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Alterations in cardiac mitochondrial energy metabolism and oxidative stress following lactational lead exposure: Reversal effects of nutrient metal mixtures

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Exposure to environmental contaminant heavy metal lead (Pb) is known to affect cardiovascular system causing heart rate variability, a marker of poor cardiac health and vascular oxidative stress. Recent studies have shown that Pb even at relatively low level exposure has the potential to harm not only the young but also older people. In this study, we examined the alterations in cardiac mitochondrial enzymes of energy metabolism and the mitochondrial markers of oxidative stress. Rats were lactationally exposed to lead acetate (0.2%) and lead acetate together with a metal mixture containing 0.02% iron (Fe), calcium (Ca) and zinc (Zn) via drinking water of the mother. Cardiac tissue was dissected out and mitochondrial fractions were separated from young (PND45), older adults (12 months) and aged (24 months) rats for the studies on alterations in the sensitive markers of energy metabolism (succinate dehydrogenase-SDH, Isocitrate dehydrogenase-ICDH) and oxidative stress (catalase-CAT, glutathione peroxidase-GPx, Mn- superoxide dismutase-MnSOD, lipid peroxidation-LP). The activity of the mitochondrial enzymes increased with age reaching maximum in older adults (12 months) and showed a decrease towards old age. The LP levels however were found to be greater in aged rats compared older adults and young. Pb-exposure decreased the activities of all the mitochondrial enzymes in all the age groups where as the LP level increased following Pb-exposure. These Pb-induced alterations were greater in young rats compared other age groups. Supplementation of nutrient metal mixture containing Fe, Ca and Zn significantly reversed the effects Pb in all the enzymatic markers and LP levels in all the age groups with greater reversal effect in young rats (PND45) than the aging and aged. The risk of cardiac dysfunctions was old > older adult > young suggesting that aging and older subpopulations are more susceptible to Pb-induced cardiac toxicity. Further, the data also provide evidence for the therapeutic application of nutrient metal mixture containing essential metals Fe, Ca and Zn for protection against Pb-toxicity.