QUICK REFERENCE GUIDE FOR CONTRAST MEDIA POLICY

CT & MR CONTRAST AGENTS

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INDEX

How to use the information in this Document

1. The information is arranged in boxes.

2. The information is organized according to the commonly faced clinical scenarios.

3. The information is brief, concise and accurate and to the point to allow rapid reference and application in clinical practice, and to address common questions presented by patients.

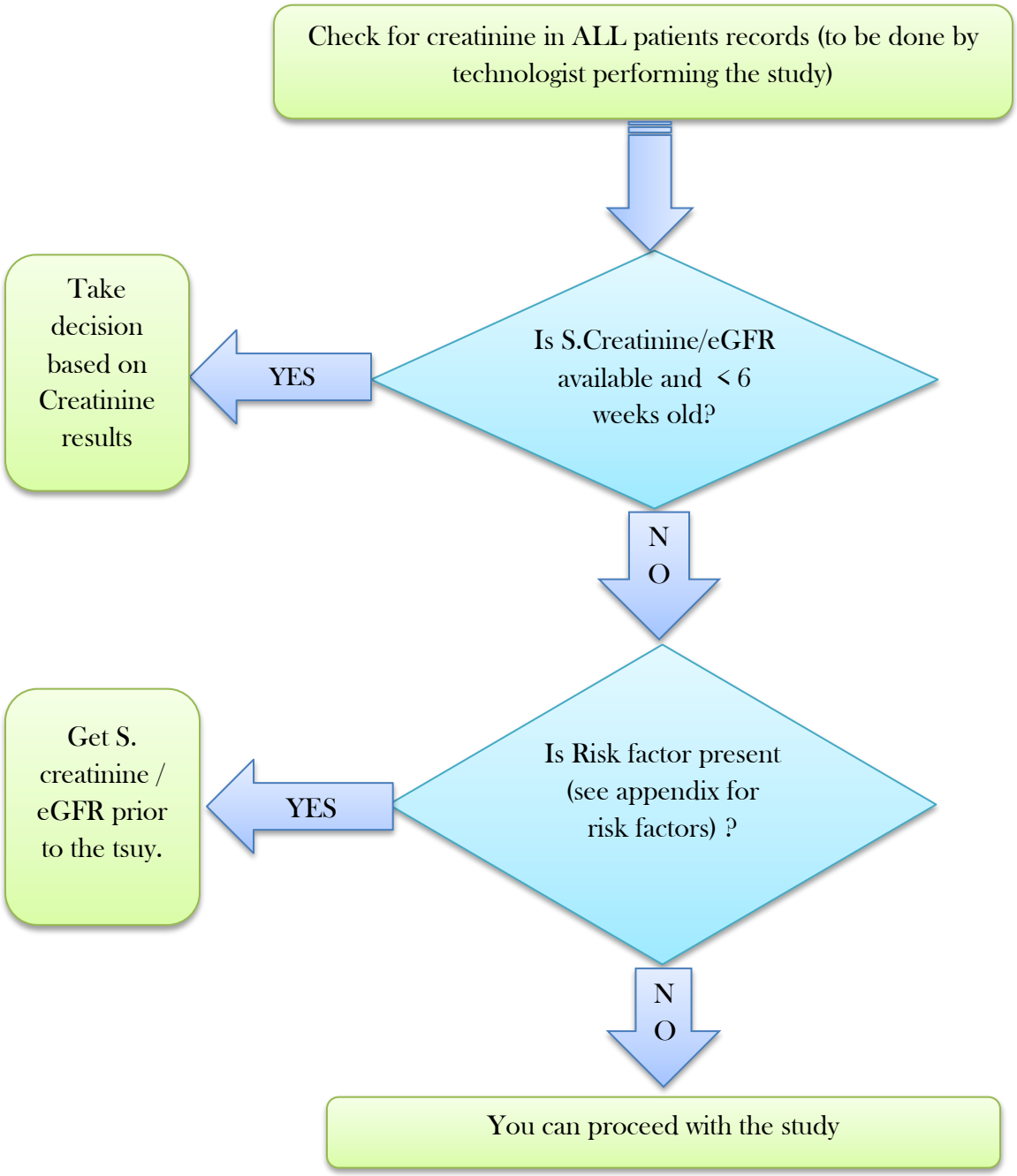
4. In order to, quickly find the correct information, look for the appropriate clinical scenario in the index table and go to the corresponding Box number.

5. Each box is labeled as either I + G (meaning the information is relevant for both Iodine based and Gadolinium based contrast agents), I (meaning the information is relevant only for Iodine based contrast agents) or G (meaning, information is relevant for Gadolinium contrast agents only).

6. The box which are prefixed with double asterisk sign (**) indicates that the latest EUSR version 10.0 guidelines have introduced significant changes in recommendations and same has been updated.

Algorithm # 1

When to do S.Creatinine testing / eGFR before giving Iodine based or Gadolinium contrast agents?



Disclaimer: In general, these guidelines are just guidelines, and slavish adherence in every case is neither expected nor appropriate. Physician discretion and judgment are paramount, and commonsense should be applied to individual patient circumstances. For example, creatinine testing can be omitted for an urgent study where time is critical, particularly a contrast-enhanced stroke CT protocol requested by the Emergency Department (this determination should be made by the requesting physician). Conversely, it may be prudent to check creatinine in a sick debilitated patient even if they do not have any of the specific factors listed in box no. 1.

Appendix

** Box # 1 (I +G)

Risk factors which necessitate creatinine testing prior to ANY contrast administration
1. Age over 60 years (according to latest ESUR guidelines this age cutoff has been increased to 70 years) 2. History of "kidney disease"- including: • Dialysis • Renal tumor • Renal transplant • Single kidney. • Renal surgery. 3. Diabetes treated with insulin or other prescribed medications 4. Hypertension (high blood pressure) requiring medication 5. Multiple myeloma 6. Solid organ transplant 7. History of severe hepatic disease/liver transplant/pending liver transplant
In addition to above 7 factors, 5 more risk factors need to be considered if Iodine contrast media is being used rather than gadolinium: 1. Family history of kidney failure. 2. SLE / collagen vascular diseases 3. Metformin or metformin containing combinations. 4. Gout (controversial) 5. Congestive heart failure.
Note: For patients in category 7 (that is severe hepatic disease / liver transplant or pending liver transplant)- The Serum creatinine, must be acquired immediately prior to exam. In other categories, creatinine values from exam up to 6 weeks prior to study are acceptable for all outpatients. For in patients a shorter interval may be desirable and based on case to case basis.

Box # 2 (I +G)

How is eGFR Calculated?
An online calculator for eGFR with this formula can be found on the web browsers at the following link to the National Kidney Foundation: http://www.kidney.org/professionals/KDOQI/gfr_calculator (For age > 19 yers) https://www.kidney.org/professionals/KDOQI/gfr_calculatorPed (for age < 19 years)

IPhone users scan following QR code to download the NKF IPhone App for eGFR	Android Phone users please scan following QR code to download eGFR App from Google play store:

Note:
In the NKF app for eGFR calculation, use MDRD equation.
The NKF eGFR calculators require no data regarding patient height or weight.
For calculating eGFR in patient < 17 years of age, Shwartz equation (also available in the App) should be used. This equation required entering the Height of the patient in order to get eGFR.

You will need to download QR scanner app in your smart phone to scan the above QR code. Or you can simply search "eGFR calculator by NKF "in your app store search box to find the appropriate app.
Make sure correct App is downloaded to ensure reliability and homogeneity of results in our institutional practice.

Glomerular filtration rate (GFR) is the best overall index of kidney function. Normal GFR varies according to age, sex, and body size, and declines with age. The National Kidney Foundation recommends using the CKD-EPI Creatinine Equation (2009) to estimate GFR.

** Box # 3 (I +G)

<table>
<tr><th colspan="2">Role of Dialysis After Iodine based contrast agents/Gadolinium Administration in patient already on Dialysis</th></tr>
<tr><td colspan="2">Patient on Hemodialysis</td></tr>
<tr><td><u>CT (Iodine based) contrast agents</u></td><td><u>Gadolinium based contrast agents</u></td></tr>
<tr><td>Extra hemodialysis session to remove contrast medium is unnecessary.</td><td>Extra hemodialysis session to remove contrast medium <u>as soon as possible</u> after it has been administered is recommended.</td></tr>
<tr><td colspan="2">Patient on continuous ambulatory Peritoneal dialysis</td></tr>
<tr><td><u>CT (Iodine based contrast agents)</u></td><td><u>Gadolinium based contrast agents</u></td></tr>
<tr><td>Extra hemodialysis session to remove contrast medium is unnecessary.</td><td>Hemodialysis (not peritoneal dialyses) should be considered and discussed with the referring physician.</td></tr>
<tr><td colspan="2">All contrast media, iodinated and gadolinium, can be removed by hemodialysis or peritoneal dialysis. However, there is no evidence that hemodialysis protects patients with impaired renal function from contrast medium induced nephropathy and as such as, dialysis is not routinely recommended in advanced renal disease patient NOT already on dialysis.</td></tr>
</table>

Box # 4 (G)

Use of power injectors for administration of Gadolinium
No gadolinium chelate is approved in the United States for use in a power injector". Although gadolinium administration via a power injector is a commonly accepted practice, it is technically an off-label use of the power injector.

Box # 5 (I +G)

Contrast Administration in Patients with Multiple Myeloma	
CT Contrast agents (Iodine based)	**MR contrast agents (Gadolinium)**
Contrast may be administered if the clinical indication is appropriate and the patient is well hydrated (please also see box # 17).	Gadolinium is safer in MM **(no special precautions required except fro ensuring normal renal function prior to study)** However, a report published in 2009 in Journal Blood (http://www.bloodjournal.org/content/114/22/1809?sso-checked=true) cited In vitro, In vivo (in mice) and autopsy (human patients) evidence of proliferation of MM cells due to Gadolinium administration. The study is the only paper supporting this and no international body has endorsed this view as far as our research. Authors of above article themselves suggested to go for more research before coming to any definite conclusions regarding clinical implication of their findings.
References McCarthy CS, Becker JA. Multiple myeloma and contrast media. Radiology 1992; 183: 519-521.	

Box # 6 (I +G)

Permissible Doses
There are no strict maximum permissible doses of iodine based contrast, but in general volumes of over 250-300 cc in a 24 hour period should be avoided. For Gadolinium, maximum permissible dose is usually mentioned in contrast vial. But in general, never exceed 30 ml dose volume.
References 1. Lasser EC, Lyon SG, Berry CC. Reports on contrast media reactions: analysis of data from reports to the U.S. Food and Drug Administration. Radiology 1997; 203: 605-610. 2. Omnipaque package insert. Nycomed-Amersham, Princeton, NJ.

** Box # 7 (I)

Contrast Administration in Patients Receiving Metformin	
Category I Definition: In patients with no evidence of AKI and with eGFR ≥45 mL / min/1.73m	Category II Definition: Patients taking metformin who are known to have acute kidney injury or chronic kidney disease (eGFR 30-44) Or Patients on Metformin and who need to undergo arterial catheter studies that might result in emboli (atheromatous or other) to the renal arteries
Recommendation There is no need to discontinue metformin either prior to or following the intravenous administration of iodinated contrast media, nor is there an obligatory need to reassess the patient's renal function following the test or procedure	Recommendation Metformin should be temporarily discontinued at the time of or prior to the procedure, and withheld for 48 hours subsequent to the procedure and reinstituted only after renal function has been re-evaluated and found to be normal. Patient should be hydrated (E.g. at least 1 ml per kg body weight per hour of intravenous normal saline up to 24 hours after contrast medium administration – In warm areas more fluid should be given). (Preferable).

Reference

1. Bush WH, Bettmann MA. Update on metformin (Glucophage®) therapy and the risk of lactic acidosis: change in FDA-approved package insert. ACR Bulletin 1998; 54: 15.
2. Manual on Contrast Media, Edition 7.0, 2010: 33-35. American College of Radiology.
3. http://depts.washington.edu/druginfo/Alerts/Details/metformin_bulletin.html.

Box # 8 (I +G)

Pregnancy and contrast agents			
Iodine based contrast agents (CT contrast):		Gadolinium based contrast agents (MR contrast)	
For Mother	**For Neonate**	**For Mother**	**For Neonate**
CT contrast agents can be administered in exceptional circumstances when radiographic examination is essential.	Following administration of iodinated agents to the mother during pregnancy, Thyroid function test should be checked in the neonate during the first neonatal week	When MR examination is necessary in pregnancy , Gadolinium may be given to the pregnant woman, but only after ascertaining and documenting following: 1. That information required for MRI study cannot be acquired without IV contrast or any other imaging modality. 2. That, information needed affects the care of the patient/fetus. 3. That, referring physician is of opinion that it is not prudent to wait. 4. Informed consent to be taken from patient – after discussion with reporting physician.	If gadolinium is given to mother during pregnancy, there is no need of any tests in the neonate.

** Box # 9 (I +G)

Lactation and contrast agents	
CT contrast (iodine based)	**Gadolinium (MR) contrast agents**
CT contrast agents may be administered without any need for disruption of breast-feeding or any special test or precautions for neonate.	Gadolinium based agents are safe and extremely small amount of contrast is secreted in milk and even smaller amount is absorbed by the baby. AS such there is NO need to discontinue lactation after administration of Gadolinium agents. *However, Latest ESUR guidelines (version 10.0)(changed from earlier version)* Patient should be offered to make a choice after discussion with radiologist to decide that whether they would wish to discard breast milk for a maximum up to 24 hours following gadolinium contrast administration.

Box # 10 (I +G)

Decision making process based on eGFR results	
eGFR results	**Recommendation**
≥60 (normal)	Proceed
45 - 60	Proceed
30 - 44 (negligible risk)	Recheck eGFR (if labs results are not from within 7 days). If same results persist- can give contrast agent after Radiologist approval (single minimum dose)
<30 (eg: means S.creatine of approx. 1.7 mg/dl in a 70 years female who is not from black race)	High risk – Contrast administration is not recommended. If contrast administration is considered imperative, then follow guideline in box # 18

Box # 11 (I +G)

Non renal Contrast related adverse reaction (Allergic reactions)
At the time of referral – Identify patients with increased risk of reaction For both Iodine based contrast agents (CT contrast) and Gadolinium based contrast agents (MR contrast)
Patients with a history of • Previous moderate or severe acute reaction to iodine/ Gadolinium contrast agent • Asthma (on treatment) • Allergy requiring medical treatment.
Note: The risk of an acute reaction to a gadolinium contrast agent is significantly lower than the risk with an iodinated contrast agent.

Box # 12 (I +G)

Non renal Contrast related adverse reaction (Allergic reactions)

Before the examination – Premedications regimes and recommendations when contrast is to be given to a patients who had been identified to be with increased risk of reaction (See box # 11) For both Iodine based contrast agents (CT contrast) and Gadolinium based contrast agents (MR contrast)

- Consider an alternative test not requiring an iodinated / Gadolinium agent
- Consider the use of premedication.

Clinical evidence of the effectiveness of premedication is limited. If used, a suitable pre-medication regime is -:

PREMIEDICATION REGMIES

Prednisolone 30 mg (or methylprednisolone 32 mg) ***orally*** *given 12 and 2 hours before contrast medium.* **(12-13 hour regime)**

OR

(if more urgent investigation is required)

Hydrocortisone sodium succinate 200 mg ***IV*** *immediately, and then every 4 hours until contrast medium administration, plus diphenhydramine 50 mg IV 1 hour before contrast medium administration.* **(4-5 hours in duration)**

OR

(if very urgent investigation is required)

Hydrocortisone sodium succinate 200 mg ***IV,*** *plus diphenhydramine 50 mg IV, each 1 hour before contrast medium administration* **(1 hour regime)**- this regimen and any other regimen with duration < 4-5 hour has no evidence of efficacy and may be considered in emergent situations only when there is no alternative. If tis regime is used, the crash cart should be especially kept ready.

Note: Risk of an acute reaction to a gadolinium contrast agent is significantly lower than the risk with an iodinated contrast agent.

Box # 13 (I+G)

<table>
<tr><th colspan="2">Non renal Contrast related adverse reaction (Allergic reactions)

Guideline <u>at the time of examination</u> for patients identified to be with increased risk of allergic reaction (see box # 11)</th></tr>
<tr><td>Iodine based contrast agents (CT contrast):</td><td>Gadolinium based contrast agents (MR contrast)</td></tr>
<tr><td>Use a non-ionic contrast medium.
Use a different iodinated contrast agent.
Keep the patient in the Radiology Department for 30 min after contrast medium injection.
Have the drugs and equipment for resuscitation readily available</td><td>No specific Gadolinium agent recommended over other.
Use a different gadolinium contrast agent.
Keep the patient in the Radiology Department for 30 min after contrast medium injection.
Have the drugs and equipment for resuscitation readily available.</td></tr>
<tr><td colspan="2">Note: The risk of an acute reaction to a gadolinium contrast agent is significantly lower than the risk with an iodinated contrast agent.</td></tr>
</table>

Box # 14 (I+G)

<table>
<tr><th colspan="2">Non renal Contrast related adverse reaction (Allergic reactions)

Possible late and very late allergic like adverse reactions <u>after the examination</u></th></tr>
<tr><td colspan="2">Late adverse reactions
Definition: An adverse reaction, which occurs 1 hour to 1 week after contrast medium injection.</td></tr>
<tr><td>Iodine based contrast agents (CT contrast)</td><td>Gadolinium based contrast agents (MR contrast)</td></tr>
<tr><td>Skin rashes may occur

<u>Risk factors of Skin reactions:</u>

1. Previous late contrast medium reaction.
2. Interleukin-2 treatment.
3. Use of nonionic dimers.</td><td>None described</td></tr>
<tr><td colspan="2">Very late adverse reactions
Definition: An adverse reaction, which usually occurs more than 1 week after contrast medium injection.</td></tr>
<tr><td>Iodine based contrast agents (CT contrast)</td><td>Gadolinium based contrast agents (MR contrast)</td></tr>
<tr><td>Thyrotoxicosis</td><td>NSF (Also see box # 17)</td></tr>
</table>

Box # 15 (I+G)

<table>
<tr><th>Non renal Contrast related adverse reaction (Allergic reactions)

Guidelines for Extravascular administration of iodinated contrast media in patients who are identified to be at increased risk of allergic reaction (see box # 11).</th></tr>
<tr><td>When absorption or leakage into the circulation is possible, take the same precautions as for intravascular administration. (See box # 12 to 14)</td></tr>
</table>

Box # 16 (I)

Thyrotoxicosis **(Only relevant when Iodinated contrast media given. NO relation with Gadolinium contrast media.**	
Who is at risk:	• Patients with untreated Grave's disease. • Patients with Multi-nodular goiter and autonomy especially if -: 1. Elderly 2. Living in area endemic in Iodine deficiency.
Who is not at risk:	Patients with normal Thyroid function.
Recommendations:	1. DO NOT give Iodine contrast medium to patient with hyperthyroidism. 2. Prophylaxis is not useful. 3. Patient at risk (see row # 2 above) should be closely monitored by the endocrinologist.

** Box # 17 A (G)

Gadolinium and NSF	
Definitions: The link between nephrogenic systemic fibrosis (NSF) and gadolinium-based contrast agents was recognized in 2006.	
Onset	**From day of exposure to up to 2-3 months. Sometime can be delayed for years.**
Initial symptoms	• Symptoms usually start in leg-: • Pain • Pruritus • Swelling • Erythma
Late symptoms and sings	• Woody texture and brawny appearance of the skin (due to skin thickening). • Fibrosis of organs (heart, liver, lungs, Diaphragm and muscles etc.)
Sequel	• Contracture • Cachexia • Death (in some patients)

Renal function and Risk of NSF	
eGFR values	**Risk of NSF**
< 30 ml/min or patient on Dialysis or patients with AKI	Highest risk
30-59 ml/min	Lower risk
> 60 ml/min	No increased risk.

Box # 17 B (G)

Type of contrast agents and risk of NSF The ACR recognizes three categories of GCBAs with respect to risk of NSF	
Group of Gadolinium contrast agents	**Compound and market names**
Group I Agents associated with the greatest number of NSF cases	Gadodiamide (Omniscan®) Gadopentetate dimeglumine (Magnevist®) Gadoversetamide (OptiMARK®)
Group II Agents associated with few, if any, unconfounded cases of NSF	Gadobenate dimeglumine (MultiHance®) Gadoteridol (ProHance®) *Gadobutrol (Gadavist®)* *Gadoterate acid (Dotarem®)*
Group III Agents for which data remains limited regarding NSF risk	Gadoxetic acid (Eovist®

Note: We are using Dotarem and Gadavist (both group II agents)- the details of the dose these contrast is as follows-:

Contrast	Compound	Dose
Dotarem	Gadoterate Maglumine	0.2 ml /Kg
Gadavist	Gadobuterol	0.1 ml/Kg

There are approximately 10 main gadolinium contrast agents. The doses of all these 10 gadolinium based contrast agents is either 0.2 ml/Kg except for Gadavist and Ablavar.

All the Gadolinium based contrast agents are general purpose MRI contrast agents except for-

- Eovist -: which is a liver specific contrast agent and
- Ablavar -: which is specifically recommended in MR angiography studies for aortoocclusive disease,

Box # 18 (I+G)

Recommendations for performing Contrast examination in patients with -: Raised creatinine /reduced eGFR (<30) Or Emergency examination with non-availability of creatinine / eGFR but presence of high risk factors	
Iodine contrast medias	**Gadolinium contrast media**
1. **N acetyl Cystine** (free radical scavenger), **Doses:** 1200 mg in two divided doses a day prior to the administration of contrast or 150 mg/kg intravenously half an hour prior to contrast administration. 2. Stop nephrotoxic drugs (mannitol and loop diuretics), at least 24 hours before contrast medium administration 3. Start hydration. A suitable intravenous regime is 1ml/kg body weight per hour of normal saline for at least 6 hours before and after the procedure. In hot climates the volume should be increased. 4. Use low or iso-osmolar contrast media in case of Iodine based contrast agents. 5. Use the lowest dose of contrast medium consistent with a diagnostic result.	1. Gadolinium should NOT be given to patients with eGFR <30 unless contrast is considered absolutely necessary for clinical management. 2. Only Group II or III may be used in such cases where contrast administration is deemed necessary (in our department we only use Group II agents). 3. As per ACR guidelines, while using Group II agents in patient with eGFR < 30 , no informed consent is necessary. 4. Use Gadavist instead of Dotarem in all such cases.

Box # 19 (I+G)

<table>
<tr><th colspan="2">Contrast media and catecholamine producing tumors (Pheochromocytoma and Paraganglioma)</th></tr>
<tr><td colspan="2">Guidelines to perform contrast study (iodine based or gadolinium contrast) for tumor localization when catecholamine-producing tumor has been detected biochemically</td></tr>
<tr><td>Intravenous contrast medium (iodinated or gadolinium):</td><td>Intra-arterial iodinated contrast medium (iodinated or gadolinium) (ESUR V 10.0)</td></tr>
<tr><td>1. No special preparation is required.
2. Use nonionic agent in case of CT contrast. No special recommendation for any specific gadolinium agent.</td><td>1. α and β-adrenergic blockade with orally administered drugs under the supervision of the referring physician.
2. α-blockade with intravenous route is also necessary
3. Use nonionic agent in case of CT contrast. No special recommendation for any specific gadolinium agent.</td></tr>
<tr><td colspan="2">Guideline for performing contrast study (iodine based or gadolinium based contrast agent) for characterization of incidentally detected adrenal mass (or biochemical results not available)</td></tr>
<tr><td>Intravenous contrast medium (iodinated or gadolinium)</td><td>Intra-arterial iodinated contrast medium (iodinated or gadolinium)</td></tr>
<tr><td>No special preparation</td><td>No special preparation</td></tr>
</table>

**Box # 20 (I+G)

Guidelines for timing Biochemical assays / Laboratory tests after contrast media (both CT & MR contrast agents) (ESUR V 10.0)	
Do not perform non-emergency biochemical analysis urine collected within 24 hours of contrast medium administration. In patients with normal renal function, blood can be collected four hours after contrast agent administration. For patient with eGFR <45, blood collection should be delayed as long as possible. Preferably collect urine & blood before administration of contrast agent.	
Guidelines for timing isotope studies/treatments when iodine based contrast medium is to be used or had been used. (No relation with gadolinium contrast agents with Isotope studies)	
Thyroid isotope scan/ Thyroid radioactive treatment	**Bone/ Red blood cell labeling isotope scans**
• Patients undergoing therapy with radioactive iodine should not have received iodinated contrast media for at least two months before treatment. • Isotope imaging of the thyroid should be avoided for two months after iodinated contrast medium injection. Hence, wherever possible, one should perform Isotope imaging of thyroid PRIOR to the CT study.	Avoid iodinated contrast medium injection for at least 24 hours before the isotope study.

Box # 21 (I)

Administration of Iodine contrast media in vascular interventions- effect of contrast media on Endothelium and blood
1. All Iodine contrast media are known to have anticoagulant properties (especially ionic agents). 2. High Osmolar iodinated contrast media may in addition cause endothelium damage. 3. Drugs and interventional devices which reduces the risk of thromboembolic complications during the interventional procedures also reduces the thrombotic effect of contrast media.
Guidelines 1. Meticulous angiographic technique is mandatory and is the most important factor in reducing thromboembolic complications. 2. Low- or isoosmolar contrast media should be used for diagnostic and interventional angiographic procedures including phlebography.

Box # 22 (G)

Brain deposition of Gadolinium
• Deposition of gadolinium in the brain has been increasingly reported in recent years. First described by Kanda et al. in 2014, high signal in the dentate nucleus and globus pallidus after prior gadolinium administration has now been documented in over 20 studies. *The clinical significance of this brain deposition, however, is unknown* • Brain deposition is related to the strength of gadolinium binding by different gadolinium compounds. Less stable compounds (linear agents) are more strongly linked to brain deposition than more stable compounds (macrocyclic agents).
Guidelines 1. Use Macrocyclic agents (we are using Gadavist routinely, which is Macrocyclic agent). 2. In spite of conceding to the fact that Gadolinum do deposit in brain (and many other organs), FDA believes that there is no sufficient evidence that Gadolinium deposition into brain leads to clinically significant detrimental effects and therefore recommends continued use of Gadolinium based agents. 3. ***Gadolinium as an MRI contrast agent should only be used when diagnostically necessary.***
References: 1. https://www.fda.gov/Safety/MedWatch/SafetyInformation/SafetyAlertsforHumanMedicalProducts/ucm589580.htm 2. Kanda T et al. High Signal Intensity in the Dentate Nucleus and Globus Pallidus on Unenhanced T1-weighted MR Images: Relationship with Increasing Cumulative Dose of a Gadolinium-based Contrast Material. Radiology 2014; 270:834-841. 3. Olchowy C et al. The presence of the gadolinium-based contrast agent depositions in the brain and symptoms of gadolinium neurotoxicity – A systematic review. PLoS One. 2017 Feb 10;12(2):e0171704.

Box # 23

Truth v/s Hype			
S.NO	**Context**	**Hype**	**Truth**
1	Risk of allergic reactions	Allergy to Iodine contrast and Gadolinium contrast is common	The allergy to Iodine and G+adolinium contrast is rare- Aggregate incidence for iodine contrast- 0.6 %; Incidence of severe reactions is 0.04 %. For Gadolinium contrast-: 0.01-0.22 % aggregate; 0.008 % severe
2	Risk CT contrast in patients who are allergic reaction to Iodine containing substances	Patients with shellfish or povidone-iodine (e.g., Betadine) allergies **are at greater risk** from iodinated contrast medium than are patients with other allergies	Patients with shellfish or povidone-iodine (e.g., Betadine) allergies **are** at no greater risk from iodinated contrast medium than are patients with other allergies
3	Beeta blocker and contrast agents	Patients on beta-blocker therapy need to discontinue their medication(s) prior to contrast medium administration	Patients on beta-blocker therapy do not need to discontinue their medication(s) prior to contrast medium administration
4	Mysethina Gravis and contrast agents.	Mystheina Gravis patient should not be give iodine based contrast as it leads to exacerbation of myasthenia symptoms.	It is controversial whether iodinated contrast medium should be considered a relative contraindication in patients with myasthenia gravis
5	Role of Intradermal skin tastings	Intradermal skin testing with contrast media can predict the likelihood of adverse reactions.	Intradermal skin testing with contrast media to predict the likelihood of adverse reactions has not been shown to be useful in minimizing reaction risk. Prior sensitization is not required for a contrast reaction to occur.

References:

The above summary guidelines are based on mainly:

1. ACR Contrast manual (V 10.3)
2. ESUR Guidelines (V 10.0)
3. Contrast media tutorial by Jessica B. Robbins, Md amd Myron A. Pozniak MD
4. RANZCR-Iodinated contrast media guidelines.
5. National Kidney foundation (links for eGFR calculator links)