Case Report

A case of cognitive impairment in an ex-boxer

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Abstract

Chronic traumatic encephalopathy (CTE) is a neurodegenerative disease related to the long-term consequences of repetitive cranial trauma. However, the CTE clinical phenotype has yet to be clearly defined. A 63-year-old man visited the hospital due to memory impairment. He was a former boxer. He scored 23 points on the Mini-Mental State Examination (MMSE). Magnetic resonance imaging (MRI) of the brain showed mild hippocampal atrophy. Reduced perfusion is identified in the bilateral frontal and parietotemporal lobes in cerebral blood flow on single photon emission computed tomography (SPECT). From detailed history taking, neuropsychological testing and neuroimaging, our case has not only suggestive probable CTE but also comorbid Alzheimer's disease (AD). The diagnosis process of CTE is complex; therefore, detailed longitudinal history taking, neuropsychological testing and imaging were important.

Keywords: Alzheimer's disease, chronic traumatic encephalopathy, cognitive impairment, traumatic brain injury

Introduction

Chronic traumatic encephalopathy (CTE) is a neurodegenerative disease related to the long-term consequences of repetitive cranial trauma.[1] First recognized in 1928 in boxers who had suffered repeated head trauma, the disease was initially termed "punch-drunk" syndrome.[2] The disease nomenclature evolved into "dementia pugilistica" and finally CTE. CTE has been reported in not only boxers but also other athletes, as a result of repetitive mild traumatic brain injury (TBI). CTE is currently characterized by the accumulation of phosphorylated tau (p-tau) in the sulci and the perivascular region, with accompanying astrogliosis, microgliosis and TAR DNA-binding protein 43 (TDP-43).[3] To the best of our knowledge, case reports of CTE are considered to be limited. Therefore, the case aims to provide an overview of CTE and how to diagnose CTE.

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Case Report

A 63-year-old Japanese man visited Shin-suma Hospital with a coworker due to memory impairment. According to his coworker, he was working as a security guard. Nine months ago, his coworker had noticed his memory disturbance. He was living alone and had never married. According to his sister-in-law, he was a former boxer with 9 years of formal education. He fought as a professional boxer in 37 matches from age 18 to 28 years. His history included whiplash due to a traffic accident 15 years ago. He had no history of psychiatric disturbances, alcoholism, or drug abuse and no family history of dementia. A general physical examination revealed no abnormalities.

The patient was submitted to the protocol of exams for the evaluation of cognitive disorders. He completed the Hasegawa Dementia Rating Scale-revised (HDS-R), Mini-Mental State Examination (MMSE), Rey's Complex Figure Test, Logical memory, Clock Drawing Test (CDT), Trail-Making Test (TMT) A and B, and Frontal Assessment Battery (FAB) [Table 1]. He

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scored 21 points on the HDS-R, losing points on calculation, recall and goods registration. He scored 23 points on the MMSE, losing points on calculation and recall. He had difficulty copying the drawing for Rey's Complex Figure Test. Three minutes later, he was unable to redraw the figure. On the TMT-A, he exhibited slowed information processing and on the TMT-B, he showed a lack of strategy and flexibility of thought [Table 1]. From these results, his memory, visual ability, attention and executive function were considered to be impaired. In the present case, the assessment of his activities of daily living (ADL) was evaluated by the Dementia Assessment Sheet for Community-based Integrated Care System -21 items (DASC-21). Recently, the DASC-21 was developed by Awata *et al*.[4] The DASC-21 is useful for diagnosing and promoting integrated care in cases of dementia. Subjects with a DASC-21 score of 31 or more are categorized as having suspected cognitive impairment or dementia. In the present case, information on his daily life was also provided by his coworker. On the DASC-21, memory, orientation, solving issues/common sense and instrumental ADL (IADL) outside were impaired [Table 2]. His serum levels for vitamin B12, folate, thyroid stimulating hormone and free T4 were all normal.

Magnetic resonance imaging (MRI) of his brain showed mild hippocampal atrophy [Figure 1a and b]. Reduced perfusion was identified in the bilateral frontal and parietotemporal lobes in cerebral blood flow on single photon emission computed tomography (SPECT) [Figure 2].

Discussion

From detailed history taking, neuropsychological testing and neuroimaging, our case has suggestive probable CTE. The CTE clinical phenotype has yet to be clearly defined. According to McKee's classification,[3] the present case was Stage III, in which patients typically present with more cognitive deficits, including memory loss, executive functioning deficits, and visuospatial dysfunction. Furthermore, based on the results of imaging and cognitive function tests and the criteria of the National Institute of Neurological and Communication Disorders Association,[5] we diagnosed not only CTE but also comorbid Alzheimer's disease (AD).

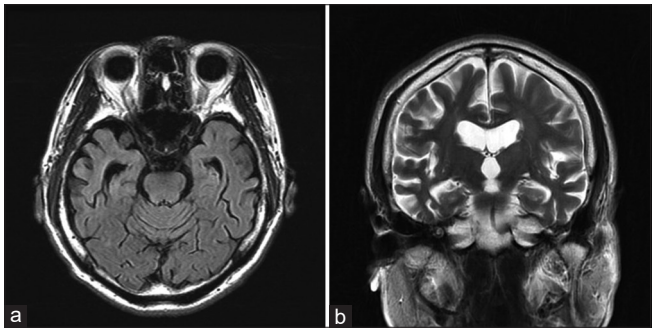

Figure 1: Magnetic resonance imaging reveals mild hippocampal atrophy. (a) Flair, axial image; (b) T2, coronal image

According to Jordan *et al*.,[6] CTE is associated with boxing and has a prevalence of about 20% among professional boxers. Risk factors for CTE are the frequency of repeated exposure to head blows, intensity of technical supervision, frequency of sparring, and presence of the apolipoprotein genotype (APOE). There have been many studies on the diagnostic potential of imaging biomarkers in CTE but no such biomarkers have been established. Omalu *et al*.[7] reported that the first-generation tau ^{18}F-FDDNP-PET tracer revealed a specific topographic pattern of tau accumulation in CTE. However, ^{18}F-FDDNP-PET seemed not to be selective for tau only as it also binds to other molecules composed of β-sheet structures, such as Aβ.[8]

Table 1: Detailed Neuropsychological Assessment

	Score	Abnormal
HDS-R	21/30	≦20
MMSE	23/30	≦23
DASC-21	35/84	≧31
MOCA-J	17/30	≦26
CDT (Rouleau)	4/10	≦8
Rey Copy drawing	12/36	≦34
Rey 3 min Recall	0/36	≦10
Logical memory	0/25	≦2
TMTA	82s	61s≦
TMTB	240s	188s≦
GDS	2/15	≧8
FAB	12/18	≦10

HDS-R=Hasegawa Dementia Scale-Revised, MMSE=Mini-Mental State Examination, DASC-21=Dementia Assessment Sheet for Community-based Integrated Care System-21, MOCA-J=Montreal Cognitive Assessment-Japan), CDT=Clock Drawing Test, TMT=Trail Making Test, GDS=Geriatric Depression Scale, FAB=Frontal Assessment Battery, S=seconds

Table 2: Each Item and Total Score of DASC-21

	Score
Memory	7/12
Orientation	5/12
Solving issues/common sense	9/12
IADL Outside	5/12
IADL Inside	3/12
Physical ADL①	3/12
Physical ADL②	3/12
Total	35/84

DASC-21=Dementia Assessment Sheet for Community-based Integrated Care System-21, IADL=instrumental ADL

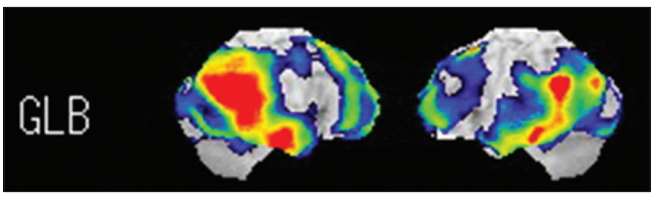

Figure 2: Reduced perfusion was revealed in the bilateral frontal and parietotemporal lobes in cerebral blood flow SPECT (3D-SSP, decreased)

In AD pathology, a history of TBI has been reported to increase the incidence of AD and other dementias, including younger-onset dementias.[9-11] Postmortem pathologic analysis is characterized by neurofibrillary tangles and Aβ plaques in 50% of cases.[12] Therefore, a history of TBI has been accepted as a major risk factor for AD. A retrospective analysis of TBI patients demonstrated that the onset of AD was significantly earlier in those who survived TBI,[13,14] especially in men.[15] However, Katsumoto *et al.*[16] concluded that it remains unclear whether AD develops concurrently with CTE or if instead CTE induced AD. In the diagnostic potential of imaging biomarkers in AD, impairment of the cerebral metabolic rate of glucose (CMRglu) in the temporoparietal association cortex is typical and can be revealed by ^{18}F-FDG PET.[17,18] However, FDG PET was not evaluated in the present case. PET findings of AD are similar to SPECT findings.[19,20] Thus, we diagnosed this case not only with suggestive probable CTE but also comorbid AD.

There are two limitations in the present case. Recently, NINDS-NIBB criteria for the neuropathological diagnosis of CTE was recommended as pathology.[21] However, pathology and APOE were not evaluated.

Conclusion

We emphasize that detailed history taking, neuropsychological testing and imaging of CTE are important.

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Declaration of patient consent

Written informed consent was obtained from the patient and his family to publish this report in accordance with the journal's patient consent policy.

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Conflicts of interest

There are no conflicts of interest.

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