

### Delayed Neuropsychiatric Sequelae of Carbon Monoxide Poisoning: A Case Report

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#### ABSTRACT

Delayed neuropsychiatric sequelae is an important condition which commonly occur during recovery from acute carbon monoxide poisoning. Typical presentation would be apathy, disorientation, amnesia, hypokinesia, bizarre behavior, insomnia and neurological manifestations such as gait disturbance, hypertonia and tremor. We report here a case of a man presented with delayed neuropsychiatric sequelae one month after the carbon monoxide poisoning in his suicidal attempt. He presented with the typical presentation and diagnosis confirmed with the MRI findings. His MRI showed abnormal signal in subcortical hemisphere white matter of both temporo-fronto-parietal-occipital regions along the insula and both globus pallidus. He was treated with Olanzapine, Fluvoxamine, Chlorpromazine and Levodopa and his condition slowly improved. It is important for clinicians to recognize the symptoms and risk factors to develop delayed neuropsychiatric sequelae in patients who previously had carbon monoxide poisoning.

**KEYWORDS:** Carbon monoxide, poisoning, suicide, neuropsychiatry

#### INTRODUCTION

Carbon monoxide poisoning as a suicide method is relatively uncommon in Malaysia. Available data reported that the rate for suicide by carbon monoxide poisoning accounted for less than 1% in Malaysia in 1995 and the figure remained the same in 2011 [1]. The health risks associated with carbon monoxide vary with its concentration and duration of exposure. The toxic effects range from subtle cardiovascular and neurobehavioral effects at low concentrations to unconsciousness and death after prolonged exposures or after acute exposures to high concentrations of carbon monoxide [2]. Many physicians and psychiatrists are unfamiliar with this form of poisoning and have difficulty in recognizing the neuropsychiatric sequelae especially when the presentation is delayed. Typical presentations of delayed neuropsychiatric sequelae would be apathy, disorientation, amnesia, hypokinesia, bizarre behavior, insomnia and neurological

manifestations such as gait disturbance, hypertonia and tremor [3-6]. In this case, we demonstrate a typical presentation of delayed neuropsychiatric sequelae following carbon monoxide poisoning. The patient had consented for his case to be reported here.

#### CASE PRESENTATION

A 41-year-old man, who was a divorcee with no known medical illness had presented to the hospital with a suicide attempt via carbon monoxide poisoning. He was found unconscious by his family, locked in a room and had charcoal burning in his room for an unknown period of time. He was intubated in the Emergency Department as his Glasgow Coma Scale (GCS) was 3/15 and had severe metabolic acidosis. CT Brain done on admission was normal. He was extubated after 3 days. The patient was diagnosed to have major depressive disorder and his main stressor was mounting gambling debts. The other differential diagnoses that we considered for him

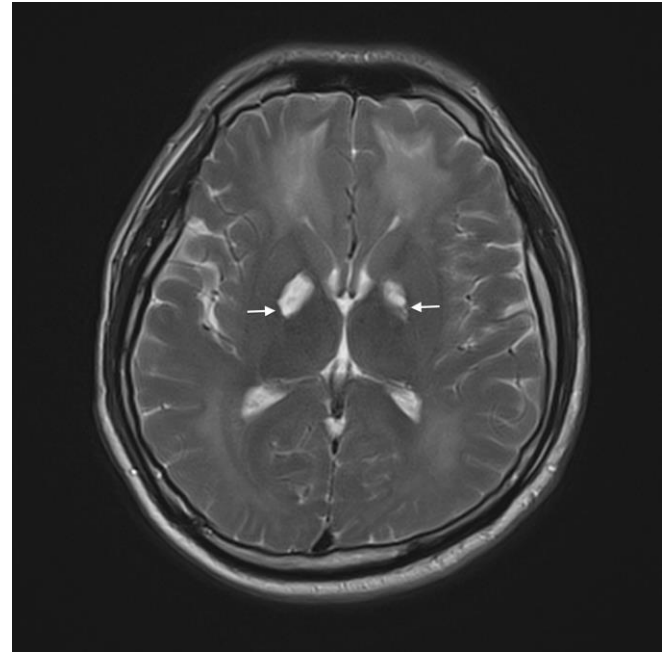
were adjustment disorder with depressed mood and bipolar disorder in depressive phase. He was started on an antidepressant Fluvoxamine 50 mg ON and subsequently discharged with outpatient follow up.

After discharged his cognition appeared to be slower than normal but still managed to return to work. One month later, he presented to Emergency Department with acute behaviour change for one day. There was no history of recent infection, fall or head trauma. He was unable to recognize family members, talking irrelevantly with disorganized behaviour and unable to care for self-hygiene. He was unable to unlock his mobile phone password, dressed 3 layers of pants with underpants on the outside, unable to remember where the toilet was, forgot how to feed himself and disorientated to time, place and person. Family also noted that the patient appeared restless, kept wiping his face with a piece of dry cloth and folded and unfolded his legs repetitively. He also had unsteady gait and rocking movements of his limbs and trunk.

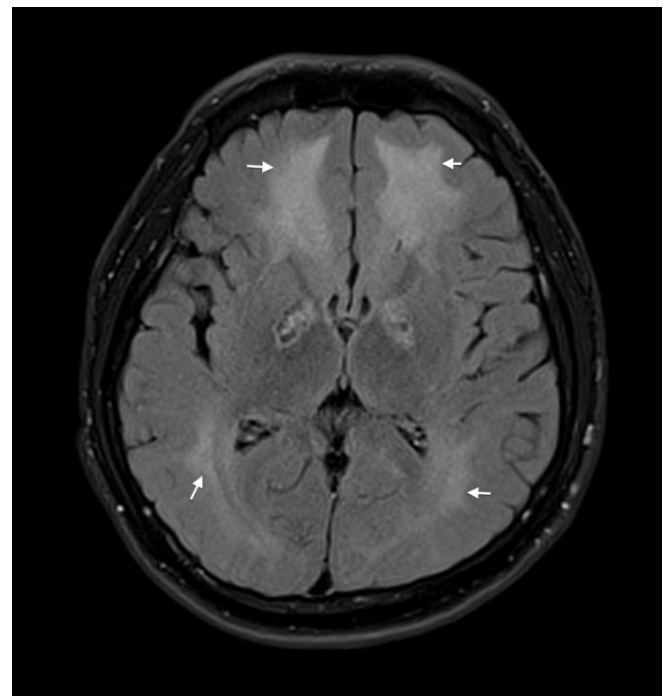
Neurological examination during admission showed that the patient was conscious and alert but restless. He was disorientated to time, place and person. There were involuntary alternating leg movements with his body thrusting up and down on his chair. There was unsteady gait but no choreathethosis movements. Both upper and lower limbs had normal tone and power. There was no muscle rigidity and his sensation was normal. All reflexes were normal and Babinski's sign was negative. Kernig's sign was also negative. There was dysdiadochokinesia. However, there was no other cerebellar signs. During his admission, full cognitive assessment was not done because patient was confused and kept moving.

In the ward, patient was able to obey command but unable to control his bowel. He remained disorientated even to his family members and had episodic involuntary movements of his limbs. He was bedbound during admission due to his unsteady gait. The blood investigations (full blood count, renal profile, liver function test, thyroid function test) revealed normal findings. The creatine kinase and lactate dehydrogenase levels were both within normal range. CT Brain done during the admission found two well-defined hypodense lesions at genu of both internal capsules. MRI brain was performed about 5 weeks after

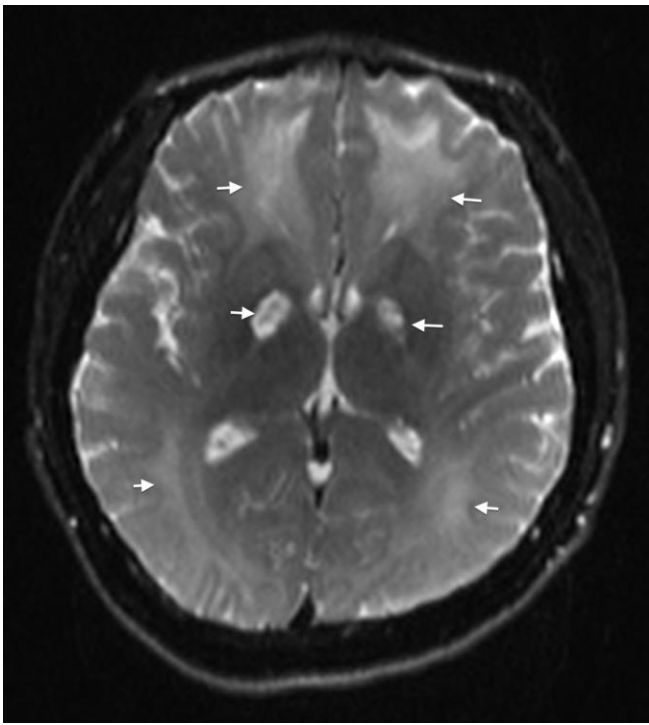
the CO poisoning. The MRI brain was reported as below (Figure 1, Figure 2, Figure 3 and Figure 4).



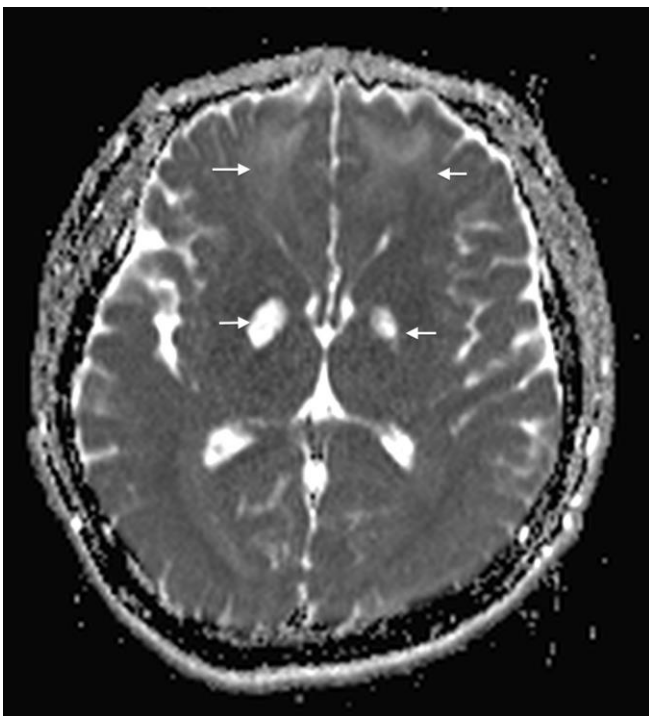
**Figure 1** T2-weighted MRI of the brain in axial view, showing abnormal high signal intensity of the white matter mainly at subcortical regions of both temporo-fronto-parieto-occipital lobes along the insula and globus pallidus (arrowed) of both internal capsule



**Figure 2** T2-weighted FLAIR of the brain showing abnormal high signal intensity at both temporo-fronto-parieto-occipital in the white matter subcortical regions along the insula and both globus pallidus (arrowed)



**Figure 3** Axial Diffusion Weighted Imaging (DWI) mapping showing symmetrical bilateral restricted diffusion in both cerebral white matter and both putamen (basal ganglia). Corresponding areas are bright on ADC (Figure 4) map, implying chronic ischemia



**Figure 4** Apparent Diffusion Co-Efficient (ADC) mapping corresponding areas to DWI as mentioned above (Figure 3)

In view of the history, these MRI features were consistent with carbon monoxide poisoning.

The patient was treated with T. Olanzapine 5 mg BD, T. Chlorpromazine 25 mg ON and T. Fluvoxamine 50 mg ON. He was reviewed by the neuropsychiatric team and found to be apathetic, hypokinetic with lack of verbal response. He had cogwheel rigidity elicited in both upper limbs. He was started on T. Levodopa to reduce his rigidity.

The patient's condition slowly improved over time. His last review 3 months later noted that he was no longer on wheelchair and was able to walk without support. He could speak normally and smiled, able to drive a car and was motivated to work again. He had sought alternative treatment like music therapy. He was not depressed and had stopped gambling. Mental State Examination showed that he was mildly rigid but had no other involuntary movements. He spoke in fluent Cantonese, coherent and relevant. His mood was euthymic with appropriate affect. There was no suicidal ideation. However, cognitive assessment showed impairment in the domains of memory and executive function.

## DISCUSSION

This case illustrated an example of delayed neuropsychiatric sequelae (DNS) of carbon monoxide poisoning by charcoal inhalation following a suicide attempt. The onset of the DNS in this patient started with gradual deterioration in his cognitive function followed by disorganized behaviour and development of movement disorders. He was also noted to have double incontinence and unsteady gait when he was admitted to the ward.

DNS following acute carbon monoxide poisoning is not commonly encountered in psychiatric services in Malaysia and there is no documented prevalence rate. From literature, there is usually a period of complete recovery ranging from 2-40 days with an average of 3 weeks following acute carbon monoxide poisoning [3, 4]. This period is subsequently followed by the emergence of neuropsychiatric symptoms. Those commonly observed are cognitive impairment, disorientation, apathy, psychosis, changes in personality, anxiety, mood lability, urinary or fecal incontinence, hypokinesia, hypertonia, gait disturbance and tremor [3]. Deterioration in the cognitive function, disorganized behaviour, movement disorders, double

incontinence and unsteady gait were amongst the common DNS symptoms reported and observed in this patient.

DNS following acute carbon monoxide poisoning has a wide range of reported incidence of 3-40% [3, 5-8]. Pepe et al reported that 24.1% incidence of DNS at 30 days from hospital discharge [5]. The risk factors that have been associated with the development of DNS include advanced age group, longer duration of exposure to carbon monoxide, delayed time in seeking treatment, duration of loss of consciousness, coma, early changes on head computed tomography (CT) or magnetic resonance (MRI) and grossly elevated CK, CKMB and LDH levels on blood investigations and severe metabolic acidosis [3, 5, 8-11]. In this patient, the risk factors to develop DNS were prolonged exposure to carbon monoxide, presented in coma and had severe metabolic acidosis. O'Donnell et. al reported that globus pallidus is the commonest site of abnormality in carbon monoxide poisoning [12]. In addition, signal abnormalities have also been reported at thalamus, caudate nucleus and putamen in carbon monoxide poisoning [12].

Gradual recovery of the DNS symptoms in the first months were reported in 75-100% of cases [13]. In our patient, his psychotic symptoms and neurological symptoms of hypokinesia, hypertonia, gait disturbance and tremor resolved with the initiation of Olanzapine and Levodopa. However, cognitive assessment during the last clinic follow-up indicated impairment in the domains of memory and executive function. There were no studies that clearly documented the recovery rate of cognitive impairment in DNS of carbon monoxide poisoning in our extensive literature search.

## CONCLUSIONS

This case illustrates the importance of doctors to recognize the risk factors for patients to develop DNS and aware of the common symptoms of DNS of carbon monoxide poisoning as it has a good prognosis with early detection and prompt treatment.

## Conflicts of Interest

Authors declare none.

## REFERENCES

1. Chang SS, Chen YY, Yip PS, Lee WJ, Hagihara A, Gunnell D. Regional changes in charcoal-burning suicide rates in East/Southeast Asia from 1995 to 2011: A Time Trend Analysis. *PLoS Med.* 2014; 11(4): e1001622
2. Raub JA, Mathieu-Nolf M, Hampson NB, Thom SR. Carbon monoxide poisoning -a public health perspective. *Toxicology.* 2000; 145(1): 1-14.
3. Choi IS. Delayed neurologic sequelae in carbon monoxide intoxication. *Arch Neurol.* 1983; 40(7): 433 - 5.
4. Min SK. A brain syndrome associated with delayed neuropsychiatric sequelae following acute carbon monoxide intoxication. *Acta Psychiatr Scand.* 1986; 73(1): 80-6.
5. Pepe G, Castelli M, Nazerian P, Vanni S, Del Panta M, Gambassi F, Botti P, Missanelli A, Grifoni S. Delayed neuropsychological sequelae after carbon monoxide poisoning: Predictive risk factors in the emergency department. A retrospective study. *Scand J Trauma Resusc Emerg Med.* 2011; 19(1): 16.
6. Thom SR, Taber RL, Mendiguren, II, Clark JM, Hardy KR, Fisher AB. Delayed neuropsychologic sequelae after carbon monoxide poisoning: Prevention by treatment with hyperbaric oxygen. *Ann Emerg Med.* 1995; 25(4): 474-80.
7. Weaver LK, Hopkins RO, Chan KJ, Churchill S, Elliott CG, Clemmer TP, Orme JF Jr, Thomas FO, Morris AH. Hyperbaric oxygen for acute carbon monoxide poisoning. *N Engl J Med.* 2002; 347(14): 1057-67.
8. Weaver LK, Valentine KJ, Hopkins RO. Carbon monoxide poisoning: Risk factors for cognitive sequelae and the role of hyperbaric oxygen. *Am J Respir Crit Care Med.* 2007; 176(5): 491-7.
9. Ku HL, Yang KC, Lee YC, Lee MB, Chou YH. Predictors of carbon monoxide poisoning-induced delayed neuropsychological sequelae. *Gen Hosp Psychiatry.* 2010; 32(3): 310-4.
10. Kudo K, Otsuka K, Yagi J, Sanjo K, Koizumi N, Koeda A, Umetsu MY, Yoshioka Y, Mizugai A, Mita T, Shiga Y, Koizumi F, Nakamura H, Sakai A. Predictors for delayed encephalopathy

- following acute carbon monoxide poisoning. *BMC Emerg Med.* 2014; 14(1): 3.
11. Raphael JC, Elkharrat D, Jars-Guinestre MC, Chastang C, Chasles V, Vercken JB, Gajdos P. Trial of normobaric and hyperbaric oxygen for acute carbon monoxide intoxication. *Lancet.* 1989; 2: 414-9.
  12. O'Donnell P, Buxton PJ, Pitkin A, Jarvis LJ. The magnetic resonance imaging appearances of the brain in acute carbon monoxide poisoning. *Clin Radiol.* 2000; 55(4): 273-80.
  13. Wolf SJ, Lavonas EJ, Sloan EP, Jagoda AS, American College of Emergency Physicians. Clinical policy: Critical issues in the management of adult patients presenting to the emergency department with acute carbon monoxide poisoning. *Ann Emerg Med.* 2008; 51(2): 138-52.