Pregnancy alters fatty acid metabolism, glucose regulation, and detoxification of the liver in synchrony with biomechanical property changes

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Abstract

Pregnancy places a metabolic burden on the body including the liver, which is responsible for ensuring adequate nutrition for the maternal and fetal systems. To gain a better understanding of liver adaptation, this study investigates metabolic shifts occurring in livers of pregnant rats. Metabolic capacities of the livers of pregnant and non-pregnant female Wistar rats were assessed using comprehensive metabolic models. Kinetic metabolic models were generated for each animal based on protein abundance data from proteomics analysis allowing for a subject-specific assessment of hepatic metabolic functions. Data are available via ProteomeXchange with identifier PXD050758. Additionally, tissue stiffness, viscosity, and water diffusion obtained from magnetic resonance imaging and elastography were correlated with metabolic capabilities to study the relationship between metabolic function and biophysical properties. Proteome profiling revealed differences in protein expression in the livers of pregnant and non-pregnant animals. Functional analysis showed significant variations in metabolic capacities. Livers of pregnant rats had reduced capacities in carbohydrate and fatty acid metabolism, along with altered urea synthesis. Additionally, there were associations between metabolic functions and biophysical properties highlighting potential links between changes in liver structure and metabolic capacities during pregnancy. In summary, our work reveals extensive hepatic metabolic changes in pregnant rats. The liver adapts its metabolic capacities to ensure whole-body metabolic homeostasis but may struggle to counteract nutritional challenges, such as hypoglycemia. The study, employing a personalized approach combining proteomics, kinetic modeling, and advanced imaging, sheds light on the intricate interplay between hepatic adaptations and medical imaging markers, providing a foundation for further investigations into the implications for maternal and fetal health.