



Research article

Gray cases of child abuse: Investigating factors associated with uncertainty[☆]



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ABSTRACT

Research in child abuse pediatrics has advanced clinicians' abilities to discriminate abusive from accidental injuries. Less attention, however, has been paid to cases with uncertain diagnoses. These uncertain cases – the “gray” cases between decisions of abuse and not abuse – represent a meaningful challenge in the practice of child abuse pediatricians. In this study, we describe a series of gray cases, representing 17% of 134 consecutive children who were hospitalized at a single pediatric hospital and referred to a child abuse pediatrician for concerns of possible abuse. Gray cases were defined by scores of 3, 4, or 5 on a 7-point clinical judgment scale of the likelihood of abuse. We evaluated details of the case presentation, including incident history, patient medical and developmental histories, family social histories, medical studies, and injuries from the medical record and sought to identify unique and shared characteristics compared with abuse and accidental cases. Overall, the gray cases had incident histories that were ambiguous, medical and social histories that were more similar to abuse cases, and injuries that were similar to accidental injuries. Thus, the lack of clarity in these cases was not attributable to any single element of the incident, history, or injury. Gray cases represent a clinical challenge in child abuse pediatrics and deserve continued attention in research.

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Introduction

Uncertainty has a substantial presence in many medical diagnoses, and successfully managing uncertainty is an important aspect of clinical medicine (Hall, 2002). When making a diagnosis of child abuse, uncertainty is particularly disquieting given the high stakes of an inaccurate decision: returning a child to an unsafe environment or inappropriately disrupting a child's life (Deutsch, 2015; Moles & Asnes, 2014). Additionally, given the multi-disciplinary nature of child abuse investigations, the inherent uncertainty in medicine may not be well understood by colleagues in other professions (Lindberg, Lindsell, & Shapiro, 2008). Thus, uncertain cases of child abuse, the “gray” cases, represent a meaningful challenge in the practice of child abuse pediatricians (CAPs).

There are at least three factors that may contribute to a gray diagnosis. First is the availability of relevant research. Many gray cases have been averted by research that has advanced clinicians' abilities to discriminate abusive from accidental injuries. Specific injury patterns have gained recognition as highly suggestive of abuse including rib fractures (Kemp et al.,

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2008), bruising on the torso, ears, or neck (Pierce, Kaczor, Aldridge, O'Flynn, & Lorenz, 2010), and retinal hemorrhages (Bechtel et al., 2004; Levin, 2010). However, it is also recognized that abuse can manifest in unusual injury patterns, and some very concerning injury patterns can have plausible accidental explanations.

Second, identifying a case as gray is subject to variability in the clinical diagnosis patterns of CAPs. Studies of individual clinical decision-making in child abuse pediatrics have demonstrated high variability in clinicians' judgments and expert opinions (Laskey, Sheridan, & Hymel, 2007; Lindberg et al., 2008). Perceived divergence of expert opinions or variability in clinicians' certainty may encourage an individual CAP toward a gray diagnoses. Collaborative assessment and discussion by multiple CAPs as a team may provide clarity in some circumstances yet may be difficult to implement given the pressures of clinical care or structure of clinical practices.

Finally, gray cases have received little direct attention in research. In the absence of a diagnostic gold standard that would minimize uncertainty and control for CAP variability, research studies often use a panel of experts to establish a demarcation between abuse and accidental cases. The uncertain cases are then not studied, resulting in a lack of knowledge about them.

Therefore, since no previous study has focused on cases of suspected abuse that have been classified as uncertain, the purpose of this study was to describe a series of gray cases to clarify unique and shared characteristics compared with abuse and accidental cases.

Methods

We compared gray cases to abuse and accidental cases within a consecutive series of hospitalized children referred for consultation by a CAP. In order to identify salient patterns associated with gray diagnoses, we reviewed the medical record to evaluate the details of the case presentation, including history of present illness, patient medical and developmental histories, family social histories, relevant medical studies, and injuries. Representative cases were described more extensively to illustrate characteristics noted among the gray cases.

Study Sample

All cases referred for inpatient CAP evaluations at Yale-New Haven Children's Hospital from January 1, 2007 to December 31, 2010 ($n = 145$) were considered for this study. The decision to obtain consultation by the CAP was determined by the attending physician of record for the child, and no institutional guidelines for CAP consultation existed. Subjects were identified from an electronic referral database maintained by the CAP team. We included all cases for which a scale of the likelihood of physical abuse was available ($n = 134$). We excluded 11 cases: six cases with no suspected physical abuse and five with incomplete consultation data.

Study Data

CAP consult notes were generated per routine standard of care. The 2 CAPs (AGA and JML) who completed consultations during the study time period became board certified in Child Abuse Pediatrics at the first CAP American Board of Pediatrics examination in the fall of 2009.

At the time of patient discharge, the consulting CAP completed a 7-point clinical judgment scale concerning the likelihood of abuse; there were 3 levels of certainty for abuse (1 = definite, 2 = probable, and 3 = questionable), a middle score (4 = unknown cause), and 3 levels of certainty for accident/medical cause (5 = questionable, 6 = probable, and 7 = definite). Each point on the scale had predefined criteria (Thomas, Rosenfield, Leventhal, & Markowitz, 1991). Gray cases were defined as scores of 3, "questionable abuse," 4, "unknown cause," or 5, "questionable accident/medical cause." The CAP also completed eight questions to describe the consistency and plausibility of the history provided by caregivers with relation to the injury sustained. The questions assessed: (1) if caregivers attributed blame to someone, (2) if there was a delay in seeking medical attention, (3) if the history was consistent between caregivers and (4) if the history was consistent over time, and if the history was plausible for the injury on a scale of Yes, Maybe, or No in terms of (5) mechanism, (6) timing, (7) severity, and (8) overall.

Case information was retrospectively extracted from CAP notes and medical records. The majority of variables were extracted without interpretation. For some variables, discreet data points were combined or recoded to more clinically meaningful variables after discussion among the research team. "Adequacy of well-child care" included up-to-date immunizations and adherence to the well-child care schedule per documented conversation between the CAP and the child's primary care clinician. "Caregiver childhood adversity" included caregiver's history as foster child, history of child protective service involvement during childhood, or caregiver's personal history of child abuse.

Within the history of present illness, common features of the history describing the incident were also categorized. Incident histories were coded as "witnessed" if a responsible caregiver (e.g., a parent) witnessed the traumatic event. "Transition in responsible caregiver" included cases for which the injury purportedly occurred while the child was under the care of a person other than the caregiver presenting to healthcare; for example, if the incident history reported by parents was that the injury occurred while the child was with a babysitter. Injuries were coded as "found" if the injury was incidentally noticed without any known traumatic history; for example, a bump was noticed while giving a bath and an underlying skull fracture was detected after seeking medical attention.

Table 1
Patient demographics.

	<i>n</i> 134	Abuse 48	Gray 23	Accident 63	<i>p</i> -Value
Age (in months)					
0–11		77.1%	65.2%	63.5%	0.552
12–23		10.4%	21.7%	19.0%	
≥24		12.5%	13.0%	17.5%	
Gender					
Female		37.5%	47.8%	39.7%	0.730
Male		62.5%	52.2%	60.3%	
Ethnicity					
African American		27.1%	39.1%	20.6%	0.634
Caucasian		39.6%	30.4%	34.9%	
Hispanic		27.1%	26.1%	31.7%	
Other/unknown		6.3%	4.3%	12.7%	

Table 2
Incident history.

	<i>n</i> ^a	Abuse	Gray	Accident	<i>p</i> -Value
Unwitnessed specific event	87	17.9% (5 of 28)	50.0% (6 of 12)	51.1% (24 of 47)	0.012
“Found” injury	134	35.4% (17 of 48)	43.5% (10 of 23)	17.5% (11 of 63)	0.021
Transition in responsible caregiver	109	50.0% (19 of 38)	47.4% (9 of 19)	17.3% (9 of 52)	0.002
Delayed medical Attention	117	37.5% (15 of 40)	28.6% (6 of 21)	10.7% (6 of 56)	0.006
Blame attributed by caregivers	119	22.5% (9 of 40)	4.5% (1 of 22)	1.8% (1 of 57)	0.002
History consistent between caregivers	62	73.7% (14 of 19)	88.9% (8 of 9)	94.1% (32 of 34)	0.099
History consistent over time	100	78.8% (26 of 33)	93.8% (15 of 16)	94.1% (48 of 51)	0.072

^a The number of patients depends on the relevance of the incident history to each of the variables. For example, injuries that were found were not associated with a specific incident.

Injuries were categorized by type (bruising, fracture, and head injuries) and stratified into high risk of abuse and not. Head injuries included intracranial hemorrhages and were categorized as high risk if concurrent with retinal hemorrhages (Bechtel et al., 2004). High risk bruising was classified by the TEN4FACES clinical decision-making rule: for children less than 4 years of age, if the bruise was located on Torso, Ear, Neck; if there was a Frenulum tear, bruising that was pre-Auricular, Cheek, or Eyelids; or if there was bruising in any region for an infant 4 months or less of age (Pierce, 2014). Classic metaphyseal lesions, also known as bucket-handle or corner fractures, and rib fractures were considered high-risk fractures.

Statistical Analysis

Exploratory analysis was done to compare data from gray (scores 3, 4, 5), abuse (scores 1, 2), and accident/medical (scores 6, 7) cases. The clinical data extracted from all cases were compared to determine the distribution of variables across cases that were abuse, accidental, or gray. Data were analyzed by Fisher exact tests in STATA v13. No formal correction was made for the statistical risk of multiple tests; analysis was limited to clinically meaningful variables. The research team chose illustrative cases for vignettes. This study was approved by the Yale School of Medicine’s Institutional Review Board.

Results

Of 134 cases rated on the likelihood of abuse scale, 23 (17%) were gray, 48 (36%) were abuse, and 63 (47%) were accidental (Table 1). Overall, there was a predominance of males (60%) and children less than one year old (69%). There were no significant differences in age, gender, or racial distribution among diagnoses.

Incident histories in gray cases shared attributes with abuse and accidental injuries (Table 2). Gray and abuse cases had similar percentages of “found” injuries without any recollection of relevant trauma (Gray (G): 43%, Abuse (Ab): 35%, Accident (Ac): 17%, $p = 0.021$), “transition in responsible caregiver” (G: 47%, Ab: 50%, Ac: 17%, $p = 0.002$), and delay in seeking medical attention as judged by CAP (G: 29%, Ab: 38%, Ac: 11%, $p = 0.006$). In contrast, gray and accidental cases had similar percentages of unwitnessed specific events (G: 50%, Ab: 18%, Ac: 51%, $p = 0.012$). Gray and accidental cases were less likely to attribute blame to a specific person (G: 5%, Ab: 23%, Ac: 2%, $p = 0.002$). Incident histories in all cases had high rates of consistency between caregivers (G: 89%, Ab: 74%, Ac: 94%, $p = 0.072$) and over time (G: 94%, Ab: 79%, Ac: 94%, $p = 0.099$).

Patients’ medical and developmental histories in gray cases were notable for a higher percentage of patients with developmental or psychiatric history than either the abuse or accidental groups (G: 30%, Ab: 7%, Ac: 14%; $p = 0.037$; Table 3). Reported developmental delay or psychiatric diagnoses in gray cases included autism, Trisomy 21, and delay from birth complications.

Otherwise, patients’ medical and developmental histories and families’ social histories in the gray cases were more similar to abuse than accidental cases. Gray and abuse cases had more documented concerns regarding the adequacy of well-child

Table 3
Patients' medical and developmental histories and families' social histories.

	<i>n</i> ^a	Abuse	Gray	Accident	<i>p</i> -Value
Patient history					
Preterm birth	116	31.7% (13 of 41)	27.8% (5 of 28)	24.6% (14 of 57)	0.721
Chronic medical condition	130	22.2% (10 of 45)	22.7% (5 of 22)	15.9% (10 of 63)	0.631
Developmental or psychiatric history	131	6.7% (3 of 45)	30.4% (7 of 23)	14.3% (9 of 63)	0.037
Well-child care concern	100	28.1% (9 of 32)	16.7% (3 of 18)	4.0% (2 of 50)	0.006
Difficult baby	77	22.6% (7 of 31)	16.7% (2 of 12)	0.0% (0 of 34)	0.007
Mother's age (years)	118	26.1 (±6.3)	29.1 (±8.0)	26.5 (±6.4)	0.258
Father's age (years)	96	28.4 (±7.1)	28.9 (±5.3)	30.2 (±7.8)	0.552
Caregiver risk factors					
Criminal History		36.7%	50.0%	20.0%	0.052
Substance Abuse		42.4%	21.1%	22.4%	0.102
Domestic Violence		38.2%	28.6%	22.4%	0.277
Childhood Adversity		37.0%	42.9%	31.1%	0.646
Unemployment		40.5%	33.3%	34.6%	0.829
Preexisting CPS involvement		43.9%	30.4%	29.3%	0.299

^a The number of patients was variable due to availability of relevant documentation in the medical record.

Table 4
Injuries.

	<i>n</i>	Abuse	Gray	Accident	<i>p</i> -Value
	134	48	23	63	
Fracture					
High risk (CML, Rib)		33.3%	0.0%	3.2%	<0.001
Skull		8.3%	26.1%	39.7%	0.001
Other		8.3%	34.8%	19.0%	0.028
Bruising					
TEN4FACES		34.8%	9.1%	0.0%	<0.001
Any		35.4%	13.0%	3.2%	<0.001
Head injury					
ICH with retinal hemorrhages		16.7%	0.0%	0.0%	<0.001
ICH		31.3%	21.7%	22.2%	0.559
Multiple simultaneous injuries		75.0%	21.7%	31.7%	<0.001

CML: classic metaphyseal lesion; ICH: intracranial hemorrhage.

care (G: 17%, Ab: 28%, Ac: 4%, $p = 0.006$) and higher percentages of parental description of the child as “difficult” (G: 17%, Ab: 23%, Ac: 0%, $p = 0.007$). There was a trend toward more disclosures of criminal history by the caregivers in gray and abuse cases (G: 50%, Ab: 37%, Ac: 20%, $p = 0.052$).

In contrast, injuries in gray cases were typically more similar to accidental than abuse cases (Table 4). There was infrequent bruising (G: 13%, Ab: 35%, Ac: 3%, $p < 0.001$) or high-risk bruising (G: 9%, Ab: 35%, Ac: 0%, $p < 0.001$). Gray and accidental cases had fewer instances of multiple simultaneous injuries (G: 22%, Ab: 75%, Ac: 32%, $p < 0.001$) and very rare instances of high-risk fractures (G: 0%, Ab: 33%; Ac: 3%, $p < 0.001$) or intracranial bleed with retinal hemorrhages (G: 0%; Ab: 17%; Ac: 0%; $p < 0.001$).

Consistency between injury and incident histories was more difficult for the CAP to judge for gray cases (Table 5). When three factors contributing to the plausibility of the incident history (timing, severity, and mechanism) were rated on a scale of Yes–Maybe–No, over 50% of gray cases with evaluable incident histories had at least one factor that was rated as “maybe” plausible compared to abuse and accident cases (G: 53%, Ab: 12%, Ac: 2%, $p < 0.001$). Put another way, if assessments of the incident histories were viewed as definitive when either fully inconsistent (all No) or fully consistent (all Yes), gray cases had lower rates of definitive judgments (G: 33%, Ab: 85%, Ac: 96%, $p < 0.001$).

Clinical Vignettes

Case 1. A 10-month-old boy presented to the emergency department after his mother noted an area of swelling on his head while giving him a bath. The child had been with his father and then his paternal grandmother for the two days preceding the mother's noticing the injury. All caregivers denied an immediate history of a fall or other trauma. The mother did report that the child had fallen off the bed twice over the previous months. Developmentally, the child was crawling and could pull to stand. On exam, the only injury was a boggy hematoma over the right side of the skull. The head CT and skeletal survey were negative.

Case 2. A 6-year-old girl with a history of autism was brought to the emergency department by emergency medical services (EMS) from school after she refused to bear weight on her right leg. The child's teacher reported that the child was sitting on the ground with her legs folded and was crying. When the teacher tried to pick her up to stand, she cried and could not

Table 5
Evaluation of plausibility.

	<i>n</i> 95	Abuse 34	Gray 15	Accident 46	<i>p</i> -Value
History consistent with mechanism					
Yes		14.7%	20.0%	95.7%	
No		76.5%	33.3%	2.2%	<0.001
Maybe		8.8%	46.7%	2.2%	
History consistent with timing					
Yes		20.6%	53.3%	95.7%	
No		70.6%	20.0%	2.2%	<0.001
Maybe		8.8%	26.7%	2.2%	
History consistent with severity					
Yes		14.7%	20.0%	95.7%	
No		79.4%	40.0%	2.2%	<0.001
Maybe		5.9%	40.0%	2.2%	
History consistent overall					
Yes		14.7%	26.7%	95.7%	
No		79.4%	46.7%	2.2%	<0.001
Maybe		5.9%	26.7%	2.2%	

bear weight so he called EMS. According to her mother, the child had been walking that morning without a problem. The mother disclosed several episodes of the child refusing to get on the bus and coming home from school with red marks on her arms. The child's school explained to the mother that the previous red marks happened when the child had tantrums and needed to be picked up from the ground. The child had autism with profound speech impairment, frequent tantrums and a history of hip dysplasia. Upon evaluation, the child was found to have a right-sided femur fracture. Testing showed that the child had age appropriate bone density.

Case 3. A 22-month-old boy was transferred from an outside hospital after a reported 3-foot fall onto a wooden floor. According to his mother the child was on the changing table and after she turned away to discard his diaper, he was on the ground crying. The mother was unable to describe the mechanism of the child's fall. The mother picked him up and soothed him to sleep. He later woke up and vomited, prompting the parents to call the pediatrician's office and bring the child to the emergency department for evaluation. The child was found to have a subarachnoid hemorrhage and several midline bruises on his back over the vertebrae. Additional work up was negative including dilated eye exam, hypercoagulability workup and skeletal survey.

Case 4. A 7-month-old girl with Beckwith-Wiedemann Syndrome was admitted with a left femur fracture. The mother reported that she had put the infant down for a nap on a toddler bed in a room with her 2-year-old sister. The mother went to the bathroom, and when she returned, the infant was in a different position on the bed and was crying. Over the next several hours, the infant would become upset if her left leg was moved. The family took the infant to the emergency room but left before care was received. The subsequent day, the family took the infant to the pediatrician's office where the fracture was discovered on X-ray. Skeletal survey was negative. Developmentally, the infant could not yet roll over or sit unassisted. The family had a history of child protective services involvement approximately two years prior. The mother had left her parents' home at the age of 17 with the 2-year-old sister as an infant, and this resulted in the mother temporarily losing custody of the older sister.

Discussion

In this series, gray cases represented 17% of consecutive child abuse consultations for suspected child abuse. This percentage is within the range of percentages (14.5%, 19.8%, and 26.1%) of gray cases from a study where CAPs used similar likelihood scales at three other children's hospitals (Hoofst et al., 2015).

From our analysis, gray cases shared characteristics with both abuse and accidental cases, confirming them as diagnostic dilemmas. Incident histories in gray cases had shared characteristics with both abuse and accidental cases: for example, gray cases had a similar percentage of "found" injuries and delay in medical attention as seen in abuse cases, and at the same time, had an almost identical percentage of unwitnessed events as seen in accidental cases. The patient's medical and family social histories in gray cases were more similar to abuse cases with more frequent reports of social risk factors, such as concerns regarding well-child care. In contrast, injuries in gray cases were more similar to accidental injuries with few instances of multiple injuries and few high-risk isolated injuries. The plausibility of the incident histories in gray cases was difficult to assess with fewer definitive assessments than either abuse or accident cases. Thus, the lack of clarity in these cases was not attributable to any single element of the history, injury, or incident.

Two findings were specific to gray cases. First, gray cases had a uniquely elevated percent of reported developmental or psychiatric diagnoses in the affected child. Second, the perceived plausibility of the incident history in terms of mechanism,

severity, and timing was more often ambiguous in gray cases, indicating that the CAP had difficulty assessing compatibility between the injuries and the incident history. Both of these findings represent important areas in need of further research.

For several known risk factors for abuse, including pre-term birth (Spencer, Wallace, Sundrum, Bacchus, & Logan, 2006), chronic medical conditions (Sullivan & Knutson, 2000), and history of domestic violence (Jouriles, McDonald, Slep, Heyman, & Garrido, 2008), there were no significant differences found among the three groups, including the expected increase in abuse versus accidental cases. These findings may suggest that front-line providers have a lower barrier to refer children whose families have these risk factors for child abuse evaluations.

This case series has five main limitations. First, all cases were drawn from a single hospital, thus limiting sample size and the number of CAPs who were evaluating the cases. Second, this series does not control for clinician variability. A study of expert opinions in child abuse pediatrics showed high variability in case ratings (Lindberg et al., 2008). While this hospital practice has weekly multi-disciplinary team meetings to discuss cases, the influence of those meetings was not quantified, and, thus, final clinical diagnoses were attributable to a single evaluating clinician.

Third, case details were abstracted retrospectively and may not fully reflect the CAP's clinical decision-making process at the time of the evaluation. Inclusion of certain details, for example complete cataloguing of the child's bruising in the record, may have been influenced by clinical impression. Fourth, the influence of circular reasoning cannot be excluded. For example, questions about the compatibility of the incident history and the injury were completed at the same time as the physical abuse likelihood scale and may be less likely to represent truly independent assessments of plausibility. Fifth, cases were limited to those referred for child abuse evaluation as opposed to all children hospitalized with injuries, and, thus, these referrals were influenced by front line practitioners' insight into concerns of abuse.

Long-term follow-up of gray cases would shed important insight to the true nature of these injuries. Also, additional subpopulation analysis would be helpful to clarify the decision-making process of CAPs. For example, studying the population of "found" injuries for which no traumatic explanation is available may clarify details about the importance of objective characteristics of injuries versus social risk factors when making decisions about the likelihood of abuse. Injuries without traumatic explanation may also provide insight into the future risk of neglect. A larger, prospectively gathered dataset would allow for examination of clinical judgments in more detail and for more advanced statistical modeling, including cluster analysis that may clarify integrated patterns of data.

In summary, through the first analysis examining gray cases, we provide pragmatic support for CAPs by recognizing and openly describing the clinical conundrums experienced in regular practice. These cases had medical and social histories that were similar to abuse cases, injuries that were similar to accidental injuries, and incident histories that were ambiguous. Gray cases represent a clinical challenge in child abuse pediatrics, and these cases of uncertainty cannot be attributed to a single source.

Disclosures

RLM, AGA, and JML each testify as an expert witness in child abuse cases.

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