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COMMENTARY

Safety considerations of using Gadolinium as a contrast agent for MRIs: A Commentary

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Narrative abstract: Gadolinium is a contrast agent that has been used in magnetic resonance imaging (MRI) for decades. It has historically been thought to be an innocuous substance that would be excreted from the body without any negative side effects. Emerging evidence is now suggesting gadolinium does have risks with patients that have renal issues, sensitivity to contrast agents, and it might persist after its use or have unintended cellular consequences. Regarding MRI diagnostics with the usage of contrast agents such as gadolinium, consideration of the risk benefit ratio is crucial and sometimes alternative options may be an important consideration.

Indexing terms: Chiropractic; Gadolinium; Risk-benefit; MRI

Introduction

Gadolinium is a contrast agent that has been used in magnetic resonance imaging (MRI) for decades. Its purpose is to create better contrast to search for findings that may not be seen with MRI alone. It has historically been thought to be an innocuous substance that would be excreted from the body without any negative side effects.

'... Renal function is a consideration in patients who may have undergone MRI scanning with the common contrast medium, Gadolinium...'

For consideration by a chiropractor

A chiropractic perspective is critical of the notion that a chemical substance injected into the body could be completely innocuous and research is beginning to reflect that. The first significant issue was its relationship to nephrotic toxicity so anyone with renal issues was cautioned against its use. (1) We are beginning to see other complications that suggest caution for patients even without renal issues and that the contrast agent might persist after its use or have unintended cellular consequences. (2, 3, 4, 5)

Attempts are being made to reduce the amount of gadolinium used with patient MRI procedures. For instance, recent studies are suggesting that distinguishing prostate cancer (PCa) from benign tissue might be possible with MRI with a low gadolinium-based contrast agent. (6) Also, it is possible that gadolinium dose can be reduced 10-fold while preserving contrast information and avoiding significant image quality degradation for study of brain tumours (e.g. glioma). (7)

With the advent of higher power Tesla MRIs, (e.g., 3.0T) there is hope that they will offer greater contrast and clarity and might mitigate the need for gadolinium. Even with 3T MRIs, contrast is

needed so alternatives to contrast agents are being explored. On a 3T MR unit, preliminary studies suggest arterial spin labelling as an appropriate alternative to dynamic susceptibility contrast-enhanced MRI when contrast medium is contraindicated or intravenous (IV) injection is not possible. (8)

Sequences such as diffusion-weighted imaging (DWI) and multi-contrast MRI pulse sequences are beginning to offer promise for tissue characterisation without IV contrast agents. (9) Gupta et al. have found that brain MRI without contrast agent appears to be just as effective as the contrast-enhanced approach for monitoring disease progression in patients with multiple sclerosis (MS), Noncontrast MR imaging techniques, such as Diffusion tensor imaging (DTI)-based fractional anisotropy (FA), can assess MS lesion acuity without gadolinium. (10) Superparamagnetic iron oxide may also be another option for gadolinium-based contrast agents, and could be used safely in patients with bronchial asthma, renal dysfunction, or a history of contrast media allergy. (11)

Essentially, we can no longer look to gadolinium-based contrast agents as being completely innocuous. However, when alternatives are not adequate and a patient's life might be hanging in the balance, the risk associated with using gadolinium might not be as great as the risk of not using this contrast agent. Radiologists are attempting to screen patients who might have an adverse reaction to gadolinium. Therefore, a patient with a history of renal compromise and estimated glomerular filtration rate (eGFR) less than 30 mL per minute per 1.73 m2 is a relative contraindication for the use of gadolinium-based contrast agents. (12, 13)

In the mid 1990s Murphy et al. reviewed adverse reactions to gadolinium in 36 patients. They '*classified adverse reactions into four groups: mild nonallergic reactions (15 patients with nausea or vomiting), mild reactions resembling allergy (12 patients with hives, diffuse erythema, or skin irritation), moderate reactions resembling allergy (seven patients with respiratory symptoms), and life-threatening reactions resembling allergy (two patients with severe chest tightness, respiratory distress, and periorbital oedema*)'. (14) As we study patient adverse reactions to gadolinium, (15) we are finding that even pre-medicating patients who have a history of allergic sensitivity with corticosteroid and antihistamine may still not prevent allergic reactions. (16)

Conclusion

Regarding MRI diagnostics with the usage of contrast agents such as gadolinium, consideration of the risk benefit ratios is crucial. For patients with specific red flags such as renal compromise or history of sensitivity to contrast agents, safer alternatives should be considered. As further research is gathered about gadolinium's unintended deposition into cells (2, 3, 4, 5) a deeper exploration of less toxic options to increase contrast for MRI studies is warranted.

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