EDITORIAL

Evaluating Traumatic Brain Injury: Correlating Perfusion Patterns and Function

Holman and Devous describe the value of SPECT imaging and list SPECT imaging of head trauma as a widely accepted use of the procedure (*1*). Nevertheless, SPECT is underutilized to evaluate traumatic brain injury (TBI), perhaps because there are few papers reporting correlative data to support the claims regarding SPECT's clinical use for this patient population.

Traditional structural imaging techniques such as CT and MRI are necessary in the acute state to decide on surgical intervention. It is unclear if SPECT imaging in the acute state provides information that cannot be obtained by CT or MRI. An extrapolation of Ichise et al.'s (*2*) data suggests that SPECT be performed on patients with minor TBI on admission. Detection of small nonstructural lesions may be of particular value for those patients who are minimally symptomatic in the emergency room, but who return later with complaints suggesting alterations in cognitive function.

Most patients who sustain TBI, major or minor, suffer chronic changes in cognitive and behavioral impairment that may require significant and costly rehabilitation. It is in this chronic state that SPECT imaging offers a potential advantage over CT or MRI. A previous study by Ichise's group (*3*) showed that SPECT is more sensitive than CT in revealing abnormalities in chronic TBI patients. Although this finding is useful, knowledge of where and how many lesions are present only represents part of the contribution that SPECT imaging can make with respect to TBI.

It is important to know if the lesions identified by SPECT or MRI account for the patient's clinical presentation. To make such a determination requires clinical research designs that include appropriate behavioral measures. Test selection should be based on hypotheses that evaluate specific regions which could result in specific cognitive impairments (e.g., memory, executive function, etc.). Ichise et al. (*2*) move in this direction, they have established the basis for developing more specific hypothesis testing driven research. Their approach to establishing the SPECT data base to examine alterations in tracer uptake and test performance is easily adapted to other research paradigms. In particular, the method of placing ROIs on sagittal images is one that should not be difficult to replicate in most nuclear medicine laboratories. It is clear from the data that there is minimum intraobserver variability in finding the anterior-posterior perfusion ratio (APR). Questions that relate magnitude of APR to severity of neuropsychological impairment still must be resolved. If the degree of the correlation increases the accuracy in estimating recovery from TBI, then the argument to include SPECT imaging as part of the standard TBI work-up is strengthened.

Another important contribution that Ichise et al. (*2*) make relates to their choice of sagittal images as the basis for calculating the APR. Many lesions resulting from brain trauma secondary to motor vehicle accidents are in the medial anterior and inferior frontal regions. The mid-line sagittal images provide the best visualization of these lesion sites. Additional inferior frontal ROIs would provide a more thorough analysis of the frontal lobe impairment. Visual identification of lesions in these regions may be enhanced by imaging with multidetector systems.

Many patients with chronic TBI will also experience depression along with the cognitive changes. This complicates the interpretation of the SPECT scans in terms of APR. The use of SPECT images to predict specific cognitive impairment or depression in chronic TBI is related to the sensitivity of the neuropsychologic instruments to distinguish between these changes in behavior and personality. To improve the understanding of the relationship between perfusion deficits seen on SPECT and test performance requires close collaboration between the nuclear medicine and neuropsychological communities. Such collaborative efforts are a logical extension of this report.

SPECT imaging therefore provides a useful tool for "proving" the physiological basis for sustained cognitive impairment in patients with chronic TBI in two ways. First, it helps to rule out malingering. This can become an important medico-legal question where issues of workmen's compensation or insurance claims are involved. Second, it is useful in predicting further recovery of function, and as a corollary, contributing to decisions regarding continued rehabilitative efforts. More research is needed to support these assertions.

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