Chronic Traumatic Encephalopathy

Tracy J Eicher, MD
Chronic Traumatic Encephalopathy (CTE)

- A progressive degenerative disease of the brain found in athletes (and others) with a history of repetitive brain trauma
CTE

- Associated symptoms: confusion, impaired judgement, impulse control problems, aggression, depression, memory loss, paranoia and eventually progressive dementia

- Some develop symptoms of Parkinsonism including tremor, rigidity, masked facies, slowed movement
CTE

Pathologic changes occur in the brain including the build-up of Tau protein

Changes may begin months, years, or decades after the last concussion

Many questions unanswered at this time
CTE-- history

- 1928; “Punch drunk” syndrome described by NJ pathologist HS Martland
  - Martland HS: Punch drunk. JAMA 91:1103-1107, 1928
  - Noted symptoms of slowed movement, tremors, confusion, speech problems

- 1966; term “Chronic Traumatic Encephalopathy” first appears in medical literature
CTE-- history

- 1973; J.A. Corsellis et al described neuropathologic findings of CTE after autopsy of 15 former boxers

- Between 1928 and 2009 only 49 cases of CTE described in all medical literature; 39 of the cases were boxers

- Others: battered housewife, an epileptic w drop attacks, 2 “mentally disturbed individuals” prone to “head butting behavior”, former circus performer employed at the art of “dwarf throwing”
CTE
CTE--history

- 2002-2005; Dr Bennet Omalu, forensic pathologist in Pittsburg Pennsylvania identified CTE in brains of two former Pittsburg Steelers; Mike Webster and Terry Long

- 2005; Publishes findings in journal ‘Neurosurgery’

- NFLs mTBI committee (est 1997) refutes the article and demands a retraction.

- Retraction denied
Former WWE wrestler Chris Nowinski worked with families of 3 other deceased NFL players, Andre Waters, Justin Strzelczyk, and Tom McHale to have their brains examined.

- All had symptoms of CTE before death including suicide or attempted suicide, impulse control/anger issues
- Autopsy showed CTE in all three
June 2007; Chris Nowinski and Dr. Robert Cantu founded The Sports Legacy Institute (SLI)
- Non-profit organization dedicated to research, treatment, education, and prevention of CTE

2008; SLI partnered with Drs. Ann McKee and Robert Stern to create the Center for the Study of Traumatic Encephalopathy at Boston University School of Medicine (BU-CSTE)
High School Football and Risk of Neurodegeneration: A Community-Based Study

Rodolfo Savica, MD, MSc, Joseph E. Parisi, MD, Lester E. Wold, MD, Kieth A. Josephs, MD, MSt, MSc and J. Eric Ahiskog, PhD, MD

Mayo Clinic Proceedings

CTE—Rochester Study; high school football players ‘46-’56

- High School FB players from 1946-1956 (2 schools)
- Control group; male members from band, glee club, choir in same high schools
- N=438; Controls =140
- Compared incidence of Dementia, Parkinson’s Disease and ALS
FIGURE 1

Lourdes HS
Rochester MN
1946
CTE--Gross Pathology

- Reduced Brain weight;
  - Brain atrophy most in Frontal lobes (36%), temporal lobes (31%), Parietal Lobes (22%); occipital lobes rarely
  - Enlargement of lateral and third ventricles (in 53% and 29% respectively); Thinning of Corpus Callosum
  - Pallor of substantia nigra and locus ceruleus
CTE--Gross Pathology

- Atrophy of thalamus, mammillary bodies, olfactory bulbs, cerebellum and brainstem → progressive atrophy of Hippocampus, entorhinal cortex, amygdala
CTE-- Pathology
CTE-- MicroPathology

- Neuronal loss
- Neurofibrillary tangles (NFTs)
  - Aggregates of hyperphosphorylated tau protein
  - A primary marker of Alzheimer’s Disease
- Neuropil Threads (NTs) and Neuropil Neurites
  - Made of Abnormally phosphorylated tau proteins
- +/- Beta Amyloid plaques
Alzheimer’s Disease
CTE– Pathology vs Alzheimers

- Neurofibrillary Tangles
  - present in both diseases
  - locations of NFTs differs from AD
- Beta Amyloid
  - a primary pathologic feature in AD, virtually always present
  - Present in 6 – 45 % in CTE
Tom McHale
(Feb 25, 1963 – May 25, 2008)

Offensive Lineman;
TB Buccaneers
9 yr NFL Career
Tom McHale
Inferior Orbial Cortex
Hippocampus; Temporal Cortex
65 yo Control  

John Grimsley  
(age 45)  

73 yo former world champion boxer
65 yo Control

John Grimsley (age 45)

73 yo former world champion boxer
1946-1956

- Poor equipment
- Little regard for dangers of concussion
- No rules prohibiting head-first tackling (Spearing)
CTE—Rochester Study; Results

- **No increased incidence** of Dementia, PD, or ALS found among football players compared with non-football playing male classmates.

- No data on specific numbers of concussions, other health factors, or activities outside of football or beyond the high school years.
CTE—Unanswered questions

- What factors put one person at higher risk of developing CTE than another?
  - ApoE4
  - Other genetic markers

- Does younger age at time of concussions portend worse or better outcome?

- Biomarkers for prognosis/prediction of risk
CTE—Unanswered questions

- Do fewer but more severe concussions carry the same risk for CTE as multiple lower grade concussions? (military vs athletes)

- Blast injury mechanism for concussion… more or less risk of CTE?

- ALS…