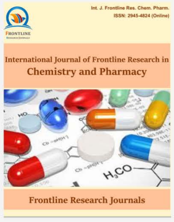
International Journal of Frontline Research in
Chemistry and Pharmacy
Journal homepage: https://frontlinejournals.com/ijfrcp/
ISSN: 2945-4824 (Online)



(Research Article)

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Successive infusion of $Mncl_2$ in order to analyze the image produced by MRI machines

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International Journal of Frontline Research in Chemistry and Pharmacy, 2022, 01(01), 032–036

Publication history: Received on 27 February 2022; revised on 02 April 2022; accepted on 04 April 2022

Article DOI: https://doi.org/10.56355/ijfrcp.2022.1.1.0005

Abstract

The use of MRI machines is a fast growing in the field of Medical Imaging. MRI machine operates on the principal of Nuclear Magnetic Resonance Imaging which can be explained by Quantum Mechanics or Classical Mechanics. Nuclear Magnetic Resonance Imaging is a process by which atomic nuclei containing protons and neutrons which are all inform of a magnetic field absorb and re-emit electromagnetic radiation. The energy of the emitted electromagnetic radiation is usually at a certain resonance frequency, which depends upon the strength of the magnetic field and the magnetic properties of the atoms. The resonance frequency produced is similar to radio frequency RF radiation, which when observed it produce a fine spectrum of anatomical structure of objects. MRI machines are currently used in hospitals and clinics to take the anatomical structures of the human body. And a wide variety of artifacts is routinely encountered on the images produced by this Machines. Manganese is a metal that was proposed to be use in NMRI machines, but due to it's toxic nature and it is a heavy metal, it is not use at all. But we are able to produce metallic chloride of Mn^{2+} which over comes the toxicity of metal and behaves like a metallic Salt in the human body. However, we are able to successfully infuse MnCl2 into a Rat and a Rabbit due to its unique properties in order to analyse the images produced by a MRI Machine. Conclusively, we are able to observe that $MnCl_2$ improves the images quality produced by the MRI Machine.

Keywords: Nuclear; Resonance; Toxicity; MRI

1. Introduction

In the year 1973, Paul Lauterbur present a seminar paper that was titled "Image formation by induced local interactions: examples employing nuclear magnetic resonance" which was later published. In the paper, the basic concepts of MRI was extensively explained. This concepts was used later in modern MRI. However, in the content of his paper a new type of medical imaging was proposed which depends one on the magnetic resonance frequency of water hydrogen atoms when an externally magnetic field gradient of same frequency is applied. At the time of Lauterbur's work, the notion to image water distribution seemed to be limited for medical applications because water density varied by only a small degree in tissues. However, by that time there were already results that demonstrated that magnetic resonance relaxation times of water were different in different tissues and might be altered by pathology [2]. Lauterbur used the well know ability of the paramagnetic ion, Mn^{2+} to alter the longitudinal relaxation time of water [1]. Today there are over 80 million MRI exams per year and approximately 25% rely on adding contrast [3].

However, there have been much interest to use Mn^{2+} to serve as a contrast agent in taking the anatomical images of animals. Whenever this method is developed it can be use or MRI of human beings. Though, the ability of Mn^{2+} to serve as an MRI contrast agent gives more possibilities for using Manganese Chloride ($MnCl_2$) to improve the images produced. A lot of research works has been performed showing the use of Mn^{2+} in order to improve the quality of images

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produced by MRI machines. However, we have reviewed this recent work using $MnCl_2$ and we are able to analyse the quality of images produced by MRI Machines.

2. Material and methods

2.1 Materials

The materials used in this research work was a 3 Tesla MRI Machine that was constructed by Siemens. This machine has an active shielded super-conducting magnet with an operational field strength of 3 Tesla (±10%) suitable for high-resolution structural imaging, functional imaging, diffusion imaging and spectroscopy. It also consist of a gradient system, with active shielding in X, Y, Z and other planes, that is capable of simultaneously achieving a maximum gradient strength of 80 milli Tesla/meter with a slew rate of 200 Tesla/meter/sec along each axis with a 100% duty cycle for full FOV. The MRI machine consists of a hardware and software that is capable to perform proton spectroscopy and multinuclear spectroscopy along with optimized sequences and software for post processing and evaluations. We also prepare $MnCl_2$ in a liquid form at room temperature and pressure. A suitable digital balance was also used. Few calibrated syringes where also involved in the research work. Finally, we are able to use a rat and rabbit of 350 grams and a rabbit of 1.35 kilograms.

2.2 Methodology

The method we used was a successive infusion of the $MnCl_2$ with a syringe and then injecting it into the two samples; which were the rat and the rabbit. However, we first all prepare the $MnCl_2$ in its liquid form at room temperature. We then test the $MnCl_2$ to make sure that it has completely changed to a metallic salt, by mixing it with a small fragment of concrete H_2SO_4 acid. Which after mixing the metallic salt and acid they eventually produced a base. This result confirmed that the $MnCl_2$ can be as metallic salt just like $NaCl_2$ (common salt). After we have prepared the $MnCl_2$, we then use a calibrated syringe. By putting 5ml of the $MnCl_2$ into the syringe. We then take our first sample which the rat and we measured it's weight using a digital balance. After the measurement, we then infused or rather inject the $MnCl_2$ into the sample and we recorded the time of the infusion. After 10 minutes of the infusion, we then introduced the sample into the MRI Machine and take the anatomical structure of rat brain. This method was also repeated to rabbit only that 10ml of $MnCl_2$ was administered into the rabbit because of its weight.

After 24 hours of the successive infusion of $MnCl_2$ into the rat and the rabbit. They were also administered into the MRI Machine to take their anatomical structure of the brain respectively. However, this method was successfully continued for 3 days. We are able to analyse the images produced by MRI Machine.

3. Results and discussion

Generally the use of $MnCl_2$ as a MRI contrast agent depend on giving or infusion of $MnCl_2$ and also monitoring its distribution in the tissues of our samples. But our major concern was to monitor how the $MnCl_2$ affected our samples before infusion and after infusion. Conclusively, after infusion $MnCl_2$, our samples were not affected at all before and after the infusion. However, at each instance of the infusion we took MRI images of the brain of our samples. Below is the MRI image of a rat brain after successive infusion of 5ml of $MnCl_2$ at an interval 4 hours respectively.

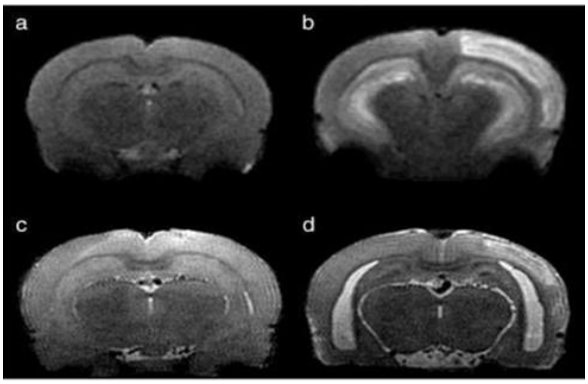

Figure 1 The MRI images of the rat brain after successive infusion of MnCl2.

However, after 24 hours the MRI image of the rat brain was taken and it was compared with the previous images. But the image produced was far better in contrast compared with the later images. Conclusively, after comparing the MRI images, it reveals that the successive infusion of $MnCl_2$ improves the image quality produced.

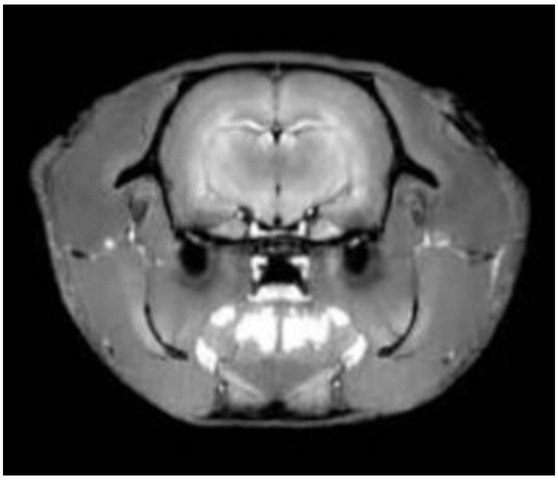

Figure 2 The MRI image of a rat brain after 24hours of successive infusion of MnCl2.

Similar procedure was conducted for the rabbit and the MRI images shows that the image quality was improved. This can be seen below.

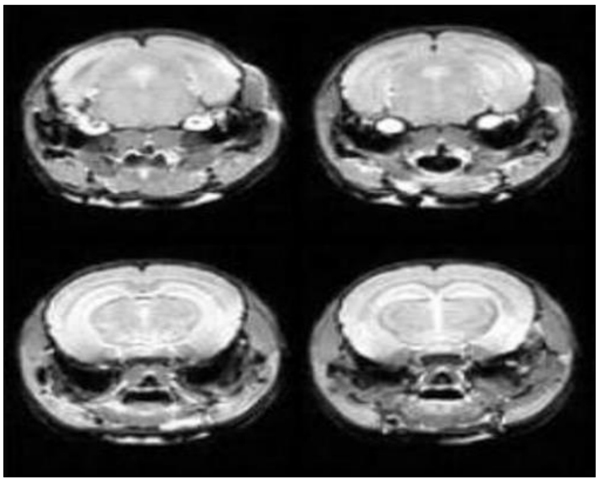

Figure 3 The MRI images of the rabbit brain after successive infusion of MnCl2

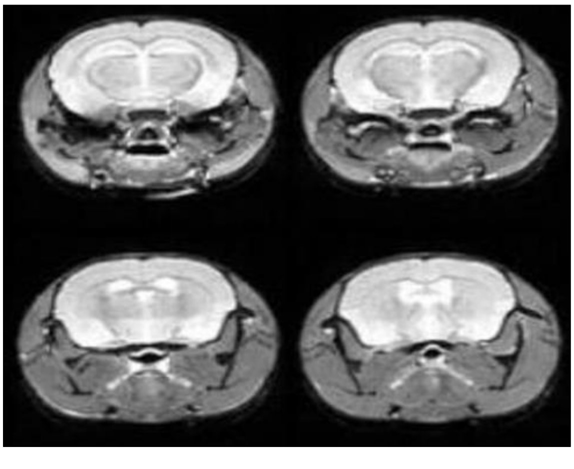

Figure 4 The MRI image of a rabbit brain after 24hours of successive infusion of MnCl2

4. Conclusion

Generally, most of MRI images when they are produced are often encountered with different artefacts. A lot of research have been done and more research are still on trying to find out methods on how to minimise this artefacts. In our research work we have use $MnCl_2$ which has served as a common salt and we have administered it dose into a rat and a rabbit by successively infusing it into the rat and the rabbit respectively. The images that were produced after successive infusion of $MnCl_2$ have a better contrast compared to those MRI images produced before the infusion of $MnCl_2$. However, we have also gradually monitored how the rat and the rabbit behaves before and after the successive infusion of $MnCl_2$.

Conclusively, the rat and the rabbit were not affected at all after infusing the dose of $MnCl_2$ into their bodies. Finally, after the successive infusion of $MnCl_2$ into our samples and their MRI images were taken, analysed and compared. The images produced have a nicer contrast. This means that the successive infusion of $MnCl_2$ improves the quality of images produced by MRI Machines.

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