Uncinate fasciculus integrity and impaired problem solving and memory in complex partial seizures

Mario F. Dulay, Ph.D.1, Christof Karmonik, Ph.D.1, Amit Verma, M.D.1, Kimberly P. Raghuvar, M.A.1, Adriana M. Strutt, Ph.D.2, Michele K. York, Ph.D.2, Robert G. Grossman, M.D.1

The Methodist Hospital Neurological Institute1 and the Department of Neurology, Baylor College of Medicine2

BACKGROUND

Executive functions refer to complex behavioral processes associated with frontal lobe functioning that involve planning actions, initiating actions, adapting to and solving problems, using feedback to choose future responses, inhibiting undesirable or incorrect responses, and using strategies to remember. A subset of individuals with complex partial seizures of the temporal lobe have unexpected executive function impairments, as well as expected memory impairments. The uncinate fasciculus (UF) has been found to be associated with attention, set shifting, emotion regulation, intelligence and memory difficulties in various populations (e.g., healthy older adults, mild cognitive impairment, schizophrenia, depression), as well as memory impairment in patient with epilepsy.

OBJECTIVE

The purpose of this study was to relate the structural integrity of the uncinate fasciculus, a corticocortical fiber tract connecting the frontal and temporal lobes, to functional measures of memory and problem solving in individuals with complex partial seizures.

PARTICIPANTS

Ten patients (5 women) diagnosed with video-EEG confirmed intractable TLE (4 left, 6 right) underwent DTI and neuropsychological assessment. Table 1 shows the demographic and disease-related data for the sample.

RESULTS (Table 2)

One-way ANOVA indicated that patients with problem solving impairment (z-score -1.32 below normative data) had significantly lower mean uncinate fasciculus FA values (F[1,9]=6.2, p < 0.05; Table below). Specifically, the four patients with impaired problem solving ability had lower mean uncinate fasciculus FA values compared to patients with relatively intact problem solving ability.

RESULTS (Figure 1)

Controlling for age, lower left uncinate fasciculus FA values were significantly correlated with problem solving (r = 0.75; see Figure 1), mental flexibility (r = -0.68), verbal learning (r = -0.81), and visual constructive learning (r = 0.72; see Figure 2; all p values < 0.05). Spatial learning impairment was the only ability associated with lower right uncinate fasciculus FA values (r = 0.77, p < 0.05).

RESULTS (Figure 2)

Lower left uncinate fasciculus FA was significantly associated with poorer visual learning in patients with CPS.

CONCLUSIONS

Results are consistent with previous studies that have found associations between unilateral UF white matter tract integrity and cognition. Disruption of the UF may partly explain the executive and strategic memory impairments found in individuals with CPS. Studies with larger sample sizes are needed to replicate our structure-function correlations.

REFERENCES