Assessment of urine metabolite biomarkers for the detection of S. haematobium infection in pre-school aged children in a rural community in Zimbabwe

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Abstract

Background

Early diagnosis of urogenital schistosomiasis is key to its control and elimination. The current gold standard microscopic examination techniques lack sensitivity in detecting light Schistosomiasis infections in pre-school aged children thus it is urgent to develop diagnostic tools that may be integrated into control programs. In this study, we evaluated the diagnostic performance of urine metabolite biomarkers using a chemical reagent strip in the detection of S. haematobium infection in pre-school aged children.

Methods

A case-control study was conducted involving 82 pre-school aged children that were age and sex matched. Urine samples were collected for 3 consecutive days and were evaluated using urine filtration gold techniques as the gold standard method. The samples were simultaneously measured for metabolite biomarkers specifically haematuria, proteins, ketones, nitrites, glucose, bilirubin and urobilinogen using chemical reagent strips. Pearson correlation test was used to measure the relationship between S. haematobium infection and the urine metabolite biomarkers.

Results

The diagnostic performance of urine biomarkers were correlated with the microscopic examination urine filtration technique. Haematuria ($r = 0.592$, $p = 0.0001$) and proteinuria ($r = 0.448$, $p = 0.0001$) were correlated to S. haematobium infection. Negative correlations with $p > 0.05$ were recorded for ketones and urobilinogen. Highest sensitivity was 65.9 % (CI, 49.4 - 79.9) for haematuria whilst protein (albumin) biomarker had a lower specificity value of 43.9 % (28.5 – 60.3). Inversely, highest sensitivity was 87.8 % (73.8 – 95.9) for proteinuria whilst haematuria had a lower sensitivity value of 82.9 % (67.9 – 92.8). The positive predictive values ranged from 57.7 % (41.6 – 72.2) to 79.4 % (65.5 - 88.7) whereas negative predictive values

ranged from 70.8 % (60.8 – 79.2) to 52.0 % (48.7 – 55.3). With respect to diagnostic efficiency, haematuria had a fair diagnostic performance with an area under the curve of 0.76 followed by proteinuria with proteinuria whilst the remaining metabolites fail discriminating ability with an area under the curve of <0.5.

Conclusion

Although haematuria and protein biomarkers in urine are moderately sensitive and specific, they are important morbidity indicators of urogenital schistosomiasis in pre-school aged that may be utilised during screening in schistosomiasis control programs. We recommend comprehensive analysis of biomarkers using metabolomics techniques to identify novel urine biomarkers.