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Identification of oxygen-18 isotope of breath carbon dioxide as a non-invasive marker to distinguish type 1 and type 2 diabetes

Mr Chiranjit Ghosh[1], Mr Santanu Mandal[1], Dr Prabuddha Mukhopadhyay[2], Dr Shibendu Ghosh[2], Dr Manik Pradhan[1]

[1]Satyendra Nath Bose National Centre For Basic Sciences, Kolkata, India, [2]Vivekananda Institute of Medical Science, Kolkata, India

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Background: There is a pressing need to develop a new and an effective strategy for early detection of type 1 diabetes (T1D) and to precisely distinguish T1D from type 2 diabetes (T2D). The aim of the present study was to find out the potential link between the erythrocytes carbonic anhydrase (CA) activity and oxygen-18-isotopic exchange of breath carbon dioxide in T1D and T2D.

Methods: Fasting and post-dose breath and blood samples were collected simultaneously after ingestion of 75-gm normal glucose in 150-mL water. Blood samples were analysed to measure the CA activity. The breath samples were utilized to measure the carbon dioxide isotopes by a laser based high-precision carbon dioxide isotope analyzer.

Results: The CA activities are markedly altered during metabolism of T1D and T2D and this facilitates to oxygen-18 isotopic fractionations of breath carbon dioxide. T1D exhibited considerable depletions of oxygen-18 isotopes of carbon dioxide, whereas T2D manifested isotopic enrichments of oxygen-18 isotopes, thus unveiling a missing link of breath oxygen-18 isotopic fractionations in T1D and T2D. The optimal diagnostic cut-off points were determined to be $\delta DOB18O‰ = 2.1‰$ and $\Delta CA = 3.15$ U/min/mL for screening T1D and T2D individuals.

Conclusions: Our findings suggest the changes in erythrocytes CA activities may be the initial step of altered metabolism of T1D and T2D, and breath oxygen-18 isotope regulated by the CA activity is a potential diagnostic biomarker that can selectively and precisely distinguish T1D from T2D and thus may open a potential unifying strategy for treating these diseases.