



Managing Moderate and Severe Pain in Mountain Rescue

20131223-MED-REC0032 Alpine Emergency Medicine Commission
Recommendation

History of Revisions	
issued	2013



Managing Moderate and Severe Pain in Mountain Rescue

John Ellerton, MRCSP,^{1,2} Mario Milani, MD,^{2,3} Marc Blancher, MD,^{2,4} Grégoire Zen-Ruffinen, MD,^{2,5}
Sven Christjar Skaiaa,^{2,6} Bruce Brink,^{2,7} Ashish Lohani, MD,^{2,8} and Peter Paal, MD^{2,9}

Abstract

Ellerton, John, Mario Milani, Marc Blancher, Gregoire Zen-Ruffinen, Sven Christjar Skaiaa, Bruce Brink, Ashish Lohani, and Peter Paal. Managing moderate and severe pain in mountain rescue. *High Alt Med Biol.* 15:8–14, 2014.—**Aims:** We aimed to describe evidence-based options for prehospital analgesia, and to offer practical advice to physicians and nonphysicians working in mountain rescue. **Methods:** A literature search was performed; the results and recommendations were discussed among the authors. Four authors considered a scenario. The final article was discussed and approved by the International Commission for Mountain Emergency Medicine (ICAR MEDCOM) in October 2013. **Results and Recommendations:** Many health care providers fail to recognize, assess, and treat pain adequately. Assessment scales and treatment protocols should be implemented in mountain rescue services to encourage better management of pain. Specific training in assessing and managing pain is essential for all mountain rescuers. Persons administering analgesics should receive appropriate detailed training. There is no ideal analgesic that will accomplish all that is expected in every situation. A range of drugs and delivery methods will be needed. Thus, an ‘analgesic module’ reflecting its users and the environment should be developed. The number of drugs carried should be reduced to a minimum by careful selection and, where possible, utilizing drugs with multiple delivery options. A strong opioid is recommended as the core drug for managing moderate or severe pain; a multimodal approach may provide additional benefits.

Key Words: analgesia, emergency medicine, environmental medicine, mountain rescue, pain management.

¹General Practitioner and Medical Officer, Mountain Rescue (England and Wales), Birbeck Medical Group, Penrith, United Kingdom.

²International Commission for Mountain Emergency Medicine (ICAR MEDCOM).

³Regional Emergency Medical Services Agency (AREU/118), A.O. Ospedale di Lecco, Lecco, Italy, and Mountain and Cave Rescue National Association (CNSAS) Medical Director, Italy.

⁴Department of Emergency Medicine and French Mountain Rescue Association (ANMSM), Grenoble University Hospital. Grenoble, France.

⁵General Practitioner and Anesthesia, Medical director Air-Glaciers Sion, medcom OCVS-KWRO Valais, Sion, Switzerland.

⁶Department of Emergency Medicine and Critical Care, Oslo University Hospital, Oslo, Norway.

⁷Whistler/Blackcomb Ski Patrol and British Columbia Ambulance Service, Whistler, British Columbia, Canada.

⁸Mountain Medicine Society of Nepal, Diploma in Mountain Medicine, Kathmandu, Nepal.

⁹Department of Anesthesiology and Critical Care Medicine, Innsbruck Medical University, Innsbruck, Austria.

Official Recommendations of the International Commission for Mountain Emergency Medicine, ICAR MEDCOM. Intended for Mountain Rescue First Responders, Nurses, Paramedics, Physicians, and Rescue Organizations.

Introduction

THE PROVISION OF EFFECTIVE AND SAFE ANALGESIA is a core principle of prehospital care (Thomas and Shewakramani, 2008). Recognizing its importance, the International Commission of Mountain Emergency Medicine (ICAR MEDCOM) published a recommendation for the treatment of pain in 2001 (Thomas et al., 2001). Since then, there has been an expansion in facilities that provide mountain emergency medicine, such as the medical posts at Everest Base Camp, and in the sophistication of organized mountain rescue (Brugger et al., 2005; Elsensohn et al., 2009; Tomazin et al., 2011). There has also been recognition that pain is frequently poorly treated as a result of logistical factors, poor assessment, operator-dependant fears, and environmental factors, including constraints on IV access. In many mountain areas, nonphysicians provide the emergency care, monitoring is rudimentary, and time scales are protracted. These factors encourage a wider range of less well-known therapies that are often taken from other austere environments (Ellerton et al., 2013).

We aim to review current knowledge of prehospital analgesia and suggest evidence-based options that are applicable in the mountains. By using a scenario, we wish to stimulate diverse thinking. We believe a didactic approach will not overcome the practical difficulties rescuers encounter.

Scenario

A fit, healthy 40-year-old man (80 kg) with no allergies or past medical history falls on a 50° snow and rock slope, and clinically has a closed fracture of the shaft of the femur. His pain score is 9 out of 10 and he is “begging for pain relief.” There is no other apparent injury.

In all settings, scene safety, an assessment and management of life-threatening conditions (primary survey), and basic history (including allergy) are essential (Lee and Porter, 2005). Consideration of environmental protection (prevention of hypothermia), and early planning and communication of an evacuation plan may also be required. Nonpharmacological methods of providing pain relief, including timely splinting of the injury and packaging of the casualty, will be needed (Ellerton et al., 2009b). Early pharmacological interventions should be considered to facilitate these procedures if conditions permit. The casualty is frequently not in a horizontal supine position; correcting this may or may not be achievable. This should be considered before a drug that may induce altered consciousness or hypotension is given. Oxygen is recommended if hypoxemia is present or to be expected. The preferred analgesia strategy and any alternatives will depend on the health professional’s training and skills. Techniques new to the provider should be experienced in controlled situations first. The strategy should become simpler as the conditions become more difficult, the casualty more severely injured, and the equipment less sophisticated.

We asked four co-authors with very different geographical and professional backgrounds to describe how they might achieve analgesia in their particular environment:

GZR, Switzerland: “With the infrastructure of a dedicated Helicopter Emergency Medical Service and short flight times, there is the opportunity to manage the casualty in a way similar to the Emergency Department (Tomazin et al., 2012). Ideally, the team disembarks some 50 m away from the casualty to

reduce cooling of the unprotected casualty from the helicopter downwash. If at all possible, an intravenous (IV) cannula is inserted and fentanyl given in 50 mcg boluses every 2–4 min until pain relief (as assessed on a verbal pain score) is achieved (Kanowitz et al., 2009). Using this titrated approach, an adult normally will have 200–300 mcg of fentanyl (approximately 3 mcg/kg). If analgesia is inadequate, racemic ketamine is added (20–40 mg boluses every 2 min) expecting that 80 mg (approximately 1 mg/kg) will be given. Half the dose is required if S-ketamine is used (Marland et al., 2013). The aim is to maintain verbal contact throughout. The casualty is also monitored by pulse oximetry, electrocardiography, and non-invasive blood pressure measurement. Routinely, a small titrated dose of midazolam (1–2 mg total dose) is also given, as an agitated casualty is not suitable for transporting in a helicopter (Bredmose et al., 2009).”

BB, Canada: “In the mountains of British Columbia and Alberta, Advanced and Critical Care Paramedics are likely to be members of the mountain rescue teams and professional ski patrols. Their first choice analgesic is a parenteral opioid. In the rare occasions where the IV route is time consuming or disruptive, 100 mcg of intranasal (IN) fentanyl (approximately 1.4 mcg/kg) via an atomizer is considered as an alternative (Borland et al., 2007). Though it works well, there is minimal evidence of its use in adults, and none on the effects that a cold environment may have on its bioavailability. Properly applied traction and splinting must not be overlooked as an effective way of providing pain relief, and may lead to a reduced opioid requirement. When opioids are relatively contraindicated (for example, when shivering may be impaired) or supplementary analgesia is required, 30 mg of IV ketorolac is considered, noting its effect on coagulation, reports of acute renal and gastrointestinal damage and its restricted prehospital use in some countries (MHRA, 2007; Wedmore et al., 2005).”

SCS, Norway: “In an austere cold environment, the on-scene time has to balance with need to start an evacuation to a less hostile environment. The goals are to optimize patient’s safety and comfort, and reduce disruptions during the evacuation. On scene time should not exceed 30 min, if at all possible. ‘Rendezvous systems’ have been described in the use of helicopters in mountain rescue; a similar approach during a prolonged terrestrial rescue may be helpful if a staging shelter was readily available en route (Tomazin et al., 2011). Co-morbidities such as hypothermia, hypovolemia, and head and chest injury are often present but ill-defined in the field. Nevertheless, they must still be taken into account. Analgesics have increased clearance times in hypothermia and will accumulate if standard doses are given. A loading dose of oral paracetamol (acetaminophen) 1.5–2 g followed, if necessary, by titrated IV opioid or ketamine is recommended to allow proper splinting and packaging. If this scenario encompasses an evacuation time of many hours, there is a strong indication for a regional anesthesia, as this may provide many hours of good quality analgesia and thus avoid repeated doses of opioid or ketamine. With suitable experience, a femoral nerve block or a fascia iliaca compartment block with 20–30 mL of lidocaine (10 mg/mL) can be performed very successfully and safely (Lopez et al., 2003; Gros et al., 2012).”

AL, Nepal: “As a doctor working at ‘Everest ER’ and administering strong analgesics at altitude, the potential of strong opioids to worsen the casualty’s oxygen desaturation

concerns me. Monitoring will be effectively restricted to clinical parameters. An incident occurring above base camp will involve long transport times and objective dangers. Usually splinting and packaging to transfer the casualty to a safer location is a priority. Analgesics with a quick onset of action and noninvasive route of administration are preferable. Ketamine, by one of its routes of administration, and methoxyflurane are appealing in this scenario (Grindlay and Babl, 2009; Windsor et al., 2009). IV tramadol, which is available at pharmacies in Nepal and not regulated as severely as morphine and fentanyl, could be judiciously used. In the context of postoperative pain, respiratory depression due to tramadol is said to be less than morphine; whether that translates into a clinical significant advantage at altitude is not known (Houmes et al., 1992). A multimodal approach using nonpharmacological techniques, such as local cooling, and a combination of drugs to limit opioid side effects would be preferred.”

General Considerations

Pain is “An unpleasant sensory and emotional experience associated with actual or potential tissue injury” (International Association for the Study of Pain, 2013). It is not easily measured, and may vary with the age, condition, ethnicity, and gender of the patient (Post et al., 1996). Time and comorbidities also affect pain. These differences have important effects in the way pain is expressed and how pain relief is requested. Furthermore, the provision of prehospital analgesia by health care providers is determined by their knowledge and beliefs, as well as the pervading culture of the work environment. These factors contribute to the described inadequacies in pain relief. Using a pain score, such as a verbal numerical rating, can be helpful (Jennings et al., 2009; Berben et al., 2012). Quality improvement programs can optimize pain management and should incorporate non-pharmacological techniques. When conditions are extreme, the health care provider must remember that a great deal of pain relief can be provided by distraction, confidence, and reassurance, and a cold compress and splinting of injuries (McManus and Sallee, 2005; Ellerton et al., 2009b).

Does Prehospital Analgesia Influence Outcome?

Pain increases the stress response leading to tachycardia, hypertension, increased oxygen consumption, and endocrine and immunological effects. Linking these physiological changes to a poor outcome has been elusive. However, recent research has linked acute pain following trauma with psychological distress (Keene et al., 2011). For example, early use of IV morphine was associated with a reduction in the development of posttraumatic stress disorder (PTSD) in a military setting (Holbrook et al., 2010). Whether this finding can be generalized to all analgesics and other environments is unknown, though there is supportive evidence that higher pain levels are associated with higher rates of acute stress disorder and PTSD (Norman et al., 2008).

Which Analgesics Have an Evidence Base in the Prehospital Setting for Treating Moderate or Severe Pain?

No single drug is perfect for prehospital care but there is ample support that strong IV opioids (particularly fentanyl and

morphine) or ketamine (with midazolam) given in a titrated manner are safe and effective in managing severe pain (Smith et al., 2009; Smith et al., 2012). Other IV candidates (e.g., weaker opioids such as tramadol, acetaminophen/paracetamol, and nonsteroidal anti-inflammatory drugs) may have a role in moderate pain (Cepeda et al., 2005; Craig et al., 2012).

Inhalational agents, such as 50% nitrous oxide/50% oxygen and methoxyflurane, are appealing as a simple way of rapidly achieving analgesia in moderate pain (Babl et al., 2008; Ducassé et al., 2013; Ellerton et al., 2013). However, pain relief is inferior to IV morphine or IN fentanyl (Johnston et al., 2011; Middleton et al., 2011). When peripheral IV access is difficult, other parenteral routes including intraosseous (IO) and intramuscular (IM) can be utilized. The less invasive IN and buccal routes can be recommended, though facial injury may preclude their use and the bioavailability in a cold environment may not match that of the published literature. Fentanyl IN is effective and comparable to IV morphine (Rickard et al., 2007; Hansen et al., 2012). High concentration formulations are necessary and have recently been introduced. Sufentanil and diamorphine are alternatives (Kendall et al., 2001; Steenblik et al., 2012). A shorter time from the decision to give IN analgesia to its administration would be expected, though this has not always been demonstrated (Regan et al., 2013). Buccal administration of fentanyl citrate provides another effective method, though its onset time may be inferior to IV administration (Mahar et al., 2007; Wedmore et al., 2012).

Loco-regional anesthesia, which can offer excellent analgesia, is another technique to consider. It also may permit patient contribution during difficult or long evacuations that occur in cave and high altitude rescue. Femoral nerve blocks have been performed in the prehospital environment (Gros et al., 2012). Simple procedures like wrist blocks and digital blocks may be considered (Pasquier et al., 2012; Simpson et al., 2012). More complex nerve blocks including interscalene, intercostal, sciatic, and ankle blocks may be possible if the health care provider has suitable skills (Wedmore et al., 2005).

Is a Multimodal Drug Approach Supported by Literature?

Using a combination of analgesics to improve pain relief is in vogue, particularly in view of low success rates to single agents, and is frequently used (Ellerton et al., 2013; Moore et al., 2013). However the literature is sparse and conflicting as to its advantages. For example, in one study, IN fentanyl and methoxyflurane were no better than IN fentanyl alone (Johnston et al., 2011). In another study, morphine combined with ketamine was advantageous in terms of morphine sparing, but at the expense of more side effects (Galinski et al., 2007; Jennings et al., 2012). Minimizing side effects, which may be more common when multiple drugs are used, is important as even minor problems such as nausea and vomiting can become potentially hazardous during an evacuation. Prophylactic antiemetics such as ondansetron or a phenothiazine may be appropriate. Managing severe complications in an austere environment could be very challenging.

What Agents Are Recommended for Prehospital Procedural Sedation?

When procedural sedation is required ketamine, midazolam, etomidate, and propofol are commonly used in

emergency departments (Sacchetti et al., 2007). In this setting, the advantages of using a synergistic combination of ketamine and propofol compared with either agent alone have been discussed with no firm conclusion (Green et al., 2011). In the prehospital environment, co-administration of ketamine and midazolam is regarded by some as the standard (Brednose et al., 2009; Ellerton et al., 2009a). The combination may reduce the incidence of emergence phenomena;

an important consideration during an evacuation (Moy and Le Clerc, 2011; Sener et al., 2011).

What Monitoring Should Be Performed?

Prehospital analgesia for moderate or severe pain must be given under continuous clinical observation supplemented with appropriate noninvasive monitoring. A minimum set of

TABLE 1. RECOMMENDED PHARMACOLOGICAL AGENTS FOR TREATING MODERATE OR SEVERE PAIN IN MOUNTAIN RESCUE

<i>Technique/ agent</i>	<i>Adult starting dose (Dose in children)</i>	<i>Adult subsequent doses*</i>	<i>Comments contraindication</i>
Opioids			
Morphine ¹			
IV	5–10 mg* (100 mcg/kg, max 10 mg)	5 mg	Avoid if renal failure
IM	10–20 mg* (200 mcg/kg, max 10 mg)	10 mg	As above
IO	5–10 mg* (100 mcg/kg, max 10 mg)	5 mg	As above
Fentanyl			
IV	50–100 mcg* (1–3 mcg/kg, max 100 mcg)	25 mcg	Avoid if on monoamine oxidase inhibitors (MAOI) drugs
IN	180 mcg* (1.5 mcg/kg)	60 mcg x2 (15 mcg x2)	As above
Buccal	OTFC 800 mcg* (10–15 mcg/kg)		As above
Tramadol			
IV	50–100 mg (700 mcg/kg) over 2–3 min	50 mg every 20 min; max 600 mg/day	Avoid if on monoamine oxidase inhibitors (MAOI) drugs
NSAID			
Ketorolac			
IV	15–30 mg (0.5 mg/kg, max 15 mg)	none	Avoid if risk of GI bleeding and if current or past cardiovascular disease
Others			
Paracetamol			
IV	> 50 kg–1 g; < 50 kg–15 mg/kg over 15 min	Repeat after 4–6 hours	100 mL infusion over 15 min
Ketamine (for analgesia) halve dose if S-Ketamine used			
IV	10–20 mg* (100 mcg/kg)	5–20 mg	Larger doses for procedural sedation. Midazolam may be co-administered
IM	1 mg/kg*	–	
IN	0.5 mg/kg*	0.5 mg/kg	
Inhalational			
Pentrox [®] (Methoxyflurane)			
Inhaled	Self-administered 3 mL via inhaler	3 mL (max 6 mL/day; 15 mL/week)	Avoid if renal impairment
50% Nitrous oxide/50% Oxygen			
Inhaled	Self-administered	-	Avoid after SCUBA diving and when tension pneumothorax suspected. Maintain cylinder at 10°C (50°F)

*Consider halving in the elderly, frail and hemodynamically compromised.

¹Diamorphine, where available, is an alternative with the advantage that intranasal administration can be used.

OTFC=oral transmucosal fentanyl citrate.

Data from: Thomas, 2008; Rickard, 2007; Moy and Le Clerc, 2011; Ellerton, 2013; Royal Pharmaceutical Society of Great Britain and British Medical Association, 2013; Finn and Harris, 2010; Borland et al., 2007; BOC Healthcare, 2011.

observations would be: level of consciousness including verbal responses to questions; respiratory rate and pattern; skin color and heart rate. As the potency of drug(s) given increases to include strong opioids, noninvasive monitoring of blood pressure and oxygen saturation is recommended though does not replace clinical observations. When procedural sedation is contemplated, exhaled carbon dioxide concentration and electrocardiogram monitoring should also be considered (Goodwin et al., 2005). In the mountains, electronic monitoring maybe unreliable or impractical; sensor placement, battery performance, and the normal range of readings at altitude are a few of the factors that disrupt reliability (Luks and Swenson, 2011). In the same situations, managing adverse responses to analgesics and drug combinations can also be challenging. The clinician must anticipate these factors and their consequences, when deciding on their analgesic strategy particularly in circumstances where continuous monitoring is impossible and reversal agents (such as naloxone) are less available. As the highest risk of serious adverse events occurs within 25 min of receiving the last dose of IV analgesics, starting the evacuation 25–30 min after administration may be an appropriate compromise in a non-time critical scenario (Newman et al., 2003).

Which Analgesics Are Recommended for Non-Health Care Professionals?

In some countries, such as the United Kingdom, trained and certified mountain rescue team members are able to give analgesia according to protocols. Oral, inhalational, nasal, and buccal routes are preferred (Ellerton et al., 2013). It is particularly important to emphasize the benefits of non-pharmacological therapies in training, as the drug protocols will be inherently conservative to reflect the experience of the team members and their ability to manage adverse events. Rescue organizations where health care professionals do not routinely attend the incident site should consider developing an analgesia strategy though frequently options are constrained by national laws.

Do Patient Factors Influence Which Analgesia Can Be Used?

Individualizing analgesia to each casualty is becoming more important as the rescue population becomes older and co-morbidities commoner. However, in a fit adult with no pre-existing drug use, initial doses can be standardized in many cases. Table 1 outlines dose information and specific contraindications.

Concurrent hypothermia alters the pharmacokinetics and pharmacodynamics of widely used drugs, including fentanyl, morphine, ketamine, and midazolam (van den Broek et al., 2010). The effects are complex but caution is urged particularly when additional doses are given. The sympathomimetic effects of ketamine on an irritable hypothermic heart have the potential for serious side effects (Marland et al., 2013).

In casualties with traumatic injury, the case for giving any of the classes of drugs mentioned in the scenario can be made. The consensus view is that opioids remain the gold standard for managing pain in acute trauma (Thomas et al., 2001). Unmasking significant blood loss, resulting in hypotension, is a concern; when there is doubt, the initial dose is often reduced and given over a longer period of time. Chest and head injury have, in the past, been regarded as contraindications to opioids.

This absolute has been revised to a caution with an emphasis being placed on actively avoiding hypotensive or hypoxic episodes. In facial injury, absorption via the buccal and nasal routes may be impaired; other routes would be preferred.

Pain relief for medical and surgical conditions, such as acute coronary syndrome and an acute abdomen, will mimic as far as possible the healthcare professional's usual management.

Recommendations

- Many health care providers fail to adequately recognize, assess, and treat pain. Hence, assessment scales and treatment protocols should be implemented in mountain rescue services.
- Specific training in assessing and managing pain is essential for all mountain rescuers. The importance of nonpharmacological methods should not be neglected.
- Persons administering analgesics, whether a healthcare professional or not, should receive appropriate detailed training.
- There is no ideal analgesic that will accomplish all that is expected in every situation. A range of drugs and delivery methods will be needed. Thus an 'analgesic module', reflecting its users and the environment should be developed either by the organization or the individual (Elsensohn et al., 2011).
- The number of drugs carried should be reduced to a minimum by careful selection and, where possible, utilizing drugs with multiple delivery options.
- A strong opioid is recommended as the core drug for managing moderate or severe pain; a multimodal drug approach may provide additional benefits.

Limitations

Prehospital data on analgesia are limited. The mountain environment can impose extreme conditions that could have significant clinical effects on the efficacy of a drug and its side effects. The techniques described have all been used in mountain rescue, but many are in their infancy with much is still to be learnt. Using them outside an organized rescue structure has not been assessed thoroughly. Persons administering analgesics must accept responsibility for their actions.

Acknowledgments

This article reflects the consensus opinion of the International Commission for Mountain Emergency Medicine, ICAR-MEDCOM, which has full responsibility for the content.

Author Disclosure Statement

No manufacturer supported this study financially or materially. The authors have no financial or personal interest, nor obtain any grants or hold any patents concerning the described drugs or devices.

References

- Babl FE, Oakley E, Puspitadewi A, and Sharwood LN. (2008). Limited analgesic efficacy of nitrous oxide for painful procedures in children. *Emerg Med J* 25:717–721.
- Herben SA, Meijs TH, Van Grunsven PM, Schoonhoven L, and van Achterberg T. (2012). Facilitators and barriers in pain management for trauma patients in the chain of emergency care. *Injury* 43:1397–1402.

- BOC Healthcare. (2011). Entonox[®] Medical Gas Data Sheet. Available at http://www.bochealthcare.co.uk/internet.lh.lh.gbr/en/images/Entonox_MGDS_HLC_407285409_57640.pdf; accessed December 2013.
- Borland M, Jacovs I, King B, and O'Brien D. (2007). A randomized controlled trial comparing intranasal fentanyl to intravenous morphine for managing acute pain in children in the Emergency Department. *Ann Emerg Med* 49:335–340.
- Bredmose PP, Lockey DJ, Grier G, Watts B, and Davies G. (2009). Pre-hospital use of ketamine for analgesia and procedural sedation. *Emerg Med J* 26:62–64.
- Brugger H, Elsensohn F, Syme D, Sumann G, and Falk M. (2005). A survey of emergency medical services in mountain areas of Europe and North America: Official recommendations of the International Commission for Mountain Emergency Medicine (ICAR Medcom). *High Alt Med Biol* 6:226–237.
- Cepeda MS, Carr DB, Miranda N, Diaz A, Silva C, and Morales O. (2005). Comparison of morphine, ketorolac, and their combination for postoperative pain: Results from a large, randomized, double-blind trial. *Anesthesiology* 103:1225–1232.
- Craig M, Jeavons R, Probert J, and Bengner J. (2012). Randomised comparison of intravenous paracetamol and intravenous morphine for acute traumatic limb pain in the emergency department. *Emerg Med J* 29:37–39.
- Ducassé JL, Siksik G, Durand-Béchu M, et al. (2013). Nitrous oxide for early analgesia in the emergency setting: A randomized, double-blind multicenter prehospital trial. *Acad Emerg Med* 20:178–184.
- Ellerton JA, Greene M, and Paal P. (2013). The use of analgesia in mountain rescue casualties with moderate or severe pain. *Emerg Med J* 30:501–505.
- Ellerton J, Paal P, and Brugger H. (2009a). Prehospital use of ketamine in mountain rescue. *Emerg Med J* 26:760–761.
- Ellerton J, Tomazin I, Brugger H, and Paal P. (2009b). Immobilization and splinting in mountain rescue. Official Recommendations of the International Commission for Mountain Emergency Medicine, ICAR MEDCOM, Intended for Mountain Rescue First Responders, Physicians, and Rescue Organizations. *High Alt Med Biol* 10:337–342.
- Elsensohn F, Niederklapfer T, Ellerton J, Swangard M, Brugger H, and Paal P. (2009). Current status of medical training in mountain rescue in America and Europe. *High Alt Med Biol* 10:195–200.
- Elsensohn F, Soteris I, Resiten O, Ellerton J, Brugger H, and Paal P. (2011). Equipment of medical backpacks in mountain rescue. *High Alt Med Biol* 12:343–347.
- Finn M, and Dan Harris D. (2010). Intranasal fentanyl for analgesia in the paediatric emergency department. *Emerg Med J* 27:300–301.
- Godwin SA, Caro DA, Jagoda AS, Charles R, Marett BE, and Moore J. (2005). Clinical policy: Procedural sedation and analgesia in the Emergency Department. *Ann Emerg Med* 45:177–196.
- Galinski M, Dolveck F, Combes X, et al. (2007). Management of severe acute pain in emergency settings: Ketamine reduces morphine consumption. *Am J Emerg Med* 25:385–390.
- Green SM, Andolfatto G, and Krauss B. (2011). Ketofol for procedural sedation? Pro and Con. *Ann Emerg Med* 57:444–448.
- Grindlay J, and Babl FE. (2009). Review article: Efficacy and safety of methoxyflurane analgesia in the emergency department and prehospital setting. *Emerg Med Australas* 21:4–11.
- Gros T, Viel E, Ripart J, Delire V, Eledjam JJ, and Sebbane M. (2012). Prehospital analgesia with femoral nerve block following lower extremity injury. A 107 cases survey *Ann Fr Anesth Reanim* 31:846–849. [Article in French]
- Hansen MS, Mathiesen O, Trautner S, and Dahl JB. (2012). Intranasal fentanyl in the treatment of acute pain—A systematic review. *Acta Anaesthesiol Scand* 56:407–419.
- Holbrook TL, Galarneau MR, Dye JL, Quinn K, and Dougherty AL. (2010). Morphine use after combat injury in Iraq and post-traumatic stress disorder. *N Engl J Med* 362:110–117.
- Houmes R-JM, Voets MA, Verkaaik A, Erdmann W, and Lachmann B. (1992). Efficacy and safety of tramadol versus morphine for moderate and severe postoperative pain with special regard to respiratory depression. *Anesth Analg* 74:510–514.
- International Association for the Study of Pain. Part III: Pain terms, a current list with definitions and notes on usage (1994). *Classification of Chronic Pain, Second Edition, IASP Task Force on Taxonomy*, Merskey H, and Bogduk N, eds. IASP Press, Seattle. pp. 209–214. Available at: http://www.iasp-pain.org/AM/Template.cfm?Section=Pain_Definitions; Accessed March 2013.
- Jennings PA, Cameron P, and Bernard S. (2009). Measuring acute pain in the prehospital setting. *Emerg Med J* 26:552–555.
- Jennings PA, Cameron P, Bernard S, Walker T, Jolley D, Fitzgerald M, and Masci K. (2012). Morphine and ketamine is superior to morphine alone for out-of-hospital trauma analgesia: A randomized controlled trial. *Ann Emerg Med* 59:497–503.
- Johnston S, Wilkes GJ, Thompson JA, Ziman M, and Brightwell R. (2011). Inhaled methoxyflurane and intranasal fentanyl for prehospital management of visceral pain in an Australian ambulance service. *Emerg Med J* 28:57–63.
- Kanowitz A, Dunn TM, Kanowitz EM, Dunn WW, and Vanbuskirk K. (2006). Safety and effectiveness of fentanyl administration for prehospital pain management. *Prehosp Emerg Care* 10:1–7.
- Keene DD, Rea WE, and Aldington D. (2011). Acute pain management in trauma. *Trauma* 13:167–179.
- Kendall JM, Reeves BC, and Latter VS. (2001). Multicentre randomized controlled trial of nasal diamorphine for analgesia in children and teenagers with clinical fractures. *BMJ* 322:261–265.
- Lee C, and Porter KM. (2005). Prehospital management of lower limb fractures. *Emerg Med J* 22:660–663.
- Lopez S, Gros T, Bernard N, Plasse C, and Capdevila X. (2003). Fascia iliaca compartment block for femoral bone fractures in prehospital care. *Reg Anesth Pain Med* 28:203–207.
- Luks AM, and Swenson ER. (2011). Pulse oximetry at high altitude. *High Alt Med Biol* 12:109–119.
- Mahar PJ, Rana JA, Kennedy CS, and Christopher NC. (2007). A randomized clinical trial of oral transmucosal fentanyl citrate versus intravenous morphine sulfate for initial control of pain in children with extremity injuries. *Pediatr Emerg Care* 23:544–548.
- Marland S, Ellerton J, Andolfatto G, Strapazzon G, Thomassen O, Brandner B, Weatherall A, and Paal P. (2013). Ketamine: Use in anesthesia. *CNS Neurosci Ther* 19:381–389.
- McManus JG, and Sallee DR. (2005). Pain management in the prehospital environment. *Emerg Med Clin North Am* 23:415–431.
- Medicines and Healthcare products Regulatory Agency. (2007) Ketoprofen and ketorolac: Gastrointestinal risk in drug safety update; Available at: <http://www.mhra.gov.uk/home/groups/pl-p/documents/publication/con2032519.pdf>; accessed August 2013.
- Middleton PM, Simpson PM, Sinclair G, Dobbins TA, Math B, and Bendall JC. (2010). Effectiveness of morphine, fentanyl,

- and methoxyflurane in the prehospital setting. *Prehosp Emerg Care* 14:439–447.
- Moore A, Derry S, Eccleston C, and Kalso E. (2013). Expect analgesia failure; Pursue analgesic success. *BMJ* 346:f2690.
- Moy RJ, and Le Clerc S. (2011). Ketamine in prehospital analgesia and anaesthesia. *Trends Anaesth Crit Care* 1:243–245.
- Newman DH, Azer MM, Pitetti RD, and Singh S. (2003). When is a patient safe for discharge after procedural sedation? The timing of adverse effect events in 1367 pediatric procedural sedations. *Ann Emerg Med* 42:627–635.
- Norman SB, Stein MB, Dimsdale JE, and Hoyt DB. (2008). Pain in the aftermath of trauma is a risk factor for post-traumatic stress disorder. *Psychol Med* 38:533–542.
- Pasquier M, Ruffinen GZ, Brugger H, and Paal P. (2012). Prehospital wrist block for digital frostbite injuries. *High Alt Med Biol* 13:65–66.
- Post LF, Blustein J, Gordon E, and Dubler NN. (1996). Pain: Ethics, culture, and informed consent to relief. *J Med Ethics* 24:348–359.
- Regan L, Chapman AR, Celnik A, Lumsden L, Al-Soufi R, and McCullough NP. (2013). Nose and vein, speed and pain: comparing the use of intranasal diamorphine and intravenous morphine in a Scottish paediatric emergency department. *Emerg Med J* 30:49–52.
- Rickard C, O'Meara P, McGrall M, Garner D, McLean A, and Le Lievre P. (2007). A randomized controlled trial of intranasal fentanyl vs intravenous morphine for analgesia in the prehospital setting. *Am J Emerg Med* 25:911–917.
- Royal Pharmaceutical Society of Great Britain, and British Medical Association. (2013). *British National Formulary*. GGP Media GmbH Pössneck, Germany
- Sacchetti A, Senula G, Strickland J, and Dubin R. (2007). Procedural sedation in the community emergency department: Initial results of the ProSCED registry. *Acad Emerg Med* 14:41–46.
- Schjerning Olsen AM, Fosbøl EL, Lindhardsen J, et al. (2011). Duration of treatment with nonsteroidal anti-inflammatory drugs and impact on risk of death and recurrent myocardial infarction in patients with prior myocardial infarction: A nationwide cohort study. *Circulation* 123:2226–2235.
- Simpson PM, McCabe B, Bendall JC, Cone DC, and Middleton PM. (2012). Paramedic-performed digital nerve block to facilitate field reduction of a dislocated finger. *Prehosp Emerg Care* 16:415–417.
- Smith JE, Russell R, Mahoney PF, and Hodgetts TJ. (2009). What is the ideal pre-hospital analgesic? A questionnaire study. *J R Army Med Corps* 155:44–46.
- Smith MD, Wang Y, Cudnik M, Smith DA, Pakiela J, and Emerman CL. (2012). The effectiveness and adverse events of morphine versus fentanyl on a physician-staffed helicopter. *J Emerg Med* 43:69–75.
- Steenblik J, Goodman M, Davis V, Gee C, Hopkins CL, Stephen R, and Madsen T. (2012). Intranasal sufentanil for the treatment of acute pain in a winter resort clinic. *Am J Emerg Med* 30:1817–1821.
- Sener S, Eken C, Schultz CH, Serinken M, and Ozsarac M. (2011). Ketamine with and without midazolam for emergency department sedation in adults: A randomized controlled trial. *Ann Emerg Med* 57:109–114.e2.
- Thomas A, Wiget U, and Rammlair G. (2001). Treatment of pain in the field. In: *Consensus Guidelines on Mountain Emergency Medicine and Risk Reduction*. Elsensohn, eds. Casa Editrice Stefanoni, Lecco, Italy; pp. 55–57.
- Thomas SH, and Shewakramani S. (2008). Prehospital trauma analgesia. *J Emerg Med* 35:47–57.
- Tomazin I, Ellerton J, Reisten O, Soterias I, and Avbelj M. (2011). Medical standards for mountain rescue operations using helicopters: Official consensus recommendations of the International Commission for Mountain Emergency Medicine (ICAR MEDCOM).; International Commission for Mountain Emergency Medicine. *High Alt Med Biol* 12:335–341.
- Tomazin I, Vegnuti M, Ellerton J, Reisten O, Sumann G, and Kersnik J. (2012). Factors impacting on the activation and approach times of helicopter emergency medical services in four Alpine countries. *Scand J Trauma Resus Emerg Med* 20:56.
- Van den Broek MP, Groenendaal F, Egberts AC, and Rademaker CM. (2010). Effects of hypothermia on pharmacokinetics and pharmacodynamics: A systematic review of preclinical and clinical studies. *Clin Pharmacokinet* 49:277–294.
- Wedmore IS, Johnson T, Czarnik J, and Hendrix S. (2005). Pain management in the wilderness and operational setting. *Emerg Med Clin North Am* 23:585–601.
- Wedmore IS, Kotwal RS, McManus JG, Pennardt A, Talbot TS, Fowler M, and McGhee L. (2012). Safety and efficacy of oral transmucosal fentanyl citrate for prehospital pain control on the battlefield. *J Trauma Acute Care Surg* 73:S490–495.
- Windsor J, van der Kaaij J, Ellerton J, Oxer H, Hillebrandt D, and Rodway G. (2009). Methoxyflurane as an analgesic for prehospital use at high altitude. *High Alt Med Biol* 10: 201–202.

Address correspondence to:
 John Ellerton, MRCP
 Birbeck Medical Group
 Penrith
 Cumbria CA11 8HW
 United Kingdom

E-mail: johnellerton01@btinternet.com

Received November 23, 2013;
 accepted in final form December 23, 2013.