ABSTRACT

Background: Methanol is widely industrially used alcohol with known neurotoxic properties. Bilateral necrosis of basal ganglia is a typical finding detected on MRI or CT scan of the brain in acute methanol poisoning. The impact of methanol exposure on peripheral nervous system is unknown.

Aim: To study the prevalence and predisposing factors of haemorrhagic and non-haemorrhagic brain lesions in survivors of acute methanol poisoning; to investigate whether ^{123}I-ioflupane SPECT (DaT SPECT) has the potential as a marker of basal ganglia damage in acute methanol poisoning; to investigate the role of acute methanol exposure in the development of peripheral polyneuropathy (PNP) during the years following discharge from the hospital.

Methods: A six year prospective, single-centre, cohort study of patients with confirmed methanol poisoning was conducted. The examination protocol consisted of neurological examination, including magnetic resonance imaging (MRI) of the brain, DaT SPECT and electromyographic examination, further, visual evoked potentials, ocular examination with retinal nerve fiber layer thickness measurement, series of biochemical and toxicological tests. In 46 patients, follow-up examinations including brain MRI were performed 3–8 and 24–28 months after discharge from the hospital, in 42 patients brain MRI was performed four times during a six-year period and DaT SPECT was performed twice, 55 patients underwent electromyographic examination once to four times within the study.

Results: Of 46 patients (median age of 49 years, IQR 35–57 years, 37 males and 9 females), who underwent MRI examination, 24 (52 %) patients had a total of 40 abnormal brain findings with haemorrhagic lesions detected in 15 (33 %) and non-haemorrhagic lesions found in 9 (19 %) patients. The typical site of brain haemorrhage was the putamen but haemorrhagic lesions in the globus pallidus and the subcortical white matter were prevalent as well. The patients with haemorrhagic brain lesions were more acidemic (lower arterial blood pH, higher base deficit) and had higher glycaemia and lactacidaemia on admission than those without haemorrhages (all $p<0.05$). The long-term visual damage was present more often in the group of patients with haemorrhagic CNS lesions. Brain haemorrhage was found in severely intoxicated patients treated without systemic anticoagulant therapy, whereas treatment with high doses of heparin did not always result in haemorrhagic brain damage.

Forty-two patients (mean age 46.3±4.2 y; 8 females) underwent DaT SPECT twice. Volumetry was calculated in 35 of the patients assessed. The SBR for the left putamen was positively correlated with its volume. Correlations between SBR and the volume of the right putamen were significant only for the posterior putamen ($r = 0.386$, $p = 0.022$). A strong correlation was observed between the SBR of the posterior putamen and arterial blood pH ($r=0.574$; $p<0.001$) and other toxicological parameters of severity of poisoning including serum lactate, glucose, and creatinine concentrations ($p<0.05$). The SBR of the posterior putamen positively correlated with the global RNFL thickness ($p<0.05$).

Peripheral neuropathy was observed in 20/55 (36%) patients, in most of the cases mild axonal sensorimotor neuropathy. The patients with PNP were significantly older (57.3±5.3 versus 42.5±3.9 years; $p <0.001$), with higher blood glucose (5.93±0.97 versus 4.81±0.32 mmol/L; $p=0.035$) and lower vitamin B_1 (45.5±7.4 versus 57.5±5.2 ug/L; $p=0.015$) concentrations. The number of chronic alcohol abusers was significantly higher in the PNP group (18/20 versus 19/35; $p=0.005$). No association of PNP prevalence was found with acute parameters of poisoning severity – arterial blood pH, serum methanol and ethanol concentrations at admission (all $p>0.05$). No difference in the number of patients with visual (9/20 with PNP versus 12/35 patients without PNP, $p=0.431$) and CNS sequelae (9/20 with PNP versus 15/35 patients without PNP; $p=0.877$) of poisoning was present.

Conclusion: The prevalence of haemorrhagic lesions was higher than the prevalence of non-haemorrhagic ones. No association between brain haemorrhages and systemic anticoagulation during dialysis was found. ^{123}I-ioflupane SPECT (DaT SPECT) reflecting dopaminergic axonal dysfunction in the striatum demonstrates significant potential for the diagnosis of methanol-induced functional damage of the basal ganglia. No association was found between the prevalence of PNP and acute methanol exposure.

Keywords: Methanol poisoning; Long-term health sequelae; Basal ganglia lesion; Putamen necrosis; Brain haemorrhages; ^{123}I-ioflupaneSPECT; MRI-volumetry; Peripheral polyneuropathy; Electromyography.