



Anschutz

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

William K. Canty, MS; Daniel M. Lindberg, MD; Nicholas Stence, MD

University of Colorado School of Medicine; Children's Hospital Colorado



Background

- Pediatric traumatic brain injury (TBI) frequently requires neuroimaging
- CT is fast but exposes children to ionizing radiation
- Conventional MRI avoids radiation but has longer scan times, often requiring sedation
- Fast MRI (rapid-sequence MRI) does not expose children to radiation, does not require sedation, and has an increasing clinical use
- **Key concern:** does fast MRI miss clinically important injuries?
- **Objective:** evaluate whether fast MRI misses traumatic findings compared with routine MRI

Methods

Study Design: retrospective study (2014-2024)

Population: children <7 years undergoing fast MRI

Two Cohorts:

1. **Paired Cohort:** Fast MRI + Routine MRI within 7 days (n = 69)
 - Routine MRI as reference standard
2. **Follow-Up Cohort:** Fast MRI only (n = 2,471)
 - Reviewed 1-year return visits for missed injuries

Outcomes:

- **Primary:** detection of any traumatic intracranial injury
- **Secondary:** injury-specific sensitivity (SAH, SDH, EDH, parenchymal) and missed injuries on follow-up

Results

Table 1. Agreement and diagnostic performance of fast MRI compared with routine MRI (paired cohort; n = 69).

Radiologic Finding	Routine MRI Positive, n	Fast MRI Positive, n	Agreement (κ)	McNemar p-value	Sensitivity (95% CI)	NPV (95% CI)
Any TBI	68	68	0.66	1.00	98.6% (92.2-99.7)	50.0% (9.5-90.5)
EDH	6	6	1.00	1.00	100% (61.0-100)	100% (94.3-100)
SDH	59	58	0.83	1.00	96.6% (88.5-99.1)	81.8% (52.3-94.9)
SAH	24	18	0.80	0.03	75.0% (55.1-88.0)	88.2% (76.6-94.5)
Extra-axial	4	5	0.88	1.00	100% (51.0-100)	100% (94.3-100)
Parenchymal Injury	31	20	0.67	<0.001	64.5% (46.9-78.9)	77.6% (64.1-87.0)

Footnote: Routine MRI was treated as the reference standard. Missed findings represent individual radiologic features not identified on fast MRI despite the presence of other radiologic findings consistent with traumatic brain injury on the index study. No patient had complete absence of traumatic brain injury identified on fast MRI.

Table 2. Summary of discordant injury components (paired cohort; n=69).

Radiologic finding	Routine MRI positive (n)	Missed on fast MRI (n)	Missed on fast MRI (%)	Fast MRI only (n)
EDH	6	0	0.0%	0
SDH	59	2	3.4%	1
SAH	24	6	25.0%	0
Extra-Axial	4	0	0.0%	1
Parenchymal Injury	31	11	35.5%	0
Any traumatic intracranial finding	68	0	0.0%	0

Follow-Up Cohort:

- 2,471 children with negative fast MRI
- 1,122 returned within 1 year
- 5 had traumatic findings on follow-up imaging, all due to **new** trauma

Key Findings

- Fast MRI detected all cases of TBI at patient level, with a sensitivity of 100% (68/68)
- Zero missed injuries from initial fast MRI in follow-up cohort

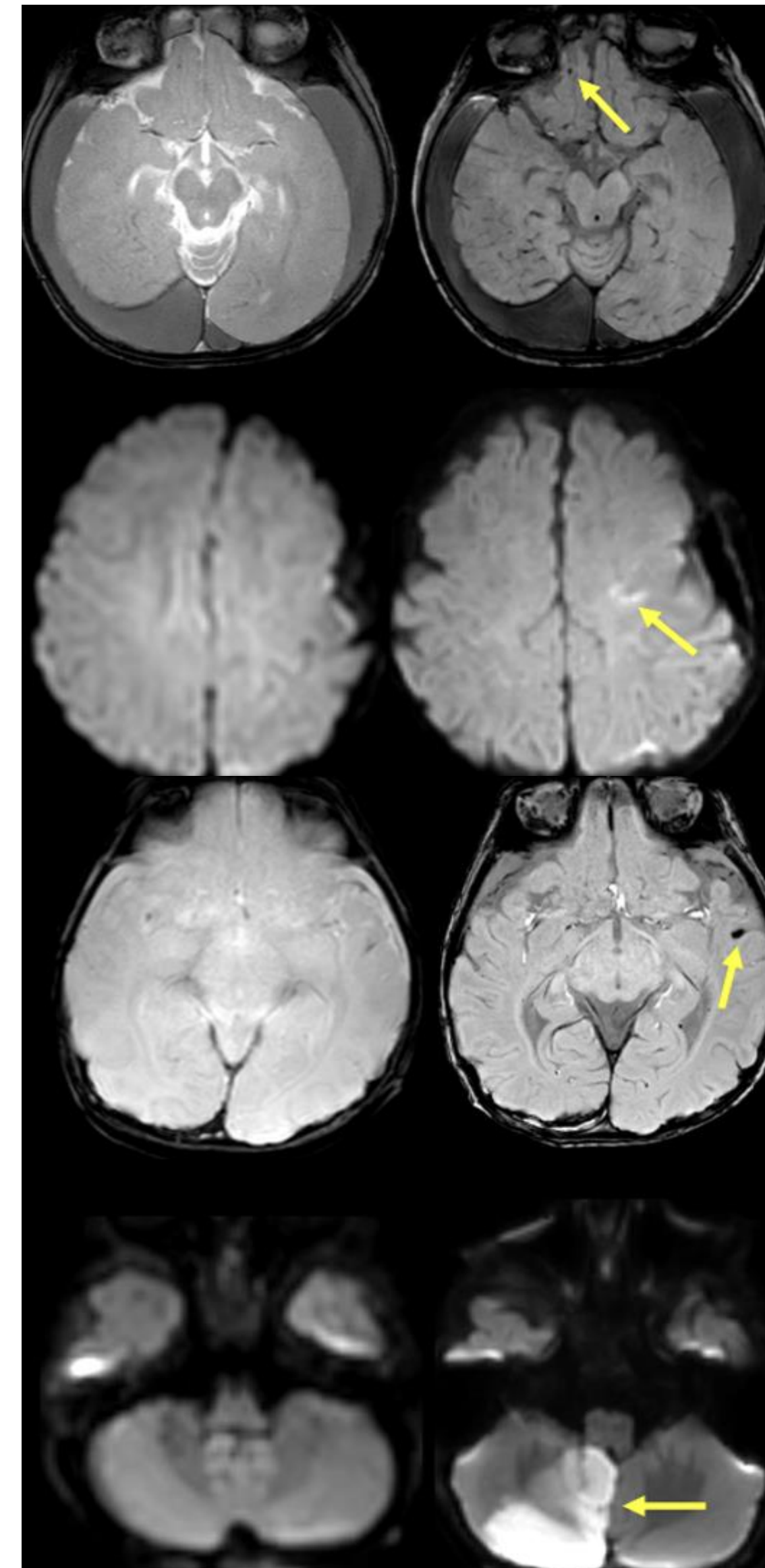


Figure 1. Fast MRI (left) vs routine MRI (right) in four cases. Arrows indicate findings seen only on routine MRI. Some DWI abnormalities (rows two and four) may represent interval changes rather than true misses on fast MRI.

Conclusions

- Fast MRI did not miss any TBIs at the patient level, however, some injury components (SAH, parenchymal injury) were missed
- Results support the use of fast MRI as a first-line screening tool
- Fast MRI should be integrated into clinical pathways with clear escalation strategies

Implications

- Fast MRI is a highly sensitive screening tool for pediatric TBI
- "Missed" radiologic findings are at the component-level, not whole-injury
- Major advantages include no radiation (vs CT) and no sedation (vs conventional MRI)
- Best used as an initial screening in clinically stable children
- Escalation still required when high clinical concern persists, detailed injury characterization is needed, or abusive head trauma is suspected