Late Whiplash Syndrome: 
Correlation of Brain SPECT with Neuropsychological Tests and 
P300 Event-Related Potential 


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FROM ABSTRACT:

Background:
The acceleration forces infringing the cervical spine in whiplash injury are frequently associated with multiple cerebral symptoms. The purpose of this study was to determine whether there is a correlation between:
(1) Cerebral perfusion findings [as measured with SPECT, brain single-photon emission computed tomography]
(2) P300 recording (an electrophysiologic marker of cognitive ability), and
(3) Neuropsychological tests in patients with whiplash injury.

Methods:
Twenty patients with chronic whiplash injury underwent extensive clinical evaluation and neuropsychological testing.

A brain single-photon emission computed tomography (SPECT) study using 99mTc-HMPAO was performed in all patients within 24 hours of neuropsychological evaluation.

P300 event-related potentials were performed in 15 patients and in 9 normal volunteers.

Results:
Thirteen of 20 patients had brain perfusion abnormalities on the SPECT studies, in one or more regions.

Eight of 15 patients had abnormal P300 studies.

Seven of eight patients with abnormal P300 had also an abnormal SPECT study.

Seven of 15 patients had normal P300 results, 6 of them with a normal SPECT and 1 with SPECT abnormalities.

There was no significant correlation between the SPECT findings or the P300 results and the scores of attention and working memory.

There was, however, close agreement between the SPECT and P300.
Conclusion:
SPECT perfusion abnormalities in patients with chronic whiplash syndrome correlate well with P300 recording.

The combination of these studies with neurocognitive and neurobehavioral tests may be useful in identifying a subgroup of patients having organic brain lesions.

THESE AUTHORS ALSO NOTE:

“The acceleration forces impinged on the cervical spine [from whiplash injury] are frequently associated with cerebral symptoms such as headache, vertigo, disturbances in concentration and memory, difficulty in swallowing, and impaired vision.”

“Computed tomographic scanning and magnetic resonance imaging (MRI) have been unable to delineate traumatic brain lesions in patients with whiplash injury.”

[IMPORTANT]

Functional single-photon emission computed tomography (SPECT) and positron emission tomography (PET) neuroimaging may detect organic brain injury.

The most extensively studied cognitive component of brain function is the P300.

“The P300 event-related potential is a stimulus-independent wave related to cognitive processing of an unexpected stimulus. It is either delayed, absent, or of lower amplitude in a variety of confusional states or dementing disorders and in multiple sclerosis, but normal in depressive disorders.”

The P300 amplitude indicates the amount of stimulus information processed.

The P300 latency denotes the speed of information processing.

In this study, 20 patients with post-whiplash syndrome were examined at a mean interval 12 months after injury (range 6 months to 5 years).

“All patients complained of persistent head or neck pain and most patients complained of disturbances in concentration and memory.”

All patients had standard neuropsychological testing.

Nine normal volunteers without prior neurologic disease or a history of head trauma were used as a control group.

All patients had a SPECT study performed within 24 hours of the neuropsychological testing.
SPECT requires an intravenous injection of 99mTc-HMPAO, followed by imaging within 30 to 40 minutes after the injection.

RESULTS

“There was no significant correlation between the SPECT findings or the P300 results and the scores of the various neuropsychological tests.”

This would suggest that although SPECT and P300 testing is superior to MRI and CT in documenting post-whiplash organic brain injury, that neuropsychological testing is more sensitive than SPECT and P300.

“No structural brain damage was detected in any of the patients on MRI.”

13 of 20 patients had brain perfusion abnormalities on the SPECT studies, in one or more regions. [13/20 = 65% of the selected group]

8 of 13 patients showed diminished perfusion in the temporal lobes.

3 patients had occipital perfusion abnormalities.

2 patients had frontal lobe abnormalities.

2 patients showed asymmetric perfusion in the basal ganglia.

“The odds ratio for temporal lobe abnormalities was 13.5, which means that a person with altered temporal lobe perfusion is 13.5 times as likely as a person with a normal temporal lobe to have an abnormal P300.” [WOW]

DISCUSSION

There are more than 1 million whiplash injuries every year in the USA.

“About 5% of patients with whiplash remain incapacitated after 1 year.”

“Various studies have reported impairment in cognitive performance in patients who had whiplash injury, particularly in tasks requiring working memory and emotional functioning.”

“These results may indicate that the provocation of emotional and cognitive symptoms after the initial injury is not invariably associated with morphologic or functional brain damage.”

“Computed tomography and MRI have been unable to delineate traumatic brain lesions in patients with whiplash injury.”

“By contrast, functional brain imaging using SPECT and HMPAO or ethyl cysteinate dimer demonstrated a pattern of biparieto-occipital hypoperfusion in most patients.”
“It was hypothesized that parieto-occipital hypometabolism may be caused by activation of nociceptive afferent nerves from the upper cervical spine.”

“Abnormalities in glucose metabolism were also reported in whiplash injuries showing bilateral parieto-occipital hypometabolism by PET imaging.”

“We found close agreement between the SPECT findings and P300 results in whiplash injury. To the best of our knowledge, this is the first study that correlates SPECT imaging and P300 recording.”

CONCLUSION

“We conclude that combined functional assessment using SPECT imaging and P300 recording in association with neuropsychological testing may be more appropriate than morphologic imaging alone for better evaluation of whiplash-associated complaints.”

KEY POINTS FROM DAN MURPHY

(1) About 5% of whiplash injured patients remain disabled 1 year later.

(2) Whiplash has the ability to cause organic brain injury.

(3) Typical symptoms associated with organic brain injury include headache, vertigo, disturbances in concentration and memory, difficulty in swallowing, and impaired vision.

(4) Post-whiplash organic brain injury cannot be adequately detected on MRI or CT scanning.

(5) The best way, to date, to document organic brain injury following whiplash injury, even months later (this study was done 6 months to 5 years after injury), are ALL of the following:

(A) Cerebral perfusion findings as measured with SPECT, brain single-photon emission computed tomography.
(B) P300 recording, which is an electrophysiologic marker of cognitive ability.
(C) Neuropsychological testing.

(6) PET (positron emission tomography) measurement of glucose metabolism can also document post-whiplash organic brain injury, but was not assessed in this study.

(7) Afferents from the upper cervical spine can cause brain abnormalities on these tests [WOW, IMPORTANT]