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 practising clinicians. The search strategies used to find the best evidence are reported in detail in order to allow clinicians to update searches whenever necessary.

Five of the BETs published below were first reported at the Critical Appraisal Journal Club at the Manchester Royal Infirmary.1 Four guest BETs submitted from around the world are also shown. 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.org3


Negative urine analysis to exclude urinary tract infection
Report by Bruce Martin, Specialist Registrar in Emergency Medicine
Checked by Angaj Ghosh, Senior Clinical Fellow

Clinical scenario
A very anxious mother brings her 4 year old daughter to the emergency department concerned about her persistent fever. Examination reveals that she does indeed have a temperature of 37.6°C. She has no obvious signs of localised infection, so you decide that you need to test her urine to see whether she has got a urinary tract infection (UTI). After much coaxing she provides you with a sample but you now wonder if dipstick analysis is sufficient for diagnosis, or whether you ought to arrange for urgent microscopy.

Three part question
In [children with pyrexia with suspected UTI] is [dipstick urine analysis as sensitive as microscopy] in [ruling out infection]?

Search strategy
Medline 1966–08/01 using the OVID interface. {(exp adolescence/ OR exp child/ or exp child of impaired parents/ or exp child, abandoned/ or exp child, exceptional/ or exp child, hospitalized/ or exp child, institutionalized/ or exp child, preschool/ or exp child, unwanted/ or exp disabled children/ or exp homeless youth/ or exp infant/ or exp only child/ OR child$.mp) OR (exp pediatrics/ OR pediatric$.mp OR paediatric$.mp)} AND (exp Indicators/ and reagents/ OR exp Reagent strips/ OR exp Urinalysis/ OR dipstick.mp) AND (exp Urinary tract infections/ OR urinary tract infection.mp) AND (exp “sensitivity and specificity”/ or “sensitivity and specificity”.mp OR diagno$.mp OR exp Diagnosis/) LIMIT to human AND english.

Search outcome
Altogether 156 papers found. Of these, one was a recent meta-analysis that included all those papers identified as answering the three part question (table 1)
### Table 1

<table>
<thead>
<tr>
<th>Author, date and country</th>
<th>Patient group</th>
<th>Study type (level of evidence)</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Study weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gorelick MH and Shaw KN, 1999, USA</td>
<td>Children from 26 previous studies age range from 0–21 years and from outpatients, wards and emergency departments</td>
<td>Meta-analysis</td>
<td>Sensitivity and specificity of Gram stain, leucocyte esterase, nitrite and pyuria against a gold standard of urine culture. Only tests using definition of UTI as &gt;100 000 colony forming units used for calculating sensitivity and specificity</td>
<td>Sensitivity: Gram stain 0.93, leucocyte esterase or nitrite 0.88, Pyuria 0.67 (&gt;5 WC), 0.77 (&gt;10 WC) Specificity: Gram stain 0.95, leucocyte esterase and nitrite 0.96</td>
<td>Significant heterogeneity between tests performed, method of collection, age group, setting and definition of UTI</td>
</tr>
</tbody>
</table>

### Clinical bottom line
Children who present with fever and who have positive dipstick testing for leucocyte esterase and nitrite should be given antibiotics and referred for further investigation. Dipstick testing would appear to have the sensitivity for children with negative testing to be discharged, with the urine being sent for Gram stain and culture the following day rather than arranging urgent microscopy.


### Intramuscular piroxicam or intramuscular diclofenac for renal colic

**Report by Russell Boyd, Consultant in Emergency Medicine**
**Checked by Polly Terry, Specialist Registrar in Emergency Medicine**

### Clinical scenario
A 35 year old man presents to the emergency department with acute renal colic proven on urine dipstick analysis and urgent IVU. His pain is severe and you would like to give him IM diclofenac as he is vomiting and it is your current practice. He tells you he developed a sterile abscess last time he was given IM diclofenac. You wonder if an alternative NSAID, piroxicam, given by the IM route would be as effective as the diclofenac you are reluctant to give.

### Three part question
[In renal colic] is [IM piroxicam or IM diclofenac] better [at reducing pain]?

### Search strategy
Medline 1966–08/01 using the OVID interface. [exp piroxicam/ OR piroxicam.mp OR feldene.mp] AND [exp diclofenac/ OR diclofenac.mp OR voltarol.mp] AND [exp kidney calculi/ OR exp Ureteral calculi/ OR renal colic.mp]

### Search outcome
Two papers were identified of which one was relevant (table 2).

### Comment(s)
Both forms of IM NSAID work well with some small advantage in favour of piroxicam in terms of pain relief at 30 minutes. IM voltarol has several notable administration problems that piroxicam does not.

### Clinical bottom line
IM piroxicam appears to perform better than IM diclofenac for renal colic pain relief. Given it has fewer injection site side effects IM piroxicam should replace IM diclofenac for renal colic.


### Table 2

<table>
<thead>
<tr>
<th>Author, date and country</th>
<th>Patient group</th>
<th>Study type (level of evidence)</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Study weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-Waili NS and Saloom KY, 1999, Germany</td>
<td>64 patients with proven diagnosis of renal colic on IVU, USS and clinical examination Those taking NSAIDs or pethidine on long term basis excluded</td>
<td>Double blind randomised controlled study</td>
<td>Change in mean pain scores at 30 and 60 minutes post administration of 75 mg IM diclofenac or 40 mg IM piroxicam as measured on a Visual Analogue 10 cm line</td>
<td>Both treatments dramatically decreased pain scores by 30 minutes. Diclofenac pre-treatment score 7.83 and 30 minutes post treatment score 1.47; piroxicam pre-treatment score 7.41 with 30 minutes post treatment score 0.84. There was a significant improvement in favour of piroxicam for pain relief at 30 minutes (t test of means p&lt;0.05)</td>
<td>The blinding mechanism is not given Uncertain of sampling method</td>
</tr>
</tbody>
</table>

### Oral (fast dissolving) piroxicam or intramuscular diclofenac for renal colic

**Report by Russell Boyd, Consultant in Emergency Medicine**
**Checked by Polly Terry, Specialist Registrar in Emergency Medicine**

### Clinical scenario
You have just seen a patient with presumed renal colic. You have prescribed a dose of IM diclofenac as per departmental policy but wonder if a newer fast dissolving oral piroxicam agent would be as effective as the usual parenteral diclofenac agent.
Table 3

<table>
<thead>
<tr>
<th>Author, date and country</th>
<th>Patient group</th>
<th>Study type (level of evidence)</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Study weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervia A et al, 1998, Spain</td>
<td>80 sequential patients with a clinical diagnosis of renal colic confirmed by either urine analysis or ultrasound.</td>
<td>Double blind randomised controlled trial</td>
<td>Pain as measured by visual analogue score at 30 minutes</td>
<td>Both treatments significantly reduced pain scores at 30 minutes post administration. No significant difference evident between treatments in terms of efficacy of pain relief.</td>
<td>Relatively small numbers with no power study so possible type II error.</td>
</tr>
</tbody>
</table>

Three part question
In [renal colic] is [oral fast dissolving piroxicam or IM diclofenac] better [at reducing pain]?

Search strategy
Medline 1966–08/01 using the OVID interface. [exp Diclofenac/ OR exp diclofenac sodium/ OR diclofenac.mp OR voltarol.mp] AND [exp piroxicam/ OR piroxicam.mp OR feldene.mp] AND [renal colic.mp OR exp ureteral calculi/ OR exp renal calculi]

Search outcome
Two papers were identified of which one was found to be relevant (table 3).

NIPPV for acute cardiogenic pulmonary oedema
Report by Rupert Jackson, Specialist Registrar in Emergency Medicine
Checked by Steve Jones, Specialist Registrar in Emergency Medicine

Clinical scenario
A 76 year old man is brought in to the emergency department in a collapsed state. He has a history of ischaemic heart disease. He is agitated, tachypnoeic and sweating profusely. His neck veins are distended and there are widespread coarse crepitations in his chest. He has a diminished oxygen saturation. You make a clinical diagnosis of acute cardiogenic pulmonary oedema. In addition to vasodilator treatment and opioids, you wonder whether you should administer non-invasive positive pressure ventilation (NIPPV).

Three part question
In [patients with acute LVF] is [NIPPV better than alternative treatment strategies] at [avoiding intubation and improving mortality]?

Search strategy
Medline 1966–08/01 using the OVID interface. [exp pulmonary edema/ or “pulmonary edema”]

Table 4

<table>
<thead>
<tr>
<th>Author, date and country</th>
<th>Patient group</th>
<th>Study type (level of evidence)</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Study weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mehta S et al, 1997, USA</td>
<td>27 patients with ACPO NIPPV v CPAP</td>
<td>Prospective randomised controlled trial</td>
<td>Clinical variables</td>
<td>BP and PaCO2 lower in NIPPV group (p&lt;0.05)</td>
<td>Small numbers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Incidence of myocardial infarction</td>
<td>10/14 in NIPPV group v 4/13 with CPAP (p=0.05)</td>
<td>Study stopped early due to IM differences NIPPV had more chest pain at baseline</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Length of ICU/hospital stay, intubation rates, mortality</td>
<td>N/S differences between groups</td>
<td>No power calculation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mortality Intubation rate</td>
<td>2/20 in NIPPV group v 0/20 (NS)</td>
<td>Study stopped early due to differences in rate of intubation Pre-hospital setting</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16/20 in NIPPV group v 2/20 (p=0.0004)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sharon A et al, 2000, Israel</td>
<td>40 patients with ACPO NIPPV and low dose nitrates v high dose nitrates alone</td>
<td>Prospective randomised controlled trial</td>
<td>Incidence of myocardial infarction SaO2; pulse and respiratory rates Mortality</td>
<td>Improvement significantly slower with NIPPV Control 2/18 Intervention 0/18 Control 6/18 Intervention 1/19 (P=0.04)</td>
<td>Not analysed on basis of intention to treat Small numbers with likely effect of underpowered study</td>
</tr>
<tr>
<td>Masip J et al, 2000, Spain</td>
<td>40 patients with ACPO NIPPV v O2</td>
<td>PRCT</td>
<td>Intubation</td>
<td>No significant difference between groups</td>
<td>No power calculation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hospital stay</td>
<td>No difference at 60 mins O2—4/10 CPAP—3/9 BiPAP—0/7</td>
<td></td>
</tr>
<tr>
<td>Park M et al, 2001, Brazil</td>
<td>26 patients with ACPO O2 v BiPAP v CPAP</td>
<td>PRCT</td>
<td>Intubation</td>
<td>O2—0 CPAP—1 (day 3) BiPAP—0</td>
<td>Small numbers No power calculation No clear randomisation</td>
</tr>
</tbody>
</table>
edema”.mp or exp ventricular dysfunction, left/ or exp heart failure, congestive/ or exp myocardial infarction/ or “Left ventricular failure”.mp or “lvt”.mp] AND [exp positive-pressure ventilation/ or exp respiration, artificial/ or “non-invasive ventilation”.mp or “bilevel”.mp or “BiPAP”.mp or “pressure support”.mp] LIMIT to (human and english language) AND maximally sensitive RCT filter.

**Search outcome**

Altogether 208 papers were found, of which four randomised controlled trials directly addressed the three part question (table 4).

**Comment(s)**

This group of trials compared NIPPV with different alternative treatments; oxygen, continuous positive airways pressure (CPAP) or high dose medical therapy. One study showed a benefit in the reduction of intubation rates when NIPPV is compared to oxygen alone, but others have reported evidence of harm with an increased incidence of myocardial infarction in the NIPPV groups. CPAP has already been shown to be of benefit in this patient group.1

**Clinical bottom line**

The evidence for the use of NIPPV in acute pulmonary oedema is moot. At present CPAP is the safer proven option.


**Corticosteroids in the management of near-drowning**

Report by Bernard A Foex, Specialist Registrar

Checked by Russell Boyd, Consultant (Adelaide, Australia)

**Clinical scenario**

A 15 year old boy was playing in the local canal. He jumped off a small bridge and got his foot caught in an old shopping trolley on the bottom. He was pulled out but he was unconscious and apnoeic. He was given BLS by the paramedics so that when he arrived in accident and emergency he was conscious, tachypnoeic, and centrally cyanosed. He had rhonchi and coarse crepitations in both lung fields. You wonder whether he would benefit from intravenous corticosteroids.

**Three part question**

In a case of [near-drowning], does the [use of corticosteroids] affect [outcome in terms of survival or pulmonary complications]?2

<table>
<thead>
<tr>
<th>Author, date and country</th>
<th>Patient group</th>
<th>Study type (level of evidence)</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Study weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sladen A and Zauder HL, 1971, USA</td>
<td>10 fresh water near-drownings.</td>
<td>Prospective (?) No corticosteroid versus methylprednisolone (5 mg/kg/24 h iv divided into 6 equal doses).</td>
<td>Survival</td>
<td>All corticosteroid group survived, all others died.</td>
<td>Consecutive groups. Before and after study does not take account of potential change in other aspects of practice with time. Small numbers.</td>
</tr>
<tr>
<td>Martin CM and Baeren O Jr, 1971, USA</td>
<td>64 cases near-drowning, 29 cases drowning.</td>
<td>Retrospective analysis. Unspecifed corticosteroid treatment.</td>
<td>Descriptive analysis</td>
<td>9 cases received corticosteroids - no benefit shown.</td>
<td>No standard treatment. Not a controlled trial.</td>
</tr>
<tr>
<td>Corbin DO and Fraser HS, 1981, Barbados</td>
<td>98 near-drownings.</td>
<td>Retrospective analysis of charts.</td>
<td>No outcome measure as all were survivors</td>
<td>66 received unspecified corticosteroids.</td>
<td>Not a controlled trial. No deaths. Therefore a comparison of death rates impossible.</td>
</tr>
<tr>
<td>van Berkel M et al, 1996, Netherlands</td>
<td>125 submersion victims.</td>
<td>Retrospective analysis of charts. Prednisolone (10.6 mg/kg, then 2.5 mg/kg/day; 1.8 d)</td>
<td>Pneumonia</td>
<td>Corticosteroids: no effect on pneumonia.</td>
<td>Not controlled trial. No survival data</td>
</tr>
</tbody>
</table>

Search strategy

Medline 1966 to 08/01 using the OVID interface. (Exp drowning/ or exp near drowning/ or “drowning”.mp) AND (exp steroids/ or “steroid”.mp OR exp adrenal cortex hormones/ or “adrenal cortex hormones”.mp OR exp adrenalin cortex hormones/ or “corticosteroids”.mp OR exp methylprednisolone/ or “methylprednisolone”.mp OR exp hydrocortisone/ or “hydrocortisone”.mp OR exp dexamethasone/ or “dexamethasone”.mp OR exp prednisone/ or “prednisone”.mp). LIMIT to human AND English language.

**Search outcome**

Altogether 33 papers were identified by the search strategy. There were no prospective randomised placebo controlled trials but there was one prospective study. Four papers were retrospective analyses of case reports and included some data on the effects of corticosteroids. Another retrospective analysis was found from
Comment(s)
All the case reports suggested that corticosteroids are of benefit in near-drowning. The only prospective study included 10 patients. However, all seven of those given methylprednisolone (5mg/kg/24 hours IV divided into six equal doses) survived. All the other studies were retrospective analyses of case notes. None showed any benefit from corticosteroids, but they did not provide enough data about the corticosteroids used, the doses used, or specific outcomes to provide reliable evidence.

Case reports, which may be inherently biased, show some benefit, but there is no good evidence that the routine use of intravenous corticosteroids improves the outcome in cases of near-drowning. There may be a case for conducting a properly controlled trial to settle the issue.

Clinical bottom line
There is very little evidence on the value of giving intravenous corticosteroids in cases of near-drowning.

The Ottawa ankle rules in children
Report by Man-Cheuk Yuen, Senior Medical Officer
Checked by Fiona Saunders, Specialist Registrar

Clinical scenario
A 5 year old boy attends the emergency department after sustaining a twisting injury to his left ankle. On examination there is swelling and tenderness over the lateral malleolus. You know that the Ottawa ankle rules are applicable in adult patients and you wonder whether they are applicable in children too.

Three part question
In [paediatric patients with blunt ankle injuries] are [the Ottawa ankle rules] sensitive in [detecting fractures]?

Search strategy
Medline 1966–08/01 using the OVID interface. [exp ankle/ or ankle.mp. or exp ankle injuries/ or exp ankle joint/ or exp lateral ligament, ankle/] AND [clinical decision.mp. or exp Decision Support Systems, Clinical/ or exp Decision Support Techniques/ or ottawa.mp.] AND [pediatr$.mp. or paed$.mp. or exp Age Factors/ or age factors.mp. or Child/] LIMIT to human and english

Search outcome
Altogether 14 papers were found of which 10 were irrelevant or of insufficient quality for inclusion. The remaining four papers are shown in the table.

Comment(s)
Apart from Chande’s study, the other studies did not examine all patients with radiography. Therefore, fractures might be missed by the Ottawa ankle rules and unidentified because of the design of the study. It is anticipated that application of the Ottawa ankle rules in preschool children is difficult as the rules rely on their ability to report tenderness. However, the number of preschool children included in all these studies was small. Hence the role of

<table>
<thead>
<tr>
<th>Author, date and country</th>
<th>Patient group</th>
<th>Study type (level of evidence)</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Study weaknesses</th>
</tr>
</thead>
</table>
| Chande VT, 1995, USA     | 68 patients aged 2–18 years | Prospective. Diagnostic | Ankle fractures | Sensitivity 100% (95% Cl. 77% to 100%). Specificity 32% (95% Cl. 21% to 43%) | Small sample size
|                          |              |                               |          |            | Only 54% of patients were aged 12 or below |
|                          |              |                               |          |            | Inter-rater reliability was not assessed |
|                          |              |                               |          |            | Not every patient was radiographed |
|                          |              |                               |          |            | Only 305 eligible patients were not included |
|                          |              |                               |          |            | Only 25% of patients were aged 9.7 or below |
|                          |              |                               |          |            | Inter-rater reliability was not assessed |
|                          |              |                               |          |            | Not every patient was radiographed |
|                          |              |                               |          |            | Not every patient was radiographed |
|                          |              |                               |          |            | Inter-rater reliability was not assessed |
| McBride KL, 1997, Canada | 318 adults and children (37 children) presenting with ankle injury to a community ED | Validation Cohort | Sensitivity of rules in age <16 | 100% sensitivity |
| Plint AC et al, 1999, Canada | 670 patients aged 2–16 years | Prospective. Diagnostic | Ankle and midfoot fractures | 22% |
| Libetta C et al, 1999, UK | 761 patients aged 1–15 years | Prospective. Diagnostic | Ankle and midfoot fractures | Sensitivity 98.3% (95% Cl not given). Specificity 46.9% (95% Cl not given) |

www.emjonline.com
Belching as a symptom of myocardial ischaemia

Report by Jason Smith, Specialist Registrar in Emergency Medicine

Checked by Simon Carley, Specialist Registrar in Emergency Medicine

Clinical scenario
A 60 year old man attends the emergency department with chest pain. He also gives a history of belching since the onset of the pain. His initial ECG is normal. You wonder if the symptom of belching has any prognostic value in the diagnosis of cardiac chest pain, or is more suggestive of a gastrointestinal cause.

Three part question
In [patients with chest pain] is [belching a useful discriminatory symptom] of [myocardial ischaemia]?

Search strategy
Medline 1966 to 08/01 using the OVID interface. ([exp myocardial infarction OR myocardial infarction.mp. OR MI.mp OR exp myocardial ischaemia OR myocardial ischemia.mp OR myocardial ischaemia.mp OR exp anginapectoris) AND (exp eructation OR eructation.mp OR belching.mp OR eructonesius.mp)] LIMIT to human and english.

Search outcome
Seven articles were found of which five were irrelevant or of insufficient quality. The two remaining papers are shown in the table.

Comment(s)
There are no randomised trials that answer the question. The best evidence would appear to come from two questionnaire studies, which show that belching is a symptom of myocardial ischaemia or infarction in a significant number of patients. It should not be assumed, therefore, that patients who have both chest pain and belching are more likely to be suffering from a non-cardiac cause.

Clinical bottom line
Belching is a recognised symptom of myocardial ischaemia or infarction.

Table 7

<table>
<thead>
<tr>
<th>Author, date and country</th>
<th>Patient group</th>
<th>Study type (level of evidence)</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Study weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Darsee JR, 1978, USA</td>
<td>108 consecutive patients presenting to CCU</td>
<td>Questionnaire</td>
<td>Belching as a symptom in patients with confirmed inferior myocardial infarction</td>
<td>Sensitivity 69%, specificity 84% (no p value given)</td>
<td>Possible bias from direct questioning.</td>
</tr>
<tr>
<td>Logan RL, et al, 1986, NZ</td>
<td>227 consecutive patients presenting to CCU</td>
<td>Questionnaire</td>
<td>Belching as a symptom in patients with confirmed cardiac ischaemia</td>
<td>Positive predictive value of 72% (no p value given)</td>
<td>Possible bias from population chosen, that is, CCU admissions.</td>
</tr>
</tbody>
</table>

Skull fracture and intracranial injury in children

Report by Andrew Munro, Specialist Registrar in Emergency Medicine

Checked by Ian Maconochie, Paediatric Consultant in Emergency Medicine

Clinical scenario
Different emergency departments have different protocols/preferences in the way children with mild or minor head injury are investigated. Some prefer observation plus or minus plain skull radiographs, others use head scan as the first choice modality. The department you are currently working in uses plain radiology. You are concerned that in children with mild head injury with no abnormal neurology and no fracture seen on plain skull films there is a tendency to be falsely reassured that intracranial injury (ICI) is unlikely.

Three part question
In [children with minor head injury] does [absence of skull fracture] predict [absence of ICI]?

Search strategy
Medline 1985–08/01 using the OVID interface. ([exp brain injuries/ or exp craniocerebral trauma/ or exp head injuries, closed/ or head trauma.mp or head injur$.mp or exp skull fractures/ or skull fracture$.mp] AND (exp child/ or exp adolescence/ or exp child, abandoned/ or exp child, exceptional/ or exp child, hospitalized/ or exp child, institutionalized/ or exp child of impaired...
<table>
<thead>
<tr>
<th>Author, date and country</th>
<th>Patient group</th>
<th>Study type (level of evidence)</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Study weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chan KI et al, 1990, Hong Kong</td>
<td>1178 adolescents (11–15 y)</td>
<td>Prospective</td>
<td>Fracture on plain skull radiograph with ICI</td>
<td>13 of 26 with skull fracture developed ICI. Of those CTed 4 developed diffuse brain swelling</td>
<td>Not restricted to mild head trauma. CTs done selectively.</td>
</tr>
<tr>
<td>Levi L et al, 1991, Israel</td>
<td>Sub group of 384 (GSC 13–15) from 653 children = 14 years old analysed from paper. Mean age 7.1 yrs, 62% male.</td>
<td>Prospective</td>
<td>Skull fracture and ICI</td>
<td>Of 97 children, 22% had ICI</td>
<td>Results shown are secondary outcomes of the study. Not clear if truly prospective.</td>
</tr>
<tr>
<td>Dietrich AM et al, 1993, USA</td>
<td>Sub-group of 233 children with minor head injury and GCS 15, all were head scanned.</td>
<td>Prospective. Cohort</td>
<td>CT results</td>
<td>11% had isolated skull fracture</td>
<td>Not restricted to mild trauma.</td>
</tr>
<tr>
<td>Quayle KS et al, 1997, USA</td>
<td>Data collected in 322 'non-trivial' head injuries.</td>
<td>Prospective cohort</td>
<td>Skull radiograph and head CT</td>
<td>Surgical follow up</td>
<td>Selective and incomplete data collection on subgroup.</td>
</tr>
<tr>
<td>Lloyd DA et al, 1997, UK</td>
<td>883 head injured children</td>
<td>Prospective data over 2 years</td>
<td>Skull # on radiograph and CT</td>
<td>66% of 162 with skull fracture were CTed of which 13% had ICI</td>
<td>Not restricted to mild trauma.</td>
</tr>
<tr>
<td>Greenes DS and Schutzman SA, 1999, USA</td>
<td>608 infants &lt;2 years. (11.2 ± 6.8 months, 57% male)</td>
<td>Prospective (selected CT scan).</td>
<td>Imaging</td>
<td>15.9% of those scanned had ICI - 77% of whom had skull fracture. 27.7% of those imaged had skull fracture diagnosed - 26.1% of whom had ICI. 2.1% of those whom were CTed had ICI with no fracture) or observed only.</td>
<td>Only 18% had head CT. Not clearly prospective.</td>
</tr>
<tr>
<td>Wang MY et al, 2000, USA</td>
<td>157 children less than 15 years old with field/paramedic GCS (or infant CS) of 13–14 transported by ambulance to a trauma center over twelve month period.</td>
<td>Prospective, multicenter</td>
<td>Disposition</td>
<td>Head CT results</td>
<td>Data not available for 52 additional patients who fitted inclusion criteria but were not transported to the trauma center.</td>
</tr>
</tbody>
</table>

### Comment(s)

Seven prospective papers were found. No consistent evidence exists to show that the presence or absence of skull fracture reliably predicts ICI. There is a suggestion that older children with skull fracture may have higher risk for ICI. Computed tomography was used to show isolated ICI (that is, no fracture seen), in 4%–15% of children with mild head injury (GSC=13). The significance of ICI in this group remains unclear, 1%–3% have neurosurgical implications that missed ICI from mild head injury can occasionally have severe consequences.

### Search outcome

Altogether 194 papers were found, of which 187 were irrelevant or of insufficient quality to include. The remaining seven papers are shown in the table.

### Clinical bottom line

The absence of skull fracture does not predict absence of ICI as seen on computed tomography. Computed tomography is therefore the imaging modality of choice if ICI is to be excluded in children with mild head injury.

---

### Indication for head CT in children with mild head injury

**Report by Andrew Munro, Specialist Registrar in Emergency Medicine**

Checked by Ian Maconochie, Paediatric Consultant in Emergency Medicine

**Clinical scenario**

It is 9 pm on a Saturday, a 5 year old boy is brought to the emergency department by his mother after an unobserved fall on a trampoline. The mechanism is unclear but he was playing with an older boy. He was not thought to have cried immediately. He has a moderate sized contusion to his occiput but no focal neurology. He has a GCS of 14, opening his eyes to voice only. No skull fracture is identified on plain films. You consider it appropriate to use computed tomography on the basis of his GCS, scalp haematoma and the possibility of loss of consciousness. The on call radiologist thinks it more appropriate to admit for neurological observation. You are concerned that there is an incidence of intracranial injury (ICI) in this group, but have no data to support an argument for early head scanning.

**Three part question**

In [children who have sustained a mild or minor head injury with a GCS=13–15] do [clinical findings] predict [intracranial injury on computed tomography]?

**Search strategy**

Medline 1985–08/01 using the OVID interface. {((exp brain injuries OR exp craniocerebral trauma OR exp head injuries, closed) OR (head trauma.mp) OR (head injur$.mp)) AND ((exp adolescence OR exp head OR exp child OR exp child of impaired parents OR exp child, abandoned OR exp child, exceptional OR exp child, hospitalized OR exp child, institutionalized, OR exp child, preschool OR exp child, unwanted OR exp disabled children OR exp homeless youth OR exp infant OR exp only child OR child$.mp) OR (exp pediatrics OR pediatrict$.mp OR paediatric$.mp)) AND (exp tomography scanners, x-ray computed OR exp tomography, x-ray computed OR tomography.mp OR CT scan$.mp) AND (exp prospective studies OR prospective.mp OR prospectively.mp)) LIMIT to (human AND english language AND yr=1985–2001).

**Search outcome**

Altogether 194 papers were found of which five were considered relevant and of sufficient quality to include (see table 9).

---

### Table 9

<table>
<thead>
<tr>
<th>Author, date and location</th>
<th>Patient group</th>
<th>Study type (level of evidence)</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Study weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teasdale GM et al, 1990, Glasgow</td>
<td>Sub group in paper of 99 head injured children requiring neurosurgery</td>
<td>Multicentred prospective comparative</td>
<td>Fully conscious and no skull fracture</td>
<td>16% of those with ICI</td>
<td>Incomplete data</td>
</tr>
<tr>
<td>Dietrich AN et al, 1993, USA</td>
<td>All head trauma children scanned in 12 month period n=322, mean age of 7.1 years 20% &lt;2 years old 62% male</td>
<td>Prospective cohort</td>
<td>Impaired consciousness and no skull fracture CT results</td>
<td>7.6% of all attendees in this category</td>
<td>Not restricted to mild trauma</td>
</tr>
<tr>
<td>Quayle KS et al, 1997, USA</td>
<td>322 ‘non-trivial’ head injuries</td>
<td>Prospective cohort</td>
<td>Imaging</td>
<td>8.4% had ICI</td>
<td>Not restricted to mild trauma</td>
</tr>
<tr>
<td>Greens DS and Schutzman SA, 1999, USA</td>
<td>608 infants &lt;2 years (11.2 +/- 6.8 months. 57% male) with head trauma</td>
<td>(selected CT scan)</td>
<td>CT result</td>
<td>Surgical follow up</td>
<td>Not restricted to mild trauma</td>
</tr>
<tr>
<td>Wing MV et al, 2000, USA</td>
<td>157 of 209 children with GCS of 13–14 as assessed by paramedic at scene transported to trauma centre and were CT scanned</td>
<td>Prospective multicentre</td>
<td>Head CT</td>
<td>19.1% had ICI, half of whom had no skull fracture</td>
<td>Real rate of ICI injury on CT probably underestimated as only 31% had CT following pre-existing ED protocol GCS not given</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Difference in GCS</td>
<td>60% of those with ICI had an improvement in GCS on re-examination (IC &gt;13)</td>
<td>Not restricted to minor injury</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Change in GCS</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Loss of consciousness</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>M &amp; M</td>
<td>Data not available for 52 patients</td>
<td></td>
</tr>
</tbody>
</table>

---
Comment(s)
While no paper directly answered the question, five prospective studies clearly demonstrate ICI occurring in the absence of altered GCS and/or focal neurology. It is also clear that ICI occurs in children whose GCS has improved.

There seems to be no consistent linear relation between other clinical factors and predictability of ICI. Two papers showed that in infants who have no focal signs and no altered mental state the presence of significant scalp haematoma was an indication of increased risk of ICI. The full significance of ICI in asymptomatic head injured children is not clear however as many as one in six asymptomatic infants with ICI may be given neurosurgery.

Clinical bottom line
All head injured children who have a GCS of < 15 should undergo cranial CT. Asymptomatic infants who have head injury and a scalp haematoma should also undergo cranial CT.