Clinical Imaging 39 (2015) 1056–1060

Contents lists available at ScienceDirect

Clinical Imaging

journal homepage: http://www.clinicalimaging.org

Computed tomography detection of clinically unsuspected skeletal tuberculosis☆,☆☆,★

Pankaj Gupta [a,1], Mahesh Prakash [a,*,1], Navneet Sharma [b], Rajinder Kanojia [c], Niranjan Khandelwal [a]

[a] Department of Radiodiagnosis and Imaging, Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh, 160012
[b] Department of Internal Medicine, Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh, 160012
[c] Department of Orthopedics, Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh, 160012

ARTICLE INFO

Article history:
Received 25 April 2015
Received in revised form 18 July 2015
Accepted 30 July 2015

Keywords:
Computed tomography
Skeletal tuberculosis
Spine
Tuberculosis

ABSTRACT

Objective: To report the frequency of clinically unsuspected axial skeletal tuberculosis (STB) and findings on computed tomography (CT).
Materials and methods: An evaluation of CT chest, abdomen, and pelvis of patients with tuberculosis was done. Bone window images were evaluated for skeletal involvement.
Results: Of the 726 CT studies, 34 (4.7%) patients had skeletal involvement. Thoracic spine was the most commonly affected site with involvement of body in 58% cases. Intervertebral disc involvement, soft tissue abscess, and epidural extension were identified in 83%, 53%, and 39% of cases, respectively.
Conclusion: Evaluation of bone window on CT can detect axial STB.

1. Introduction

Tuberculosis (TB) is a major health problem in developing countries [1]. Even in the developed countries, there is an upsurge in the cases of TB [2]. This is related to the pandemic of human immunodeficiency virus (HIV) infection. Skeletal tuberculosis (STB) comprises one third of all cases of extrapulmonary TB [3]. Spine is the most common site of STB [4]. The presentation of patients with STB is vague, leading to inadvertent delay in diagnosis. Imaging plays a crucial role in diagnosis of patients presenting with localising symptoms such as back pain. Magnetic resonance imaging (MRI) is the modality of choice for evaluation of patients suspected to have STB. Computed tomography (CT) has inferior soft tissue resolution and provides limited evaluation of spinal canal and, hence, is less frequently utilised. However, CT is highly sensitive in detecting soft tissue calcification, a pathognomonic feature of TB [5]. Moreover, CT is frequently performed in patients with suspected pulmonary or abdominal TB and can detect clinically unsuspected STB. Besides, CT allows planning of image-guided fine needle aspirations or biopsies to establish the diagnosis.

The imaging appearance of STB including tubercular spondylitis on CT and MRI has been extensively reviewed [3,6,7]. However, in the present study, we aimed to detect the skeletal changes in patients not clinically suspected to have STB who underwent CT studies for evaluation of TB in chest and/or abdomen [(Ab)]. The role of CT in detection of clinically unsuspected STB has not been reviewed previously.

2. Material and methods

We conducted a retrospective study to evaluate clinically unsuspected skeletal involvement on CT chest, CT (Ab)/pelvis (CT AP) and CT chest, (Ab), and pelvis (CAP) in patients with pulmonary, abdominal, or disseminated TB. The study was approved by departmental ethics committee. A total of 799 patients who were referred to our department with a diagnosis of TB of chest and/or (Ab) were included. These patients underwent CT from January 2013 to June 2014. The clinical data [presence of constitutional symptoms (fever, night sweats, weight loss), neurological involvement, back pain, joint pain, sputum for acid fast bacilli (AFB), AFB culture, any fine needle aspiration cytology or biopsy, previous history of TB, intake of antitubercular therapy (ATT), duration of intake of ATT, response to ATT] and imaging files of these patients were retrieved from our database. The diagnosis of TB of chest and/or (Ab) was based on a combination of clinical (fever, weight loss), laboratory (positive Mantoux test, sputum positivity for AFB), histological (demonstration of caseating granuloma and AFB), and radiological criteria (typical radiological findings of pulmonary, nodal, or abdominal involvement). Patients who had clinical diagnosis of STB or neurological features at presentation were excluded. This led to exclusion of 73 patients. A total of 726 patients finally entered for analysis.

☆ Conflict of interest: none declared.
☆☆ Financial disclosure: none declared.
★ Source of funding: none declared.
* Corresponding author. Department of Radiodiagnosis and Imaging, Postgraduate Institute of Medical Education and Research (PGIMER), Chandigarh, 160012. Tel.: +91-9914209870.
E-mail address: Image73@gmail.com (M. Prakash).
[1] Both authors contributed equally.

http://dx.doi.org/10.1016/j.clinimag.2015.07.033
0899-7071/

3. Imaging technique

Imaging was performed on three multidetector CT scanners (Somatom Sensation 16; Somatom Definition Flash; Philips iCT). Patients reported fasting (8 h) on the morning of examination for contrast-enhanced studies. Abdominal CT scans were performed following oral intake of 2 l of contrast [40 ml of ionic water soluble contrast (UROGRAFIN®, Schering AG, Germany) in 2 l of plain water] over 45 min. Abdominal CT [or chest plus (Ab)] and chest CT scans were performed with 85 ml and 50 ml of nonionic intravenous contrast (OMNIPAQUE™ 300, Iohexol, GE Healthcare, Princeton, NJ, USA), respectively, injected via 18-G cannula in the cubital fossa of upper limb. The intravenous injection was achieved with a pressure injector at a rate of 2.5 ml/s. Imaging was performed in the portal venous phase at 65 s from the start of contrast injection for abdominal [or chest plus (Ab)] CT scan and 40 s from the start of contrast injection for chest CT scan and included the area from domes of diaphragm to pubic symphysis for abdominal CT and from the level of thoracic inlet to domes of diaphragm for chest CT. Analysis of images was done on workstations (*Syngo ®.via, Siemens; Brilliance™ Workspace V2, Philips*). Axial and multiple planar reformatted (MPR) images were reviewed in soft tissue [(Ab), mediastinum; window width (WW)/window level (WL): 45/315], lung (WW/WL: −400/1500), and bone windows (WW/WL: 300/1500).

4. Analysis of CT images

The CT images were analysed in consensus by two radiologists (blinded to original CT reports) with 3 years and 10 years experience in general radiology. The lung and soft tissue window images were reviewed for pattern of involvement: (a) presence of centrilobular (CL) nodules, miliary nodules, consolidation (Cons) with or without cavitation; (b) lymphadenopathy with or without necrosis or calcification; (c) ileocecal involvement (thickening with or without luminal narrowing); (d) ascites with or without peritoneal involvement (Peritn) (thickening and enhancement). The bone window images were reviewed for (a) site of involvement: divided into vertebral, joint, and appendicular skeleton; (b) pattern of involvement: *vertebral involvement* was classified into body (anterior, central, posterior), posterior elements, or both; *pattern of involvement* was classified into fragmentary, osteolytic, subperiosteal, and well-defined lytic with sclerotic margins based on the work of Jain et al. [6]; (c) intervertebral disc involvement; (d) associated soft tissue; (e) associated collection; and (f) calcification within the collection. Though the reviewers were blinded to the original CT reports, no comparison with the original CT reports was done.

5. Results

A total of 726 patients were evaluated. There were 263 females (Fs) and 463 males (Ms). The mean age was 42.9 years (range, 13–76 years). A total of 304 chest CT, 316 CT AP, and 106 CT CAP were evaluated. Thirty-eight patients were HIV positive.

CT findings in each group (chest, AP, CAP) were separately reported and compared to findings in the group with STB (Table 1).

Thirty-four patients [who underwent CT chest ($n=5$), AP ($n=4$), and CAP ($n=25$)] had evidence of skeletal involvement (4.7%). In the rest of the subjects, the bones were either normal or showed evidence of degenerative changes ($n=96$). Among patients with skeletal involvement, mean age was 43.4 years (range, 14–72 years) with M predominance ($n=21$). The presence of caseating granulomas in biopsy specimen [from chest/(Ab)] with or without the presence of AFB (on microscopy or culture) comprising histopathologically confirmed cases were found in 15 cases. In the rest of the patients, diagnosis was based on typical clinical presentation with positive Mantoux test ($n=8$), clinical, and/or radiological response to ATT ($n=11$). Five patients were HIV positive. Twenty-three patients had active disease in the chest ($n=16$), (Ab) ($n=4$), or both sites ($n=3$). In the chest, the most common findings were presence of CL nodules ($n=13$; Fig. 1a), Cons ($n=10$), and mediastinal/hilar lymphadenopathy ($n=10$; Fig. 1b). "Tree in bud" appearance suggesting endobronchial spread was noted in 10 patients, while pleural effusion (Pl Ef) and hydropneumothorax (Hydro Pneu) were noted in 8 and 3 patients, respectively. In the (Ab), ileocecal (IC) junction and lymph nodes were the most commonly involved sites ($n=5$, Fig. 2a), followed by adrenals (Ads) ($n=4$), peritoneum ($n=2$, Fig. 2b), and pancreas (Panc) ($n=1$). Ascites and hepatic and splenic lesions were noted in four, two, and five patients, respectively. Overall nodal calcification was found in 20% and necrosis in 15% of the cases.

Bone involvement: Average number of bones involved was 2.5 (range, 1–9). Spine was the most common site of involvement ($n=23$). Thoracic spine was involved in 14 patients. Lower thoracic spine (T8–T12) was the most common thoracic spinal segment involved. Lumbar spine was involved in five and sacrum in four cases. Single vertebral level involvement was noted in three patients. Contiguous involvement of two or more vertebrae was seen in 16 cases (Fig. 1c). Non-contiguous involvement of two vertebral levels was present in four cases. Intervertebral disc involvement was seen in 19 patients.

Overall vertebral body was the most commonly involved part of the spine ($n=20$). Anterior part, central part, and posterior part of the vertebral body were involved in 17, 2, and 1 cases, respectively (Fig. 2c). Both anterior and posterior parts of the vertebral body were involved in two cases. Posterior element involvement was seen in three cases. Most common pattern of involvement was fragmentary ($n=16$; Fig. 3a) followed by osteolytic ($n=4$), subperiosteal ($n=1$), and well-defined lytic lesion ($n=1$; Fig. 3). In one case, there was sclerosis. Paravertebral soft tissue involvement was seen in more than 50% cases ($n=18$; Fig. 4a). Epidural extension was seen in nine patients. Soft tissue calcification was seen in five cases (Fig. 4a). Other sites of involvement were hip joints ($n=5$), pelvic bones ($n=3$), ribs ($n=2$),

Table 1
Findings among patients with TB undergoing CT chest, AP and CAP, and those with STB

	CT site (n)	CT findings							Multiple findings	Necrotic nodes	Calcified nodes
	M/F	n (%)									
Total patients with TB of chest/(Ab)	Chest (304)	CL Nodules	Cons.	Node	Pl Ef	Hydro Pneu	PE	TIB/M	121 (40%)	87 (28%)	21 (7%)
	187/117	210 (69%)	190 (62%)	144 (47%)	63 (21%)	29 (9%)	8 (3%)	64/18 (21/6%)			
	AP (316)	Bowel/ICJ	Node	Ascites	H/S	Peritn	Ad	Panc	112 (35%)	53 (18%)	8 (2%)
	201/115	163/55 (51/17%)	110 (35%)	40 (13%)	15/23 (5/7%)	21 (6%)	8 (2%)	2 (1%)			
	CAP (106)	CL Nodules	Cons.	Node (c)	Pl Ef	HydroPneu	PE	TIB/M	34 (32%)	16 (15%)	5 (5%)
		48 (45%)	35 (33%)	25 (23%)	21 (20%)	7 (7%)	1 (1%)	18/5 (17/5%)			
	75/31	Bowel/ICJ	Node (Ab)	Ascites	H/S	Peritn	Ad	Panc			
		37/15 (35/14%)	19 (18%)	10 (10%)	4/7 (4/7%)	3 (3%)	3 (3%)	0			
Patients with STB	34	CL Nodules	Cons.	Node (c)	Pl Ef	Hydro Pneu	PE	TIB/M	12 (35%)	5 (15%)	7 (20%)
		13 (38%)	10 (29%)	10 (29%)	8 (23%)	3 (9%)	0	10/0 (29/0%)			
	21/13	Bowel/ICJ	Node (Ab)	Ascites	H/S	Peritn	Ad	Panc			
		7/5 (20/15%)	5 (15%)	4 (12%)	2/5 (6/15%)	2 (6%)	4 (12%)	1 (3%)			

PE, pericardial effusion; TIB/M, tree in bud/miliary nodules; ICJ, ileocecal junction; H/S, hepatic/splenic lesions; (c), chest; (Ab), abdomen.