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**SPECT neuroimaging useful for traumatic brain injury: literature review**

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By Megan Brooks

NEW YORK (Reuters Health) - Single-photon emission tomography (SPECT) should be part of the clinical workup of patients with traumatic brain injury (TBI), conclude the authors of a comprehensive review of the literature on SPECT neuroimaging in TBI.

There is a "considerable body of literature" establishing a relationship between SPECT and improved lesion detection in TBI (compared to structural CT and MRI), neuropsychological and neurological outcomes, and treatment responses, the reviewers reported in PLoS One online March 19.

"Structural CT and MRI are excellent for identifying acute structural damage to the brain, but functional neuroimaging methods such as SPECT can provide dynamic information about the brain," first author Dr. Cyrus Raji, from the Department of Radiology, UCLA Medical Center in Los Angeles, California, noted in an interview with Reuters Health.

"A rigorous review of 30 years of peer reviewed literature showed that SPECT neuroimaging can reveal functional deficits that can be missed by conventional structural imaging modalities or demonstrate larger brain areas of abnormality compared to structural lesions that are found," he added.

The diagnosis of TBI, particularly mild TBI, remains a clinical challenge. Dr. Raji and colleagues found 1600 articles on SPECT for TBI and included 71 in their review (19 longitudinal studies and 52 cross-sectional studies).

They focused their main analysis on the 19 longitudinal studies (including five intervention studies) involving a total of 903 patients.

Ten studies included comparison modalities to SPECT (structural CT or MRI or both). In all 10, SPECT identified abnormalities not seen on MRI and CT.

Fourteen of the 19 longitudinal studies (77%) had neurological or neuropsychological outcomes and SPECT abnormalities correlated with these outcomes in 13 (93%).

"Specifically, SPECT perfusion changes were statistically significant in their association with neuropsychological or neurological tests," the researchers report. "This included two out of five intervention trials (40%) correlating SPECT perfusion changes with improved neuropsychological or neurological outcomes."

These findings, they say, highlight the "utility of cerebral blood flow on SPECT as a potential biomarker for surrogate endpoints in assessing the effectiveness of new treatments."

Three longitudinal studies examined specific metrics of diagnostic predictive value. One used SPECT to prospectively evaluate 25 patients with mild and 42 with moderate TBI. Each patient had a clinical evaluation and a SPECT scan within four weeks of the initial injury and three months after the first scan.

Among the 33 patients who showed no significant abnormalities on their initial SPECT scan, clinical symptoms resolved within three months in 97%. By contrast, of the 34 patients who had abnormalities on their first SPECT scan, 59% of the patients continued to experience significant clinical symptoms.

The positive predictive value of an abnormal initial scan was only 59% (20 of 34), but if the second scan three months later was also abnormal the sensitivity for the repeat SPECT rose to 95% (19 of 20), the researchers say.

The data also suggest that a negative initial SPECT scan can be a reliable predictor of a favorable clinical outcome. "A negative SPECT scan after TBI is reassuring in showing that that person probably doesn't have permanent neurological damage," Dr. Raji told Reuters Health.

The 52 cross sectional studies, which includes a combined sample of 2,121 persons with TBI, "support the clinical utility of SPECT suggested by longitudinal studies," the researchers report.

They conclude, "The current state of the literature demonstrates both associative and predictive value of SPECT in the setting of TBI. This same literature also demonstrates certain advantages of SPECT compared to structural MRI and CT in multiple studies, particularly in mild TBI. SPECT can therefore be used to provide actionable information in the identification and management of TBI."

SPECT is "reasonably cost-effective and available in outpatient setting," Dr. Raji commented. A SPECT scan costs roughly $1100, MRI ranges between $800 to $1200 and CT costs about $400 to $600 but is the least sensitive for chronic mild TBI, he noted. "Even in the acute setting it's been estimated that a non-contrast head CT scan in the ER will only show up as positive about 10% of the time. SPECT is a good compromise in providing useful functional information at an affordable cost," he said.

"Non-contrast head CT is great in the acute trauma setting, but for chronic repetitive concussions that athletes get, or blast injury that veterans sustain, or sheer force rotational injury, SPECT scans can show larger functional deficits that may be missed on structural imaging," Dr. Raji said.

"With a SPECT scan, you'd be more likely to see abnormalities in brain blood flow and metabolism. That's the big message we are getting out of the review of the literature over the last 30 years - that the SPECT scan can show these abnormalities that can be useful in the assessment and treatment of traumatic brain injury," Dr. Raji said.

Four of the authors have financial interests in entities that provide SPECT services. All of the authors are members of the International Society of Applied Neuroimaging (ISAN), a volunteer organization devoted to the understanding and appropriate clinical use of SPECT brain imaging.

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