**BEST EVIDENCE TOPIC REPORTS**

Towards evidence based emergency medicine: Best BETs from the Manchester Royal Infirmary

Edited by K Mackway-Jones

Best Evidence Topic reports (BETs) summarise the evidence pertaining to particular clinical questions. They are not systematic reviews, but rather contain the best (highest level) evidence that can be practically obtained by busy practicing clinicians. The search strategies used to find the best evidence are reported in detail in order to allow clinicians to update searches whenever necessary. Each BET is based on a clinical scenario and ends with a clinical bottom line which indicates, in the light of the evidence found, what the reporting clinician would do if faced with the same scenario again.

The BETs published below were first reported at the Critical Appraisal Journal Club at the Manchester Royal Infirmary1 or placed on the BestBETs website. Each BET has been constructed in the four stages that have been described elsewhere.2 The BETs shown here together with those published previously and those currently under construction can be seen at http://www.bestbets.org.3 Four BETs are included in this issue of the journal.

- Prehospital endotracheal intubation in adult major trauma patients with head injury
- Headache in paediatric head injury
- S-100b protein levels as a predictor for long-term disability after head injury
- Aspirin and the risk of intracranial complications following head injury

K Mackway-Jones, Department of Emergency Medicine, Manchester Royal Infirmary, Oxford Road, Manchester M13 9WL, UK; Kevin.mackway-jones@man.ac.uk


Prehospital endotracheal intubation in adult major trauma patients with head injury

Report by Ayan Sen, Senior House Officer, Critical Care

Search checked by Raj Nichani, Specialist Registrar, Anaesthesia and Critical Care

Manchester Royal Infirmary, Manchester, UK
doi: 10.1136/emj.2005.031716

Abstract

A short cut review was carried out to establish whether prehospital intubation was of benefit to patients with moderate to severe head injury. 4630 papers were found using the reported searches, of which 9 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 prehospital intubation is associated with increased mortality in these patients.

Clinical scenario

A 41 year old car driver was involved in a major road traffic accident, sustaining injuries to his head, a fracture of his right femur and multiple bruises on his chest. On scene he had altered sensorium and his GCS was estimated to be 5. He was intubated by the paramedics and brought to the Emergency Department. You wonder about the evidence in favour of endotracheal intubation as compared to bag and mask ventilation in trauma patients.

Three part question

In [patients with major trauma and head injury needing airway management in prehospital setting] is [endotracheal intubation better than bag and mask ventilation] for [improved outcomes]

Search strategies

Medline 1966-Week 4 August 2005 using the OVID interface, {Cochrane Prehospital Search filter} AND (exp Intubation, Intratracheal/ or endotracheal intubation.mp. OR ETL.mp. OR RSI.mp OR rapid sequence intubation.mp), Embase 1980-2005 week 37, {exp Emergency Health Service/ OR exp Rescue Personnel/ OR exp Emergency Treatment/ OR exp Emergency Medicine/ OR exp Ambulance/ OR exp First Aid/ OR exp Military Medicine/} AND [intratracheal intubation.mp. OR exp Endotracheal Intubation/ OR ETL.mp. OR RSI.mp. OR rapid sequence intubation.mp. OR rapid sequence induction.mp.] LIMIT to Human, English Language, Abstracts, (adult <18 to 64 years> or aged <65+ years>) and Clinical Queries Prognosis filter – sensitive, The Cochrane Library Issue 3 2005, exp intubation, intratracheal [MeSH] AND exp Emergency Medical Services [MeSH]

Search outcome

4360 papers found, of which nine were relevant and of sufficient quality for inclusion. These are summarised in the table:

Comments

Quite a few studies have been conducted to address the question of prehospital endotracheal intubation in major trauma victims needing airway management. All of them are of retrospective design and most of them show that there is increased mortality, longer transit times with prehospital endotracheal intubation. The reasons could be difficulty in ascertaining tube position, paramedic experience,
<table>
<thead>
<tr>
<th>Author, country, date</th>
<th>Patient group</th>
<th>Study type</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Study weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hoyt DB, 1997 USA</td>
<td>All adult trauma patients admitted to trauma centres in San Diego county from 1991–1995 who underwent field intubation when GCS ≤ 8 or were intubated and 527 were not intubated in field</td>
<td>Retrospective registry based review</td>
<td>Scene GCS scores in intubated and non-intubated groups</td>
<td>No difference</td>
<td>Retrospective design, matching may have left out important parameters, multivariate analysis not done, functional outcomes not compared</td>
</tr>
<tr>
<td>Slosne et al, 2000 USA</td>
<td>All adult trauma patients who underwent prehospital RSI to 1995 (47 patients) compared with those who had RSI upon arrival to trauma resuscitation centre 1992-1995 (537 patients) as per RSI protocol</td>
<td>Retrospective study</td>
<td>Field intubation versus hospital intubation success rates</td>
<td>97.9% versus 98.5%</td>
<td>Retrospective study, small sample of field intubation, matching was not adequate esp. related to age, retrospective definition of number of attempts at intubation and record review, field patients had worse trauma severity scores, no blinding of data collector</td>
</tr>
<tr>
<td>Murray et al, 2000 USA</td>
<td>All adult patients with severe head injury GCS ≤ 8, head AIS score &gt; 3 over a 3 yr period 1995-1997 who were intubated (81) in the field or non-intubated (714) and 403 BVM</td>
<td>Retrospective study, review of trauma registry</td>
<td>Crude mortality figures in intubated versus non-intubated group</td>
<td>82% versus 43%, OR 1.88 (CI 1.65 to 2.15)</td>
<td>Retrospective design, matching done but certain critical parameters missed out, selection bias, only patients with more severe injuries selected for intubation</td>
</tr>
<tr>
<td>Eckstein et al, 2000 USA</td>
<td>All adult patients from 1993 to 1995 who met trauma centre criteria, had airway intervention performed by paramedics and transported to medical centre, ETI or BVM done as per hospital policy, 93 patients had ETI and 403 BVM</td>
<td>Retrospective cohort study</td>
<td>Prehospital transit time for ETI versus BVM</td>
<td>12.8 mins versus 11 mins p = 0.09</td>
<td>Data obtained from paramedic field reports, retrospective study, groups compared by age, gender and not true controls, effect of hyperventilation not studied, small number of patients with ETI, despite adjustment for ISS through logistic regression, ETI group had a very high mortality based on ISS, limitations of ISS, RSI not used</td>
</tr>
<tr>
<td>Bocchini et al, 2003 USA</td>
<td>Data collected on 191 patients admitted to a trauma centre with field GCS ≤ 8, head AIS score &gt; 3 over a 3 y period 1995-1997 who were intubated (78) in the field or intubated on arrival to hospital (113), patients who died within 48 hrs excluded</td>
<td>Prospective cohort study</td>
<td>Dispatch time field ETI versus hospital ETI</td>
<td>p = 0.05</td>
<td>Cohort study, death within 48 hrs excluded, individual paramedic bias in intubation, difference between ground and state paramedic flight parameters, lack of longterm data or functional outcomes, bias on the practice of neurosurgeons</td>
</tr>
<tr>
<td>Davis et al, 2003 USA</td>
<td>Adult major Trauma victims with severe head injuries &gt; 18 y, suspected head injury by mechanism or physical findings, GCS 3-8, estimated time for transport &gt;10 minutes, exclusion if unable to achieve IV access or needed PR before RSI</td>
<td>Prospective cohort study</td>
<td>Mortality in ETI versus BVM</td>
<td>33% VERSUS 24.2%, OR 1.6 (CI 1.1 to 2.2)</td>
<td>Cohort study with historical controls though matched well, GCS not used for matching as they were not consistently calculated pre-trial cohort and omitted from trial as they were paralysed and intubated, higher mortality in RSI cohort who had low GCS2, possibility of hyperventilation contributing to increased mortality, Other parameters may have been present which were unmatched in the two groups</td>
</tr>
<tr>
<td>Stockinger Z, Mannheim, 2004 USA</td>
<td>Review of records from Dec 1999 to Sept 2002 who met level 1 trauma criteria and who received ETI or BVM ventilation</td>
<td>Retrospective cohort study</td>
<td>Overall mortality</td>
<td>65.3%</td>
<td>Retrospective design, record review, not controlled, small number of ETI survivors to compare functional outcomes or prehospital transit time, inadequately matched groups</td>
</tr>
<tr>
<td>Wang et al, Nov 2004 USA</td>
<td>All trauma patients &gt; 18 years sustaining severe traumatic brain injury who were intubated in prehospital or hospital setting</td>
<td>Retrospective cohort study</td>
<td>Prehospital versus hospital intubation mortality</td>
<td>OR of 3.99 (CI 3.21 to 4.93)</td>
<td>Non-randomised study, use of pre-existing and unvalidated registry, unvalidated functional impairment score, adjustment not done for some factors that could affect prehospital intubation, no information of course of ED airway care, Could not identify failed prehospital intubation efforts and analysis, propensity score used but matching techniques not used</td>
</tr>
<tr>
<td>Davis DP et al, 2005, USA</td>
<td>13,625 patients with moderate to severe traumatic brain injury included on a country trauma registry of whom 19.3% were intubated in the prehospital environment</td>
<td>Mortality</td>
<td>Increased with prehospital intubation (OR 0.36 p &lt; 0.001)</td>
<td></td>
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</tbody>
</table>
hyperventilation, transient hypoxia, or lack of sufficient pre-oxygenation prior to RSI. Prospective multi-centre randomised trials are needed to avoid the inherent problems associated with the study designs.

► CLINICAL BOTTOM LINE
Prehospital endotracheal intubation is associated with increased mortality in patients with moderate to severe traumatic brain injury

Winchell RJ, Hoyt DB. Endotracheal intubation in the field improves survival in patients with severe head injury. Archives of Surgery 1997;132:592–597


Headache in paediatric head injury

Report by Michelle Jacobs

Search checked by Ian Maconochie, Consultant
St Mary’s Hospital, London, UK

doi: 10.1136/emj.2005.031724

Abstract

A short cut review was carried out to establish whether headache was a significant indicator of the severity of head injury in children. 301 papers were found using the reported searches, of which 2 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 headache is not an independent risk factor for intracranial injury in children.

Clinical scenario

A 10 year old girl has presented on several occasions since a recent head injury with a persistent headache. Clinical examination has previously been documented as normal. You wonder how significant the headache is with respect to the initial head injury.

Three part question

In [a child with a head injury] does [the presence of headache] predict [intracranial injury]?

Search strategies

Medline 1966– Week 4 August 2005 [exp brain injuries/ or brain injur$.mp. or exp craniocerebral trauma/ or head injur$.mp.] AND [exp headache/ or headache.mp.] AND [BestBETs Paediatric filter ] LIMIT to Human AND English. Embase 1980–2005 week 37 [craniocerebral trauma.mp. OR Head Inj/] OR exp Brain injury/ OR brain injur$.mp.] AND [exp headache/ OR headache.mp.] LIMIT to Human, English Language. Abstracts and (infant <1 to one year>) or child (unspecified age>) or preschool child <1 to 6 years>) or school child <7 to 12 years>) or adolescent <13 to 17 years>) The Cochrane Library Issue 3 2005 Exp brain injuries [MeSH] OR exp craniocerebral trauma [MeSH] AND exp headache [MeSH] AND exp Child [MeSH]

Search outcome

Altogether 301 papers were found, of which one was a meta-analysis. One further paper postdated the meta-analysis. These two papers are shown in the table.

Comments

The consensus opinion is that the presence of headache does not correlate with the presence of or severity of intracranial injury in children. Several retrospective studies found high levels of association between extradural haemorrhage and initial presentation symptoms including headache. However, these were a highly selected group of patients and small numbers were involved.

► CLINICAL BOTTOM LINE
Headache does not appear to be an independent risk factor for intracranial injury in children.


S-100b protein levels as a predictor for long-term disability after head injury

Report by John-Paul Lomas, House Officer

Search checked by Joel Dunning, Clinical Research Fellow

Manchester Royal Infirmary, Manchester, UK
doi: 10.1136/emj.2005.031732

Abstract

A short cut review was carried out to establish whether levels of S-100b were predictive of long-term disability after head injury. 200 papers were found using the reported searches, of
## Table 3

<table>
<thead>
<tr>
<th>Author, country, date</th>
<th>Patient group</th>
<th>Study type</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Study weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterloo K et al, 2005, Norway</td>
<td>7 patients with high S-100b after mild head injury matched with 7 patients with no detectable S-100b</td>
<td>Case control study</td>
<td>Overall cognitive function</td>
<td>No difference</td>
<td>Non-independent gold standard</td>
</tr>
<tr>
<td>Rothwell et al, 1999, Germany</td>
<td>30 patients with a severe head injury (GCS&lt;5) and 11 with minor head injury (GCS 13-15) admitted to a neurological unit, 5-100 levels measured mean 2.5 hrs after injury</td>
<td>Diagnostic Cohort study (4)</td>
<td>Glasgow Outcome Scale on discharge (Mean days 19 in severe group and mean day 1.3 in minor head injury group), Detectable level of S-100 (&lt;0.5mcg/l)</td>
<td>Patients with GOS 3-5 S-100 level mean 1.2mcg/l SD 3.8</td>
<td>Non-independent gold standard</td>
</tr>
<tr>
<td>Rosba A et al, 1999, Germany</td>
<td>82 patients after severe head injury (GCS &lt; 8), s-100 taken at admission and every 24 hours</td>
<td>Diagnostic cohort study (2b)</td>
<td>Glasgow outcome score at 6 months</td>
<td>For S-100 level of &gt;2.0mcg/l, unfavourable outcome was predicted with Sensitivity 44%</td>
<td>Non-consecutive</td>
</tr>
<tr>
<td>Woertgen et al, 1999, Germany</td>
<td>44 patients after severe head injury (GCS score &lt; 8)</td>
<td>Diagnostic cohort study (3b)</td>
<td>Glasgow outcome score calculated at mean 11 months after trauma (GOS 1-3 uncorrectable)</td>
<td>Sensitivity 97% Specificity 95%</td>
<td>Tables 2, 3 and 4 are incorrect, with errors printed in a later edition</td>
</tr>
<tr>
<td>Ingelbrigtzen et al, 1999, Sweden</td>
<td>50 patients with minor head injury and LOC (GCS 13-15) referred to Neurosurgery dept after CT scan</td>
<td>Diagnostic cohort study (3a)</td>
<td>Neuropsychological testing at 3 months (for attention, psychomotor speed, trail-making test, memory, digit span) In 36 patients, MRI and CT scan findings within 48hrs</td>
<td>There were no significant trends to reduced impairment in the S-100 negative group 4 of 5 patients with brain contusion had S-100 &gt;0.4mcg/l Sensitivity 80% (p = 0.03)</td>
<td>Small sample size with no sample size estimates</td>
</tr>
<tr>
<td>Mussak T et al, 2000, Germany</td>
<td>182 patients from 3 centres with GCS 13-15 and brief Loss of Consciousness. 5-100 taken on admission</td>
<td>Diagnostic cohort study (2b)</td>
<td>Rivermead post concussion symptoms questionnaire score (RPCQ) In 36 patients.</td>
<td>Patients with a positive S-100 had mean RPCQ 6.0 vs 4.0 in S-100 negative group p = 0.07</td>
<td>Only 36 of 50 patients followed up at 3 months</td>
</tr>
<tr>
<td>Herrmann et al, 2001, Germany</td>
<td>69 patients admitted to a neurological unit (mostly GCS &gt;13)</td>
<td>Diagnostic study (3b)</td>
<td>Intracranial pathology on CT scan at &lt;24 hours</td>
<td>Patients discharged &lt; =6hrs 0.29 +/- 0.11 ng/ml Patients discharged &gt; =24hrs 0.70 +/- 0.19 ng/ml</td>
<td>No gold standard outcome measures</td>
</tr>
<tr>
<td>Chatfield DA et al, 2002, UK</td>
<td>20 patients with severe head injury (GCS&lt;8) admitted to neurological unit s-100 taken at admission</td>
<td>Diagnostic cohort study (4)</td>
<td>Glasgow outcome score at 6 months after trauma (GOS 1-3 uncorrectable)</td>
<td>Patients with GOS 1-3 S-100 level mean 2.66 +/- 0.32mcg/l</td>
<td>Data not clearly presented</td>
</tr>
<tr>
<td>Townsend WD et al, 2002, UK</td>
<td>148 adult head injury patients (GCS 6-15) in 4 hospitals. Most had a minor head injury. 5-100 levels taken within 6 hours of head injury</td>
<td>Diagnostic study (2b)</td>
<td>Extended Glasgow outcome score at 1 month</td>
<td>S-100 &lt; 0.5mcg/l predicted severe disability (1-5 patients with GOS&lt;5) Sensitivity 93% (63%-100%) Specificity 72% (54%-79%) NPV 95% (93%-100%)</td>
<td>Non-consecutive Wide definition of head injury (including no LOC) 80% follow up rate</td>
</tr>
<tr>
<td>Spinella et al, 2003, USA</td>
<td>27 children &lt; 18yrs with traumatic brain injury</td>
<td>Diagnostic cohort study (3a)</td>
<td>Pediatric Cerebral performance category score (PCPQ) assessed at discharge and 6 months</td>
<td>For s-100 level of &gt; 2.0mcg/l, unfavourable outcome was predicted with Sensitivity 86% Specificity 95%</td>
<td>No cut off points or ROC curves calculated Very small study</td>
</tr>
<tr>
<td>Senkila O &amp; Hillbom M, 2003, Finland</td>
<td>172 consecutive patients with mild head injury (GCS 13-15)</td>
<td>Diagnostic cohort study (2b)</td>
<td>Post concussional symptoms defined by Rivermead Post Concussion Symptoms Questionnaire at 2-6 weeks</td>
<td>Sensitivity 27% Specificity 93%</td>
<td>Non-consecutive No confidence intervals or sample size calculations</td>
</tr>
</tbody>
</table>
which 12 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 a raised level of S-100b is a marker of poorer long-term outcome after both major and minor head injury.

Clinical Scenario
A 17 year old male presents to the Emergency Department after a road traffic accident. His GCS was 8 on arrival but an immediate CT scan showed no focal abnormality. His GCS returned to 14 after 4 hours. You are talking to his mother who is reassured that he does not need urgent neurosurgery, but she asks whether he will suffer any long term consequences from this injury. You tell her that it is difficult to predict. You have recently heard that S-100 protein measurement is available in your hospital for research purposes. You wonder whether S-100 could help predict his long term prognosis.

Three part question
In [patients with a head injury] do [levels of S-100B protein] predict [long-term disability]?

Search strategy
Medline 1966-Week 4 August 2005 using the OVID interface [(exp S100 Proteins/ OR s100.mp OR s-100.mp) AND (exp Brain Injuries/ OR brain injury.mp OR exp Cerebrocerebral trauma/ OR head inj$.mp)] Embase 1980-2005 week 37 [exp Protein S100/ OR s100.mp OR s-100.mp] AND [exp Brain Injury/ OR brain injury.mp. OR cerebrocerebral trauma.mp. OR head Injury/] LIMIT to Human and English Language The Cochrane Library Issue 3 2005 Exp Brain injuries [MeSH] OR exp Cerebrocerebral trauma [MeSH] AND exp S100 proteins [MeSH]

Search outcome
200 papers were found of which 13 were found to be relevant. Two relevant papers described the same patient population. The remaining 12 papers are shown in the table.

Comments
All studies were under 200 patients in size and most were under 100 patients. The studies find sensitivities from 27%–95% and specificities from 70% to 97%. The reasons for this great variation in findings may in large part be due to the small sample sizes. The specificities seem to perform better than the sensitivities and thus the finding of a high S-100 protein measurement is available in your hospital for research purposes. You wonder whether S-100 could help predict his long term prognosis.

► CLINICAL BOTTOM LINE
A high S-100 is a marker of poorer long term outcome following minor and major head injury.

Aspirin and the risk of intracranial complications following head injury

Report by Magdy Sakr, Consultant in Emergency Medicine
Search checked by Libby Wilson, Clinical Research Fellow
University of Coventry and Warwickshire, UK
doi: 10.1136/emj.2005.031740

Abstract
A short cut review was carried out to establish whether pre-injury aspirin increases the risk of intracranial complications following head injury. 124 papers were found using the reported searches, of which three 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 aspirin may increase the risk of developing intracranial complications. More research is needed.

Clinical scenario
A 65 year old man on aspirin presents to the Emergency Department having fallen sustaining a minor head injury. You wonder whether he is at higher risk of intracranial bleeding due to aspirin.

Three part question
In [adults with head injury] does [pre-injury aspirin] adversely [affect clinical outcome]?
Altogether 103 were found in Medline and 104 in Embase. Three were relevant to the three part question, these are shown in the table below:

<table>
<thead>
<tr>
<th>Author, country, date</th>
<th>Patient group</th>
<th>Study type</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Study weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reymond MA et al, 1992, Switzerland</td>
<td>189 patients with severe head injury</td>
<td>Retrospective Risk analysis</td>
<td>Chronic subdural haematoma</td>
<td>Aspirin is a risk factor for chronic subdural haematoma</td>
<td>Retrospective nature of the study</td>
</tr>
<tr>
<td>Mina AA et al, 2002, USA</td>
<td>37 patients admitted with intracranial injury on anticoagulants 37 case matched patients</td>
<td>Retrospective case controlled</td>
<td>Mortality due to head injury</td>
<td>Higher percentage of those on aspirin than any other anticoagulant died</td>
<td>Retrospective, Subgroup analysis, and small sample size</td>
</tr>
<tr>
<td>Spektor S et al, 2003, Israel</td>
<td>Mild (GCS13-15) and moderate (GCS 9-12) head injuries in 231 patients &gt;60 years old, 110 of which were on aspirin therapy</td>
<td>Prospective cohort study</td>
<td>Intracranial haemorrhage</td>
<td>No difference in frequency or type of ICH whether on aspirin or not</td>
<td>Small sample size</td>
</tr>
</tbody>
</table>

Mild & moderate injuries included

Comments
There was conflicting evidence that prior chronic use of aspirin increases the risk of intracranial haemorrhage following minor head injury. However, there is some evidence to suggest that there is increased risk of chronic subdural haemorrhage. A well designed prospective cohort study with adequate sample size and follow up is needed to address such important and common problem.

> CLINICAL BOTTOM LINE
Pre-injury aspirin may increase the risk of intracranial complications following head injury. More research is needed.

Towards evidence based emergency medicine: Best BETs from the Manchester Royal Infirmary

K Mackway-Jones

doi: 10.1136/emj.2005.031708

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