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.org

Guest BETs
- The Ottawa ankle rules in children
- Belching as a symptom of myocardial ischaemia
- Skull fracture and intracranial injury in children
- Indication for head CT in children with mild head injury

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$.mp) AND (exp Indicators/ and reagents/ OR exp Reagent strips/ OR exp Urinalysis/ OR dipstick.mp) AND (exp Urinary tract infections/ OR urinary tract infection.mp) AND (exp “sensitivity and specificity”/ or “sensitivity and specificity”.mp OR diagnos$.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>

### 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 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>

### 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.


### 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>
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</tr>
</thead>
<tbody>
<tr>
<td>Supervia A et al, Spain, 1998</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 oedema”].

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) 10/14 in NIPPV group v 4/13 with CPAP (p=0.05)</td>
<td>Study stopped early due to MI differences in sample size</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>Incidence of myocardial infarction</td>
<td></td>
<td>N/S differences between groups</td>
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<td></td>
<td></td>
<td></td>
<td>Length of ICU/hospital stay, intubation rates, mortality</td>
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<td></td>
<td></td>
<td></td>
<td>Mortality</td>
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<td></td>
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<td>Intubation rate</td>
<td>2/20 in NIPPV group v 0/20 (NS) 16/20 in NIPPV group v 2/20 (p=0.0004)</td>
<td>No power calculation</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>Incidence of myocardial infarction</td>
<td>11/20 in NIPPV group v 2/20 (p=0.006)</td>
<td>Study stopped early due to differences in rate of intubation</td>
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<td></td>
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<td>SaO2, pulse and respiratory rates</td>
<td>Improvement significantly slower with NIPPV Control 2/18</td>
<td>Pre-hospital setting</td>
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<td>Mortality</td>
<td>Intervention 0/18</td>
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<td>Control 6/18</td>
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<td>Intervention 1/19</td>
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<td>(P=0.04)</td>
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<td></td>
<td></td>
<td></td>
<td>Hospital stay</td>
<td>No significant difference between groups</td>
<td>Not analysed on basis of intention to treat</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Clinical variables (for example, RR, HR, etc)</td>
<td>No difference at 60 mins</td>
<td>Small numbers with likely effect of underpowered study</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Intubation</td>
<td>O2—4/10</td>
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<td></td>
<td></td>
<td>CPAP—3/9</td>
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<td>BiPAP—0</td>
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<td></td>
<td>Death</td>
<td>O2—0</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>CPAP—1 (day 3)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>BiPAP—0</td>
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</tbody>
</table>

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Corticosteroids in the management of near-drowning

Report by Bernard A Foex, Specialist Registrar

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]?

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 others who 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.

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 adenal 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.

Comment(s)

This group of trials compared NIPPV with different alternative treatments; oxygen, continuous positive airsways 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

Table 5

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<tr>
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<th>Outcomes</th>
<th>Key results</th>
<th>Study weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sladen A and Zauder HL,</td>
<td>10 fresh water near-drownings. 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>
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<tr>
<td>1971, USA</td>
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<tr>
<td>Martin CM and Baren O Jr,</td>
<td>64 cases near-drowning, 29 cases drowning. Retrospective analysis. Unspecified corticosteroid treatment.</td>
<td>Descriptive analysis</td>
<td>9 cases received corticosteroids = no benefit shown.</td>
<td>Retrospective. No standard treatment. Not a controlled trial.</td>
<td></td>
</tr>
<tr>
<td>1971, USA</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Corbin DO and Fraser HS,</td>
<td>98 near-drownings. Retrospective analysis of charts.</td>
<td>No outcome measure as all were survivors</td>
<td>66 received unspecified corticosteroids.</td>
<td>Retrospective. No deaths. Therefore a comparison of death rates impossible.</td>
<td></td>
</tr>
<tr>
<td>1981, Barbados</td>
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<tr>
<td>van Berkel M et al, 1996, Netherlands</td>
<td>125 submersion victims. 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>Retrospective. Not controlled trial. No survival data.</td>
<td></td>
</tr>
</tbody>
</table>
the references. Of the remaining papers, nine were individual case reports or short series. All the others were irrelevant (table 5).

**Comment(s)**
All the case reports suggested that corticosteroids are of benefit in near-drowning. However, 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.

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**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

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

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Table 6

<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>Chande VT, 1995, USA</td>
<td>68 patients aged 2–18 years</td>
<td>Prospective. Diagnostic</td>
<td>Ankle fractures</td>
<td>Sensitivity 100% (95% CI. 77% to 100%). Specificity 32% (95% CI. 21% to 43%)</td>
<td>Small sample size. Only 54% of patients were aged 12 or below.</td>
</tr>
<tr>
<td>McBride KL, 1997, Canada</td>
<td>318 adults and children (37 children) presenting with ankle injury to a community ED</td>
<td>Validation Cohort</td>
<td>Sensitivity of rules in age 16 years</td>
<td>100% sensitivity</td>
<td>Inter-rater reliability was not assessed.</td>
</tr>
<tr>
<td>Plint AC et al, 1999, Canada</td>
<td>670 patients aged 2–16 years</td>
<td>Prospective. Diagnostic</td>
<td>Ankle and midfoot fractures</td>
<td>For ankle fractures - Sensitivity 100% (95% CI. 95% to 100%). Specificity 24% (95% CI. 20% to 28%). For midfoot fractures - Sensitivity 100% (95% CI. 82% to 100%). Specificity 36% (95% CI. 29% to 43%)</td>
<td>Not every patient was radiographed. 305 eligible patients were not included.</td>
</tr>
<tr>
<td>Libetta C et al, 1999, UK</td>
<td>761 patients aged 1–15 years</td>
<td>Prospective. Diagnostic</td>
<td>Ankle and midfoot fractures</td>
<td>Sensitivity 98.3% (95% CI not given). Specificity 46.8% (95% CI not given). (Combined analysis for ankle and foot fractures)</td>
<td>Not every patient was radiographed. Inter-rater reliability was not assessed.</td>
</tr>
</tbody>
</table>

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the Ottawa ankle rules in small children is not yet answered.

Clinical bottom line
More work is required to determine if the Ottawa rules are applicable in children. Early results suggest that they will.

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 infarction 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>
<thead>
<tr>
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<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 cranioencephalic 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...
parents/ 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$.mp OR exp pediatrics/ OR pedi- 
atric$.mp OR paediatric$.mp) AND (exp tom- 
ography scanners, x-ray computed/ or exp  
tomography, x-ray computed/ or tomogra- 
phy.mp OR CT scan$.mp) AND (exp prospective 
studies/ or prospective.mp or prospec-

v$.mp)) LIMIT to (human and English  

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.

Comment(s)
Seven prospective papers were found. No con-
sistent 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 neurosur-
urgery implying that missed ICI from mild head  
run can occasionally have severe conse-
quences.

Clinical bottom line
The absence of skull fracture does not predict  
absence of ICI as seen on computed tomogra-
phy. Computed tomography is therefore the  
imagining modality of choice if ICI is to be  
excluded in children with mild head injury.

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### Table 8

<table>
<thead>
<tr>
<th>Author, date and country</th>
<th>Patient group</th>
<th>Study type (level of evidence)</th>
<th>Outcomes</th>
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<th>Study weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chan KH et al, 1990, Hong Kong</td>
<td>1178 adolescents (11–15 y)</td>
<td>Prospective</td>
<td>Fracture on plain skull radiograph with ICI without fracture</td>
<td>13 of 26 with skull fracture developed ICI. 10 of those had admission GCS of 15</td>
<td>Not restricted to mild head trauma</td>
</tr>
<tr>
<td>Levi L et al, 1991, Israel</td>
<td>Sub group of 384 (GSC 13–15) from 693 children = 14 yrs 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>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>Results shown are secondary outcomes of the study.</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 Surgical follow up</td>
<td>8.4% had ICI 59% (16) of those with ICI had GCS 15 and no focal neurology, 1 of whom required neurosurgery. 6 of these asymptomatic children were &lt; 1 year (5% had skull fracture)</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 No skull # and CT</td>
<td>66% of 162 with skull fracture were CTed of which 13% had ICI Only 6% of 708 CTed of which 9% had ICI, remainder went to CT (4 of 5 who were CTed had ICI with no fracture) or observed only.</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)</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 who were CT scanned had evacuation of haematoma.</td>
<td>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, Head CT results</td>
<td>No deaths 27.4% had abnormal CT. 19.1% with intra-cranial haemorrhage - 53% of whom had no fracture, 18.5% had skull fractures - 48% of whom had intra-cranial haemorrhage. 3.2% had evacuation of intra-cranial haematoma. No deaths</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>

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**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 cranio-cerebral trauma OR exp head injuries, closed) OR (head trauma.mp) OR (head injur$.mp)] AND [(exp adolescence OR exp child OR exp child of impaired parents OR exp child, abandoned OR exp child, exceptional OR exp child, hospitalized OR exp child, institutionalized, OR exp child, preschool OR exp child, unwanted OR exp disabled children OR exp homeless youth or exp infant or exp only child OR child$.mp) OR (exp pediatrics OR paediatric$.mp OR paediatric$ 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 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>Teasdale GM et al, 1990,</td>
<td>Sub group in paper of</td>
<td>Multicentred prospective</td>
<td>Fully conscious and no skull fracture</td>
<td>16% of those with ICI</td>
<td>Incomplete data</td>
</tr>
<tr>
<td>Glasgow</td>
<td>99 head injured children requiring neurosurgery</td>
<td>comparative</td>
<td>0.5% of all attendees with head injury in this category</td>
<td>12% of those with ICI</td>
<td>Not restricted to mild trauma</td>
</tr>
<tr>
<td>Dietrich AN et al, 1993,</td>
<td>All head trauma</td>
<td>Prospective</td>
<td>Impaired consciousness and no skull fracture</td>
<td>7.6% of all attendees in this category</td>
<td>Not restricted to mild trauma</td>
</tr>
<tr>
<td>USA</td>
<td>children scanned in 12 month period n=322, mean age of 7.1 years 20% &lt;2 years old 62% male</td>
<td>cohort</td>
<td>CT results</td>
<td>12% with ICI</td>
<td>Not clear if all head trauma seen was scanned</td>
</tr>
<tr>
<td>Quayle KS et al, 1997, USA</td>
<td>322 ‘non-trivial’ head injuries</td>
<td>Prospective</td>
<td>Clinical factors</td>
<td>Amnesia for event highest sensitivity of 87% LOC less sensitive at 68%. Absence of amnesia, LOC, focal neurology and headache &gt;89% negative predictive value</td>
<td>Not clear if truly prospective</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M &amp; M</td>
<td>Incomplete clinical data</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Imaging</td>
<td>No available data on interventions required for those with minor head injury 410 children originally identified as ‘non-trivial’</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Surgical follow up</td>
<td>5% of those with ICI had evacuation of haematoma. 13% died</td>
</tr>
<tr>
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<td></td>
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<td></td>
<td>CT result</td>
<td>8.4% had ICI</td>
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<td></td>
<td>Clinical factors in CT proven ICI</td>
<td>59% (16) of those with ICI GCS of 15 and no focal neurology, 1 of whom required neurosurgery. 6 of those asymptomatic children were &lt;1 year (5/6 had scalp haematoma). Four-fold increase of intracranial haematoma with skull fracture</td>
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<tr>
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<td>Age</td>
<td>16% of those imaged shown to have ICI</td>
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<td>Scalp haematoma</td>
<td>Half of those with ICI had no symptoms. Significantly more ICI in infants &lt;3 months</td>
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<td>M &amp; M</td>
<td>93% of infants who were asymptomatic with ICI had scalp haematoma (77% of those with ICI overall)</td>
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<td></td>
<td>No deaths</td>
<td>13% of infants with ICI had evacuation of haematoma</td>
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<td></td>
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<td></td>
<td>Two week follow up</td>
<td>No deaths</td>
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<td></td>
<td>Head CT</td>
<td>No deaths</td>
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<tr>
<td></td>
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<td></td>
<td>Difference in GCS</td>
<td>No significant difference in ICI or skull fracture between GCS 13 and 14</td>
</tr>
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<td></td>
<td></td>
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<td></td>
<td>Change in GCS</td>
<td>60% of those with ICI had an improvement in GCS on re-examination (ie ≥13)</td>
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<tr>
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<td></td>
<td>Loss of consciousness</td>
<td>67% of those with ICI had no history of LOC</td>
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<td></td>
<td>M &amp; M</td>
<td>3.2% had haematoma evacuation, one of whom required long term rehabilitation. All lived</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Data not available for S2 patients</td>
<td>Not data on focal neurology</td>
</tr>
</tbody>
</table>

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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.