The evidence base for shaken baby syndrome

We need to question the diagnostic criteria

The phrase “shaken baby syndrome” evokes a powerful image of abuse, in which a carer shakes a child sufficiently hard to produce whiplash forces that result in subdural and retinal bleeding. The theory of shaken baby syndrome rests on core assumptions: shaking is always intentional and violent; the injury an infant receives from shaking is invariably severe; and subdural and retinal bleeding is the result of criminal abuse, unless proved otherwise.1 These beliefs are reinforced by an interpretation of the literature by medical experts, which may on occasion be instrumental in a carer being convicted or children being removed from their parents. But what is the evidence for the theory of shaken baby syndrome?

Retinal haemorrhage is one of the criteria used, and many doctors consider retinal haemorrhage with specific characteristics pathognomonic of shaking. However, in this issue Patrick Lantz et al examine that premise (p 754) and conclude that it “cannot be supported by objective scientific evidence.” Their study comes hard on the heels of a recently published review of the literature on shaken baby syndrome from 1966 to 1998, in which Mark Donohoe found the scientific evidence to support a diagnosis of shaken baby syndrome to be much less reliable than generally thought.3

Shaken baby syndrome is usually diagnosed on the basis of subdural and retinal haemorrhages in an infant or young child, although the diagnostic criteria are not uniform, and it is not unusual for the diagnosis to be based on subdural or retinal haemorrhages alone.4 The website of the American Academy of Ophthalmology states that if the retinal haemorrhages have specific characteristics “shaking injury can be diagnosed with confidence regardless of other circumstances.”5 Having reviewed the evidence base for the belief that perinatal folds with retinal haemorrhages are diagnostic of shaking, Lantz et al were able to find only two flawed case-control studies, much of the published work displaying “an absence of … precise and reproducible case definition, and interpretations or conclusions that overstep the data.”6 Their conclusions are remarkably similar to those of Donohoe, who found that “the evidence for shaken baby syndrome appears analogous to an inverted pyramid, with a very small database (most of it poor quality original research, retrospective in nature, and without appropriate control groups) spreading to a broad body of somewhat divergent opinions.”7 His work entailed searching the literature, using the term “shaken baby syndrome” and then assessing the methods of the articles retrieved, using the tools of evidence based inquiry. Reviewing the studies achieving the highest quality of evidence rating scores, Donohoe found that “there was inadequate scientific evidence to come to a firm conclusion on most aspects of causation, diagnosis, treatment, or any other matters,” and identified “serious data gaps, flaws of logic, inconsistency of case definition.”8

The conclusions of Lantz et al and of Donohoe make disturbing reading, because they reveal major shortcomings in the literature relating to a field in which the opportunity for scientific experimentation and controlled trials does not exist, but in which much may rest on interpretation of the medical evidence.3

If the concept of shaken baby syndrome is scientifically uncertain, we have a duty to re-examine the validity of other beliefs in the field of infant injury. The recent literature contains a number of publications that disprove traditional expert opinion in the field. A study of independently witnessed low level falls showed that such falls may prove fatal, causing both subdural and retinal bleeding.4 6 A biomechanical analysis validates that serious injury or death from a low level fall is possible and casts doubt on the idea that shaking can directly cause retinal or subdural haemorrhages.6 The evidence base for shaken baby syndrome is critically uncertain, we have a duty to re-examine the validity of other beliefs in the field of infant injury. The recent literature contains a number of publications that disprove traditional expert opinion in the field. A study of independently witnessed low level falls showed that such falls may prove fatal, causing both subdural and retinal bleeding.4 6 A biomechanical analysis validates that serious injury or death from a low level fall is possible and casts doubt on the idea that shaking can directly cause retinal or subdural haemorrhages.6 An important lucid interval may be present in an ultimately fatal head injury in an infant.7 Neuropathological studies have shown that abused infants do not generally have severe traumatic brain injury and that the structural damage associated with death may be morphologically mild.10 What is the relevance of the craniospinal injuries to corticospinal tracts, dorsal nerve roots, and so on that have been described?10 11 We do not know. What is the force necessary to injure an infant’s brain? Again, we do not know.

While most abused children indisputably show the signs of violence, not all do. No one would be surprised to learn that a fall from a two storey building or involvement in a high speed road traffic crash can cause retinal and subdural bleeding, but what is the minimum force required? “It is one thing clearly to state that a certain quantum of force is necessary to produce a subdural hematoma; it is quite another to use examples of obviously extreme force . . . and then suggest that they constitute the minimum force necessary.”5

Research in the area of infant injury is difficult. Quality evidence may need to be based on finite element
modelling from data on infants' skulls, brains, and neck structures, rather than living animals. Any studies on immature animal models, if performed, will need to be validated against the known mechanical properties of the human infant. Pending completion of such studies, the reviews by Lantz and Donohoe are a valuable contribution and provide a salutary check for anyone wishing to cite the literature in support of an opinion. Their criticisms of lack of case definition or proper controls can be levelled at the whole literature on child abuse. If the issues are much less certain than we have been taught to believe, then to admit uncertainty sometimes would be appropriate for experts. Doing so may make prosecution more difficult, but a natural desire to protect children should not lead anyone to proffer opinions unsupported by good quality science. We need to reconsider the diagnostic criteria, if not the existence, of shaken baby syndrome.

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Shaken baby syndrome
Pathological diagnosis rests on the combined triad, not on individual injuries

Shaken baby syndrome is a form of physical non-accidental injury to infants, characterised by acute encephalopathy with subdural and retinal haemorrhages, occurring in a context of inappropriate or inconsistent history and commonly accompanied by other apparently inflicted injuries. Injuries to the neck and spinal cord may also be present. Controversy surrounds the precise causation of the brain injury, the retinal and subdural haemorrhages, as well as the degree of force required and whether impact in addition to whiplash forces is needed. Although most discussion has concerned fatal injuries of this nature, not all are lethal, but they may be associated with subsequent neurological disability of varying severity.

Expert medical evidence about inflicted injury must have scientific validity, but applying the evidence based criteria appropriate to clinical practice entails some difficulties. In clinical practice medical management of defined clinical problems can be compared and best practice distinguished by clinical outcomes. Conversely, in inflicted paediatric injuries, one is presented with the outcome, investigation follows rather than precedes that outcome, and the history may be incomplete or deliberately misleading. A need exists for an impartial and intelligent assessment, but how may this be achieved in practice?

Because of the serious implications of diagnosing inflicted injury such as shaken baby syndrome, every case must be evaluated in detail, taking account of all the circumstances surrounding the injury and considering the pathological features in full, rather than attempting to evaluate the significance of each component.

Competing interests: JFG and JP have given evidence in criminal cases at the request of both the prosecution and the defence.

5 Milov CM. Medical experts and the criminal courts. RJM 2003;328:294-5.
Risk assessment for spinal injury after trauma

The guidelines are simple and evidence based

About 600-700 people sustain acute traumatic injuries to the spinal cord in the United Kingdom each year. Previously published data indicate that the injury to the spinal cord remains unrecognised in 4-9% of individuals. Inadequate management of patients with injury to the spinal cord has the potential to lead to neurological deterioration, additional functional handicaps, and possibly medical litigation. Thousands of patients, however, routinely present to primary care centres every day with injuries to the neck and back. The immediate care and appropriate assessment of patients with spinal injury is a skill that is expected of all doctors. General practitioners and hospital doctors with little or no training and experience of caring for patients with trauma might have to help the victims of a recent accident. They will certainly have to advise patients who complain of spinal pain after injury. This article is written to guide clinicians in these situations.

The evidence base for this subject has improved recently with some large scale studies from North America. Several consensus guidelines have been published by the National Institute for Clinical Excellence and the British Trauma Society. Most of...

w2 Kim KA, Wang MY, Griffith PM, Summers S, Levy ML. Analysis of pediatric head injury from falls. 
*Neurosurg Focus* 2000;8: www.aans.org/education/journal/neurosurgical/jan00/8-1-3.asp

The evidence base for shaken baby syndrome

Response to editorial from 106 doctors

Editor—In challenging the diagnosis of shaken baby syndrome in their recent editorial Geddes and Plunkett make a number of serious errors in interpreting the research on this issue, and they display a worrisome and persistent bias against the diagnosis of child abuse in general.1

In their opening sentence Geddes and Plunkett describe shaking a child to “produce whiplash forces that result in subdural and retinal bleeding” omitting the most important element in this condition: brain injury itself. They elaborate that the “theory” of shaken baby syndrome rests on some core assumptions, including that the injury an infant receives “from shaking is invariably severe.” This is in conflict with the research of Alexander et al, Ewing-Cobbs et al, Kemp et al, and Jenny et al, who found that 30%-40% of newly diagnosed shaken baby cases had medical evidence of previously undiagnosed head injury.1-4 These infants had such mild or non-specific symptoms and signs that their trauma was previously not diagnosed. The diagnosis was ultimately made when the children had subsequent severe episodes of abuse, with computer tomographic evidence of both acute and older subdural haematoma and brain injuries.

Retinal haemorrhages

Geddes and Plunkett then consider retinal haemorrhages. Lantz et al, in the same issue, question the specificity of perimacular folds in abusive head trauma in infancy.5 They conclude from a literature review that there was no support for the contention that perimacular folds are pathognomonic for abusive head injury. Geddes and Plunkett applied these authors’ conclusions not only to perimacular folds but also to retinal haemorrhages.

Although research on the subject of inflicted childhood neurotrauma—over 600 peer reviewed articles—does not claim that retinal haemorrhages are pathognomonic for abuse, it does show that retinal haemorrhages are, overwhelmingly, more common in abuse than in non-inflicted injury. When massive retinal haemorrhages are seen in carefully studied children with non-inflicted major injuries, such as from motor vehicle crashes, crushing head injuries, as in Lantz et al’s report, and falls from several storeys, child abuse is not a consideration.

One study analysed these obviously non-inflicted injuries and compared them with abusive head injuries in children under 6 years of age. Severe retinal haemorrhages were seen in 5 of the 235 (2%) children in the non-inflicted group and in 18 of the 54 (33%) in the abuse group.6 Retinal pathology from major trauma mimicking shaken baby syndrome is old news.6-11 Its incidence is dramatically lower than that resulting from inflicted head injury and because of the obvious major trauma history it does not present a diagnostic dilemma.

Literature on shaken baby syndrome

To discredit the literature on shaken baby syndrome over the past 30 years, Geddes and Plunkett rely on an article by Donohoe.12 In so doing they have erred in their assessment of the status of the science in the field.

Donohoe’s purpose was to examine trends in the quality of scientific evidence. Donohoe used evidence based medicine (EBM) criteria for weighting evidence to judge the comparative merit of published studies published before such criteria were widely embraced by authors, reviewers, and journals. He also plans to apply this process to more recently written articles. He explicitly did not challenge the existence of shaken baby syndrome and, to our knowledge, his review of more recent work has not yet been published. The cited paper reviewed studies published up to six years ago and purposely did not include research that has been published since that time.

One striking limitation of the Donohoe paper is that he used only the keywords “shaken baby syndrome” to search the literature whereas many of the articles on the subject use keywords such as “inflicted childhood neurotrauma,” “childhood head injury,” “cerebrocerebral trauma,” “inflicted traumatic brain injury,” as well as several others. We know of a number of qualified studies that were not included. If the search had been appropriately more inclusive, the resulting conclusions would likely have been quite different.

The application of EBM criteria to judge articles is intended to help physicians discern truth among competing works. The absence of clinical trials and definitive population based studies means lower EBM scores when the work is compared with more definitive work. Low EBM scores, in the absence of more highly regarded work, do not mean that the work is wrong, only that there is room for further research to learn more and that prior conclusions may not be definitive. Many aspects of clinical practice and medical knowledge have not been established with certainty by EBM criteria.

The comparative paucity of well-done population based cohort studies, in the face of a rather large literature of case reports, case series, cohort studies, and case-control studies underscores how hard research in this area is to complete. It also emphasises the need for more research and more government research assistance. Child abuse is a particularly difficult area in which to conduct research. Issues of informed consent, inadequacy of animal models, and the potential legal consequences of participation and telling the truth make this a complicated field.

Short falls in childhood

Geddes and Plunkett claim that “the recent literature contains a number of publications that disprove traditional expert opinion in the field” about short falls in childhood. However, they cite only two publications, and neither disproves the evidence presented in over 25 other studies of short falls in infancy and childhood.

Plunkett cites his own article on fatal falls from short distances in playgrounds, using archived data from various sources.12 His study has significant problems: the determination of the distances of the falls in the 75 000 cases presented relies on information supplied by the original sources of data and is thus open to question; no infants were studied; several of the falls were from 7 feet (that is, they were not “short” falls); several of the children had crush injuries or pre-existing conditions; and none of the children had “formal retinal evaluation.” Nevertheless, Plunkett and others assert that this study “proves” that short falls can kill and cause retinal haemorrhages.

Contact subdural and epidural haemorrhages may, however, result from short falls,13, 14 They can occasionally cause severe...
illness or death from space occupying lesions. Occasionally children with contact injuries due to short falls develop malignant cerebral oedema. Plunkett’s fatal cases seem to fall into these categories, as opposed to the whiplash brain injuries associated with immediate concussions seen with severe inflicted head injuries.4 Even if one were to accept his conclusions despite these methodological shortcomings, the study found that death from short falls was still exceedingly rare (18/75 000 = 0.02%). The only other article cited is a review by Ommaya et al that provides no new data and makes sweeping conclusions.5

**Biomechanical studies**

Geddes and Plunkett end by dismissing animal model studies unless they are “validated against the known mechanical properties of the human infant.” How are these properties to be known? How can an investigator measure the tensile strength of the living infant dura, skull, bridging veins, cerebral cortex, and neck musculature? Although more appropriate studies of the mechanical properties of infant animal brain are beginning to be done,6 7 no current studies reflect the response of infant animal brain tissue to harmonic forces, such as those likely occurring with infant shaking. Although more biologically faithful mechanical models of infants are being constructed,8 9 they will still only approximate the response of living infants to shaking.

Assuming that shaking cannot cause infant brain injury, on the basis of current biomechanical studies is premature. Juxtaposed with these mechanical approximations, there is extensive clinical experience and an emerging literature of confessed shaking causing brain injury in infants.10

**Conclusion**

Child abuse is an enormous social, medical, and mental health problem and its evaluation and treatment have far-reaching implications for children, families, and society. To provide optimal diagnosis and treatment, careful objective research and intellectual honesty are needed and must prevail over the entrenchment of ideological schools of thought and “winning” in court. Unfortunately, there remains considerable difficulty for some doctors to accept that children are abused. We must look at these cases using all of the information available, including collected clinical experience and the synthesis of the best literature on the subject.11

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This letter is signed by another 105 doctors (see bmj.com for details). Competing interests: None declared.

**Authors’ reply**

EDITOR—It is difficult to understand how Reece et al could interpret our editorial as displaying “a worrisome and persistent bias against the diagnosis of child abuse in general.” Child abuse exists, and we know and attest that it exists. The editorial does not discuss “child abuse in general.”

Child abuse exists in many forms: our editorial addresses the diagnostic criteria for a specific type of abuse, the so-called shaken baby syndrome. We emphasise, as have Donohoe and Lantz et al,2 12 that the literature to support a diagnosis of shaken baby syndrome/inflicted head injury is based on imprecise and ill-defined criteria, biased selection, circular reasoning, inappropriate controls, and conclusions that overstep the data. If it is the questioning of the criteria that we will continue to do so and to cause worry.

We encouraged the readers to evaluate critically the evidentiary basis for a diagnosis of shaken baby syndrome in the light of the questions raised by the two papers. Of course Donohoe’s study was limited and would retrieve only papers that included the words “shaken baby syndrome” in the title, key words, or abstract. The lack of scientific rigour that the identified is not restricted to infant head injury papers that specifically mention shaken baby syndrome. If Reece et al perform a critical review of the “number of qualified studies” that they assert would have been included by a wider search, they will encounter the same “data gaps, flaws of logic, and inconsistency of case definition” that were present in the literature studied by Donohoe. We would urge them to look again, for example, at the paper they cite by Alexander et al, where they will find all the above shortcomings.

Finally, we are at a loss to explain or accept the authors’ statements in their penalultimate sentence: “Unfortunately, there remains considerable difficulty for some doctors to accept that children are abused.”

The authors are suggesting that we are among those doctors, or are encouraging others to be so, their argument is a willful misinterpretation of what we have written. When there is new evidence that challenges an established conviction, medicine has the responsibility to critically evaluate the data, and if verifiable, reflect that change. We must have no vested interest in yesterday’s belief. We are encouraging doctors to think clearly and critically, even in an area as emotive as child abuse. No more. And no less.

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**Details of the other 105 signatories are available on bmj.com, as are details of references w1–w11**


**Authors’ communication of trust, care, and respect**

**Details of paper were incorrect**

EDITOR—Burkitt Wright et al have not attended one of my group’s communication skills courses; yet it doesn’t stop them from saying that patients valued forms of communication that are currently not emphasised in training and research, and did not intrinsically value others that are currently thought important, including provision of information and choice.1 Apart from the breathtaking arrogance of their suggestion that a qualitative analysis of views of 39 women with breast cancer should overturn painstaking research and survey findings gathered by many, their assertions are factually incorrect.

Firstly, we always ensure that patient needs inform the content of communication skills courses by involving patient groups and considering empirical research findings. Secondly, patient centredness is a core component of our courses, which includes learning how to tailor information giving, providing choice if wanted, responding appropriately to patient led cues, and expressing empathy and respect.

Thirdly, each day CancerBACUP receives many calls from distressed patients and relatives made anxious and distraught by the lack of information they have received. We need trust, care, and respect, but no convincing evidence exists to show that those things in themselves are enough.

I am indignant that our work and that of others whom I respect receives such
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Evidence based case report

Perimacular retinal folds from childhood head trauma

P E Lantz, S H Sinal, C A Stanton, R G Weaver Jr

A previously healthy 14 month old child was transferred to our medical centre with a severe head injury. The father had collected the boy and his 3 year old brother from their mother at his workplace car park and taken them home while their mother went to work. The children had been watching television while the father prepared dinner. After hearing something fall, the father found the boy on the floor with the television covering his lower legs. His older brother stated, “television fell.” As soon as the father removed the television, he found the boy on the floor with the television covering his right side of the head and anterior chest. A homemade television stand was partially across the television stand was partially across the right side of the head and anterior chest. A previously healthy 14 month old child was transferred to our medical centre with a severe head injury. The father had collected the boy and his 3 year old brother from their mother at his workplace car park and taken them home while their mother went to work. The children had been watching television while the father prepared dinner. After hearing something fall, the father found the boy on the floor with the television covering his lower legs. His older brother stated, “television fell.” As soon as the father removed the television, he found the boy on the floor with the television covering his right side of the head and anterior chest. A homemade television stand was partially across the right side of the head and anterior chest. A homemade television stand was partially across the right side of the head and anterior chest.

The child’s condition deteriorated, and he died 18 hours after the incident. Child Protective Services was notified. When investigators went to the house to recover the television before the family returned home, it was still on the carpeted floor. The 480 mm screen television had a bottom drawer that held videotapes. A greasy smudged area on the glass of the television screen had a bottom drawer that held videotapes. A greasy smudged area on the glass of the television screen...
television stand to readily topple forward. According to investigators, the family home was 7.8 km from the workplace and about 6 km from the local hospital. Based on the distance and estimated driving times plus workplace time clock records, the father was home with the children about 20 minutes when the incident happened. The day after the incident, while in foster care, the 3 year old sibling corroborated the father’s account. Despite all this evidence, the paediatric ophthalmologist repeated that perimacular retinal folds coincident with retinal haemorrhages were considered specific for shaken baby syndrome secondary to retinal traction exerted by the oscillating vitreous.

Search for published evidence

We were unable to find a published report of perimacular retinal folds in a childhood non-abusive head injury. We therefore did a systematic review of the medical literature on perimacular retinal folds associated with abusive head trauma in infants and young children. Our background question became: “In infants and young children with an acute intracranial injury, are perimacular retinal folds specific for head injury from vitreoretinal traction occurring during cycles of acceleration and deceleration (shaken baby syndrome)?”

We searched the Medline (1966-2003) database using the terms retinal folds and child abuse and uncovered seven non-comparative case series articles.1–7 We also examined references cited in these articles plus review articles and book chapters on ocular findings in child abuse mentioning or discussing perimacular retinal folds relative to non-accidental head injury. Similar searches in the Cochrane Library, ISI Web of Science, and Ovid found no additional articles.

Results

We found 42 articles and book chapters discussing perimacular retinal folds in childhood abusive head trauma. Seventeen mentioned the presence of retinal folds in non-accidental head injury but did not comment on specificity or formative mechanism. A table on bmj.com gives details of the remaining articles. All but two of the articles are non-comparative clinical or autopsy case series, case reports, review articles, or book chapters.

The two studies that included controls both showed bias in selection of controls and contained no cases with perimacular retinal folds but discussed the postulated causal mechanism.8–9 In the prospective controlled study, the authors reported on 79 children younger than 3 years who had sustained head injuries.8 The manner of injury in one case was indeterminate. Three children, including one who died, had non-accidental head injury diagnosed, all of whom had retinal haemorrhages; 72 of the 75 children with non-abusive injuries were managed by observation alone. No perimacular retinal folds were observed; however, the presumed causative mechanism of traumatic retinoschisis and retinal folds was discussed.

The second controlled study was a prospective autopsy study that examined the presence and location of ocular findings in 169 childhood deaths.9 Ocular haemorrhages (retinal, peripheral retinal, optic nerve sheath and intrascleral) were more likely in craniocebral trauma than in non-head injuries and natural diseases. Although case selection was purportedly random, the study contained a disproportionately high number of deaths from child abuse compared with natural and non-abusive causes. Case selection depended on the pathologist’s willingness to participate in the study, and we were told by one of the authors that pathologists were more willing to participate when they believed that the deaths were abusive or suspicious (M Gilliland, personal communication, 2002). Perimacular retinal folds were not noted, but the authors concluded that acceleration-deceleration injury to the retina accounts for peripheral retinal haemorrhages and retinal folds.

 Supporting evidence

The references cited to support statements about the specificity or causal mechanism of perimacular retinal folds and abusive head injury in the articles we found are all non-comparative observational reports, unsystematic review articles, and book chapters. Seventy per cent of the articles cited four non-comparative case series.1 5 8 10 We assessed the quality of this evidence.

Gaynon et al reported on two infants with presumed shaken baby syndrome who had retinal folds and concluded that these folds may be a hallmark
of shaking injuries in child abuse victims.1 One infant reportedly fell 1.5 m to the floor while being carried down a stairway.

Massicotte et al reported the ocular findings at autopsy of three children with perimacular retinal folds.2 Two infants had sustained direct head trauma, but in the other there was no physical or forensic evidence of direct head trauma. They observed that the vitreous had partially separated from the retina but remained attached to the internal limiting membrane at the apices of the folds and the vitreous base. They concluded that their study confirmed the role of vitreous traction in formation of perimacular folds and proved that shaking alone caused these folds and shaking was never an accidental phenomenon.

Ehler et al reviewed the ocular and autopsy findings in 10 consecutive children who died of suspected child abuse.3 Perimacular retinal folds were observed in three children, all of whom had evidence of blunt head injuries.

Greenwald et al reported five cases of children in whom definite or probable physical abuse during infancy was associated with traumatic retinoschisis.4 They hypothesised that when an infant is shaken, the head is subjected to repetitive accelerations and decelerations causing the relatively dense lens to move forward and back within the ocular fluids. Transmission of force through firm attachments between the lens, vitreous gel, and particularly the macular retina presumably would result in appreciable traction on the retina causing it to split and creating the surrounding folds.

**Discussion**

Statements in the medical literature that perimacular retinal folds are diagnostic of shaken baby syndrome are not supported by objective scientific evidence. Non-comparative observational reports and unsystematic narrative review articles contain insufficient evidence to provide unbiased support for or against diagnostic specificity, and inferences about associations, causal or otherwise, cannot be determined. Clinical and autopsy evidence of ocular lesions must therefore be considered alongside other physical findings and a thorough investigation before concluding whether a head injury is caused by abuse. The child in our case had ocular haemorrhages (peripheral retinal, optic nerve sheath and intrascleral) and retinoschisis, which again some people consider specific for child abuse. Unfortunately, the evidence for these assumptions has similar problems to that for perimacular retinal folds. An evidence based analysis of indexed medical publications on shaken baby syndrome from 1966-1998 uncovered a weak scientific evidence base.5 Selection bias, inappropriate controls, and the lack of precise criteria for case definition were identified as important problems with the data. Many studies committed a fallacy of assumption, selecting cases by the presence of the clinical findings that were sought as diagnostically valid. Unsystematic reviews and consensus statements often mingled opinion with facts and added no original supporting evidence.

Perimacular retinal folds are associated with increased neurological morbidity and mortality in infants and children with abusive head injuries.6 The reported incidence of perimacular retinal folds in shaken baby syndrome varies from 0% in a consecutive clinical case series to 50% in a sequential autopsy case series.7-9 Clinical and autopsy studies with appropriately matched controls are needed to determine the causal mechanism of perimacular retinal folds and their specificity for abusive head injury. Until good evidence is available, we urge caution in interpreting eye findings out of context.

**Contributors:** PEL conceived the idea, collected the articles, and wrote the initial draft. All authors contributed to the review process, writing, and final editing of the paper. PEL is the guarantor. Competing interests: None declared.


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References


Table

Articles referring to diagnostic specificity or causal mechanism of periamacular retinal folds (PRF) in childhood non-accidental head injury

<table>
<thead>
<tr>
<th>Reference</th>
<th>Publication date</th>
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<td>Clinical case series (6; 2 with PRF)</td>
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PRF = perimacular retinal fold.

*Reference w18 could not be verified as cited.
Patterns of presentation of the shaken baby syndrome

Four types of inflicted brain injury predominate

ErroneOne of the controversies that has recently arisen in cases of alleged shaken baby syndrome concerns the disparity between certain neuropathological findings at necropsy and whether these findings are consistent with the entity regarded as the shaken baby syndrome.

A database was collected for more than five years of documented Scottish cases of suspected non-accidental head injury diagnosed after a multiagency assessment and including cases with uncoerced confessions of perpetrators and criminal convictions. Several patterns of presentation allow delineation of cases into four predominant types.

Hyperacute encephalopathy (cervicomedullary syndrome) This hyperacute encephalopathy (6% of all cases) results from extreme “whiplashing” forces, the infant suffering the equivalent of a broken neck or, more correctly, a broken brain stem. In infants with a median survival of one day Geddes et al described localised axonal damage at the craniovertebral junction, in the corticospinal tracts, and in the cervical cord roots, consistent with hyperflexion and hyperextension movements.1 These cases, which truly reflect a “whiplash” injury to the stem, are infrequently seen by clinicians because the patients are either dead on admission or die shortly thereafter.

Presentation is at 2-3 months of age, with acute respiratory failure (direct medullary injury) and cerebral oedema (a “black brain” on imaging). At necropsy these infants have severe brain swelling and hypoxic injury but little axonal shearing and only a thin (trivial) subdural haemorrhage. Such presentations could result from a primary injury to the brain stem, induced by hyperflexion and hyperextension, or, rarely, from traumatic thrombosis of the vertebral arteries in the foramina of the cervical vertebrae.

Acute encephalopathy An acute encephalopathic presentation (53% of cases) is characterised by a depressed conscious state, raised intracranial pressure, fits, apnoea, hypotonia or decerebration, anaemia, shock, bilateral subdural haematomas, and widespread haemorrhagic retinopathy. Coexistent rib fractures, metaphyseal fractures, or other non-accidental injuries may be found. This is the commonest presentation seen by paediatricians and is referred to as the classic shaken baby syndrome (repetitive rotational injury). Depending on whether additional signs of impact are noted (focal subdural, extradural, or subgaleal haemorrhage; scalp injury; or skull fracture), the syndrome has been referred to as the shaken impact syndrome.

The brain injury is well documented from studies of magnetic resonance imaging,2 which show widespread vascular shearing with convexity subdural haemorrhages enlarging over the first week (as well as interhemispheric, subtemporal, suboccipital, and posterior fossa subdural haemorrhages), torn bridging veins, cerebral oedema, haemorrhagic contusions and lacerations, and white matter shearing, with tears and petechial haemorrhages at the junction between grey and white matter and in the corpus callosum. Up to 60% of cases have serious long term morbidity.

Subacute non-encephalopathic presentation In infants with a non-encephalopathic subacute presentation (19% of cases) the brain injury is less intense, without swelling, diffuse cerebral hypodensities, or clinical encephalopathic features. These children have various combinations of subdural and retinal haemorrhages, rib fractures and other skeletal fractures, bruising, etc. The outcome in this group is better.

Chronic extracerebral presentation A chronic extracerebral presentation (22% of cases) is seen in children of a few months of age who present with an isolated subdural haemorrhage, which is often chronic (>3 weeks) and late in presenting. A rapidly expanding head circumference and signs of raised intracranial tension are common: the child may be irritable, vomiting, failing to thrive, hypotonic, fitting but with little encephalopathy.

The primary injury is extracerebral but with potential secondary injury from raised intracranial pressure and reduced cerebral perfusion pressure and hypoperfusion, oedema, and metabolism to flow mismatch in the white matter.3 Any retinal haemorrhages originally present have disappeared by presentation. The injury has occurred weeks earlier, and its force has been sufficient to rupture the weakest bridging vein(s) but insufficient to produce an acute encephalopathy. The prognosis is good with recognition and appropriate treatment.

Clinicians will have difficulty in attributing a causative mechanism and timing to such late presenting (idiosyncratic) subdural haemorrhages. Only in the presence of residual features of physical abuse (such as fractures), along with identifiable risk factors, would non-accidental injury be considered. Most cases remain aetologically unexplained, although trauma remains the likely cause, but they are unlikely to be legally pursued beyond medical investigations and social work inquiry.

Conclusions We postulate that a spectrum of clinical features is related to the intensity and type of injury in babies with inflicted brain injury, reconciling the clinical and neuropathological findings. Infants can be traumatically injured in many ways, and many instances are unwitnessed. Thus the generic term non-accidental head injury or inflicted traumatic brain injury should be used in preference to shaken baby syndrome, which implies a specific mechanism of injury.

After the history, examination, and investigations have been considered the following conclusions about the cause of brain injury can be reached: It is characteristic of, consistent with, possibly due to, or not the result of, non-accidental trauma.

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Competing interests: None declared.


Subdural and retinal haemorrhages are not necessarily signs of abuse

EDITOR—The “serious data gaps, flaws of logic, and inconsistency of case definition” shown up by the evidence-based case report of the shaken baby syndrome (p 754) and highlighted in the accompanying editorials (pp 719 and 720) will be of interest to the many parents who over the past 10 years have maintained that they have been wrongly accused and convicted of causing their children’s injuries.  

Furthermore, the recent evidence emphasised by Geddes and Plunkett that trivial falls and other minor injuries can give rise to the allegedly characteristic signs of subdural and retinal haemorrhages is consistent with a triad of possible alternative explanations for shaken baby syndrome. This triad has emerged from an analysis of 98 parental accounts reported to the support group the Five Percenters, each of the three being compatible with a distinct type of neuropathology.

The first is minor trauma (37% of cases). This group gives a history of minor trauma (such as a fall from a bed or sofa) with either immediate loss of consciousness or delayed presentation of an acute subdural bleed and retinal haemorrhages. This is in line with the recently reported series from the United States of independently witnessed minor falls resulting in an acute intracranial bleed, the retinal haemorrhages being caused by a sudden rise in retinal venous pressure as in Terson’s syndrome. The second is birth injury (29% of cases). The clinical presentation in the second group is quite different. There is a general period of variable length of non-specific symptoms such as vomiting and lethargy warranting repeated medical consultations until computed tomography shows the presence of a chronic subdural haemorrhage. The most likely aetiology is a subdural bleed at birth, which, though usually associated with prematurity or a difficult delivery,1 can follow a normal delivery.

The third is respiratory arrest (22% of cases). In this group the precipitating event is suggestive of respiratory arrest—often followed by attempts at resuscitation—that could result in the subdural and retinal haemorrhages characteristic of hypoxic encephalopathy. The findings that severe traumatic brain damage is not, as previously thought, present in these cases contradicts the assumption that such injuries could only have been induced by violent shaking. A fourth type of presentation, epileptiform seizures (12%) is presumably secondary to underlying intracranial disease—and is thus uninformative about possible aetiology. These three patterns of clinical events—in the absence of other circumstantial evidence for non-accidental injury—offer a more credible explanation than shaken baby syndrome for the presence of subdural and retinal haemorrhages. It should be noted that shaking has never been directly observed or proved to cause such injuries but is rather an inference based on (contested) theories of biomechanics. By contrast, consistent parental testimony tallies with descriptions from independent witnesses. Furthermore, each pattern of clinical events is consistent with a distinctive type of neuropathology of acute subdural, chronic subdural, or the thin subdural of hypoxic encephalopathy.

While we recognise the limitations of the volunteered parental testimony on which this analysis is based, the same triad of presentations—designated as acute encephalopathic, idiopathic subdural, and hyperacute presentation—has also been independently identified from an extended database of cases of suspected non-accidental injury (see previous letter). These findings necessarily raise disturbing questions about the validity of the opinions expressed by medical experts in the courts. They warrant further, urgent, and appropriate scientific investigation.

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Reluctance in child protection must be for several reasons

EDITOR—In his news item Dyer reports that doctors are reluctant to work on child protection committees. They have yet to meet a paediatrician who is genuinely keen to do child protection work. Not surprisingly, the Royal College of Paediatrics and Child Health is experiencing enormous difficulties filling the relevant posts.

Most paediatricians in training today do not wish to do community paediatrics in the future. It is certainly essential to have a named paediatrician for child protection in every hospital, but, ironically, in my experience, even the named paediatricians for child protection in some cases are reluctant to show passion in this field. This general reluctance must be for several reasons, namely a lack of proper training. The royal college should look into this with an open mind. Also, why should only paediatricians have the responsibility for child protection work? There is no reason why other medical specialties such as general practice and orthopaedics should not take equal responsibility.

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Competing interests: None declared.

Labouring in water

Method is unclear

EDITOR—The method of the study by Chett et al comparing labouring in water with standard augmentation in managing dystocia requires clarification. The authors have not defined the criteria by which the first stage of labour was diagnosed, thus putting into question the diagnosis of dystocia.

In current practice an expectant policy is advocated especially during the latent phase of labour, to avoid unnecessary intervention. It is unclear whether the authors have taken this into account and whether some women were inappropriately recruited.

We think that an alternative arm of the study should have included an expectant group without recourse to water immersion or augmentation and thus the true impact of water immersion would be defined. The inclusion of women with both intact and ruptured membranes in each study arm further adds to difficulty in evaluating the true effect of water immersion.

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Competing interests: None declared.

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The evidence base for shaken baby syndrome

Meaning of signature must be made explicit

Editor—Reece et al’s response to the editorial of Geddes and Plunkett claims to be a response of “106 doctors.” What, precisely, do the 106 signatures attached to this letter signify? That all had reviewed the letter and were in full agreement with the entire content? That they agreed in general with the thrust of the letter? Or was this more a show of solidarity on the part of doctors who care deeply about the risks of shaking on children?

This needs clarification if the signatures are to carry any weight whatsoever. Science—even medical science—is not a popularity contest. The meaning of a signature must be made explicit for it to add weight to a document.

Each signature carries with it responsibilities of authorship. Reece’s letter declared no competing interests, but all signatories would need to comply for this to be true.

Six of the signatories (Levin, Chadwick, Alexander, Barr, Jenny, and Reece) are medical practitioners on the International Advisory Board of the National Center on Shaken Baby Syndrome (www.dontshake.com). They participate in this group’s conferences and are presumably compensated or reimbursed for this work—information requiring disclosure under BMJ guidelines.

The letter of Reece exemplifies a problem identified in my own paper—that the literature on shaken baby syndrome is polarised and based more on strong beliefs and opinions than strong data. Ten thousand signatures cannot change this.

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Competing interests: None declared.

Some serve on non-profit boards of organisations with concerns about child maltreatment, including shaken baby syndrome, and are not compensated for this service.

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It is our policy to obtain a competing interest declaration before publication. In this case our oversight occurred because Professor Reece’s letter did not come in the usual way via bmj.com and our checking mechanisms failed—EDITOR

Response to Reece et al from 41 physicians and scientists

Editor—Reece et al have implied that child abuse is a particularly difficult area in which to conduct research. This difficulty does not justify circular reasoning, selection bias, imprecise case definition, unscientific review publications, or conclusions that overstep the data.

Geddes and Plunkett described the use of evidence based medicine in evaluating the causes of head injury in infants and children. Evidence based medicine is the conscientious, explicit, and judicious use of scientific evidence in making medical decisions and cautions against unsystematic, untested reasoning and intuition based clinical applications. It integrates scientific principles and clinical experience with valid, current research.

While much of clinical medicine still relies on observation, it is critical that these observations are verified and validated. Often, the clinician must be more deliberate than the experimentalist who uses a planned systematic approach. The clinical researcher may have to await the natural sequence of events—deducing relationships that lie below observed phenomenon, being more logical and less dogmatic, and avoiding the fallacy of mistaking correlation with causation.

If the principles of science and evidence based medicine are not critically applied to observational studies, a set of formulated beliefs among like-minded people may be reinforced, leading to misconceptions and misinterpretations. When this occurs, the primary principle of medicine—first, do no harm—may be violated.

Child abuse in any form is always unacceptable. However, if errors in diagnosis, false accusations, and wrongful convictions result from untested and unverified beliefs, then we have done harm.

Critically evaluating one’s own understanding is far more constructive than

1 Reasons for the need to declare a competing interest are given in the Guidelines for BMJ authors and editors (BMJ 1999;319:1784-6).
Post-immigrant refugee medicine

Population mobility must be considered

Editor—Adams et al highlight the importance of pre-departure and migration history in post-immigration refugee medicine, but health professionals must also consider the ongoing reality of mobility in this population.

For example, a newcomer, in whom diabetes has been diagnosed during screening, happens to mention the recent death of her mother. This leads to the discovery of plans to travel back home to the Sudan and a timely provision of health advice, malaria prophylaxis, and a summary of drug treatment.

Population mobility in the context of refugees refers to the forced movement of people beginning before departure and continuing for years, sometimes a lifetime, as people search for a place to call home. Historically, refugee programmes have continued for years, sometimes a lifetime, as people begin their journeys before departure and continue to move as they seek community and improved quality of life.

These movements unveil global health disparities related to diseases and access to healthcare—for example, immigrants are at increased risk of travel related illness. Immigrants are often unaware of the importance of travel advice and disease prevention strategies. Acknowledging the reality of this mobility can allow for a systematic delivery of advice on travelling home, health promotion for cancers and cardiovascular diseases, and low cost mechanisms to communicate and transfer medical histories.

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Competing interests: None declared.

6 Despite increasing focus on the mental health of refugee children, research data are lacking. Some researchers have found an increased risk of post-traumatic stress disorder, depression, and anxiety. Others found no differences between the incidence of psychiatric disorders in refugee children and the local population. Whether this reflects better assimilation of these children into the society or unknown variables remains to be explored.

Children comprise nearly half of the refugee population in many countries and may arrive malnourished without any screening or immunisation. They need culturally sensitive dietary advice and information about sexual habits and avoiding drugs.

Children are worried not just about health but about loss of family members, loneliness, feeling cold, being depressed, lack of money, being bullied, language barriers, and being used as interpreters for their parents. They may not seek care for legal reasons or fear of persecution.

Doctors need training in interviewing skills that explore these unique issues and awareness of locally available resources to act as advocates on their behalf. Collaboration between doctors and mental health, social, and education services is required. Children's needs should not be seen in isolation but in the context of their families. The best way to help them is to help their families. A timely understanding of these needs will be critical in safeguarding our future.

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Competing interests: None declared.

Millennium development goals: whose goals and for whom?

Editor—Millennium development goals are the most recent statement of commitment towards narrowing gaps between the developed and developing regions of the world. But how realistic are these goals?

Although goals help in making assessments of progress, they should not be blind to existing potentials for progress, which is conditioned by the existing status as well as the motivation of nations and states towards realising them. Unfortunately, millennium development goals are considered to be a tool for assessing accountability and highlighting a need for urgency that could violate the autonomy of nations and states. This raises a question about whose goals they are.

Often such initiatives are seen as global priorities, overriding local concerns. The best example is the vaccination initiative, which has consistently reflected failures by countries without the required infrastructure. In other circumstances, such externally aided initiatives are never integrated into the local health system to make the most of such intervention. In terms of measuring the extent of achievement of such goals, caution is advised in assessing progress conditioned by local realities that may not always be conducive to making the expected progress.

Finally, who benefits from the achievement of such goals needs to be made clear. Would there be any space to account for the inequalities resulting in achievement of such goals? If yes, the assessment of progress in achieving these goals needs to make adjustments for this to have a realistic evaluation of progress.

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Competing interests: None declared.

1 Haines A, Casellas A. Can the millennium development goals be attained? BMJ 2004;329:934-7. (14 August.)

Women in medicine

Doctors of both sexes are seeking balance between life and work

Editor—The Medical Women's Federation supports Heath's statement in her editorial that all occupations should seek to mirror the demographics of society. Child care support at levels found in Scandinavian countries would greatly support women in medicine to achieve their potential. How-
The 41 signatories to the letter and competing interest statements

Competing interests: We are physicians and scientists who have a common interest in applying the principles of science and medicine to infant injury evaluation. Each of us either participated in writing this letter or reviewed it prior to submission. Each of us agrees with its content.

FAB, PDB, TC, BJC, DLC, VJMD, LJD, JEL, PEL, DM-P, MDN, AKO, JO, GR, SJR, MJS, PS, WS, JBS, ST, HW, and PW have consulted or testified for the prosecution and the defence as part of their official salaried responsibilities, as paid consultants or pro bono in fatal and non-fatal alleged child abuse cases.

RS has given evidence to the Courts (not for either prosecution or defence) and has been reimbursed by the public Legal Aid system.

JHD, GS, and LCT have testified for the prosecution in fatal alleged child abuse cases as part of their official salaried responsibilities.

JG, HG, RJ, REM, MM, KT, JBL, RR, JS, RU, CVE, and EW have consulted and testified for the defence pro bono and as paid consultants in fatal and nonfatal alleged child abuse cases.

TLB, KM and JN have no competing interests other than as stated in the first sentence above.

None of us answers, "Yes" to Questions 1, 2, 3 or 5 in the BMJ "Declaration of competing interest".
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