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Etomidate for Prehospital Emergency Anesthesia

John Schou, MD
County Hospitals
Lörrach, Germany
john@schou.de

Learning Objectives
1. To identify the indications for use of etomidate in the prehospital setting
2. To understand the prehospital conditions that constitute contraindications for the use of etomidate
3. To appreciate the advantages of etomidate administration for some patients during the prehospital phase of care

Induction of general anesthesia and tracheal intubation in emergency situations is hazardous. Compared with patients undergoing elective surgery, patients requiring prehospital emergency interventions are at high risk for aspiration of gastric contents into the lungs and hemodynamic instability, and many have unknown or undiagnosed diseases as well as unrecognized injuries. Moreover, on the front line we occasionally find less experienced anesthetists (or paramedics) with a higher risk of failed or false endotracheal intubation. The risk of an unrecognized esophageal intubation following administration of neuromuscular blocking agents has led some clinicians to suggest avoiding neuromuscular relaxants altogether for emergency tracheal intubation. Only a few pharmacologic or technical suggestions have been presented to ease this dilemma.[1]

Omission of anesthetic agents and/or neuromuscular relaxants can make tracheal intubation even more difficult, but complete avoidance of anesthetics for intubation cannot be recommended. Intubation is a potent noxious stimulus that can itself provoke vomiting, increase intracranial pressure (ICP), cause unfavorable hemodynamic responses, and cause utter discomfort to responsive patients. Moreover, strict avoidance of anesthetic drugs can make the intubation procedure technically impossible; therefore, anesthetic agents are invaluable in the prehospital setting. This discussion focuses on the author's use of hypnotic agents for prehospital emergency medicine (PHEM).

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Choice of Anesthetic Agent for PHEM

The choice of anesthetic agent depends on its pharmacologic profile; physicochemical characteristics; and effects on the cardiovascular, respiratory, central nervous, and other systems. Several serious adverse effects may be associated with the use of intravenous anesthetics, such as histamine release (barbiturates), negative inotropic effects (barbiturates, propofol), laryngospasm (ketamine, barbiturates), and respiratory depression (barbiturates, propofol). Etomidate, on the other hand, has many desirable properties for use in the prehospital setting: rapid onset of profound hypnosis of short duration, hemodynamic stability, minimal respiratory depression, and favorable cerebral effects. Unlike thiopental, which must first be dissolved in a liquid, etomidate is ready to use, a very important advantage in the field. For these reasons, etomidate has become the author's preferred anesthetic induction agent in PHEM, although ketamine is still used in certain circumstances.

Another important advantage of using etomidate as the preferred hypnotic in PHEM is the salutary effect of etomidate on upper airway reflexes in the absence of neuromuscular blockade (Table 1). However, it is extremely difficult to report on the effects of etomidate on the muscles of the pharynx, larynx, and trachea because these reflexes are extremely difficult to measure accurately. In addition, such measurements would not reflect the effect of the concomitant administration of other anesthetic agents and paralytics. Thus, the data listed in Table 1 must be interpreted with caution.[2]

Table 1. Impact of IV Induction Agents on Upper Airway Reflexes

	Pharynx	Larynx	Trachea	Respiration
Barbiturates, low-dose	Increased	Spasm	Increased	Depressed
Barbiturates, high-dose	Depressed	Depressed	Depressed	Apnea
Ketamine	Increased	Spasm	Depressed	None
Propofol	Depressed	Depressed	Depressed	Depressed
Etomidate	Depressed	Depressed	None	None

Spasm = tendency to laryngospasm.

Adverse Effects of Etomidate

The side effects of etomidate consist of convulsive-like muscle movements, myocloni, which can be effectively suppressed by premedication with an opioid or a benzodiazepine.[3,4] However, premedication may potentiate the effects of etomidate and result in other adverse effects, such as respiratory depression (fentanyl, midazolam), undesirable reflex depression (midazolam), and vomiting before consciousness is completely regained (nitrous oxide, fentanyl). In the author's experience, the combination of nalbuphine or pentazocine with etomidate effectively reduces the incidence of myocloni while simultaneously blocking pharyngeal reflexes and preserving spontaneous respiration. The combination of etomidate and nalbuphine is particularly desirable because these drugs provide sufficient hypnosis and analgesia to allow laryngoscopy and intubation without retching or vomiting. Pentazocine was abandoned from PHEM after serious cardiac and cerebral adverse effects were associated with its use.[5]

It is known that reduced cortisol synthesis may result from a single induction dose of etomidate, although the clinical relevance of this completely reversible cortisol synthesis inhibition is of doubtful significance.[6] Nonetheless, prolonged maintenance of anesthesia with etomidate cannot be advised because of the potential for prolonged adrenal suppression. Finally, etomidate in a propylene glycol solution is associated with venous injection pain and thrombophlebitis. In Europe, this problem has been eradicated with the introduction of a lipid solution.[7,8]

Anaesthesia in the Prehospital Setting

Three prehospital techniques were developed by the author[9] for 1) tracheal intubation, 2) continuation of anaesthesia after intubation until admission, and 3) short anaesthesia without intubation. These techniques require active participation of an anaesthetist at the scene of emergency, a precondition that is not met in many countries.

Tracheal Intubation in PHEM. The need for endotracheal intubation exists occasionally in the prehospital setting, and safe techniques for this purpose may widen its indications. A retrospective analysis (Table 2) of the author's prehospital intubations during a 12-year period reflects such a development. Among the initial 30 patients (group 1), intubated with thiopental, etomidate, ketamine or without anesthetic, the choice of hypnotic became evident. Eight patients did not receive any anesthetic because they were unconscious. Two of these eight, though unconscious, vomited during intubation

Table 2. Author's Choice of Anesthetic for Intubation*

Anesthetic	Group 1	Group 2	Group 3	Total	In Coma
Etomidate	13	107	78	198	120
Thiopental	8	0	0	8	7
Ketamine	1	1	0	2	0
None	8	10	1	19	14
Total	30	118	79	227	141

*From 227 consecutive prehospital emergencies. The three groups refer to different (successive) time phases over a 12-year period.
In Coma: Comatose patients among the total number.
Indications for tracheal intubation in the prehospital setting are shown in Table 3.

Table 3. Predominant and Additional Indications for Intubation

Indication	Primary	Secondary	Total
Coma	119	22	141
Respiratory failure	62	30	92
Multitrauma	16	39	55
Shock	22	48	70
Extreme pain*	8	–	8
Patients/indications	227	141	366

Patients sustaining trauma often had several indications for prehospital intubation.
*Excessive pain despite analgesic efforts was considered only when this was the primary indication for intubation.

Table 4. Long-Term Outcome of Patients Requiring Prehospital Tracheal Intubation

Type of Emergency	Survived	Died	Unknown	Total
Traffic crash	59	23	6	88
Occupational incident	9	5	3	17
Other incident	11	4	3	18
Disease	31	40	5	76
Suicide attempt	16	5	1	22
Other emergency	6	0	0	6
Total	132	77	18	227

Table 5. Anesthetic Agent, Route, and Technique of Tracheal Intubation

Agent	Blind Nasal	Nasal With Direct Laryngoscopy	Oral With Direct Laryngoscopy	Total
Etomidate	139	54	5	198
Thiopental	5	1	2	8
Ketamine	2	0	0	2
None	12	2	5	19
Total	158	57	12	227

attempts (the only patients with this complication in the whole study). Thiopental was soon abandoned for being not use-ready and for being dangerous in many emergencies. In all cases, intubation was carried out without relaxation and thus by maintained breathing. Ketamine, however, because of its stimulating impact on upper airway reflexes, proved unsuitable for intubation though it was useful as an adjunct afterward.

In the next phase of 118 patients (group 2), etomidate was used at a much higher frequency for intubation in the prehospital setting. The third group, including a later study of patients otherwise treated identically, was used to study the drugs used in the second technique.

It is a widespread misunderstanding that unconscious patients do not need further anesthesia. The use of etomidate in the vast majority of comatose patients is justified not only by facilitating the "mechanical" act of intubation but also for preventing its adverse effects, i.e., a secondary increase in intracranial pressure and vomiting. Thus, the drug was used to prevent what is greatly feared from anesthesia in emergency patients, even aspiration.

There were often multiple indications for tracheal intubation in the prehospital setting such as the common combination of trauma, shock, respiratory failure, and depressed level of consciousness (Table 3). Patients sustaining cardiac arrest were excluded since they did not receive any anesthetic agents for intubation. It should be noted that many patients in the study had been seriously injured, and the severity of injury was perhaps reflected by the prehospital and in-hospital mortality (Table 4). Seven trauma victims died at the scene after intubation, with no or only brief cardiopulmonary resuscitation (CPR). None of the patients in cardiogenic shock developed circulatory complications during intubation after etomidate anesthesia, thus confirming the relative safety of etomidate in hemodynamically unstable patients. Three of the survivors were disabled by severe neurologic damage and were released to long-term care facilities.

The route of intubation (Table 5) was predominantly nasotracheal (95%), but the technique was slightly altered during the 12 years of study. With the observation that gross pharyngeal manipulations were well tolerated, there was a tendency toward fewer blind intubations and more using direct laryngoscopy, with the tip of the laryngoscope utilized for indirect anteflexion of the epiglottis.

Maintainance of Anaesthesia After Intubation. With the patient intubated, the question arises as to how to maintain some state of anesthesia. Etomidate is not suitable for prolonged use under primitive conditions. Referring to the drugs used instead (nalbuphine supplemented by titrated midazolam), the author prefers another term, "analgosedation." Muscular relaxants were not used at all.

Short Anaesthesia Without Intubation. This technique resembles the first one, except for the tube. It is virtually identical to "procedural sedation,"[10] a misleading term that hides the risk of using hypnotics without a protected airway. Still, even in prehospital care, this risk must be balanced with the risks related to intubation itself, then for a brief procedure. Without assuming these risks to be eliminated, this ultrashort intravenous (IV) anesthetic technique can be used occasionally for setting fractures and dislocations.[11]

Case Report

A 67-year-old man complained of sudden and severe precordial chest pain, and an ambulance was called. The paramedics found the patient in cardiogenic shock but still awake, complaining of severe chest pain. The presence of an emergency physician (an anesthesiologist) at the scene was requested. When the physician arrived, the patient was barely arousable, blood pressure was not recordable, and ventilation was impaired by pulmonary edema. Etomidate, 20 mg IV, was injected and the patient's trachea was nasally intubated. Pulmonary edema resolved somewhat after positive-pressure ventilation, and the patient was admitted to the hospital with an infusion of dopamine. There he died only 2 hours later in persistent cardiogenic shock. However, he did not die from the intubation itself, nor from the preceding drug therapy. This case emphasizes that even patients in terminal shock can and should receive etomidate for endotracheal intubation. Despite the fact that we could not save his life, this man did experience some comfort from our mission.

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