

Radiology and its relationship with the environment: rational use of intravenous contrast media

In magnetic resonance imaging (MRI), gadolinium-based contrast media (CM) are very useful and improve diagnostic accuracy in clinical situations such as detection, characterization and follow-up of tumors, infectious inflammatory lesions, as well as assessment of the activity of immune-mediated diseases such as lupus or multiple sclerosis, which has led to their use as intravenous CM increasing exponentially in recent decades. Nonetheless, how much do we know about what happens to gadolinium compounds once they have fulfilled their diagnostic function? Let us see: it is rapidly excreted in the urine without being metabolized and possibly a percentage of it can be deposited in some sites of the central nervous system such as the basal ganglia; it is known that it can produce systemic nephrogenic fibrosis in people with chronic renal failure, the incidence of which is low and decreasing thanks to advances in the creation of new gadolinium-based CM, such as macrocyclics, with a very low possibility of adverse reactions.

Wastewater receives this compound, which will remain in it even after treatment processes that do not provide a way to remove it. In other words, drinking water may contain traces of gadolinium, with risks of toxicity for fish and other organisms such as algae and oysters. Its potential teratogenic effect by altering the cell reproduction process has also been described. Contrary to what happens with radiopharmaceuticals -which, when their potential toxic effect became known, the treatment of waste, particularly urine, of patients who have received them was regulated-, the use of gadolinium-based compounds has not alerted the medical and environmental community as to the detection, control and creation of mechanisms to mitigate their toxic effects.

This fact should promote a universal policy for the responsible administration of CM only when definitely indicated. In conditions such as multiple sclerosis, the multidisciplinary groups leading the protocols for its diagnosis and control have set an example by showing that it is not required for its diagnosis and limit its use to the follow-up of the disease in particular situations, such as treatment modification. Similarly, the recommendations in the follow-up of brain tumors, where the use of CM is key, indicate that if the patient is in disease progression, periodic imaging controls are not required, except in patients who are undergoing research studies in the treatment of the disease.

This responsible and controlled use is the mission of radiologists, who can actively promote their non-use even if the treating physician indicates it. Does it improve the diagnostic certainty of a brain MRI indicated for headache or cognitive disorder? It is known that it is not required for the performance of arterial MR angiography and perhaps with the improvement in angiographic sequences, its use is absolutely not necessary in the diagnosis of lesions of venous origin.

As for iodine-based CM, their potential renal damage and the possibility of adverse reactions that can be fatal are known; the evolution of pharmacological science has reduced these effects. Regarding their relationship with the environment and their sustainable use, some reports show how traces of iodinated MC in wastewater can, when combined with some disinfectants, result in toxic iodinated disinfectant compounds, a situation that is less likely if pH conditions are alkaline. However, under normal conditions toxicity has not yet been demonstrated for levels of MCs found in water for human ingestion. As with gadolinium-based CM, wastewater treatment does not include methods to recover it.

Due to the shortage of iodinated contrast medium for clinical use that occurred during the pandemic and because of the war in Ukraine, the medical world learned to "save" contrast medium and these lessons - even without its shortage - are useful in the practice of sustainable radiology. Iodinated CM should be used only if it is truly useful for diagnosis. It is historical, but worth remembering, how excretory urography disappeared and today the diagnosis of urinary tract lithiasis does not require the use of CM.

The use of individualized doses according to the weight of each patient is a sustainable practice for iodized CM. The use of saline solution at the end of the injection makes it possible to reduce the quantity of CM while preserving the quality of the enhancement. Advances in CT technology, such as the development of iterative reconstruction techniques or dual-energy CT scanners, allow lower doses of CM to be used.

If multiple-use CM vials are used for daily work in a CT scanner, the waste involved in using smaller vials and discarding excess product will be reduced. It also reduces plastic, glass, paper and cardboard waste from drug packaging and has the additional advantage of reducing the costs of CM use.

Some studies, such as GREENWATER (1), promote the permanence of the patient who has received iodinated or gadolinium-based CM in the hospital institution for a period of time that allows the urine containing the highest concentration of the drug to be collected, to dispose of it properly.

An important point that motivated this editorial is communication with physicians and paramedics involved in the use of CM so that, upon learning of the risks to sustainability of their indiscriminate use, they are encouraged to engage in sustainable practices when formulating and using them and when disposing not only of their waste, but also of their packaging.

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Reference

1. Zanardo M, Cozzi A, Cardani R, Renna LV, Pomati F, Asmundo L, et al. Reducing contrast agent residuals in hospital wastewater: the GREENWATER studyprotocol. Eur Radiol Exp. 2023;7(1):27. https://doi.org/10.1186/s41747-023-00337-w.