

A vital test for spinal muscular atrophy

A new chip-based sensor could detect and monitor spinal muscular atrophy faster and more cheaply than current methods.

Spinal muscular atrophy (SMA) is a hereditary disease that affects around 1 in 6,000 newborns, with symptoms including weakness, difficulty moving, bone problems and impaired breathing. The more severe forms of the illness are a cause of infant mortality, yet laboratories still lack a simplistic method to diagnose it. The disease results from a mutation to the ‘survival motor neurone’ (SMN) gene, causing a significant decrease in the expression of SMN protein.

A Saudi research team led by Mohammed Zourob, of Alfaisal University and King Faisal Specialist Hospital and Research Center, has now developed a chip-based assay that has no moving parts, requires no reagents after construction, and can be screen-printed at low cost.

Clinicians diagnose SMA through genetic testing, and investigations currently look for the illness by quantifying SMN protein levels in blood samples. However, these techniques are expensive, time-consuming, and involve complex steps and equipment.

The chip produced by Zourob’s team consists of carbon nanomaterial electrodes, which are modified to enable the attachment of SMN-specific antibodies on the electrode surface. When a patient’s blood is applied to the sensor, the antibodies bind the protein of interest, which in turn produces an electrical signal that can be detected and recorded. The greater the concentration of SMN protein, the greater the magnitude of the signal’s peak.

In developing the biosensor, the researchers first trialed six different kinds of carbon nanomaterials. “We were looking for the carbon nanomaterial that

gives the best response signal and with the best selectivity for SMN protein,” explains Khalid Abu-Salah, co-author of the team’s *Biosensors and Bioelectronics* paper. Biosensors were produced from the six different candidates, and the response recorded after adding SMN protein to the electrodes. To check the specificity of the sensors, responses were also measured after adding other physiological proteins to the chips.

Abu-Salah and his colleagues found carbon nanofibre to be the highest performing nanomaterial in their study, able to specifically detect SMN protein even at lower concentrations than a

more complex, commercially available assay kit.

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“This technique will benefit the clinic by providing a highly sensitive biosensor for SMN protein detection and quantification,” he adds. Looking to the future, the team is looking for corporate partners to help move their biosensor from bench to business and into clinics, where it can provide vital assistance to those suffering from SMA.

Eissa, S., Alshehri, N., Abdel-Rahman A. M., Dasouki, M., Abu-Salah, K. M., Zourob, M. Electrochemical immunosensors for the detection of survival motor neuron (SMN) protein using different carbon nanomaterials-modified electrodes. *Biosensors and Bioelectronics* **101**, 282–289 (2018).



With the advent of functionally-engineered carbon nanomaterials, biosensors to detect disease-related proteins may become a mainstay of diagnostic medicine