

Contrast Medium: Gadolinium versus Iodine in patients with kidney problems

General Information

Contributors:

A/Prof Stacy Goergen

MBBS (Hons), FRANZCR, M.Clin.Epi

Ms Ann Revell, Dr Christine Walker

What is Contrast Medium?

Contrast media (sometimes called contrast agents or dye) are chemical substances used in medical X-ray, [magnetic resonance imaging \(MRI\)](#), [computed tomography \(CT\)](#), angiography, and occasionally [ultrasound](#) imaging.

Contrast media enhance and improve the quality of images (or pictures) so that the radiologist (a specialist doctor trained to interpret the images) can more accurately report on how your body is working and whether there is any disease or abnormality present.

Two commonly used contrast media are [iodine-containing contrast medium](#) and [gadolinium contrast medium](#). These are used for CT scanning or angiography and MRI, respectively.

The [radiologist](#) performing the procedure is responsible for deciding if contrast medium is needed and which contrast medium will provide the best images, depending on which part of the body is being scanned and the reason for the scan. This decision will be based on the information provided to the radiologist by your doctor or specialist on the referral form, such as your medical history and what your doctor or specialist thinks may be wrong with you.

Why do I need Contrast Medium?

X-ray or radiography is the imaging of body structures using X-ray beams that are absorbed by different parts of the body in different ways to create an image or picture and this includes CT scans (see [Computed Tomography \(CT\)](#) and [Plain Radiography/X-rays](#).) This makes different structures in the body look lighter or darker on the images, depending on what these structures are made of, i.e. soft tissue shows as dark grey and bone as light grey. This difference in how different parts of the body absorb and transmit the X-ray beam is called **contrast**.

MRI and ultrasound do not use radiation but also produce images of the body using a magnetic field, radiowaves, and sound energy, respectively. (see [Magnetic Resonance Imaging \(MRI\)](#)) and ultrasound scans use high frequency soundwaves (see [Ultrasound](#)).

The use of artificial contrast media enhances the contrast between different parts of the body. Contrast media is used to help distinguish between parts of the body that have a similar composition to provide a clearer image of how the body is working, or if there is any disease present.

With clearer images, the radiologist can provide your doctor with a more accurate diagnosis of your symptom or condition, to assist in deciding what treatment will be most appropriate.

Contrast media are not needed for every type of imaging test in order to obtain very high quality images. The radiologist will determine if the use of contrast will be helpful in your particular situation.

Where can I find information about Iodine and Gadolinium Contrast Media?

The Inside Radiology website contains information on both iodine (see [Iodine-containing Contrast Medium \(ICCM\)](#)) and gadolinium (see [Gadolinium Contrast Medium \(MRI Contrast agents\)](#)). The information includes details of the risks and benefits of having these contrast media.

This information sheet deals with their use in patients whose kidney function is much less than normal. This is more common in older people and those who are on dialysis or who have had kidney surgery or kidney disease in the past. Contrast media are regarded as generally very safe for patients with normal kidney function.

What do I need to know about having Gadolinium Contrast Medium versus Iodine Contrast Medium if I do not have normal kidney function?

If you have reduced kidney function for any reason (in other words, your kidneys are not working as well as would normally be expected), you need to be aware of possible increased risks that may be associated with contrast injections (either iodine based contrast or gadolinium based contrast).

These risks need to be balanced with the benefits of the contrast media providing imaging that may result in a more accurate diagnosis of your symptoms or condition. It is also true that minor abnormality in kidney function means very little risk with gadolinium or iodine contrast agents but as kidney function gets worse, the risk increases.

Gadolinium based contrast media can cause a condition known as Nephrogenic Systemic Fibrosis (NSF) in patients with reduced kidney function. On the other hand, unlike iodine containing contrast media, they do not have the potential to cause a condition known as Contrast Induced Nephropathy (which results in temporary and sometimes permanent reduction in kidney function to those with an already existing kidney problem). On average, NSF occurs in about 5 in every hundred people (5%) who have very severe kidney function

abnormalities and it is not seen in people with normal kidney function who have gadolinium. Permanent decrease in kidney function would be expected in about the same number of people with this severe level of abnormal kidney function if they had a moderate dose of iodine contrast, say for a CT scan or an angiogram.

The decision about whether you should have iodine based contrast media and a CT scan or gadolinium with an MRI or no contrast injection at all can be a difficult one if you have severely reduced kidney function. This decision is best made through discussion between you, your doctor, and the radiologist, and the risks versus the benefits of each of these options need to be considered for your particular situation. There is no right answer for everyone and it depends very much on your current problem and how this is best diagnosed and treated.

What are Nephrogenic Systemic Fibrosis and Contrast Induced Nephropathy?

Nephrogenic Systemic Fibrosis (NSF) (also known as Nephrogenic Fibrosing Dermopathy)

This condition is rare and, so far, has occurred *only* in people with severe kidney disease. No cases were reported prior to 1997. It causes swelling and tightening of the skin of the extremities and less often the trunk. It develops over days to weeks and may reduce movement of the joints. It can also cause damage to internal organs in rare cases. About 5% of people with the most severe level of kidney function reduction will get NSF after a gadolinium injection and less than 5% of these people (or 3 in every 10,000 people with severely reduced kidney function) will die of it. NSF is much more common with some gadolinium contrast agents than others and is more common after multiple doses of gadolinium based contrast media.

Improvements in kidney function, through kidney transplant or other measures, have been shown in some cases to result in remission of NSF but this is not always the case. Certain medical conditions and procedures can increase the risk of NSF in patients with kidney function impairment and these include: vascular procedures (e.g. dialysis fistula revision, angioplasty), those with thrombotic tendency (for example, deep venous thrombosis), and those with recent onset of acute kidney failure (including transplant failure) in the weeks before developing NSF.

The risk of contracting NSF should be seen in the context of how rare it is. On 8 June 2006 the U.S. Food and Drug Administration (FDA) issued a public health advisory indicating that 25 patients who had received a gadolinium compound (Omniscan (gadodiamide)) had developed NSF. All of these patients had kidney failure and of the 25 cases (reported by the Danish Medicines Agency) 20 of the cases were reported in Denmark and 5 in Austria. An updated warning from the FDA was issued in May 2007 and confirmed cases in association with other gadolinium compounds (Omniscan, Magnevist (gadopentetate dimeglumine) and Optimark (gadoversetamide)).

Patients at greatest risk were again identified as those with acute or chronic renal impairment. The risk is increased if a patient has multiple doses of gadolinium compounds.

It appears that the contrast agents Gadovist (Bayer Schering Pharma) Dotarem (Guerbet) and Prohance are associated with a much lower chance of NSF even in patients with poor kidney function, and so these are often used when it is felt that gadolinium administration is essential for diagnosis in patients with very poor kidney function. An example of this might be in a patient with cancer and neurological symptoms who needs a brain MRI to search for spread of the tumour, but who also has very poor kidney function. The use of gadolinium contrast in this situation makes it much easier in many cases for the radiologist to see evidence of early (metastatic) disease, i.e. where the cancer has spread from the original tumour to another part of the body. One of the agents listed above, that are known to be much lower risk in terms of causing NSF, may be used in this situation after explaining the risk versus benefit to the patient.

Contrast Induced Nephropathy

There is an increased risk of this condition occurring in patients with an already reduced kidney function. The risk is increased if a patient has large amounts of iodine containing contrast medium or multiple procedures using iodine containing contrast medium over a short period of time, i.e. hours to a few days.

It can result in temporary, prolonged or permanent worsening of kidney function which could result in the need for temporary or permanent dialysis in the most severely affected patients.

There is a clinical prediction rule available to estimate the probability of contrast induced nephropathy in a patient, based on risk factors.

PLEASE NOTE: If you have a kidney problem the radiologist is very likely to completely avoid using gadolinium or iodine if a diagnosis can be confirmed using another test or by performing a CT or MRI without gadolinium or iodine.

What are the comparative risks of Gadolinium Contrast Medium versus Iodine Contrast Medium in people with severely reduced kidney function?

Reference: Acta Radiologica (2007)

	Iodinated Contrast	Gadolinium Contrast
The risk of a severe allergic reaction occurring	1:100,000 of people having iodinated contrast	Less than 1:170,000 of people having gadolinium contrast.

	Iodinated Contrast	Gadolinium Contrast
The risk of renal failure if eGFR < 30 ml/min):	20-40% will get contrast induced nephropathy (CIN) 5% will experience permanent decrease in renal function	No risk
The risk of NSF if eGFR < 15ml/min):	No risk	5%
The risk of a missed diagnosis if contrast medium is not used:	If CT scanning is inferior to MRI for the particular symptom or disease, the consequences of a missed diagnosis from the scanning procedure need to be taken into consideration as a risk	If MRI is inferior to CT scanning for the particular symptom or disease, the consequences of a missed diagnosis from the scanning procedure need to be taken into consideration as a risk.
The effect of a patient receiving dialysis soon after gadolinium contrast medium is given, to reduce the risk of developing NSF:		
Haemodialysis	No effect	Reduces risk if performed fairly soon after the gadolinium contrast medium is given. Haemodialysis itself carries risks and unless the patient is already on haemodialysis the risks involved in starting haemodialysis probably outweigh the benefits.

	Iodinated Contrast	Gadolinium Contrast
Chronic ambulatory peritoneal dialysis (CAPD)	No effect	No significant effect at removing or reducing the amount of gadolinium in the circulation and tissues for many days.

Who can I speak to if I have I do not have normal kidney function and have been told I will need Gadolinium or Iodine Contrast Medium?

You can discuss the use of contrast media with your own doctor or specialist who is referring you for the radiology test. Talk to your doctor about the need for a kidney function test or any special medication you may need to take before having the test.

If you have any concerns you can also talk to medical staff where you are having the scan/procedure performed, i.e. the medical imaging technologist (radiographer) who will perform the scan, or to the radiologist (specialist doctor) who interprets the images and provides your doctor with a report.

Please note:
This information is of a general nature only and is not intended as a substitute for medical advice. It is designed to support, not replace, the relationship that exists between a patient and his/her doctor. It is recommended that any specific questions regarding your procedure be discussed with your family doctor or medical specialist

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