Ketamine for military prehospital analgesia and sedation in combat casualties

Ross Moy,1 C Wright2

ABSTRACT
Ketamine is an effective drug for battlefield analgesia. Recent evidence suggests that it can be safely and effectively used by Level 6 Pre-Hospital Emergency Care (PHEC) practitioners. This article presents a review of the evidence, and outlines the future use of ketamine for provision of analgesia and sedation in combat casualties.

In prehospital medicine, the undertreatment of pain is a significant issue.1 The use of ketamine as a dissociative analgesic and sedative agent is well established in advanced pre-hospital medical practice.2–3 Its use forms part of the training programme for doctors in Pre-Hospital Emergency Medicine.4 It has found especial favour in military practice for producing less hypotension than other agents in hypovolaemic patients.5–6

When used by appropriately trained clinicians, it offers a safe and effective option for pre-hospital pain relief. Its intense analgesia and rapid onset make it particularly suitable to make procedures and extrications more tolerable for patients. In combination with other analgesic options available to prehospital clinicians, it has the potential to offer a significant improvement in battlefield pain relief.

HISTORICAL CONTEXT AND CAPABILITY GAP
The most common agent for combat analgesia in the last century was morphine, often administered via intramuscular injection.7 The recent introduction of the fentanyl lozenge has provided a more easily administered alternative. Opioids, however, retain the collective downside that they provide only moderate analgesia in lower doses, and have a relatively narrow therapeutic window. In higher doses, they risk respiratory depression, and loss of upper airway reflexes.8–9 The addition of ketamine to opioids may provide better pain relief than opioids alone.10–12

Ketamine was historically been regarded as a drug which requires anaesthetic skills to use safely.13 Although ketamine is contained within the trauma module deployed to regimental aid posts, many general practitioners without anaesthetic experience have hesitated to use it. In addition, the Propaq Encore monitor, which until recently was on general issue, lacks capnometry.14 Recent evidence has demonstrated that ketamine can be used by practitioners without anaesthetic skills, provided they are trained to employ it safely.15–16

During Operation HERRICK, there was rapid access to a Level 8 qualified Medical Emergency Response Team (MERT) for most troops in most locations. This meant timely access to a consultant who was skilled and experienced in providing forward advanced analgesia and anaesthesia. As a result, it was uncommon for forward deployed general practitioners to require advanced analgesia options. We are now preparing for future operations where there may not be rapid access to either tactical aeromedical evacuation, or a Level 8 MERT. It is more likely, however, that an injured casualty will have access to a Level 6 practitioner in an Regimental Aid Post (RAP).

It follows, therefore, that we must equip and train our Level 6 practitioners to conduct advanced analgesia and procedural sedation safely, in order to ensure injured troops are not without adequate pain relief.

KETAMINE
Ketamine is derived from phencyclidine and acts by blocking N-methyl-D-aspartate receptors. It is regarded as a ‘Dissociative anaesthetic’, and can be used to provide analgesia, sedation or anaesthesia, dependant on the dose. Ketamine should be administered by a parenteral route. It can be intravenously, intramuscularly, intranasally or via intraosseous line. It is metabolised by a combination of lipid redistribution and hepatic metabolism. This produces inactive metabolites, which are then excreted in urine.

In the cardiovascular system, it produces sympathetic activation, resulting in raised HR and BP. It should therefore be used with care in patients with ischaemic heart disease, as increased HR may reduce diastolic time, and potentially reduce coronary blood flow.

Respiratory effects include increased RR and bronchodilation, along with preservation of the upper airway reflexes. In the central nervous system, ketamine produces a sense of dissociation and intense analgesia, taking about 90s for maximum effect. 2mg/kg will provide around 10–15 min of anaesthesia.13

TRAINING AND EQUIPMENT
In order to conduct ketamine analgesia and sedation, practitioners must be accredited as Level 6 Pre-Hospital Emergency Care (PHEC) providers. This classification includes doctors, and allied health professionals who have undergone specific PHEC training. This provides the requisite background theoretical and practical knowledge to conduct medium complexity interventions in the deployed prehospital environment.

Defence-specific training is conducted via a number of routes. Newly qualified General Duties Medical Officers are introduced to ketamine for analgesia as part of their Postgraduate Medical Officers’ Course. The Military PHEC course also covers dosages and safe administration of ketamine for sedation. Practitioners will be assessed giving ketamine in a simulated patient encounter during this course.

The use of capnography improves the safety of sedation, and is mandated in both emergency department and pre-hospital practice.17–18 The Tempus Pro monitor, which is currently being issued, has this facility.19

PROTOCOL
Administration should be intravenous for preference, although intranasal, intraosseous and intramuscular are all viable routes.15–20 The intramuscular route has several specific disadvantages. It requires higher strengths of drug, to avoid large volume infusions, and also has uneven uptake in hypovolaemic patients. We therefore recommend this route be avoided unless no other option exists.

The suggested doses for ketamine are noted in table 1. Doses should be reduced in critically hypovolaemic patients with a reduced level of consciousness. When...
administered for sedation, the patient must have three-lead ECG, non-invasive BP, SpO2, and end tidal CO2 monitoring in place. Sedation also requires two clinicians, one to sedate, and the other to perform the procedure.

ADVERSE EFFECTS

Ketamine has a fairly wide therapeutic window, and is safe even in large doses.21 When used for pre-hospital analgesia and sedation, the incidence of significant complications is low.13 It is, however, associated with a number of side effects.

The most common adverse effect of ketamine administration is the so-called ‘emergence phenomenon’, where ketamine causes unpleasant dreams. This can be worse in noisy or chaotic environment, which is an issue in combat trauma. This can be managed with small doses of benzodiazepines (midazolam 0.01 mg/kg). Level 6 practitioners have midazolam in their modules to manage this.

There is a small incidence of transient laryngospasm, which in a case series of 1022 administrations did not require intubation in any patients.22 Laryngospasm can be managed by application of positive pressure ventilation, which can be achieved using either a bag/valve mask, or a supraglottic airway.21

There is a 6% incidence of nausea or vomiting in patients after administration of ketamine.23 This generally happens following recovery from sedation, and past the point of sedation where there is concern for airway soilage. Patients should be managed with appropriate positioning, and antiemetics if required.

Ketamine is a Schedule III controlled drug, and has some potential for abuse. It must therefore be appropriately secured and accounted for.24

GOVERNANCE

There is a requirement to monitor the use of ketamine, in order to and identify potential issues, and ensure good practice. The current pre-hospital governance process ensures that all high-risk interventions are captured and reviewed. Defence pre-hospital governance is conducted both locally and worldwide.

At a local level, each theatre has a Senior Medical Officer, who will be the pre-hospital clinical lead. They would be responsible for conducting local review of procedures and interventions. In addition, there is a defence-wide governance process which provides a further level of assurance. Every pre-hospital trauma patient interaction generates a pre-hospital patient report form, which is forwarded to the Medical Directorate. All administrations of ketamine are reviewed by pre-hospital clinicians, and lessons identified are fed back to clinicians. This will also allow us to capture and audit all uses of ketamine and disseminate general lessons more widely.

CONCLUSION

The use of ketamine for combat casualties offers a safe and effective means to augment current analgesia options when managing combat casualties.

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Table 1: Doses of ketamine

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<thead>
<tr>
<th>Indication</th>
<th>Intravenous/intraosseous dose (mg/kg)</th>
</tr>
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<tbody>
<tr>
<td>Analgesia</td>
<td>0.1–0.3</td>
</tr>
<tr>
<td>Sedation</td>
<td>0.5–1</td>
</tr>
<tr>
<td>General anaesthesia</td>
<td>1–2</td>
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</tbody>
</table>

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