## Selected Articles

# Clinical indicators of intracranial injury in head-injured infants

**Reviewer:** Les Vertesi, MD
Royal Colulmbian Hospital, New Westminster, BC
**Date appraised:** Nov. 2, 1999
*This article has been peer reviewed.*

### Clinical questions

Are clinical signs of brain injury sensitive indicators of intracranial injury (ICI)? Is radiographic imaging of asymptomatic infants with scalp hematoma useful? Can head-injured infants without signs of brain injury or scalp hematoma be safely managed without imaging?

### Article chosen

Greene SG, Schutzman SA. Clinical indicators of intracranial injury in head-injured infants. Pediatrics 1999;104: 861-7.

### Objective

To develop a radiographic imaging policy (plain x-rays or CT) for apparently minor head injuries in infants.

### Background

Most emergency physicians use clinical signs of brain injury to determine the need for imaging in head-injured patients. When imaging is required, CT scan has essentially replaced skull x-rays as the modality of choice. Scalp hematoma, in the absence of other signs of brain injury, is generally not considered an indication for CT, but indications vary widely among physicians and are based more on gut feeling than science. Clinical findings may have different prognostic value in children, yet there are no studies that correlate the reliability of clinical signs with patient age.

### Population studied

Infants less than 2 years of age presenting with any head injury to a tertiary pediatric emergency department (ED) over a 1-year period.

### Study design

A prospective cohort study with 2-week follow-up. Physicians filled out questionnaires regarding clinical signs of brain injury, presenting history, and presence or absence of scalp hematoma before any imaging was performed. Physicians were allowed to order x-rays or CT scans as they saw fit and according to their usual practice. The following were defined as clinical signs of brain injury: loss of consciousness, behaviour change, seizures, emesis, depressed mental status, irritability, bulging fontanel, focal neurologic findings, or vital signs suggesting increased intracranial pressure.

### Outcomes measured

The primary outcome measured was the presence or absence of ICI based on the radiologists's CT scan report. Secondary outcomes included all necessary therapeutic interventions (e.g., surgery, intubation).

### Results

A total of 608 patients were enrolled in the study and 177 (29%) had at least 1 clinical sign of brain injury (criteria defined above). Of these, 104 (59%) had CT scans done and 27 (15%) had plain x-rays. The 431 patients without clinical signs of brain injury were stratified into those with significant scalp hematoma ($n$ = 164) and those without ($n$ = 267). The "CT scan rate" in the former group was 35% and in the latter, 10%. These groups were then compared with respect to presence or absence of ICI.

Overall, 30 of 608 patients (5%) had ICI. Of these, 14 had none of the defined clinical signs of brain injury. Age was clearly associated with intracranial injury: 13% of children under 2 months had ICI vs. 2% of those over 12 months. Apart from age, the clinical signs most indicative of ICI were lethargy or irritability on examination, depressed mental status, bulging fontanel, and abnormal vital signs. Loss of consciousness and vomiting were not associated with ICI.

Scalp hematomas were the most sensitive clinical indicator of ICI (odds ratio [OR] = 4.65). This association was even stronger among asymptomatic children (OR = 22.4). Of 164 patients with significant scalp hematomas, 23 had ICI, and all of these (except one 2-month-old infant) had a skull fracture on plain x-ray.

## Study conclusions

Clinical signs of brain injury are insensitive indicators of ICI in infants. A substantial fraction of infants with ICI can be detected through plain x-ray imaging of all infants with significant scalp hematomas, even if they are otherwise asymptomatic. Asymptomatic infants older than 3 months of age without significant scalp hematoma may be safely managed without any imaging.

## Commentary

The finding of ICI in a significant proportion of infants who have no clinical signs of brain injury is startling, but before we mandate CT scans for everyone, 2 serious limitations of the study should be considered. First, only 31% of the study subjects underwent CT. Clearly some process was used to determine who would receive a CT, but the nature of that process is unknown. Whatever it was, it involved more than the information recorded by the authors, because only 59% of the "symptomatic" group were scanned, while 10% of those without even a hematoma were scanned. This introduces a selection bias that makes the study irreproducible. It also guarantees that any ED that institutes the authors' recommended policy will obtain different results — unless they inadvertently follow the same undefined selection criteria for imaging. The study would have been stronger had all patients undergone imaging; however, this would have required the authors to obtain informed consent from patients — something that was not done.

Second, the primary outcome defined in the study (presence of ICI on a radiology report) is a surrogate endpoint for the real outcome of interest (clinically important ICI requiring treatment). It is a CT outcome, not a patient outcome. To illustrate this, of the 14 asymptomatic patients with ICI, 5 were discharged from the ED, and only 2 of the 9 who were admitted had an intervention (one child underwent surgical evacuation of an *asymptomatic* epidural hematoma and the other received prophylactic anticonvulsants).

The authors' imaging recommendations imply that it is important to detect asymptomatic ICI, yet 69% of their study patients were discharged without CT and may well have had such an injury. The authors boldly state that, based on their follow-up data, no ICIs were subsequently diagnosed in the 420 patients who were discharged from the ED without head CT. However, this flies in the face of their own study conclusions, which are that "silent" ICI are not reliably detected by any combination of clinical symptoms.

An interesting observation from the study was the correlation between significant scalp hematoma and positive skull x-ray in infants less than 2 months of age. This suggests skull x-rays may be a useful screening tool for infants in smaller centres without CT availability, although a better correlation with patient outcomes would make x-rays more worthwhile. In centres with CT capability there is little reason to think that plain skull films will add value. This study does demonstrate that relatively asymptomatic ICI can occur and that it is more likely in infants under 2 months of age. The authors did not show, however, that patients will benefit from having their ICI detected; nor did they prove that their recommended strategy reliably detects asymptomatic ICI.

All of this is too bad, because the study had sufficient power to give us better guidance if these issues had been addressed in the study design phase. Now we will have to await another large study to answer the questions left behind by this one.

**Correspondence to:** Lvertesi@home.com

# Hyperbaric oxygen therapy in carbon monoxide poisoning: effects on neurological sequelae

## Clinical question

Is hyperbaric oxygen superior to normobaric oxygen for preventing neurologic sequelae in carbon monoxide (CO) poisoned patients?

## Article chosen

Scheinkestel CD, Bailey M, Myles PS, Jones K, Cooper DJ, Millar IL, et al. Hyperbaric or normobaric oxygen for acute carbon monoxide poisoning: a randomized controlled clinical trial. Med J Aust 1999;170:203-10.

**Reviewers**
David J. Rhine, MD; Tony Best, MD
Department of Emergency Medicine, King Faisal Specialist Hospital & Research Center, Riyadh, Saudi Arabia
**Date appraised:** Nov. 7, 1999
*This article has been peer reviewed.*

## The search

National Library of Medicine, PubMed, MEDLINE