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(UG) (POS-24) Toward the development of a rapid diagnostic test for bacterial meningitis using laser-induced breakdown spectroscopy

Tuesday 28 May 2024 18:15 (2 minutes)

Bacterial meningitis is a life threatening disease resulting from the bacterial infection of the meninges, which are the layers protecting the brain and spinal cord. The bacteria that cause this affliction can be diagnosed via a spinal tap where a sample of the patient's cerebrospinal fluid (CSF) is taken and tested for bacteria. Currently, it can take up to three days to receive positive test results. Without swift diagnosis, this illness can progress to the point of irreversible brain damage and, in severe cases, death.

To address this issue of long diagnostic wait times and the corresponding prescription of inappropriate broad-spectrum antibiotics, the use of laser-induced breakdown spectroscopy (LIBS) as a rapid diagnostic is being investigated. LIBS can be performed very quickly and with minimal sample preparation. This technique can provide a rapid and accurate pathogen diagnosis by ablating a target specimen and measuring its elemental composition. During the ablation process, a high-temperature microplasma is created. The atomic emission from the plasma is collected and dispersed using a high-resolution Echelle spectrometer to produce a broad-band elemental emission spectrum. The ratios of the elements measured have been shown to be unique to a variety of bacterial species. This technique has been used in the past to successfully detect the presence of bacteria in clinical specimens of blood and urine as well as to differentiate between four different species of bacterial pathogens in these fluids.

In the current work, artificial cerebrospinal fluid (aCSF)—a safe and synthetic fluid with ionic concentrations that mimic clinical CSF—was used. LIBS spectra were obtained from aCSF alone and compared with LIBS spectra acquired from aCSF into which known aliquots of several bacterial pathogens which may include *Staphylococcus aureus*, *Escherichia coli*, *Steptococcus mitis*, *Mycobacterium smegmatis*, and *Enterobacter clocae* were added. The computerized chemometric algorithms and machine learning techniques used to classify the resulting spectra will be presented. The overall sensitivity and specificity of the diagnostic test will be discussed, as will the overall ability of the diagnostic to accurately identify the bacteria in the aCSF.

Keyword-1

LIBS spectroscopy

Keyword-2

Bacteria

Keyword-3

Cerebrospinal fluid

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