BEST EVIDENCE TOPIC REPORTS

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

Edited by K Mackway-Jones

Best evidence topic reports (BETs) summarise the evidence pertaining to particular clinical questions. They are not systematic reviews, but rather contain the best (highest level) evidence that can be practically obtained by busy 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 [3]

- Negative urine analysis to exclude urinary tract infection
- Intramuscular piroxicam or intramuscular diclofenac for renal colic
- Oral (fast dissolving) piroxicam or intramuscular diclofenac for renal colic
- NIPPV for acute cardiogenic pulmonary oedema
- Corticosteroids in the management of near-drowning

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

1 Carley SD, Mackway-Jones K, Jones A, *et al*. Moving towards evidence based emergency medicine: use of a structured critical appraisal journal club. *J Accid Emerg Med* 1998;**15**:220–2.
2 Mackway-Jones K, Carley SD, Morton RJ, *et al*. The best evidence topic report: a modified CAT for summarising the available evidence in emergency medicine. *J Accid Emerg Med* 1998;**15**:222–6.
3 Mackway-Jones K, Carley SD. bestbets.org: Odds on favourite for evidence in emergency medicine reaches the worldwide web. *J Accid Emerg Med* 2000;**17**:235–6.

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)

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Table 1

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

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.

1 Gorelick MH, Shaw KN. Screening tests for urinary tract infection in children: a meta-analysis. *Pediatrics* 1999; **104**:e54.

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.

1 Al-Waili NS and Saloom KY. Intramuscular piroxicam versus intramuscular diclofenac sodium in the treatment of acute renal colic: double-blind study. *European Journal of Medical Research* 1999;**4**:23–6.

Table 2

Author, date and country	Patient group	Study type (level of evidence)	Outcomes	Key results	Study weaknesses
Al-Waili NS and Saloom KY, 1999, Germany	64 patients with proven diagnosis of renal colic on IVU, USS and clinical examination Those taking NSAIDS or pethidine on long term basis excluded	Double blind randomised controlled study	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	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 $p<0.05$)	The blinding mechanism is not given Uncertain of sampling method

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

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

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).

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.

1 Supervia A, Pedro-Botet J, Nogues X, *et al*. Piroxicam fast-dissolving dosage form vs diclofenac sodium in the treatment of acute renal colic: a double-blind controlled trial. *Br J Urol* 1998;**81**:27–30.

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 diminshed 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

Table 4

Author, date and country	*Patient group*	*Study type (level of evidence)*	*Outcomes*	*Key results*	*Study weaknesses*
Mehta S *et al*, 1997, USA	27 patients with ACPO NIPPV *v* CPAP	Prospective randomised controlled trial	Clinical variables	BP and PaCO2 lower in NIPPV group (p<0.05)	Small numbers
			Incidence of myocardial infarction	10/14 in NIPPV group *v* 4/13 with CPAP (p=0.05)	Study stopped early due to MI differences
			Length of ICU/hospital stay, intubation rates, mortality	N/S differences between groups	NIPPV had more chest pain at baseline
Sharon A *et al*, 2000, Israel	40 patients with ACPO NIPPV and low dose nitrates *v* high dose nitrates alone	Prospective randomised controlled trial	Mortality	2/20 in NIPPV group *v* 0/20 (N/S)	No power calculation
			Intubation rate	16/20 in NIPPV group *v* 2/20 (p=0.0004)	Study stopped early due to differences in rate of intubation
			Incidence of myocardial infarction	11/20 in NIPPV group *v* 2/20 (p=0.006)	Pre-hospital setting
			SaO2, pulse and respiratory rates	Improvement significantly slower with NIPPV	
Masip J *et al*, 2000, Spain	40 patients with ACPO NIPPV *v* O2	PRCT	Mortality	Control 2/18 Intervention 0/18	Not analysed on basis of intention to treat
			Intubation	Control 6/18 Intervention 1/19 (P=0.04)	Small numbers with likely effect of underpowered study
			Hospital stay	No significant difference between groups	
Park M *et al*, 2001, Brazil	26 patients with ACPO O2 *v* BiPAP *v* CPAP	PRCT	Clinical variables (for example, RR, HR, etc)	No difference at 60 mins	Small numbers No power calculation
			Intubation	O2—4/10 CPAP—3/9 BiPAP—0/7	No clear randomisation
			Death	O2—0 CPAP—1 (day 3) BiPAP—0	

edema".mp or exp ventricular dysfunction, left/ or exp heart failure, congestive/ or exp myocardial infarction/ or "Left ventricular failure".mp or "lvf".mp] AND [exp positive-pressure respiration/ or exp intermittent 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.[5]

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

1 Mehta S, Jay GD, Woolard RH, *et al*. Randomized, prospective trial of bilevel versus continuousositive airway pressure in acute pulmonary edema. *Crit Care Med* 1997;**25**:620–8.
2 Sharon A, Shpirer I, Kaluski E, *et al*. High-dose intravenous isosorbide-dinitrate is safer and better than Bi-PAP ventilation combined with conventional treatment for severe pulmonary edema. *J Am Coll Cardiol* 2000;**36**:832–7.
3 Masip J, Betbese AJ, Paez J, *et al*. Non-invasive pressure support ventilation versus conventional oxygen therapy in acute cardiogenic pulmonary oedema: a randomised trial. *Lancet* 2000;**356**:2126–32.
4 Park M, Lorenzi-Filho G, Feltrim MI, *et al*. Oxygen therapy, continuous positive airway pressure, or non-invasive bilevel positive pressure ventilation in the treatment of acute cardiogenic pulmonary edema. *Arq Bras Cardiol* 2001;**76**: 221–30.
5 Jackson R, Carley S. Towards evidence based emergency medicine: best BETs from the Manchester Royal Infirmary. CPAP in acute left ventricular failure. *Emerg Med J* 2001;**18**:63–4.

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]?

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 adrenal 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

Table 5

Author, date and country	*Patient group*	*Study type (level of evidence)*	*Outcomes*	*Key results*	*Study weaknesses*
Sladen A and Zauder HL, 1971, USA	10 fresh water near-drownings.	Prospective (?) No corticosteroid versus methylprednisolone (5 mg/kg/24 h iv divided into 6 equal doses).	Survival	All corticosteroid group survived, all others died.	Consecutive groups. Before and after study does not take account of potential change in other aspects of practice with time. Small numbers.
Martin CM and Barrett O Jr, 1971, USA	64 cases near-drowning, 29 cases drowning.	Retrospective analysis. Unspecified corticosteroid treatment.	Descriptive analysis	9 cases received corticosteroids - no benefit shown.	Retrospective. No standard treatment. Not a controlled trial.
Moddell JH *et al*, 1976, USA	91 near-drownings (salt, fresh, brackish). (1–79 years).	Retrospective analysis of charts.	Survival	52 given corticosteroids - 8 died. 38 no corticosteroids - 2 died	Retrospective Different corticosteroids, different doses. Not a controlled trial
Corbin DO and Fraser HS, 1981, Barbados	98 near-drownings.	Retrospective analysis of charts.	No outcome measure as all were survivors	66 received unspecified corticosteroids.	Retrospective. Not a controlled trial No deaths. Therefore a comparison of death rates impossible.
Oakes DD *et al*, 1982, USA	40 near-drownings.	Retrospective analysis of charts.	Survival	30 dexamethasone ? number died	Retrospective. Not controlled trial. Variable doses, ? data.
van Berkel M *et al*, 1996, Netherlands	125 submersion victims.	Retrospective analysis of charts. Prednisolone (10.6 mg/kg, then 2.5 mg/kg/day; 1.8 d)	Pneumonia	Corticosteroids: no effect on pneumonia.	Retrospective. Not controlled trial. No survival data

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.

1 Sladen A, Zauder HL. Methylprednisolone therapy for pulmonary edema following near drowning. *JAMA* 1971;**215**:1793–95.
2 Martin CM, Barrett O Jr. Drowning and near-drowning: A review of ten years' experience in a large Army Hospital. *Mil Med* 1971;**136**:439–43.
3 Modell JH, Graves SA, Ketover A. Clinical course of 91 consecutive near-drowning victims. *Chest* 1976;**70**:231–8.
4 Corbin DO, Fraser HS. A review of 98 cases of near-drowning at the Queen Elizabeth Hospital, Barbados. *West Indian Med J* 1981;**30**:22–9.
5 Oakes DD, Sherck JP, Maloney JR, Charters AC 3rd. Prognosis and management of victims of near-drowning. *J Trauma* 1982;**22**:544–9.
6 van Berkel M, Bierens JJ, Lie RL, *et al*. Pulmonary oedema, pneumonia and mortality in submersion victims; a retrospective study in 125 patients. *Intensive Care Med* 1996;**22**:101–7.

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 6

Author, date and country	*Patient group*	*Study type (level of evidence)*	*Outcomes*	*Key results*	*Study weaknesses*
Chande VT, 1995, USA	68 patients aged 2–18 years	Prospective. Diagnostic	Ankle fractures	Sensitivity 100% (95% CI. 77% to 100%). Specificity 32% (95% CI. 21% to 43%)	Small sample size Only 54% of patients were aged 12 or below 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 potential reduction in radiographs if rules had been applied	100% sensitivity 22%	Very small number of children in larger study Not all patients received radiographic gold standard
Plint AC *et al*, 1999, Canada	670 patients aged 2–16 years	Prospective. Diagnostic	Ankle and midfoot fractures	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%)	Not every patient was radiographed. 305 eligible patients were not included Only 25% of patients were aged 9.7 or below Inter-rater reliability was not assessed
Libetta C *et al*, 1999, UK	761 patients aged 1–15 years	Prospective. Diagnostic	Ankle and midfoot fractures	Sensitivity 98.3% (95% CI not given). Specificity 46.9% (95% CI not given). (Combined analysis for ankle and foot fractures)	Only 10.6% of patients were aged 5 or below Not every patient was radiographed Inter-rater reliability was not assessed.

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.

1 Chande VT. Decision rules for roentgenography of children with acute ankle injuries. *Arch Pediatr Adolesc Med* 1995;**149**:255–8.
2 McBride KL. Validation of the Ottawa ankle rules. Experience at a community hospital. *Can Fam Physician* 1997;**43**:459–65
3 Plint AC, Bulloch B, Osmond MH, *et al*. Validation of the Ottawa ankle rules in children with ankle injuries. *Acad Emerg Med* 1999;**6**:1005–9.
4 Libetta C, Burke D, Brennan P, *et al*. Validation of the Ottawa ankle rules in children. *J Accid Emerg Med* 1999;**16**:342–4.

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 ischemia OR myocardial ischemia.mp OR myocardial ischaemia.mp OR exp angina pectoris) 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.

1 Darsee, JR. Eructonesius with inferior myocardial infarction. *N Engl J Med* 1978;**298**:221–2.
2 Logan RL, Wong F, Barclay J. Symptoms associated with myocardial infarction: are they of diagnostic value? *NZ Med J* 1986;**99**:276–8.

Table 7

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

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 8

Author, date and country	*Patient group*	*Study type (level of evidence)*	*Outcomes*	*Key results*	*Study weaknesses*
Chan KH *et al*, 1990, Hong Kong	1178 adolescents (11–15 y)	Prospective	Fracture on plain skull radiograph with ICI ICI without fracture	13 of 26 with skull fracture developed ICI. 10 of these had admission GCS of 15 Of those CTed 4 developed diffuse brain swelling	Not restricted to mild head trauma CTs done selectively
Levi L *et al*, 1991, Israel	Sub group of 384 (GSC 13–15) from 653 children = 14 years old analysed from paper.	Prospective	Skull fracture and ICI No skull fracture and ICI	Of 97 children, 22% had ICI Of 287 children 15% had ICI	
Dietrich AM *et al*, 1993, USA	Sub-group of 233 children with minor head injury and GCS 15, all were head scanned. Mean age 7.1 yrs, 62% male. (1 Jan 1990 to 31 Dec 1990)	Prospective. Cohort	CT results Plain skull radiographs	11% had isolated skull fracture 5% had ICI ± fractured skull, none of whom had abnormal neurology 64% of isolated skull fractures were seen on plain skull radiograph No deaths	Results shown are secondary outcomes of the study. Not clear if truly prospective The incidence of skull fracture with ICI was not given
Quayle KS *et al*, 1997, USA	Data collected in 322 'non-trivial' head injuries.	Prospective cohort	Skull radiograph and head CT Surgical follow up	15.5% had skull fracture ± ICI 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 <1 year (5/6 had scalp haematoma)	410 children originally identified as 'non-trivial' Selective and incomplete data collection on subgroup. Not restricted to mild trauma
Lloyd DA *et al*, 1997, UK	883 head injured children	?Prospective data over 2 years	Skull # on radiograph and CT No skull # and CT	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 out of 5 who were CTed had ICI with no fracture) or observed only.	Not restricted to mild trauma Only 18% had head CT Not clearly prospective Up to 23% of skull fractures not seen by ED staff
Greenes DS and Schutzman SA, 1999, USA	608 infants <2 years. (11.2 ± 6.8 months, 57% male)	Prospective (selected CT scan).	Imaging Disposition	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. No deaths	Only 31% had head CT, with a further 20% having skull radiograph only. GCS not formally used.
Wang MY *et al*, 2000, USA	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.	Prospective, multicenter	Head CT results Disposition	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 haematoma. 3.2% had evacuation of intra-cranial haematoma. No deaths	Data not available for 52 additional patients who fitted inclusion criteria but were not transported to the trauma center. No plain radiology.

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$.mp or exp pediatrics/ or pediatric$.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).

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.

1 Chan KH, Mann KS, Yue CP, *et al*. The significance of skull fracture in acute traumatic intracranial hematomas in adolescents: a prospective study. *J Neurosurg* 1990;**72**:189–94.
2 Levi L, Guilburd JN, Linn S, *et al*. The association between skull fracture, intracranial pathology and outcome in pediatric head injury. *Br J Neurosurg* 1991;**5**:617–25.
3 Dietrich AM, Bowman MJ, Ginn-Pease ME, *et al*. Pediatric head injuries:can clinical factors reliably predict an abnormality on computed tomography? *Ann Emerg Med* 1993;**22**:1535–40.
4 Quayle KS, Jaffe DM, Kuppermann N, *et al*. Diagnostic testing for acute head injury in children: When are computed tomography and skull radiographs indicated? *Pediatrics* 1997;**99**:E11.
5 Lloyd DA, Carty H, Patterson M, *et al*. Predictive value of skull radiography for intracranial injury in children with blunt head injury. *Lancet* 1997;**349**:821–4.
6 Greenes DS, Schutzman SA. Clinical indicators of intracranial injury in head-injured infants. *Pediatrics* 1999;**104**:861–7.
7 Wang MY, Griffith P, Sterling J, *et al*. A prospective population-based study of pediatric trauma patients with mild alterations in conciousness (Glasgow coma scale of 13–14). *Neurosurgery* 2000;**46**:1093–9.

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).

Search outcome

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

Table 9

Author, date and country	*Patient group*	*Study type (level of evidence)*	*Outcomes*	*Key results*	*Study weaknesses*
Teasdale GM *et al*, 1990, Glasgow	Sub group in paper of 99 head injured children requiring neurosurgery	Multicentred prospective comparative	Fully conscious and no skull fracture	16% of those with ICI 0.5% of all attendees with head injury in this category	Incomplete data Not restricted to mild trauma
			Impaired consciousness and no skull fracture	12% of those with ICI 7.6% of all attendees in this category	
Dietrich AN *et al*, 1993, USA	All head trauma children scanned in 12 month period n=322, mean age of 7.1 years 20% <2 years old 62% male	Prospective cohort	CT results	12% with ICI	Not restricted to mild trauma
			Clinical factors	Amnesia for event highest sensitivity of 87%. LOC less sensitive at 68%. Abscence of amnesia, LOC, focal neurology and headache >89% negative predictive value	Not clear if all head trauma seen was scanned Not clear if truly prospective
			M & M	5% of those with ICI had evacuation of haematoma. 13% died	Incomplete clinical data No available data on interventions required for those with minor head injury
Quayle KS *et al*, 1997, USA	322 'non-trivial' head injuries	Prospective cohort	Imaging	8.4% had ICI	410 children originally identified as 'non-trivial'
			Surgical follow up	59% (16) of those with ICI GCS of 15 and no focal neurology, 1 of whom required neurosurgery. 6 of these asymptomatic children were <1 year (5/6 had scalp haematoma). Four-fold increase of intracranial haematoma with skull fracture	Selective and incomplete data collection on subgroup Not restricted to mild trauma
Greenes DS and Schutzman SA, 1999, USA	608 infants <2 years (11.2 +/− 6.8 months. 57% male) with head trauma	Prospective (selected CT scan)	CT result	16% of those imaged shown to have ICI	Real rate of ICI injury on CT probably underestimated as only 31% had CT following pre-existing ED protocol GCS not given Not restricted to minor injury
			Clinical factors in CT proven ICI	Half of those with ICI had no symptoms. Significantly more ICI in infants <3 months	
			Age	93% of infants who were asymptomatic with ICI had scalp haematoma (77% of those with ICI overall)	
			Scalp haematoma	13% of infants with ICI had evacuation of haematoma	
			M & M	No deaths	
			Two week follow up	No CT's ordered for those not imaged originally, no clinical deterioration for those who had a normal CT originally	
Wang MY *et al*, 2000, USA	157 of 209 children with GCS of 13–14 as assessed by paramedic at scene transported to trauma centre and were CT scanned	Prospective multicentre	Head CT	19.1% had ICI, half of whom had no skull fracture	Data not available for 52 patients No data on focal neurology
			Difference in GCS	No significant difference in ICI or skull fracture between GCS 13 and 14	
			Change in GCS	60% of those with ICI had an improvement in GCS on re-examination (ie >13)	
			Loss of consciousness	67% of those with ICI had no history of LOC	
			M & M	3.2% had haematoma evacuation, one of whom required long term rehabilitation. All lived	

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.

1 Teasdale GM, Murray G, Anderson E, *et al*. Risks of acute traumatic intracranial haematoma in children and adults: implications for managing head injuries. *BMJ* 1990; **300**:363–7.
2 Dietrich AM, Bowman MJ, Ginn-Pease ME, *et al*. Pediatric head injuries: can clinical factors reliably predict an abnormality on computed tomography? *Ann Emerg Med* 1993;**22**:1535–40.
3 Quayle KS, Jaffe DM, Kuppermann N, *et al*. Diagnostic testing for acute head injury in children: When are head computed tomography and skull radiographs indicated? *Pediatrics* 1997;**99**:E11.
4 Greenes DS, Schutzman SA. Clinical indicators of intracranial injury in head-injured infants. *Pediatrics* 1999;**104**:861–7.
5 Wang MY, Griffith P, Sterling J, *et al*. A prospective population-based study of pediatric trauma patients with mild alterations in consciousness (Glasgow coma scale score of 13–14). *Neurosurgery* 2000;**46**:1093–9.