Metabolomics for biomarker discovery in schistosomiasis: A systematic scoping review

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Abstract:

Background: Metabolomic based approaches are essential tools in the discovery of unique biomarkers for infectious diseases via high-throughput global assessment of metabolites and metabolite pathway dysregulation. This in-turn allows the development of diagnostic tools and provision of therapeutics. In this review, we aimed to give an overview of metabolite biomarkers and metabolic pathway alterations during Schistosoma haematobium and Schistosoma mansoni infections.

Methods: We conducted the review by systematically searching electronic databases and grey literature to identify relevant metabolomics studies on schistosomiasis. Arksey and O'Malley methodology for conducting systematic scoping reviews was applied. A narrative summary of results was conducted following the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for scoping review guidelines.

Results: Twelve articles included in the review identified 127 metabolites, whose concentrations were considerably altered during S. mansoni and S. haematobium infections. The metabolites were assigned to metabolic pathways involved in energy (34.6%), gut microbial (11.0%), amino acid (25.2%), nucleic acids (6.3%), immune proteins (8.7%) hormones (2.4%) and structural proteins/lipids (11.8%). Energy related metabolic pathways were the most affected during schistosome infections with metabolites such as succinate, citrate, aconitate and fumarate of the tricarbocylic acid cycle being significantly altered in organ, serum and plasma samples. Amino acid metabolism was also impacted during schistosome infections as phenylacetylglycine, alanine, taurine, 2-oxoisocaproate and 2-oxoisovalerate emerged as potent biomarkers. Elevated structural proteins such as actin, collagen and keratin concentrations were identified as biomarkers of liver fibrosis, a common pathological feature in chronic schistosomiasis infections. Hippurate was a major metabolite biomarker in the gut microbial related pathway.

Conclusions: The analysis of the literature revealed that energy related metabolic pathways are considerably altered during S. mansoni and S. haematobium infections. Therefore, their metabolites may provide biomarkers for diagnosis and prognosis in addition to providing therapeutics for parasitic infections. This scoping review has identified a need to replicate more schistosomiasis metabolomic studies in humans to complement animal-model based studies.