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Solved Papers
Radiodiagnosis
for PG Students

A must for MD, DNB and DMRD Radiodiagnosis Students

Soumik Das

Foreword
Barindranath Mallick

JAYPEE

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CHAPTER

5 Genitourinary Imaging

Kasturi Rakshit

QUESTIONS

Imaging Techniques

1. Write short note on: CT urography and MR urography. [5] [MD (WBUHS) 24, MD (WBUHS) 22, [MD (WBUHS) 18, DNB Dec 18]
2. MR urography, technique, application, advantages and disadvantages. [10] [DNB June 22]
3. Technique, imaging sequences and clinical application of MR urography. [3+3+4] [MD (WBUHS) 18, DNB Dec 20]

Renal Infections

1. Describe the imaging findings in nontubercular renal infections. [10] [MD (WBUHS) 19]
2. Write short notes on: (a) Emphysematous pyelonephritis. (b) Horseshoe kidney. [5+5] [MD (WBUHS) 22]
3. Pathophysiology, X-ray, USG and CT in genitourinary TB. [10] [DNB June 22, AIIMS May 23, AIIMS Dec 24]

Tumors of the Urogenital Tract

1. Imaging modalities of renal neoplasm with special reference to PET scan. [10] [MD (WBUHS) 19]
2. Various benign and malignant solid renal masses. Imaging features of malignant solid renal masses. [10] [DNB Dec 21, AIIMS Dec 23]
3. Draw and discuss—T-staging of bladder tumors. [5] [DNB Dec 21]

Lower Urinary Tract

1. Discuss role of IVU, CT urography, MR urography in obstructive uropathy. [10] [MD (WBUHS) 20]
2. IVU in the diagnosis of posterior urethral value. [10] [MD (WBUHS) 19]
3. Discuss the types of urinary bladder trauma and role of imaging in diagnosis and management of such cases. [4+6]
4. A 74-year-old with urinary incontinence-approach and role of imaging. [10] [DNB June 22]
5. Draw and discuss—male urethral injury. [5] [DNB Dec 21]
6. Describe TNM staging of bladder cancer. Draw a schematic diagram of T-staging of bladder tumor. Enumerate the role of ultrasound, computed tomography and MRI in the diagnosis and staging of the bladder carcinoma. [2+2+(2+2+2)] [DNB June 20, MD (WBUHS) 18]

Miscellaneous Urinary Tract Lesions

1. Write short note on nephrocalcinosis. [5] [MD (WBUHS) 20]
2. Discuss briefly the role of imaging in a 40-year-old female presenting with hematuria. [10] [MD (WBUHS) 24]

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3. Causes of nephrocalcinosis and imaging. [10] [DNB June 22]
4. (a) Bosniak classification of renal cyst 2019 (b) syndromic association of renal cyst in adult. [10] [DNB June 21]
5. Describe approach to a patient in renal trauma with a flowchart and discuss the role of imaging with grades of renal injury. [4+6] [MD (WBUHS) 18, AIIMS May 24]

Retroperitoneum

1. Discuss the retroperitoneal anatomy with suitable diagram. Discuss the common retroperitoneal tumors and appropriate radiological modalities to evaluate them. [4+3+3] [MD (WBUHS) 23, RG 18, AIIMS May 24]
2. Describe retroperitoneal compartments and their contents in reference to medical imaging. [10] [MD (WBUHS) 20]
3. Classify adrenal tumors with their radiological features. [10] [MD (WBUHS) 19]
4. Discuss in brief the imaging modalities in the diagnosis of adrenal lesion. [10] [MD (WBUHS) 22, RG 18]
5. Enumerate the imaging modalities used for adrenal lesions. Describe in brief the CT scan protocol and systematic approach to evaluate adrenal lesions. [2+(3+5)] [MD (WBUHS) 24, MD (WBUHS) 18]
6. (a) Radiological anatomy of retroperitoneum. (b) Cross-sectional imaging in retroperitoneal liposarcoma. [10] [DNB June 21]
7. (a) Imaging evaluation of a patient with Cushing's syndrome. (b) Role of imaging in differentiating adrenal adenoma from adrenal metastasis. [5+5] [DNB Dec 20]

Interventions

1. Discuss the indications and procedure of percutaneous nephrostomy. [3+7] [MD (WBUHS) 23, MD (WBUHS) 17]
2. Classify renal injuries, imaging features and intervention in them. [3+4+3] [MD (WBUHS) 21]
3. What are the indications of embolization in genitourinary tract? Describe the technique of renal artery angioplasty and stenting. [5+5] [MD (WBUHS) 22]

Diseases of Female Pelvis

1. Classify morbid adhesions of placenta. Write down USG findings in ectopic pregnancy. [5+5] [MD (WBUHS) 23]
2. Describe the role of USG and Doppler studies in IUGR. [5+5] [MD (WBUHS) 23, AIIMS Dec 23]
3. Discuss the indications and the procedure of uterine artery embolization. [3+7] [MD (WBUHS) 23, AIIMS Dec 23]
4. Briefly describe development of uterus in reference to different uterine malformations. [10] [MD (WBUHS) 20, AIIMS Dec 23]
5. Write short note on imaging of placenta previa. [5] [MD (WBUHS) 20]
6. Discuss USG in IUGR. [10] [MD (WBUHS) 20]
7. Discuss role of imaging in a suspected case of ectopic pregnancy. [10] [MD (WBUHS) 20]
8. Write short note on: (a) PNDT ACT. (b) Role of Doppler in IUGR. [5+5] [MD (WBUHS) 19]
9. List various causes of female infertility. Discuss the role of HSG and MRI in their evaluation. [2+4+4] [MD (WBUHS) 21]
10. Classify the cystic pelvic lesions in middle-aged female patient. Discuss the imaging features of common cystic lesions. [4+6] [MD (WBUHS) 22, MD (WBUHS) 18]
11. Discuss the role of various imaging modalities in detection of congenital anomalies of the fetus with their advantages and disadvantages. [10] [MD (WBUHS) 22]
12. What are the indications of 1st trimester ultrasound? Briefly discuss the assessment of fetal congenital anomalies by first trimester ultrasound. [4+6] [AIIMS May 24]
13. Discuss the imaging evaluation and differential diagnosis in a 60-year-old woman with postmenopausal bleeding. [4+6]
14. What is fetal growth restriction? Discuss the role of ultrasound and Doppler in its diagnosis and management. [2+8]

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15. Uterine artery Doppler in pregnant female. [5]
16. Right pelvic pain in a woman—causes and imaging. [10] [DNB June 22]
17. USG in ectopic pregnancy. [10] [DNB June 22]
18. Role of USG, CT and MRI in endometrial carcinoma. [10] [DNB Dec 21, DNB Dec 18]
19. Role on USG and MRI in morbidly adherent placenta. [10] [DNB Dec 21, AIIMS May 23]
20. Bleeding PV at 18 weeks. Causes and imaging findings. [5] [DNB Dec 21]
21. Oligohydramnios. [5] [DNB Dec 21]
22. MRI in Ca cervix. [5] [DNB Dec 21, AIIMS May 24]
23. Antenatal MRI—indications, safety and protocols. [5] [DNB Dec 21]
24. Different variety of gestational trophoblastic disease and role of imaging. [10] [DNB June 21]
25. (a) Imaging evaluation of female presented with infertility. (b) MRI imaging feature of uterine adenomyosis. [10] [DNB June 21, AIIMS May 23]
26. (a) MRI evaluation method in ovarian mass. (b) Differentiating features of benign and malignant ovarian mass on USG and MRI. [10] [DNB June 21]
27. (a) Enumerate the causes of acute pelvic pain in a young female patient. (b) Role of imaging in ovarian torsion. [4+6]
28. Enumerate various causes of postmenopausal bleeding in a 60-year-old female. Discuss the role of imaging in evaluation of endometrial carcinoma and its management based on staging. [2+(5+3)] [MD (WBUHS) 24]
29. Describe imaging algorithm in a suspected case of ectopic pregnancy. Describe role of imaging in differentiating three common clinical mimics of ectopic pregnancy. [5+5] [MD (WBUHS) 24, DNB June 20]
30. Describe various indications, protocol, advantages, and disadvantages of fetal MRI. [2+3+3+2] [DNB June 20]

Prostrate

1. Imaging of prostate cancer with regards to TRUS and MRI. [5+5] [MD (WBUHS) 23]
2. Describe the protocols and MR imaging features in prostatic carcinoma. [3+7] [MD (WBUHS) 21]
3. Discuss multiparametric MR imaging of the prostate. [10] [MD (WBUHS) 21]
4. Discuss in brief about radiological anatomy of prostrate with its radiological implications. [5+5] [MD (WBUHS) 22]
5. Draw cross-sectional anatomy of prostate. Discuss briefly the role of MRI in prostate pathologies. [2+5] Discuss PIRADS. [3] [MD (WBUHS) 24]

Scrotum and Male Sexual Dysfunction

1. Discuss the role of sonogram in various scrotal pathologies. [10] [MD (WBUHS) 19]
2. What are the common causes of a young adult presenting with acute unilateral scrotal pain and swelling? Discuss the ultrasound/Doppler evaluation of such cases. [5+5] [MD (WBUHS) 22, MD (WBUHS) 17, AIIMS May 24]
3. Color Doppler in testicular torsion. [5]
4. Role of radiology in erectile dysfunction. [10] [DNB June 22]
5. (a) Describe various causes and role of imaging modalities in male infertility. (b) Role of sonography in erectile dysfunction. [(3+3)+4] [AIIMS Dec 24, AIIMS Dec 23]

Vascular Diseases

1. What are the common types of renal artery dysplasia with its clinical features? What are the angiographic features of FMD? [10] [MD (WBUHS) 19]
2. Imaging in renal artery stenosis. [5] [DNB Dec 21, MD (WBUHS) 24]
3. Discuss imaging features of renal artery stenosis on ultrasonography and MR angiography and briefly the role of interventions in its management. [3+3+4] [MD (WBUHS) 24, AIIMS Dec 24]

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Recent Advances

1. Discuss radiological evaluation of renal transplant donor. [10] [MD (WBUHS) 20]
2. How would you evaluate donor kidney for renal transplant. Discuss role of ultrasonography and scintigraphy in various types of renal graft dysfunction. [4+3+3] [MD (WBUHS) 21]
3. Briefly discuss USG features of renal transplant. [10] [MD (WBUHS) 19]
4. Briefly discuss the role of ultrasound Doppler in postoperative evaluation of AV fistula for dialysis. [5]
5. Role of imaging in management of renal transplant patient. [10] [DNB June 22]
6. (a) Imaging workup of a potential renal donor. (b) Imaging evaluation of vascular complications of a transplant kidney. [5+5] [DNB June 20]

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ANSWERS

Imaging Techniques

1. Write short note on: CT urography and MR urography. [5] [MD (WBUHS) 24, MD (WBUHS) 22, [MD (WBUHS) 18, DNB Dec 18]

CT Urography

Introduction

It is an examination to evaluate the genitourinary tract. Renal parenchyma and urothelium both can be evaluated.[1]

Indications

- Hematuria
- Urolithiasis
- Urothelial thickening
- Renal neoplasm
- Ureteric lesions
- Pelviureteric junction obstruction
- Congenital anomalies

Patient Preparation

- Oral administration of 1 L of water for diuresis and better delineation of the ureters.
- Diuretics and saline infusion can be used.

Technique and Protocol

Two approaches to perform CT urography:

1. CT hybrid urography:
   - It combines CT urography and intravenous urography (IVU).
   - Uses projection radiographs (scout image, scanogram).
   - Post-processing of CT images not required.
   - CT urography and IVU performed at different locations (not preferred) or same location (preferred) by ceiling mounted X-ray tube.
   - Bowel preparation required.
2. CT only—CT urography **(Table 1)**
   - Bowel preparation not required.
   - Post-processing of CT images is required.
   - 125 mL IV contrast medium followed by 250 mL saline administration.
   - MPR of excretory—phase images using MIP and volume rendering.

TABLE 1: CT urography protocol.

Phase	*Timing*	*Range*	*Slice thickness*	*What to detect*
Non-enhanced	Pre-contrast	Lung bases to pubic symphysis	5 mm	Calculi. Hemorrhage/hemorrhagic cysts
Nephrogram	100 sec	Lung bases to pubic symphysis	3 mm	Renal tumors, renal vein thrombosis
Excretory	5–8 min	Lung bases to base of bladder	2 or 3 mm	Papillary necrosis, urothelial carcinoma

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There are two techniques:

1. Multiphase and
2. Split bolus

Phases of multiphase CT urography

- Non-contrast
- Nephrographic (80–100 seconds)
- Excretory phase (7–12 minutes)

Split Bolus Technique

- At first, nonenhanced scan is obtained.
- 30–50 mL of intravenous contrast given.
- After 8–10 minutes, 80–100 mL of intravenous contrast given.
- Then after 90 seconds, scan is done.
- Images have combined nephrographic and excretory phases.

Applications

- To detect calculi and resultant obstructive changes.
- To detect hemorrhage in collecting system and within cysts.
- To assess renal tumors, their characterization and extent.
- To evaluate renal vein thrombosis, IVC thrombosis and its extent.
- To detect papillary necrosis and assess its cause and urothelial carcinoma.
- Perinephric and periureteral fat stranding can be seen.

Advantages

- High contrast and spatial resolution.
- Detection of pathologies (listed above).

Disadvantages

- Use of ionizing radiation.
- Use of large amount of contrast.
- Detection of small plaque like thickening of bladder and those near the neck, is difficult.

MR Urography

Introduction

MR urography (MRU) is a noninvasive examination for the assessment of abnormalities of the urinary tract. Both anatomical and functional status can be assessed.[2]

Indications

- Congenital anomalies
- Obstructive uropathy
- Pregnant patients and children requiring imaging of the urinary tract.
- Deranged renal function
- Hematuria

Technique and Protocol

- **Magnet**: 1.5 or 3T
- **Coil**: Eight channel phase array body coil.

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There are two types of MR urography:

1. Static fluid MRU (based on T2 W imaging)
2. Excretory MRU (based on T1 W imaging)

Sequences

- **Precontrast**:
  - Localizer—axial, sagittal, coronal
  - 2D T2 FSE—axial, coronal
  - 2D T2 FS FSE—coronal
  - 3D SSFSE OR HASTE (post diuretic)—coronal
  - 3D T1 FS GRE (precontrast)—axial
  - CINE (T2 SSFSE)
- **Postcontrast**: 3D T1 FS GRE (20sec, 45 sec and 5 min)—axial
- **Post-processing**:
  - Maximum intensity projection images—with thin and thick slab
  - Volume rendered images

Patient Preparation

- Intake of fluid is restricted for four hours prior to the commencement of the examination.
- Voiding before the examination to avoid discomfort.
- Administration of 250 mL of intravenous normal saline for distension of collecting system.
- Administration of furosemide (0.1 mg/kg) may be considered.
- Excretory MRU—administration of 0.1 mmol/kg of gadolinium followed by 15–20 mL saline push.

Advantages

- No ionizing radiation is used.
- Ureteral peristalsis can be seen by CINE images as intermittent distention and collapse.
- The level of complete or partial obstruction is determined.
- It can provide anatomical and structural details and details of anomaly if any.
- Assessment of function can also be done as normal renal parenchyma and bladder wall enhance showing the different phases.
- Minimal ascites, perirenal and periureteral edema can also be seen in static fluid MR urography since it is heavily T2 weighted.
- Static fluid MR urography does not use contrast, so it can be used in patients with deranged renal function as well as in pediatric and pregnant patients.

Disadvantages

- Less spatial resolution than CT urography.
- Presence of fluid in the bowel and metal artifacts may interfere with interpretation of the images.
- Bowel and ureteral peristalsis can create artifacts.
- Time-consuming process and requires expertise.
- Difficult for pregnant patients to lie down so long in the machine.
- Air introduced due to any intervention is difficult to differentiate from calculi.
- Small calculi can be missed.

Static MRU: Cannot assess the excretory function.

Excretory MRU: Cannot be used in patients having derangement in excretory function, such as anuric patients.

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Applications

- Anomalies of urinary tract—duplex kidney, horseshoe or ectopic kidney.
- For assessment of urinary tract obstruction—its cause, extent and level.
- For assessment of hematuria and determine its cause.
- Imaging modality of choice in children and pregnant patients.
- Imaging modality of choice in case of deranged renal function and allergy to iodinated contrast.
- Preoperative and postoperative assessment.

2. MR urography, technique, application, advantages and disadvantages. [10] [DNB June 22]

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3. Technique, imaging sequences and clinical application of MR urography. [3+3+4] [MD (WBUHS) 18, DNB Dec 20]

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- Imaging modality of choice in children and pregnant patients.
- Imaging modality of choice in case of deranged renal function and allergy to iodinated contrast.
- Preoperative and postoperative assessment.

Renal Infections

1. Describe the imaging findings in nontubercular renal infections. [10] [MD (WBUHS) 19]

Routinely imaging is not done in infections unless there is:

- Obstruction or complications, such as abscesses, emphysematous pyelonephritis
- Immunocompromised patient
- Diabetic patient
- Postrenal transplant patient
- Failure to respond to antibiotics within 72 hours.

Modality of choice for adults: Contrast enhanced CT
Modality of choice for children: Ultrasound

Acute Pyelonephritis

Introduction

- Acute infection of renal pelvis and parenchyma without formation of abscess.[3]
- Focal or diffuse
- Unilateral or bilateral

Sex predilection: Females > males

Causative Organisms

- *E. coli* (most common)
- *Proteus*
- *Klebsiella*
- *Pseudomonas*
- *H. influenzae*
- *Enterobacter*

Ultrasound

- Low sensitivity
- Enlarged kidney
- Echogenic perinephric and renal sinus fat
- Dilated collecting system
- Urothelial thickening
- Bladder wall thickening ≥2 mm in distended bladder and ≥5 mm in nondistended state.
- Significant PVRU

Modality of choice: Contrast enhanced CT

- Anatomical and functional information of kidney
- Intra- and extrarenal pathology

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NCCT:
To look for:
- Calculi
- Obstruction
- Gas
- Hemorrhage

CECT-CT urography protocol:
- Renal enlargement may/may not be present.
- Enlarged kidney—right kidney >1.5 cm than left kidney, left kidney >2 cm than right kidney.
- Striated nephrogram—nonenhancing hypodense bands extending from medulla to the cortex alternating with the normally enhancing parenchyma, caused due to adjacently located normal and obstructed tubules.
- Wedge-shaped hypodense areas—renal capsule is not spared.
- Perinephric fat stranding

[To be differentiated from renal infarct:
  - Cortical rim sign—renal capsule is spared because capsular artery branches earlier.
  - Clinical features are different]
- Delayed persistent enhancement
- Focal form—hypodense rounded lesions and abscess
- Diffuse form—diffuse involvement of kidney

MRI

Modality of choice of pregnant and pediatric patients **(Table 2)**.

TABLE 2: Various magnetic resonance imaging sequences that can be used in assessing acute pyelonephritis.

Sequences	*Description*
Non-contrast	Affected regions in the kidney appear hyperintense on T2-weighted imaging and hypointense on the T1 sequence. reflecting edema within the renal parenchyma
Postgadolinium-based contrast	Correctly depicts the regions of involvement. The findings on MRI follow those of CT namely, increased renal size. perinephric fat stranding, and fluid, and striated nephrograms
Gadolinium-enhanced inversion recovery	Because of tubular obstruction and stasis, less amount of gadolinium accumulates in the affected region of the kidney while the rest of the healthy kidney that is normally perfused shows a much higher signal drop, making the affected region stand out against a backdrop of a generalized signal drop
MRU	Used when an obstruction is suspected
Diffusion-weighted imaging	Areas of pyelonephritis show significantly lower apparent diffusion coefficient values than that of in the normal renal parenchyma

Chronic Pyelonephritis

Introduction
- Occurs due to recurrent or chronic infection to kidney, resulting in fibrosis and scarring of renal pelvis and calyces.
- **Most common cause**: Reflux nephropathy.
- Associated with vesicoureteral reflux in childhood.

Imaging Features
- Decreased size of kidney
- Irregular outline of kidney and architectural distortion.
- Focal parenchymal scars with cortical thinning.
- Underlying calyceal clubbing
- Hypertrophy of residual tissue and perinephric fat.

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Solved Papers
Radiodiagnosis
for PG Students

Salient Features

- A must-read for MD, DNB, and DMRD Radiodiagnosis students.
- *Solved Papers Radiodiagnosis for PG Students* is a unique, one-of-its-kind comprehensive text dedicated to students of Radiodiagnosis appearing for their final MD, DNB and DMRD examinations.
- Provides a comprehensive and valuable review question-answer format designed to assist exam-going residents in the subject of Radiodiagnosis with their theory examination preparation.
- The questions over the last 5 years have been classified topic wise at the beginning of each chapter.
- The relevant answers are in line with the standard textbooks of "Radiodiagnosis" presented in a lucid point-wise manner with schematic diagrams and flowcharts as necessary that can be easily understood, remembered, revised prior to the examinations, and represented in the answer within the time constraints of the examination.

Soumik Das MD(Radiodiagnosis) DNB(Radiodiagnosis) DM(Neuroimaging and Interventional Radiology) is presently attached as an Assistant Professor in the Department of Radiodiagnosis, Institute of Postgraduate Medical Education and Research, Kolkata, West Bengal, India. He was born in Kolkata. After completing higher secondary examination from the prestigious Ramakrishna Mission Residential College, Narendrapur, he got admission into Medical College Kolkata for MBBS course in 2005. After obtaining MBBS degree, he joined as a housestaff in the Department of Pediatrics for 1 year. He stood first in MD entrance examination conducted by the West Bengal University of Health Sciences in 2012 and took admission in MD Radiodiagnosis course in Medical College Kolkata. He has passed Fellowship of Royal College of Radiologists (FRCR) Part 1 and 2A in 2014–2015. He was the winner of a state-level quiz competition conducted by ISVIR in 2014. After obtaining MD Radiodiagnosis degree, he joined National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru (Bangalore), for a DM degree in Neuroimaging and Interventional Radiology in 2015. Under the proper guidance of Professor Arun Kumar Gupta, he became skilled in diagnostic as well as interventional radiology. After successful completion of this course, Dr Soumik started to work as a Consultant Radiologist in Institute of Neurosciences, Kolkata in 2018. He also obtained a DNB in Radiodiagnosis degree conducted by National Board of Examinations, New Delhi in 2020.

Dr Soumik is a member of Indian Radiological and Imaging Association (IRIA), Indian Society of Vascular and Interventional Radiology (ISVIR), Indian Society of Neuroradiology (ISNR), Society of Therapeutic Neurointerventions (STNI), and National Academy of Medical Sciences (MNAMS). He has several publications in many national and international journals. He has also contributed a chapter—*Pitfalls in the Diagnosis of Brain Tumors: A Neuroradiologist's Perspective* in the prestigious book titled *Pitfalls in the Diagnosis of Neurological Disorders* by Ambar Chakravarty, published by Jaypee Brothers Medical Publishers Pvt Ltd in 2022.

During his preparation for final MD Radiodiagnosis examination in 2015, Dr Das had felt the need for a comprehensive question-answer book useful for theory examination preparation. He hopes that this book will be useful for preparation of final MD and DNB examinations.

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