

**FERNE / EMRA 2007 Acute Ischemic Stroke Patients:  
Clinical Policy: Neuroimaging and Decisionmaking in Adult Mild Traumatic Brain Injury  
in the Acute Setting  
Andy Jagoda, MD, FACEP**

**Clinical Policy: Neuroimaging and  
Decisionmaking in Adult Mild Traumatic  
Brain Injury in the Acute Setting**

**An ACEP / CDC Collaborative Project**

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**Disclosures**

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**Introduction**

- Revision of a policy first published in 2002
- Project funded by the CDC
  - Public health issue
  - “Signature casualty of the the war in Iraq
- Approximately 1 million ED visits for TBI
  - Majority of TBI are “mild”
  - Challenge is to identify patients with MTBI who have neurosurgical lesions or at risk for post concussive symptoms / syndrome

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**Introduction**

- Less than 10% of patients with a GCS of 14 / 15 have evidence of an acute intracranial lesion on head CT
- Up to 30% of patients with a GCS of 13 have an acute intracranial lesion on head CT
- Less than 1% of patients with GCS of 14 / 15

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**MTBI: Definition**

- Blunt head injury (or blast?)
  - GCS score of 13 – 15
  - Any period of observed or self-reported:
    - ✓ Loss of consciousness
    - ✓ transient confusion, disorientation, or impaired consciousness
    - ✓ dysfunction of memory (amnesia) around the injury
    - ✓ neurological or neuropsychological dysfunction

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**MTBI: Definition**

- Two large data bases have demonstrated that LOC is not a defining criterion for an intracranial lesion nor neurosurgical lesion in MTBI
- Clinical Policy inclusion criteria
  - Nonpenetrating trauma to the head
  - Presentation to the ED within 24 hours of injury
  - A GCS score of 14 or 15
  - Age 16 years or greater

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### GCS and Neuroimaging

- Dx of MTBI does not take into account neuroimaging
- Retrospective study, 215 hospitalized patients
  - Mild TBI without complications
  - Mild TBI with complications (positive CT)
  - Moderate TBI
- Mild TBI patients with positive CT performed on neuropsychiatric testing like moderate TBI
- Moderate group had worse function at 6 months
- Length of LOC or amnesia did not differentiate mild from moderate groups

Williams et al. *Neurosurgery* 1990;27:422.

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### 2002 Clinical Policy

- Is there a role for plain film radiographs in the assessment of acute MTBI in the ED?
- Which patients with acute MTBI should have a noncontrast head CT scan in the ED?
- Can a patient with MTBI be safely discharged from the ED if a noncontrast head CT scan shows no evidence of acute injury?

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### Is there a role for plain skull radiographs in the evaluation of patients with a MTBI?

- Hoffman 2000 Lancet: Meta-analysis
  - 20 articles reviewed out of 200 identified
  - Sensitivity .13-.75; PPV of skull fracture in predicting +CT .4
  - Specificity .9-.99; NPV of skull fracture in predicting +CT .94
- Skull films are not recommended in the evaluation of MTBI; although the presence of a skull film increases the likelihood of an intracranial lesion, its sensitivity is not high enough to allow it to be a useful screen



### 2008 Clinical Policy

- Which patients with MTBI should have a noncontrast head CT scan in the ED?
- Is there a role for head magnetic resonance imaging (MRI) over noncontrast CT in the ED evaluation of a patient with acute MTBI?
- In patients with MTBI, are brain specific serum biomarkers predictive of an acute traumatic intracranial injury?
- Can a patient with an isolated MTBI and a normal neurologic evaluation be safely discharged from the ED if a noncontrast head CT scan shows no evidence of intracranial injury?

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### 2008 Clinical Policy: Outcome Measures

- Presence of any acute intracranial injury on noncontrast head CT scan was chosen as the primary outcome measure for Questions #1,2,3
  - Lesion requiring a neurosurgical intervention was the secondary outcome measure
- Neurologic deterioration was the primary outcome measure for Question #4
- There is insufficient evidence to use post concussive symptoms / syndrome as an outcome measure

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### Description of the Process

#### Strength of evidence (Class of evidence)

- I: Randomized, double blind interventional studies for therapeutic effectiveness; prospective cohort for diagnostic testing or prognosis
- II: Retrospective cohorts, case control studies, cross-sectional studies
- III: Observational reports; consensus reports

#### Strength of evidence downgraded based on methodologic flaws

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**Description of the process:**

Strength of recommendations:

- A / Standard: Reflects a high degree of certainty based on Class I studies
- B / Guideline: Moderate clinical certainty based on Class II studies
- C / Option: Inconclusive certainty based on Class III evidence

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**Which patients with MTBI should have a noncontrast head CT scan in the ED?**

- **Level A Recommendation:** A noncontrast head CT is indicated in head trauma patients with loss of consciousness or post traumatic amnesia only if one or more of the following is present: headache, vomiting, age greater than 60 years, drug or alcohol intoxication, deficits in short term memory, physical evidence of trauma above the clavicle, posttraumatic seizure, GCS score less than 15, coagulopathy, or focal neurologic deficit.

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**Which patients with MTBI should have a noncontrast head CT scan in the ED?**

- Haydel 2000 NEJM; Class I study; 2 phases
  - > Phase I 520 patients to establish predictive criteria
  - > Phase II 909 patients to validate criteria
  - > 7 predictors identified with 100% sensitivity for predicting intracranial lesion in patients with LOC
  - > Use of criteria would decrease head CT by 22%
- High sensitivity (95-100%) but low sensitivity (5-30%) confirmed by large data bases in Italy, Holland, and Spain
- Canadian CT Head Rule has higher specificity (50%) BUT the primary outcome measure is neurosurgical lesion and minor acute intracranial lesions (e.g. small subdurals and SAH) are not considered important

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**Which patients with MTBI should have a noncontrast head CT scan in the ED?**

- **Level B Recommendation:** A noncontrast head CT should be considered in head trauma patients with no loss of consciousness or post traumatic amnesia if there is a focal neurologic deficit, vomiting, severe headache, age 65 years or greater, physical signs of a basilar skull fracture, GCS score less than 15, coagulopathy, or a dangerous mechanism of injury

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	Smits <sup>11</sup> OR (95%CI)	Bunce <sup>12</sup> OR (95%CI)	Fabrizi <sup>13</sup> OR (95%CI)
Class of evidence	II	II	III
Variable			
GCS 14	2 (1-3)	7 (4-14)	19 (14 - 26)
Neurologic deficit	2 (1-3)	7 (2-25)	19 (13-28)
Signs of basilar skull fracture	25 (13-47)	11 (6-23)	10 (6-16)
LOC	2 (1-3)	7 (4-11)	2 (2-3)
Post traumatic amnesia	1.5 (1-2)	3 (2-5)	8 (6-12)
Headache - mild - moderate	1 (0.8-2)	1 (0.8-2)	-
Headache - severe	-	3 (2-6)	-
Vomiting	3 (2-4)	4 (2-7)	5 (3-8)
Post traumatic seizure	3 (0.8-10)	2 (0.25-17)	2 (3-5)
Alcohol or drug intoxication	1 (0.6-2)	1 (0.3-3)	-
Anticoagulation	2 (1-5)	4 (3-7)	8 (3-9)
Age ≥65 years	-	2 (1-3)	2 (1-3)
Dangerous mechanism	2 (1-4)	-	3 (2-4)

**Is there a role for head MRI over noncontrast CT in the ED evaluation of a patient with acute MTBI**

- MRI is up to 30% more sensitive than CT in detecting axonal shear injury
- No studies looked specifically at patients with MTBI within 24 hours of injury
- No studies have shown a clinical correlation with MRI abnormalities with neuropsychologic outcome
- No recommendations

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In patients with MTBI, are brain specific serum biomarkers predictive of an acute traumatic intracranial injury?

- Traumatic injury results in the release of proteins
  - Neuronal proteins include neuron specific enolase and tau
  - Astrocyte proteins include S-100B, CK-BB
- S-100B is best studied; found within the serum within 30 minutes with a half life of 97 minutes
  - Elevated in multiple trauma
  - Elevated in marathon runners
- Eight studies reviewed; 2 Class II
  - Sensitivities 90 – 100%
  - Specificities 4 – 65%

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In patients with MTBI, are brain specific serum biomarkers predictive of an acute traumatic intracranial injury?

- Biberthaler et al: 1309 patients with isolated MTBI and CT scan
  - Cutoff for serum level 0.1 ug / L
  - 7% had an acute intracranial lesion
  - Sensitivity 0.99 (CI 0.96 – 1.0)
  - Specificity 0.30 (CI 0.29 – 0.31)
- Level B Recommendation: In patients with MTBI without significant extracranial injuries, a CT should be considered if the S-100B serum level is >0.1 ug / L

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Can a patient with an isolated MTBI and a normal neurologic evaluation be safely discharged from the ED if a noncontrast head CT scan shows no evidence of intracranial injury?

- Stein 1992 J Trauma. Retrospective
  - 1339 patients with negative CT, none deteriorated
- Dunham 1996 J Trauma Infect Crit Care. Retrospective review of a prospectively collected data base
  - 2587 patients, no patient with a negative CT deteriorated; those patients who did deteriorate (without initial CT), did so within 4 hours
- Nagy 1999 J Trauma Infect Crit Care. Retrospective
  - 1190 patients with CT and admission
  - No patient with a negative CT deteriorated (spectrum bias towards sicker patients)

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Can a patient with an isolated MTBI and a normal neurologic evaluation be safely discharged from the ED if a noncontrast head CT scan shows no evidence of intracranial injury?

- af Geijerstam and Britton reviewed 2187 abstracts and 410 full text papers
  - 62,000 MTBI patients GCS 15
  - 3 cases of delayed adverse outcome identified
- Level B recommendation: Patients with an isolated MTBI who have a negative head CT are at minimal risk for developing an intracranial lesion and therefore may be safely discharged from the ED
- Level C Recommendation: MTBI patients discharged from the ED should be informed about postconcussive symptoms

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## Postconcussive symptoms / syndrome

- Symptom complex related to TBI
  - Somatic
    - Headache, sleep disturbance, dizziness, nausea, fatigue, sensitivity to light / sound
  - Cognitive
    - Attention / concentration problems, memory problems
  - Affective
    - Irritability, anxiety, depression, emotional lability
- Incidence in MTBI patients:
  - 80% at 1 month
  - 30% at 3 months
  - 5 - 15% at 12 months



In patients with a GCS of 15, what is the risk of developing the postconcussive syndrome?

- Saunders et al. *Ann Emerg Med* 1986;15:160.
  - 47 consecutive MTBI discharged from the ED
  - No patient could remember more than 2 of the 8 items on the home care discharge instructions
  - 20% denied ever having received instructions
  - Third party involvement improved compliance with instructions to 67%
- Levitt et al. *Amer J Emerg Med* 1994;12:172.
  - 23% of MTBI patients discharged from the ED could not remember any of their discharge instructions
- Studies emphasize importance of involving third parties in discharge process



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**Discharge instructions: design considerations**

- Instructions to patients and their families should:
  - Be written at approximately a 6th to 7th grade level
  - Given to the patient and immediate caregiver in both print and verbal form
  - Layout and type fonts appropriate for low literacy materials (ie, no type font under 12 points, wide margins, left justified)
- Patients who have been assessed in the ED using recommendations in this MTBI clinical policy have a very low rate of developing delayed intracranial pathology.
- For patients who have a negative CT or have been deemed too low risk for neuroimaging, home observation including frequent waking or assessment of pupils is not supported by the literature and thus is not recommended.

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**Discharge instructions: design considerations**

- Postconcussive symptoms should be identified at the time of assessment. A list of these symptoms should be provided to the patient in written and verbal form and be used as a prompt for the patient to seek referral to a specialist in traumatic brain injury. These symptoms should either have lasted for greater than 3 weeks or less time if planning to return to sports.
- Patients who are experiencing postconcussive symptoms should refrain from strenuous mental or physical activity until they are symptom free. They may require 2 to 3 days off work or school.

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**Conclusions**

- Predictors of intracranial injury after blunt head trauma exist but no prediction rule has both high sensitivity & high specificity
- There is no evidence to support MRI over CT in the acute management of TBI
- S100-B biomarker has a high sensitivity if assessed within 4 hours of injury: If less than 0.1 ug / l, a head CT can be avoided

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**Conclusions**

- Patients with MTBI who have a normal exam and a negative head CT can be safely discharged
- Patients with MTBI discharged from the ED should receive both verbal and written information on post-concussive symptoms and provided follow up resources

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**Questions??**

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