Fast MRI for Pediatric Traumatic Brain Injury: What Findings Are Missed Compared with Routine MRI?

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Abstract

Background: Traumatic brain injury is a frequent indication for neuroimaging in young children. Head CT is widely available and fast, but it exposes children to ionizing radiation. Conventional MRI avoids radiation but is longer and frequently requires sedation. Fast MRI avoids radiation and can be performed without sedation. Concerns persist regarding missed subtle traumatic findings, particularly in abusive head trauma.

Methods: We performed a retrospective study of children <7 years who underwent fast MRI and subsequent routine brain MRI within 7 days 2014-2024. Radiology reports were abstracted for injury type. Separately, over the same 10-year study period, we identified children who underwent fast MRI as their initial neuroimaging but without a subsequent routine MRI during the 7-day period. We then reviewed any return inpatient or emergency department visits within the year following the initial fast MRI for missed traumatic brain injuries.

Results: Sixty-nine children had both fast and routine MRI. Fast MRI identified at least one traumatic intracranial abnormality in all 68 cases where traumatic injury was recognized by routine MRI (sensitivity 100%, 95% CI 94.7–100). Compared with routine MRI, fast MRI was less sensitive for subarachnoid hemorrhage (18/24, 75.0%) and parenchymal injury (20/31, 64.5%). Among 2471 children with an initially negative fast MRI, 1,122 presented to the emergency department or inpatient setting within one year. Of these, five traumatic findings were detected on follow-up neuroimaging, all of which were associated with new trauma rather than delayed recognition.

Conclusions: Fast MRI detected traumatic brain injury consistently, while missing selected injury components. These results support fast MRI as a reasonable initial screening examination for appropriately selected young children.