Cerebral atrophy in heroin abuse

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Although psychoactive substance abuse has been known to cause cerebral atrophy, there are no previous reports of a similar nature pertaining to the use of heroin. We describe a 26-year-old male intravenous heroin abuser who had prominent cerebral atrophy that could not be explained by other medical conditions. The possible relationship between cerebral atrophy and chronic heroin use is discussed.

HKMJ 1996;2: 96-98

Key words: Substance abuse; Substance abuse, intravenous; Substance abuse, complications; Heroin dependence; Atrophy, cerebral

Introduction

Loss of brain substance results in cerebral atrophy. Various causes of cerebral atrophy have been identified, including the toxic effect of psychoactive substances, such as alcohol, benzodiazepines, and cannabis.[1-3] However, there have been no previous reports of opiates causing cerebral atrophy. In this paper, we report a case of cerebral atrophy in an intravenous heroin addict with no other medical conditions that may account for his widened sulci.

Case report

The patient was a 26-year-old unemployed man, who was admitted to a university teaching hospital because of heroin overdose. He had been regularly injecting heroin intravenously for the past nine years, with a daily consumption of 300 mg. At its peak, his consumption reached 1500 mg per day. He denied the use of other psychoactive substances, such as alcohol, cannabis, or benzodiazepines, and did not re-use or share needles.

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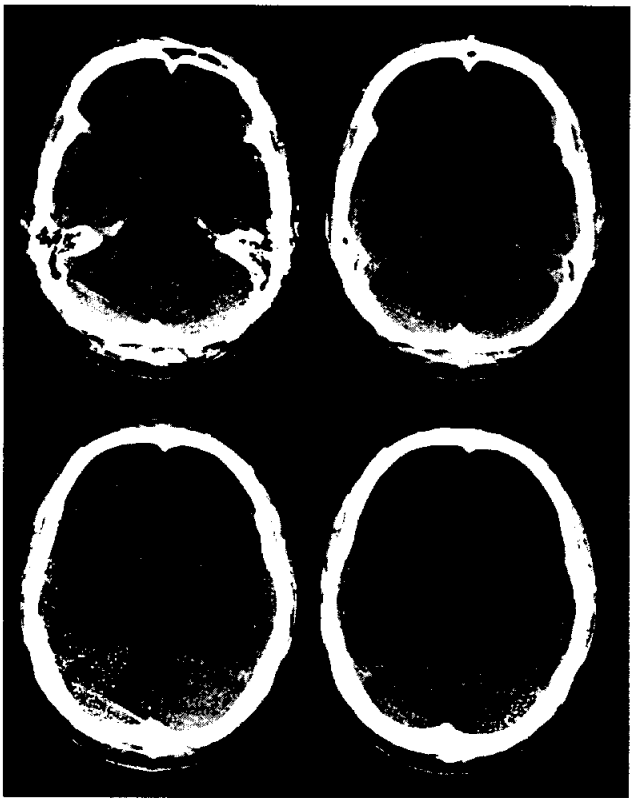
His antenatal and perinatal history had been unremarkable according to maternal report. He had normal developmental milestones and finished nine years of education, following which he worked as a hairdresser. There was no history of occupational exposure to heavy metal. His past health had been unremarkable and he denied any history of head injuries. There was no family history of neurodegenerative diseases.

The patient was well hydrated with average body build (height 1.75 m; weight 67.9 kg). On admission, he was confused and disoriented. After intravenous naloxone 0.4 mg, he regained full consciousness. No focal neurological signs could be elicited. A plain axial computed tomography (CT) scan showed prominent bifrontal cerebrospinal fluid spaces, prominent parafalcine sulcus anteriorly, prominent prepontine cisternae and large Sylvian fissures bilaterally (Fig 1). These atrophic changes were confined to the bifrontal and brainstem areas. The cerebellum and posterior temporal areas were normal. There was no dilatation of the fourth ventricle or cisterna magna, and the ventricles were normal in shape. The parietal cortical sulci were normal. There was grey and white matter differentiation, periventricular white matter appeared normal and there was no abnormal intracranial calcification. There was also no evidence of small infarcts in the corona radiata or in the basal ganglia. No fractures, cerebral haematoma, or contusion were seen.

Biochemical investigations, including thyroid function tests, VDRL and human immunodeficiency virus

(HIV) antibody tests were normal. Neuropsychological assessment was limited as the patient insisted on being discharged. However, his performance on the Rey complex figure test and Wisconsin card sorting test showed frontal lobe dysfunction (perseverative and organisational



errors) consistent with the CT scan findings. On followup, clinical features of frontal lobe dysfunction were observed, including impulsivity, inflexibility, and impaired executive function.

Fig 1. Plain axial computed tomography scan images at four levels showing prominent cerebrospinal fluid spaces at both the frontal lobes and anterior interhemispheric fissure. The Sylvian fissures and basal cisternae are also prominent.

Discussion

Cerebral atrophy can be caused by a variety of medical conditions. Of particular relevance to drug taking behaviour are alcoholism, repeated head injuries, neurosyphilis, HIV encephalopathy, and hypoxic brain damage. None of these conditions were present in our patient. Degenerative diseases are uncommon in this age group and his CT scan showed no evidence of leucodystrophy. The developmental and family history also made the possibility of degenerative pathology unlikely.

Widened cerebral sulci are possible in communicating hydrocephalus. However, our patient's CT scan did not show dilated fourth ventricle or dilated cisterna magna, and the ventricles retained their normal shape. Apart from the widened sulci, there was no other sign of hydrocephalus. It is therefore unlikely that our patient has communicating hydrocephalus or any other medical condition that may account for the brain atrophy.

It is known that some psychoactive substances can cause cerebral atrophy. A well-known example is alcohol. Its direct toxic effect, in conjunction with other factors (e.g. nutritional deficiency), can cause Wernicke's encephalopathy and alcoholic dementia. Widened sulci and enlarged ventricles are found in one-third to two-thirds of alcoholic patients.[1] Similarly larger ventricular/brain ratios are found in benzodiazepine users when compared with normal controls.[2] Cerebral atrophy has also been reported in young cannabis smokers.[3] However, there are no previous reports of heroin causing cerebral atrophy. A literature search, using computerised Medline and PsycLIT (1966 to 1994), was conducted and could not identify a single case of cerebral atrophy and heroin abuse.

In fact, Western literature may not be relevant because the drug scene and pattern of drug use varies across cultures and countries. For instance, the purity of street heroin in Hong Kong is approximately 50% whereas it is less than 10% in the United States. Heroin addicts in Hong Kong also tend to consume much higher doses of heroin compared with their Western counterparts. Our patient has been using high doses of heroin consistently for the past nine years. At the peak of his addiction, he was constantly intoxicated from using 1500 mg of heroin per day—50 times the lethal dose for a normal individual. As with alcohol or cannabis, prolonged high doses of heroin may exert a toxic effect on the brain, leading to cell death and cerebral atrophy.

Apart from direct neurotoxicity, there is evidence that heroin induces an autoimmune reaction against brain tissues.[4] Serum autoantibodies against brain antigens (human brain S100 protein, neurone specific enolase, and myelin basic protein) have been detected in heroin addicts.[4] Delayed hypersensitivity skin reactions to brain antigens were also observed in the same series of heroin addicts. Both the incidence of autoantibodies and delayed skin responses were positively related to the duration of abuse, supporting a causal relationship between heroin abuse and autoimmunity. Unfortunately, brain imaging was not included as part of the study.

Given the fact that an autoimmune reaction can cause cerebral atrophy (e.g. in systemic lupus erythematosus), it is possible that heroin may cause cerebral atrophy via an autoimmune reaction. Certainly, the evidence is preliminary and further investigations are needed.

Our patient has no medical conditions that may explain the widened sulci, leaving prolonged and heavy heroin use as the most likely explanation. Possible pathogenic mechanisms include neurotoxicity and an autoimmune process. Further investigations (e.g. a case control study) are needed to confirm the association between cerebral atrophy and heroin abuse as well as to elucidate the underlying pathogenic mechanism.

Acknowledgement

The authors would like to thank Dr J Ch'ien for commenting on the manuscript.

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