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Computed tomography in spondylitis

CT versus other radiographic methods

Eighteen patients with spondylitis underwent 21 examinations by computed tomography (CT). Bone destruction was found in all, paravertebral inflammatory mass in 18, and epidural extension in 12 examinations. Conventional techniques revealed a paravertebral mass in only two cases. Plain radiographs showed destruction in fewer vertebrae in nine cases, in one of which the plain radiographs were definitely negative. Simultaneous conventional tomography gave sufficient clinical information of bone changes but was not better than plain radiographs in the evaluation of soft tissue structures. Abscesses could only be demonstrated by CT. The operative findings were in agreement with CT scans in almost all cases operated. CT was valuable when planning the surgical approach.

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During a 4-year period we have analyzed CT examinations in patients suffering from spondylitis with tuberculous or other bacterial etiology. We wanted to know if early diagnosis could be improved by CT, and if CT was valuable in planning an operation.

Patients and methods

Eighteen patients suffering from bacterial spondylitis were investigated in 1980–83. Four patients had tuberculotic and eight had pyogenic spondylitis (Table 1), diagnosed histologically, bacteriologically, or serologically. In six patients the etiology could not be exactly determined. The site of involvement was lumbosacral in one patient, lumbar in 11, thoracolumbar in two, thoracic in three, and cervical in one.

In one patient CT was used as a primary diagnostic tool. Other CT examinations were performed when the spondylitis had been diagnosed by conventional radiological techniques, including scintigraphy in 13 patients. Three patients were re-examined after 6 weeks to 9 months. Twelve patients had neurological symptoms – radicular pain in all 12, sensibility disturbances in eight and reflex changes in two.

The examinations were performed with an EMI 5005 scanner using a 320 × 320 matrix, and slice thickness and slice distance were 5 mm in most cases; in ten investigations intravenous contrast medium was used.

CT scans were compared to simultaneous plain radiographs in all cases, and in nine cases also with conventional tomography. Scintigraphy was performed at the same time in seven patients; in six patients scintigraphy was performed earlier. Nine patients were operated and five were biopsied immediately after the CT. Evacuation of infected tissue, trepanation and drainage were performed by an anterolateral retroperitoneal approach in six and by a dorsal approach in three cases.

Results

Bone destruction was seen in all examinations (Table 2), and usually two vertebrae were affected. In two examinations only one vertebra was involved. In one of these the plain radiographs were normal, and spondylitis was detected by CT (Figure 1). In two tuberculosis patients (in three examinations), there was destruction in five vertebrae. Fragmentation was seen in 15 of 21 examinations.

Sclerosis was seen in all scans of tuberculotic patients and in three of seven cases with unknown etiology. Sclerosis was found in only one of ten scans of pyogenic spondylitis. In this patient the sclerosis was not found in the first CT scans, but it was detected on follow-up 2½ months later.

The density of the areas of destruction measured in Hounsfield units (HU) was quite variable, and the value questionable because of summation of bone and destructed foci. In six examinations, larger areas of relatively low density (below 32 HU) were found. Such values may indicate a collection of fluid, such as pus.

Table 1. Spondylitis. Clinical data

Case	Sex	Age	First ESR	Duration of the disease at the time of CT (mo)	Affected vertebrae on CT	Etiology	Bacterial cultures or serology	Histology	Surgical procedure
1	F	67	74	4	T IX–X	*M. tuberculosis*	Positive from pus	Tuberculous spondylitis	Operation
2	F	47	57	1	L I–II	Unknown	Culture negative from urine and sputum	–	–
3	M	58	98	3	L II–III	*Staphylococcus*	ASTA ↑	–	–
4	M	74	58	12	L I–II	Unknown	Negative from biopsy sample	Necrotic bone	Needle biopsy (twice)
5	M	58	70	2 3½	T IX–X	*Staphylococcus*	Positive from pus	–	Needle biopsy
6	M	59	115	1 3	L IV–V	*Staphylococcus*	Pus from wound	–	Disc operation 2 mo earlier
7	M	57	7	4	T IX–X	Unknown	–	–	Needle biopsy failed
8	F	42	55	2	C V–VI	*Streptococcus*	Negative from granulation tissue, AST ↑	Chronic osteitis	Operation
9	M	2	33	1	L IV	Unknown	Negative from biopsy sample	Unspecific discitis	Needle biopsy
10	F	61 62	57	21 30	T X–C I	*M. tuberculosis*	Positive from pus	–	Operation
11	F	60	78	2	L I–II	*Staphylococcus*	Positive from blood ASTA ↑	Chronic inflammation	Operation
12	F	55	55	1	L I–II	*M. tuberculosis*	–	Tuberculous spondylitis	Operation
13	F	60	124	2	L IV–V	*Staphylococcus*	Negative from biopsy sample, ASTA ↑	Sample scanty	Needle biopsy
14	M	44	35	3	L IV–V	Unknown	Negative from pus	Not specific inflammation	Operation
15	M	53	58	4	L IV–S I	*Staphylococcus*	Positive from pus	Chronic spondylitis	Operation
16	F	67	30	2	L II–III	Unknown	Negative from seromatous fluid	Postinflammatory changes	Operation
17	M	48	46	1	L III	*Staphylococcus, streptococcus*	Positive from blood *(Staph.)* AST ↑		
18	M	65	41	11	T IX–XII, L IV	*M. tuberculosis*	Positive from pus	Tuberculous spondylitis	Operation

An inflammatory paravertebral mass was seen in 18 examinations. The mass was usually inhomogenous, and low density areas were observed in five patients. Four of these patients were re-examined with intravenous contrast medium, and a ring enhancement, typical of an abscess, was seen in three patients (Figure 2). Calcification within the paravertebral mass was seen in tuberculotic cases only.

Extension of inflammatory tissue into the anterior epidural space was demonstrated in 12 examinations (Figure 3). No intraspinal abnormalities were found in seven examinations. In two cases of thoracic spondylitis the anterior epidural space could not be assessed on plain scans and contrast enhancement was not performed.

In only 12 of 21 examinations was an equal amount of destruction found on plain radiographs (Table 3). Fragmentation of bone was demonstrated by CT only, but sclerosis was demonstrated equally by both techniques. Paravertebral masses were rarely detected on plain radiographs.

Conventional tomography showed as large destruction as CT did, but it did not demonstrate fragmentation. Paravertebral masses were found in the same two patients as on plain radiographs.

Narrowing of disk spaces as well as spinal

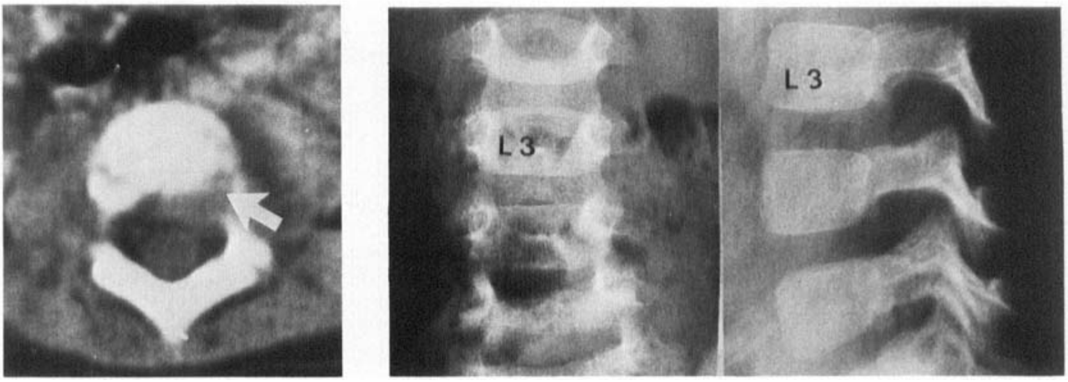

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Figure 1. Case 9. 2½-year-old boy with unspecific discitis L IV–V treated conservatively.
A. CT scan 1 month after clinical onset. Destruction inferiorly in L IV (arrow). Thin layer of pathologic tissue in the anterior epidural space on the left.
B. Contemporary plain films without any pathological changes.
In the plain films narrowing of disc space was first seen 2 weeks and destruction of bone 4 weeks later.

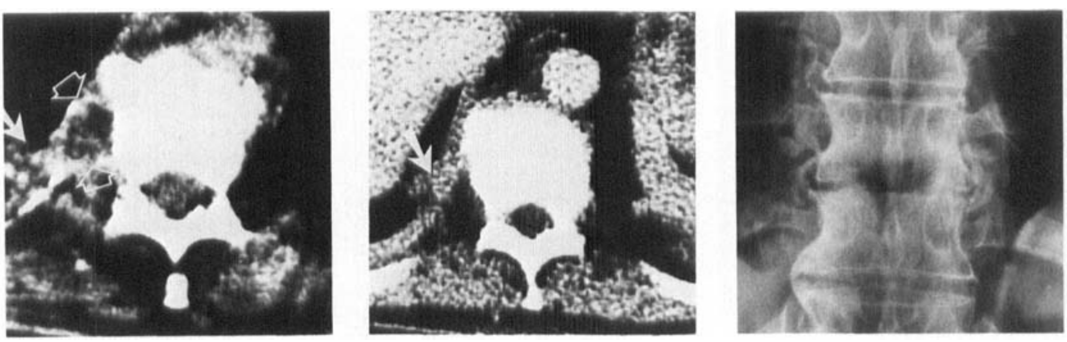

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Figure 2. Case 5. Paravertebral staphylococcal abscess at the level of T X.
A. Ring enhancement (open arrows) around a low density area. The patient also has old pleural thickenings (white arrow).
B. Pleural thickenings (arrow), but no abscesses were seen in a scan undertaken 6 weeks earlier. Both scans were performed with intravenous contrast medium. Window setting for soft tissues; bone details are not seen in these pictures.
C. Contemporary plain radiograph showing a narrowed disc space and bone destruction. Pleural thickenings were unchanged throughout.

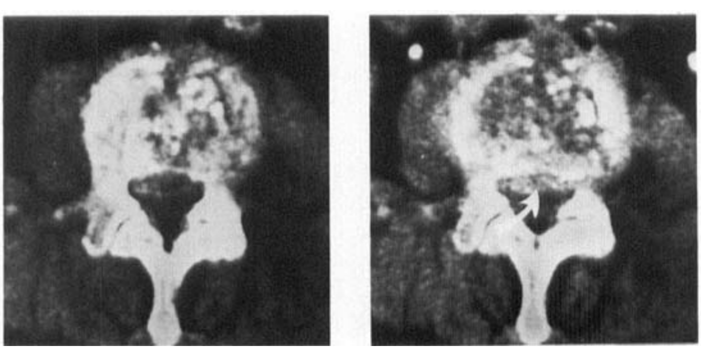

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Figure 3. Case 16. Spondylitis of L II–III, a slice from L III.
A. *Plain scan.*
B. Contrast-enhanced scan. Destroyed and fragmented vertebral body. The inflammatory mass in the anterior epidural space was enhanced and seen better with intravenous contrast medium (arrow). Operative evacuation of the interdisc space revealed granulomatous, inflammatory tissue with seromatous, thin fluid under tension.

Table 2. CT findings in spondylitis

	Etiology			Total
	Pyogenic 10	Tuberculous 5	Unknown 6	21
Bone changes				
Destructions				
1–2 vertebrae	9	2	6	17
3–5 vertebrae	1	3	–	4
Destructions with liquid density	1	3	2	6
Fragmentation	6	5	4	15
Sclerosis around destructions	1	5	3	9
Soft tissue changes				
Paravertebral mass	6	5	6	17
Calcifications	–	5	–	5
Fluid collections	3	–	2	5
Anterior epidural mass	4/10	4/4	4/5	12/19[a]

[a] Two examinations were excluded because the intraspinal structures were poorly demonstrated.

deformities may be difficult or even impossible to detect on axial CT slices and they were more easily demonstrated by plain radiographs.

Radionuclide bone scans, undertaken in 13 patients, were positive in all but one. The patient with the negative scan had had positive CT the day before and was operated 5 days later, at which time granulomatous tissue and pus were found.

Four patient underwent needle biopsy without successful aspiration of pus; one of these cases had a large low density area, suggestive of fluid, within a partially destroyed vertebral body which was probably missed by the needle.

The findings at operation were in agreement with the CT in six of seven cases. In five of these six patients paravertebral inflammatory masses were found: two patients had cavities containing pus, as demonstrated by CT, and in the third non-suppurative fluid was found at operation. In two cases neither fluid nor pus was detected on CT or at operation. In the seventh case, CT showed a large, nonhomogenous, calcium-containing mass around a fragmented vertebral body, but no fluid. However, at operation, thick pus was found within the granulomatous tissue. Sequestra, corresponding to the fragments on CT, were removed.

Ten of the 12 patients with neurological symptoms had an epidural mass on CT (Fig. 3). One of two patients with neurological symptoms without an epidural CT finding had postoperative diskitis and peroneal palsy even before the first infectious symptoms.

Two other patients with intraspinal radiographical abnormality but without neurological symptoms had a very thin rim of pathologic tissue visualized with intravenous contrast medium. Seven of these 12 patients were operated, and the neurological symptoms disappeared in all cases except in the patient with peroneal palsy.

Discussion

CT has been found superior to plain radiography in demonstrating bone destruction (Soye et al. 1982, Raininko & Sonninen 1985), and thus an earlier diagnosis of bone involvement is facilitated by CT also in spondylitis. Hypodensity of the invertebral disk has been

Table 3. Comparison of CT and conventional radiography in spondylitis

	Comparison to plain radiographs 21 examinations				Comparison to conventional tomography 9 examinations			
	Positive on plain radiographs	Positive on CT	Findings identical	CT superior	Positive on conventional tomography	Positive on CT	Findings identical	CT superior
Destruction of bone	20	21	12	9	9	9	9	–
Fragmentation of bone	2	15	–	15	1	6	–	6
Sclerosis	9	9	9	–	5	5	5	–
Paravertebral mass	2	18	2	16	2	6	2	4

reported to permit diagnosis of early vertebral osteomyelitis and to be relatively specific (Lardé et al. 1982). However, reliable measurements can be performed only if a disk space is high enough. Tuberculous spondylitis may occur without disk involvement (Lardé et al. 1982). CT permits earlier diagnosis of spondylitis than conventional radiographic methods and changes are visualized in a larger area. Radionuclide bone scan gives a positive finding earlier than radiographs but is less specific, and does not demonstrate anatomic details. Multiple-affected vertebrae were detected most frequently in tuberculous spondylitis, which is in agreement with an earlier report (Whelan et al. 1983).

Two-dimensional conventional tomography seems to be reliable in demonstrating bone destruction, and in our small material CT was not superior to conventional tomography in detecting bone destruction. However, CT gives more information; fragmentation of bone was rarely seen on conventional tomography, but was seen on CT in most cases. Fragmentation did not correlate with narrowing of the vertebral body or with spinal deformities.

Sclerosis was detected equally well by all three methods. It was seen in tuberculotic cases, but also in some cases without known etiology. Sclerosis around the destruction areas seems to be associated with a slow progress of the infection, and it can also be seen in the healing stage of a more florid infection.

Plain radiography and conventional tomography do not adequately show soft tissue involvement. These methods are usually reliable in the thoracic region, but if there are previous pathological changes, such as pleural thickenings, paravertebral changes may be undetected in a conventional examination.

On the basis of our study and other investigations, it seems that the existence of soft tissue involvement is very typical of spondylitis (Golimbu et al. 1984, Kattapuram et al. 1983, Price et al. 1983, Sartoris et al. 1983, Whelan et al. 1983); paravertebral invasion was seen in 17 of our 21 examinations. The combination of soft tissue involvement and bone destruction is also found in neoplastic cases, but differential diagnosis between neoplastic and spondylitic changes is usually possible on CT. CT is a superior method in demonstrating a paravertebral mass and is the only method which permits qualitative evaluation. Large abscess cavities are easily detected, but not small collections of dense pus within the inflammatory mass. The density of fluid (or pus) measured in Hounsfield units may vary a great deal and is dependent on its protein content. Thus, numerical values do not give direct evidence of liquid pus. Summation of other tissues, especially of bone fragments, increases the unreliability of the measurements. Intravenous contrast medium may be helpful (Fig. 3), because inflammatory tissue is enhanced and therefore seen more distinctly. CT also gives valuable information about the necessary surgical approach.

Differentiation of tuberculous and pyogenic spondylitis does not seem to be possible in the individual case, although certain findings are prevalent in tuberculosis. In all our cases with proven tuberculosis, calcification was seen in the paravertebral mass, but cases without calcification have also been reported (Whelan et al. 1983). Reactive sclerosis and involvement of multiple vertebrae are seen more frequently in tuberculosis than in other infections.

We conclude that CT may facilitate the diagnosis of spondylitis, as it detects even early bone changes. Furthermore, the extent of the inflammatory process and its relation to adjacent structures is better depicted by CT than by conventional methods. The technique seems to be reliable in detection of large abscesses, but smaller collections of pus can be hidden in granulomatous tissue.

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