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Review Article

Review of Repetitive Head Injury Syndrome

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Abstract

Originally known as "punch drunk syndrome" and first documented in boxers in the 1920s, chronic traumatic encephalopathy (CTE) has grown to be a well-known topic in the sports medicine community [1,2,5]. CTE is due to traumatic head injuries and most commonly repetitive injuries. These can be caused by participating in contact sports, military service, or from any banging of the head. CTE has been shown to cause degeneration to parts of the brain and a reduction in brain mass, but this is usually many years after the repetitive injuries had occurred. Currently, the treatments for CTE are limited, primarily consisting of supportive treatment. The damage done to cause CTE is irreversible, however, with increasing awareness, research will continue to provide more answers. To avoid developing CTE, it is recommended to not partake in the activities that have been shown to be risk factors.

Keywords: *Chronic Traumatic Encephalopathy (CTE); Football; Sports; Head Trauma; Repetitive Head Injury Syndrome; Concussion*

Introduction

A common topic in today's news regarding sports medicine is the issue of former professional athletes being diagnosed with the condition, repetitive head injury syndrome. Also, more commonly known as chronic traumatic encephalopathy (CTE) or "punch drunk syndrome," repetitive head injury syndrome grew in nontertiary when autopsies were performed on former professional football players and CTE was present in these patients [5]. These studies were done in the 2000s and it is because of this that the research and understanding of CTE is limited. However, each year more and more research is done regarding CTE and with it, our knowledge of CTE grows as well. In this study, we reviewed current articles to provide an overview of the condition.

Etiology

Repetitive head injury syndrome is due to trauma to the head most notably repetitive mild traumatic brain injuries [1]. It has been shown that this repetitive mild traumatic brain injury alone is sufficient to trigger CTE in some people [2]. This trauma can be due to a wide variety of causes such as military profession, professional athlete of a contact sport such as boxing and football, motor vehicle accidents, or any other miscellaneous source of head trauma [1]. Sports that have been shown to cause CTE in some participants include, boxing, MMA, football, soccer, hockey, and rugby as well as others [5]. However, even though head trauma is a causative agent of Repetitive Head Injury Syndrome, experiencing trauma does not always lead to the development of CTE [1].

Epidemiology

CTE appears to effect of individuals over a wide range of ages ranging from teenage to into the '90s [1,2]. In subjects diagnosed with CTE, the age for diagnosis was most commonly found in the 60 - 69 age range, with the next most prevalent ages being the 70 - 79, 50 - 59

and 40 - 49 age ranges [1]. The sex that makes up the larger percent of diagnosis for CTE is male [1,2]. This is in part due to the larger number of men participating in sports or activates that have been shown to cause CTE.

Pathophysiology

Repetitive Head Injury Syndrome is usually characterized by the presence of ventricular dilatation, thinning of the corpus callosum, generalized global atrophy, and cavum septum pellucidum, as well as other macroscopic degenerative changes [1]. Irregular, multifocal, and generally perivascular tau-immunoreactive neurofibrillary tangles (NFTs) are found in CTE and are considered exclusive to it [1]. This differs from AD, which also is commonly found to present with neurofibrillary tangles [1,2,5]. Studies have pointed to CTE beginning perivascularly in the cerebral cortex and spreads slowly over time to regions of the neocortex, medial temporal lobe, basal ganglia, spinal cord, and diencephalon [2]. A reduction in brain mass is also commonly seen among patients diagnosed with CTE [1].

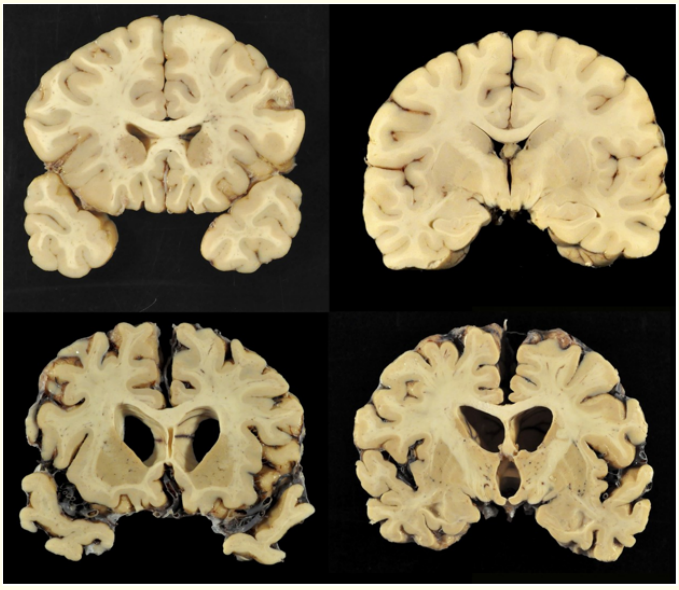

Figure 1: *Brain disections of normal brain (top) and a brain with stage IV chronic traumatic encephalopathy.*

History and physical

"Punch drunk syndrome" was first described in 1928, which was the original report describing the effects of repetitive head trauma associated with sports [1,2,5]. Originally termed dementia pugilistica, the name of this disorder was later changed to CTE. The first published case of CTE was in 1954 [1]. CTE relatively recently became a more well-known disease with autopsies of former professional football players revealing the presence of CTE [5]. CTE commonly presents with progressive cognitive decline, impaired attention, executive dysfunction, and memory impairment [5].

Treatment/management

Currently, there is little in the area of treatment as the damage done is irreversible. The disease is managed similarly to other forms of dementia in that it is supportive treatment [4]. However, there have been some indications that certain factors may have beneficial effects. Studies have shown that general health and well-being, such as a nutrient-rich diet and reducing stress, may allow for a slower progression or mild improvement of CTE [3,5].

Differential diagnosis

Alzheimer's disease, frontotemporal lobar degeneration (FTLD), and Parkinson's disease are common differential diagnosis when CTE is suspected [2]. Perivascular foci of p-tau immunoreactive astrocytic tangles and neurofibrillary tangles, irregular cortical distribution of

p-tau-immunoreactive neurofibrillary tangles and astrocytic tangles with a predilection for the depth of cerebral sulci, clusters of subpial and periventricular astrocytic tangles in the cerebral cortex, diencephalon, basal ganglia and brainstem, and neurofibrillary tangles in the cerebral cortex located preferentially in the superficial layers are the criteria for CTE [2]. CTE differs from concussions and other head trauma-related conditions in the fact that it usually presents with a latent asymptomatic period of years [1]. A differentiation between CTE and Alzheimer disease is that p-tau and neurofibrillary tangles (NFTs) predominantly within neocortex layers II and III in CTE and are located in p-tau is typically found in layers III and V [5]. Currently, research is being done as to the efficacy of different scanning methods in the diagnosis of CTE.

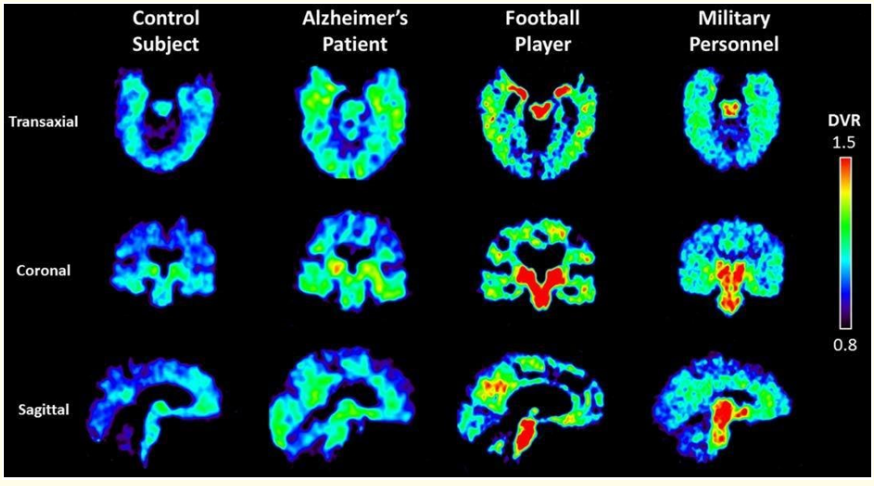

Figure 2: *Radioactive imaging of brain to see if this could be used as a diagnostic method for CTE. Warmer colors represent areas with more abnormal proteins.*

Prognosis

CTE can be categorized into four groups. Stage 1 presents with perivascular p-tau neurofibrillary tangles in focal epicenters [2]. Stage 2 usually has more mental issues and presents with neurofibrillary tangles found in superficial cortical layers [2]. Stages 3 and 4 showed continued progressive deterioration. In the later stages and as the disease advances, the continued neurological deterioration can appear as Alzheimer's Disease or frontotemporal dementia [2]. Patients with stage 3 CTE have memory loss and mental impairment as well as macroscopic evidence of mild cerebral atrophy, septal abnormalities, and ventricular dilation [2]. Stage 4 CTE is associated with a significant decrease in brain weight and increased severity of cognitive abnormalities [2]. However, upon autopsy, some patients were asymptomatic while still presenting with decreased brain mass [5].

Complications

It has been reported that many of those with Repetitive head injury syndrome suffer from substance abuse and it is uncertain if the damage done by CTE causes patients to seek the use of drugs [1,2]. It has also been shown that mood and behavioral changes can present in CTE ranging from depression, irritability, anxiety, explosivity, aggression, violence, and impulsivity [5].

Deterrence and patient education

To reduce the chances of developing CTE, the only deterrence is to reduce the number of traumatic collisions to the head. Partaking in any of the before mentioned activities, such as football, wrestling, hockey, soccer, boxing, mixed martial arts, and military services, increases the risk of an individual later developing repetitive head injury syndrome [1].

Enhancing healthcare team outcomes

It is believed that cognitive training might offer some way of reducing possible symptoms [5]. These mental exercises being used in a professional athlete's career or earlier in their life may prove more effective [5].

Conclusion

In conclusion, repetitive head injury syndrome is a serious problem that affects the brain permanently. No treatment exists besides symptom reduction and supportive care. As, such prevention of repetitive head injury syndrome is important.

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