

## Organisation of Health Care – PC-AKI

When compared to the CBO 2007 guideline on iodine-containing contrast media, several recommendations have been revised. Overall, the most important changes involve: an improved terminology and PC-AKI definition, a lower threshold of eGFR for hydration indication, another type of hydration (bicarbonate) as a recommended preventive measure and a conservative attitude towards preventive measures for PC-AKI other than hydration. To enhance the implementation of this guideline, changes in the organizational structure are recommended as described in the paragraphs below.

### Electronic medical records

In the Netherlands, different electronic medical records (EMR) or Hospital Information Systems (HIS) are available from different vendors.

We strongly recommend the same manner of implementation of this guideline, with at least:

- application forms with eGFR, in combination with a medication order for intravascular contrast medium and a medication order for hydration;
- in the medication list, an overview of the administered intravascular contrast media;
- a query regarding all imaging studies / procedures with intravascular iodine-containing contrast media, eGFR and administered hydration;

### Hospital-based protocol

For optimal implementation of this guideline a hospital-based protocol describing preventive measures, workflow and responsibilities should be designed. This protocol should be determined by a panel of various experts (including at least a nephrologist, an (vascular) internist, a pharmacist, a cardiologist, a radiologist, a CT or an Angiography technologist, and a quality assurance officer).

The referring physician is responsible for analysing and giving notice of the patient's kidney function, instructing about the patient's medication, and instructing on the administration of hydration and the patient's after-care. The decision on contrast administration should be taken by the physician (radiologist, cardiologist, etc.) responsible for the diagnostic or interventional procedure. Actions can be delegated to others according to local rules and protocols. For example, patients at risk can be referred to a nephrology outpatient clinic (or even a "CI-AKI Prevention Clinic"). This has the advantage of a broader expertise and a better data acquisition.

### Workflow and responsibilities

Responsible person	Action and responsibility
Referring physician	Order procedure: contrast enhanced CT (ceCT), angiography / intervention Discuss alternative imaging with the physician responsible for procedure, if indicated Inform patient about procedure Determine eGFR Assess patient's hydration status Assess necessity of preventive measures - hydration Instruct patient about medication (stop or continue) metformin / nephrotoxic drugs Instruct patient about fluid intake Arrange hospital admission for hydration

	Order hydration in patient record
Physician responsible for the procedure - Cardiologist / Radiologist / Nuclear Medicine specialist / Radiotherapist	Check order procedure Discuss alternative imaging with referring physician, if indicated Check eGFR Check hydration Determine procedure protocol and choice of intravascular contrast medium In case of disagreement, consult referring physician Order contrast medium in patient record
Referring physician	<i>Before procedure:</i> Administrate hydration Record hydration in patient record (type/name, concentration, volume, duration) <i>After procedure:</i> check eGFR If PC-AKI, then treatment and follow-up and record PC-AKI in patient record
Physician responsible for the procedure	<i>Before and during procedure:</i> Check eGFR and check whether hydration is administered correctly Check contraindications for CM administration Administer contrast medium Record contrast administration in patient record (name, concentration, volume)

### *Exceptions*

#### Emergency patients / procedures

In case of a major life-threatening medical condition requiring rapid decision-making including emergency imaging or intervention (e.g. stroke), the determination of the eGFR can be postponed or the imaging or intervention can be started while the eGFR is being determined in the laboratory. If the possibility exists to wait a short time before commencing diagnosis or intervention, without doing harm to the patient, eGFR should be determined immediately, and if indicated, individualized preventive measures should be taken before the administration of intravascular iodine-containing contrast medium.

#### Kidney transplant recipients

Caution is advised in kidney transplant recipients, because of the lack of good scientific research related to intravascular iodine-containing contrast administration in this group. Considering an alternative imaging modality (e.g. MRI or ultrasound with or without contrast media) is advisable.

Optimal nephrology care should always be mandatory. If iodine-containing contrast medium needs to be given in patients with an eGFR < 30 ml/min/1.73m<sup>2</sup>, preventive hydration is advised, and when necessary individualized to the condition of the patient. For elective examinations, consultation of a nephrologist is recommended.

### **General safety issues**

#### *Hydration situation*

Optimal nephrology care is mandatory. Dehydration of patients before intravascular contrast administration is undesirable and should be avoided or corrected by giving normal saline or Ringer's lactate.

### *Alternative methods of investigation*

In patients with severe renal failure, the need for the use of contrast medium should be re-examined. Some diagnoses may just as well be made with other potential imaging modalities, like MRI or ultrasound, or by performing an unenhanced study. CO<sub>2</sub> angiography may be an alternative to angiography with intravascular iodine-containing contrast medium.

### *Contrast media*

The dose of iodine-containing contrast medium should be minimized without compromising the diagnostic aspect of the study/procedure, taking into consideration the indication and the patient's body weight. In angiography / interventional procedures the amount of contrast medium used is highly variable. There must always be a commitment to use the lowest possible dose of contrast medium.

With the development of new generations of CT scanners and angiography equipment, and improved contrast media injection systems, the total volume of contrast medium used for most contrast-enhanced CT /angiography studies has dropped. Also, lower tube voltages allow for lower volumes of CM as lower tube voltage give more signal/ml CM.

### *Consecutive procedures in a patient*

Multiple procedures with intravascular iodine-containing contrast medium within 24 hours should be avoided when possible, and only performed when strictly indicated. There are no strict maximum permissible doses of contrast, but in general volumes of over 250-300 cc in a 24-hour period should be avoided.

In addition, one must realize that intravascular iodine-containing contrast medium is used in contrast-enhanced CT, PET/CT scans with diagnostic contrast-enhanced CT, and angiography / interventional procedures at the departments of cardiology and radiology.

## **Information and registration**

### *Patient information*

Appropriate patient information leaflets should be available, both about the investigational method applied and about the preventive hydration procedure. One should consider having these available in multiple languages.

### *Patient checklist for contrast medium*

Consider a checklist for outpatients to check essential information directly before administration of intravascular iodine-containing contrast media. The checklist should include: impaired renal function, dialysis, diabetes mellitus, metformin therapy, and previous hypersensitivity reaction to contrast media.

### *Registration of the contrast medium*

Intravascular contrast administration (agent name, concentration, volume) should be recorded in 2 ways:

- A. Patient record
- B. On the CT images

The correct information about contrast medium - agent name, concentration and volume in ml - on the CT images will ensure optimal transparency, both in the hospital where the CT

images are performed and in any other hospital to which the patient might have been referred.