

Organisation of Health Care - Hypersensitivity Reactions

Hospital-based protocols

Develop hospital-based protocols on the safe use of contrast media (CM) describing (preventive) measures, workflow and responsibilities. Protocols should be available about

- The prevention of adverse reactions.
- Treatment of adverse reactions.
- Safety of gadolinium use.
- Contrast media extravasation.
- Safe use of catheters using power injectors.

A panel of various local experts should establish these protocols. The panel members will depend on the specific protocol (including a nephrologist, a (plastic) surgeon, an internal medicine specialist, a pharmacologist, a cardiologist, an allergology specialist and a radiologist). The referring physician is held responsible for analysing and giving notice of the patient's kidney function and hypersensitivity reactions to contrast media, instructing about the patient's medication, and the patient's after-care. And for taking blood samples for laboratory testing (tryptase levels) in case of moderate to severe hypersensitivity reactions to contrast media and for referring the patient to an allergy specialist in case of moderate to severe hypersensitivity reactions to contrast media. The physician responsible for the procedure should take the decision about contrast administration. Make agreements with the allergy specialist about the procedure for referral and testing for contrast media allergy. Actions can be delegated to others according to local rules and protocols.

Hypersensitivity reactions to contrast media and prevention

Have a description of preventive measures in patients with a previous allergic reaction, for outpatient and clinical patients. Appropriate patient information leaflets should be available, about the procedure and about the preventive measures. Including the instruction about not driving a car/motorcycle for 24 hours after administration of clemastine.

Workflow and responsibilities

Responsible person	Action and responsibility
Referring physician	Order procedure: contrast-enhanced CT, contrast-enhanced MRI or angiography / intervention Inform patient about procedure Assessment hypersensitivity reactions to contrast media Mention previous hypersensitivity reactions in the order Instruct patient about preventive measures Record severe hypersensitivity reactions to contrast media in allergy registry of the patient record Record all severe drug (including contrast media) adverse reactions at the National Pharmacovigilance Institute LAREB
Physician responsible for the procedure - Cardiologist/Radiologist/ Nuclear Medicine/ Radiotherapist	Check the order for the imaging examination/procedure Check previous hypersensitivity reactions to contrast media Determine examination protocol and the choice of intravascular contrast medium Determine prophylactic medication If there is disagreement about the examination order, consult the referring physician Order contrast medium and prophylaxis medication in patient record

	Record and authorize CM safety alerts in patient record Record all severe drug (including contrast media) adverse reactions at the National Pharmacovigilance Institute LAREB
Physician responsible for the procedure	Before and during examination/procedure: Check hypersensitivity reactions and prophylactic medication Check medication and contra-indications Administration of prophylactic medication Administration of contrast medium Recording prophylactic medication and contrast administration in patient record (name, concentration, volume) Recording presence of any hypersensitivity symptoms

Treatment of acute hypersensitivity reactions to contrast media

Have a description of measures in patients with an acute hypersensitivity reaction.

Appropriate patient information leaflets should be available, including the instruction about not driving a car/motorcycle for 24 hours after administration of clemastine.

Workflow and responsibilities

Responsible person	Action and responsibility
Management of department of the Physician responsible for the procedure - Cardiologist/Radiologist/Nuclear Medicine/Radiotherapist	Drugs (minimum requirement), equipment and protocol available in every room where contrast media are administered Crash cart in every department where CM are administered Telephone number rapid response team available Organisation of regular training of personnel dealing with contrast media in the management of hypersensitivity reactions to contrast media and other emergency situations.
Physician responsible for the procedure - Cardiologist/Radiologist/Nuclear Medicine/Radiotherapist	Check and stabilize patient Stop infusing contrast media Act according to type of reaction If applicable, call rapid response team Keep patient for at least 30 minutes after contrast agent injection in a medical environment After administration of clemastine, instruct the patient that is not possible/safe to drive a car/motorcycle for 24 hours Determine serum tryptase 1-2h after start of CM administration
Physician responsible for the procedure	Record contrast administration in patient record (name, concentration, volume) – see details below Record moderate and severe hypersensitivity reactions to contrast media in patient record (in allergy registry)
Referring physician	Take blood samples for laboratory testing (tryptase levels) in case of moderate to severe hypersensitivity reactions to contrast media

	Refer patient to allergy specialist in case of moderate to severe hypersensitivity reactions to contrast media AND elevated tryptase levels Record name contrast medium in consult order
Allergy specialist	Test contrast medium given to patient, which caused a hypersensitivity reaction, and alternative contrast media

Gadolinium Safety

Have a description of the safety of macrocyclic and linear gadolinium-based contrast agents (GBCA), nephrogenic systemic fibrosis (NSF), signs of gadolinium deposition, preventive measures and when to evaluate kidney function. Use always macrocyclic GBCA. For liver MRI the use of intravenous linear GBCA is allowed, because they are taken up in the liver and meet an important diagnostic need. For MR arthrography the use of intra-articular linear GBCA is also allowed.

Workflow and responsibilities

Responsible person	Action and responsibility
Referring physician	Order procedure: contrast-enhanced MRI Check laboratory results for eGFR value or determine eGFR If eGFR < 30 ml/min, be careful with gadolinium-based contrast agents
Physician responsible for the procedure - Radiologist	Check order procedure Check eGFR if available If eGFR < 30 ml/min consider indication Re-examine the need for the use of contrast medium with respect to an unenhanced study or other potential imaging modalities If there is no agreement on indication consult referring physician
Physician responsible for the procedure - Radiologist	Before and during procedure: Check eGFR Check contra-indications Administration of contrast agent Recording contrast agent administration in patient record (name, volume, concentration)

Contrast Media Extravasation

Have a description of measures in patients with extravasation of contrast media. Appropriate patient information leaflets should be available.

Workflow and responsibilities

Responsible person	Action and responsibility
Physician responsible for the procedure - Cardiologist/Radiologist/Nuclear Medicine/Radiotherapist	Clinical assessment of CM extravasation Treatment of non-severe extravasation injury If severe injury, consider a surgical consultation (if needed a plastic surgeon) Clear instructions to the patient to be aware of alarming symptoms Record CM extravasation and treatment in patient record Record contrast extravasation as a complication in the local reporting system

	Notify the referring physician
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Contrast injection via central catheters and ports using power injectors

Have a description of the use of various catheters and ports applicable in the hospital, where use of power injectors for contrast media is permitted.

Workflow and responsibilities

Responsible person	Action and responsibility
Management of department of the Physician responsible for the procedure - Cardiologist/Radiologist/Nuclear Medicine/ Radiotherapist	A (digital) protocol should be available in every room where contrast media are administered using power injectors

Exceptions:

Emergency patients/ procedures

In case of a major life-threatening medical condition, requiring rapid decision making including emergency imaging or intervention, determination of the eGFR and assessment of hypersensitivity reactions to contrast media can be postponed. If it is possible to wait a short time without harm to the patient, eGFR should be determined immediately. And assessment of hypersensitivity reactions should be done. When indicated, preventive measures should be taken before the administration of intravascular contrast medium.

Recording of hypersensitivity reactions to contrast media

Proper recording of any hypersensitivity reaction to CM is important, but the way of recording is not well standardized and often insufficient (Balfour, 2015; Deng, 2019).

It is mandatory that the physician responsible for the administration of the CM accurately records the following:

- The contrast agent name, dose (volume, concentration), and time of administration in the imaging report and in the electronic patient file.
- The patient symptoms (blood pressure, pulse, respiration rate, oxygen saturation, skin abnormalities), the treatment given, and the response of the patient to the treatment in the imaging report and in the electronic patient file.
- Any clinical follow-up and advice on need for future premedication in the imaging report and in the electronic patient file.
- Any results of consultation with a drug allergy specialist on future CM administration in the electronic patient file.
- All details of the reaction (blood pressure, pulse, respiration rate, oxygen saturation, skin abnormalities, tryptase levels 1 to 2 hours after start of reaction), in the hospital adverse events register (“complicatie registratie”).
- The presence of a documented allergy in the electronic patient file allergy registry (“allergie registratie”). This reporting should be based on the name of contrast medium.

If the adverse reaction to a contrast medium is severe or unusual, report all details of the reaction to the National Pharmacovigilance Authority (LAREB).

Patient information leaflets

Appropriate patient information leaflets on the various radiological examinations with contrast medium should be available. The occurrence of late reactions must be mentioned in these leaflets.

And indicate what patient should do, ask for advice at the hospital or consult their general practitioner.

In addition, appropriate patient information leaflets about preventive measures in patients with a previous allergic reaction, about treatment of acute hypersensitivity reactions to contrast media, and contrast extravasation should be available.

One should consider having these leaflets available in multiple languages.

Training of Personnel

It is important that personnel that work in departments where CM are administered to patients are regularly trained in the management of hypersensitivity reactions and other emergency situations. It has been shown that high-fidelity hands-on simulation training programs are more effective than other forms of training, such as didactic lectures or computer-based training (Ali, 2019; Parsian, 2018; Wang, 2011 and Wang, 2014). Checklists and visual aids can help personnel in accurate management of hypersensitivity reactions to CM (Gardner, 2018; Parsian, 2018).

References

- Ali S, Alexander A, Lambrix M, Ramakrishna R, Yang CW. High-fidelity simulation training for the diagnosis and management of adverse contrast media reactions. *AJR Am J Roentgenol* 2019; 212: 2-8.
- Balfour S, McCloskey J, Patel P, Xue X, Hershey B. Event documentation and transfer of care after severe contrast reactions. *J Am Coll Radiol* 2015; 12: 1069-1072.
- Deng F, Li MD, Wong A, Kowalski LT, Lai KH, Digumarthy SR, Zhou L. Quality of documentation of contrast agent allergies in electronic health records. *J Am Coll Radiol* 2019; 16: 1027-1035.
- Gardner JB, Rashid S, Staib L, Asch D, Cavallo J, Arango J, Kirsch J, Pahade J. Benefit of a visual aid in the management of moderate-severity contrast media reactions. *AJR Am J Roentgenol* 2018; 211: 717-723.
- Parsian S, O'Malley RB, Hippe DS, Bush WH, Bhargava P, Chen LE, Wang CL. A checklist manifesto: effectiveness of checklist use in hands-on simulation examining competency in contrast reaction management in a randomized controlled study. *AJR Am J Roentgenol* 2018; 211: W1-W12.
- Wang CL, Davenport MS, Chinnugounder S, Schopp JG, Kani K, Zaidi S, et al. Errors of epinephrine administration during severe allergic-like contrast reactions: lessons learned from a bi-institutional study using high-fidelity simulation testing. *Abdom Imaging* 2014; 39: 1127-1133.
- Wang CL, Schopp JG, Petscavage JM, Paladin AM, Richardson ML, Bush WH. Prospective randomized comparison of standard didactic lecture versus high-fidelity simulation for radiology resident contrast reaction management training. *AJR Am J Roentgenol* 2011; 196: 1288-1295.