Patients who have sustained traumatic injury are often hemodynamically unstable, and frequently require emergency tracheal intubation to protect their airway and for induction of general anesthesia. The Advanced Trauma Life Support Guidelines of the American College of Surgeons recommend the use of etomidate under these circumstances for rapid sequence induction and intubation (RSI) of the trachea.¹ We believe however, that for many reasons ketamine has many desirable pharmacodynamic properties that make it a reliable alternative to etomidate, and should be considered when a traumatically injured patient requires emergency intubation.

An ideal induction agent (see Figure 1) should have: rapid onset, short duration of action, similar dosing in the setting of organ dysfunction, minimal impact on hemodynamic stability, inhibit sympathetic outflow, minimal abuse potential.² Ketamine has many of these properties and therefore, should be considered to manage patients who are traumatically injured because they're often hypovolemic, anemic, have poor organ perfusion, and may have a significant inflammatory response.²
Is ketamine preferable for induction of anesthesia in trauma patients?

The ability of etomidate to maintain hemodynamic stability during RSI is well-documented. Equally well described is the adrenal suppression that results from etomidate's inhibition of 11β-hydroxylase. In a prospective, randomized, controlled trial, Jabre et al confirmed that a single bolus dose of etomidate was enough to cause adrenal suppression, even though there was no increase in morbidity or mortality compared to controls. A continuous infusion of etomidate, however, was correlated in this study with an increase in mortality.

In comparison, racemic ketamine has rapid blood–brain equilibration leading to optimal conditions for intubation in 45 seconds when administering 1.5 mg/kg. Additionally the sympathomimetic effects on the autonomic nervous system act to increase heart rate, blood pressure and cardiac output in patients with an intact autonomic nervous system. Due to the drug's large therapeutic window, dose adjustment for organ dysfunction is not needed.

Of equal importance, a single bolus of ketamine has been shown to be equivalent to etomidate for achieving optimal intubating conditions with no difference in terms of 30-day mortality in patients who are traumatically injured. While some have argued against the use of ketamine in patients with increased intracranial pressure (ICP), the effects of ketamine on ICP are controversial. Bar-Joseph et al. demonstrated that a bolus of ketamine decreased ICP. In addition, when

**Figure 1. Ideal Drug Characteristics**
considering cerebral perfusion, in hypovolemic patients who have sustained traumatic brain injury, the increase in blood flow to the brain may be desirable.\textsuperscript{5}

Following intubation of the trachea ketamine can be continued as an infusion, which is not an option for etomidate because of the associated adrenal suppression and increased morbidity and mortality associated with etomidate infusions in critically ill patients. The benefits to an infusion of ketamine are its anxiolytic and analgesic properties. It is an NMDA antagonist, which acts centrally to suppress the sensory cortex, limbic system, and thalamus.\textsuperscript{8} Infusions of fentanyl, midazolam, dexmedetomidine and propofol can also be administered to provide analgesia and sedation to trauma patients who are admitted to an ICU, but because many of these patients may be hemodynamically compromised, they are at risk for under treatment of pain due to concerns for hemodynamic instability (and because of potential respiratory depression for those being weaned from a ventilator).\textsuperscript{9,10} Inadequate pain control can have detrimental effects on the stress response from the over–exuberant release of catecholamines, as well as a resultant acute phase reactant activation that may impair coagulation and decrease the immune response.\textsuperscript{9}

Other benefits to the use of a continuous infusion of low–dose ketamine for sedation and analgesia is a decrease in the amount of opioids administered in the post–operative period.\textsuperscript{10} Furthermore, provided that the dose of ketamine is not excessive, less pain may result in less delirium.\textsuperscript{11} Continuous infusion of ketamine throughout the patient's emergency department, operating room and Intensive care unit stays may have the advantage of decreasing the incidence of depression\textsuperscript{12} and
PTSD (post-traumatic stress disorder)\textsuperscript{13} that many trauma patients develop during recovery.

The administration of ketamine for RSI followed by a low dose infusion of ketamine is efficacious and safe; has potential opioid-sparing and anti-depressant benefits; and may attenuate the incidence of PTSD associated with traumatic injury. This would be close to what would be considered an ideal hypnotic in the setting of the traumatically injured (see Figure 2). The administration of a bolus of ketamine for RSI followed by an infusion of ketamine may provide the best risk-benefit ratio of any of the currently available intravenous induction drugs.

**References**


