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Design and fabrication of a centrifugal microfluidic disc including septum valve for measuring hemoglobin A1c in human whole blood using immunoturbidimetry method

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ABSTRACT

Diabetes mellitus is a global endemic with a rapidly increasing prevalence in both developing and developed countries. Recently, hemoglobin A1c has been recommended by the American Diabetes Associations as a possible substitute for fasting blood glucose for the diagnosis of diabetes, because it is an indicator of long-term glycemic control. Also, centrifugal microfluidic systems have good potential for use in the point of care testing systems. In this study, a centrifugal microfluidic disc was designed and manufactured to measure hemoglobin A1c in whole blood using an immunoturbidimetry based method. Also, a new passive valve, named septum valve, was presented to precisely control the entry and exit of reagents. This design comprises three inputs for injection of reagents and a blood sample, three septum valves, a two-part mixing chamber and a chamber to measure the absorbance of the sample based on the immunoturbidimetry method. Fourteen blood samples were tested using the manufactured disc, and the results were very congruous with the clinical data. By using the designed centrifugal microfluidic disc, the hemoglobin A1c in whole blood was measured in 8 minutes, with a standard deviation of ± 0.36 % HbA1c.

Graphical Abstract

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