IN THE \_\_\_\_\_\_ JUDICIAL DISTRICT COURT, STATE OF UTAH

[COUNTY], [ DEPARTMENT]

|  |  |
| --- | --- |
| THE STATE OF UTAH, | **STATE'S MEMORANDUM IN** |
|  | **SUPPORT OF BINDOVER** |
| Plaintiff, |  |
| -vs- | Case No. |
| [DEFENDANT], | Judge |
| Defendant. |  |

The State of Utah, through its counsel, [DA], Salt Lake County District Attorney, and [ADA], Deputy District Attorney, hereby submits this Memorandum in Support of Bindover. A preliminary hearing was held before this Court on [DATE], with [WITNESSES] providing testimony. The State also introduced a number of physical exhibits including copies of CT and MRI scans of the victim and a chart showing the location of four rib fractures. At the conclusion of the evidence, Defense counsel asked for permission to brief the matter of bindover. On [DATE], the Defense submitted a memorandum opposing bindover on Count 2, but submitting to the Court the issue of bindover on Count 1 of the Amended Information. This memorandum is in response to the Defendant's arguments and also

represents the State's argument as to why it is appropriate for this Court, acting as Magistrate, to bind the Defendant over on both counts of Child Abuse, a second degree felony, as charged in the Amended Information.

# INTRODUCTION

[DEFENDANT] is charged with two counts of Child Abuse, a second degree felony, in violation of Utah Code Annotated §76-5-109(2)(a). Count 1 relates to injuries suffered by the two month-old victim, F.I., while in the care of the Defendant, on [DATE]. Count 2 relates to older injuries suffered by the baby which included both subdural bleeding in her head and four anterior-lateral rib fractures, all of which dated to about 2-3 weeks or in the case of the subdural hemorrhages 2 to 4

weeks old.

# STATEMENT OF MATERIAL FACTS1

# ARGUMENT

**I. THE STATE INTRODUCED SUFFICIENT EVIDENCE AT THE PRELIMINARY HEARING OF THIS MATTER TO ESTABLISH THAT THE CHARGED CRIMES WERE COMMITTED AND THAT THE DEFENDANT COMMITTED THEM**

In Utah, the role of the magistrate in a preliminary hearing is to determine if there is probable cause to bind a defendant over to the District Court for trial. Utah R. Crim. P. 7(i)(l)(i)(2). A Defendant may be bound over for trial if the "magistrate finds probable cause to believe that the crime charged has been committed and that the defendant has committed it." *Id.* In a preliminary hearing, the prosecution must establish probable cause by "present[ing] sufficient evidence to support a reasonable belief that the defendant committed the charged crime." *State v. Virgin,* 2006 UT 29, 4, 137 P.3d 787

*(citing State v. Clark,* 2001 UT 9, 16, 20 P.3d 300). The prosecution's burden is to produce "believable evidence of all the elements of the crime charged," but not evidence "capable of supporting a finding of guilt beyond a reasonable doubt." *State v. Clark,* 2001 UT 9, 15, 20 P.3d 300. "The bindover standard is intentionally low so that the

credibility of witnesses and the truthfulness of the facts are left to the fact-finder [at trial]." *State v. Balfour,* 198 P. 3d 471,475 (Ut. Ct. App. 2008).

As the Utah Supreme Court clarified in the case of *State v. Clark,* cited above, the standard of probable cause required of the State at a preliminary hearing is the same as the probable cause needed to sustain the issuance of an arrest warrant. Further, at a preliminary hearing, "the magistrate must view all evidence in the light most favorable to the prosecution and must draw all reasonable inferences in favor of the prosecution." 2001 UT 9, 10. The Supreme Court concluded: "[I]f the State presents the court with sufficient information to issue an arrest warrant, a defendant's motion to quash a bindover should not be granted." Id. at p. 16. The *Clark* Court acknowledged the confusion created by various previous recitations of the standards applicable at a criminal preliminary hearing and concluded: "Therefore, at both the arrest warrant and the preliminary hearing stages, the prosecution must present sufficient evidence to support a reasonable belief that an offense has been committed and that the defendant committed it." Id. at p. 11, 20 P.3d 300, 306.

In the 2012 case of *State v. Maughan,* 2012 Ut App 121, the Utah Court of Appeals again made clear that: "In circumstances where alternative but equally reasonable inferences may be drawn from the evidence in favor of either the defendant or the State, the magistrate must rely on those inferences that are favorable to the State," 2012 Ut App 121, 10. The *Maughan* Court further clarified, "An inference is a deduction as to the existence of a fact which human experience teaches us can reasonably and logically be drawn from proof of other facts." Id. at 11. In *Maughan,* the Court of Appeals agreed with the magistrate's decision not to bind the defendant over because of

an absence of evidence or reasonable inference that the defendant acted with the specific intent required by the statute under which he was charged.

In this case, the crimes charged require the State to prove that the Defendant, while acting intentionally or knowingly, caused serious physical injury to F.I. Under

§76-5-109(2)(a), which defines the second degree felony version of the crime of Child Abuse, to prove a "serious physical injury", the State must show that a physical injury or set of injuries either (1) seriously impaired the child's health, (2) involved physical torture, (3) caused serious emotional harm to the child, or (4) involved a substantial risk of death to the child; and, must show one or more of the examples of serious physical injury set out in subsection 76-5-109(1)(f)(ii). The evidence introduced at the Preliminary Hearing made clear that the injuries inflicted on F.I. seriously impaired her health and involved a substantial risk of death to the baby, and under subsection 76-5- 109(1)(f)(ii)(A) the set of rib fractures clearly fit the definition of fracture of any bone or bones. Further, the evidence of both new and old subdural hemorrhages along with the severe fresh or acute injuries to the brain of F.I. clearly fit the definition of 76-5- 109(1)(f)(ii)(B)-"intracranial bleeding, swelling or contusion of the brain, whether caused by blows, shaking, or causing the child's head to impact with an object or surface."

[APPLICATION OF FACTS TO LEGAL STANDARDS]

CONCLUSION

The State provided sufficient evidence to support a reasonable belief that the crimes charged were committed and that they were committed by the defendant. Under the standard to be applied by this Court sitting as magistrate, a bind over is proper unless the evidence is "wholly lacking and incapable of reasonable inference to prove some issue which supports the prosecution's claim" such that even after drawing all reasonable

inferences from the evidence in favor of the State, there is no evidence of one or more elements of the crimes charged that support a reasonable belief. *Virgin,* supra, 23. Of course, in this case, there was no evidence introduced by the defendant, so the only

issue is whether the prosecution's evidence, judged by the proper standard, justifies a reasonable belief the crimes were committed by the defendant. The defense has not established in any way that the State's evidence at the preliminary hearing of this matter

was "so contradictory, inconsistent, or unbelievable that it is unreasonable to base belief of an element of the prosecutor's claim on that evidence", and thus a bindover of the defendant to the District Court on both Counts 1 and 2 of the Amended Information is appropriate.

RESPECTFULLY SUBMITTED this *.* day of June, 2013.

---------------------------------------

Deputy District Attorney

- ORIGINAL CONTRIBUTION

**Analysis of Missed Cases of Abusive Head Trauma**

Carole Jenny, MD, MBA

Lt Col Kent P. Hymel, MD, USAF, MC Alene Ritzen, MD, JD

**Context** Abusive head trauma (AHT) is a dangerous form of child abuse that can be difficult to diagnose in young children.

**Objectives** To determine how frequently AHT was previously missed by physicians

in a group of abused children with head injuries and to determine factors associated

Steven E. Reinert, MS Thomas C. Hay, DO

A

BUSIVE.HE AD T RAUMA (AHT) IS

a dangerous fo r m of c hild abuse. More c h il d abuse deaths occur from head inju ­

ries than any other type of injury.' In­ fants and toddlers who survive AHT of­ ten have serious neurologic sequelae.2.3 Head injury in infants and toddlers can be difficult to diagnose because symp­ toms are often nonspe cific. Vomiting, fe­ ver, irritability, and leth argy are com­ mon symptoms of a variety of conditions seen in children, including head trauma. When caretakers do not give a history of injury and the victim is preverbal, an abu­ sive head injury can be mistakenly di­

agnosed as a less-serious condi tio n.

In March 1995, we evaluated a 14- month-old child who had sustained an abusive head injury 4 months previ­

with the unrecognized diagnosis.

**Design** Retrospective chart review of cases of head trauma presenting between Janu­ ary 1, 1990, and December 31, 1995.

**Setting** Academic children's hospital.

**Patients** One hundred seventy-three children younger than 3 years with head in­ juries caused by abuse.

**Main Outcome Measures** Characteristics of head-injured children in whom diag­ nosis of AHT was unrecognized and the consequences of the missed diagnoses.

**Results** Fifty-four (31.2%) of 173 abused children with head injuries had been seen by physicians after AHT and the diagnosis was not recognized. The mean time to cor­ rect diagnosis among these children was 7 days (range, 0-189 days). Abusive head trauma was more likely to be unrecognized in very young white children from intact families and in children without respiratory compromise or seizures. In 7 of the chil­ dren with unrecognized AHT, misinterpretation of radiological studies contributed to the delay in diag nos is . Fifteen children (27.8%) were reinjured after the missed diag­ nosis. Twenty-two (40 .7%) experienced medical complications related to the missed diagnosis. Four of 5 deaths in the group with unrecognized AHT might have been pre­ vented by earlier recognition of abuse.

**Conclusion** Although diagnosing head trauma can be difficult in the absence of a history, it is important to consider inflicted head trauma in infants and young children presenting with nonspecific clinical signs.

*JAMA. 1999;281:621-626* www .jama.com

ously. Shortly after his initial injury, he had been examined by his physician and his new-onset seizures were attributed

been previously missed. We also exam­ ined factors that may have contributed to the unrecognized diagnosis of AHT.

a referral center for Colorado, Wyoming, Montana, and western Nebraska.

The children in this study were evalu­

to his history of prematur ity. During the

ated by the hospital's Child Advocacy and

next 4 months, the child had 7 physi­ cian visits and 2 cranial imaging stud­ ies. At each visit, the diagnosis of AHT was not recognized. When we exam­ ined him 4 months later, he had mul­ tiple old and new fractures and healing brain injuries, including extensive brain atro phy and healing brain infarctions.

**METHODS**

We studied cases of AHT in children younger than 3 years evaluated at the Chil­ dren's Hospital, Denver, Colo, fromJanu­ ary 1, 1990, through December 31, 1995. The Children's Hospital is an academic medical center affiliated with the Univer­ sity of Colorado School of Medicine. It is

Protection Team (CAP Team ). The CAP Team is a multidisciplinary group that con­ sults on cases of suspected child abuse and neglect. The team is led by pediatricians whose clinical focus is child abuse. Social workers, nurses, psychologists, child psy­ chiatrists, and attorneys also participate . The team routinely interviews caretakers

This case encouraged us to review our

experience with AHT cases to deter­ mine if the appropriate diagnosis had

**Author Affiliations:** Department of Pediatrics, Brown University School of M edicine(Dr Jenny), and Lifespan Medical Computing (Mr Reinert), Providence, RI; De­

*(Dr* Ritzen); and the Department of Radiology, Univer­ sity of Colorado School of Medicine, Denver *(Dr* Hay). **Corresponding Author and Reprints:** Carole Jenny,

partment of Pediatrics, Nation al Naval Medical *Center ,* MD, MBA, Hasbro Children's Hospital, M OC-140 ,

**For editorial comment seep 657.**

Bethesda, Md (Dr Hymel); Department of Pediatrics, Uni­ versity of Oregon Health Sciences Center, Portland

593 Eddy St, Providence, RI 02903 (e-mail: cjenny@lifespan. org) .

©1999 American Medical Association. All rights reserved.

JAMA, February 17, 1999- Vol 282, No , 7 **621**

UNRECOGNIZED CASES OF ABUSIVE HEAD TRAUMA

*·*

**Table 1.** Types of Injuries Sustained by Study Population

Types of Injury **No.(%)**

Head injuries 173 (100)

Subdural hematoma 150 (86.7)

Diffuse parenchymal brain injury 77 (44.5)

and impact cause the signs and symp­ toms commonly referred to as *shaken baby synd rome.4 6* The mechanism of in­ jury cannot always be accurately deter­ mined in child abuse cases. Because shak­ ing, impact to the head, or both are all

the period of diagnostic delay were clas­ sified as *reinjured.* Study patients whose medical records after their inflicted head trauma revealed abnormal head growth, recurrent seizures, psychomotor de­ lays, chronic anemia, vomiting, weight

Localized brain contusions *or*

shearing injuries

64 (37.0)

potentially harmful to infants and tod­ dlers, we grouped all head injuries caused

loss, and/or sensory deficits were classi­ fied as having *medical complications*

Skull fracture 55 (31.8)

Epidural hemorrhages 4 (2 .3)

Retinal hemorrhages 114 (65 .9) Facial or scalp trauma 98 (56.6)

by abuse into the single category of AHT. Factors considered by the multidisci­ plinary team in reaching the diagnosis of AHT (rather than nonintentional head in­

of AHT.

We examined data to determine what

factors were associated with a missed vs recognized diagnosis. We used x2 test­

Trauma to parts of body other than head or face

63(36.4)

jury) included (1) confession of inten­

tional injury by an adult caretaker; (2) in­

ing to assess the independence of 10 vari­

ables on the outcome variable of a cor­

Fractures other than skull fractures 60 (34.7)

to document medical history and the his­ tory of the acute injury, review previous medical and social service records, re­ view prior radiological studies, perform a careful physical examination , and order appropriate new diagnostic studies. In all cases, organic illnesses that mimic AHT are ruled out. Confirmation that head trauma was inflicted requires multidisciplinary team consensus.

Head trauma cases were identified from the log records of the CAP Team and charts were reviewed in depth. To ensure concurrence, study cases were re­ viewed by at least 2 of the authors (in­ cluding CJ) and radiological imaging studies were reviewed by a pediatric ra­ diologist (T.C.H.). Permission for the anonymous chart review was granted by the hospital's human subjects commit­ tee. Information gathered included de­ mographics, social and family data, de­ tails of the children's injuries, presenting complaints, clinical course, and details of previous medical visits related to head trauma, if applicable.

We limited the study to children with head injuries who were younger than 3 years for 2 reasons. First, children older than 3 years are not as likely to sustain severe injury when struck in the head or shaken. Second, children older than 3 years are more likely to be able to ar­ ticulate their experiences. Hence, AHT is much less likely to be missed as the appropriate diagnosis.

Abusive head trauma was defined as *inflicted cranial injury.* Researchers de­ bate whether shaking alone or shaking

consistent or inadequate histories given by caretakers (the history given did not ex­ plain the nature and severity of the inju­ ries); (3) associated unexplained inju­ ries, such as fractures or intra-abdominal injuries; and (4) delay in seeking care.

Cases of AHT were defined as *missed* if review of medical records and radiologi­ cal studies confirmed the following pre­ defined criteria: (1) Prior to the diagnosis of AHT, a physician evaluated the child (on l occasions) for nonspecific clini­ cal sign(s) compatible with head trauma (ie, recurrent vomiting, initability, facial and/or scalp injury, altered mental sta­ tus, abnormal respiratory status, and/or sei­ zures). (2) The medical evaluation(s) for these nonspecific clinical sign(s) did not result in a diagnosis of AHT. (3) Thereaf­ ter, 1 or more of the following scenarios occurred: *(a)* The child improved clini­ cally, later experienced (repeat) acute trauma confirmed as abusive, and under­ went diagnostic imaging that revealed old cranial injuries and other new inj uries.

(b) The child remained symptomatic or ex­ perienced worsening clinical signs until head trauma was recognized, verified by cranial imaging studies, and confirmed as abusive. *(c)* The person who injured the child later admitted to abusing the child shortly before the onset of the child's non­ specific clinical sign(s). In all cases, the es­ timated age of the cranial injuries docu­ mented by imaging studies was consistent with the prior time of onset of the child's nonspecific clinical sign(s).

All remaining cases of AHT evalu­ ated during the study period were con­ sidered *recognized.* Children who sus­ tained any new inflicted injuries during

rect diagnosis of head trauma. Variables resulting in x2 P:5o .25 or less were en­ tered into an initial multivariate logistic

regression model. We then used Wald and likelihood ratio testing to iteratively re­ move noncontribut01y variables from the model.7 Analysis was performed using Stata software, Version 5.0 (Stata Corp, College Station, Tex).

**RESULTS**

A total of 232 children with suspected head injuries were evaluated by the CAP Team from January 1990 through De­ cember 1995. Fifty-nine children did not meet study criteria. Of these, 8 were eliminated because they were aged 3 years or older. It was determined that 38 were not abused. The medical records of 13 children could not be located. The re­ maining study sample included 173 abused children with head injuries.

The mean age of the 173 children was 247 days (range, 10 days to 2.9 years). Ninety-five (55%) of the children were male and 78 (45%) were female. The boys' ages at the Lime they were first seen for symptoms of AHT were not significantly different than the girls' ages. In our study sample, minorities were overrepre­ sented (33.5% minority) compared with the racial distribution of the Denver met­ ropolitan area (19.7% minority).8

The types of injuries noted in the chil­ dren are shown in **TABLE 1.** Many of the children sustained more than 1 type of injury. Eighty-nine children (51.4%) were covered by Medicaid-funded in­ surance programs . Twenty-seven chil­ dren (15.6%) were uninsured. The re­ mainder had private health insurance.

**622** JAMA, February 17, 1999-Vol 282, No. 7 ©1999 American Medical Association. All rights reserved.

UNRECOGNIZED CASES OF ABUSIVE HEAD TRAUMA

**Missed vs Recognized AHT**

In the 173 children withAHT, 54 cases (31.2%) were classified as missed. For children with missed AHT, the mean number of physician visits before the trauma was recognized was 2.8 (range, 2-9 visits).

For children in whom the diagnosis of AHT was missed, the mean length of time to diagnosis of head trauma from the day of the first visit was 7 days (range, 0- 189 days). In 5 cases, the children were seen twice in the same day and the di­ agnosis was made on the second visit; hence, the designation of O days until di­ agnosis in some cases of missed AHT.

When missed cases were compared with recognized cases, several factors were found to be significantly different.

**Age**

Children with missed AHT were much younger than those in whom the diagno­ sis was recognized on the first physician visit. The mean age of missed AHT cases at the time of their first medical visit for head injury symptoms was 180 days (95% confidence interval [CI], 125-236). The mean age of the recognized cases was 278 days (95% CI, 228-328). The mean ages of children with missed and recognized AHT were significantly different (inde­

to be recognized as having head trauma at first visit to the physician. **TABLE 2** summarizes the number and percent- age of children who were missed and rec­ ognized as having AHT compared with their symptoms and signs. At the first visit, children who were comatose, whose breathing was compromised, who were having seizures, or who had facial bruis­ ing were more likely to be accurately di­ agnosed. Conversely, children who pre­ sented with irritability or vomiting at the first visit were less likely to be identi­ fied as having AHT.

**Fadors Not Significantly Different** Several factors were found not to differ be­ tween children with missed vs recog­

nized AHT. These included whether the

parents were employed, whether the par­ ents had private insurance coverage, the sex of the child, the birth weight of the child, and whether the child had been born prematurely (<37 weeks' gestation).

**fadors Associated**

**With Missed Diagnosis of AHT**

Nine variables were found to be signifi­ cantly associated with missing the diag­ nosis of AHT by univariate analysis. These

were transformed to dichotomous vari­ ables and entered into a logistic regres­ sion model. They included age younger than 6 months, minority race, parents not living together , and 6 signs and symp­ toms noted at the first visit, including fa­ cial injury, seizures, decreased mental sta­ tus, abnormal respiratory status, vomiting, and irritability. Of these 9 variables, 4 were retained in the multivariate logistic model. These 4 independent variables predict­ ing the correct diagnosis of AHT at the first visit included (1) abnormal respiratory sta­ tus (odds ratio [OR], 7.23; 95% CI, 2.4-

21.3; P<.001); (2) seizures present (OR,

6.67; 95% CI, 2.5-17.3; P<.001); (3) fa­

cial and/or scalp injury present (OR, 4.81; 95% CI, 2.1-11.0; P<.001); and (4) par­

ents not living together (OR, 2.49; 95% CI, 1.1-5.7; P = .03).

Applying the logistic regression model constructed from the data, we found that if none of these 4 factors were present , the probability that a physician would

make the correct diagnosis of AHT was P = .20. That is, if a child had normal res­ pirations, had no seizures, had no facial or scalp injury, and came from an intact family, the probability that AHT would

be recognized was less than 1 in 5.

pendent samples *t* test, P = .02).

**Table 2.** Missed and Recognized Abusive Head Trauma Cases: Severity of Presenting Symptoms

children of minority races. In white chil­

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Race**  **Symptoms** | | **No.** (%)  **Recognized** | **No.** (%)  **Missed** | x2  **Test** | ***P***  **Value** |
| Abusive head trauma was missed signifi­ Facial and/or scalp injuries | | 78/119 (65.5) | 20/54 (37.0) | 12.293 | <.001 |
| cantly more often in white children than Other bodily trauma (not head | | 53/118 (44.9) | 10/54 (18.9) | 10.664 | .001 |
| dren, 43 (37.4%) ofll5 casesofAHTwere  missed and in minority children, 11 (19%) | Mental status Awake and alert | 35/119 (29.4) | **35/54 (64.8)]** | | |
| of 58 were missed (Pearson x2 , P = .0 1) . Sleepy and/or lethargic 31/119 (26.1) 17/54 (31.5) 31.397 | | | | | < .001 |

or face trauma)

Normal breathing

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Comatose and responsive to pain | | 21/119 (17.6) | 1/54 (1.9) |  | |
| **family Composition** Comatose and unresponsive to pain | | 32/119 (26.9) | 1/54 (1.9) |
| Abusive head trauma was more likely to Mental status by group  be missed in families in which both par­ Awake and alert | | 35/119 (29.4) | 35/54 (64.8J) | 19.326 <.001 | |
| ents lived with the child. Thirty-seven Depressed or comatose  (40.2%) of 92 cases were missed in in­ Respiratory status | | 84/119 (70.6)  45/119 (37.8) | 19/54 (35.2)  44/54 (81.5) ] |  | |
| tact families. In families in which the | Compromised | 20/119 (16.8) | 8/54 (14.8) | 33.778 | < .001 |
|  |  |  |  |  |  |
| mother and father of the child were not Requiring resuscitation or ventilation  living together, 14 (18.7%) of 75 cases Respiratory status by group  were missed (Pearson x2, P = .003). Normal | | 54/119 (45.4)  45/119 *(37* .8) | 2/54 (3.7)  44/54 (81.5J | 28.354 < .001 | |
| Abnormal (compromised or requiring | | 74/119 (62.2) | 10/54 (18 .5) |  | |
| **Severity of Symptoms** | resuscitation or ventilation) |  |  |  |  |

)

**at Initial Visit**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Seizures at first visit | 55/119 (46.2) | 8/54 (14.8) | 15.820 | < .001 |
| Vomiting at first visit | 42/111 (37.8) | 30/54 (55.6) | 4.637 | .03 |
| Irritable at first visit | 53/111 (47.7) | 34/52 (65.4) | 4.426 | .04 |

Not surprisingly, the more severely symptomatic children were more likely

©1999 American Medical Association. All rights reserved. JAMA, February 17, 1999-Vol 282, No. 7 **623**

UNRECOGNIZED CASES OF ABUSIVE HEAD TRAUMA

**Misdiagnoses Applied to Children With AHT**

The 54 children with missed AHT re­ ceived 98 diagnoses other thanAHT dur­ ing their 98 patient visits. **TABLE 3** lists the diagnoses applied to the children with

cases, 5 (9.3%) of 54 children died. The percentage of children in the missed AHT group who died was not statistically dif­ ferent than in the recognized AHT group

Cx2 = 1.712; *P* = .19). In our estimation, 4 of the 5 deaths in the missed AHT group

missed for longer than 7 days involved radiological misreadings. **TABLE 5** sum­ marizes the nature of the errors made and

**Table 3.** Frequent Erroneous Diagnoses Made in Cases of Missed Abusive Head Trauma\*

missed AHT. The most common diag­

might have been prevented by earlier rec­

**Diagnosis**

**No. of Times**

**Diagnosis Made**

noses made were for viral gastroenteri­ tis and accidental head injury. In some cases, the diagnoses were correct, even though coexistent head trauma was not recognized. For example, in 1 case an in­ fant was accurately assessed to have a ret­ ropharyngeal abscess, but the accompa­ nying subdural hematoma, retinal hemorrhages, and skull fracture were not recognized. In other cases, the symp­ toms of head trauma were attributed to conditions other than AHT. In 10 cases, the wrong diagnosis was applied more than once to the same child. We did not count these repeated diagnoses on our frequency table.

**Outcome and Consequences** Twenty-five (14.5%) of the 173 children died as a result of their head injuries. Of

the recognizedAHT cases, 20 (16.8%) of

119 children died. In the missed AHT

ognition of abuse **(TABLE 4).**

Of the missed AHT cases, 15 (27.8%) of the 54 children were known to have been reinjured because of the delay in diag­ nosis. Twenty-two children (40.7%) had medical complications related to the delay in diagnosis. These conditions included seizure disorders, chronic vomiting, and increasing head size because of increas­ ing untreated subdural hematomas.

**Radiological Misdiagnosis**

In 7 of the children whose diagnosis of AHT was missed, radiological errors con­ tributed to the delay. These 7 children had 8 studies in which trauma was missed, including 6 computed tomog­ raphy scans of the head, 1 skeletal sur­ vey, and 1 long-bone radiograph of the arm. The 2 longest delays in diagnosis (141 days and 174 days) and 6 of 25 cases in which the diagnosis of AHT was

Viral gastroenteritis or 14

influenza Accidental head injury 10

Rule out sepsis 9

Increasing head size 6

Nonaccidental trauma 4

(not head injury)

|  |  |
| --- | --- |
| Otitis media | 5 |
| Seizure disorder | 5 |
| Reflux | 3 |
| Apnea | 3 |
| Upper respiratory tract infection | 2 |

Urinary tract infection or 2

pyelonephritis

Bruising of unknown origin 2

Hydrocephalus 2

Meningitis 2

\*Incorrect diagnoses made only once included anxiety, bronchiolitis, colic, complications of prematurity, constipation, failure to thrive, fever of unknown cause, hemiparesis, milk allergy, myositis, pneumonia, postmeningitic subdural effusion, retropharyngeal abscess, rule out osteomyelitis, sudden infant death syndrome, torticollis, urticaria, viral encephalitis, and **vomiting of unknown cause**

**Table 4.** Clinical Presentations of 4 Potentially Preventable Deaths With Missed AHT\*

**Patient Time Between**

**Age, mo Visits Documented Clinical Signs Evaluation Results Diagnosis**

18 First visit Vomiting, sleepy, normal respirations, facial bruising

None Influenza

7 Days after

first visit

Vomiting, alert and responsive, normal respiration, new bruising

None Otitis media

11 Days after first visit

Vomiting, coma, unresponsive to pain, respiratory arrest

Retinal hemorrhages, subdural hemorrhage, focal brain injury, diffuse brain injury, noncranial trauma

AHT

2 First visit Failure to thrive, vomiting, alert and responsive,

normal respiration, bruising to face and chest

Normal computed tomography result with missed subdural hemorrhage and brain shearing tears

Apnea

7 141 Days after first visit

Seizures, coma, unresponsive to pain, respiratory arrest

Retinal hemorrhages, skull fracture, subdural hemorrhage, diffuse brain injury, noncranial trauma, old cranial trauma

AHT

5 First visit Vomiting, irritability, sleepiness, normal

respiration, "went limp"

None Anxiety secondary

to new day care

6 Days after first visit

Vomiting, diarrhea, irritability, alert and responsive, normal respiration

None Acute gastroenteritis

9 Days after

first visit

Vomiting, irritability, coma, unresponsive to pain, seizures, cardiorespiratory arrest

Retinal hemorrhages, subdural hemorrhages, diffuse brain injury

AHT

3 First visit Vomiting, irritability, alert and responsive, normal

respiration, dehydration

None Acute gastroenteritis

8 Days after

first visit

Coma, unresponsive to pain Retinal hemorrhage, subdural hemorrhage, diffuse brain injury, old brain injury, old cranial trauma

AHT

\*In all cases of missed abusive head trauma (AHD, the estimated age of cranial injuries documented by imaging studies was consistent with the time of onset of the child's nonspecific clinical sign(s) before his/her first physician visit,

**624** JAMA, February 17, 1999-Vol 282, No. 7 ©1999 American Medical Association. All rights reserved.

UNRECOGNIZED CASES OF ABUSIVE HEAD TRAUMA

the time in delay of diagnosis attributed to the radiological misreading.

**COMMENT**

It is difficult to study the cases of child abuse that clinicians do not recognize. In l 972,Jackson9 reviewed traumatic in­ juries in children at King's College Hos­ pital in London, England, and found 18 of 100 cases to have been missed cases of child abuse. O'Neill et alto reported a series of 110 battered children in 1973. Eighty percent of those children had signs of prior injury. Alexander et aPl found physical evidence of previous head trauma in 8 of24 children evaluated for head injury due to shaking . Ewing­ Cobbs et aln discovered signs of preex­ isting brain injmy in 45% of children with inflicted traumatic brain injury com­ pared with none in children with acci­ dental traumatic brain injury.

Incidental cases of missed child abuse have been published. 13 In their study of abusive head injuries, Benzel and Had­ den mention that 9 of 23 abused chil­ dren with head injuries"... were known to have been seen by other physicians be­ cause of similar problems or other inju­ ries consistent with child abuse."14 Since then, an increased awareness of child abuse has occurred, but similar studies

sodes of shaking that led to the infant's various illnesses.

In the current study, we found that 31.2% of children who were clinically symptomatic after AHT were misdiag­ nosed as having other conditions. Infants have few ways to demonstrate illness or injury. Nonspecific signs, such as vomit­ ing, fever, and irritability, are seen in a myriad of conditions, including many be­ nign, self-limited illnesses. The diffi­ culty, then, is to be able to discern when these signs and symptoms indicate poten­ tially serious or fatal pathology.

The possibility exists that in some of the visits we classified as missed, the child had not yet been injured. How­ ever, in another study by our group, we found that patients became symptom­ atic immediately after their injuries in 37 cases in which perpetrators admit­ ted to causing head injuries in infants.16 To guard against misclassification, we examined the medical records ex­ tremely carefully to correlate clinical and radiological findings.

Not surprisingly, the infants and tod­ dlers in our study whose head injuries were misdiagnosed were overall less ill than those whose head injuries were rec-

ognized. The fact that they were not as ill made the diagnosis of AHT difficult. Also, the children whose AHT was missed were, as a group, younger. The difficulty of diagnosing serious illness or injury in young infants is complicated by the limited range of their normal behav­ ior. With less-sophisticated behavioral and neurologic signs to assess, the changes in young infants with head in­ juries are more difficult to detect.

Striking differences were seen in the race and family composition of infants with missed and recognized injuries. Infants with recognized AHT were more likely to be minority children or children whose mothers and fathers were not living to­ gether. We speculate that this may repre­ sent a subtle bias in decision making based on the physician's assessment of risk. A physician examining a white child from an intact family may be less likely to think about the possibility of child abuse. An­ other hypothesis is that perhaps minor­ ity and single-parent families were more likely to obtain care from public clinics or hospital emergency departments, where physicians may be more attuned to abuse issues. In the current study, the children of intact, 2-parent households were much

have not been reported.

We do not know how many cases of

**Table 5.** Radiological Errors in Cases of Missed Abusive Head Trauma\*

**Visit No. in Which Case Radiological Error**

**Length of Delay in Diagnosis Due to**

AHT are never detected. Surely, the inju­

ries occurring from impact or shaking rep­ resent a range of severity, from no inju­ ries to mild concussion or small subdural hemorrhage, severe brain damage, exten­ sive intracranial bleeding, and cerebral edema. Caffey15 speculated in 1972 that many children who are found to have mild neurologic abnormalities and learning dis­ abilities may have been victims of AHT.

Parents who confess to shaking or hitting the heads of their children fre­ quently report doing the same thing previously. In 1 study case, an infant was hospitalized 3 times before some­ one witnessed the child being shaken violently. On 1 occasion, he was evalu­ ated and treated for possible sepsis. The other 2 hospitalizations were for apnea and reflux, respectively. The

**No. Was Made**

1. First visit of 2
2. Third visit of 4
3. Second visit of 3
4. First visit of 2
5. Second visit of 3
6. First visit of 2
7. Second visit of 9

Fifth visit of 9

**Nature of Misdiagnosis**

Result of CT of head read as normal; CT showed subdural hemorrhage and shearing tears of the parenchyma

Result of CT of head read as consistent with internal hydrocephalus; CT showed subdural hemorrhage

Result of CT of head read as normal; CT showed subdural hemorrhage

Result of skeletal survey read as normal; child had a metaphyseal fracture of the tibia and unilateral periosteal elevation of the same bone

Result of CT of head read as normal; CT showed subdural hemorrhage

Result of CT of head read as normal; CT showed subdural hemorrhage

Result of CT of head read as normal; CT showed subdural hemorrhage and shearing tears of the parenchyma

Long-bone radiographs of both arms read as consisent with myositis; x-ray film showed extensive periosteal reaction of both humeri and metaphyseal fractures of proximal humeri bilaterally

**Radiological Error, d**

141

4

11

4

51

174

74

child's father admitted to multiple epi-

\*CT indicates computed tomography.

**©1999 American Medical Asso ciation . All rights reserved.** JAMA, Februa ry 17, 1999-Vol 282, No. 7 **625**

UNRECOGNIZED CASES OF ABUSIVE HEAD TRAUMA

more likely to have private insurance (Pear- son x2, 23.953; P<.001). In addition, white families were much more likely to have private insurance than min01ity fami­ lies (Pearson x2, 5.148; P = .02). How­ ever, we did not collect data on the prac­ ticesetting in which missed and recognized diagnoses were made.

Are missed cases of AHT inevitable? If a child's caretakers cannot or will not give an accurate history, making the cor­ rect diagnosis is extremely difficult. Phy­ sicians cannot obtain cranial computed tomographic scans for every infant and toddler who presents with vomiting, ir­ ritability, and fever. Based on this study and on our experience with these cases, we make the following suggestions to fa­ cilitate the diagnosis of AHT.

* 1. Be alert for bruises or abrasions on the faces or heads of children presenting with nonspecific symptoms. In 20 of 54 missed AHT cases in this study, facial or head bruising was attributed to acciden­ tal injury unrelated to the presenting ill­ ness symptoms. One study of bruising in healthy, nonabused children found no bruises on children who were not yet strong enough to pull to standing.17 The presence of bruises in infants raises the possibility of inflicted injury.
  2. When evaluating infants and tod­ dlers with nonspecific symptoms, such as vomiting, fever, or irritability, con­ sider head trauma in the differential di-

agnosis. Perform a head-to-toe physical examination, palpate the fontanelles, measure the head circumference, and be alert for signs of trauma.

* 1. When collecting spinal fluid in cases of suspected infantile sepsis, ex­ amine any bloody cerebrospinal fluid for xanthochromia . A supernatant of a spi­ nal fluid contaminated by blood second­ ary to a traumatic procedure should be clear in color if the specimen is exam­ ined shortly after it is collected. Xantho­ chromic spinal fluid can represent old blood in the cerebrospinal fluid from pre­ vious trauma, although it is not specific for an intracranial bleed.18 20

·

* 1. Pediatrically trained radiologists should be consulted to interpret x-ray film and computed tomographic im­ ages in cases of suspected child abuse.

In addition to these suggestions, other as yet unvalidated strategies to detect occult abuse could be consid­ ered. Dilated retinal examinations in infants and children with nonspecific symptoms of illness could increase the recognition of retinal hemorrhages. Retinal hemorrhages have been re­ ported in the majority of children who are victims of AHT.21 Other possibili­ ties need further research. Some mark­ ers of brain trauma are known to cross the blood-brain barrier, such as the BB fraction of creatine kinase. If rapid tests were available for such markers, a

simple blood test possibly could be done to detect occult trauma. In a re­ cent study by Hymel and colleagues,22 children with traumatic parenchymal brain injury were frequently noted to have prolonged prothrombin and par­ tial thromboplastin times. These tests are generally available and inexpensive to run. Their sensitivity and specificity as screening tests for head trauma in in­ fants are not known.

There are other ways for AHT to pre­ sent clinically that we did not see in this group of patients. The list of signs and symptoms we examined is not univer­ sally inclusive. Another limitation of our method is that the study was done ret­ rospectively through record review. However, this seems to be the only op­ tion we currently have for examining di­ agnostic errors. Finally, information con­ cerning the training, experi ence, or practice setting of the physicians evalu­ ating these patients was not obtained.

Although it is difficult to detect all se­ rious AHT in the clinical setting, an awareness of the nonspecific nature of the signs and symptoms of AHT, particu­ larly in less-s erious cases, could in­

crease the likelihood that more cases **will**

be detected .

**Disclaimer:** The opinions and conclusions in this ar­ ticle are those of the authors and are not intended to represent the official positions of the US Air Force, US Department of Defense, or any other governmental agency.

**REFERENCES**

1. Levitt CJ, Smith WL, Alexander RC. Abusive head trauma. In: Reece RM, ed. *Child Abuse: Medical Di­ agnosis and Management.* Philadelphia, Pa: Lea & Fe­ biger; 1994:1-22 .
2. Hadley **MN,** Sonntag VKH, Rekate HL, Murphy A. The infant whiplash-shake injury syndrome: a clinical and pathological stud y. *Neurosurgery.* 1989;24:536- 540.
3. Sinai SH, Ball MR . Head trauma due to child abuse: serial computerized tomography in diagnosis and man­ agement. *South Med J.* 1987;8 0:1505-1512.
4. Duhaime AC, Gennarelli TA, Thibault LE, Bruce DA, Marguilies 55, Wiser R. The shaken baby syndrome: a clinical, pathological, and biomechanical stud y. *J Neu­ rosurg.* 1987;66:409-415.
5. Alexander R, Sato Y, Smith W, Bennett T. Inci­ dence of impact trauma with cranial injuries ascribed to sha king. *AJDC.* 1990;144:724-726.
6. Duhaime AC, Christian CW, Rorke LB, Zimmer­ man RA. Nonaccidental head injury in infants: the "shaken baby syndrome. " *N Engl J Med.* 1998;338: 1822-1829.
7. Hosmer DW Jr, Lemeshow S. *Applied Logistic Regression .* New York, NY: John Wiley & Sons Inc; 1989.
8. US Bureau of the Census . 7*990* Census *of Popu­ lation and Housing, Summary Tape File 1.* Washing­ ton, DC: US Government Printing Office; 1991.
9. Jackson G. Child abuse syndrome: the cases we miss.

*BM J.* 19 72;2:756-757 .

1. O'Neill JA Jr, Meacham WF, Griffin JP, Sawyers JL Patterns of injury in battered child syndro me. *J Trauma.* 1973;13:332-339.
2. Alexander A, Crabbe L, Sato Y, Smith W, Ben­ nett T. Serial abuse in children who are shaken. *AJDC.* 1990;144:58-60.
3. Ewing-Cobbs L, Kramer L, Prasad M, et al. Neuroimaging, physical, and developmental findings after inflicted and noninflicted traumatic brain injury in young children. *Pediatrics .* 1998;102:300- 307.
4. Diamond P, Hansen CM, Christofersen MR . Child abuse presenting as a thoracolumbar spinal fracture dislocation: a case report. *Pediatr Emerg Care.* 1994; 10:83-86,
5. Benzel EC, Hadden TA. Neurologic manifesta­ tions of child abuse. *South Med J.* 1989;82:1347- 1351.
6. Caffey J\_ On the theory and practice of shaking infants: its potential residual effects of permanent brain

damage and mental retardation. *AJDC.* 1972;124: 161-169.

1. Starling SP, Holden JR, Jenny C. Abusive head trauma: the relationship of perpetrators to their vic­ tims. *Pediatrics .* 1995;95:259-262 .
2. Wedgwood J. Childhood bruising. *Practitioner .*

1990;234:598-601.

1. Kortbeek LH, Booij AC. Bilirubin excess, eryth­ rophages and siderophages in differentiation of blood in cerebrospinal fluid . *Clin Neurol Neurosurg.* 1979; 81:265-279.
2. Resurreccion EC, Rosenblum JA. Common causes of spurious xanthochromia in cerebrospinal fluid . *An­ giology .* 1972;23:105-110.
3. Spear RM, Chadwick D, Peterson BM. Fatalities associated with misinterpretation of bloody cerebra­ spinal fluid in the "shaken baby syndrome" [letter] . AJDC. 1992;146:1415-1417 .
4. Smith WL, Alexander RC, Judisch GF, Sato Y, Kao SC Magnetic resonance imaging evaluation of neo­ nates with retinal hemorrhages. *Pediatrics .* 1992;89: 332-333.
5. Hymel KP, Abshire TC, Luckey DW, Jenny C.Co­ agulopathy in pediatric abusive head trauma. *Pedi­ atrics.* 1997;99:371-375.

**626** JAMA, February 17, 1999- Vo! 282, No . 7

©1999 American Medical Association. **All** rights reserved.

LETTERS

**Table.** Transaminase Values of Patients at Discharge \*

Patients With Normal Transaminase Levels at Admission

also were receiving non-Chinese drug treatments. Based on these findings, we recommend that liver function be moni­ tored in patients receiving traditional Chinese drugs, espe­ cially in patients with possible previous liver disease or risk

**:51.25-Fold**

**1.26- to**

**2-Fold**

**> 2-Fold**

of decreased liver function.

**Enzyme Normal Elevation Elevation Elevation**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ALT (n = 1330) | 1249 (93.9) | 42 (3.1) | 26 (2.0) | 13 (1.0) | Klaus Linde, MD |
| AST (n = 1413) | 1392 (98.5) | 10 (0.7) | 11 (0.8) | 0 | Wolfgang Weidenhammer |
| -y-GT (n = 1248) | 1210 (96.9) | 17 (1.4) | 21 (1.7 ) | 0 | Technische Universitat |

Dieter Melchart, MD

**Patients With Elevated Transaminase Levels at Admission**

**s 1.25-Fold 1.26- to**

**of 2-Fold of > 2-Fold of**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **sAdmission** | **Admission** | **Admission** | **Admission** | Debbie Shaw, BSc |
| ALT(n = 120) | 89(74.1) | 14 (11.6) | 16 (13.2) | 1 (1.1) | Guy's *&:* St Thomas' Hospital Trust |
| AST(n = 37) | 28 (75.7) | 4 (10.8) | 4 (10.8) | 1 (2.7) | London, England |
| -y-GT (n = 20 2) | 168 (83.1) | 20 (9.9) | 11 (5.5) | 3 (1.5) | RudolfBauer, PhD |

Munich, Germany Stefan Hager, MD

Hospital for Traditional Chinese Medicine

Koetzting, Germany

\*ALT indicates alanine aminotransferase: AST, aspartate aminotransferase; and -y- G T,

-y-glutamyttransferase. All dat a are presented as number (percentage) of patients.

of the 1507 patients consuming Chinese herbs. Two of the 14 patients also had temporary clinical symptoms (nausea and vomiting in 1 patient, itching **in** the second patient). Based on assessments by 2 independent physicians review­ ing the records, a causal relationship of elevated ALT levels with Chinese drug therapy seemed possible in 13 patients and likely in 1. All patients were also receiving non­ Chinese drug treatment, and, for some of the drugs used (for example, minocycline, mesalazine, and diclofenac), liver enzyme elevations are listed as possible adverse effects.4 Thir­ teen patients had started these treatments with non­ Chinese drugs before their hospital stays, and the dosages had been kept constant or diminished.

Follow-up values of ALT obtained within 8 weeks of hospital discharge were normal in 11 patients (6 of them had continued to take traditional Chinese drugs) and nearly normal in the remaining 3. In 5 patients there were indications of previous liver function abnormalities. The 14 patients with increased ALT levels had received a total of 115 different traditional Chinese drugs. When the fre­ quency of drugs used in these cases was compared with the frequency in patients who had normal liver enzyme values, an increased risk was observed for formulas con­ taining *Glycyrrhizae radix* and *Atractylodis macrocephalae rhizama.*

Comment. In the population and setting studied , clini­ cally relevant liver enzyme elevations occurred in about 1 in 100 patients treated with traditional Chinese drugs who

©1999 American Medical Association. All rights reserved .

Heinrich-Heine-University Dusseldorf, Germany

**Disclosure:** Dr Hager is the chief physician at Hospital for Traditional Chinese M edi­ cine, where the study was performed. Dr Melchart of Technische Universitat, and Dr Bauer of Heinrich-Heine-University, are members of the scientific advisory board .

1. Chan TY, Critchley JA. Usage and adverse effects of Chinese herbal medicines.

*Hum Exp Toxico /.* 1996;15 : 5 - 12 .

1. Perharic L, Shaw D, Leon C, De Smet PA, Murray VS. Possibl e association of liver damage with the use of Chinese herbal medicine for skin disease. Vet *Hum Toxi col .* 1995;37:562-566 .
2. Kane JA, Kane SP, Jain S. Hepatitis induced by traditional Chinese herbs: pos­ sible toxic components . *Gut .* 1995;36:146-147.
3. Rote Liste Service GmbH. *Rote Liste 1997 .* Aulendo rf, Germany: Editio Can­ tor; 1997.

**CORRECTIONS**

Incorrect Description: In the Editorial entitled " Understanding Parkinson Disease" published in the January 27, 1999, issue ofTHE JOURNAL (1999 ;281:376-378), sele ­ giline was ident ified as an MAO type A inhibitor rather than a type B inhibitor . On page 377, the sentence should have read, "Selegiline is a monoamine oxidase type B inhibitor that limits the formation of free radicals derived from oxidation of do­ pamine, and application of this agent in clinical trials suggests an effect on disease progression consistent with a neuroprotective action." ·" "

**Incorrect Byline and Affiliation:** In the Original Contribution entitled "Analysis of Missed Cases of Abusive Head Trauma," published in the February 17, 1999, issue of THE JOURNAL (1 999;281 :621-626), the third author's name was m is­ spelled in the byline on page 621. It should have read "Arlene Ritzen, MD, JD." Additionally, in the author affiliation s on the same page, Dr Ritzen's affiliation should have read "Department of Pediatrics, Oregon Health Sciences University, Port­ land."

**Author Omi tted:** In the Reply Letter entitled "Talking With Patients About Screen­ ing for Prostate Cancer" published in the January 13, 1999, issue of THE JOURNAL (1999;281:133), the first author was inadvertently omitted . Scott Stern, MD, should have been listed above Wendy Levinson, M D. Both authors are affiliated with the University of Chicago.

JAMA, July 7, 1999- Vol 281, No 1 **29**