A Radiologist's Lexicon for Reporting in Child Abuse

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See the slide presentation here.

Child abuse is a common and critical problem encountered by radiologists. Injury-mechanism correlation is vital and relies on informed radiologic terminology for clinical, forensic, and medicolegal applications. The radiology report should follow the rule of "five C's" established by Strouse et al. It should be: *(a)* complete, *(b)* correct (including relevant pertinent negatives), *(c)* conclusive, *(d)* cogent (balanced between conciseness and detail), and *(e)* clean (free of abbreviations, shorthand, acronyms, and addenda).

After reviewing the accompanying slide presentation, the radiologist will be able to identify the most important imaging findings of child abuse and optimize radiology reports for use by child abuse pediatricians.

Neuroimaging in Child Abuse

Subdural hemorrhage is very common in both abusive head trauma (AHT) and accidental head trauma (AccT). Inappropriate dating language is frequently applied (Fig 1). Dating descriptors such as "acute-on-chronic" should not be applied to mixed-attenuation or mixed-signal-intensity collections, as dating is uncertain in cases of traumatic hematohygroma (which has variable appearances). Similarly, collections that are isoattenuating or isointense to cerebrospinal fluid without internal membranes should not be referred to as "chronic," because acute traumatic hygroma cannot be distinguished from a chronic collection. Bridging vein thrombosis implicates high-energy-mechanism trauma as the cause of subdural hemorrhage and should be described. Cytotoxic parenchymal brain injury (low diffusivity on diffusion-weighted images) is also highly associated with AHT and is a finding that is easily missed or misinterpreted at head CT.

Parenchymal laceration is an underrecognized infant-specific impulse loading (shaking) injury that is explained by shearing at the unmyelinated white matter–gray matter interface. When the finding is isoattenuating or isointense to cerebrospinal fluid, inappropriate dating language is often applied if injury is mistaken for encephalomalacia.

Retinal injury should be reported when visualized; it may be useful to the child abuse team when ophthalmologic examination must be deferred or in cases of patient demise.

Recent data reported by Karmazyn et al indicate that total MRI rather than cervical spine MRI may be beneficial in cases of suspected abuse with positive neuroimaging and/or skeletal survey findings, as salient injuries may be found in the thoracolumbar region.

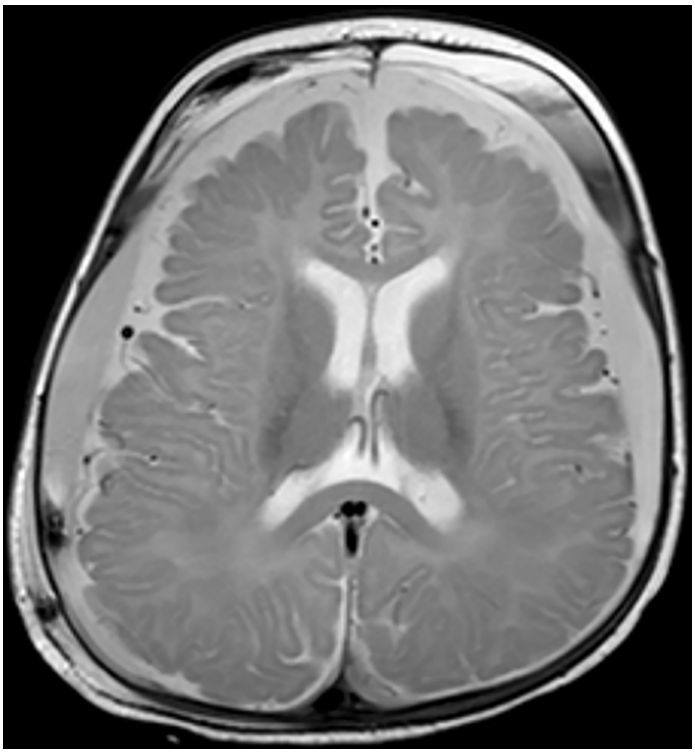

Figure 1. Axial T2-weighted MR image of the brain in an infant who experienced AHT shows bilateral holohemispheric mixed-signal-intensity subdural hematohygromas with a chronic component. Membranes or loculations visible within a subdural collection are one of the few findings that allow accurate radiologic dating (>2 weeks). The term *acute-on-chronic* is commonly used in both CT and MRI reports but should usually be avoided due to difficulties presented in the medicolegal setting. Descriptive language describing the anatomic location and attenuation or signal intensity is usually preferred.

Skeletal Trauma

Skull fracture and scalp injury can be seen in both AHT and AccT. Matching the fracture pattern to the clinical history is key to determining the mechanism, and specific terminology should therefore be applied in each case. Selected key considerations include differentiating fracture from normal variants such as vascular grooves and accessory sutures (and expressing uncertainty when appropriate) and avoiding the use of dating language, with awareness that radiologic dating of these injuries has been found to be unreliable.

Reporting of skeletal trauma beyond the skull should consistently include specific fracture descriptors that illuminate

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Abbreviations: AccT = accidental head trauma, AHT = abusive head trauma

TEACHING POINTS

- Optimal radiologic terminology for suspected abuse-associated injuries may differ from that used in other scenarios (eg, older patients, accidental trauma).
- Varying word usage for the same finding may sometimes lead to confusion.
- Child abuse pediatricians' expert evaluation of injury-mechanism correlation relies on precise, appropriately detailed, and consistent use of radiologic terminology.

the trauma mechanism (Fig 2). With appropriate knowledge, dating language may be applied to rib and long bone fractures. Bone mineralization should be routinely reported.

Thoracoabdominal Injury

In reporting visceral injury, there are fewer specific terminologic considerations compared with those for AHT and skeletal trauma. However, careful cataloging of injuries (which overlap with those of AccT) that may be correlated with the clinical history is important.

When trauma is included in the differential diagnosis for an imaging finding on a study obtained for other reasons (eg, unexplained peripancreatic stranding and fluid in an infant), it should be included in the radiology report.

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Suggested Readings

Barber I, Bixby SD, Morris NB, et al. An electronic tool for systematic reporting of fractures on skeletal surveys in suspected child abuse: prototype development and physician feedback. Pediatr Radiol 2014;44(12):1564–1572.

Hahnemann ML, Kinner S, Schweiger B, et al. Imaging of bridging vein thrombosis in infants with abusive head trauma: the "tadpole sign." Eur Radiol 2015;25(2):299–305.

Jenny C, ed. Child Abuse and Neglect: Diagnosis, Treatment and Evidence. St Louis, Mo: Saunders/Elsevier, 2010.

Figure 2. Anteroposterior radiograph of the distal tibia and fibula shows a classic metaphyseal lesion of the distal tibia (arrow), which is highly associated with abusive trauma in infants. Complete and precise description of long bone injuries is essential for correlation with the provided history and physical examination findings, and thus, identification of the injury mechanism. Classic metaphyseal lesions are associated with shear or tension mechanisms.

Karmazyn B, Marine MB, Wanner MR, Sağlam D, Jennings SG, Hibbard RA. Establishing signs for acute and healing phases of distal tibial classic metaphyseal lesions. Pediatr Radiol 2020;50(5):715–725.

Karmazyn B, Reher TA, Supakul N, et al. Whole-Spine MRI in Children With Suspected Abusive Head Trauma. AJR Am J Roentgenol 2022;218(6):1074–1087.

Kleinman PK, ed. Diagnostic Imaging of Child Abuse. 3rd ed. Cambridge, UK: Cambridge University Press, 2015.

Palifka LA, Frasier LD, Metzger RR, Hedlund GL. Parenchymal Brain Laceration as a Predictor of Abusive Head Trauma. AJNR Am J Neuroradiol 2016;37(1):163–168.

Prosser I, Lawson Z, Evans A, et al. A timetable for the radiologic features of fracture healing in young children. AJR Am J Roentgenol 2012;198(5):1014–1020.

Strouse PJ, Peréz-Rosselló JM, Moreno JA. The radiology report in child abuse. Pediatr Radiol 2021;51(6):1065–1069.

Tsai A, Perez-Rossello J, Connolly SA, Kawai K, Kleinman PK. Temporal Pattern of Radiographic Findings of Costochondral Junction Rib Fractures on Serial Skeletal Surveys in Suspected Infant Abuse. AJR Am J Roentgenol 2021;216(6):1649–1658.

Qiersema JM, Love JC, Derrick SM, Pinto DC, Donaruma-Kwoh M, Greeley CS. Standardized descriptive method for the anthropological evaluation of pediatric skull fractures. J Forensic Sci 2014;59(6):1487–1492.

Wittschieber D, Karger B, Pfeiffer H, Hahnemann ML. Understanding Subdural Collections in Pediatric Abusive Head Trauma. Am J Neuroradiol 2019; 40(3):388-395.