Opinion
Volume 13:10, 2022

Journal of
Nuclear Medicine & Radiation Therapy

ISSN: 2155-9619

Open Access

The Use of Nuclear Magnetic Resonance Spectroscopy in the Detection of Metabolic Inborn Defects

Mc. Carthy*

Department of Molecular Biophysics, University of Yale, New Haven, CT 06510, USA

Introduction

Nuclear Magnetic Resonance (NMR) is a powerful technique used in chemistry, physics and medicine to determine the physical and chemical properties of molecules. NMR spectroscopy exploits the magnetic properties of atomic nuclei, specifically the intrinsic property of spin. In this article, we will discuss the principles of NMR, its applications in various fields and the different types of NMR spectrometers available. NMR spectroscopy is based on the principle of nuclear magnetic resonance, which occurs when a sample is exposed to a strong magnetic field. Nuclei with an odd number of protons or neutrons possess an intrinsic magnetic moment, or spin. When placed in a magnetic field, the nuclei align themselves with the field, resulting in two energy states, each with a slightly different energy. The energy difference between these two states is dependent on the strength of the magnetic field and the nuclear properties of the atom [1].

Description

Magnetic resonance signals from multiple nuclei can be excited or received simultaneously, making it possible to acquire multiple nuclei simultaneously or rapidly interleaved. When compared to sequential multi-nuclear acquisitions, the advantages include a shorter total scan time and the ability to obtain additional information from heteronuclear data at the same time and in the same anatomical position. By providing a more comprehensive MR-based image of a transient state (such as an exercise bout), information content can be improved qualitatively. Additionally, image coregistration is benefited by combining non-proton MR acquisitions with 1H information (such as dynamic shim updates and motion correction). In vivo interleaved and simultaneous multi-nuclear MRI and MRS are the subject of this review. Brain and muscle are the most prominent clinical and research applications for this methodology, but other targets, such as the lung, knee, breast and heart, have also been the subject of studies. Multiple nuclei have been measured simultaneously in the liver and kidney, but only in rodents. A consistent nomenclature is suggested in this review to help make the terms used to describe this principle in the in vivo MR literature more understandable. An overview covers the fundamentals, the MR scanner's technical requirements and the various implementations, either by vendors of MR systems or research groups, from the beginning to the present. Future in vivo applications for interleaved multinuclear MR pulse sequences are identified, as are considerations regarding the required multituned RF coils and heteronuclear polarization interactions.

Nuclear Magnetic Resonance (NMR) spectroscopy has been utilized in numerous scientific fields and is increasingly being considered as a clinical tool. This review looks at how it can be used to diagnose inborn metabolic abnormalities (IEMs). Nearly 3% of the world's population suffers from IEMs, which can be caused by deficiencies in lipoprotein metabolism or in the synthesis and degradation of metabolites. Because it does not destroy or otherwise chemically alter the sample, NMR is a preferred method for comprehensive evaluation of complex biofluids like blood or urine. Additionally, NMR can provide a relatively unbiased overview of all compounds that are present. NMR has advantages, particularly for urine analysis, with respect to the ease of sample preparation and the reproducibility of results. Current newborn screening programs use other more sensitive methods, such as mass spectrometry. Because it provides information about the size and density of lipoproteins that cannot be easily obtained by other methods, NMR spectroscopy is particularly compatible with lipoprotein analysis. This information can assist clinicians in better managing dyslipidemic patients. In the future, we believe that NMR has great potential for expanding clinical diagnosis beyond IEMs.

When a radiofrequency pulse is applied to the sample at the resonance frequency, the nuclei are excited to a higher energy level and when the pulse is turned off, the nuclei return to their original energy state. During this relaxation process, the nuclei emit electromagnetic radiation, which can be detected by a sensitive radiofrequency receiver. The resulting signal, known as an NMR spectrum, is a plot of the resonance frequencies of the nuclei in the sample. NMR spectroscopy has a wide range of applications in various fields, including chemistry, physics and medicine. In chemistry, NMR is used to identify and characterize organic molecules, determine the purity of samples and study reaction kinetics. NMR is also used to determine the structure and conformation of proteins, nucleic acids and other biomolecules, which is essential for drug discovery and development.

In physics, NMR is used to study the properties of materials, such as their magnetic and electrical properties. NMR is also used to study the behavior of liquids and gases in porous media, such as rocks and soils, which is essential for understanding geologic processes and developing oil and gas reserves. In medicine, NMR is used in magnetic resonance imaging (MRI), which is a noninvasive diagnostic tool that produces detailed images of the human body. MRI is used to diagnose a variety of conditions, including cancer, neurological disorders and cardiovascular disease. MRI is also used to monitor the progress of treatment and to guide surgical procedures.

There are two main types of NMR spectrometers: continuous-wave (CW) spectrometers and pulsed Fourier transform (FT) spectrometers. CW spectrometers operate by continuously applying a radiofrequency pulse to the sample and detecting the resulting signal. These instruments are less expensive than FT spectrometers, but they are less sensitive and less versatile. FT spectrometers, on the other hand, use a series of radiofrequency pulses to excite the sample and measure the resulting signals. The signals are then transformed mathematically into a frequency domain spectrum. FT spectrometers are more sensitive and versatile than CW spectrometers and can be used to analyze a wide range of samples [2-5].

Conclusion

In conclusion, Nuclear Magnetic Resonance (NMR) is a powerful technique used in chemistry, physics and medicine to determine the physical and chemical properties of molecules. NMR spectroscopy exploits the magnetic properties of atomic nuclei and is based on the principle of nuclear magnetic

***Address for Correspondence:** Mc. Carthy, Department of Molecular Biophysics, University of Yale, New Haven, CT 06510, USA, E-mail: mc.carthy66@gmail.com*

Received: 28 September, 2022, Manuscript No. jnmrt-23-90705; **Editor Assigned:** 30 September, 2022, PreQC No. P-90705; **Reviewed:** 14 October, 2022, QC No. Q-90705; **Revised:** 20 October, 2022, Manuscript No. R-90705; **Published:** 28 October, 2022, DOI: 10.37421/2155-9619.2022.13.514

resonance. NMR has a wide range of applications in various fields, including chemistry, physics and medicine and is used in magnetic resonance imaging (MRI), which is a noninvasive diagnostic tool that produces detailed images of the human body.

Acknowledgement

None.

Conflict of Interest

None.

References

1. Ngwa, Wilfred, Omoruyi Credit Irabor, Jonathan D. Schoenfeld and Jürgen Hesser, et al. "Using immunotherapy to boost the abscopal effect." *Nat Rev Cancer* 18 (2018): 313-322.
2. Topalian, Suzanne L., F. Stephen Hodi, Julie R. Brahmer and Scott N. Gettinger, et al. "Five-year survival and correlates among patients with advanced melanoma, renal cell carcinoma, or non–small cell lung cancer treated with nivolumab." *JAMA Oncol* 5 (2019): 1411-1420.
3. Deng, Liufu, Hua Liang, Byron Burnette and Michael Beckett, et al. "Irradiation and anti–PD-L1 treatment synergistically promote antitumor immunity in mice." *J Clin Investig* 124 (2014): 687-695.
4. Hamid, O., C. Robert, A. Daud and F. S. Hodi, et al. "Five-year survival outcomes for patients with advanced melanoma treated with pembrolizumab in KEYNOTE-001." *Ann Oncol* 30 (2019): 582-588.
5. Badiyan, Shahed N., Michael C. Roach, Michael D. Chuong and Stephanie R. Rice, et al. "Combining immunotherapy with radiation therapy in thoracic oncology." *J Thorac Dis* 10 (2018): S2492.

How to cite this article: Carthy, Mc. “The Use of Nuclear Magnetic Resonance Spectroscopy in the Detection of Metabolic Inborn Defects.” J Nucl Med Radiat Ther 13 (2022): 514.