Metabolomics fingerprint of chorionic villi in physiological state and chromosomal disorders during the first trimester of pregnancy

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Background: Placenta is constantly developing and these changes are accompanied by metabolic alterations. Metabolomics is one of the most powerful and promising approaches for the elucidation of the placenta metabolism, and metabolomic profiling of the placenta might help to explain physiological processes in normal pregnancy and pathological mechanisms as well, such as in chromosomal anomalies.

Aim: To investigate metabolic changes in chorionic villi (CV) occurring during the first trimester of pregnancy in both euploid and cases of abnormal chromosomes (Trisomy 21,13,18) by means of a metabolomics approach.

Methods: CV were collected from 21 women (13 controls and 8 chromosomal disorders). Samples were analyzed with 1H-Nuclear Magnetic Resonance (NMR), Gas Chromatography-Mass Spectrometry (GC-MS) and High-Performance Liquid chromatography (HPLC). Subsequently, multivariate statistical analysis was performed. The discriminant metabolites were used to identify the metabolic pathways most altered to better understand the metabolic changes occurring in euploid and chromosomally abnormal pregnancies.

Results: A Partial Least Square regression model was performed to test the correlation between fetal crown rump length (CRL) and the metabolic profile of chorionic villi in healthy pregnancies. Subsequently, Partial Least Square Discriminant Analysis (PLS-DA) model was performed to compared chorionic villi of healthy fetuses and fetuses with aneuploidy.

Polyols pathways and myo-inositol seem to have a fundamental role during the development of pregnancy and in chromosomally abnormal cases where an increased level of oxidative stress was found.

Conclusion(s): Metabolomics is a promising approach to investigate metabolic changes occurring in the first trimester of pregnancy in both normal and pathological conditions such as the presence of chromosomal anomalies, directly in chorionic villi samples.