

Gowda NK, Agrawal D, et al. Technetium Tc-99m Ethyl Cysteinate Dimer Brain Single-Photon Emission CT in Mild Traumatic Brain Injury: A Prospective Study. Am J Neuroradiol 2006;27:447-451.

Design: Diagnostic cohort study

Population/sample size/setting:

- 92 patients (28 children, 64 adults, 75 male, 17 female) evaluated for mTBI in an academic neurosurgery department in New Delhi
- Definition of mTBI was (1) loss of consciousness (LOC) of 30 minutes or less, (2) GCS score of 13-15 after 30 minutes from injury, (3) posttraumatic amnesia (PTA) not exceeding 24 hours
- Exclusion criteria were past history of head injury or known neurologic disease
- Hospital policy required admission for 24 hours observation in all mTBI patients

Main outcome measures:

- All patients had CT within 12 hours and SPECT within 72 hours of injury
- CT was noncontrast, with 8 mm sections; abnormality was defined as any contusion, hematoma, or subarachnoid blood
- SPECT perfusion was based on the cerebellum (100% as the reference structure), with abnormal perfusion defined as <70% in the cortex or basal ganglia and <50% in the medial temporal lobe
- SPECT images were assessed by 2 neuroradiologists blinded to the clinical symptoms and to the CT findings; the SPECT was considered positive only if there was concordance between the 2 interpretations; the consensus rate was 93%
- 12 patients had GCS of 13, 25 had GCS of 14, and 55 had GCS of 15
- Cause of TBI was road accident in 69 patients, domestic falls in 14 patients, and blunt injury in 9 patients
- Postconcussive syndrome (PCS), defined with ICD-10 criteria, was assessed 1 week after injury in the neurosurgery department, and was assessed as present in 26 patients
- SPECT was abnormal in 58 (63%) patients, and CT was abnormal in 31 patients (34%)
 - o CT showed epidural hematoma in 7 pts, hemorrhagic contusion in 25 pts, and subarachnoid hemorrhage in 3 pts
 - o In all CT cases with epidural hematoma and hemorrhagic contusion, the SPECT showed a corresponding area of hypoperfusion
 - o In the 3 CT cases with subarachnoid hemorrhage, SPECT was normal in 2
 - o SPECT had higher sensitivity than CT for PTA (80 and 43.3% respectively), for LOC (74.5 and 47.1%), and for PCS (84.6% and 53.9%)

- Although moderate and severe TBI have been observed to show hyperperfusion on SPECT in some studies, no case of mTBI in this patient series had hyperperfusion of any region with CT abnormality
- SPECT abnormality correlated with the GCS score; it was abnormal in 11 of the 12 pts with GCS of 13, in 18 of 25 pts with GCS of 14 and in 30 of 55 pts with GCS of 15

Authors' conclusions:

- SPECT is more sensitive than CT in detecting cerebral perfusion abnormalities and can be especially useful in patients with TBI, LOC, or PCS with normal CT imaging
- The normal SPECT in 2 of the 3 patients with subarachnoid hemorrhage on CT may be due to poorer resolution of SPECT and the absence of significant cerebral perfusion changes in the brains of these patients
- Serial SPECT imaging could potentially serve to test the efficacy of drugs and neurobehavioral interventions in mTBI

Comments:

- Although the 2 neuroradiologists were clearly described as blinded to the clinical status of the patients, it is not clear that the clinicians who rated the presence or absence of PCS at the 1 week follow-up visit were blinded as to the SPECT and CT images
- An important source of potential bias therefore cannot be excluded
- Although SPECT was more sensitive to PTA, LOC, and PCS than was CT, Table 2 also makes clear that it was less specific, with a large proportion of false positive images
- The likelihood ratio (LR) of a positive test, defined as the ratio of sensitivity/(1-specificity), is a good indicator of the predictive performance of a test, and can be calculated from Table 2 for both SPECT and CT
 - o For PTA, the LR of SPECT is 1.45 and the LR of CT is 1.49
 - o For LOC, the LR of SPECT is 1.52 and the LR of CT is 2.75
 - o For PCA, the LR of SPECT is 1.55 and the LR of CT is 2.09
- Therefore, the predictive performance of CT is greater than or equal to SPECT on each of the mTBI conditions in the study population
- The LR of a negative test, defined as the ratio of (1-sensitivity)/Specificity, is related to the negative predicate value of the test; for SPECT, the LRs for PTA, LOC, and PCA are 0.44, 0.45, and 0.34
- There is no firm rule, but the usefulness of a test (which should have high sensitivity and high specificity), is related to the ratio of LR+/LR-; a ratio of 50 or greater is generally considered good
- For SPECT, these ratios for PTA, LOC, and PCA are only 3.3, 3.4, and 4.6

Assessment: Inadequate for evidence that SPECT is better than CT for identification of conditions associated with mTBI (LR not superior, blinding of clinicians unclear)