H124 Chronic Traumatic Encephalopathy Pathology Following Shotgun Injury to the Brain

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Learning Overview: After attending this presentation, attendees will: (1) assess significance of tau pathology after traumatic brain injury, (2) correlate tau pathology with clinical signs, (3) interpret consensus guidelines for Chronic Traumatic Encephalopathy (CTE) interpretation, and (4) assess appropriateness of the CTE diagnosis for death certification

Impact on the Forensic Science Community: This presentation will impact the forensic science community by clarifying broad misunderstanding regarding brain interpretation for CTE pathology, its significance in terms of clinical problems during life, and the lack of appropriateness of the CTE diagnosis for death certification

CTE was suggested initially in boxers (i.e., dementia pugilistica) who developed neurological abnormalities after long boxing careers. Autopsy studies in the mid-20th century variably highlighted Neurofibrillary Tangles (NFT) among the features of dementia pugilistica, prompting the hypothesis that dementia pugilistica shares pathogenic similarities with Alzheimer's Disease (AD). In the past decade, the CTE concept has extended to other athletes, although with limited clinical correlations and more subtle neuropathology. A consensus group has recently set provisional criteria for CTE pathology and highlighted a pattern of phosphorylated tau (p-tau) neuropathology considered "pathognomonic" for CTE. The consensus group did not adopt a staging scheme for CTE and did not address the question of whether CTE pathology represents the substrate for a progressive neurodegenerative disease.

Reported here is the case of a 63-year-old man who suffered a shotgun injury to the brain in his early twenties. He remained neurologically compromised for 42 years after the injury but showed no evidence of neurological disease progression after the initial injury. He had no other Traumatic Brain Injury (TBI) exposure and did not play football or other high-energy collision sports. Neuropathological examination confirmed tissue damage from the shotgun injury, with multiple foci of encephalomalacia. Also present were mammillary body atrophy, atrophy of the fornices, and an atrophic and convex thalamus, gross features occasionally described in historical cases of dementia pugilistica. Mamillary body atrophy and evidence of previous TBI are listed as supportive neuropathological features of CTE. Also present were localized deposits of p-tau within neurons and astrocytes around small blood vessels at the depths of cortical sulci, meeting neuropathological criteria for CTE. P-tau and TDP-43 deposits within marginal brain tissue damaged by penetrating shotgun injury were also present focally, indicating focal proteinopathy as a direct consequence of neurotrauma. No amyloid-β (Aβ) deposits were present.

These findings indicate that CTE pathology may occur in the aftermath of single, severe TBI. The fact that it remained stationary for decades with no evidence of clinical or pathological progression, and no evidence of AD pathology, raises questions about the TBI-progressive proteinopathy paradigm, and the theory that CTE pathology is a hallmark for neurodegenerative disease. The absence of correlation between p-tau pathology in this case and in the CTE literature in general, along with the lack of disease progression in a manner of canonical neurodegenerative disease, suggests that CTE is a descriptive neuropathological, and at times a purely immunohistochemical entity, that lacks clinical meaning. Moreover, an abundance of literature calls into question a cause-effect relationship between TBI and progressive neurodegenerative proteinopathy. The many uncertainties surrounding the CTE concept suggests that CTE is inappropriate for death certification and may lead to unnecessary confusion. More research is needed before concluding that CTE is a cohesive clinicopathological entity responsible for neurological or psychiatric problems during life.

Traumatic Brain Injury, Chronic Traumatic Encephalopathy, Tauopathy