous evaluation of sedation that may also be less affected by rater bias. When used with standardized sedation protocols, BIS is highly correlated with sedation scale (RASS)[55] and pain scale (Critical-Care Pain Observation Tool).[35] However, care must be taken when evaluating the BIS scores, as some patients with greater facial muscle activities during routine care or procedures may overestimate BIS scores.[35] Therefore BIS may not be ideal as a single method of sedation assessment in the critically ill.

Pain and Anxiety Assessment Challenges

Many situations may lead to an incomplete assessment and/or management of pain or anxiety. These include delirium and the administration of neuromuscular blocking (NMB) agents.

Delirium

A relationship exists among acute delirium, pain, and anxiety. Delirium (acute brain dysfunction) is characterized by an acutely changing or fluctuating mental status, inattention, disorganized thinking, and altered levels of consciousness as defined by the Diagnostic and Statistical Manual of Mental Disorders-IV.[81] Acute delirium is common in critically ill patients; more than 70% to 80% of patients develop some form of delirium, resulting in longer duration of mechanical ventilation and longer ICU stay than those without delirium.[86,116]

Delirium is categorized according to the level of alertness and level of psychomotor activity. It is divided into three clinical subtypes: hyperactive, hypoactive, and mixed (Table 5-7). Patients with *hyperactive delirium* are agitated, combative, and disoriented.[81,86,120] These patients place themselves or others at risk for injury because of their altered thought processes and resultant behaviors.[4] Psychotic features such as hallucinations, delusions, and paranoia may be seen. Patients may believe that members of the nursing or medical staff are attempting to harm them.

Hypoactive delirium is often referred to as quiet delirium and often goes undiagnosed and underestimated when there is no active monitoring with a validated clinical instrument; it is also the most prevalent, occurring in more than 60% of patients.[86] The *mixed subtype* describes the fluctuating nature of delirium. Some agitated patients with hyperactive delirium may receive sedatives to calm them, and then may emerge from sedation in a hypoactive state; this subtype occurs in about 6% of patients. Pure hyperactive delirium is rare, occurring in less than 1% of patients.[86]

TABLE 5-7 CLINICAL SUBTYPES OF DELIRIUM

SUBTYPE	CHARACTERISTICS
Hyperactive	Agitation Restlessness Attempts to remove catheters or tubes Hitting Biting Emotional lability
Hypoactive	Withdrawal Flat affect Apathy Lethargy Decreased responsiveness
Mixed	Concurrent or sequential appearance of some features of both hyperactive and hypoactive delirium

From Truman B, Ely EW. Monitoring delirium in critically ill patients: using the confusion assessment method for the intensive care unit. *Critical Care Nurse.* 2003;23(2):25-36.

The exact pathophysiological mechanisms involved with the development and progression of delirium are unknown. However, they may be related to imbalances in the neurotransmitters that modulate the control of cognitive function, behavior, and mood.[120] Risk factors for the development of delirium include hypoxemia, metabolic disturbances, electrolyte imbalances, head trauma, the presence of catheters and drains, and certain medications. Neurotransmitter levels are affected by medications with anticholinergic properties. Benzodiazepines, opioids, and other psychotropic medications are associated with an increased risk of developing delirium (Box 5-3), yet these medications are commonly given to critically ill patients.

Since delirium occurs in many patients receiving mechanical ventilation and is independently associated with more deaths, longer hospital stays, and higher costs, all critically ill patients should be assessed for delirium.[25,50,118] Older patients are especially at risk for delirium.[8] Delirium may be assessed in critical care settings by nonpsychiatrists. Two of the most frequently used validated instruments are the Confusion Assessment Method for the ICU (CAM-ICU)[20] and the Intensive Care Delirium Screening Checklist (ICDSC).[9] The CAM-ICU (Box 5-4) is designed to be a serial assessment tool for use by bedside nurses and physicians. It is easy to use, takes only 2 minutes to complete, and requires minimal training.[120] A patient is considered delirium positive in CAM-ICU if the following are present: criteria 1 (acute mental status change) and 2 (inattention), and either 3 (disorganized thinking) or 4 (altered level of consciousness).

Similarly, the ICDSC is a screening checklist of eight items based on Diagnostic and Statistical Manual of Mental Disorders (DSM) criteria (Table 5-8). After consciousness is

BOX 5-3 RISK FACTORS FOR DELIRIUM

- Older than 70 years
- Transfer from a nursing home
- History of depression, dementia, stroke
- Alcohol or substance abuse
- Electrolyte imbalance
- Hypothermia or fever
- Renal failure
- Liver disease
- Cardiogenic or septic shock
- Human immunodeficiency virus infection
- Rectal or bladder catheters
- Tube feedings
- Central venous catheters
- Malnutrition
- Presence of physical restraints
- Visual or hearing impairment

Modified from Truman B, Ely EW. Monitoring delirium in critically ill patients: using the confusion assessment method for the intensive care unit. *Critical Care Nurse.* 2003;23(2):25-36.

assessed and rated on a scale of A through E, the patient is assessed for seven indicators of delirium. One point is given for each positive sign of delirium that is identified. The scores range from 0 to 8 points, and a patient with more than 4 points is defined as delirium positive.

Management of delirium focuses on keeping the patient safe. The least restrictive measures are used because unnecessary use of restraints or medication may precipitate or exacerbate delirium. Splints or binders may be needed to restrict movement if the patient is pulling at catheters, drains, or dressings. Any type of tubing should be removed as soon as possible, particularly nasogastric tubes, which are irritating to agitated patients.[54] If these measures are not successful, medication may be necessary to improve cognition, not to sedate the patient. Haloperidol, a neuroleptic agent, is the recommended medication for delirium because it produces mild sedation without analgesia or amnesia, and it has few anticholinergic and hypotensive effects. In the critically ill patient, the intermittent intravenous route of delivery is preferred because it results in better absorption and fewer side effects than the oral or intramuscular routes. Prolongation of the QT interval on the electrocardiogram may be seen and can result in torsades de pointes. Patients with cardiac disease are at higher risk for this dysrhythmia. Other side effects include neuroleptic syndrome, as evidenced by extreme anxiety, tachycardia, tachypnea, diaphoresis, fever, muscle rigidity, increased creatine phosphokinase levels, and hyperglycemia.[36,50] The ABCDE bundle associated with preventing delirium associated with critical care illness is presented in a QSEN Exemplar box.

BOX 5-4 THE CONFUSION ASSESSMENT METHOD FOR THE CRITICAL CARE UNIT

Delirium is diagnosed when both Features 1 and 2 are positive, along with either Feature 3 or Feature 4.

Feature 1. Acute Onset of Mental Status Changes or Fluctuating Course

- Is there evidence of an acute change in mental status from the baseline?
- Did the (abnormal) behavior fluctuate during the past 24 hours, that is, did it tend to come and go or increase and decrease in severity?

Sources of information: Serial Glasgow Coma Scale or sedation score ratings over 24 hours as well as readily available input from the patient's nurse or family.

Feature 2. Inattention

- Did the patient have difficulty focusing attention?
- Is there a reduced ability to maintain and shift attention?

Sources of information: Attention screening examinations by using either simple picture recognition or random letter test. These tests don't require verbal response, and thus they are ideally suited for mechanically ventilated patients.

Feature 3. Altered Level of Consciousness: Any Level of Consciousness Other Than "Alert"

- **Alert:** normal, spontaneously fully aware of environment and interacts appropriately
- **Vigilant:** hyperalert

Feature 3—cont'd

- **Lethargic:** drowsy but easily aroused, unaware of some elements in the environment, or not spontaneously interacting appropriately with the interviewer; becomes fully aware and appropriately interactive when prodded minimally
- **Stupor:** difficult to arouse, unaware of some or all elements in the environment, or not spontaneously interacting with the interviewer; becomes incompletely aware and inappropriately interactive when prodded strongly
- **Coma:** unarousable, unaware of all elements in the environment, with no spontaneous interaction or awareness of the interviewer, so that the interview is difficult or impossible even with maximal prodding

Feature 4. Disorganized Thinking

- Was the patient's thinking disorganized or incoherent, such as rambling or irrelevant conversation, unclear or illogical flow of ideas, or unpredictable switching from subject to subject?
- Was the patient able to follow questions and commands throughout the assessment?
  1. "Are you having any unclear thinking?"
  2. "Hold up this many fingers."
  3. "Now, do the same thing with the other hand." (not repeating the number of fingers)

Sources of information: Present if RASS score anything other than zero.

TABLE 5-8 INTENSIVE CARE DELIRIUM SCREENING CHECKLIST (ICDSC)

Patient evaluation	Day 1	Day 2	Day 3	Day 4	Day 5
Altered level of consciousness* (A–E)					
If A or B do not complete patient evaluation for the period					
Inattention					
Disorientation					
Hallucination-delusion-psychosis					
Psychomotor agitation or retardation					
Inappropriate speech or mood					
Sleep/wake cycle disturbance					
Symptom fluctuation					
Total score (0-8)					

*Level of consciousness:
A: No response, score: None
B: Response to intense and repeated stimulation (loud voice and pain), score: None
C: Response to mild or moderation stimulation, score: 1
D: Normal wakefulness, score: 0
E: Exaggerated response to normal stimulation, score: 1

From Bergeron N, Dubois MJ, Dumont M, Dial S, & Skrobik Y. (2001). Intensive Care Delirium Screening Checklist: evaluation of a new screening tool. *Intensive Care Medicine. 2001;27,* 859-864.

QSEN EXEMPLAR

Patient Centered Care, Evidence-Based Practice

Recent emphasis on preventing delirium and weakness associated with critical illness has resulted in the development of the **Awakening and Breathing Coordination, Delirium Monitoring and Management, and Early Mobility** (ABCDE) bundle. Implementation of the ABCDE bundle focuses on improving communication among team members, standardizing care of the critically ill patient, and avoiding oversedation, which can lead to prolonged mechanical ventilation, delirium, and weakness. The authors described roles of team members in implementing the ABCDE bundle. Nurses lead protocol-driven sedation management, including regular assessment of sedation and agitation. They also communicate with team members to coordinate spontaneous breathing trials, early mobility, and extubation. Ongoing implementation of the ABCDE bundle as part of the management of the critically ill patient results in improved outcomes.

Reference

Balas MC, Vasilevskis EE, Burke WJ, et al. Critical care nurses' role in implementing the "ABCDE Bundle" into practice. *Critical Care Nurse.* 2012;32:35-47.

Neuromuscular Blockade

NMB agents, historically used in the operating room, are used in critically ill patients to facilitate endotracheal intubation and mechanical ventilation, to control increases in intracranial pressure (ICP), and to facilitate procedures at the bedside (e.g., bronchoscopy, tracheostomy). The goal of neuromuscular blockade is complete chemical paralysis.

During a difficult endotracheal intubation, the use of a rapidly acting NMB agent allows the airway to be secured quickly and without trauma. Some patients are unable to tolerate mechanical ventilation despite adequate sedation, especially nontraditional modes such as inverse ratio and pressure control.[69] Long-acting NMB agents may improve chest wall compliance, reduce peak airway pressures, and prevent the patient from ventilator dyssynchrony. The result is improved gas exchange with increased oxygen delivery and decreased oxygen consumption. In patients with elevated ICP, suctioning, coughing, and agitation can provoke dangerous elevations in ICP. NMB agents diminish ICP elevations during these activities. In some patients, complete immobility may be required for a short period for minor surgical and diagnostic procedures performed at the bedside.

NMB agents do not possess any sedative or analgesic properties. Any patient who receives effective neuromuscular blockade is not able to communicate or to produce any voluntary muscle movement, including breathing. Therefore any patient receiving these agents must also be sedated. Many institutions start continuous infusions of sedative medications before they administer an NMB agent.

Patients receiving NMB therapy are closely monitored for respiratory problems, skin breakdown, corneal abrasions, and the development of venous thrombi. If a patient experiences pain or anxiety while receiving an NMB agent, an increase in heart rate or blood pressure may be noted. Nursing care for patients receiving NMB therapy is presented in Box 5-5.

One important nursing intervention is assessing the level or degree of paralysis by using a peripheral nerve stimulator to determine a *train-of-four* (TOF) response. The TOF evaluates the level of neuromuscular blockade to ensure that the greatest amount of neuromuscular blockade is achieved with the lowest dose of NMB medication. The ulnar nerve and the facial nerve are the most frequently used sites for peripheral nerve stimulation. The peripheral nerve stimulator delivers four low-energy impulses, and the

BOX 5-5 NURSING CARE OF THE PATIENT RECEIVING NEUROMUSCULAR BLOCKADE

- Perform train-of-four testing before initiation, 15 minutes after dosage change, then every 4 hours, to monitor the degree of paralysis.
- Ensure appropriate sedation.
- Lubricate eyes to prevent corneal abrasions.
- Ensure prophylaxis for deep vein thrombosis.
- Reposition the patient every 2 hours as tolerated.
- Monitor skin integrity.
- Provide oral hygiene.
- Maintain mechanical ventilation.
- Monitor breath sounds; suction airway as needed.
- Provide passive range of motion.
- Monitor heart rate, respiratory rate, blood pressure, and oxygen saturation.
- Place indwelling urinary catheter to monitor urine output.
- Monitor bowel sounds; monitor for abdominal distention.

number of muscular twitches is assessed. Four twitches of the thumb or facial muscle indicate incomplete neuromuscular blockade. The absence of twitches indicates complete neuromuscular blockade. The TOF goal is two out of four twitches. An example of a peripheral nerve stimulator is shown in Figure 5-6.

No tools or devices can adequately assess pain and sedation in patients receiving NMB agents. The patient is monitored for physiological changes (see Box 5-2), and if changes occur, the nurse must determine whether pain or anxiety is the potential cause. The BIS or PSI system may assist in monitoring in these patients.

FIGURE 5-6 A train-of-four peripheral nerve stimulator. (Courtesy Fisher & Paykel Healthcare, Auckland, New Zealand.)

Although several NMB agents are available, the most frequently used are outlined in Pharmacology Table 5-9.

TABLE 5-9 PHARMACOLOGY

Drugs Frequently Used in the Treatment of Anxiety, Pain, or for Neuromuscular Blockade*

MEDICATION	ACTION/USES	DOSE/ROUTE	SIDE EFFECTS	NURSING IMPLICATIONS
Treatment of Anxiety				
Midazolam (Versed)	Benzodiazepine; anxiety/sedation	*IV loading dose:* 0.5-4 mg; may repeat in 10-15 min *Infusion:* 1-7 mg/hr	CNS depression Hypotension Respiratory depression Paradoxical agitation	Titrate infusion up or down by 25% to 50% of the initial infusion rate to ensure adequate titration of sedation level and to prevent tolerance development. Monitor blood pressure and respiratory status. Administer fluids as indicated. Slowly wean drug after prolonged therapy (decrease by 10% to 25% every few hours).
Diazepam (Valium)	Benzodiazepine; anxiety/sedation	*PO:* 2-10 mg bid-qid *Elderly* 2-2.5 mg 1-2 times/day; increase gradually PRN *IM/IV:* 30 mg, depending on assessment; may repeat in 1 hr *Moderate anxiety:* 2-5 mg IM or IV, repeat 3-4 hr PRN	Hypotension Respiratory depression Paradoxical agitation	Monitor blood pressure and respiratory status. Inject slowly over 1 min (5 mg/mL). Unstable in plastic (PVC) infusion bags; possibility of precipitation.

Continued

TABLE 5-9 PHARMACOLOGY

Drugs Frequently Used in the Treatment of Anxiety, Pain, or for Neuromuscular Blockade—cont'd

MEDICATION	ACTION/USES	DOSE/ROUTE	SIDE EFFECTS	NURSING IMPLICATIONS
Diazepam (Valium)—cont'd		*Severe anxiety:* 5-10 mg IM or IV, repeat 3-4 hr PRN *IV:* inject no faster than 5 mg/min		
Lorazepam (Ativan)	Benzodiazepine; anxiety/sedation	*PO:* 2-6 mg/day given bid-tid *IM:* 0.05 mg/kg; 4 mg maximum *IV:* 2 mg initially; may repeat 1-2 mg in 10 min *Mild anxiety:* 0.5-1 mg *Moderate-severe anxiety:* 2-4 mg; inject no faster than 2 mg/min *Elderly* 1-2 mg/day, PRN *IV, continuous infusion:* 0.01-0.1 mg/kg/hr IV to maintain desired level of sedation.	Hypotension (less than midazolam) Respiratory depression Paradoxical agitation Hyperosmolar metabolic acidosis (IV prolonged infusion)	Monitor blood pressure and respiratory status. Assess acid-base status with prolonged infusion. Avoid smaller veins to prevent thrombophlebitis. High-dose infusions (greater than 18 mg/hr for more than 4 weeks, or greater than 25 mg/hr for several hours or days) have been associated with tubular necrosis, lactic acidosis, and hyperosmolality states due to the polyethylene glycol and propylene glycol solvents.
Propofol (Diprivan)	Nonbenzodiazepine; sedative/anesthetic	*Initial infusion:* 5 mcg/kg/min for 5 min; increase dose in 5-10 mcg/kg/min increments over 5-10-min until sedation target achieved *Maintenance:* infusion rate of 5-50 mcg/kg/min (or higher)	Hypotension Fever, sepsis Hyperlipidemia Respiratory depression CNS depression	Patient should be intubated and mechanically ventilated. Monitor blood pressure and hemodynamic status. Change infusion set every 12 hr. Monitor plasma lipid levels.
Dexmedetomidine (Precedex)	Selective alpha$_2$-adrenoreceptor agonist; anesthetic; sedative	*IV: loading dose:* 1 mcg/kg over 10 min (must dilute) *Infusion:* 0.2-0.7 mcg/kg/hr	Hypotension Nausea Bradycardia	Give only by continuous infusion. It is recommended not to exceed 24 hr, but in several studies prolonged use of the drug did not increase adverse-event.[40,62,98] Evaluate hepatic and renal function. Observe for bradycardia.
Management of Pain				
Fentanyl (Sublimaze [IV]/ Duragesic [patch])	Opioid; treat pain	Dosage varies depending on desired effect *Infusion:* general pain relief (1-3 mcg/kg/hr); sedation (up to 20 mcg/kg/hr); or amnesia (20-50 mcg/kg/hr) *TD:* 25 mcg/hr, titrate as needed	Hypotension Muscle rigidity Decreased gastric motility Respiratory depression Bradycardia Itching	Titrate infusion slowly in increments. Monitor blood pressure, heart rate, and respiratory status. Administer fluids as indicated. Give as an infusion for extended therapy. Patch: avoid direct heat (e.g., heating blanket), which accelerates fentanyl release. Change patch every 72 hr.
Hydromorphone (Dilaudid)	Opioid; treat pain	*PO:* 2-4 mg every 4-6 hr *SC/IM:* 1-2 mg every 4-6 hr PRN *IV:* 1-2 mg every 4-6 hr slowly over 2-3 min	Hypotension Decreased gastric motility; constipation Respiratory depression	Titrate infusion slowly in increments. Monitor blood pressure, heart rate, and respiratory status. Administer fluids as indicated.

TABLE 5-9 PHARMACOLOGY

Drugs Frequently Used in the Treatment of Anxiety, Pain, or for Neuromuscular Blockade—cont'd

MEDICATION	ACTION/USES	DOSE/ROUTE	SIDE EFFECTS	NURSING IMPLICATIONS
Morphine (Duramorph/MS Contin/Roxanol)	Opioid; treat pain	*SC/IM:* 2.5-20 mg every 3-4 hr PRN. Give very slowly over 4-5 min. *PO:* 5-30 mg every 4 hr PRN *Extended release:* 15-60 mg every 8 to 12 hr *Rectal:* 10-30 mg every 4 hr PRN *Chest pain:* 2-4 mg repeat as necessary *IV:* 10 mg every 4 hr *Continuous IV:* 0.8-10 mg/hr *Maintenance dose:* 0.8-80 mg/hr; rates up to 440 mg/hr have been used *IV patient-controlled analgesia or subcutaneous patient-controlled analgesia:* 1-2 mg injected 30 min after a standard IV dose of 5-20 mg. The lockout period is 6-15 minutes. The 4-hr limit is 30 mg. *Continuous subcutaneous:* 1 mg/hr after a standard dose of 5-20 mg *Epidural:* initial injection of 5 mg in lumbar region may provide relief for up to 24 hr; may give 1-2 mg more after 1 hr to a maximum of 10 mg. *Intrathecal:* 0.2-1 mg one time *Intrathecal continuous:* 0.2 mg/24 hr. May be increased up to 20 mg/24 hr. *Intracerebroventricular:* 0.25 mg via an Ommaya reservoir	Hypotension Decreased gastric motility; constipation Urinary retention Respiratory depression Nausea and vomiting Itching or rash	Titrate infusion slowly in increments. Monitor blood pressure, heart rate, and respiratory status. Administer fluids as indicated.
Acetaminophen (Tylenol) IV (Ofirmev)	Nonnarcotic analgesic	*PO/PR:* 325-1000 mg every 4-6 hours PRN, not to exceed 4 g/day *IV:* patient 50 kg or greater: 650 mg IV every 4hr OR 1000 mg IV every 6hr; not to exceed 4 g/day *Patient less than 50 kg:* 12.5 mg/kg IV every 4hr OR 15 mg/kg IV every 6hr; not to exceed 750 mg/dose or 3.75 g/day Infuse IV over at least 15 min	Renal failure with chronic overdosage Blood dyscrasias Hepatic toxicity	Monitor renal and liver function. Assess other drugs for acetaminophen content (e.g., Percocet).
Aspirin (Ecotrin/Bayer)	Nonsteroidal antiinflammatory drug (NSAID)	*PO:* 325-1000 mg every 4-6 hr PRN, not to exceed 4 g/day (analgesic) *Rectal:* 1 suppository every 4 hr for no more than 10 days or as directed	Bleeding Gastrointestinal ulcers Tinnitus Thrombocytopenia	Administer with food if taking PO. Do not exceed recommended doses. Monitor complete blood count and renal function.

Continued

TABLE 5-9 PHARMACOLOGY

Drugs Frequently Used in the Treatment of Anxiety, Pain, or for Neuromuscular Blockade—cont'd

MEDICATION	ACTION/USES	DOSE/ROUTE	SIDE EFFECTS	NURSING IMPLICATIONS
Ibuprofen (Advil, Motrin) (IV: Caldolor)	NSAID	*PO:* Mild to moderate pain: 200-400 mg orally every 4-6 hr as needed. Doses greater than 400 mg have not been proven to provide greater efficacy. Do not exceed 3200 mg total daily dose. *IV-Pain:* 400-800 mg intravenously over 30 min every 6 hr as needed. Do not exceed 3200 mg total daily dose.	Bleeding Gastrointestinal ulcers Tinnitus Thrombocytopenia	Do not exceed recommended doses. Monitor complete blood count. Monitor renal and liver function. Patients should be well hydrated before IV ibuprofen administration.
Ketorolac (Toradol)	NSAID	*IV/IM:* 30 mg every 6 hr (max 120 mg); duration should not exceed 5 days *Patients greater than or equal to 65 years of age, renal impairment, or patient less than 50 kg:* the recommended dose is 15 mg IV/IM every 6 hr (max daily dose not to exceed 60 mg)	Headache Dyspepsia Nausea Acute renal failure	Monitor complete blood count. Monitor renal and liver function.
Epidural Analgesia				
Bupivacaine	Local anesthetics/ analgesic	Concentration of 0.1% to 0.75% (25-150 mg) provides partial to complete motor block	Hypotension, respiratory paralysis, nausea, itching, urinary retention, or vomiting	Assess dermatomes for sensation and movement. Monitor renal and liver function.
Levobupivacaine		Concentration of 0.125% (0.1 mL/kg/hr-0.3 mL/kg/hr)	Urinary retention, hypotension, hypokinesia, respiratory paralysis, nausea, itching, urinary retention, or vomiting	Assess dermatomes. Monitor renal and liver function.
Ropivacaine	Postoperative pain management	Dosing varies based on location. Concentration of 0.2% (2-5 mg/mL). Lumbar/thoracic epidural for continuous infusion (12-28 mg/hr)	Hypotension, bradycardia, paresthesia, pruritus, rigors	Assess dermatomes. Monitor renal and liver function.
Therapeutic Paralysis				
Atracurium (Tracrium)	Neuromuscular blockade	*IV:* loading dose: 0.4-0.5 mg/kg *Maintenance infusion:* 5-10 mcg/kg/min to a maximum of 17.5 mcg/kg/min	Hypotension Tachycardia Rash	Ensure adequate airway. Safer than other paralytic agents in patients with hepatic or renal failure.

TABLE 5-9 PHARMACOLOGY

Drugs Frequently Used in the Treatment of Anxiety, Pain, or for Neuromuscular Blockade—cont'd

MEDICATION	ACTION/USES	DOSE/ROUTE	SIDE EFFECTS	NURSING IMPLICATIONS
Succinylcholine	Neuromuscular blockade; short-term use	*IV:* loading dose: 1-1.5 mg/kg; maximum 2 mg/kg	Hyperkalemia	Secure airway. Avoid in patients with elevated serum potassium.
Delirium				
Haloperidol (Haldol)	Neuroleptic; used to treat delirium and alcohol withdrawal	*PO:* 0.5-5 mg bid or tid; maximum 30 mg/day *IM:* 2-5 mg every 1-8 hr PRN *IV, intermittent:* 0.03-0.15 mg/kg IV (2-10 mg) every 30 min to 6 hr. Mild agitation: 0.5-2 mg Moderate agitation: 5 mg Severe agitation: 10 mg; may require dosing every 30 min (maximum single dose, 40 mg) *IV, infusion:* 3-25 mg/hr by continuous IV infusion has been used for ventilator patients with agitation and delirium.	Drowsiness Prolonged QT interval Extrapyramidal symptoms Euphoria/agitation Paradoxical agitation Neuroleptic malignant syndrome Tachycardia	Measure QT interval at start of therapy and periodically. Monitor blood pressure with initial treatment or change in the dose. Use with caution when patient is receiving other proarrhythmic agents. Administer anticholinergic for extrapyramidal symptoms.

Data from *Drug Facts and Comparisons.* St. Louis: Wolters Kluwer Health; 2010; McKenry L, Tessier E, Hogan M. *Mosby's Pharmacology in Nursing.* 22nd ed. St. Louis; 2006; OFIRMEV™ (acetaminophen) injection prescribing information. Cadence Pharmaceuticals, Inc. http://www.ofirmev.com/Dosing.aspx. Accessed September 23, 2011; Drugs.com, 2000-11 [Updated: Aug 11th, 2011), http://www.drugs.com. Accessed September 23, 2011.

*All dosages are for adult patients; this table does not account for typical dose adjustments used with the geriatric population (or those undergoing alcohol withdrawal).

bid, Two times per day; *CNS,* central nervous system; *g,* gram; *IM,* intramuscular; *IV,* intravenous; *PO,* by mouth; *PR,* per rectum; *PRN,* as needed; *qid,* four times per day; *SC,* subcutaneous; *tid,* three times per day; *TD,* transdermal.

Succinylcholine (paralytic), when administered with etomidate (sedative), is frequently used for rapid sequence intubation because of its short half-life. However, succinylcholine should not be used in the presence of hyperkalemia because ventricular dysrhythmias and cardiac arrest may occur. Pancuronium is a long-acting NMB agent. When it is given in bolus doses, tachycardia and hypertension may result. The effects of pancuronium are prolonged in patients with liver disease and renal failure. Newer NMB agents such as atracurium and cisatracurium are used in critically ill patients because they are associated with fewer side effects and can be used safely in patients with liver or renal failure.[74]

MANAGEMENT OF PAIN AND ANXIETY

Nonpharmacological Management

Nonpharmacological approaches to manage pain and anxiety are early strategies because many medications used for analgesia or sedation have potentially negative hemodynamic effects. Efforts to reduce anxiety include frequent reorientation, providing patient comfort, and optimizing the environment. For example, a nurse's explanation to the patient and family of the different types of alarms heard in the critical care unit may lessen anxiety levels. Many nonpharmacological approaches are categorized as complementary and alternative therapies. The most commonly used complementary therapies in the critical care unit are environmental manipulation, guided imagery, and music therapy.

Environmental Manipulation

The nurse may decrease patient anxiety and pain by changing the environment so it appears less hostile. The presence of calendars and clocks is helpful. For a patient experiencing delirium, continual reorientation and repetition of explanations and information is helpful.

Family involvement is one of the most important strategies to decrease the patient's anxiety or pain. Family members often benefit from role modeling, as nursing staff members offer support and reassurance to patients while avoiding arguments with patients who have irrational ideas or misperceptions (see Chapter 2).

Another effective strategy is altering the patient's room. Pictures of family members and other small keepsakes provide diversions from the stressful critical care environment. In some critical care units, it may be possible to move the patient's bed so it faces a window. Some patients may benefit from being moved to a different room. Physically moving the patient to a different location prevents the patient from becoming tired of the surroundings, and it may provide some sense of clinical improvement for the patient and family. There are also critical care units in which the monitoring equipment is concealed behind cabinetry to provide a homelike atmosphere.

The patient's family is often able to interpret patient behaviors to the nursing staff, especially those associated with pain or anxiety. Families should be asked to participate in the care whenever the patient's condition allows it. Examples of family participation include coaching during breathing exercises, assisting with passive range of motion, and providing hygiene measures.

Complementary and Alternative Therapy

Guided Imagery

Guided imagery is a mind-body intervention intended to relieve stress and to promote a sense of peace and tranquility.[122] It involves a form of directed daydreaming. It is a way of purposefully diverting and focusing thoughts. Critically ill patients may be instructed in the use of guided imagery during painful procedures or weaning from mechanical ventilation. For example, when performing a needlestick puncture, the nurse may instruct a patient to imagine walking on a beach.

Relaxation and guided imagery have been found to reduce anxiety and depression in cancer patients.[66] Guided imagery with gentle touch or light massage has shown to decrease pain and tension in critically ill patients.[61] Benefits of the guided imagery program included reduced stress and anxiety, decreased pain and narcotic consumption, decreased complications, decreased length of stay, enhanced sleep, and increased patient satisfaction.[61,87,97] Guided imagery is a simple and inexpensive strategy that all nurses can easily incorporate into their daily practice during most procedures and interventions.

Music Therapy

Similar to guided imagery, a music therapy program offers patients a diversionary technique for pain and anxiety relief. Some medical institutions have staff members dedicated solely to music therapy. When appropriate, a music therapist comes to the patient's bedside in the critical care unit and offers one-on-one therapy.[101]

Music therapy may be effective in reducing pain and anxiety if patients are able to participate. Its effect on patients who are heavily sedated, chemically paralyzed, or physically restrained needs further study. Music therapy is an ideal intervention for patients with low energy states who fatigue easily, such as those who require ventilatory support, because it does not require the focused concentration necessary for guided imagery.

Musical selections without lyrics that contain slow, flowing rhythms that duplicate pulses of 60 to 80 beats per minute decrease anxiety in the listener.[15] Music can also provide an alternative focus on a pleasant, comforting stimulus, rather than on stressful environmental stimuli or thoughts. Music therapy can reduce anxiety, and some studies show a shorter duration of intubation.[65,123] Careful scrutiny of musical selections and of personal preferences of what is considered relaxing is important for success.

Animal-Assisted Therapy

Animal-assisted therapy (AAT) involves interaction between patients and trained animals (as therapist) accompanied by human owners or handlers. Commonly used animals are dogs and cats, but use of fish and guinea pigs in the hospital setting has been reported.[22,42] AAT has shown to improve patient's physiological and emotional well-being, lowering cardiopulmonary pressures, decreasing neurohormone levels, and reducing anxiety levels.[18,42]

Pharmacological Management

Even with the most aggressive nonpharmacological therapies, many critically ill patients require medications to relieve pain, anxiety, or both. The appropriate management of pain may result in improved pulmonary function, earlier ambulation and mobilization, decreased stress response with lower catecholamine concentrations, and lower oxygen consumption, leading to improved outcomes.[11,19,117] Pharmacology Table 5-9 summarizes pharmacological therapies used in managing pain and anxiety.

Opioids

Medications for managing pain include opioids and nonsteroidal antiinflammatory drugs (NSAIDs) (see box, "Clinical Alert"). The most commonly used opioids in the critically ill are fentanyl, morphine, and hydromorphone. The selection

! CLINICAL ALERT

Intravenous Administration of NSAIDs

Intravenous (IV) preparations of acetaminophen (Ofirmev) and ibuprofen (Caldolor) are now available to treat mild to moderate pain, providing more options for the critically ill patient. These drugs are active ingredients in many other preparations; therefore it is important to ensure that the maximum daily dosage is not exceeded. When these drugs are given, patients are at an increased risk for liver damage (acetaminophen) or renal damage (ibuprofen). Laboratory results must be used to guide therapy and monitor effects of treatment. Results will also assist in determining the most appropriate NSAID for the patient. Collaboration with the clinical pharmacist is essential.

of an opioid is based on its pharmacology and potential for adverse effects. The benefits of opioids include rapid onset, ease of titration, lack of accumulation, and low cost. Fentanyl has the fastest onset and the shortest duration, but repeated dosing may cause accumulation and prolonged effects. Morphine has a longer duration of action, and intermittent dosing may be given. However, hypotension may result from vasodilation, and its active metabolite may cause prolonged sedation in patients with renal insufficiency. Hydromorphone is similar to morphine in its duration of action.

Fentanyl may also be administered by a transdermal patch in hemodynamically stable patients with chronic pain. The patch provides consistent drug delivery, but the extent of absorption varies depending on permeability, temperature, perfusion, and thickness of the skin. Fentanyl patches are not recommended for acute analgesia because it takes 12 to 24 hours to achieve peak effect and, once the patch is removed, another 12 to 24 hours until the medication is no longer present in the body.

Adverse effects of opioids are common in critically ill patients. Respiratory depression is a concern in nonintubated patients. Hypotension may occur in hemodynamically unstable patients or in hypovolemic patients. A depressed level of consciousness and hallucinations leading to increased agitation may be seen in some patients. Gastric retention and ileus may occur as well.

Renal or hepatic insufficiency may alter opioid and metabolite elimination. Titration to the desired response and assessment of prolonged effects are necessary. Elderly patients may have reduced opioid requirements. Administration of a reversal agent such as naloxone is not recommended after prolonged analgesia. It can induce withdrawal and may cause nausea, cardiac stress, and dysrhythmias.[50]

Preventing pain is more effective than treating established pain. When patients are administered opioids on an "as needed" basis, they may receive less than the prescribed dose, and delays in treatment may occur. Analgesics should be administered on a continuous or scheduled intermittent basis, with supplemental bolus doses as required.[50] Intravenous administration usually requires lower and more frequent doses than intramuscular administration to achieve patient comfort. Intramuscular administration is not recommended in hemodynamically unstable patients because of altered perfusion and variable absorption.[50] A pain management plan should be established for each patient and reevaluated as the patient's clinical condition changes.

Patient-Controlled Analgesia

Patient-controlled analgesia (PCA) is a medication delivery system in which the patient is able to control when medication is given. PCA involves a special type of infusion pump (Figure 5-7) that has a "locked" supply of opioid medication. When the patient feels pain or just before any pain-inducing therapy, the patient can depress a button on the pump that will deliver a prescribed bolus of medication. Opioids delivered by PCA pump result in stable drug concentrations, good quality of analgesia, less sedation, less opioid consumption, and potentially fewer side effects. PCA is a safe and effective method of pain management.[89]

FIGURE 5-7 A patient-controlled analgesia infusion pump. (Courtesy Smiths Medical ASD, Inc., St. Paul, Minnesota.)

BOX 5-6 TYPICAL PATIENT CRITERIA FOR PATIENT-CONTROLLED ANALGESIA THERAPY

- An elective surgical procedure
- Large surgical wounds likely to result in pain (e.g., thoracotomy incisions)
- Large traumatic wounds
- Normal cognitive function
- Normal motor skills (able to depress the medication delivery button)

PCA management is rarely appropriate for critically ill patients because most are unable to depress the button, or they are too ill to manage their pain effectively.[89] However, some critically ill patients may benefit from PCA therapy to manage postoperative incisional pain. Typical patient criteria for PCA therapy are listed in Box 5-6.

TABLE 5-10 POTENTIAL BENEFITS OF EPIDURAL ANALGESIA

SYSTEM	RESPONSE
Pulmonary	↑ Vital capacity
	↑ Functional residual capacity
	Improved airway resistance
Cardiac	Coronary artery vasodilation
	↓ Blood pressure, heart rate
Gastrointestinal	Less nausea and vomiting
	Faster return of gastrointestinal function
Neurological	↓ Total opioid requirement
	↓ Sedation
Activity	Earlier extubation
	Earlier mobilization
	Decreased length of stay

Modified from Alpen MA, Morse C. Managing the pain of traumatic injury. *Critical Care Nursing Clinics of North America.* 2001;13(2):243-257.

Epidural Analgesia

Opioids or dilute local anesthetics agents, or both, can also be delivered through a catheter placed in either the epidural, intrathecal caudal space, or via nerve blockade to interrupt the transmission of pain. The discovery of opioid receptors in the spinal cord is considered a major breakthrough in the management of pain associated with traumatic injury of the chest and abdomen. Patients with such injuries do not want to cough, breathe deeply, ambulate, or participate in pulmonary exercises because these activities are too painful. Eventually, atelectasis, hypoxemia, respiratory failure, and pneumonia result.

The administration of epidural agents has many benefits in addition to pain relief (Table 5-10). Some of the most commonly used epidural local anesthetics include bupivacaine, levobupivacaine, and ropivacaine. A recent advancement in epidural analgesia is the combination of magnesium sulfate ($MgSO_4$) with epidural or intrathecal analgesia.[5] $MgSO_4$ blocks the *N*-methyl-D-aspartate (NMDA) receptor in the spinal cord, which decreases the induction and maintenance of central sensitization, thereby decreasing pain.

Patients receiving epidural analgesia are carefully assessed to determine the appropriateness of spinal analgesia. Contraindications include coagulopathies, cardiovascular instability, sepsis, spine injury, infection or injury to the skin at the proposed insertion site, patient refusal, inability to lie still during catheter insertion, and alcohol or drug intoxication.[3] In addition, it is difficult to place an epidural catheter in patients who are obese or have compression fractures of the lumbar spine. Because of issues associated with spinal analgesia, research is being conducted to assess outcomes of caudal epidural analgesia or paravertebral blockade as an alternative to spinal epidural analgesia.[57,77,104]

Potential side effects of spinal analgesia with opioids include respiratory depression, sedation, nausea and vomiting, and urinary retention. Potential side effects of spinal analgesia with local anesthetics include sympathetic blockade (hypotension, venous pooling), motor weakness, sensory block, and urinary retention.

Nonsteroidal Antiinflammatory Drugs

NSAIDs provide analgesia by inhibiting cyclooxygenase, a critical enzyme in the inflammatory cascade. NSAIDs have the potential to cause significant adverse effects including gastrointestinal bleeding, bleeding secondary to platelet inhibition, and renal insufficiency. The risk of developing NSAID-induced renal insufficiency is higher in patients with hypovolemia or renal hypoperfusion, in the elderly, and in patients with preexisting renal impairment. NSAIDs should not be administered to patients with asthma and aspirin sensitivity.

NSAIDs are available in oral, liquid, and intravenous forms. NSAIDs such as ibuprofen have been used to treat the hypermetabolic response and fever. More recently, demonstrated effects of ibuprofen that is administered intravenously include significant reductions in opioid requirements and decrease in pain levels.[114]

Other Pain Relievers

Acetaminophen is used to treat mild to moderate pain, such as pain associated with prolonged bed rest. In combination with an opioid, acetaminophen has a greater analgesic effect than higher doses of an opioid alone. Acetaminophen is administered cautiously in patients with hepatic dysfunction.

Sedative Agents

Anxiety in the critical care setting is typically treated with benzodiazepines, propofol, or dexmedetomidine. Both pain and anxiety may exist with evidence of psychotic features (as manifested in delirium). In this situation, neuroleptic agents, antidepressants, and anesthetic agents are administered.

Benzodiazepines are sedatives and hypnotics that block new information and potentially unpleasant experiences at that moment. Although they are not considered analgesics, they do moderate the anticipatory pain response. Benzodiazepines vary in their potency, onset and duration of action, distribution, and metabolism. The patient's age, prior alcohol abuse, concurrent drug therapy, and current medical condition affect the intensity and duration of drug activity. Elderly patients and patients with renal or hepatic insufficiency may exhibit slower clearance of benzodiazepines, which may contribute to a significant delay in elimination.

Benzodiazepines should be titrated to a predefined end point, for example, a specific level of sedation using a standard sedation scale. Sedation may be maintained with intermittent doses of lorazepam, diazepam, or midazolam; however, patients requiring frequent doses to maintain the desired effect may benefit from a continuous infusion by using the lowest effective dose. Patients receiving continuous infusions must be monitored for the effects of oversedation.

Additionally, patients who are hemodynamically unstable may become hypotensive with the initiation of sedation; the nurse must be cautious when administering medication to these patients.

Propofol is an intravenous general anesthetic; however, sedative and hypnotic effects are achieved at lower doses. Propofol has no analgesic properties. It has a rapid onset and short duration of sedation once it is discontinued. Adverse effects include hypotension, bradycardia, and pain when the drug is infused through a peripheral intravenous site. Propofol is available as an emulsion in a phospholipid substance, which provides 1.1 kcal/mL from fat, and it should be counted as a caloric source.[50] Long-term or high-dose infusions may result in high triglyceride levels, metabolic acidosis, or dysrhythmias. Propofol requires a dedicated intravenous catheter for continuous infusion because of the risk of incompatibility and infection. The infusion should not hang for more than 12 hours.

Dexmedetomidine is an anesthetic agent with selective alpha-2 agonist properties that is approved for short-term use as a sedative (less than 24 hours) in patients receiving mechanical ventilation. It reduces concurrent analgesic and sedative requirements and produces anxiolytic effects comparable to those of the benzodiazepines. Transient elevations in blood pressure may be seen with rapid administration. Bradycardia and hypotension may develop, especially in the presence of hypovolemia, in patients with severe ventricular dysfunction and in the elderly. The role of this medication in the sedation of critically ill patients is being determined.

Implementation of sedation guidelines have been shown to reduce the cost of sedation medication, the number of hours patients require mechanical ventilation, and the length of time patients spend in the critical care unit.[50] The use of an algorithm assists in this process (Figure 5-8).

Tolerance and Withdrawal

Patients who require high-dose opioid or sedative therapy to maintain sedation may develop physiological dependence and tolerance to the drug. Drugs should be tapered slowly and another drug selected. Stopping these medications abruptly may lead to withdrawal symptoms. Opioid withdrawal symptoms include pupillary dilation, sweating, rhinorrhea, tachycardia, hypertension, tachypnea, vomiting, diarrhea, increased sensitivity to pain, restlessness, and anxiety. Signs of benzodiazepine withdrawal include tremor, headache, nausea, sweating, fatigue, anxiety, agitation, increased sensitivity to light and sound, muscle cramps, sleep disturbances, and seizures. Doses should be tapered slowly and systematically.

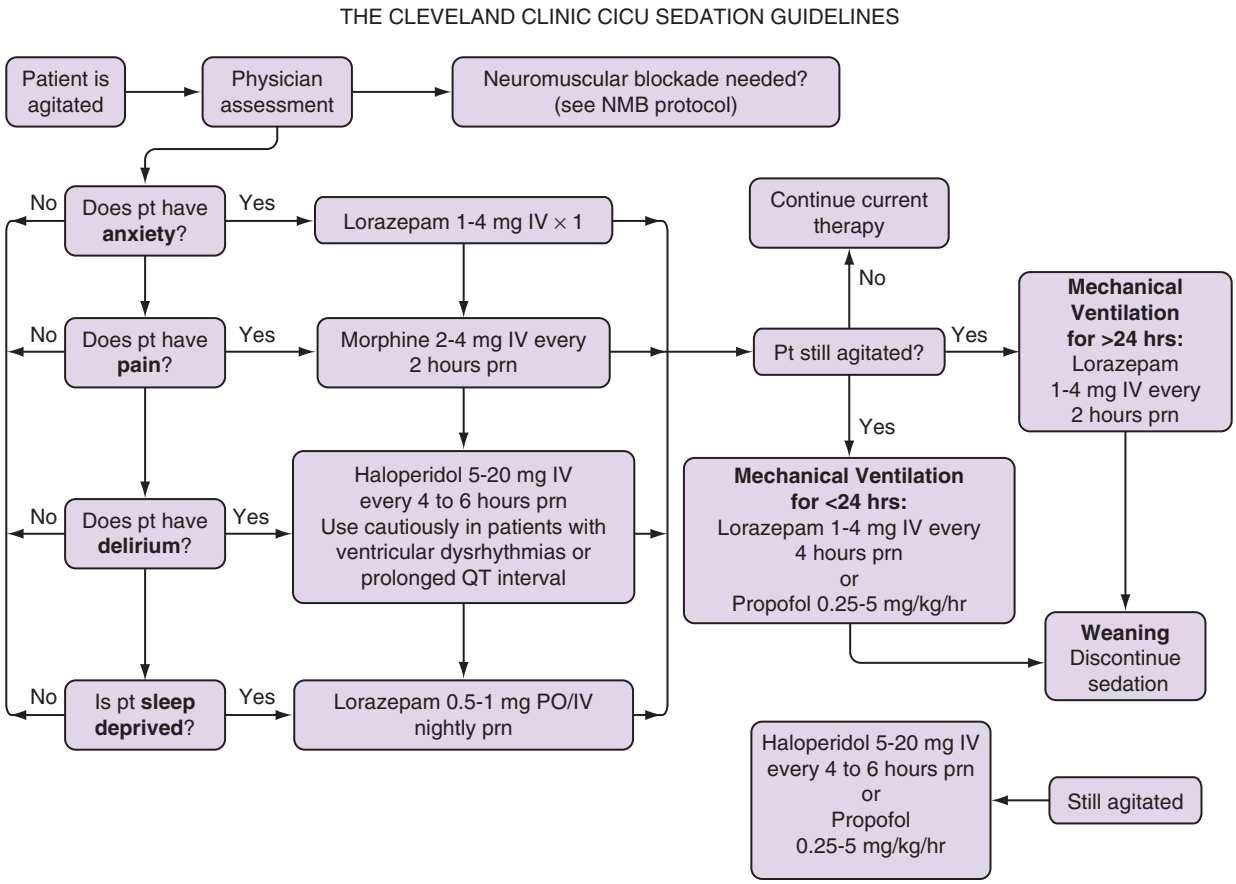


FIGURE 5-8 Sample algorithm of sedation guidelines. (Courtesy Cleveland Clinic, Cleveland, Ohio.)

MANAGEMENT CHALLENGES

Invasive Procedures

Many invasive procedures, including nasogastric tube insertion, tracheal suctioning, central venous catheter insertion, chest tube insertion, wound care, and removal of tubes, lines, and sheaths, take place in the critical care unit. All these invasive procedures have the likelihood of inducing pain or anxiety.[93] If pain or anxiety occurs during a procedure, the length and difficulty of the procedure may be increased, inaccurate data may be obtained, and physical harm can result.[80] To avoid negative outcomes, the patient's comfort and anxiety must be appropriately assessed and managed. Many times, the patient is kept in a conscious state during the procedure to avoid the risk of complications such as respiratory depression and hypotension. Therefore sedative or analgesic agents, or both, are given in a way that the patient appears sedate yet is able to verbalize. This type of sedation has been referred to as *procedural sedation* or *conscious sedation.*

Typical nursing care during these procedures involves monitoring vital signs including pulse oximetry, ensuring a patent airway, and observing for the adverse effects of medications. With the advent of the electronic medical record (EMR), customized pain assessment forms can be developed to improve clinical efficiency and documentation (Figures 5-9 and 5-10). Many institutions use specialized flow sheets in which assessment findings are documented during invasive procedures (Figure 5-11).

Substance Abuse

Critically ill patients who have a history of substance abuse or drug use disorders pose special challenges. Drug use disorder combined with alcohol has been associated with increased need for mechanical ventilation, increased risk of developing pneumonia and sepsis, and a longer critical care stay.[102] A history of alcoholism alone also increases hospital length of stay and mortality secondary to complications such as higher infection rates, sepsis, septic shock, acute respiratory distress syndrome, and acute delirium.[82,83,85,124] The pharmacological management of patients in the critical care unit typically involves the administration of sedative and hypnotic medications. Patients with a history of substance abuse may have a higher-than-normal dosage threshold to achieve therapeutic actions with many of these pharmacological agents. If alcoholism or drug abuse is suspected, it may be beneficial

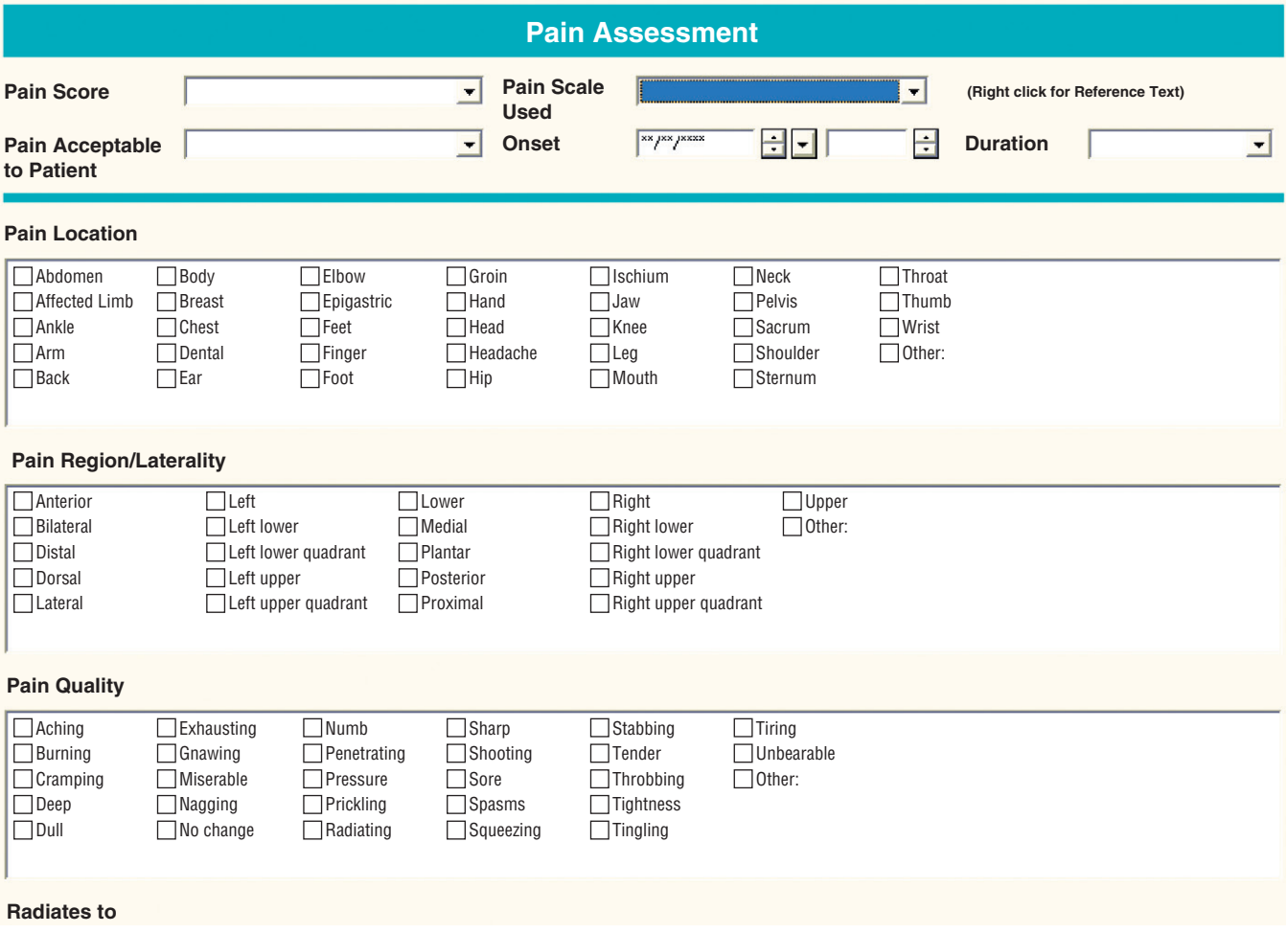
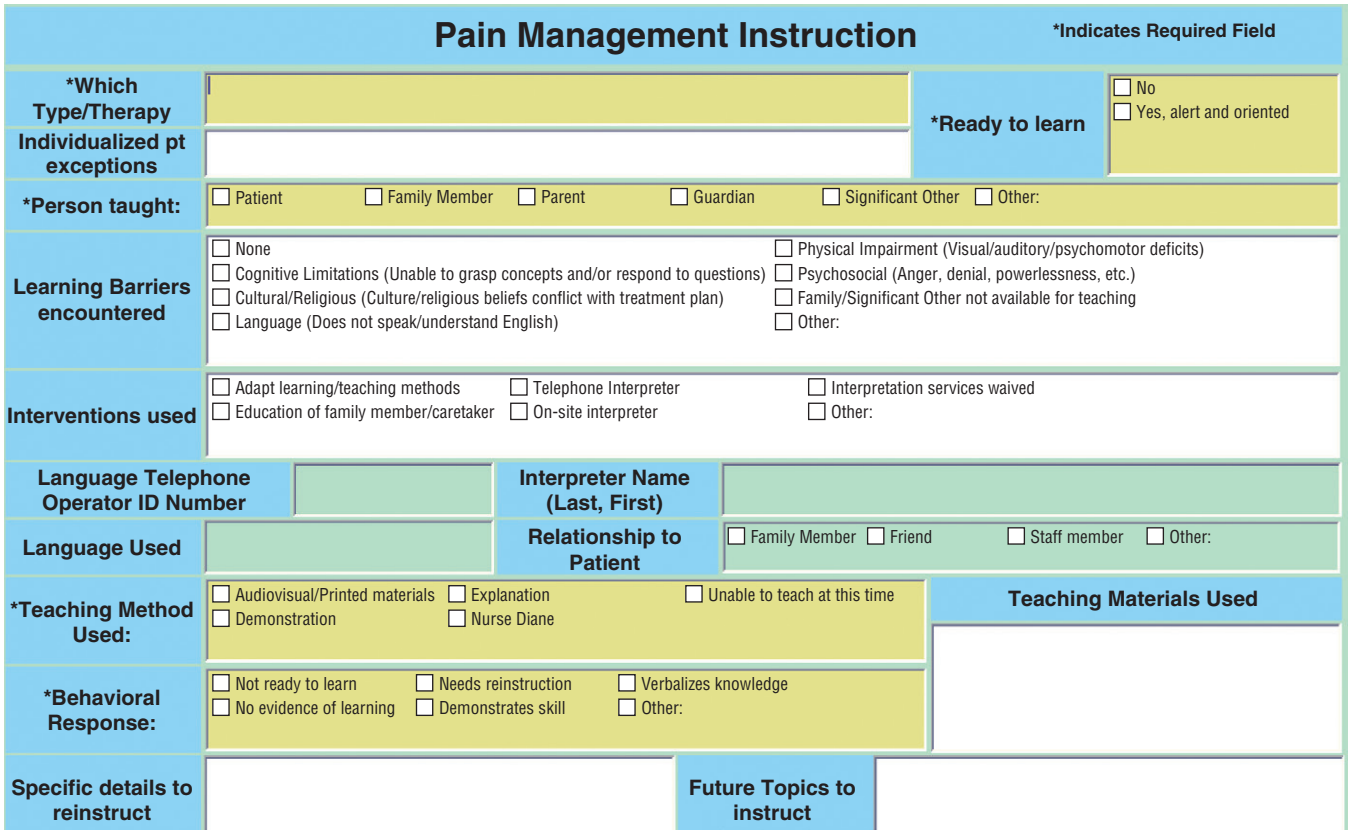


FIGURE 5-9 Electronic Medical Record: Pain Assessment Form. (Courtesy Virginia Commonwealth University Health System, Richmond, Virginia.)



Pain Management Instruction *Indicates Required Field

*Which Type/Therapy		*Ready to learn	☐ No ☐ Yes, alert and oriented
Individualized pt exceptions			
*Person taught:	☐ Patient ☐ Family Member ☐ Parent ☐ Guardian ☐ Significant Other ☐ Other:		
Learning Barriers encountered	☐ None ☐ Cognitive Limitations (Unable to grasp concepts and/or respond to questions) ☐ Cultural/Religious (Culture/religious beliefs conflict with treatment plan) ☐ Language (Does not speak/understand English) ☐ Physical Impairment (Visual/auditory/psychomotor deficits) ☐ Psychosocial (Anger, denial, powerlessness, etc.) ☐ Family/Significant Other not available for teaching ☐ Other:		
Interventions used	☐ Adapt learning/teaching methods ☐ Education of family member/caretaker ☐ Telephone Interpreter ☐ On-site interpreter ☐ Interpretation services waived ☐ Other:		
Language Telephone Operator ID Number		Interpreter Name (Last, First)	
Language Used		Relationship to Patient	☐ Family Member ☐ Friend ☐ Staff member ☐ Other:
*Teaching Method Used:	☐ Audiovisual/Printed materials ☐ Explanation ☐ Unable to teach at this time ☐ Demonstration ☐ Nurse Diane	Teaching Materials Used	
*Behavioral Response:	☐ Not ready to learn ☐ Needs reinstruction ☐ Verbalizes knowledge ☐ No evidence of learning ☐ Demonstrates skill ☐ Other:		
Specific details to reinstruct		Future Topics to instruct	

FIGURE 5-10 Electronic Medical Record: Pain Management Patient Education Form. (Courtesy Virginia Commonwealth University Health System, Richmond, Virginia.)

to start with higher-than-normal doses of sedative and analgesic medications. Based on the patient's response, it may be necessary to exceed the recommended maximum dosage of a medication.

Patients with a history of alcohol use must be assessed for symptoms of alcohol withdrawal syndrome (AWS), which usually present within 72 to 96 hours after the patient's last alcohol intake. The initial symptoms, such as disorientation, agitation, and tachycardia, and delirium tremens (shaking of the extremities or digits), may be mild. If untreated, symptoms can progress to severe confusion, paranoid-like behavior, seizures, convulsions, and even death. The most important treatment of AWS is prevention, which has been shown to improve morbidity and mortality and decrease hospital and critical care unit lengths of stay. Continuous infusion of ethanol as prophylaxis decreases the rate of withdrawal symptoms.[24] In addition, thiamine is frequently given to patients with a history of alcoholism to prevent Wernicke encephalopathy.[107,119] Research shows that surgical patients who received symptom-oriented bolus titration of intravenous flunitrazepam (agitation), intravenous clonidine (sympathetic hyperactivity), or intravenous haloperidol (productive psychotic symptoms) required fewer days of mechanical ventilation, had a lower incidence of pneumonia, and had shorter ICU stays.[115] Flunitrazepam is not approved in the United States.

Restraining Devices

Restraining or immobilizing devices are commonly used in the critical care setting to ensure that the patient is unable to disrupt invasive lines or pull at lifesaving devices. The purpose of restraints is to promote patient safety; however, restraints can be dangerous if the patient is disoriented.[28] Use of physical restraint without sedation has been associated with PTSD after critical care unit discharge.[52] The goal of applying restraints is to use the least restrictive device so the patient still has some movement. Commonly used restraining devices are listed in Table 5-11.

A common adverse event associated with restraints involves complications associated with immobility. Patients with restraining devices must be repositioned, and the areas where the restraints are applied are assessed for perfusion and sensation at least every hour. This assessment is documented on the critical care flow sheet.

Effects of Aging

As the population ages, the number of elderly patients admitted to a critical care unit continues to increase. Elderly patients have a high prevalence of pain, and they might experience a multitude of painful conditions (neoplasms, injuries and other external causes, and diseases of the musculoskeletal and connective tissues systems). Patients older than 65 years pose special concerns because of their physiology, many comorbidities, use of multiple medications, physical frailty, and

Cleveland Clinic

PROCEDURAL SEDATION RECORD

Page 2 of 4

For scanning accuracy, affix patient label within this outlined box.

Transportation home verified? ❑ Yes ❑ No ❑ Not applicable
Support person: _____ Phone Number: _____
Nothing by mouth since: _____
Identification Band check: _____
Dentures: ❑ Yes ❑ No ❑ Not applicable
Glasses: ❑ Yes ❑ No ❑ Not applicable
Other: _____

Initials: _____ Time: _____

Prep: _____

Intravenous site/gauge: _____

Initials: _____ Date: _____ Time: _____

Nursing Assessment:

Patient Education re: procedure ❑ Yes ❑ No ❑ Not applicable
Nursing Plan of care initiated: ❑ Yes ❑ No ❑ Not applicable

Patient Assessment Score	pre	post
Moves 4 extremities voluntarily on command	2	2
Moves 2 extremities voluntarily on command	1	1
Moves 0 extremities voluntarily on command	0	0
Able to breathe deeply & cough freely	2	2
Dyspnea or limited breathing	1	1
Apneic	0	0
Fully awake	2	2
Arousable on calling	1	1
Not responding	0	0
Able to maintain oxygen saturation greater than 90 percent on RA	2	2
Needs oxygen to maintain oxygen sat greater than 90 percent	1	1
Oxygen sat less than 90 percent with oxygen	0	0
Able to stand up and walk upright	2	2
Vertigo when erect	1	1
Dizziness when supine	0	0
Non-ambulatory	0	0
TOTAL		
Initials		
Time		

INTAKE

TIME	SOLUTION - ml's/hour	ABSORBED	CREDIT	INITIALS

OUTPUT

TIME	URINE				INITIALS

NOTES:

PRE-PROCEDURAL VASCULAR ASSESSMENT ❑ No deferred/not indicated
ASSESSMENT OF EXTREMITY ACCESSED: PALPABLE: 4+= BOUNDING 3+= normal 2+= decreased 1+= weak 0= absent
CHECK APPROPRIATE BOX

Pulses: Post Check Appropriate Box	F	P	DP	PT	AXILLARY	BRACHIAL	ULNAR	RADIAL
Right ☐ Leg ☐ Arm								
Left ☐ Leg ☐ Arm								

Initials _____ Time _____

Procedure Information

Procedure Start Time: _____
Procedure Finish Time: _____
Endoscope Size: _____
Total fluoroscopy time: _____
Electrosurgical Unit #: _____ Pad #: _____
Pad Location: _____
Site Condition after removal: _____
Specimens Collected: _____
Specimens sent to: _____

Sign in Communication: ❑ Completed ❑ Emergent Case N / A

Initials: _____

Time Out–Team Agrees:
Correct Patient
Correct Procedure
Correct Side / Site Marking
Correct Position (if applicable)

Initials: _____ Time: _____

complete (if applicable):
Affirmation of time out

Initials: _____

Procedural Activities completed Initials: _____ Time: _____

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FIGURE 5-11 The Cleveland Clinic Procedural Sedation Record: Nursing Assessment Page. (Courtesy Cleveland Clinic, Cleveland, Ohio.)

Cleveland Clinic

PROCEDURAL SEDATION RECORD

Page 3 of 4

For scanning accuracy, affix patient label within this outlined box.

Vital Signs

*****Airway Manipulation:** Intervention required to assist in maintaining adequate airway: CL=chin lift, JT=jaw thrust, OA=oral airway, NA=nasal airway, MV=mask ventilation, LMA=laryngeal mask airway, ETT=endotracheal tube

****Modified Ramsay Score** LOC 1=Anxious, 2=Awake, tranquil, 3=Drowsy, responds easily to verbal commands, 4=Asleep, brisk response to tactile or loud auditory stimulus, 5=Asleep, minimal but purposeful response to painful or loud auditory stimulus, 6=Asleep, no response even to painful stimuli (pure reflex)

Pain Key
Pain Level: 0=None, 10=Extreme
Pain Quality: Type: Cramping (CR) Burning (B) Aching (A) Throbbing (T) Dull (D) Sharp Consistency: Intermittent (I) Consistent (C)

TIME	BP	P	R	O_2 SAT	Airway Manip.	LOC	PAIN LEVEL	PAIN QUALITY	MEDS/O_2	NOTES	INITIALS
									Immediate Pre-Sedation Vital Signs		

POCT Stickers

Sign Out Discussion ❑ Completed Initials: ________

Brief Post Procedural Note

List Proceduralist and assistants: ________________

❑ **Please check if Brief Post Procedural Note is in EPIC, if not complete below.**

Pre-Procedural Diagnosis: ________________ Post-Procedural Diagnosis: ________________

Procedure performed if different from the planned procedure: ________________

Findings: ________________

____

No specimens collected unless noted here: ________________

Discharge / Transfer when discharge assessment criteria are met. Estimated Blood Loss if greater than minimal: ________

Physician / Licensed Independent Practitioner Signature: ________________
(For Procedural/Medication Orders)

Print Name: ________________ Date: ________ Time: ________

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FIGURE 5-11, cont'd

TABLE 5-11 COMMON RESTRAINING DEVICES

RESTRAINT TYPE	DESCRIPTION
Soft wrist restraints	Constructed from padded foam with Velcro or tie straps. Typically applied around the wrist and tied to the bed frame. Prevents the patient from pulling at items on the upper torso or near the face.
Soft mitts	Constructed from a padded foam material with mesh. Slipped over the hand so the palm rests on a pillow foam. Allows the patient full range of motion with the upper extremities but does not allow a grasping motion with the fingers. Ideal for patients who are "picking" at items such as dressings, intravenous infusion sites, or feeding tubes.
Elbow immobilizer	Large plastic sheath that is soft but does not have any flexion. Slipped over the forearm and placed over the elbow joint. Allows full range of motion at the shoulder and wrist but does not allow the elbow to bend. The patient cannot bring the forearm towards the head. Works well for patients who are attempting to remove an endotracheal tube.
Vest	Made from a Teflon mesh material with straps that can be tied. Typically worn around the upper torso and can be tied to a bed frame or a chair. Keeps the patient bound to the bed or chair. Full range of motion in the lower extremities is possible. Ideal for patients who are sitting in chairs. Prevents the patient from standing unassisted.

GERIATRIC CONSIDERATIONS

Strategies for Managing Pain and Anxiety

- Speak slowly and clearly.
- Verify any underlying cognitive deficits (e.g., dementia, Alzheimer's disease, cerebrovascular accident).
- Ensure that scales or other assessment tools have a large font/text.
- Stoic behavior may be the patient's normal baseline; therefore, assess for nonverbal cues to pain (facial grimace or withdrawal).
- Observe for changes in behavior, such as confusion or agitation. Elderly patients are at risk of developing delirium.
- Elderly patients may be resistant to taking additional medications; therefore, offer nonpharmacological strategies to manage anxiety or pain.
- Elderly patients may not ask for as-needed medications in a timely fashion. Pain medications should be routinely scheduled.
- Medication dosages may be reduced because of decreased renal and liver clearance.
- Certain medications may have paradoxical effects in the elderly (e.g., benzodiazepines causing agitation).

cognitive and sensory deficits. Elderly patients are also more vulnerable to alcohol abuse and substance abuse, and they may be more vulnerable to toxicity from analgesics. Elderly patients often have decreased renal function with a reduced creatinine clearance rate, resulting in a longer elimination half-life of analgesic drugs.

Older patients generally receive less analgesia or sedation compared with younger adults, perhaps because of elderly patients' beliefs about their pain and anxiety. Some elderly patients believe that pain is a normal process of aging and is something that they must learn to accept as normal. Elderly patients often believe that complaining of pain to nursing staff will label them as "problem" patients. Finally, elderly patients may comment to their family and friends that the nurse is too busy to listen to their complaints, and they do not want to be a "bother." Refer to the box titled "Geriatric Considerations" for strategies to manage pain and anxiety in the elderly patient.

CASE STUDY

Mr. B. is a 52-year-old man in the surgical intensive care unit after liver transplantation the previous day. He has a 15-year history of hepatic cirrhosis secondary to alcohol abuse. He is intubated and is receiving multiple vasopressor medications for hypotension. At 6:30 AM, he follows simple commands and denies pain or anxiety with simple head nods. At 7:00 AM, Mr. B. is kicking his legs and places his arms outside the side rails. Attempts by the nurse to reorient him result in his pulling at his endotracheal tube. His wrists are restrained with soft restraints. At this time, he does not follow any simple commands. He continually shakes his head back and forth. Facial grimacing is noted, and he is biting down on the endotracheal tube, which is causing the ventilator to sound the high-pressure alarm. His blood pressure is 185/110 mm Hg, with a mean arterial pressure of 135 mm Hg. The monitor displays sinus tachycardia at a rate of 140 beats per minute. Medication infusions include epinephrine (3 mcg/min), norepinephrine (15 mcg/min), dopamine (2 mcg/kg/min), and fentanyl (100 mcg/hr). His only other medications are his immunosuppressive drug regimen.

Questions

1. Score Mr. B.'s pain and/or anxiety using the objective tools listed below:

TOOL	SCORE
Behavioral Pain Scale (BPS):	_____
Critical-Care Pain Observation Tool (CPOT):	_____
Richmond Agitation Sedation Scale (RASS):	_____
Ramsay Sedation Scale (RSS):	_____
Sedation-Agitation Scale (SAS):	_____
The Confusion Assessment Method for the Intensive Care Unit (CAM-ICU)	_____

2. Would complementary or alternative medicine therapies be appropriate at this time? If not, what therapies would be appropriate?
3. What type of medication is Mr. B. receiving for pain?
4. Is this an appropriate dose of pain medication for Mr. B.?
5. What other medications could be given to manage his agitated state?

SUMMARY

Patients admitted to the critical care unit are at an increased risk of developing pain and anxiety. The critical care environment and medical interventions may be the greatest contributing factors in the development of pain and anxiety. The assessment of both is a challenge for the critical care nurse because patients may not be able to communicate. The use of assessment tools designed to recognize pain and anxiety is helpful. Nonpharmacological and pharmacological strategies to relieve pain and anxiety should be used so that critical care patients have the best possible outcomes.

CRITICAL THINKING EXERCISES

1. Describe factors that increase the risk for pain and anxiety in critically ill patients.
2. Differentiate between subjective and objective tools when assessing pain, and provide examples of each.
3. What is delirium? What are some of the behaviors seen in the hyperacute subtype?

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