



Radio-Diagnosis

RADIOLOGICAL SPECTRUM OF TUBERCULOSIS: A CASE SERIES HIGHLIGHTING PULMONARY AND EXTRA PULMONARY IMAGING MANIFESTATIONS

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ABSTRACT

Background: Tuberculosis (TB) remains a major global health problem, particularly in developing countries, with pulmonary and extra pulmonary forms contributing significantly to morbidity and mortality. Owing to its diverse clinical and radiological manifestations, TB often poses a diagnostic challenge. Multimodality imaging plays a crucial role in the early diagnosis, assessment of disease extent, detection of complications, and guidance for appropriate management. **Objective:** To highlight the diverse radiological manifestations of pulmonary and extrapulmonary tuberculosis through a series of illustrative cases and emphasize the role of imaging in facilitating early diagnosis and timely treatment. **Methods:** This educational case series presents seven patients with microbiologically confirmed tuberculosis involving different organ systems. Clinical presentation, imaging findings from chest radiography, ultrasonography, computed tomography (CT), and magnetic resonance imaging (MRI), microbiological confirmation, and treatment outcomes were reviewed and summarized. **Results:** The case series included pulmonary tuberculosis, tuberculous cervical lymphadenitis, abdominal tuberculosis, hepatosplenic tuberculosis, central nervous system tuberculosis, spinal tuberculosis (Pott disease), and genitourinary tuberculosis. Characteristic imaging findings included upper lobe cavitary lesions with tree-in-bud nodules, necrotic rim-enhancing lymph nodes, ileocecal wall thickening with mesenteric lymphadenopathy, multiple hepatic and splenic microabscesses, basal meningeal enhancement with intracranial tuberculoma, vertebral body destruction with paravertebral abscess formation, and calyceal deformity with ureteric stricture. Imaging findings correlated well with microbiological confirmation and were instrumental in establishing the diagnosis and guiding patient management. **Conclusion:** Tuberculosis demonstrates a broad spectrum of imaging manifestations involving multiple organ systems. Familiarity with these characteristic radiological features enables prompt diagnosis, facilitates microbiological confirmation, guides therapeutic decision-making, and improves patient outcomes. A multimodality imaging approach remains indispensable in the evaluation of both pulmonary and extrapulmonary tuberculosis.

KEYWORDS : Tuberculosis; Pulmonary tuberculosis; Extrapulmonary tuberculosis; Computed tomography; Magnetic resonance imaging; Ultrasonography; Case series.

INTRODUCTION

Tuberculosis (TB) remains one of the leading causes of infectious disease-related morbidity and mortality worldwide, particularly in low- and middle-income countries. Despite significant advances in microbiological diagnosis and effective antitubercular therapy, TB continues to pose a major public health challenge. Although pulmonary tuberculosis is the most common form and the principal source of disease transmission, extrapulmonary tuberculosis (EPTB) accounts for approximately 15–20% of all TB cases in immunocompetent individuals and up to 50% in immunocompromised patients. Owing to its diverse clinical presentations, TB is often referred to as the "great mimicker," making early diagnosis challenging.

Radiological imaging plays a pivotal role in the evaluation and management of tuberculosis. Conventional radiography, ultrasonography, computed tomography (CT), and magnetic resonance imaging (MRI) are invaluable in detecting disease, determining its extent, identifying complications, guiding image-guided interventions, and monitoring therapeutic response. Cross-sectional imaging, particularly CT and MRI, provides excellent anatomical detail and facilitates early recognition of both pulmonary and extrapulmonary involvement, thereby improving diagnostic accuracy and patient outcomes.

This case series highlights the diverse radiological manifestations of tuberculosis involving multiple organ systems, including the lungs, cervical lymph nodes, abdomen, liver and spleen, central nervous system, spine, and genitourinary tract. Through these illustrative cases, we emphasize the characteristic imaging findings and the complementary role of multimodality imaging in the diagnosis and management of pulmonary and extrapulmonary tuberculosis.

MATERIALS AND METHODS

This retrospective educational case series included seven microbiologically confirmed cases of tuberculosis evaluated at our institution between January 2024 and December 2025. Patients with pulmonary and extrapulmonary tuberculosis who underwent imaging with chest radiography, ultrasonography, computed tomography (CT), and/or magnetic resonance imaging (MRI) were included. Clinical

records, imaging findings, microbiological confirmation, treatment, and follow-up imaging were reviewed. Institutional ethical guidelines were followed, and patient identifiers were removed.

Ethics approval: The study was conducted in accordance with institutional ethical standards. Approval/waiver obtained from the Institutional Ethics Committee.

Patient consent: Written informed consent was obtained from the patients, or identifying information was removed in accordance with institutional policy.

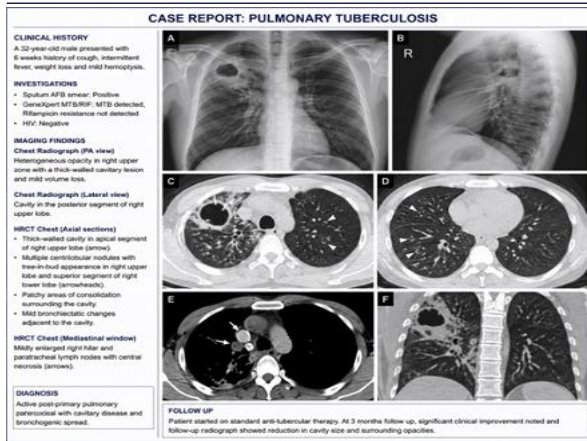
- **Conflict of interest:** None declared.
- **Funding:** None.

Case-1). Pulmonary Tuberculosis

A 32-year-old man presented with a 6-week history of persistent cough, intermittent fever, weight loss, and occasional hemoptysis. There was no significant past medical history. Laboratory investigations revealed an elevated erythrocyte sedimentation rate, and sputum GeneXpert detected *Mycobacterium tuberculosis* without rifampicin resistance.

Chest radiography demonstrated heterogeneous consolidation in the right upper lobe with a thick-walled cavitary lesion. High-resolution computed tomography (HRCT) of the chest revealed a thick-walled cavity in the apical segment of the right upper lobe, multiple centrilobular nodules with a tree-in-bud pattern indicating endobronchial spread, surrounding patchy consolidation, and mildly enlarged right hilar lymph nodes with central necrosis. No pleural effusion was identified.

Based on the clinical presentation, imaging findings, and microbiological confirmation, a diagnosis of active post-primary pulmonary tuberculosis was established. The patient was started on standard first-line antitubercular therapy. At the 3-month follow-up, there was significant clinical improvement with resolution of fever and hemoptysis. Follow-up imaging demonstrated marked reduction in the cavitary lesion and surrounding nodules, with residual fibrotic scarring in the right upper lobe, consistent with healing pulmonary tuberculosis.



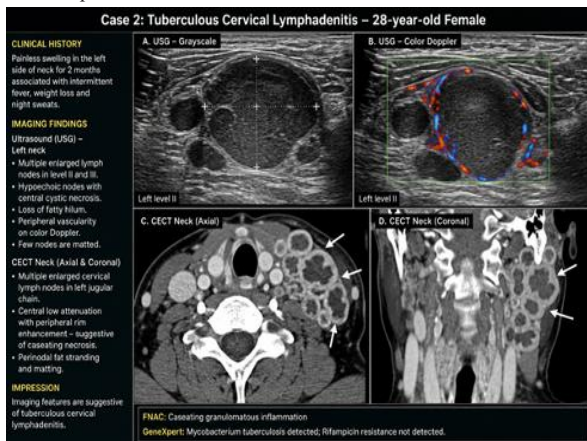
Case 2: Tuberculous Cervical Lymphadenitis

A 28-year-old woman presented with a gradually enlarging painless swelling on the left side of the neck for two months, associated with intermittent fever, weight loss, and night sweats.

Ultrasonography of the neck demonstrated multiple enlarged cervical lymph nodes with central necrosis, loss of the fatty hilum, and peripheral vascularity on color Doppler. Contrast-enhanced CT of the neck revealed multiple enlarged, matted cervical lymph nodes with central low attenuation and peripheral rim enhancement, consistent with caseating necrosis.

Ultrasound-guided fine-needle aspiration cytology showed granulomatous inflammation, and GeneXpert confirmed *Mycobacterium tuberculosis* without rifampicin resistance.

Based on the characteristic imaging findings and microbiological confirmation, a diagnosis of tuberculous cervical lymphadenitis was established. The patient was treated with standard antitubercular therapy and showed marked clinical and radiological improvement on follow-up.

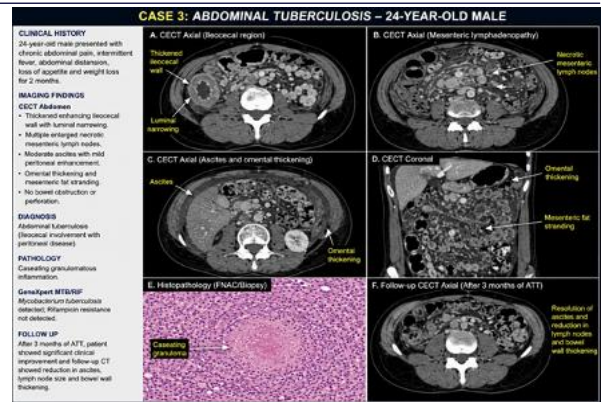


Case 3: Abdominal Tuberculosis

A 36-year-old woman presented with chronic abdominal pain, intermittent fever, abdominal distension, loss of appetite, and weight loss for three months.

Contrast-enhanced CT (CECT) of the abdomen demonstrated circumferential mural thickening of the ileocecal region with homogeneous enhancement, multiple enlarged necrotic mesenteric lymph nodes, mild high-density ascites, and diffuse omental thickening with adjacent mesenteric fat stranding. No evidence of bowel obstruction or perforation was noted.

Ultrasound-guided aspiration and histopathological examination revealed caseating granulomatous inflammation, while GeneXpert confirmed *Mycobacterium tuberculosis* without rifampicin resistance. Based on the characteristic imaging findings and microbiological confirmation, a diagnosis of abdominal tuberculosis involving the ileocecal region and peritoneum was established. The patient was started on standard antitubercular therapy and showed significant clinical and radiological improvement on follow-up.

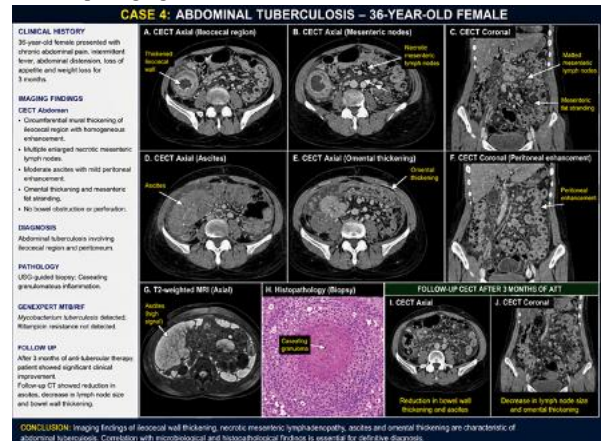


Case 4: Hepatosplenic Tuberculosis

A 42-year-old man presented with prolonged fever, generalized weakness, weight loss, and dull upper abdominal pain for two months. Physical examination revealed mild hepatosplenomegaly.

Contrast-enhanced CT (CECT) of the abdomen demonstrated mild hepatosplenomegaly with multiple small hypodense lesions scattered throughout the liver and spleen, suggestive of microabscesses. Multiple necrotic periportal and mesenteric lymph nodes were also noted. No biliary dilatation or focal hepatic mass was identified.

Ultrasound-guided aspiration from a periportal lymph node demonstrated caseating granulomatous inflammation, and GeneXpert confirmed *Mycobacterium tuberculosis* without rifampicin resistance. Based on the characteristic imaging findings and microbiological confirmation, a diagnosis of hepatosplenic tuberculosis was established. The patient was treated with standard antitubercular therapy and demonstrated marked clinical improvement with a reduction in the size and number of hepatic and splenic lesions on follow-up imaging.

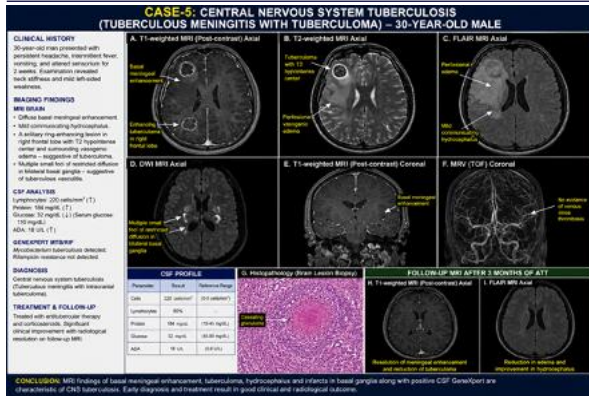


Case 5: Central Nervous System Tuberculosis (Tuberculous Meningitis with Tuberculoma)

A 30-year-old man presented with persistent headache, intermittent fever, vomiting, and altered sensorium for two weeks. Neurological examination revealed neck stiffness and mild left-sided weakness.

Contrast-enhanced MRI of the brain demonstrated diffuse basal meningeal enhancement, mild communicating hydrocephalus, and a solitary ring-enhancing lesion with a T2 hypointense center and surrounding vasogenic edema in the right frontal lobe, consistent with a tuberculoma. Multiple small acute infarcts were noted in the basal ganglia, suggestive of tuberculous vasculitis.

Cerebrospinal fluid analysis showed lymphocytic pleocytosis, elevated protein, and low glucose. GeneXpert detected *Mycobacterium tuberculosis* without rifampicin resistance. Based on the characteristic MRI findings and microbiological confirmation, a diagnosis of central nervous system tuberculosis (tuberculous meningitis with intracranial tuberculoma) was established. The patient was treated with antitubercular therapy and corticosteroids, resulting in significant neurological and radiological improvement on follow-up MRI.



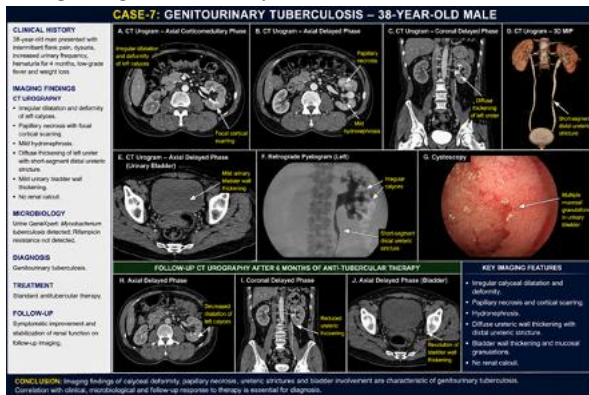
Case 6: Spinal Tuberculosis (Pott Disease)

A 45-year-old male presented with progressively worsening mid-back pain, low-grade fever, weight loss, and difficulty walking for three months. Neurological examination revealed mild weakness of both lower limbs.

MRI of the dorsolumbar spine demonstrated destruction of the D11 and D12 vertebral bodies with adjacent endplate erosions and reduced intervertebral disc height. A large prevertebral and paravertebral abscess with epidural extension caused significant spinal canal narrowing and mild cord compression. Post-contrast images showed peripheral rim enhancement of the abscess and enhancement of the affected vertebral bodies.

CT-guided aspiration from the paravertebral collection revealed caseating granulomatous inflammation, and GeneXpert detected *Mycobacterium tuberculosis* without rifampicin resistance.

Based on the characteristic imaging findings and microbiological confirmation, a diagnosis of spinal tuberculosis (Pott disease) was established. The patient was treated with standard antitubercular therapy, spinal immobilization, and surgical decompression. Follow-up MRI demonstrated resolution of the abscess, reduced inflammatory changes, and improvement in spinal canal compromise with corresponding clinical recovery.



Case 7: Genitourinary Tuberculosis

A 38-year-old male presented with intermittent flank pain, dysuria, increased urinary frequency, and occasional hematuria for four months. He also reported low-grade fever and weight loss.

Contrast-enhanced CT urography demonstrated irregular calyceal dilatation with calyceal deformity of the left kidney, papillary necrosis, focal cortical scarring, and mild hydronephrosis. Diffuse thickening of the left ureter with a short-segment distal ureteric stricture was noted. Mild urinary bladder wall thickening was also present. No renal calculi were identified.

Urine GeneXpert detected *Mycobacterium tuberculosis* without rifampicin resistance, and urine culture subsequently confirmed the diagnosis.

Based on the characteristic imaging findings and microbiological confirmation, a diagnosis of genitourinary tuberculosis was established. The patient was treated with standard antitubercular

therapy, resulting in symptomatic improvement and stabilization of renal function on follow-up imaging.



DISCUSSION

Tuberculosis (TB) remains a major global health challenge and continues to be one of the leading causes of infectious disease-related morbidity and mortality, particularly in developing countries. Although pulmonary tuberculosis is the most common presentation, extrapulmonary tuberculosis (EPTB) accounts for a significant proportion of cases and may involve virtually any organ system. The variable clinical presentation and nonspecific symptoms often delay diagnosis, making imaging an essential component in the evaluation and management of suspected tuberculosis.

This case series illustrates the broad radiological spectrum of tuberculosis involving the lungs, cervical lymph nodes, abdomen, hepatosplenic system, central nervous system, spine, and genitourinary tract. Despite the diversity of organ involvement, characteristic imaging findings enabled a high index of suspicion for tuberculosis, which was subsequently confirmed by microbiological or histopathological investigations in all cases.

Pulmonary tuberculosis remains the most common manifestation of active disease. In our series, the pulmonary case demonstrated classic imaging features, including upper lobe cavity disease, centrilobular nodules, and a tree-in-bud pattern, reflecting endobronchial spread. These findings are well recognized as hallmarks of active post-primary tuberculosis and are most accurately demonstrated on high-resolution CT. Chest radiography serves as an excellent initial screening tool; however, CT provides superior detection of early parenchymal disease, bronchogenic dissemination, and mediastinal lymphadenopathy.

Tuberculous cervical lymphadenitis is the most frequent form of extrapulmonary tuberculosis. The presence of enlarged matted lymph nodes with central necrosis and peripheral rim enhancement on ultrasonography and contrast-enhanced CT strongly suggested tuberculous lymphadenitis in our patient. Imaging also played an important role in guiding fine-needle aspiration for microbiological confirmation.

Abdominal tuberculosis commonly involves the ileocecal region, mesentery, and peritoneum. The combination of ileocecal wall thickening, necrotic mesenteric lymphadenopathy, ascites, and omental thickening observed in our series represents a characteristic imaging pattern. CT is particularly valuable in demonstrating bowel involvement, lymphadenopathy, and peritoneal disease while helping distinguish tuberculosis from Crohn disease, lymphoma, and gastrointestinal malignancy.

Hepatosplenic tuberculosis is an uncommon manifestation that may present with prolonged fever and constitutional symptoms. Multiple hypodense hepatic and splenic lesions associated with hepatosplenomegaly and necrotic periportal lymph nodes strongly suggested disseminated tuberculosis in our case. Although these findings may mimic metastatic disease or fungal infection, correlation with the clinical presentation and microbiological confirmation established the diagnosis.

Central nervous system tuberculosis is one of the most severe forms of extrapulmonary disease because of its high morbidity and mortality. MRI demonstrated basal meningeal enhancement, communicating

hydrocephalus, intracranial tuberculoma, and vasculitic infarcts, which are characteristic imaging findings of tuberculous meningitis. Early recognition is essential because delayed diagnosis may result in irreversible neurological deficits.

Spinal tuberculosis (Pott disease) predominantly involves the anterior vertebral bodies and intervertebral discs and frequently produces paravertebral and epidural abscesses. MRI proved invaluable in our patient by demonstrating vertebral destruction, epidural extension, spinal canal narrowing, and early spinal cord compression, thereby facilitating timely surgical planning and treatment.

Genitourinary tuberculosis often presents with chronic urinary symptoms and may lead to irreversible renal damage if left untreated. CT urography demonstrated calyceal deformity, papillary necrosis, cortical scarring, and ureteric stricture, which are classic imaging features of renal tuberculosis. Imaging was essential for evaluating the extent of disease and guiding subsequent management.

Collectively, these cases emphasize the complementary roles of different imaging modalities. Chest radiography remains an important first-line investigation for pulmonary disease. Ultrasonography is valuable for evaluating superficial lymph nodes, pleural collections, and abdominal pathology while facilitating image-guided procedures. Computed tomography offers excellent assessment of thoracic, abdominal, and genitourinary tuberculosis and accurately delineates disease extent and associated complications. Magnetic resonance imaging remains the modality of choice for evaluating central nervous system and spinal tuberculosis because of its superior soft-tissue contrast and ability to detect early disease.

The principal limitation of this case series is its retrospective design and the relatively small number of illustrative cases from a single center. Consequently, the findings are intended to demonstrate the imaging spectrum of tuberculosis rather than estimate disease prevalence or diagnostic performance. Nevertheless, the inclusion of microbiologically confirmed cases involving multiple organ systems provides valuable educational insight into the diverse radiological manifestations of tuberculosis.

CONCLUSION

Tuberculosis exhibits a remarkably diverse radiological spectrum that reflects its ability to involve almost every organ system. While chest radiography remains an essential initial investigation, CT provides superior evaluation of thoracic and abdominal disease, and MRI is indispensable for central nervous system and musculoskeletal involvement. Familiarity with characteristic imaging findings allows radiologists to suggest tuberculosis early, guide confirmatory testing, detect complications, and facilitate prompt treatment. A multimodality imaging approach, combined with clinical and microbiological correlation, remains the cornerstone of accurate diagnosis and optimal patient care.

TABLES:

Table 1. Clinical Characteristics of the Seven Cases

Case	Diagnosis	Age/Sex	Presenting Symptoms	Diagnostic Confirmation
1	Pulmonary Tuberculosis	32/M	Cough, fever, weight loss, haemoptysis	GeneXpert positive
2	Tuberculous Cervical Lymphadenitis	28/F	Painless neck swelling, fever, weight loss	FNAC + GeneXpert
3	Abdominal Tuberculosis	36/F	Abdominal pain, abdominal distension, fever, weight loss	Histopathology + GeneXpert
4	Hepatosplenic Tuberculosis	42/M	Fever, upper abdominal pain, hepatosplenomegaly	Lymph node biopsy + GeneXpert
5	Central Nervous System Tuberculosis	30/M	Headache, vomiting, altered sensorium	CSF GeneXpert
6	Spinal Tuberculosis (Pott Disease)	45/M	Back pain, fever, lower limb weakness	CT-guided aspiration + GeneXpert
7	Genitourinary Tuberculosis	38/M	Flank pain, dysuria, hematuria	Urine GeneXpert and urine culture

Table 2. Imaging Findings in the Case Series

Case	Imaging Modality	Principal Imaging Findings
1	Chest X-ray, HRCT	Thick-walled cavity, tree-in-bud nodules, consolidation, hilar lymphadenopathy
2	Ultrasound, CECT Neck	Necrotic cervical lymph nodes, peripheral rim enhancement, nodal matting
3	CECT Abdomen	Ileocecal wall thickening, necrotic mesenteric lymph nodes, ascites, omental thickening
4	CECT Abdomen	Hepatosplenomegaly, multiple hepatic and splenic microabscesses, necrotic periportal lymph nodes
5	Contrast MRI Brain	Basal meningeal enhancement, tuberculoma, hydrocephalus, basal ganglia infarcts
6	MRI Spine, CT	D11–D12 vertebral destruction, paravertebral abscess, epidural extension, spinal canal narrowing
7	CT Urography	Calyceal deformity, papillary necrosis, ureteric stricture, bladder wall thickening

Table 3. Organ System Involvement

Case	Organ System	Site of Disease
1	Respiratory	Lung parenchyma
2	Lymphatic	Cervical lymph nodes
3	Gastrointestinal	Ileocecal region and peritoneum
4	Hepatobiliary	Liver, spleen and periportal lymph nodes
5	Central Nervous System	Meninges and brain parenchyma
6	Musculoskeletal	Thoracolumbar spine (D11–D12)
7	Genitourinary	Kidney, ureter and urinary bladder

Table 4. Characteristic Radiological Signs

Disease	Characteristic Imaging Features
Pulmonary TB	Cavitary lesion, tree-in-bud nodules, upper lobe consolidation
Tuberculous Lymphadenitis	Central necrosis, rim enhancement, nodal matting
Abdominal TB	Ileocecal thickening, necrotic mesenteric lymph nodes, ascites, omental thickening
Hepatosplenic TB	Multiple hypodense hepatic and splenic lesions (microabscesses), hepatosplenomegaly
CNS TB	Basal meningeal enhancement, tuberculoma, hydrocephalus, vasculitic infarcts
Spinal TB	Vertebral body destruction, disc involvement, paravertebral abscess, epidural extension
Genitourinary TB	Calyceal deformity, papillary necrosis, ureteric stricture, bladder wall thickening

Table 5. Treatment and Outcome

Case	Treatment	Follow-up Outcome
1	Standard antitubercular therapy	Resolution of consolidation with residual fibrosis
2	Standard antitubercular therapy	Reduction in cervical lymph node size
3	Standard antitubercular therapy	Resolution of ascites and decrease in bowel wall thickening
4	Standard antitubercular therapy	Regression of hepatic and splenic lesions
5	Antitubercular therapy with corticosteroids	Resolution of meningeal enhancement and tuberculoma
6	Antitubercular therapy with spinal immobilization ± surgical decompression	Resolution of abscess and neurological improvement
7	Standard antitubercular therapy	Symptomatic improvement with stabilization of renal function

Table 6. Learning Points

Case	Key Learning Point
1	Tree-in-bud nodules with upper lobe cavitation strongly suggest active pulmonary tuberculosis.
2	Necrotic rim-enhancing cervical lymph nodes are highly suggestive of tuberculous lymphadenitis.
3	Ileocecal thickening with necrotic mesenteric lymphadenopathy is characteristic of abdominal tuberculosis.
4	Multiple hepatic and splenic microabscesses with hepatosplenomegaly should raise suspicion for hepatosplenic tuberculosis.
5	Basal meningeal enhancement with tuberculoma on MRI is highly suggestive of central nervous system tuberculosis.

6	MRI is the modality of choice for early diagnosis of Pott disease and assessment of epidural extension.
7	CT urography is valuable for demonstrating calyceal deformity, papillary necrosis, and ureteric strictures in genitourinary tuberculosis.

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