Clinical bottom line

While there is no direct evidence to answer the clinical question, the research available strongly suggests that it is reasonable to continue using standard wrist splints to immobilise patients with suspected scaphoid fractures.

- **Clay NR,** Diaz, JJ, Costigan PS, *et al*. Need the thumb be immobilised in scaphoid fractures? A randomised prospective trial. *J Bone Jt Surg* 1991;**73**:828–32.
- **Yanni D,** Lieppins P, Laurence M. Fractures of the carpal scaphoid. A critical study of the standard splint. *J Bone Jt Surg* 1991;**73**:600–2.

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BET 3: IS KETAMINE A VIABLE INDUCTION AGENT FOR THE TRAUMA PATIENT WITH POTENTIAL BRAIN INJURY

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ABSTRACT

A short cut review was carried out to establish whether ketamine is a viable induction agent in trauma patients with potential brain injuries. 276 papers were found using the reported searches, of which 5 presented the best evidence to answer the clinical question. The author, date and country of publication, patient group studied, study type, relevant outcomes, results and study weaknesses of these best papers are tabulated. It is concluded that there is no evidence to suggest harm with Ketamine use as induction agent for the patient with potential traumatic brain injury. The drug has major advantages in those patients with associated haemodynamic compromise and should potentially be regarded as the agent of choice.

CLINICAL SCENARIO

A 26-year-old male is brought to the Emergency Department after being struck by a car. His Glasgow coma scale on arrival is 8/15 with obvious evidence of head injury and thoracoabdominal trauma. He has a profusely bleeding scalp wound and is tachycardic. You decide to undertake a rapid sequence intubation (RSI) and begin drawing up ketamine as an induction agent. Your colleagues raise a collective eyebrow and ask you to defend your choice of agent. You offer cardiovascular stability and familiarity as two main indications. They remain concerned about the risk of raising intracranial pressure (ICP) and insist that Ketamine is contraindicated in head injured patients. They are unable to cite any evidence to support this view. You wonder whether they are right.

THREE-PART QUESTION

In (adults with head injury necessitating emergency intubation) does (the use of ketamine as an induction agent, compared to any other standard agent) lead to (increased morbidity/mortality)?

SEARCH STRATEGY

Medline and Embase using the OVID interface Medline (1948 to week 4 September 2011): ((ketamine.mp) or (exp

Table 3 Is ketamine a viable induction agent for the trauma patient with potential brain injury

Author, date and country	Patient group	Study type (level of evidence)	Outcomes	Key results	Study weaknesses
Filanovsky *et al* 2010, Canada	Narrative review article	Qualitative Literature review and expert opinion based on physiological data (level 5 evidence)	Opinion based conclusion	'ketamine appears to be the perfect agent for the induction of head injured patients for intubation.'	No attempt made at meta-analysis. Poor explanation of search strategy. Conclusions based on interpretation of individual case control/case studies
Sehdev *et al* 2006, Australia	Narrative review article	Qualitative Literature review and expert opinion based on physiological data (level 5 evidence)	Opinion based conclusion	'ketamine might be a suitable agent for induction of anaesthesia, particularly in those patients with potential cardiovascular instability.'	No attempt made at meta-analysis. Poor explanation of search strategy. Conclusions based on interpretation of individual articles
Grathwohl K *et al*, 2009, USA	Patients with traumatic brain injury undergoing operative neurosurgical intervention	Retrospective cohort with subgroup analysis of total intravenous anaesthesia (TIVA) patients and comparison of ketamine including regimens to non ketamine including regimens. (Level of evidence 2b)	Good outcome (Glasgow Outcome Score 4–5) Mortality	79% patients in the ketamine group vs 72% patients in the non ketamine group (p=0.47) 8.5% in the ketamine group vs 2.2% in the non ketamine group (p=0.36)	Method of induction unregulated and unclear. Retrospective analysis renders the study open to multiple confounders. Ketmaine used in tandem with other anaesthetic agents as part of TIVA. No raw ICP data provided
Gofrit *et al* 1996, Israel	29 prehospital care patients with GCS<8, following a single failed attempt at intubation using standard techniques. Head was the primary site of injury in 25 of these patients	Prospective cohort study (level of evidence 4)	Successful intubation following ketamine administration Survival to hospital Complications attributed to ketamine	19 patients (65.5%) 100% 0%	No comparator group. No standardised description of initial pharmacological/practical approach to intubation. No ICP data of any kind. No presentation of morbidity data. Large standardised ketamine dosage
Jabre *et al* 2009, France	104 trauma patients within 655 prospectively enrolled critically ill patients needing sedation for emergency intubation. No clarification of proportion with associated traumatic brain injury. Patients were randomly assigned to recieve intial sedation for RSI with either 0.3 mg/kg Etomidate or 2 mg/kg Ketamine	Subgroup analysis within single blind prospective RCT (level of evidence 2b)	Maximum Sequential Organ Failure Assessment (SOFA) score during the first three days ICU admission Mortality at 28 days	Mean SOFAmax for etomidate group 10.0(SD3.5) vs 9.9(SD2.8). Asolute difference 0.1 (95% CI 1.2 to 1.3) 26.3% (Etomidate group) vs 29.8% (Ketamine group). OR 0.8 (95% CI 0.4 to 2.0)	Approximately 30% initially recruited patients withdrawn following early critical care discharge, death or missing data. Underpowered for analysis of trauma patients and therefore at significant risk of type 2 error. Patients dying before arrival to hospital also exlcuded, a potential cohort of interest regarding the BET subject matter

ketamine/)) AND ((exp intubation, intratracheal/) or (rapid sequence induction.mp) or exp (anesthesia, general/) or (rapid sequence intubation.mp)) AND ((intracranial pressure.mp) or (exp intracranial pressure/) or ICP.mp) AND ((head injury.mp) or (exp craniocerebral trauma/) or (head injur$.mp)) EMBASE (1980 to week 4 September 2011): {((exp ketamine/))} AND {((exp intracranial hypertension/) OR (exp head injury/)) AND (exp anesthesia, induction) OR (exp endotracheal intubation/))}. Both search strategies were limited to English language, humans and adults. The Cochrane database of systematic reviews was also searched for any articles including the term ketamine.

SEARCH OUTCOME

Two hundred and seventy-six articles were identified. Of these, 18 were deemed directly relevant and assessed by abstract. Following further review, 5 papers were retained for critical appraisal. Of these articles, two narrative literature reviews and a predefined subgroup analysis within a prospective single blind randomised controlled trial (RCT) formed the highest level of evidence. All five articles are reviewed below:

COMMENT

The only controlled trial comparing ketamine as an induction agent to any other pharmacotherapy for RSI in patients with traumatic brain injury (TBI) is the paper by Jabre *et al* Although predefined, the subgroup analysis of trauma patients within the overall cohort is underpowered and the authors are non specific about the prevalence of traumatic brain injury within this group. Thus the highest level of evidence to answer the predefined question is 2b only. Initial concerns with ketamine use in head injured patients originate from small case control studies in the early 1970's. Ketamine administration for diagnostic pneumoventriculography in spontaneously breathing patients and procedural sedation in those with abnormal CSF flow dynamics has previously demonstrated a potentially detrimental rise in ICP. (Gibbs 1972, Evans *et al* 1971, Gardner *et al* 1971, Shapiro *et al* 1972 and List *et al* 1972). This rise was most pronounced in those with abnormal cerebrospinal fluid (CSF) pathways, with a consequent drop in cerebral perfusion pressure (CPP). However, the healthy patients involved in these studies actually demonstrated a rise in mean arterial pressure (MAP) and a concommitant increase in cerebral blood flow with intravenous ketamine usage, at doses compatible with induction. Calculations of CPP from this published data are suggestive that ketamine actually improves cerebral perfusion. Thus, in the absence of obstructed CSF flow pathways, this data goes some way to support the use of ketamine in head injured patients rather than refute it. Ketamine has been increasingly utilised in the prehospital environment in recent years, (Sibley *et al* 2011) based on maintenance of airway reflexes, predictability and cardiovascular stability. Indeed, hypotension unarguably increases mortality and worsens secondary brain injury: ketamine has the potential to limit hypotensive sequelae in those necessitating emergency intubation. Prehospital practice has now encouraged adoption in secondary care, with increasing use of ketamine based agents for sedation in the emergency department. (Senser S *et al* 2011). Critical care physicians have also warmed to its use in limiting physiological disturbance during temporarily distressing procedures such as endotracheal suction and for prolonged sedation, even in known TBI. (Bar-Joseph *et al* 2009 and Sibley *et al* 2011). In these patients, often with ICP monitors, a further evidence base is emerging to refute the previously proposed physiological disadvantages of the drug.

LEVEL OF EVIDENCE

Level 2—Studies considered were neither 1 or 3.

Clinical bottom line

There is no evidence to suggest harm with Ketamine use as induction agent for the patient with potential traumatic brain injury. The drug has major advantages in those patients with associated haemodynamic compromise and should potentially be regarded as the agent of choice.

- **Filanovsky Y**, Miller P, Kao J. Myth: ketamine should not be used as an induction agent for intubation in patients with head injury. *Can J Emerg Med* 2010;**12**:154—7.
- **Sehdev RS**, Symmons DA, Kindi K. Ketamine for rapid sequence induction in patients with head injury in the emergency department. *Emerg Med Australas* 2006;**18**:37—44.
- **Grathwohl KW**, Black IH, Spinella PC, *et al*. Total intravenous anesthesia including ketamine versus volatile gas anesthesia for combat-related operative traumatic brain injury. *Anaesthesia* 2008;**109**:44—53.
- **Gofrit ON**, Leibovici D, Shemer J, *et al*. Ketamine in the field: the use of ketamine for induction of anaesthesia before intubation in injured patients in the field. Injury 1996;**28**:41—3.
- **Jabre P**, Cornbes X, Lapostolle F, *et al*; KETASED Collaborative Study Group. Etomidate versus ketamine for rapid sequence intubation in acutely ill patients: a multicentre randomised controlled trial. *Lancet* 2009;**374**:293—300.
- **Gibbs JM.** The effect of intravenous ketamine on cerebrospinal fluid pressure. *Br J Anaesth* 1972;**44**:1298—301.
- **Evans J,** Rosen M, Weekes D, *et al*. Ketamine in neurosurgical procedures. Lancet 1971;**297**:40—1.
- **Gardner AE**, Olson BE, Lichtiger M. Cerebrospinal fluid pressure during dissociative anesthesia with ketamine. Anaesthesiology 1971;**35**:226—8.
- **Shapiro HM**, Wyte SR, Harris AB. Ketamine anaesthesia in patients with intracranial pathology. *Br J Anaesth* 1972;**44**:1200—4.
- **List WF**, Crumrine RS, Cascorbi HF, *et al*. Increased cerebrospinal fluid pressure after ketamine. *Anaesthesiology* 1972;**36**:98—9.
- **Sibley A**, Mackenzie M, Bawden J, *et al*. A prospective review of the use of ketamine to facilitate endotracheal intubation in the helicopter emergency medical services (HEMS) setting. *Emerg Med J* 2011;**28**:521—5.
- **Sener S**, Eken C, Schultz C, *et al*. Ketamine with and without midazolam for emergency department sedation in adults: a randomized controlled trial. *Ann Emerg Med* 2011;**57**:109—14.
- **Bourgain A**, Albanese J, Leone M, *et al*. Effects of sufentanil or ketamine administered in target controlled infusion on the cerebral haemodynamics of severely brain injured patients. *Crit Care Med* 2005;**33**:1109—13.
- **Bar-Joseph G**, Guilburd Y, Guilburd J. Ketamine effectively prevents intracranial pressure elevations during endotracheal suctioning and other distressing interventions in patients with severe traumatic brain injury. *Crit Care Med* 2009;**37** (12 Suppl A402):90—3493.

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BET 4: IS INTRANASAL FENTANYL BETTER THAN PARENTERAL MORPHINE FOR MANAGING ACUTE SEVERE PAIN IN CHILDREN?

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ABSTRACT

A short cut review was carried out to establish whether intranasal fentanyl is better than parenteral morphine for managing acute severe pain in children. 51 papers were found using the reported searches, of which 4 presented the best evidence to answer the clinical question. The author, date and country of publication, patient group studied, study type, relevant outcomes, results and study weaknesses of these best papers are tabulated. It is concluded that intranasal fentanyl is an effective and safe alternative to IV or IM morphine

BET 3: Is ketamine a viable induction agent for the trauma patient with potential brain injury

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