Our air medical service was dispatched to a scene response in a rural community, in which the helicopter landed at the site of the incident in order to assist prehospital personnel with their care. The patient was a male in his 20s who had fallen 20 feet from a ladder, landing on his feet. He had an obvious open right tibia/fibula fracture and a pulseless right foot, which was rotated 180 degrees posterior to anatomic position. We found the patient nearly prone, with prehospital personnel maintaining spinal immobilization. Even the slightest movement caused the patient significant pain. The patient's vital signs were all within normal limits and he had a Glasgow Coma Scale score (Table 2) of 15 upon initial evaluation. There were no primary survey issues.

Table 2. Glasgow Coma Scale Score

Eye opening	
Spontaneous	4
To speech	3
To pain	2
None	1
Best motor response	
Obeys commands	6
Localizes pain	5
Normal flexion (withdrawal)	4
Abnormal flexion (decorticate)	3
Extension (decerebrate)	2
None (flaccid)	1
Verbal response	
Oriented	5
Confused conversation	4
Inappropriate words	3
Incomprehensible sounds	2
None	1

From Teasdale G, Jennett B. Assessment of coma and impaired consciousness: a practical scale. *Lancet* 2(7872):81–4, 1974.

The decision was made to use etomidate to sedate this patient so that he could be log rolled onto the backboard and his fracture could be reduced. The patient was given 0.1 mg/kg of etomidate intravenously, and a non-rebreather oxygen mask was applied.

The patient was fully immobilized and the fracture was reduced, with return of a pulse in the right foot. The patient's vital signs remained the same throughout the procedure. The satisfaction with the level of sedation, tolerance, and recall of the procedure were determined to be excellent by the patient, flight physician, and flight nurse specialist. No side effects were noted.

We continue to enroll patients into our prospective, observational study in order to evaluate the use of etomidate in the air medical field for procedural sedation.

In summary, etomidate has great potential to become one of the most reliable and safe multipurpose agents in the air medical crew's formulary for treating critically ill patients. It has a well-documented safety record in rapid-sequence intubation, and we hope to show its salutary benefits for procedural sedation. As with any agent, there are potential risks associated with the use of etomidate for procedural sedation. These include oversedation, which can lead to hypoventilation and airway compromise, as well as nausea and vomiting, which can lead to aspiration. To minimize these risks, one must be prepared to establish a definitive airway and have a suctioning device and bag valve mask nearby.

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Etomidate for Anesthesia Induction in the Prehospital Setting

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Learning Objectives
1. To understand the pharmacology of etomidate in traumatized patients
2. To understand advantages and side effects of etomidate in trauma patients
3. To learn how etomidate should be applied in trauma patients

Etomidate is a sterile, nonpyrogenic solution containing 2 mg etomidate and 0.35 mg propylene glycol per milliliter. It is also available in Europe as an emulsion in soybean oil, glycerol, and purified egg phosphatide. It is used for induction of general anesthesia. The standard intravenous induction dose varies from 0.15 to 0.4 mg/kg. The duration of hypnosis varies from 5 to 15 minutes following a single induction dose. Etomidate is metabolized rapidly in the liver primarily by ester hydrolysis or by N-dealkylation. The primary

action of etomidate on the central nervous system is hypnosis without analgesia. Etomidate has a rapid onset of 30 to 60 seconds, equivalent to one arm–brain circulation time, and patients regain consciousness rapidly after a single dose. The properties of etomidate, an imidazole derivative, include minimal cardiovascular effects, minimal effects on ventilation, and lack of histamine release. A cerebral protective effect is observed as well.[1]

Case Report

A 65-year-old man was picking plums from a tree using a ladder. Suddenly, he felt dizzy, collapsed, and fell from the tree. He was initially unconscious but regained consciousness prior to the arrival of the mobile intensive care unit (MICU) staffed with an anesthesiologist as emergency physician (EP) and two paramedics. His symptoms included headache and chest pain; he had a fractured right arm.

When the MICU arrived at the scene, the patient was being treated by two emergency medical technicians from a first response unit with 5 L/min of oxygen by face mask; additionally, an intravenous line with saline infusion had been started. The patient's Glasgow Coma Scale score deteriorated from 11 points at the time of arrival of the MICU to 7 points. Physical examination revealed a right eye hematoma, bleeding from the right ear, and crepitation of the right hemithorax. The patient's blood pressure was 100/60 mm Hg, the pulse was 130 beats/min, and oxygen saturation was 92%.

After completion of the primary survey, and infusion of 500 ml saline and 500 ml hetastarch 6%, the EP decided to intubate and ventilate the patient because of the suspected severe chest injury. Midazolam (2 mg), fentanyl (0.15 mg), and vecuronium (2 mg) were given, and anesthesia was induced using a rapid-sequence technique with etomidate, 16 mg, and suxamethonium, 1.5 mg/kg. Throughout the anesthesia induction, blood pressure remained stable and heart rate decreased slightly to 120 beats/min. Anesthesia was maintained with titrated doses of fentanyl and midazolam, and neuromuscular relaxation was obtained by vecuronium. A chest tube was inserted into the right hemithorax, and the patient was transported to the hospital (Figure 1).

Figure 1. Patient at hospital admission.

Use of Etomidate in the Prehospital Setting

Because of its minimal effects on cardiovascular function and salutary effects on cerebral perfusion, etomidate is most appropriate for induction of anesthesia in patients with multiple trauma, shock, unstable cardiopulmonary status, and head injuries.[2] Etomidate is also of further benefit in elderly patients with coexisting cardiovascular or pulmonary diseases. In doses below 0.25 mg/kg, etomidate has little influence on hemodynamic parameters such as mean arterial pressure (MAP), heart rate, central venous and pulmonary artery pressures, stroke volume, cardiac index, and pulmonary and systemic vascular resistance.

In head-injured patients with raised intracranial pressure (ICP), etomidate reduces ICP while maintaining MAP. Cerebral perfusion pressure (CPP=MAP–ICP) is therefore well maintained or even increased. Furthermore, cerebral blood flow and cerebral metabolic rate for oxygen consumption are decreased. Cerebral vascular reactivity is maintained following administration of etomidate, and there is a beneficial net increase in the cerebral oxygen supply–demand ratio.[3]

The dose of etomidate needed to produce hypnosis varies, depending on the patient's age and physical status and on the administration of other anesthetic drugs. In general, patients in shock and geriatric patients require lower induction doses (e.g., 0.1 mg/kg), whereas the standard anesthesia induction dose ranges between 0.15 and 0.3 mg/kg. Athletic patients and children younger than 14 years of age may require higher doses. According to the package insert, the use of etomidate in children younger than 6 months or 6 years, depending on the manufacturer, is not recommended.[4–6]

Etomidate is associated with a high (10%–60%) incidence of myoclonic movements, especially of the masseter muscle.[7] For this reason, neuromuscular blocking agents or small doses of benzodiazepines, e.g., 2 mg of midazolam, with or without narcotics, are recommended to prevent such movements, as used in the present case.[8] Pain on injection is also frequently associated with etomidate. This can be reduced by the application of intravenous lidocaine, 20 to 40 mg, immediately prior to the injection of etomidate. Adverse effects of etomidate are summarized in Table 1.

Table 1. Adverse Effects of Etomidate

- Brief period of apnea, depending on dose
- Inhibition of 11-beta hydroxylation within the adrenal cortex
- Transient skeletal muscle movements
- Transient pain on IV injection (not with emulsified formulation)
- Increased incidence of nausea and vomiting
- Hiccups

Induction of general anesthesia with etomidate (or any other hypnotic drug) in the prehospital setting may place the patient at risk for pulmonary aspiration. We therefore routinely intubate the patient's trachea to protect the airway.[9,10] Because of the risk of prolonged suppression of endogenous adrenocortical function, repeated doses of etomidate for maintenance of general anesthesia are not recommenced.

Summary

Etomidate is an imidazole hypnotic agent characterized by a rapid onset of general anesthesia of short duration. In doses less than 0.25 mg/kg, etomidate has minimal effects on hemodynamic parameters, minimal respiratory depression, and very favorable effects on cerebral perfusion and the cerebral oxygen supply–demand ratio. For these reasons, etomidate is often the induction agent of choice in traumatized patients, especially those in shock, with unstable cardiopulmonary status, with multiple trauma, and/or with severe head injury, and in elderly patients with coexisting cardiovascular disease. Because of the risk of aspiration and apnea associated with induction of general anesthesia in the prehospital setting, a definitive airway is obtained routinely when administering etomidate, often aided by the use of neuromuscular relaxants.

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Perioperative Use of Etomidate for Trauma Patients

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Learning Objectives
1. To review the pharmacology of etomidate
2. To discuss the therapeutic uses of etomidate in the trauma patient

Case Presentation

A male driver of a motor vehicle is brought to the emergency department by air ambulance following an auto crash. The vehicle struck a tree head on, with the drive train being displaced into the passenger compartment. Witnesses stated that the driver was initially unconscious, regaining consciousness after several minutes, but was disoriented and uncooperative. The driver was wearing safety restraints and required 20 minutes for extrication.

In the emergency department, vital signs were a pulse of 110 beats per minute with a blood pressure of 100/80 mm Hg and a tissue oxygen saturation of 95%. The victim vocalizes and withdraws to painful stimuli, is uncooperative, opens his eyes randomly, and ventilates spontaneously. Examination reveals a fracture of the right tibia and fibula and a diagonal abrasion and contusion across the chest and abdomen. Chest film indicates two fractured ribs on the left and a widened mediastinum. Examination of the cervical spine is difficult due to lack of cooperation, and cervical spine films are inadequate to rule out cervical spine injury. Computerized tomography of the abdomen, cervical spine, and head are planned, followed by angiography of the thoracic aorta.

Comment

In view of the patient's neurologic status and inability to cooperate, elective intubation and general anesthesia will facilitate these procedures. Goals for induction of anesthesia for this patient include rapidly securing an airway to protect against aspiration and maintaining a stable blood pressure. This patient may be hypovolemic from hemorrhage and may

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