

Management of Pain and Agitation in Trauma



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KEYWORDS

- Trauma • Polytrauma • Analgesia • Sedation • Agitation • Procedural sedation
- Pain

KEY POINTS

- Non-pharmacologic measures to improve pain management in polytrauma include clearing the cervical spine and splinting fractures as early as feasible.
- Agitated polytrauma patients who demonstrate critical resuscitative urgency or severe agitation are best managed with dissociative-dose ketamine, administered at the outset of care by the intramuscular route.
- Dissociated patients may be managed with vigilant procedure sedation-level monitoring and airway readiness and allowed to emerge from dissociation after initial resuscitative maneuvers, or if strong indications for intubation are present, paralyzed and intubated once control has been established and preparations made for intubation.
- Non-critical agitated polytrauma patients should be treated for pain and then a titratable sedative such as midazolam or droperidol, based on the cause of agitation.
- Polytrauma patients requiring procedural sedation to facilitate painful procedures should be evaluated for appropriateness of emergency department (ED)-based PSA based on anesthetic risk and procedural urgency, and carried out with continuous attention to ventilation. When hypoventilation is detected, it is treated according to a measured, stepwise approach.

INTRODUCTION: I DO NOT HEAR BREATH SOUNDS ON THE RIGHT

A trauma team has assembled in the trauma bay after notification that a man in his 20s is en route with basic life support (BLS) medics and police after having been assaulted with a baseball bat and a knife. The patient arrives being held down screaming *I need something for pain! Get off me and get me something for pain!* The team leader cannot yet see the patient, who is surrounded by personnel trying to move him to the ED stretcher but can hear that at least the airway is intact. The clinician at the head of the bed attempts to engage the patient verbally without success so commences the primary survey, announcing *multiple contusions to the right side of the head and face. Pupils reactive bilaterally. Stab wound to the right flank. Good breath sounds*

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on the left. I do not hear breath sounds on the right. The patient is struggling against attempts to restrain him and loudly reminds the team that he is in pain. The nurse tells the team leader that he cannot get a line because the patient is too agitated. The monitor shows a heart rate (HR) of 140, BP 100/60, and an oxygen saturation of 87%.

This polytrauma patient is in pain, agitated, may soon require tube thoracostomy—an intensely painful procedure—and may have one or more life-threatening injuries needing prompt diagnosis and treatment. These life threats include a traumatic brain injury, which requires transfer and cooperation for computed tomographic (CT) imaging, and if traumatic brain injury (TBI) is identified, management may rely, in part, on an accurate neurological examination. Moreover, effective management of pain may forestall the urgent use of potentially dangerous sedatives, or, effective management of agitation may forestall the urgent use of potentially dangerous analgesics. However, it is uncertain, at the outset of care, which is the more urgent priority, how urgently the patient may require a painful life-saving procedure such as chest decompression, and whether endotracheal intubation (ETI)—which would simultaneously manage pain, agitation, and upcoming painful procedures—is safe, appropriate, or worth obscuring downstream neurological assessments.

Managing Pain in the Polytrauma Patient

The multiple injured patient often arrives in severe pain that is routinely undertreated in many centers. Because the initial focus of protocolized trauma care is accomplishing a set of specific assessments and maneuvers that does not include addressing pain or distress, symptom control is subordinated to a secondary priority. It may be appropriate in patients with serious injuries for trauma teams to proceed down an algorithmic series of steps designed to rapidly diagnose and treat immediate life threats; however, undertreated pain is itself a threat, as dangerous injuries are more difficult to diagnose in the patient distracted and agitated by severe pain. Clinicians may be reluctant to provide effective analgesia in the undifferentiated or hypotensive trauma patient for concerns around the potential for opioids to worsen hemodynamic status. However, poorly managed traumatic pain is also associated with a variety of downstream harms including chronic pain, posttraumatic stress disorder, and longer intensive care unit (ICU) and hospital stays. Most importantly, failure to treat pain promptly and effectively, especially severe pain as is often caused by trauma, is a failure to attend to a core mission of medicine, the relief of suffering. It is therefore essential that clinicians who care for injured patients have an analgesic strategy that is safe and effective for patients across the spectrum of trauma severity.

Early intubation of the polytrauma patient in severe pain who is clearly headed for the operating room accomplishes a variety of goals simultaneously: in addition to securing the airway, the properly induced and intubated patient is unconscious and therefore free of pain and emotional distress, still to facilitate imaging, and easily anesthetized for painful procedures or surgery, if indicated. It is therefore appropriate, compassionate care to intubate patients with intractable pain from, for example, traumatic amputation, or multiple severe orthopedic injuries, during the initial phase of management, once the team is cognitively and materially ready, and the procedure can be performed safely. Ketamine is usually the appropriate induction agent when rapid sequence intubation (RSI) is performed in trauma because it offers a variety of advantages over alternatives, including potent analgesia. In patients who do not have clear indications for intubation such as critical compromise of airway or breathing, and who do not have definitively operative findings, the decision to intubate in trauma is based on a nuanced evaluation of benefits, harms, and timing, as discussed below.

Many nonpharmacologic measures can greatly improve the analgesic management of injured patients (**Box 1**). Backboards are for extrication and transport and should be removed on arrival. Cervical spine immobilization collars offer questionable benefit and are associated with a variety of harms,¹ including significant discomfort. Immediate removal when their prehospital placement was not indicated (eg, in penetrating trauma) or clinical clearance using a validated decision tool should be performed as early as feasible, and in stable patients who do not meet such criteria, clearance based on imaging should be a high priority. Unsplinted fractures can cause severe pain that is often ameliorated by immobilization. Painful procedures such as nasogastric tube and foley catheter insertion are appropriately no longer part of a standard trauma assessment; however, in many centers the rectal examination is still routine. This painful and humiliating practice should only be performed for specific, limited indications such as a concern for penetrating rectal injury. Logrolling is of limited value and can be very painful and even dangerous; this maneuver should often be deferred or limited to a quick visual inspection, especially in patients who will receive whole-body CT.²⁻⁴ If a painful procedure is indicated in an awake patient, the clinician should explain the procedure, set expectations, and describe steps to be taken to minimize pain. This preprocedural briefing alleviates anxiety, which strongly contributes to pain and distress.

Most injured patients in pain are stable and without concern for an immediate life threat. The major barrier to timely and effective analgesia in stable trauma patients is clinician inattention or deprioritization. Using departmental pain management protocols, incorporating pain medications into trauma order sets and including pain control in trauma checklists nudges providers to consider the treatment of pain at the outset of care. Although pain scales are often incorporated into nursing assessments, the optimal method for determining if a patient will benefit from being treated with a pain medication is to ask the patient if they wish to be treated with a pain medication.

Most polytrauma patients who are not hemodynamically compromised but are in moderate or severe pain should be treated with a parenteral opioid as first-line therapy. Morphine has slightly longer time to onset compared with fentanyl; however, its much longer duration of action confers a significant advantage, especially in a busy ED where timely pain reassessment is difficult and redosing may be delayed. Nonelderly, nonfrail, normally perfused adults should be treated with an initial dose of morphine at 0.1 to 0.15 mg/kg by the intravenous, intramuscular, or subcutaneous route. If vascular access is delayed in a patient in severe pain, it is appropriate to administer the initial dose intramuscular (IM) or subcutaneous (SC). Further doses should be administered at 0.1 mg/kg as needed. Fentanyl is frequently used in trauma

Box 1**Nonpharmacologic approaches to pain in trauma**

Remove backboard as early as feasible

Remove cervical spine collar clinically or as soon as imaging allows

Splint/immobilize fractures

Only perform painful procedures/maneuvers such as rectal examination, nasogastric tube, foley catheter, and log roll when specifically indicated, not routinely

Utilize smallest chest drainage catheters possible

Preprocedural patient briefing

and is an excellent analgesic option if the patient will be frequently reassessed for pain. Fentanyl is administered at 1 to 1.5 mcg/kg IV and may also be delivered by intranasal atomizer at 2 mcg/kg.

Analgesic-dose ketamine is safe and very effective for pain; however, the use of ketamine in subdissociative doses is burdened by psychoperceptual effects that are usually perceived as odd or even enjoyable but sometimes as uncomfortable or frightening. The incidence of bothersome psychoperceptual effects is diminished by slowing its distribution to the brain⁵; this is most commonly done by administering ketamine over 10 to 30 minutes using an intravenous drip such as 0.25 mg/kg IV over 20 minutes. Ketamine may also be effectively delivered intranasally at 0.75 to 1 mg/kg,⁶ or via nebulization (ideally with a breath-actuated nebulizer) at 0.75 to 1.5 mg/kg.^{7,8} The window between effective analgesia and intrusive psychoperceptual effects is in some patients very narrow but is likely widened by calming medications such as benzodiazepines, butyrophenone antipsychotics, or opioids; for this reason, ketamine is in most circumstances best used as a second-line agent for opioid-refractory pain.

Nitrous oxide (N₂O) is a volatile anesthetic gas administered in combination with oxygen via inhalation as an analgesic, anxiolytic, and sedative. N₂O can be self-administered using a demand-valve scavenger system, which allows for rapid, effective relief of pain and anxiety, both of which are common in injured patients.⁹ N₂O has a long record of safety and has few adverse effects; however, it may not be used until pneumothorax has been excluded and its contraindications also include first or second trimester pregnancy.¹⁰ Although N₂O requires specialized equipment that limits its availability in emergency settings, it is an excellent analgesic modality for patients in moderate-to-severe pain who are able to use one hand for self-administration.¹¹

With the increase of point-of-care ultrasound, regional anesthesia performed by emergency clinicians has emerged as a powerful technique that is often highly effective for relieving traumatic pain of any severity. When bupivacaine or (preferably) ropivacaine is used, nerve blocks provide long-lasting analgesia without exposing the patient to the harms of systemic analgesics. Although most often used to treat extremity pain, several truncal blocks are available to treat pain from thoracic injuries; the serratus anterior plane block effectively relieves pain from rib fractures, which can interfere with breathing and are particularly dangerous in the elderly, who are also more likely to be harmed by opioids.

Trauma patients in shock present an analgesic challenge. For patients in profound or refractory shock, poorly perfused with systolic blood pressure less than 70, all efforts must be focused on identifying and treating the cause of shock. Any potent analgesic will act as a sympatholytic in this context and could worsen hemodynamics; therefore, treatment of pain is appropriately deferred until central perfusion is restored. Fortunately, these patients usually have a diminished level of consciousness and diminished memory of their resuscitation. However, when perfusion and mental status are improved, prompt assessment and treatment of pain returns to high priority.

In between stable injured patients and decompensated polytrauma patients in shock are patients who are bleeding with the potential to deteriorate but who are centrally perfused, with good mentation. These patients may be most at risk for undertreatment of pain as resuscitation is ongoing but the level of consciousness and potential to suffer with pain is preserved. For tenuous but mentating patients, fentanyl is preferred over morphine for its relative hemodynamic neutrality. The dose is reduced to 0.5 mcg/kg IV, which can be repeated every 10 to 15 minutes as needed for pain, as perfusion status allows. Analgesic-dose ketamine is well-supported by prehospital and military experience,^{12,13} at a slightly reduced dose versus stable patients.

Finally, many stable polytrauma patients have prolonged stays in the emergency department, which may hinder appropriate reassessment (by both physicians and nurses) and redosing of pain medications. Patient-controlled anesthesia drips of morphine, fentanyl, hydromorphone, or ketamine provide highly effective, long-lasting relief of pain, are empowering to patients, and liberate nursing resources. Analgesia strategy in polytrauma is summarized in **Fig. 1**.

Managing Agitation in the Polytrauma Patient

Polytrauma patients often arrive agitated or develop agitation during their initial assessment. Agitation may be the result of intoxication (which commonly accompanies trauma), pain, brain injury, malperfusion or hypoxia, psychiatric disease, delirium, or emotional distress related to being injured, and the circumstances that led to their injury, or how they are treated by medical providers. Apart from possibly being caused by a dangerous condition, agitation itself is a danger to the badly injured patient, by interfering with the identification and treatment of traumatic life threats.

The management of agitation at the outset of trauma care depends primarily on the severity of injury and the severity of agitation but also on the underlying cause of agitation as well as the nature and urgency of the indicated medical or surgical therapies. However, because determining the severity of injury and indicated therapies may be

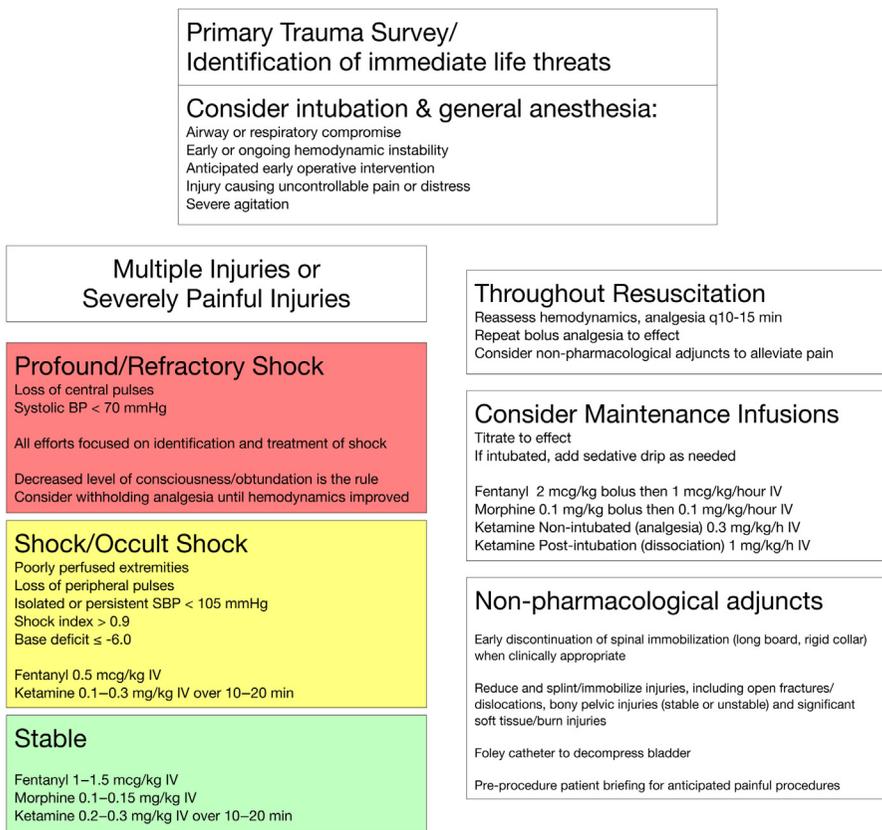


Fig. 1. Analgesia in polytrauma.

hindered by the patient's agitation, a complex interplay between agitation, pain, and resuscitative priorities can confound development of a therapeutic plan.

It is common practice in many centers to move quickly to ETI in agitated polytrauma patients, which allows the treating team to take immediate control of the patient and pivot to resuscitation. However, this strategy exposes patients who would not otherwise require ETI to its risks and may not allow for appropriate preparation and physiologic optimization before the procedure. The rise of ketamine as a treatment of agitation offers the capability to immediately calm and control the patient, without assuming the risks of RSI or the harms of ETI.

Ketamine was developed in the 1960s as an alternative to phencyclidine to provide dissociative anesthesia, where the patient is isolated from external stimuli and therefore perceives no pain. Although nystagmus and reflexive movements are common, the dissociated patient is incapable of volitional action and is generally still. However, unlike with conventional sedatives and anesthetics, airway reflexes and cardiorespiratory function are usually preserved: the ketamine-dissociated patient is *awake but unconscious*. Because ketamine reliably produces dissociation with a wide therapeutic window when administered by either the intravenous or intramuscular route, it is of particular value in treating agitation that poses an immediate threat to either patient or provider, and has been extensively studied in the management of injured and agitated patients in emergency, prehospital, and military settings.^{14–16}

Trauma patients who present agitated but with no concern for a dangerous injury or medical condition can be managed similarly to the nontrauma agitated patient, with the caveat that the less assessable the patient by history and physical examination, the more likely that patient has an occult injury, concealed from recognition by their altered mentation.

Many agitated polytrauma patients either have evidence of a dangerous injury or their presentation indicates the prompt exclusion of such injuries by expeditious evaluation and imaging, which requires a cooperative or still patient. The initial management of the agitated polytrauma patient is summarized in [Fig. 2](#). The injured patient with evidence of an immediate life threat, such as a penetrating chest wound with hypoxia and hypotension, whose agitation obstructs assessment and treatment, requires immediate calming and control. Additionally, patients without signs of critical resuscitative urgency may be sufficiently agitated that immediate danger to self or staff arises from the behavioral disturbance itself. Agitation hindering treatment of an immediate life threat and agitation that is uncontrollably violent both represent *dangerously severe agitation*.

The management of dangerously severe agitation begins by assembling adequate force to safely subdue the patient, which is one person for each limb and one for the head, which does not include the clinical team leader or the nurse administering medications. Face mask oxygen covering the mouth and nose is then applied to the patient, with the strings tightened so that the mask is closely affixed to the face. Early use of face mask oxygen empirically treats hypoxia, a critical cause of agitation, as well as controlling spit. The clinician should deliberately identify and relieve dangerous restraint holds such as compression of the neck or chest/back. Unless the patient has an intravenous line that is known to be functional, dangerously severe agitation should be treated with medications delivered intramuscularly, through the clothes unless an appropriate injection site is already exposed. Attempting IV access on a severely agitated patient is a needlestick risk and delays the onset of sedation, which is a critical pitfall in this context.

Although ketamine dissociation requires resuscitation-level monitoring and is more likely to result in intubation than conventional titratable sedatives, it is the treatment of

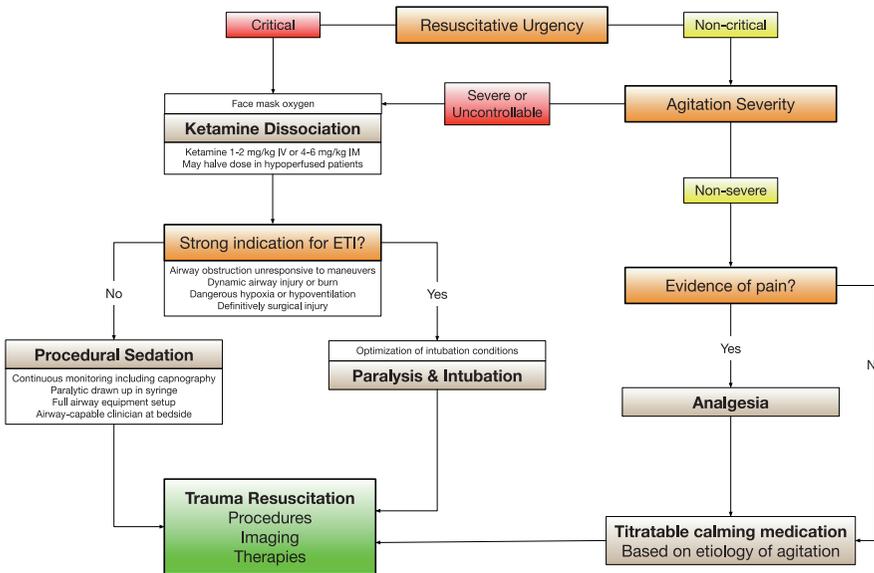


Fig. 2. Agitation management in the trauma patient.

choice for dangerously severe agitation because establishing immediate control of the patient is such an urgent priority. Although the use of dissociative-dose ketamine in nonintubated patients to facilitate painful procedures has an extensive record of safety,¹⁷ hypoventilation may occur from a variety of mechanisms including airway malpositioning, excess secretions, laryngospasm, and central apnea; all dissociated patients who are not intubated must therefore be managed as in procedural sedation with continuous cardiorespiratory monitoring including capnography, paralytic and full airway equipment setup at bedside, and an airway-capable clinician immediately available.

The standard dissociative dose of ketamine is 1 to 2 mg/kg IV or 4 to 6 mg/kg IM. Although existing data are conflicting,¹⁸ hypotensive patients may be at greater risk for adverse events when higher ketamine doses are used, and this risk must be weighed against the urgency of achieving a still patient to facilitate resuscitation. The effect of subdissociative ketamine is unpredictable; some patients will be calmed but others will require additional doses, introducing a potentially dangerous delay in their trauma assessment. It is reasonable to reduce the ketamine dose by up to half in hypoperfused patients; however, when the concern for critical injury is high, it is likely prudent to err toward a dose that will certainly dissociate the patient, so that needed tests and treatments can be expeditiously performed.

Once dissociation has calmed the dangerously agitated trauma patient, trauma resuscitation may commence in parallel with preparations to intubate, which include equipment readiness, optimization of the patient's physiology, and development of a team-based airway strategy. ETI should then be pursued if the patient demonstrates a strong intubation indication: airway obstruction not relieved by repositioning, suction, or simple airway adjuncts, dynamic airway injuries such as a penetrating wound to the neck or airway burns, dangerous hypoventilation or hypoxemia unresponsive to supplemental oxygen, definitively surgical injury such as bowel evisceration, or uncontrollably severe traumatic pain, as discussed above.

Absent a clear indication, intubation can be deferred in favor of procedural sedation monitoring including continuous capnography and readiness for airway management with paralytic and resuscitatorist clinician immediately available. Nonintubated dissociated patients may be taken for CT imaging provided that the capability to intubate (in the CT suite, if necessary) is continued. Additional doses of ketamine may be required to maintain dissociation and should be quickly available. Many agitated trauma patients managed initially with dissociative-dose ketamine, once imaging demonstrates no dangerous injuries, can be allowed to emerge from dissociation. A conventional sedative such as midazolam or droperidol/haloperidol may be required to manage further agitation or psychiatric distress that can occur on emergence.

Agitated polytrauma patients who do not demonstrate critical resuscitative urgency or uncontrollable violence can be managed in a stepwise fashion that prioritizes sedation safety over speed and efficacy. Pain often drives or contributes to agitation in this group, and analgesia should be a high treatment priority as described above. Morphine, fentanyl, and analgesic-dose ketamine effectively treat pain and may have a salutary effect on agitation apart from their analgesic effect. N₂O is an excellent treatment of the moderately agitated trauma patient in pain, owing to its complementary sedating and anxiolysis effects.

Many agitated trauma patients will require treatment with calming medications after appropriate analgesia. The commonly used agitation cocktail, haloperidol 5 mg and lorazepam 2 mg, combined in the same syringe and injected intramuscularly, is very safe, and will be effective in most patients, eventually. However, sedation after “5 and 2” often takes 15 to 20 minutes, because haloperidol is relatively slow-acting, and lorazepam is erratically absorbed intramuscularly. Droperidol and midazolam are modestly more effective than haloperidol and lorazepam, but significantly faster, with a similar safety profile, and are therefore preferred.

Droperidol has been repeatedly demonstrated to be safe and effective in the management of agitation and because it is associated with less respiratory depression than benzodiazepines and is particularly well suited to manage agitation associated with alcohol intoxication, which commonly complicates trauma presentations. The use of droperidol has been curtailed by concerns around QT prolongation; however, these concerns have been allayed by large case series demonstrating a very high degree of safety,^{19–21} and The American College of Emergency Physicians recommends that clinicians use droperidol at 5 to 10 mg intramuscular (IM) or intravenous (IV) “given studied doses up to 20 mg, regardless of initial monitoring capability or electrocardiogram (EKG).”²² Antipsychotics are the preferred treatment of agitation thought to be due to psychiatric disease, medical delirium, or dementia. Haloperidol or olanzapine may be substituted for droperidol, with dose increased by ~50%.

Midazolam is far more reliably effective when given intramuscularly than alternatives and is therefore the IM benzodiazepine of choice for any indication. The dose of IM midazolam when used as monotherapy in the treatment of agitation is 2 to 10 mg; however, doses greater than 2 mg and especially 5 mg or greater can cause respiratory depression, especially in the presence of other risk factors for respiratory depression such as alcohol intoxication, obesity, or obstructive sleep apnea. Midazolam should be used cautiously by the intravenous route, at half the IM dose, with close attention to respiration; lorazepam 1 to 2 mg IV is an appropriate substitute for midazolam when the patient has intravenous access. Benzodiazepines are the first-line treatment of agitation thought to be due to alcohol (or benzodiazepine) withdrawal or stimulant toxicity.

A combination of droperidol and midazolam will provide safe, effective, rapid sedation of nearly all agitated patients. For undifferentiated agitation, excellent results will

usually be achieved with 5 to 10 mg droperidol, depending on patient size and degree of agitation, mixed with 2 to 5 mg midazolam. It is common at many centers to add 25 to 50 mg diphenhydramine to sedation cocktails; however, this does not improve efficacy and is associated with significantly increased the length of stay, oxygen desaturation, and use of physical restraints.²³ An antimuscarinic should be administered when indicated for extrapyramidal symptoms but not added routinely to calming medications. The treatment of nonsevere agitation is summarized in **Fig. 3**.

Procedural Sedation in the Polytrauma Patient

Procedural sedation and analgesia (PSA) is the use of drugs delivered systemically to facilitate procedures that are painful and/or anxiety provoking. PSA occurs on the spectrum of analgesia and agitation management but is distinguished from the more routine use of analgesic and calming agents by the higher risk of cardiorespiratory compromise, which mandates continuous resuscitation-level monitoring and readiness for airway management. PSA is being performed when, in a nonintubated patient, benzodiazepines and opioids are used in combination in sufficient doses to depress level of consciousness, when ketamine is used in dissociative dose (≥ 1 mg/kg IV or ≥ 4 mg/kg IM), or when propofol or etomidate is used in any dose. PSA is routinely used in polytrauma to facilitate fracture reduction, tube thoracostomy, and wound or burn management. PSA may also be performed to enable rapid assessment and imaging in the agitated patient, as described above.

PSA entails important risks, especially in a seriously injured patient, and a crucial step in the performance of PSA is an explicit consideration of the appropriateness of ED-based PSA for a given patient. A checklist is recommended to prompt clinicians to this concern, as well as for decision support around the elements of PSA preparation and execution. The less cardiorespiratory reserve, the more difficult airway features, and the less procedural urgency, the more likely the patient should not receive PSA in the emergency department; other options include regional or local anesthetic, PSA or general anesthesia in the operating room, or ETI in the ED. Because many polytrauma patients will require surgery early in their care, for patients with risk factors for PSA adverse events, strong consideration should be given to either ETI or deferral of the procedure until theater.

Once a preprocedural assessment has confirmed that the patient is an appropriate candidate for ED-based PSA, the PSA medication is chosen based on the

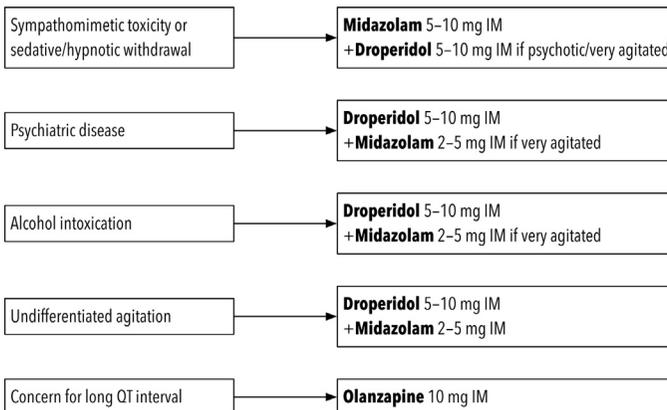


Fig. 3. Treatment of nonsevere agitation in trauma.

characteristics of the patient, procedure, and setting (Table 1). Brief procedures that require muscle relaxation, such as joint reduction, are often best managed with propofol. Although propofol can cause a drop in blood pressure as a sympatholytic and vasodilator, hypotension in the trauma patient should be assumed to be due to hemorrhage or circulatory obstruction unless these dangerous causes have been confidently excluded. Ketamine PSA is preferred for longer procedures such as fracture reduction or chest drainage. When dissociative-dose ketamine is used for PSA, rigidity, concerning hypertension, and emergence psychiatric distress can be treated with small aliquots of propofol or midazolam.

Oxygenation should be maximized before and during PSA with a nasal cannula underneath a high-flow oxygen face mask. Optimal oxygenation prolongs safe apnea time, allowing a measured, safe response to hypoventilation, as described below.

Although blood pressure and circulation remain a focus of care during PSA in the polytrauma patient, procedural sedation is most likely to cause harm by hypoventilation. Once PSA induction has occurred, ventilation should be continuously monitored by a member of the team who is not performing the procedure being facilitated. When hypoventilation occurs, the response should not be assertive bag-mask ventilation, which introduces the risk of stomach insufflation and dangerous regurgitation, especially when performed hastily. The management of PSA-induced hypoventilation should proceed deliberately down a series of steps, as slowly and cautiously as patient physiology allows (Box 2). Procedural sedation concludes when the patient responds to questions and maintains a normal oxygen saturation on room air. For

Agent	Dose	Comments
Propofol	0.5–1 mg/kg IV, then 0.5 mg/kg q1–2 min prn	Preferred for shorter procedures and where muscle relaxation is of benefit; avoid if hypotension is a concern. Egg and soy allergy <i>not</i> a contraindication
Ketamine	1–2 mg/kg IV over 30–60 sec or 4–5 mg/kg IM, repeat half dose prn	Preferred for longer procedures; avoid if hypertension/tachycardia is a concern; have midazolam or propofol available to manage emergence distress; muscle tone is preserved or increased; postprocedure emesis may be mitigated by prophylactic ondansetron
Etomidate	0.1–0.15 mg/kg IV, then .05 mg/kg q2–3 min prn	Intraprocedure myoclonus or hypertonicity, as well as postprocedure emesis, are common
Fentanyl	1–2 mcg/kg IV, then 1 mcg/kg q3–5 min prn	Comparatively delayed onset of action; do not redose too quickly
Midazolam	.05 mg/kg IV, then .05 mg/kg q3–5 min prn	Comparatively delayed onset of action; do not redose too quickly
Naloxone	0.01–0.1 mg/kg IV or IM (typical adult dose 0.4 mg)	Will precipitate withdrawal in opioid-dependent patients
Flumazenil	0.01 mg/kg IV (typical adult dose 0.2 mg) over 20 s, max 1 mg	Only use in patients known to be benzodiazepine-naïve (eg, pediatrics)

Box 2**Procedural sedation and analgesia intervention sequence**

Detect hypoventilation early (capnography, chest rise, breath sounds, mask fogging)
Position the patient (torso upright, head and neck well aligned with chin lift)
Jaw thrust
Suction if secretions present
Laryngospasm notch pressure: bilateral, firm pressure medially and cephalad (up and in)
Nasal airways
Consider reversal agents if opioids or benzodiazepines have been used
Bag mask ventilation or, if deeply unconscious, laryngeal mask ventilation
Endotracheal intubation

polytrauma patients who may have underlying insults to oxygenation or circulation and may have received psychotropic medications that interfere with assessment of mental status, a longer period of PSA-level monitoring may be required to verify postprocedural safety.

SUMMARY: CASE RESOLUTION

Polytrauma patients usually require analgesia, commonly require medications to treat agitation, and often require procedural sedation to facilitate painful procedures. The introductory case describes a young man arriving very agitated, screaming in pain after being assaulted with blunt and penetrating force, and the initial assessment raises concern for several life-threatening injuries including tension pneumothorax. This patient must be calmed promptly so that resuscitation can occur, including the immediate need to establish vascular access and likely to decompress the chest. Conventional management might call for RSI and intubation; however, the patient has no intravenous line for medication administration and transitioning to positive pressure ventilation with an untreated pneumothorax could precipitate cardiovascular collapse. Alternatively, the patient might be treated with “5 and 2,” intramuscular haloperidol and lorazepam, which is likely insufficient dosing to calm the patient and will take much longer than desired, given the acuity of illness. Instead, 5 team members are deployed to hold down the patient while the team leader applies face mask oxygen, and the nurse administers 400 mg of intramuscular ketamine. Two minutes later, nystagmus is noted and the patient is still. As intravenous vascular access is established, ultrasound confirms right-sided pneumothorax, and a finger thoracostomy is performed to a rush of air and improvement of vital signs. The primary survey is completed as a chest tube is placed, and the team leader requests preparations for intubation, although for now the plan is procedural sedation. The patient is placed on a transport monitor with continuous capnography and taken to CT with airway equipment and medications, accompanied by the airway physician. CT shows a well-placed chest tube with resolution of pneumothorax, a small traumatic subarachnoid hemorrhage, and low-grade splenic laceration. Twenty minutes later, the patient starts to emerge from dissociation with mild agitation but calms with 8 mg IV morphine and 2.5 mg IV droperidol. One hour later, he is cooperative and answering questions. He is admitted to surgical intensive care unit (SICU) on a morphine patient-controlled analgesia (PCA) pump and discharged 3 days later in good condition.

CLINICS CARE POINTS

- Incorporate analgesia into departmental trauma order sets and checklists to nudge clinicians to provide early, effective analgesia.
- Regional nerve blocks, analgesic-dose ketamine and nitrous oxide are complementary modalities that can be used very effectively in injured patients.
- The use of dissociative-dose ketamine at the outset of management of polytrauma patients who are either uncontrollably violent, or are likely to have an immediately dangerous condition, can preclude the need for intubation.

DISCLOSURE

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