

# **URO SURGERY**



# IMAGING IN UROLOGY

## Radiation management

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- Radiation exposure : Charge per unit mass of air cause by passage of radiation through tissue.  
measured in coulombs (C)/kg.
- Absorbed dose : Energy absorbed from radiation exposure.  
measured in gray (Gy).
- Equivalent dose : Conversion factor applied to absorbed dose to measure different interaction of radiation with different type of tissue.  
measured in Sievert (Sv).  
Conversion factor for diagnostic x rays = 1.
- Effective dose : Denotes radiation risk to a population of patients from an imaging study.  
measured in Sievert (Sv).  
Estimation of range of effective doses for various imaging modalities allows assignment of relative radiation level :

RADIATION QUANTITY	TRADITIONAL UNIT	SI UNIT	CONVERSION	CLINICAL RELEVANCE
Exposure	roentgen (R)	coulomb (C)/kg	1 C/kg = 3876 R	Charge per unit mass
Absorbed dose	rad	gray (Gy)	1 Gy = 100 rad	Energy absorbed by tissue
Equivalent dose	rem	sievert (Sv)	1 Sv = 100 rem	Absorbed energy based on tissue type
Effective dose	rem	sievert (Sv)		Biologic risk associated with absorbed energy

RELATIVE RADIATION LEVEL (RRL)	EFFECTIVE DOSE ESTIMATED RANGE	EXAMPLE EXAMINATIONS
None	0	Ultrasound, MRI
Minimal	<0.1 mSv	Chest radiographs
Low	0.1-1.0 mSv	Lumbar spine radiographs, pelvic radiographs
Medium	1-10 mSv	Abdomen CT without contrast, nuclear medicine, bone scan, <sup>99m</sup> Tc-DMSA renal scan, IVP, retrograde pyelograms, KUB, chest CT with contrast
High	10-100 mSv	Abdomen CT without and with contrast, whole-body PET

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Radiation protection :

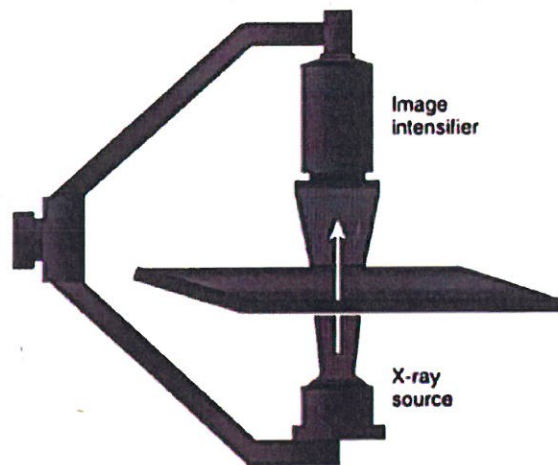
Recommended occupational exposure : 50 mSv/yr.

No safe dose of radiation (linear no threshold model).

Greater risk to eyes and gonads.

Reduction in radiation exposure.

- Limiting time of exposure :
  - Use short bursts.
  - Last image hold.
- Maximizing distance from radiation source :
  - Exposure diminishes as square of distance from radiation source.
  - Positioning image intensifier close to patient reduces scatter radiation.



Shielding :

- Radiation resistant eye protection, leaded gloves.
- Collimate to minimum required visual fluoroscopy field.

Contrast media :

1. Allergic like reactions :
  - Idiosyncratic, anaphylactoid, not dose dependent.
  - Differ immunologically from true allergic reactions.
  - Antigen antibody response rarely identified, no true IgE reaction.
  - Mechanism of action : Combination of systemic

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effects :

- Release of vasoactive substances like histamine.
  - Activation of physiologic cascades : Complement, Kinin, coagulation, fibrinolytic systems.
  - Inhibition of enzymes like cholinesterase leads to prolonged vagal stimulation.
  - Patient anxiety and fear of actual procedure.
- a. Physiologic reactions :
- Not allergic like, dose and concentration dependent.
  - Physiologic response to contrast medium molecular properties creating chemotoxicity.
  - Effects can be due to hyperosmolality.
  - Can also be due to binding of specific contrast molecules to activators.

<b>MILD REACTIONS</b>	
Self-limiting signs or symptoms	
Allergic-Like	Physiologic
Limited urticaria/pruritus	Limited nausea/emetis
Limited edema	Transient flushing/warm/chills
Limited throat irritation	Headache/dizziness/anxiety/alterd taste
Nasal congestion	Mild hypertension
Sneezing, eye irritation, rhinorrhea	Vasovagal but resolves spontaneously
<b>MODERATE REACTIONS</b>	
Commonly require medical management and may become severe if not treated	
Allergic-Like	Physiologic
Diffuse urticaria/pruritus	Protracted nausea/emetis
Diffuse erythema	Hypertension
Facial edema	Chest pain
Throat tightness	Vasovagal responds to treatment
Wheezing/bronchospasm mild	

<b>SEVERE REACTIONS</b>	
Life-threatening, may result in morbidity or mortality if not treated. Cardiac arrest may occur from allergic-like as well as physiologic adverse reactions	
Allergic-Like	Physiologic
Diffuse edema/facial edema/shortness of breath	Vasovagal reaction resists treatment
Diffuse erythema and hypotension	Arrhythmia
Laryngeal edema with hypoxia	Seizures
Wheezing/bronchospasm with hypoxia	Hypertensive emergency
Anaphylactic shock/hypotension/tachycardia	

Treatment of contrast reactions :

1. mild :
  - Observation, reassurance.
  - Diphenhydramine, chlorpheniramine, diazepam.
  - Bronchospasm management.

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2. moderate :

- Incidence : 0.5 to 2 %.
- Close observation.
- Hydrocortisone, salbutamol, oxygen.

3. Severe :

- Emergency treatment :
  - Rapid administration of epinephrine is the treatment of choice.
  - IV 0.1 ml/kg of 1:10000 dilution (0.01 mg/kg) slowly into running saline infusion, repeated every 5 to 15 min, maximum single dose 1 ml (0.1 mg), total dose 1 mg.
  - IM 0.01 mg/kg of 1:1000 dilution (0.01 ml/kg) to maximum dose 1 mg (0.01 ml/kg) up to 30 kg (0.3 mg if weight > 30 kg) in lateral thigh, repeated every 5 to 15 min up to 1 ml (1 mg).
- Vasopressors :
  - most effective vasopressor : Dopamine (2 to 10 mcg/kg/min).

Premedication :

- No known strategy to eliminate risk of severe adverse reaction to contrast media.
- Low osmolar contrast media is preferred in patients with known history of allergy.
- AR may happen after extravascular procedures too (RGP).
- Corticosteroid premedication lowers likelihood of ALR.
- Adverse effect of premedication : Leukocytosis, asymptomatic hyperglycemia, possible infection risk.
- Oral steroids preferable.
- Steroids required at least 6 hrs before contrast media injection.
- Administration within 3 hrs not useful.
- Accelerated IV premedication only used when no alternatives present.

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1. Prednisone: 50 mg by mouth at 13 hours, 7 hours, and 1 hour before contrast media injection  
Plus diphenhydramine (Benadryl) 50 mg intravenously, intramuscularly, or by mouth 1 hour before contrast medium injection
2. Methylprednisolone (Medrol): 32 mg by mouth 12 hours and 2 hours before contrast media injection  
Plus diphenhydramine (Benadryl): 50 mg intravenously, intramuscularly, or by mouth 1 hour before contrast medium injection

#### Delayed contrast reactions :

- Occur from 3 hrs to 7 days after contrast.
- m/c allergic like and cutaneous reactions.
- Typically resolve spontaneously.

#### Specific contrast considerations :

- Allergic patients (unrelated to contrast) 2 to 3 times more likely to have contrast reaction.
- Reaction to 1 class doesn't increase risk of reaction to another type of contrast medium.
- Contrast reactions more common in patients with anxiety.
- Asthma increases chance of ALR (premedication not recommended).
- Beta blockers can lower threshold for contrast reactions (cessation not recommended).
- Premedication not recommended solely on cardiac status.
- Hyperthyroid patients may develop thyrotoxicosis with contrast (rare).
- Washout of  $^{131}\text{I}$  was recommended after contrast study before radioiodine therapy.
- Premedication not recommended for myasthenia gravis/pheochromocytoma/sickle cell trait.
- Large volume extravasation of contrast :
  - Swelling, edema, erythema, pain, cellulitis, compartment syndrome.
  - maximum symptoms in 24 to 48 hrs.
  - Primary mechanism : Hyperosmolality of contrast.

- Rx : manual massage, plastic surgery consult.
- Post contrast AKI :
  - Nonspecific term : Acute, sudden deterioration in kidney function within 48 hrs.
  - CIN : Specific for sudden decrease in kidney function by IV administration of iodinated contrast medium.
  - Pathophysiology : vasoconstriction, direct tubular toxicity, osmotic mechanisms, chemotoxic mechanisms.
  - Diagnosis of CIN : ~~Criteria are as follows~~ ~~Criteria are as follows~~ :
    1. Increase in creatinine of  $> 0.3$  mg/dl.
    2. Increase in creatinine from baseline  $> 50\%$ .
    3. U/O  $< 0.5$  ml/kg/hr for at least 6 hrs.
  - GFR at least  $45$  ml/min/ $1.73$  m<sup>2</sup> not independent risk factor for CIN.
  - IV contrast risk factor for CIN with GFR  $< 30$  ml/min/ $1.73$  m<sup>2</sup>.
  - Incidence : 2 to 5 %.
  - most important risk factor for CIN is pre-existing severe renal insufficiency.

#### Other risk factors :

1. DM.
2. Dehydration.
3. CV disease.
4. Diuretic use.
5. Advanced age.
6. Multiple myeloma.
7. HTN.
8. Hyperuricemia.
9. Repeated contrast injections.
10. Low PCV.
11. EF  $< 40\%$ .
12. Renal tumor/transplant/single kidney.



13. HOCm, increased contrast viscosity.
14. ESRD with no natural renal function is no longer at risk for CIN.

Prevention :

- Hydration.
- Sodium bicarbonate : Doubtful role.
- N acetyl cysteine : Controversial.

Frusemide increases risk for CIN.

metformin use :

- Advised discontinuation 48 hrs prior in patients with renal insufficiency.
- Fatal in 50 % cases.
- Rare with normal renal function.
- Discontinuation not required before Gd MRI.

**MRI contrast agents**

00:16:56

Gadolinium :

- Paramagnetic metal ion.
- 7 unpaired electrons.
- Reduces T1 and T2 relaxation times.
- Increases tissue signal intensity on T1 weighted images.
- Can interfere with assay for Ca (false hypocalcemia for 24 hrs), iron, magnesium, iron binding capacity and zinc.

Adverse effect :

**Nephrogenic systemic fibrosis :**

- Fibrosing disease of skin, subcutaneous tissue, lungs, esophagus, heart and skeletal muscles
- Initial features are skin thickening and pruritis.
- Later : Contractures and joint immobility, death due to visceral involvement.

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- Strong association with advanced renal disease.
- Onset : 2 days to 3 months.
- Patients with GFR < 30 not on chronic dialysis, most difficult patient population, IV contrast is contraindicated, Gd may cause NSF.
- NSF risk greatest with GFR < 15 (1 to 7 % incidence).
- In high risk patients, use minimal dose, consider macrocyclic agents, avoid gadodiamide.
- mechanism : Gd dissociates from chelates in patients with poor renal clearance free Gd binds phosphate and other anions.
- Forms insoluble precipitate : Deposited in tissues with subsequent fibrotic reaction.

IVU :

- Clear liquids 12 to 24 hr and enema 2 hr before procedure.
- Scout film.
- 50 to 100 ml contrast bolus.
- Nephrogenic phase immediately after injection.
- Next film at 5 minutes and every 5 minutes.
- Abdominal compression : visualization of ureters.
- upright films possible for renal ptosis.
- Postvoid films taken.



Plain abdominal radiography :

- Supine position.