

Can Magnetic Resonance Imaging (MRI) Differentiate between Gram-positive and Gram-negative Bacteria Species in Human Blood?

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Bacterial infection of the human blood is a very common cause of illness and death. Rapid and accurate identification of the infectious agents is critical for proper antibiotic selection. The purpose of this project was to evaluate whether Magnetic Resonance Imaging (MRI) can differentiate between Gram-positive and Gram-negative bacteria species in human blood. In order to conduct this experiment, this student obtained bacterial cultures of *Escherichia coli* K12 (Gram-negative), *Rhodospirillum rubrum* (Gram-negative), *Bacillus subtilis* (Gram-positive), and *Micrococcus luteus* (Gram-positive) from Carolina Biological Supply Company, Burlington, NC. The bacteria were cultured, suspended in normal saline and diluted to a concentration of 6×10^8 /ml. Nine test tubes of blood from the student researcher, each tube containing 3 ml of blood. The blood was then mixed with 1 ml of the bacterial suspensions. The test tubes containing different types of bacteria/blood mixtures or the controls were then scanned using a Siemens 1.5 Tesla Magnetom Symphony MRI machine with 12 MRI pulse sequences designed to detect the chemical difference between Gram-positive and Gram-negative cell walls. The MRI signal intensity values were measured using a DR PACS (Picture archiving and communication system) computer. The data were analyzed using Microsoft Excel statistical software. In conclusion, FS-T1 and FS-T2 MRI sequences can differentiate between Gram-positive and Gram-negative bacterial species in human blood and in normal saline. Since this project was the first attempt of using MRI for rapid and accurate bacterial identification in human blood, these findings could potentially generate a major impact on future clinical practice with continued research.

Awards Won:

Spectroscopy Society of Pittsburgh: Honorable Mention