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Oxidative stress related to obesity: results in plasma and brain areas of obese Zucker rats

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Oxidative stress may be a consequence and/or cause of several pathologies, such as diabetes, metabolic syndrome (MetS) and cerebrovascular disease. Oxidative stress is also tightly bound to the physiological condition of obese individuals. The obese Zucker rats (OZRs), with a mutation in leptin receptors represent a model of type II diabetes mellitus, characterized by the simultaneous occurrence of obesity, hyperglycemia, hyperinsulinemia, hyperlipidemia and moderate hypertension similar to MetS. The present study has investigated oxidative stress alterations occurring in OZR compared to Lean Zucker Rats (LZRs) of 12, 16 and 20 weeks of age. Thiobarbituric acid reactive substance (TBARS), gluthatione-peroxidase (GPX) and superoxide dismutase (SOD) activity, oxidative state of protein and the expression of 8-hydroxy-2'deoxyguanosine (8-oxo-dG) as a nuclear marker, were evaluated in plasma and in various brain areas (frontal cortex and hippocampus) of rats at different age. OZRs were characterized by higher body weight, an increase of systolic pressure, glycemia, triglycerides and cholesterol values in comparison with age-matched LZRs. An age-dependent increase of these parameters was observed in OZRs. TBARS values were higher in plasma of OZRs at all ages. The SOD activity was decreased in plasma of OZRs whereas GPx activity did not show differences between lean and obese rats. Oxi-blot analysis showed an obvious increase of oxidative state of proteins on obese rats samples, particularly in the 20-weeks-old rats. In frontal cortex the TBARS values were higher in 20-weeks-old OZRs, but no difference was found in hippocampus. The enzyme activity decreased, whereas the oxidative status of protein increased in the brain of OZRs compared to age-matched LZRs. An increase of nuclear 8-oxo-dG immunofluorescence detection was revealed both in frontal cortex and hippocampus neurons of 20-weeks-old LZRs. These findings demonstrate an increase in lipid peroxidation, protein carbonylation and an alteration of enzyme activity, suggesting an increase of oxidative stress in plasma and in the brain of OZRs. These observations consistent with previous studies, confirm that the increase of oxidative stress is associated with metabolic complications in OZRs. In terms of practical consequences these data may help to better manage MetS progression and the correlations with neurodegenerative processes.

Keywords

Obesity; oxidative stress; brain; obese Zucker rats.