URINARY SYSTEM

Radiographic Procedures III (RAD228)

RADIOGRAPHIC EXAMINATIONS

Urinary System

- Antegrade Exam
  - IVU
    - Functional test
    - Hypertensive evaluation as per protocol
- Retrograde Exams
  - Retrograde Urography
    - Non-functional test
  - Retrograde Cystography
    - Non-functional test
  - Voiding Cystourethrography
    - Functional test
Urinary System

- Retroperitoneal structures
  - Kidneys and ureters
- Infraperitoneal structures
  - Distal ureters
  - Urinary bladder
  - Urethra

Kidney Orientation
(Cross-Sectional Perspective)

Kidney Location

- Halfway between xiphoid process and iliac crest
- Between T11-12 to L3
- Nephroptosis
Microscopic Structure

Collecting System

Cortex: Nephrons
Medulla: Renal pyramids (8-18)
- Renal papilla (openings)
- Minor calyces (4-13)
- Major calyces (2-3)
- Renal pelvis
- Ureter

Ureters

- 28-34 cm long, 1 mm to 1 cm in diameter
- Lie on psoas muscles
- Enter posterolateral bladder
- Points of constriction
  1. Ureters-pelvic junction (UPJ)
  2. Pelvic brim
  3. Ureterovesical junction (UVJ)

IVU Demonstrating Kidneys, Ureters, and Bladder
Clinical Indications for an IVU:

1. Abdominal or pelvic mass
2. Renal or urethral calculi
3. Kidney trauma
4. Flank pain
5. Hematuria
6. Hypertension
7. Renal failure
8. Urinary tract infection (UTI) (pyelonephritis)

High Risk Patients Contraindications:

1. Hypersensitivity toward iodinated contrast media
2. Diabetes mellitus
3. Asthma or other respiratory conditions
4. Multiple myeloma
5. Severe dehydration
6. Chronic or acute renal or hepatic disease

What is the pre-medication procedure to reduce risk?
May apply to patients with asthma, food allergy, hay fever, others
Follow department protocols
Prednisone, Benadryl 12 hrs prior

Radiographer Responsibilities

1. Patient history
   - Clinical complaints
   - Food or drug allergies?
   - Previous contrast media reaction?
   - Asthma, hay fever, or hives?
Patient History

- Check blood chemistry – normal ranges
  - Creatinine level (adult) – 0.6 to 1.5 mg/dl
  - BUN levels (adult) – 8 to 25 mg/100 ml

Patient History (continued)

Management of non-insulin dependent diabetes – Glucophage (metformin hydrochloride)

- Check chart or ask patient
  - Are you currently taking Glucophage?
  - To be withheld 48 hours before and 48 hours following iodinated contrast media procedure

Patient Preparation for an IVU

1. Light evening meal prior to procedure
2. Bowel-cleansing cathartic
3. NPO after midnight
4. Enema morning of examination
5. Void prior to procedure
Venipuncture Supplies

Remove Needle or Catheter

- Apply pressure over injection site

Side Effect vs. Reaction

Side effects:
- An expected outcome to injected contrast media
- Common side effects
  - Temporary hot flash
  - Metallic taste in mouth

Reaction:
- An unexpected outcome to injected contrast media
Radiographer Responsibilities

1. Patient history
2. Selection and preparation of contrast media
3. Preparation for possible reaction
   - Fully stocked emergency cart (epinephrine available)
   - Cardiopulmonary resuscitation equipment
   - Oxygen and suction available

Categories of Contrast Media Reactions

1. Vasomotor Effect: Non-allergic reaction often based on fear or anxiety (usually a non-threatening condition)
   Symptoms
   - Anxiety
   - Lightheadedness
   - Nausea
   - Syncope
   - Mild urticaria

Categories of Contrast Media

2. Anaphylactic Reaction: True allergic reaction (may lead to a life-threatening condition)
   Symptoms
   - Moderate to severe urticaria
   - Laryngospasm
   - Bronchospasm
   - Angioedema
   - Hypotension
   - Tachycardia (>100 beats per minute)
3. Vasovagal Reaction: Contrast agent stimulates vagus nerve (a life-threatening condition)
   Symptoms
   • Hypotension (<80 mm Hg)
   • Bradycardia (<50 bpm)
   • No detectable pulse (declare medical emergency)

4. Acute Renal Failure: Kidneys shut down
   Symptoms
   • Diminished urine output
   • Anuria

Severity Levels of Reactions

Mild Reactions
(Self-Limiting)
- Nausea and vomiting
- Hives (urticaria)
- Itching
- Sneezing
- Extravasation
- Vasovagal response
Moderate Reactions
(Requires medication)

1. Excessive urticaria
2. Tachycardia
3. Giant hives
4. Excessive vomiting

Technologist Responsibilities During Moderate Reactions

1. Call for medical assistance
2. Monitor and comfort patient
3. Document patient reaction

Severe Reactions!
(Requires Immediate Treatment)

- Very low B/P
- Cardiac or respiratory arrest
- Loss of consciousness
- Convulsions
- Laryngeal edema
- Cyanosis
- Difficulty in breathing
- Profound shock
Excretory Urography – IVU

Correct term
- Intravenous Urogram – IVU: Radiographic examination of the urinary system

Purpose of IVU (two-fold)
1. Visualize the collecting portion of the urinary system
2. Assess the functional ability of the kidneys (a timed procedure)

Ureteric Compression

- A method to enhance filling of pelvicalyceal system

Ureteric Compression
Correct placement of inflated paddles

- Stones
- Mass
- Aneurysm
- Surgery
- Pain
- Trauma

- Review the six contraindications for using ureteric compression.
Trendelenburg Position
Alternative to Ureteric Compression

IVU – Basic Routine
- Scout radiograph
- Injection
  - Note time at beginning of injection
- Sample Imaging Routine
  - 1 min. nephrogram or nephroangiography
  - 5 min. AP supine
  - 15 min. AP supine
  - 20 min. posterior obliques
  - Post-void (prone or erect)

Common Variations to IVU Routine
1. Post-release or “spill” procedure
2. Delayed radiographs
3. Erect bladder projection
### Nephrogram or Nephrotomogram

Radiographs taken early in study to demonstrate the renal parenchyma or functional portion of the kidney.
- Timing critical
- Nephrogram
- Single radiograph (1 min.)
- Nephrotomogram
- Series of tomograms starting at 1 min.

![Nephrotomogram-1 min.]

### Hypertensive IVU

Purpose: IVU for patients with high blood pressure
- Radiographs taken every minute up to five minutes
- After five minute IR, standard IVU routine

### IVU

**Basic**
- AP scout and series (5 and 15 min.)
- Nephrotomography (1 min.)
- RPO and LPO (20 min.)
- AP post-void

**Special**
- AP ureteric compression
**IVU–AP Projection**

- No rotation
- CR to level of iliac crest (include symphysis pubis)

**Criteria: (AP IVU)**

- Entire urinary system demonstrated
- No rotation
- No motion
- Appropriate technique employed
- Minute market visible

**Nephrotomogram and Nephrogram**

- No rotation
- CR midway between xiphoid and iliac crest
Criteria: (Nephrotomogram)

- Entire renal parenchyma visualized
- No motion
- Appropriate technique employed
- Specific level markers visible

Linear Tomography

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AP with Ureteric Compression

Special
- AP ureteric compression

- CR at level of iliac crest, or alternate centering to kidneys
- Compression device medial to ASIs

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Criteria: (AP with Ureteric Compression)

- Upper urinary system demonstrated with enhanced pelvic calyceal and proximal ureter filling
- No rotation
- No motion
- Appropriate technique employed
**IVU—Posterior Obliques**

- Basic
  - AP
  - Nephrotomogram
  - Posterior oblique

- CR at level of iliac crest

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**Criteria:**

(Posterior Oblique)

- Elevated side: Kidney is parallel to plane of IR
- Downside: Ureter is free of superimposition from spine
- Entire urinary system is visualized
- No motion
- Appropriate technique employed
- Minute marker visible

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**AP (PA) Post-Void**

- Basic
  - AP
  - Nephrotomogram
  - Posterior oblique
  - AP (PA) post-void

- CR at level of iliac crest
- Include symphysis pubis
Criteria:
(AP Erect Post-Void)

- Entire urinary system demonstrated
- All of symphysis pubis is included
- No rotation
- No motion
- Appropriate technique employed
- Erect/post-void markers visible

Retrograde Urography

- Performed in surgery
- Contrast media delivered retrograde through catheter

Retrograde Urography Procedure

- Scout radiograph taken
- Series of radiographs taken as requested
- Ureterogram taken once catheter has been removed
Retrograde Cystography

- Contrast media delivered through catheter
- Gravity flow of contrast media
- 15-500 cc

Cystogram

- Basic
  - AP
  - Posterior oblique

  - CR 2 in. (5 cm) superior to symphysis pubis

Left Lateral Cystogram

- Optional projection due to high gonadal dose
Voiding Cystourethrography

Purpose: Functional study of the bladder and urethra
- Performed after routine cystogram
- Catheter removed and imaged while voiding

Female—AP
Male—30° RPO

Voiding Cystourethrography (VCUG)

Technical and Positioning Factors
- IR size: 25–35 cm. (10–12 in.), lengthwise
- 70-75 kV, grid
- CR perpendicular to symphysis pubis

Female
- AP, supine or erict
- Extend and slightly separate legs

Male
- Recumbent or 30° RPO
- Superimpose urethra over right thigh