Uric Acid Monitoring with Smartphone as Biosensor

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Uric acid (UA) is the purine metabolic product and has a relationship with many clinical diseases, such as gout, kidney disease and heart disease that can result in the high UA in the blood [1–3]. Many medical investigations have indicated that the rise of blood serum UA can cause cardiovascular disease [4]. Therefore, the monitoring of UA in blood is critical for evaluating the therapy of gout patient in a long time. The current screening method for clinically measurement of the blood UA is the uricase enzymatic approaches. The working principle is based on that uricase oxidase (UOD) enzyme catalyzes blood UA decomposion into allantoin and then the difference in absorbance at λ=290nm of the enzyme catalyzed product has a linear relationship with UA concentration. However, the optics-based spectroscopic method requires bulky equipment and complicates sample pre-processing procedures, which cannot meet the need of point of care test (POCT). Electrochemical methods have been widely used in biomedical application because of its many merits, such as portability, low cost, easy integration, rapid analysis, one typical example-glucometer.

In this abstract, we demonstrate the world's first medical smartphone as an electrochemical analyzer, which is incorporated with the enzymatic test strip for point of care characterization of UA in peripheral whole blood. A disposable electrochemical uric acid test strip was connected to the electrochemical module integrated with the smartphone through the specific interface-a slot around the edge of smartphone. A 3 μL human peripheral whole blood drop is applied on the strip for UA characterization and compared to the clinical biochemical analyzer with satisfactory agreement. The proposed medical smartphone provides a mobile screening electrochemical station for point of care test of many biochemical parameters of human blood under flexible spot, which is a promising technology for meeting the urgent need of the mobile health application.

"A schematic view of the device design is illustrated in Figure 1. The measured result by proposed device as compared with the conventional clinical biochemical analyzer is shown in Fig.2. The relative standard deviations for all concentrations of UA was between 1.58% and 4.56% which are acceptable values for reproducibility in these device. Table I shows that UA concentrations measured by the medical smartphone reader were consistent with those by the commercial biochemical analyzer and that there was no significant difference among the three groups of UA test strips when measuring the same samples. These results indicates that the medical smartphone reader is highly reproducible and accurate for blood UA measurement suggesting a great potential for clinical use.

Word Count: <= 419

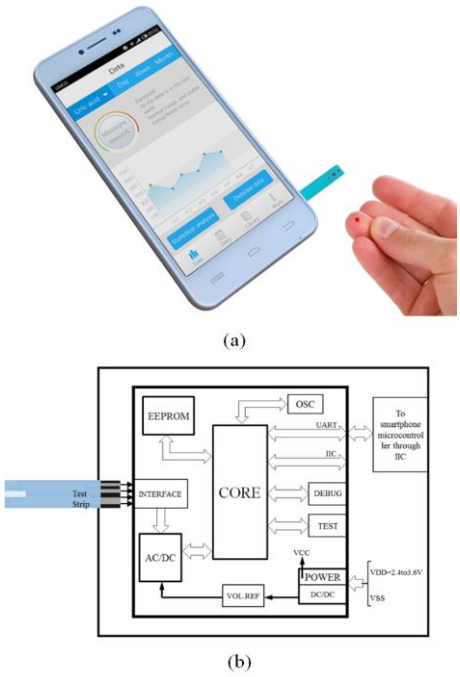

Fig. 1: (a) the photograph of the proposed medical smartphone in which an electrometer has been pre-buried. (b) Schematic structure view of the electrometer, a micro controller for resolving the electrochemical current formed in the test strip.

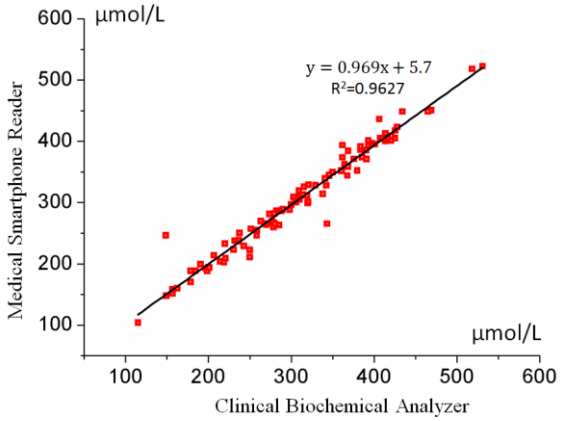

Fig. 2 Correlation analysis of UA concentrations measured by the medical smartphone reader and a clinical biochemical analyzer.

UA concentration	Test Strip #1			Test Strip #2			Test Strip #3		
	Sample number	Test Result (µmol/L)	CV(%)	Sample number	Test Result (µmol/L)	CV(%)	Sample number	Test Result (µmol/L)	CV(%)
UA (Low concentration)	30	229.43±10.47	4.56	30	237.63±9.16	3.85	30	232.73±9.06	3.89
UA (Mid concentration)	30	455.77±10.97	2.41	30	472.90±11.09	2.35	30	460.6±12.26	2.66
UA (High concentration)	30	749.57±11.86	1.58	30	761.60±13.95	1.83	30	747.23±16.44	2.20

Table.1 The reproducibility of UA measurement by the medical smartphone reader. Three different UA concentrations of blood samples were used for the test. Each blood sample was tested by three batches of UA test strips, 30 times each.. Inter and intra batch differences of UA test strips were calculated respectively.

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