

Reflections on “Shaken Baby Syndrome”: A Case Report

Jane M. Orient, M.D.

Case Summary

On November 24, 1997, Baby Alan Yurko stopped breathing while his father was briefly out of the room looking for a rag to clean up vomit. His father attempted to resuscitate him while driving to the emergency room, where he was found to be pulseless and apneic. After aggressive advanced life support, the child had a pulse. He was ventilated, and his blood pressure was supported with dopamine. He was reportedly flaccid and unresponsive throughout his hospital stay, during much of which he was receiving vecuronium (Norcuron) and midazolam (Versed), apparently because of “agonal respirations” or “gasping movements” and some twitching of his right arm. He also received gentamicin, ceftriaxone (Rocephin), and cefotaxime (Claforan) for unstated indications. Bilateral pulmonary infiltrates were present on the initial chest radiograph, according to the official report, although pediatricians noted only a healing fracture of the left sixth rib. The infant was febrile for most of his stay.

The patient was transferred to a referral center, and on arrival there about three hours after the arrest, he began receiving an infusion of heparin to keep his arterial line patent, and also an unquantifiable amount of heparin to flush lines. The fontanelle, initially described as “soft” by the transport crew, was later described as “full.” About nine hours after the arrest, a computerized tomographic (CT) scan of the head was done. The report noted the following findings: “1. Small right subdural hematoma layered over the right parietal region. 2. At least one and perhaps two sites of intraparenchymal hemorrhage in the right frontal region. 3. Minimal mass effect in the right cerebral hemisphere at this time.” The assessment in the pediatrician’s admitting note read: “Child with brain bleed—and probably irreversible brain injury.”

An ophthalmology consultant found “diffuse scattered intraretinal and preretinal hemorrhages” throughout the right fundus and none in the left on Nov 25, along with a small bruise on the right lower eyelid. The findings were described as “consistent with nonaccidental trauma.”

A skeletal survey was negative, aside from the rib findings, as was an abdominal ultrasound. An electroencephalogram (EEG) showed severe diffuse cerebrocortical dysfunction and a propensity for seizures.

On Nov 24, the attending pediatrician informed the child’s parents that he had been injured by “some form of rapid head movement,” and that he would either die or “become vegetative.”

On this day, nurses made repeated notes of a bulging fontanelle, but apparently did not call the physicians’ attention to it.

On Nov 26, the EEG was repeated and was interpreted as showing “electrocerebral silence.” The conditions of recording noted a body temperature of 90°F. Motion artifact was said to be present. It was commented that high levels of central nervous system depressant medicine should be excluded. While such drugs had been discontinued for an unknown length of time, given only as “>24 hours” for midazolam and “>48 hours” for vecuronium on the brain death examination on Nov 27, no blood levels were ever measured, before or after death.

After a neurologic examination “per protocol” by two pediatricians, and an apnea test, the infant was certified to be brain dead at 1:17 p.m. on Nov 27 by the cross-covering pediatric pulmonologist, and at 3:05 p.m. by the attending pediatrician. Consent for organ donation was obtained from the mother at 12:45 p.m. on Nov 28. Although the examination for brain death was not performed until the fourth hospital day, attending pediatrician Benjamin Guedes, M.D., testified at trial that “[w]e established that the child was brain dead within about 24 hours, and then it was determined that the child would be a transplant donor.”^{1, p49}

The infant was readied for surgery at 3:15 a.m. on Nov 29. He received heparin 1,500 units preoperatively, 300 units/kg prior to cannulation of the aorta, and 20,000 units prior to ligating the vena cavae. The heart, liver, pancreas, and part of the small intestine were harvested for transplant.

At autopsy, the cause of death was stated to be “subdural hemorrhage due to Shaken Baby Syndrome,” and the date of death was given as Nov 27.²

Past medical records and a history obtained from the child’s mother, apparently of no interest to the attending physicians, child abuse consultant, or pathologist, revealed that the infant was the product of a 35-week pregnancy complicated by oligohydramnios and numerous other problems.³ The infant was born on Sept 16, 1997, weighing 5 lb, 9 oz. He was ventilated and treated with beractant (Survanta), a bovine-derived surfactant, for respiratory distress syndrome. He had severe neonatal jaundice and a number of other medical complications. He was discharged on Sept 23.

Although he was described as “thriving” in outpatient records, the infant fed poorly, had poor weight gain, and was described as lethargic by his mother. He was given diphtheria/tetanus/acellular pertussis (DTaP), hepatitis B, oral polio, and *Hemophilus influenzae* B vaccines on Nov 11. Afterward, he was, according to his mother, warm to the touch, increasingly lethargic, and more congested. He fed even more poorly than usual and had a high-pitched cry. She was not very concerned because she had been

advised to expect such effects. She left him in the care of his father when she went to work on the day of the cardiopulmonary arrest.

Legal Summary

Mr. Yurko, who was not under arrest at the time, was interrogated by two police officers at the hospital at 2:13 a.m. on Nov 25.⁴ The officers began by administering an oath, and no Miranda warning was given. The following night, he was lured to a convenience store by an acquaintance, where he was met by police. He fled but turned himself in the following day, was jailed without bond, and was kept from learning about his son's hospital course or the request for organ donation.

Having turned down a plea bargain that would have resulted in a prison term of perhaps 2 years, Yurko went to trial in February 1999, and was convicted of murder in the first degree and aggravated child abuse. He was sentenced to life imprisonment plus 10 years, without possibility of parole.

Steadfastly maintaining his innocence, Yurko developed a vast correspondence network from his prison cell. I was one of the physicians whom he contacted early in 2000 with a variety of medical questions concerning what might really have happened to his son. Francine Ream Yurko, who married him after his conviction, has been his most important advocate. After regaining custody of her then 3-year-old daughter, who was placed in foster care at the time of Baby Alan's death, Mrs. Yurko demanded and after much effort obtained complete medical records. The Yurkos uncovered numerous discrepancies in the records and autopsy report.³ Ultimately, the pathologist, on the basis of this case and others, was forbidden to perform autopsies. The court granted the Yurkos' petition for an evidentiary hearing, a very rare occurrence.

The Yurko case raises issues applicable to hundreds of similar cases, in which parents or other caregivers are accused of murdering infants by shaking them—and almost always convicted.⁵

At the evidentiary hearing in Orlando in August 2004, a number of physicians attempted to make the case that Baby Alan had died of a vaccine reaction. While Judge Alan Lawson did not appear to find this case persuasive, he did overturn the conviction, vacate the sentence, and order a new trial, probably because of doubts about the reliability of the autopsy report,³ the keystone of the conviction. Yurko agreed to plead *nolo contendere* to a charge of involuntary manslaughter in return for immediate release, rather than remain in prison for 2 to 3 more years pending a new trial. He was sentenced to time served of nearly 7 years. He explained his rationale as accepting responsibility for permitting multiple vaccines to be given to his premature, sick infant, without adequate investigation of the potential harm.

Yurko remained free for only 2 weeks, after which he was extradited to Ohio because of minor, outdated parole violations. He had come to Florida to attend the high-risk birth of his son, without the permission of his parole officer, 2 months before the expiration of his parole, which was related to a burglary conviction when he was a teenager. The parole board later ordered his release.

Anatomy of a Prosecution

From the outset, Baby Alan was treated as a victim of suspected child abuse, rather than as an infant who had had an unexplained respiratory arrest. Instead of a thorough workup for sepsis, meningitis, recurrent pneumonia, or bleeding diathesis, the focus of the investigation was a search for signs of nonaccidental trauma. No differential diagnosis was explicitly entertained, nor did the records suggest that one was being considered. The most obvious possibility was suggested by the father's account: the child was known to be feeding and vomiting. He was briefly unattended while lying on his back. He could have vomited again and aspirated. As the initial resuscitative attempts by an untrained layman were ineffective, he undoubtedly suffered anoxic brain damage. This, together with the medical interventions including the heparin, could have explained all the findings.

Had this diagnosis been a consideration—and had the attending pediatrician not decided on day one that the child was not salvageable—management would probably have been different. For example, fluid and electrolyte management might have been meticulous, and the child might not have continued to receive intravenous bicarbonate for more than 12 hours after a pH as high as 7.7 was documented. A neurologic consultant might have considered status epilepticus and prescribed something other than midazolam in an effort to control it. And heparin might have been avoided, especially after a CT scan showed evidence of an intracranial bleed, since it is absolutely contraindicated in that situation. Even heparin flushes have caused iatrogenic bleeding,⁶ and subdural hematoma has been reported as a complication of heparinization.⁷

The case for the prosecution was basically as follows: A triad of subdural hematoma, retinal hemorrhage, and diffuse axonal injury (DAI) is supposed to be pathognomonic for shaken baby syndrome (SBS). Therefore, somebody must have shaken the baby. The expert witnesses claimed that the shaking event could be timed precisely, based on the initial presentation and autopsy findings. Yurko was alone with the child during that time interval. Therefore, he was guilty.

One might argue that, if it is necessary to show new parents videos about the dangers of shaking an infant, then harm to the child might be accidental rather than intentional, even if the person did shake the baby. Therefore, the prosecution seeks other evidence that the accused is a child abuser. The bruise under the right eyelid probably resulted from the sister accidentally hitting the baby with a bottle. But there was callus formation on four ribs interpreted as showing fractures in different stages of healing, although no signs of injury had been evident to the mother, grandparents, or medical personnel who examined the child several times in the clinic. The prosecution argued that Yurko must have viciously squeezed the child. To produce the findings, he would have had to break one and only one rib on each of four occasions, three to seven days apart,^{8, p 220} each time causing no bruises or damage to the lung. This is a virtually impossible feat, but a probabilistic analysis was not presented to the jury.

Another sign of child abuse is a history that doesn't match the injuries or is inconsistent. The prosecutor claimed that Yurko had tried to accuse his 3-year-old stepdaughter and had also claimed that the baby must have fallen into the toilet. A review of the police transcript⁴ supports Yurko's version. By my reading, the interrogators were trying to lead the witness and to get him to make absurd claims that he was actually denying. The prosecutors then misrepresented the content of the interview. Yurko's history was consistent and straightforward: the baby was "spitting up" and stopped breathing, and Yurko tried to revive him.

The prosecution admitted that the evidence against Yurko was purely circumstantial. The court stated in instructions to the jury that "a well-connected chain of circumstances, which is basically what you're relying on here, is as conclusive in proving a crime or fact as is positive evidence."^{9,p.553}

The jury was instructed that intent to murder the child was not necessary to convict. The prosecution said in its closing statement: "What we have to show is that he did an act. That he knowingly or willfully did an act that caused injury to this child." To show that Yurko knew that his presumed act would cause injury to the child, the prosecution stated: "He told the police I would never ever shake a baby. I know not to shake a baby. I've seen those commercials. I know. And no, I never shook the baby."^{10,p.490}

Layers of Doubt

1. Did the Baby Have the "Diagnostic Triad"?

In a case such as this, the jury must rely wholly on expert testimony. But the actual testimony did not support the existence of the "too-numerous-to-count, pre-, intra-, and subretinal hemorrhages, extending out to the peripheral edges of the retina, with or without macular retinoschisis" that are said to be found in two thirds of shaken infants.¹¹ At trial the medical examiner, Shashi Gore, M.D., testified that the microscopic examination showed "minute hemorrhages" in the right eye only,^{8, p. 271} and neuropathologist Gary Steven Pearl, M.D., said that there was one small hemorrhage in the one microscopic section that was reviewed.^{12,p.315}

The evidence for DAI—confidently asserted by the expert witnesses at trial though not mentioned in the autopsy report—was not the characteristic axonal retraction balls, but a few minute focal hemorrhages in the middle cerebellar peduncle, the "most common area," according to the testimony of the neuropathologist.^{12, p. 314} But according to a 1989 grading system, DAI is characterized by retraction balls throughout the white matter of the cerebral hemispheres, corpus callosum, and brain stem. In more severe cases, there are focal hemorrhages in the corpus callosum or dorsal midbrain.¹⁰

2. Is the Triad Pathognomonic?

Few findings in medicine are pathognomonic. Definitions of SBS vary in the literature. Cerebral edema may be included rather than DAI. Moreover, many studies make the logical error of

selecting cases by the very clinical findings they seek to validate as diagnostic.¹⁴ Lack of case definition or proper controls is a criticism that can be leveled at virtually the whole literature on child abuse.¹⁵ But even if the SBS syndrome can be caused by shaking, it also has a differential diagnosis.

Subdural hematoma most commonly results from trauma, but it has been described in other conditions, including scurvy.¹⁶⁻¹⁸ Early pioneers in the field of child abuse acknowledged the importance of ruling out Barlow's disease, or scurvy, before diagnosing child abuse.^{19,20}

The first witness called by the defense at the Yurko evidentiary hearing, Dr. Archie Kalokerinos of Australia, testified that vaccines can deplete vitamin C and precipitate scurvy. In his preliminary report on the Yurko case, he stated that the rib pathology was consistent with subperiosteal hemorrhage due to scurvy, citing a 1920 textbook by Hess.²¹ Kalokerinos had observed that aboriginal children had a very high mortality rate post vaccination—until he began administering a dose of vitamin C along with the vaccine. Because prosecutors had gotten him to say in his deposition that his work had not been accepted by the majority of physicians, despite his success in dramatically reducing childhood mortality, Kalokerinos was immediately disqualified as a witness.

Intracranial hemorrhage is surprisingly common in infants. An autopsy series of 50 nontraumatic deaths of infants of age up to 5 months showed fresh intradural hemorrhage in 36 cases (72 percent). An earlier study had documented intradural bleeding as a "constant feature" in premature infants. Most of the subjects had been profoundly hypoxic before death because of conditions such as bronchopneumonia, congenital heart or lung disease, placental insufficiency, septicemia, and birth asphyxia.

The study authors suggest that in the immature brain, hypoxia alone or in combination with infection is sufficient to activate the pathophysiologic cascade that culminates in altered vascular permeability and extravasation of blood within and under the dura. Additional factors include venous hypertension and sustained or episodic arterial hypertension. Retinal hemorrhages can be explained by the same factors.²²

Subdurals can occur in infants as a consequence of normal birth; the true incidence has yet to be determined.

According to the package insert for Survanta, 48 percent of infants with respiratory distress who receive this drug have an intracranial hemorrhage—about the same percentage as those who do not receive the drug (42 percent).

For these reasons, it is quite likely that Baby Alan had an unrecognized bleed during his first hospitalization. And rebleeding into an unrecognized chronic subdural may occur with minimal or no trauma.²³

Retinal hemorrhages, particularly the unimpressive ones found at autopsy in Baby Alan, have a lengthy differential diagnosis, including sepsis or increased intracranial pressure of any cause.²⁴ The reported specificity of other findings such as perimacular retinal folds (which Baby Alan did not have) is also unsupported by scientific evidence.²⁵ Accidental trauma, such as short falls, can cause retinal hemorrhages, as can any circumstance in which

intracranial pressure exceeds venous pressure. Thus, “the characteristic of the bleeding cannot be used to determine the ultimate cause.”²⁶

DAI has a long list of potential causes, as a cursory MedLine search demonstrates. Head trauma is probably the most common etiology, but the condition is also seen in nontraumatic hypoxia, metabolic encephalopathy, and increased intracranial pressure, among many other conditions. DAI was found in 12 percent of 450 nonselected human brains, and only one third of the cases with this finding had a history of trauma.¹³

The other findings attributed to child abuse, particularly fractures, also have a differential diagnosis. Temporary brittle bone disease, which may be seen in babies whose mothers had oligohydramnios, is among the possibilities,²⁷ as is the bone disease of premature infants.²⁵ Osteogenesis imperfecta is a predisposing factor both for fractures and subdural hematoma.²⁹

3. Can the Traumatic Event Be Precisely Timed?

Prosecutors need to assert that shaking-induced DAI instantly causes coma and apnea. If there is a latent period, then there is doubt that the last person present with the child was the perpetrator. In the Yurko case, it was asserted that the occurrence of the initial subdural could be timed.

At trial, Gore testified that the injury producing DAI occurred “about one to one and a half hour prior to admission into the hospital. I can’t be more precise than that.”^{8, p 275} Pearl, however, testified that the subdural occurred two to five days prior to death, which at trial was said to have occurred on Nov 27. Pearl admitted that “there are many ways to define death,” but “at the time of definitive brain death when there’s no more blood flow to the brain, . . . that’s when things cease.”^{12, p312}

At the evidentiary hearing, a staff person from the medical examiner’s office testified that the child’s body was in the morgue on Nov 27, 1997. That is clearly incorrect because the child was in the operating room on Nov 29. If Nov 29 is the actual date of death, Pearl’s window includes time during which the child was in the hospital; because of the delay in performing the CT scan, the subdural was not known to be present on admission.

When did the child die? At the moment that brain death occurred, whenever that was? At the moment that brain death was first pronounced? Or when the aorta was cross-clamped?

At autopsy, the brain maintained its structural integrity. It was not in the state of necrosis and liquefaction dubbed “respirator brain.” Could it have been totally without perfusion for 36 hours? Because the brain is not routinely autopsied in brain-dead organ donors, the time required for the development of respirator brain is not known.

The timing of a traumatic event is especially difficult, if not impossible, in children with delayed intracerebral hematomas, in which sudden deterioration follows a period of mild symptoms. Accurate dating of retinal hemorrhages based on ophthalmoscopic appearance is not possible. Information about timing from CT or magnetic resonance appearance is described as

“crude.” Necropsy adds information, but a particular area of uncertainty is the time needed for the disappearance of hemorrhage related to birth trauma.³⁰

4. Is “Shaken Baby Syndrome” a Myth?

Tragically, it is clear that child abuse is all too common, and that inflicted head trauma is a frequent accompaniment. There is no doubt that head trauma can cause the findings attributed to SBS (although “no evidence of head impact” was once the third part of the triad). Yet shaking alone, without impact, has never been demonstrated by rigorous biomechanical analysis or testing to be a possible cause of the findings.³¹

Despite the absence of proof, SBS has gained wide acceptance. Child-abuse experts hold meetings and conferences about it, and are frequently called on to testify. A MedLine search finds 97 articles published since 1996.

Prosecutors much prefer a case of pure alleged shaking and may deny that short falls can possibly cause the syndrome, even though any impact demonstrably causes much more rapid deceleration than shaking. Once the possibility of an accidental fall is raised, there is likely to be reasonable doubt about the guilt of the accused.

In their discussion of the syndrome, forensic pathologists Vincent and Dominick DiMaio³² quoted Lewis Carroll’s *Alice’s Adventures in Wonderland*: “If any one of them can explain it,” said Alice . . . “I’ll give him sixpence. I don’t believe there’s an atom of meaning in it.”

Many alleged cases turned out to have evidence of blunt trauma at autopsy that had been missed on clinical examination. DiMaio and DiMaio believe that a subdural, if caused by shaking alone, should be accompanied by cervical cord injury, which is not described in shaken babies and was not found in Baby Alan.³²

The evidence supporting SBS has been compared 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.”¹⁴ Although the theory was originally based on a small number of confessions, a number of them from one British nurse, very few confessions are ever extracted, and those that are may be untrue.³³ For example, some may confess to shaking to avoid conviction for something worse, or innocents may confess because they must do so to avoid losing custody of their children or being sent to prison. Starling et al. acknowledge, in their study of perpetrator admissions, that “an analysis of the investigative techniques involved in eliciting the admissions is beyond the scope of this article.”³⁴ There are no published reports of witnessed shaking causing subdural hematomas and retinal hemorrhages, though various other types of child abuse have been observed in covert video surveillance.³⁰ In one case that did involve a witnessed shaking and an admission of other shakings, it was simply asserted that the “shaking . . . led to the infant’s various illnesses,” which included reflux, apnea, and possible sepsis.³⁵ In a case diagnosed as SBS in an autopsy series, the witnessed “unusually vigorous shaking” was done by paramedical personnel in an attempt to

revive an infant who was said (like Baby Alan Yurko) to have “choked” and stopped breathing.³⁶

The experimental foundation is a study of rhesus monkeys in simulated rear-end motor-vehicle collisions. It was possible to produce brain injury, without impact, at a rotational acceleration exceeding 40,000 radians/s². Eleven of the 19 monkeys so injured also had pathologically demonstrable neck injuries. The experimenter calculated that the angular acceleration required to produce comparable injury in an adult human should be 6,000 to 7,000 radians/s², a figure he later revised downward to 4,000 radians/s². The required force is a biological constant for neural tissue, which is inversely proportional to the mass of the tissue raised to the two-thirds power. The smaller mass of the infant head should require greater acceleration to cause injury than in an adult, not less.^{23,37,38} Human subjects shaking dolls with hinged necks and equivalent massed heads were only able to generate, by shaking alone, mean angular accelerations of 1,138.54 radians/s², about one fourth of the concussive injury threshold. Impact against a padded or hard surface, on the other hand, could generate a mean acceleration of 52,475.70 radians/s².³⁹

At trial, Gore admitted that he could not quantify the force required to cause a subdural, but he “demonstrated” a “vigorous” and a “gentle” shaking by holding onto something and shaking it. He could not cite a scientific study but referred to a meeting on SBS that he had attended: “In our meeting we were introduced to a live person who said that he did it and he demonstrated the way that he did it.”^{38, p 266} This court accepted this hearsay—which, as far as I can determine, has never been corroborated.

Can Vaccine Reactions Play a Role?

Brain swelling after pertussis vaccine has been demonstrated in mice.⁴⁰ In humans, rare adverse neurologic reactions, including intracranial bleeds and cerebral edema, have been reported to the Vaccine Adverse Event Reporting System (VAERS) in association with hepatitis B vaccine—as has sudden infant death. Correlation, of course, does not prove causation, but there have been no studies of adequate power to rule out a possible causative role.

One of the witnesses at the Yurko evidentiary hearing, Horace Gardner, M.D., testified that the peak age for alleged SBS is much later in Japan than in the United States, around 9 months compared to 2 months, coinciding with the respective timing of childhood vaccines [unpublished observations].

One possible mechanism of a vaccine reaction is vitamin C depletion, which can occur in a variety of conditions including acute illness, strenuous exertion, or catabolic conditions.¹⁶ Ascorbate depletion is accompanied by elevated blood histamine levels and increased capillary fragility.⁴¹

A vaccine reaction could be part of a multifactorial etiology of a syndrome mimicking abuse. For example, there is another report of a case similar to the Yurko case. A child became progressively ill after receiving DPT vaccine, stopped breathing, was shaken as his father attempted to revive him, received CPR, and eventually died with retinal hemorrhages and a subdural hematoma. The father was

convicted because of a medical expert’s testimony that the injuries could only be caused by SBS; the conviction is under appeal.⁴²

Incidental Observations on Organ Donation

The possible effect of pressures to find donors of scarce organs cannot be lightly dismissed. It is impossible to know whether Baby Alan might have survived had the focus been on aggressive attempts to salvage his brain rather than a donor heart. The principal legal question in the instant case pertains to the timing of death and thus of the alleged injury. But from an ethical standpoint, one must observe certain irregularities in the determination of brain death, even if one accepts the validity of the concept.

To be certain of the absence of brainstem reflexes, the examiners must be properly trained in the performance of the tests. Were calorics done correctly? The temperature and volume of water, and the head position, are not described, nor is there any record of checking the ears for cerumen. There was no neurologic consult. The examinations were done only about two hours apart. For adults, an interval of six hours is recommended, and for children under 5, a delay of 12 hours.⁴³ Although drugs that could mimic the effect of brain death were reportedly stopped, no drug levels were determined. The “silent” EEG was actually uninterpretable because the child was so hypothermic. If the motion artifact represented shivering, then the child was not brain dead.

The conviction of a parent or caregiver for murder helps to deflect any questions concerning the child’s management, including the organ donation, by the hospital or treating physicians.

Conclusions

It appears that the tragedy of sudden infant death is being compounded by the destruction of hundreds or thousands of families by unwarranted prosecutions and imprisonment. The medical profession is complicit in the travesty of justice by providing “expert” testimony asserting a level of certainty that cannot exist in view of recent controversy in the literature and a critical look at the evidence base. An adult who has the misfortune of being alone with an infant at the time of death is at grave risk.

The “well-connected chain of circumstances” invoked in court posits that the accused could have shaken the infant just ferociously enough to cause a subdural hematoma and DAI—but not hard enough to produce evidence of head impact, neck injury, or bruises from tightly holding onto the body—and that the event had to have occurred during the window of time when he or she was alone with the child. This is an hypothesis—a highly improbable one—not proof.

An alternate hypothesis is that the infant had a condition that made it vulnerable to apneic attacks and hemorrhage, either spontaneously or with minimal provocation as from coughing or normal handling.

A medical review, with particular attention to vaccine history, should be done on all cases that have resulted in an investigation, prosecution, or conviction for SBS. But even before such a study

can be done, the mere possibility of a vaccine connection demands vigilance and preventive measures. Inexpensive apnea monitors are technologically feasible and should be widely used. Based on the results reported by Kalokerinos, a dose of vitamin C with every vaccine is a reasonable precaution. Additionally, the vaccine schedule should be reviewed, as should the practice of giving multiple vaccines on one visit, or any vaccine to a child who is ill.

If child abuse is suspected, a careful differential diagnosis must be done, after a nonthreatening medical interview—as opposed to a police interrogation—of the parents and caregivers. The physician should consider the possibility of a vaccine reaction. Fundus photography and levels of plasma ascorbic acid and whole-blood histamine¹⁷ are indicated (on admission, before vitamin repletion) as part of the medical workup and the forensic investigation. At autopsy, evidence of blunt head trauma should be sought with special care, and the neck and cervical cord should be carefully examined.

Convictions and lengthy prison terms for bereaved parents on “evidence” like that in the Yurko case also signify deep trouble in the criminal justice system, which makes a mockery of the presumption of innocence. The need to prove a mens rea and to demonstrate guilt “beyond a reasonable doubt” have become empty pretenses in American jurisprudence.

Jane M. Orient, M.D., F.A.C.P., is a general internist practicing in Tucson, Ariz., and Executive Director of AAPS. She served pro bono as an expert witness for the defense in the Yurko evidentiary hearing, after a four-year correspondence with Alan Yurko. Address: 1601 N. Tucson Blvd. Suite 9, Tucson, AZ 85716, jorient@mindspring.com.

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