Repetitive head impact

Exposure to repetitive head impacts (RHI) is associated with an increased risk of later-life neurobehavioral dysregulation and neurodegenerative disease. The underlying pathomechanisms are largely unknown.

Purpose: To investigate whether RHI exposure is associated with later-life corpus callosum (CC) microstructure and whether CC microstructure is associated with plasma total tau and neuropsychological/neuropsychiatric functioning.

Seventy-five former professional American football players (age 55.2 ± 8.0 years) with cognitive, behavioral, and mood symptoms.

Field strength/sequence: Diffusion-weighted echo-planar MRI at 3 T.

Assessment: Subjects underwent diffusion MRI, venous puncture, neuropsychological testing, and completed self-report measures of neurobehavioral dysregulation. RHI exposure was assessed using the Cumulative Head Impact Index (CHII). Diffusion MRI measures of CC microstructure (i.e., free-water corrected fractional anisotropy (FA), trace, radial diffusivity (RD), and axial diffusivity (AD)) were extracted from seven segments of the CC (CC1-7), using a tractography clustering algorithm. Neuropsychological tests were selected: Trail Making Test Part A (TMT-A) and Part B (TMT-B), Controlled Oral Word Association Test (COWAT), Stroop Interference Test, and the Behavioral Regulation Index (BRI) from the Behavior Rating Inventory of Executive Function, Adult version (BRIEF-A).

Statistical tests: Diffusion MRI metrics were tested for associations with RHI exposure, plasma total tau, neuropsychological performance, and neurobehavioral dysregulation using generalized linear models for repeated measures.

Results: RHI exposure was associated with increased AD of CC1 (correlation coefficient ® = 0.32, $P < 0.05$) and with increased plasma total tau ($r = 0.34$, $P < 0.05$). AD of the anterior CC1 was associated with increased plasma total tau (CC1: $r = 0.30$, $P < 0.05$; CC2: $r = 0.29$, $P < 0.05$). Higher trace, AD, and RD of CC1 were associated with better performance ($P < 0.05$) in TMT-A (trace, $r = 0.33$; AD, $r = 0.31$; and RD, $r = 0.28$) and TMT-B (trace, $r = 0.31$; RD, $r = 0.34$). Higher FA and AD of CC2 were associated with better performance ($P < 0.05$) in TMT-A (FA, $r = 0.36$; AD, $r = 0.28$), TMT-B (FA, $r = 0.36$; AD, $r = 0.27$), COWAT (FA, $r = 0.36$; AD, $r = 0.32$), and BRI (AD, $r = 0.29$).

Data conclusion: These results suggest an association among RHI exposure, CC microstructure, plasma total tau, and clinical functioning in former professional American football players.

Level of evidence: 3 Technical Efficacy Stage: 1.