Computed Tomography of Spinal Tuberculosis

Jin-Suck Suh¹, Jung-Ho Suh¹, Chang-Yun Park¹, Nam-Hyun Kim² and Byeong-Mun Park²

Twenty-nine patients with spinal tuberculosis were evaluated by computed tomography (CT). The contiguous involvement of the vertebral bodies as well as the detailed localization of the destruction were analyzed. Our result disclosed that there was a higher incidence of the destruction of pedicles (68 percent) and an involvement of posterior elements (13 percent). Frequent patterns were fragmentation, sequestrae, disc space narrowing, reactive sclerosis, paravertebral mass (abscess) and calcification. CT also provided precise information about the rim, density and size of the soft tissue mass, particularly following intravenous contrast infusion. CT was found to be helpful in the evaluation of the extent of osseous and soft tissue involvement as well as the destructive pattern. We conclude that CT can be used to detect the extent of osseous and paravertebral soft tissue involvement and to differentiate spinal tuberculosis from a neoplastic lesion.

Key Words: Spine, diseases, tuberculosis, computed tomography

Computed tomography (CT) helps to visualize the detailed anatomical structures of the spine in the axial plane, particularly the osseous and paravertebral soft tissue structures. However CT findings of spinal tuberculosis have been rarely documented in the literature, although CT has been widely used for the evaluation of spinal diseases. Both clinicians and radiologists should be familiar with the common and characteristic features of spinal tuberculosis on CT in order to reduce morbidity. CT permits precise detection of the infective foci and assessment of the exact extent of involvement. We report our experience with 29 patients with spinal tuberculosis evaluated by CT.

MATERIALS AND METHODS

Computed tomography was performed in 29 patients among 88 patients with tuberculous spondylitis at Severance Hospital, Yonsei University, between April 1984 and July 1987. The 29 tuberculous spondylitis patients included 11 men and 18 women ranging in age from 5 to 62 years, the average age was 35.2 years. All patients complained of back pain with the duration of symptomatology varying from 1 week to 8 years (average 18 months). 7 patients (24%) had neurological symptoms ranging from a radioculopathy to paraplegia, contrary to 28 of 88 patients (32%) having neurologic symptoms. The diagnosis of tuberculosis was confirmed by either bacteriological culture or histological examination in 23 patients. Three patients had a history of tuberculous spondylitis prior to visiting our hospital and the remaining 3 patients showed improvement following surgical intervention and anti-tuberculous medication. Eight patients presented with classic tuberculosis on chest X-ray and 9 patients with inactive tuberculosis. The remaining 12 patients showed no abnormal findings on chest X-ray.

All scans were performed on either a GE CT/T 9800 or a Philips Tomoscan 310 scanner after having localized the lesion by conventional radiography. Most patients were examined in the supine position and 5 or 6mm thick consecutive slices were made through the involved area. 13 scans were performed after intravenous contrast medium administration and two were done after the instillation of metrizamide into...
the subarachnoid space. All 29 patients with tuberculous spondylitis received conventional x-rays, and 13 patients had a 99m-Technetium MDP bone scan, 10 of which revealed hot activity on the lesion.

RESULTS

In 29 patients, a total of 66 vertebrae were involved; 16 patients (56%) had two adjacent bodies involved; 5 (17%) had three contiguous bodies involved; 4 (14%) had only one vertebra involved; and the remaining 4 (14%) had only one vertebrae involved; and the remaining 4 (14%) had four or more adjacent bodies involved. Only one patient had a separated skip lesion. Ten patients had lesions located in the thoracic spine, 18 in the lumbar spine, and the remaining one in the thoracic and lumbar spines. The locations of the vertebrae involved and paravertebral masses are found in Fig. 1. The average number of bodies involved per patient was 2.4, the average length of soft tissue masses was 3.86 vertebral units involved contiguously. In 7 patients with neurologic symptoms, 6 had a lesion in the thoracic spine. 5 presented an epidural mass and the remaining two exhibited spinal canal narrowing due to the reparative process of bony ingrowth on CT.

Because CT provided precise information as to the extent and anatomy of the destructive process, we divided the body into anterior and posterior aspects in order to evaluate the extent of bone destruction. On CT, 22 patients revealed bone destruction at the anterior and posterior aspects of the bodies, 4 cases at the posterior body, 2 cases at the spinous process and the remaining one over the entire body and the spinous process (Fig. 1). In 13 patients, CT demonstrated the bony destruction of the pedicles as well as the vertebral bodies. Also 4 patients exhibited

![Fig. 1. Location of the vertebral destruction](image1)

![Fig. 2. Location of the paravertebral mass.](image2)
Fig. 3. a. A CT scan through L2 shows lytic destruction with central bony sequestra, surrounded by reactive sclerotic rim. 
b. A CT scan through L3 shows bony fragmentation with the extension of destruction into the right pedicle.

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<th>Table 1. CT findings of the vertebral destruction of spinal tuberculosis</th>
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<tr>
<td>Number of cases (%)</td>
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<td>1. Fragmentation</td>
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<td>with pathologic fracture</td>
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<tr>
<td>without pathologic fracture</td>
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<td>2. Sequestra within a lucent defect</td>
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<td>3. Reactive sclerosis</td>
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<td>4. Disc space narrowing</td>
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<th>Table 2. CT findings of the soft tissue mass of spinal tuberculosis</th>
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<td>Number of cases (%)</td>
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<tr>
<td>1. Paravertebral mass</td>
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<tr>
<td>Indistinct margin</td>
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<tr>
<td>Distinct margin</td>
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<tr>
<td>2. Density</td>
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<tr>
<td>Low</td>
</tr>
<tr>
<td>Iso</td>
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<tr>
<td>3. Calcification</td>
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destruction of the adjacent rib.

In all patients except one, CT demonstrated a variable sized soft tissue mass. The protrusion of the soft tissue mass into the spinal canal was demonstrated in 23 patients (Fig. 2). In 17 patients, CT demonstrated bilateral paraspinal and epidural soft tissue masses. One patient had a posterior epidural mass in front of the laminae with the destruction of the spinous process. Among 23 patients with epidural masses, only 5 had neurologic symptoms.

CT revealed the fragmentation of one or more bodies in cross section in 22 patients, and a pathologic fracture was present in 20 patients; a compression fracture in 17 patients, a sagittal fracture in 2 patients and a coronal fracture in one patient. In 19 patients, the sequestra was demonstrated within a well defined bony defect being surrounded by sclerosis (Fig. 3). Reactive sclerosis at the margin of the bony destruction was frequently seen in 25 patients (Table 1). It was better to evaluate the narrowing of the disc space
Fig. 4. The consecutive images of the post-contrast CT scan show multiple low density para-vertebral and epidural soft tissue mass with thickened rim.

Fig. 5. Tuberculosis of the pedicle.

A metrizamide CT scan at the level of T10 shows the destruction of the left pedicle and posterior body with the epidural soft tissue mass, which was also well demonstrated on a reformatted sagittal view.
by available conventional X-rays rather than by axial CT scan. In 24 patients conventional X-rays demonstrated the narrowed intervertebral space.

A soft tissue mass was obvious on CT in 28 patients. In 15 patients, the margin of the mass was distinct, while in 16 patients low density loculation was present which suggested that it was an abscess (Table 2). CT demonstrated the varying degrees of calcification in the soft tissue mass or abscesses in 13 patients.

Among 9 patients presenting with a history of antituberculous medication prior to the first visit, 8 exhibited reactive sclerosis and 7 demonstrated soft tissue calcification on CT scan. The occurrence of sclerosis and soft tissue calcification in patients with a history of antituberculous medication was higher than in the group without said history (p>0.05, p<0.05 respectively). But it may be uncertain in terms of radiographical significance, because of the long history of tuberculous infection in the former group.

On precontrast scan, the paraspinal masses showed thick rims in 4 among 16 patients, and 11 among 13 patients studied following intravenous contrast infusion (p<0.005) (Fig. 4).

In 4 patients, the features of CT were intially interpreted as a metastasis in three (Fig. 5), and a herniated disc in one. The density of the soft tissue mass was relatively low in two, with isodensity in the other two. In all 4 patients, CT demonstrated the destruction of the posterior aspects of bodies or posterior elements of the vertebrae (Fig. 6). None of the 4 patients showed calcification in the soft tissue mass on CT. Three of them did not exhibit a narrowing of the intervertebral space.
DISCUSSION

The spine is the most frequent site of osseous involvement by tuberculosis, although any bone may be affected (Davidson et al. 1970; Chung et al. 1978). Most cases of spinal tuberculosis occur via the hematogenous route (Griffiths 1980; Halsey et al. 1980). Although such hematogenous dissemination is a frequent complication of primary tuberculosis, several months to many years may elapse before spinal involvement becomes clinically manifest (Whelan et al. 1983; Resnick et al. 1981). Localization in the vertebral bodies, as opposed to the posterior elements, is common and multiple, either adjacent or non-contiguous levels are usually affected (Resnick et al. 1981; Lee et al. 1986). It is generally accepted that infective process begins in the anterior portion of the vertebral body adjacent to the subchondral plate (Murray et al. 1971; Dowd et al. 1986; Weaven et al. 1984) and spreads to the adjacent intervertebral disc by extension beneath the anterior or posterior longitudinal ligaments, perforation of the subchondral bony plate and cartilaginous end-plate, or cartilaginous node formation (Lee et al. 1986), and spreads across the adjacent disks to involve contiguous vertebral bodies. Subligamentous involvement may result in infection of the vertebral bodies at non-contiguous levels (Hall et al. 1986). The authors found only one case of skip lesion undetected on conventional radiograph, as compared to a previous report with an incidence of 10.9% (Lee et al. 1986).

Tuberculous infection is frequently associated with a paraspinous or epidural abscess, or both (Whelan et al. 1983). However, CT features were not well described in detail. The radiographic appearance of spinal tuberculosis has been described in the literature and the findings of CT have been reported in recent years (Grooper et al. 1982; LaBerge et al. 1984).

The radiographic patterns presented by spinal tuberculosis can mimic other diseases affecting the spine, and vary with the following factors; the age of the patient, the time from onset of symptoms, and a history of past treatment.

The radiographic patterns of seventy-four cases of spinal tuberculosis were described in detail in a previous report (Lee et al. 1986) in which the incidence of the involvement of the posterior elements was approximately 22% by the conventional radiographs in Korea, which was higher than others (Bell et al. 1971). Also they detected two additional cases of posterior involvement by CT images, undetected on conventional x-rays.

In our series, there was no bony destruction localized only on the anterior aspect of the vertebral body, and the extension of destruction to the pedicles was observed frequently. This could be caused by the progressive destructive processes due to the late presentation of patients (average time, 18 months) and by the superiority of CT for the detection of involvement of the posterior arch as well as the pedicles. In 2 cases of spinal tuberculosis, the destruction was confined to only the posterior aspect of the body, and in one case to a pedicle and the posterior aspect of the body.

One of the possible mechanisms was documented in the cases of destruction of the posterior body, in which spinal tuberculosis could extend from the subarachnoid space (Whelan et al. 1983). In our cases, it was believed that the infective process began initially in the posterior aspect of the vertebral bodies, because there was no evidence of tuberculous menigitis clinically and no cortical destruction of the posterior aspect of the bodies radiologically. Although it was thought that tuberculosis on the vertebral pedicles was uncommon, approximately 2% of cases of spinal tuberculosis, tuberculous infection may involve the posterior elements of the vertebræ due to an extension from the foci in the bodies and may be deposited in the posterior elements (Allen et al. 1978; Bell et al. 1971; Champman et al. 1979; Colimbu et al. 1984; Hermann et al. 1983; Wiley et al. 1959). We found one unusual manifestation of spinal tuberculosis with the destruction of both pedicles, all articular processes, the lamina, and spinous process of L4, which looked like cases previously reported (Bell D et al. 1971). Although we can't offer a precise explanation for the primary focus of the destruction in this patient, careful attention should be given to the unusual localization of the destruction lesion, particularly pedicles and posterior elements, 86% of our cases presented the involvement of two or more adjacent vertebral bodies. This result was lower than previous reports (Lee et al. 1986).

To our knowledge, there is no detailed description of bony destruction pattern CT of spinal tuberculosis. From this series, it is believed that bony fragmentation, reactive sclerosis, disc space narrowing and a sequestra within a lucent bony defect could be characteristic features on CT. The radiological appearance of bony sclerosis in skeletal tuberculosis has been described in the literature (Poppe1 et al. 1953). It was thought that this sclerosis resulted from infarction of the bone and the chronicity of tuberculosis permitting reparative woven bone to be laid down on the scaffolding of dead trabecula (Hall et al. 1986).
However, the sequestra within the bony defect was not found in any previous report of the appearance on CT of spinal tuberculosis, even though it was frequently presented on CT (66 percent).

The masses were clearly defined following intravenous contrast dye infusion, particularly with the rims enhanced. Therefore CT should be performed with the infusion of contrast dye in patients suspected of infectious spondylitis. In addition we reviewed CT scans in 14 patients with metastatic disease of the spine, which did not show calcification of the soft tissue components.

We may suggest that the sequestra could be considered as an important feature on CT, as well as the disc space narrowing with contiguous vertebral involvement, clarification in differentiating tuberculous from neoplastic processes.

REFERENCES

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