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$.mp) OR (exp pediatrics/ OR pediatric$.mp OR paediatric$.mp}) AND ([exp Indicators/ and reagents/ OR exp Reagent strips/ OR exp Urinalysis/ OR dipstick.mp) AND (exp Urinary tract infections/ OR urinary tract infection.mp) AND (exp "sensitivity and specificity"/ or “sensitivity and specificity”.mp OR diagnos$.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)
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 piroxicam.f] 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 effects IM piroxicam should replace IM diclofenac for renal colic.

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>
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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 piroxicam or 40 mg IM diclofenac 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>

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.
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 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).

Comment(s)

A fast dissolving NSAID preparation of piroxicam seems effective at relieving renal colic pain and appears as effective as the standard diclofenac IM treatment in terms of speed to onset and relief of pain intensity. In terms of patient acceptability and ease of administration the oral format would intuitively seem to have advantages.

Clinical bottom line

There is reasonable evidence to suggest the use of oral fast dissolving piroxicam is as effective as IM diclofenac.


Table 4

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<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) Length of ICU/hospital stay, intubation rates, mortality Intubation rate</td>
<td>Small numbers Study stopped early due to MI differences NIPPV had more chest pain at baseline</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 Length of ICU/hospital stay, intubation rates, mortality Intubation rate</td>
<td>11/20 in NIPPV group v 2/20 (p=0.006) Improvement significantly slower with NIPPV Control 2/18 Intervention 0/18 Control 6/18 Intervention 1/19 (P=0.04) No significant difference between groups No difference at 60 mins</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></td>
<td>Small numbers No power calculation No clear randomisation</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>Hospital stay Clinical variables (for example, RR, HR, etc) Intubation Death</td>
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</table>
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 ronchi 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 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.

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 adrenergic nervous system/ or "adrenergic nervous system".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

Table 5

<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 (?)</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 Baren O Jr, 1971, USA</td>
<td>64 cases near-drowning, 29 cases drowning.</td>
<td>Retrospective analysis</td>
<td>Descriptive analysis</td>
<td>9 cases received corticosteroids - no benefit shown.</td>
<td>Retrospective. 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>Retrospective. No standard treatment. Not controlled trial.</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>Retrospective. Not controlled trial. No survival data</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. 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 [pediatric.mp. or paed$.mp. or exp Age Factors/ or age factors.mp. or Child/] LIMIT to human and english

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

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>
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</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 Inter-rater reliability was not assessed Very small number of children in larger study Not all patients received radiographic gold standard</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 &lt;16 potential reduction in radiographs if rules had been applied</td>
<td>100% sensitivity 22%</td>
<td></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></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 46.9% (95% CI not given). (Combined analysis for ankle and foot fractures)</td>
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</tbody>
</table>

Table 6
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 ango

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 injury$.mp or exp skull fractures/ or skull fracture$.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 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>

**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>
<th>Key results</th>
<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</td>
<td>13 of 26 with skull fracture developed ICI.</td>
<td>Not restricted to mild head trauma</td>
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<tr>
<td></td>
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<td></td>
<td>ICI without fracture</td>
<td>10 of those had admission GCS of 15</td>
<td>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. (1 Jan 1990 to 31 Dec 1990)</td>
<td>Prospective, cohort</td>
<td>Fracture on plain skull radiograph</td>
<td>11% had isolated skull fracture</td>
<td>Results shown are secondary outcomes of the study.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5% had ICI ± fractured skull, none of whom had abnormal neurology</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.</td>
<td>CT results</td>
<td>64% of isolated skull fractures were seen on plain skull radiograph</td>
<td>The incidence of skull fracture with ICI was not given.</td>
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<td></td>
<td>Of 97 children, 22% had ICI</td>
<td>Not restricted to mild head trauma</td>
</tr>
<tr>
<td>Qauyle 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>15.5% had skull fracture ± ICI</td>
<td>Selective and incomplete data collection on subgroup.</td>
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<td></td>
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<td>Surgical follow up</td>
<td>No deaths</td>
<td>Not restricted to mild trauma</td>
</tr>
<tr>
<td>Lloyd DA et al, 1997, UK</td>
<td>883 head injured children ?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>59% (16) of those with ICI had GCS 15 and no focal neurology, 1 of whom required neurosurgery.</td>
<td>No deaths</td>
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<td></td>
<td>No skull # and CT</td>
<td>Only 6% of 708 CTed of which 9% had ICI Remainder went to CT (4 out of 5 who were CTed had ICI with no fracture) or observed only.</td>
<td>6 of these asymptomatic children were &lt;1 year (5% had scalp hematoma).</td>
<td>Not restricted to mild trauma</td>
</tr>
<tr>
<td>Greens R and Schutzman SA, 1999, USA</td>
<td>608 infants &lt;2 years. (11.2 ± 6.8 months, 57% male)</td>
<td>Prospective cohort (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>Only 18% had head CT Not clearly prospective</td>
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<td>GCS not formally used.</td>
<td>Up to 23% of skull fractures not seen by ED staff.</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>Only 31% had head CT, with a further 20% having skull radiograph only.</td>
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<td></td>
<td>27.4% had normal CT. 19.1% with intra-cranial haemorrhage - 53% of whom had no fracture, 18.5% had skull fractures - 48% of whom had intra-cranial haematoma. 3.2% had evacuation of intra-cranial haematoma.</td>
<td>Data not available for 52 additional patients who fitted inclusion criteria but were not transported to the trauma center.</td>
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<td>No deaths</td>
<td>No plain radiology.</td>
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</table>

**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 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 neurosurgery implying that missed ICI from mild head injury can occasionally have severe consequences.

**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.

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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 craniocerebral 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 pediatric$.mp OR paediatric$.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).

Table 9

<table>
<thead>
<tr>
<th>Author, date and place</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>
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<td></td>
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<td></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>
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<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>CT results</td>
<td>7.6% of all attendees in this category</td>
<td>Not restricted to mild trauma</td>
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<tr>
<td></td>
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<td></td>
<td>Clinical factors</td>
<td>12% with ICI</td>
<td>Not clear if all head trauma seen was scanned</td>
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<td></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>M &amp; M</td>
<td>Not clear if truly prospective</td>
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<td></td>
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<td>5% of those with ICI had evacuation of haematoma. 13% died</td>
<td>Incomplete clinical data</td>
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<td></td>
<td>Imaging</td>
<td>8.4% had ICI</td>
<td>No available data on interventions required for those with minor head injury</td>
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<td>Surgical follow up</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</td>
<td>410 children originally identified as 'non-trivial'</td>
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<td>CT result</td>
<td>(5/6 had scalp haematoma). Four-fold increase of intracranial haematoma with skull fracture 16% of those imaged shown to have ICI</td>
<td>Not restricted to mild trauma</td>
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<td>Clinical factors in CT proven ICI</td>
<td>Half of those with ICI had no symptoms. Significantly more ICI in infants &lt;3 months</td>
<td>Real rate of ICI injury on CT probably underestimated as only 31% had CT following pre-existing ED protocol</td>
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<td>Age</td>
<td>93% of infants who were asymptomatic with ICI had scalp haematoma (77% of those with ICI overall)</td>
<td>GCS not given</td>
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<td></td>
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<td>Scalp haematoma</td>
<td>13% of infants with ICI had evacuation of haematoma</td>
<td>Not restricted to minor injury</td>
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<td>M &amp; M</td>
<td>No deaths</td>
<td>Data not available for 52 patients</td>
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<td>Two week follow up</td>
<td>No CT's ordered for those not imaged originally, no clinical deterioration for those who had a normal CT originally</td>
<td>No data on focal neurology</td>
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<td>Head CT</td>
<td>19.1% had ICI, half of whom had no skull fracture</td>
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<td>Difference in GCS</td>
<td>No significant difference in ICI or skull fracture between GCS 13 and 14</td>
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<td>Change in GCS</td>
<td>60% of those with ICI had an improvement in GCS on re-examination (inc &gt;13)</td>
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<td>Loss of consciousness</td>
<td>67% of those with ICI had no history of LOC</td>
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<td>M &amp; M</td>
<td>3.2% had haematoma evacuation, one of whom required long term rehabilitation. All lived</td>
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</tbody>
</table>

Table 9

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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.