Contact: Joseph DiGiovanni
Senior Communication Specialist
(414) 288-6712 – office
(414) 313-7880 – mobile
Joseph.DiGiovanni@marquette.edu

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EPR SPECTROSCOPY DETECTS DISEASE FOR THE FIRST TIME: FINDS ABNORMALITIES IN MITOCHONDRIA

Process could have significant role in diagnosing mitochondrial diseases

MILWAUKEE – Electron paramagnetic resonance (EPR) spectroscopy for the first time has been used to directly detect and characterize disease. EPR of muscle and liver biopsy tissue detected abnormalities in mitochondria, the compartments found in cells that create most of the energy needed by the body to sustain life, the chair of Marquette University's Physics Department reported in a study published this month.

The study, written by Dr. Brian Bennett and colleagues at the Medical College of Wisconsin/Children's Hospital of Wisconsin and University of Colorado, was published in the March edition of *Free Radical Biology and Medicine*. Bennett showed that EPR can detect how the respiratory chain is affected by mitochondrial disease, and the team propose a significant role for EPR in diagnosing and studying the disease.

Mitochondrial diseases in children often are fatal if not diagnosed early, Bennett said.

"This study shows that there is strong potential for EPR to be used as a diagnostic tool," Bennett said. "EPR is quick, uses rapidly frozen fresh tissue, and strongly augments existing methods.

"EPR provides direct information on the status of the mitochondrion as it was in its functioning state," he said. "Other tests require significant sample processing that destroys that time-dependent information."

Mitochondrial diseases are difficult to diagnose, and many of the children with the diseases are allergic to some anti-seizure medicines (valproate) and anesthetics (Propofol), Bennett said.

"Seizures are a symptom in some cases and administration of these medicines can be lethal," Bennett said. "So, it's very important that children with these diseases are properly diagnosed as soon as possible."

Bennett has more than 25 years of experience with EPR spectroscopy, a technique that measures the magnetic field-dependence of the absorption of electromagnetic radiation, and can provide information on the structure, oxidation state, (bio)chemical environment, and amount of distinct forms of matter.

“This is a remarkable discovery by one of the world’s foremost EPR spectroscopists,” said Richard Holz, Dean of the Helen Way Klingler College of Arts and Sciences.

Marquette’s Physics Department recently obtained a research-grade Bruker EMX EPR spectrometer and a National Science Foundation award to upgrade the instrument and provide cryogenic temperature control, expanding the research opportunities for physics and biophysics undergraduates, and investigators across campus.

The study was conducted using a rat model, developed by Dr. David Dimmock of the Medical College of Wisconsin/Children's Hospital of Wisconsin that approximates the human disease.

Bennett said the next steps scientists would take include developing new models to help distinguish the different types of the diseases, and translation of the technique to human subjects.

About mitochondrial diseases

Mitochondrial diseases result from the failure of mitochondria, specialized compartments found in every cell of the body except red blood cells. Mitochondria create more than 90 percent of the energy needed by the body to sustain life and support growth.

When they fail, less energy is created within the cell, causing cell injury and cell death. If it is repeated throughout the body, whole systems begin to fail and the life of the person is in danger.

The disease primarily affects children, but it is becoming more common in adults. Mitochondrial diseases cause the most damage to cells of the brain, heart, liver, skeletal muscles, kidney, and the endocrine and respiratory systems.

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