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Letter to the Editor

Detection of decreased striatal dopamine transporter availability by ^{123}I-FP-CIT SPECT in a patient of carbon monoxide poisoning with severe cognitive deficits but mild parkinsonian symptoms

Carbon monoxide poisoning (COP) causes acute (headache, dizziness and weakness) and delayed neuropsychiatric symptoms (parkinsonism, cognitive and personality changes, incontinence, psychosis and dementia) (Ernst and Zibrak, 1998). Based on the clinical similarity between the delayed neuropsychiatric symptoms of COP and Parkinson's disease, dopamine transporter (DAT) availability has been examined in COP patients using single photon emission computed tomography (SPECT) with ^{99m}Tc-TRODAT as a radiotracer (Yang et al., 2015; Chang et al., 2011). These studies show that COP patients exhibit lower DAT availability in striatum compared with controls, suggesting the importance of evaluating striatal DAT availability in these patients. This view is reinforced by a case report on a COP patient with impaired presynaptic dopaminergic activity in striatum as revealed by 6-[^{18}F] fluoro-L-dopa PET (Rissanen et al., 2010).

^{123}I-FP-CIT is a radiotracer for SPECT with rapid binding kinetics, and allows much earlier imaging after administration than other radiotracers (Ba and Martin, 2015). ^{123}I-FP-CIT SPECT has superior accuracy for early differential diagnosis of idiopathic parkinsonism and non-degenerative extrapyramidal disorders, as well as better sensitivity for the disease severity, compared to ^{99m}Tc-TRODAT SPECT (Van Laere et al., 2004). Therefore, we applied ^{123}I-FP-CIT SPECT to the imaging of striatal DAT availability in a patient with COP.

The case was a 43-year-old woman. She gave written informed consent for presenting her clinical course and treatment while she had no consciousness disturbance. She had no past history of physical and neurological disorders, and was not on any medication. One day, she was found unconscious after an attempted suicide by charcoal burning in a car. After 100% normobaric oxygen therapy for about 30 min, she was sent to our emergency unit. On admission, she scored 6/15 on the Glasgow Coma Scale (GCS), and her carboxyhemoglobin level was 10.8%. Magnetic resonance fluid attenuated inversion recovery image showed high-intensity in both globus pallidus, predominantly on the left side (Fig. 1). She was diagnosed as acute COP, and received 20 sessions of hyperbaric oxygen therapy. On the 7th day after the COP, her consciousness was improved to 15/15 on the GCS and 28/30 on the Mini-Mental State Examination (MMSE) without any neurological symptoms.

On the 22nd day, she began to display severe cognitive dysfunction (3/30 on the MMSE), masked face, mutism, gait disturbance, apathy, and urinary and fecal incontinence. She was not able to perform basic self-care such as food intake and toileting. The ^{123}I-FP-CIT SPECT scan showed a reduction of DAT availability in the bilateral striatum (Fig. 1). Based on a previous case report suggesting the efficacy of bromocriptine for neuropsychiatric symptoms of COP (Tack and de Reuck, 1987), she was given oral bromocriptine at a dose of 2.5 mg/day, and the dose was increased up to 7.5 mg/day. On the 98th day after the COP, she scored 28/30 on the MMSE, with no apparent neuropsychiatric symptoms, and could perform basic self-care.

Previous studies using ^{99m}Tc-TRODAT SPECT have shown that striatal DAT availability is decreased in COP patients, and the degree of decrease is related to the severity of parkinsonian symptoms (Chang et al., 2011; Sun et al., 2018). In the present case, ^{123}I-FP-CIT SPECT clearly detected decreased striatal DAT availability, despite its clinical signs, i.e., parkinsonian symptoms, were mild. This finding may be due to superior accuracy and better sensitivity of this radiotracer compared with ^{99m}Tc-TRODAT (Van Laere et al., 2004). This accuracy and sensitivity may make ^{123}I-FP-CIT SPECT particularly useful in predicting impaired cognitive function related to reduced striatal DAT availability (Yang et al., 2015) in patients with COP.

Comparative studies between hyperbaric oxygen therapy and normobaric oxygen therapy for COP have shown conflicting results, but there still is a possibility that the former is more efficacious than the latter for cognitive symptoms such as memory impairment and difficulty concentrating (Lin et al., 2018). Therefore, ^{123}I-FP-CIT SPECT may also be useful in comparing efficacies of the two treatments for COP.

As of 2012, ^{123}I-FP-CIT is available on a commercial basis in the United States, Europe and Korea, but not in other countries (Park, 2012). In Japan it is available from 2014 as an injectable syringe, which is manufactured and delivered by a pharmaceutical company (Nihon Medi-Physics Co. Ltd., Tokyo, Japan). The cost of ^{123}I-FP-CIT is relatively high compared with ^{99m}Tc-TRODAT (Van Laere et al., 2004; Park, 2012), but its introduction to clinical practice may be accelerated if reports on utility for various neuropsychiatric disorders including COP ensue.

Decreased DAT availability is considered to reflect dysfunction or degeneration of presynaptic dopaminergic neurons (Van Laere et al., 2004; Park, 2012; Ba and Martin, 2015). This phenomenon in COP may be ascribable to hypoxic damage to the basal ganglia which has limited vascularity (Rissanen et al., 2010). Alternatively, dopamine excess occurring in the acute phase of COP may induce destruction of dopaminergic synapses and nuclei (Park et al., 2014).

In the present case, ^{123}I-FP-CIT SPECT was performed only once, and neuropsychological tests focused on specific cognitive domains were not conducted. Therefore, detailed clinical utility of this imaging method for COP, e.g., associations with specific cognitive symptoms and ability to predict their improvement, should be clarified in further studies.

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Conflicts of interest

None.

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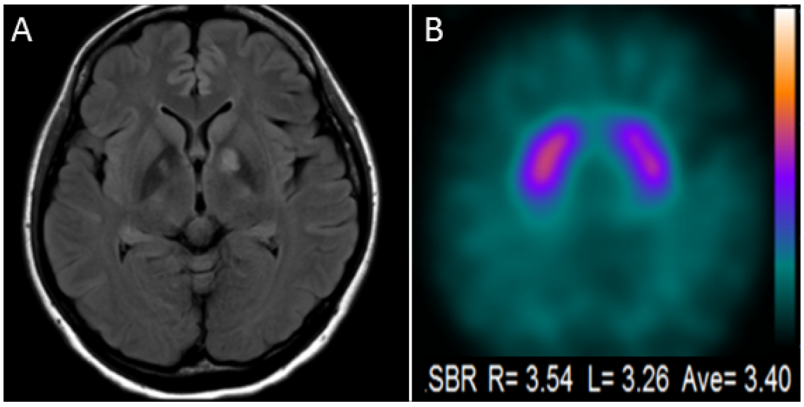

Fig. 1. Neuroradiological findings.
(A) Magnetic resonance fluid-attenuated inversion recovery image showing high-signal intensity in both globus pallidus, predominantly on the left side.
(B) ^{123}I-FP-CIT SPECT scan showing a reduction of DAT availability in the bilateral striatum.

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