Research in Pharmaceutical Sciences, 2012;7(5)
School of Pharmacy and Pharmaceutical Sciences
Isfahan University of Medical Sciences

Toxicity of Vanadium (V^{+5}) on isolated rat liver mitochondria

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Background and Aims: Vanadium is a trace element known to be essential for a number of species that is widely distributed on earth. It has been regarded as promising in therapeutic treatment of diabetes and cancer. According to the previous literature, mitochondria were proposed as an important target for vanadium accumulation. Aims: Therefore, the mitochondrial mechanisms involved in vanadium-induced liver toxicity were investigated using the isolated mitochondria obtained from rat hepatocyte.
Methods: Liver mitochondria were obtained using differential centrifugation and were incubated with different concentrations of vanadium (25-200µm.
Results: In model experiments with mitochondria, different mitochondrial toxicity factor and mitochondrial source of ROS formation using specific substrates and inhibitors were determined. In freshly isolated rat liver mitochondria, different concentrations of vanadium induced a dose-dependent progress in mitochondrial ROS formation, ATP depletion, GSH oxidation, mitochondrial potential collapse, mitochondrial swelling and cytochrome c release before the mitochondrial outer membrane rupture ensued. Our results showed that the vanadium interaction with respiratory complex III is the major source of vanadium-induced ROS formation. Our results also showed that different concentrations of vanadium significantly inhibited complex II activity.
Conclusions: In general, our data strongly supported that the vanadium-induced liver toxicity is the result of the metal disruptive effect on the liver cell mitochondrial respiratory complex II and III which are the obvious causes of metal-induced ROS formation and ATP depletion.

Keywords: Vanadium; Mitochondrial respiratory chain; Isolated mitochondria; Mitochondrial permeability transition