Plasma metabolite profiling for S. haematobium biomarkers of infection in pre-school aged children in Shamva District, Zimbabwe

Herald Midzi, Thajasvarie Naicker, Arthur Vengesai, Emilia T. Choto, Petros Muchesa, Maritha Kasambala, Tariro L. Mduluza-Jokonya, Victor Muleya, Elliot Nyagumbo, Donald Tafirenyika Kapanga, Lucy Mabaya, Francisca Mutapi and Takafira Mduluza

Abstract

Background: Metabolomics approaches are indispensable tools in infection biomarker discovery efforts as they shed light on the underlying pathophysiological mechanisms of disease. In this study, we analysed plasma metabolites that can be used as biomarkers of urogenital schistosomiasis in pre-school aged children below the age of five.

Methods: A case-control study was conducted involving 82 pre-school aged children that were age- and sex-matched. Urine samples were collected for three consecutive days to detect S. haematobium infection using urine filtration. Blood samples were also collected and processed to obtain plasma. Beckman Coulter AU480 chemistry analyser and commercial metabolite kits were used for profiling biomarkers in plasma samples. Descriptive statistics and MetaboAnalyst tool, were used for metabolite analysis. For the determination of diagnostic efficiency of plasma biomarkers, the area under the curve (AUC) was calculated from receiver operating characteristic curves at 95% CI.

Results: Succinic acid, glucose-6-phosphate, phosphatidylcholine, alanine and creatinine levels in plasma were significantly associated with urogenital schistosomiasis ($p<0.005$) at the population level. Significant increase in concentration at 1.5-fold change (FC) threshold was highest for glucose-6-phosphate with FC value of 2.02 followed by creatinine, albumin and phosphatidylcholine. Creatinine was significantly downregulated with a FC value of 1.98. Of the six dysregulated metabolic pathways, glucose and sucrose metabolism were predominantly affected. Glucose-6-phosphate had the highest AUC (0.81), sensitivity (88.85%) and specificity (90.37%). Phosphatidylcholine and succinic acid also had AUC values greater than 0.7.

Conclusion: Urogenital schistosomiasis affects the energy-related metabolic pathways in pre-school aged children. Glucose-6-phosphate was identified as a potential indicator of infection at the population level. Furthermore, we recommend intensive validation of schistosome metabolite biomarkers.

Keywords: metabolites, plasma, biomarkers, S. haematobium, Pre-school aged children