EVALUATION FOR CT CRITERIA OF GRANULOMATOUS INFECTION AND TUMOUR OF SPINE

Napaporn CHOTIKA, Pimjai SIRIWONGPAIRAJ, Suphaneewan JAOVISIDHA, Suvipaporn SIRIPORNPITAK, Manee AIMACHARIYACHAI.

ABSTRACT

To develop criteria to distinguish between granulomatous infection and neoplastic process in the spine by mean of the computed tomography scan (CT scan), the authors retrospectively analyzed 31 cases of granulomatous infection and 13 cases of neoplastic disease. The result was that the reliable criteria for granulomatous infection were diffuse bony destruction, contiguous levels of spinal involvement, absence of posterior element involvement, presence of "complete" pattern of prevertebral soft tissue, and presence of disc involvemant. Neoplastic diseases were characterized by focal bony destruction, seperated levels of spinal involvement, presence of posterior element involvement, "partial" pattern of prevertebral soft tissue, and absence of disc involvement. Blinded testing of these criteria is potential for improving diagnostic accuracy in clinical practice.

INTRODUCTION

Computed tomographic examination of the spine is an available method in Thailand for diagnosis and characterization of vertebral lesions. The importance of CT is underscored by the fact that clinical assessment and conventional radiographic analysis are occasionally inconclusive in distinguishing between granulomatous infection and neoplastic process of the spine. This retrospective study was designed to identify reliable CT criteria for distinction between these two major categories of disease involving the spine.

MATERIALS AND METHOD

Transaxial CT image from a total of 44 cases of granulomatous infection and neoplastic disease affecting the spine were retrospectively evaluated. The pathologic identity of each lesion was determined with surgical specimen (36/44) and assumed on the basis of known widespread metastasis in the remainders (8/44).

There are 31 cases of granulomatous infections and 13 cases of neoplastic diseases examined. The types of tumor included adenocarcinoma from unknown primary site, breast carcinoma, lung carcinoma, hepato-cellular carcinoma, multiple myeloma, and hemangioma. The authors defined the CT findings for which each site of involvement would be evaluated in an attempt to identify distinguishing features between the two pathologic categories.

Each CT study was assessed for [1]

a. Presence or absence of prevertebral (anterior to lamina) soft tissue involvement, and when present, whether this was partial or complete (lamina to lamina) (Fig. 1,3).
b. Presence or absence of bony destruction and whether this was focal, multifocal or diffuse (Fig 2,4,5).
c. Presence or absence of posterior element involvement (Fig.1,3)

Department of Radiology, Faculty of Medicine at Ramathibodi Hospital, Mahidol University, Rama 6 street, Bangkok 10400, THAILAND.

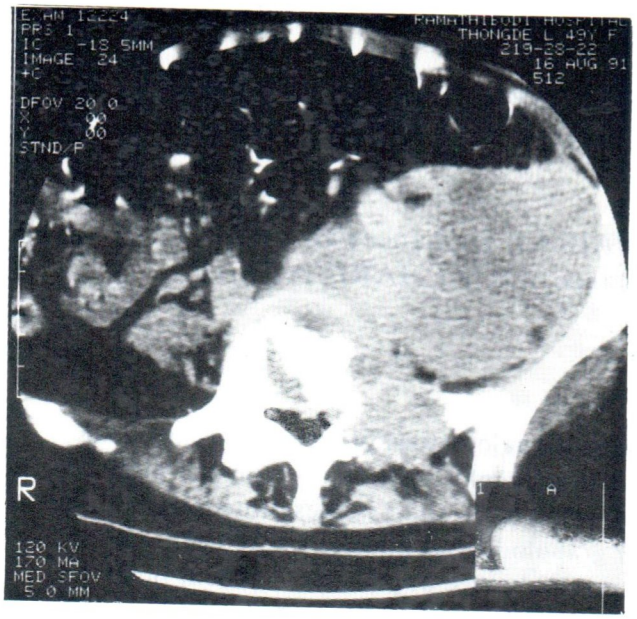

Fig 1. Breast carcinoma metastasized to L_5. Characteristic features are posterior element involvement and partial prevertebral soft tissue involvement.

Fig 2. The same case as fig 1. The image viewed in bone window also showed focal bony destruction

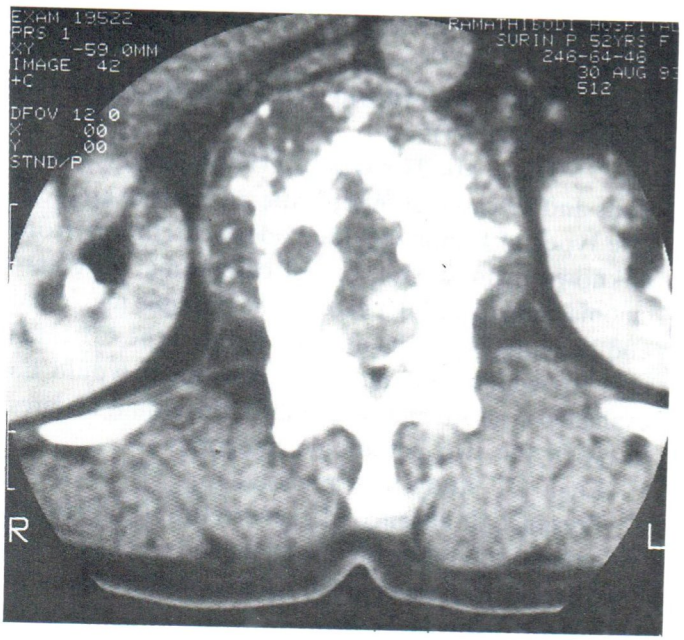

Fig 3. Pathologic tissue proved to be caseous granulomatous infection at L_1. Complete pre-vertebral soft tissue involvement and extension into the spinal canal are noted.

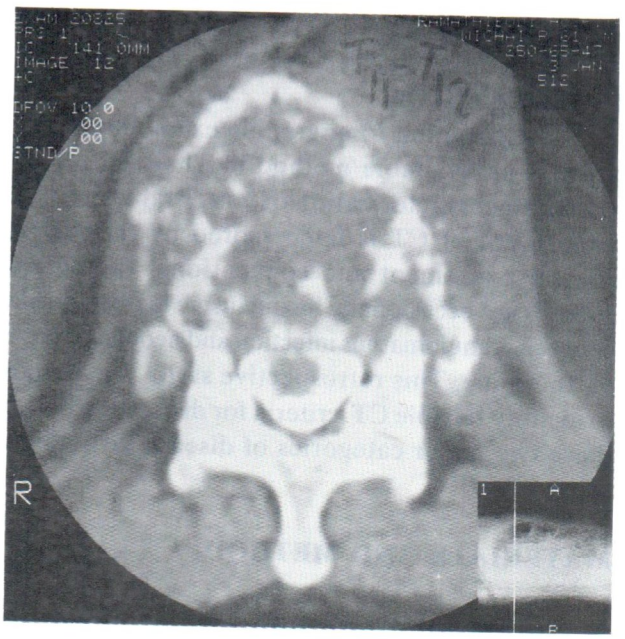

Fig 4. Pathologic tissue proved to be granulomatous infection at T_{11}. The image revealed diffuse bony destruction

d. Presence or absence of multilevel disease and whether this was contiguous (across an intervertebral disc space) or seperated.
e. Presence or absence of disc involvement.

A statistical analysis of the results were performed to determine which CT findings were most valuable in distinguising between granulomatous infection and tumoral process.

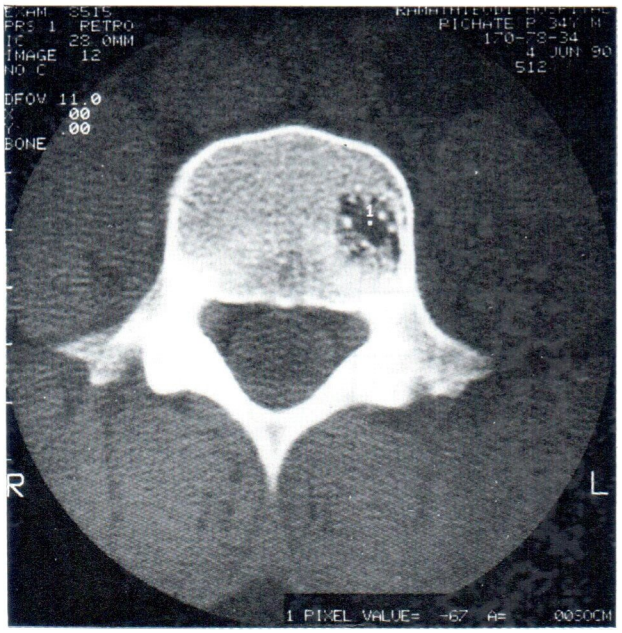

Fig 5. Pathologic tissue proved to be haemangioma of L_4. The image showed focal bony destruction

DISCUSSION

Granulomatous infection are grouped with similarities in clinical presentation and histologic feature of granulomatous identification on frozen section. They may caused by fungi, certain bacteria and spirochetes. The most common granulomatous spinal infection in the world by far is tuberculosis. As in our study, all granulomatous infection (31 cases) are tuberculosis. These infections spread hematogenously and subligamentously [2,3,4,5]. The latter route of spreading causes more prevertebral soft tissue (sensitivity 1.0, specificity 0.53, p = 0.00004) and contiguous levels of spinal involvement (sensitivity 1.0, specificity 0.25, p = 0.042) than those in neoplastic processes. Criteria of diffuse bony destruction in granulomatous diseases in this study (sensitivity 0.86, specificity 0.67, p = 0.004) differs from the previous study of Van Lom et.al [1]. They reported criteria of focal bony destruction in this disease (sensitivity 1.0, specificity 1.0). This was likely due to late presentation of many cases of granulomatous infection in Thailand. Absence of posterior element involvement is also a reliable criteria for granulomatous infection (sensitivity 0.61, specificity 0.84, p = 0.014) due to in this disease there are three major primary foci of spinal involvement : peridiscal, central body and anterior body locations. In one series of 914 cases, the disease was at peridiscal location 33% , central body 11.6% , and anterior body in 2.1%. In 52.8% of cases, the disease was widespread at presentation [5].

Neoplastic process of the spine arises from focal lesions or from distant malignancy. Local involvement of the spine may result from primary lesion arising in the spinal cord, its coverings, or contiguous spread of tumour from the paraspinous

Results

Table 1

		Granulomatous infection	Tumor	
Prevertebral soft tissue	Presence	31	6	37
	Absence	0	7	7
		31	13	44

Analysis of Single Table Odd ratio : Undefined

Chi-Squares		P-values
Yates corrected	16.03	0.0000624
Fisher exact 1-tailed P-value		0.0000448
2-tailed P-value		0.0000448
Sensitivity	1.0	
Specificity	0.53	

Table 2

		Granulomatous infection	Tumor	
Prevertebral soft tissue	complete	24	0	24
	partial	7	6	13
		31	6	37

Analysis of Single Table Odd ratio : Undefined

Chi-Squares		P-values
Yates corrected	10.04	0.0015301
Fisher exact 1-tailed P-value		0.0007381
2-tailed P-value		0.007331
Sensitivity	0.77	
Specificity	1.0	

Table 3

		Granulomatous infection	Tumor	
Pattern of bony destruction	diffuse	26	3	29
	focal	4	6	10
		30	9	39

Analysis of Single Table Odd ratio = 13.00

Chi-Squares		P-values
Yates corrected	7.72	0.0054599
Fisher exact 1-tailed P-value		0.0038571
2-tailed P-value		0.0038571
Sensitivity	0.86	
Specificity	0.67	

soft tissue and lymphatics. Regional and distant spread of metastatic disease to spine may occur with almost any of the solid tumour of the body, with osseous malignancy of appendicular skeleton, and with systemic lymphoreticular malignancy such as multiple myeloma and lymphoma. Metastases are the most common skeletal tumour , and the spine is the most common site of skeletal involvement. They are most common secondary to carcinoma of the breast, lung and prostate gland. [5,6]

Absence and partial prevertebral soft tissue involvement in neoplastic processes of the spine is

Table 4

		Granulomatous infection	Tumor	
Posterior element involvement	absence	19	2	21
	presence	12	11	23
		31	13	44

Analysis of Single Table Odd ratio : 8.71

Chi-Squares		P-values
Yates corrected	6.01	0.0142584
Sensitivity	0.61	
Specificity	0.84	

Table 5

		Granulomatous infection	Tumor	
Multiple levels of spinal involvement	contiguous	29	6	35
	seperated	0	2	2
		29	8	37

Analysis of Single Table Odd ratio = Undefined

Chi-Squares		P-values
Yates corrected	3.55	0.0593750
Fisher exact 1-tailed P-value		0.042042
2-tailed P-value		0.042042
Sensitivity	1.0	
Specificity	0.25	

a reliable criteria (sensitivity 0.53, specificity 1.0, p = 0.00004 and sensitivity 1.0, specificity 0.77,p = 0.0007 respectively) because most neoplasm spread by hematogenous and lymphatic routes, but less likely by subligamentous route. These also caused more presence of multiple seperated levels of spinal involvement (sensitivity 0.25, specificity 1.0, p = 0.042) than in granulomatous infections. Criteria of focal pattern of bony destruction (sensitivity 0.67, specificity 0.86, p = 0.004) is reliable due to marrow replacement in any degree by the tumour cells but granulomatous infection usually causes diffuse fragmentation of the vertebral bodies [8]. The intervertebral discs are spared in tumoural process (sensitivity 1.0, specificity 1.0) owing to their resistance to tumour invasion and is a reliable criteria for tumoural process, while presence of disc involvement (sensitivity 1.0, specificity 1.0) is observed in granulomatous infection.

Table 6

		Granulomatous infection	Tumor	
Disc involvement	presence	31	0	31
	absence	0	13	13
		31	13	44

Analysis of Single Table Odd ratio : Undefined

Chi-Squares		P-values
Yates corrected	39.33	0.0000
Sensitivity	1.0	
Specificity	1.0	

Table 7

		Tumor	Granulomatous infection	
Prevertebral soft tissue	absence	7	0	7
	soft tissue	6	31	37
		13	31	44

Analysis of Single Table Odd ratio = Undefined

Chi-Squares		P-values
Yates corrected	16.03	0.0000624
Fisher exact 1-tailed P-value		0.0000442
2-tailed P-value		0.000448
Sensitivity	0.53	
Specificity	1.0	

The limitation of this study is its purely retrospective nature , and all granulomatous infections in this study were tuberculosis so this study may mainly represents the spinal tuberculosis rather than other granulomatous infections.

In conclusion, under these criteria for CT interpretation of spinal pathology, it can be practical benefit in the patients with clinical undiagnostic between granulomatous infection (particularly tuberculosis) and neoplastic process [7].

ACKNOWLEDGEMENT :

We would like to thank Ms.Amarin Taksinsathian for the statistical analysis

Table 8

		Tumor	Granulomatous infection	
Prevertebral soft tissue	partial	6	7	13
	complete	0	24	24
		6	31	37

Analysis of Single Table Odd ratio : Undefined

Chi-Squares		P-values
Yates corrected	10.04	0.0014301
Fisher exact 1-tailed P-value		0.0007381
2-tailed P-value		0.0007381
Sensitivity	1.0	
Specificity	0.77	

Table 9

		Tumor	Granulomatous infection	
Bony destruction	focal	6	4	10
	diffuse	3	26	29
		9	30	39

Analysis of Single Table Odd ratio = Undefined

Chi-Squares		P-values
Yates corrected	7.72	0.0054599
Fisher exact 1-tailed P-value		0.0038571
2-tailed P-value		0.0038571
Sensitivity	0.67	
Specificity	0.86	

REFERENCE

1. Van Lom KJ, Kellerhouse LE, Pathria MN, et al. Infection versus Tumor in the Spine : Criteria for Distinction with CT. *Radiology* 1988 ; 166 : 851-855
2. Smith AS, Blaser SI. Infection and Inflammatory Process of the spine. *Radiol Clin North Am* July 1991 ; 29 (4) : 809-827
3. Latchaw RE. *MR and CT Imaging of The Head, Neck and Spine* , 2nd Ed. St.Louis ; Mosby 1991 : 1183-1221
4. La Berge JM, Brant-Zawadzki M. Evaluation of Pott's disease with computerized tomography. *Neuroradiology* 1984 ; 26 : 429-434

Table 10

		Tumor	Granulomatous infection	
Posterior element involvement	presence	11	12	23
	absence	2	19	21
		13	31	44

Analysis of Single Table Odd ratio = 8.71

Chi-Squares		P-values
Yates corrected	6.01	0.0142584
Sensitivity	0.84	
Specificity	0.61	

Table 11

		Tumor	Granulomatous infection	
Multiple levels of spinal involvement	seperated	2	0	2
	contiguous	6	29	35
		8	29	37

Analysis of Single Table Odd ratio = Undefined

Chi-Squares		P-values
Yates corrected	3.55	0.0593750
Fisher exact 1-tailed P-value		0.0420420
2-tailed P-value		0.0420420
Sensitivity	0.25	
Specificity	1.0	

5. Rothman RH, Simeone FA. *The Spine* , 3rdEd. Philadelphia ; W B Saunder 1992 : 1279-1303, 1352-1364
6. Masaryk TJ. Neoplastic disease of the Spine. *Radiol Clin North Am* July 1991 ; 29 (4) : 829-845
7. Redmond J, Spring DB, Munderloh SH, et al. Spinal Computed Tomography Scanning in the Evaluation of Metastatic Disease. *Cancer* 1984 ; 54 : 253-258
8. Chongchitnant P. Computed Tomography of Spinal Tuberculosis. *J Med Asso Thai* Oct 1992 ; 75(10) : 560-564

Table 12

		Tumor	Granulomatous infection	
Disc involvement	absence	13	0	13
	presence	0	31	31
		13	31	44

Analysis of Single Table Odd ratio = Undefined

Chi-Squares	P-values
Yates corrected 39.33	0.00000
Sensitivity 1.0	
Specificity 1.0	

Table 13

Retrospective analysis of CT examinations reveals the reliable criteria as followed :

	Sensitivity	Specificity	P-values
Reliable criteria for granulomatous infection of spines			
- presence of prevertebral soft tissue	1.0	0.53	0.00004
- complete pattern of prevertebral soft fissue	0.77	1.0	0.0007
- diffuse bony destruction	0.86	0.67	0.004
- absence of posterior element involvement	0.61	0.84	0.014
- contiguous levels of spinal involvement	1.0	0.25	0.042
- presence of disc involvement	1.0	1.0	–
Reliable criteria for neoplastic process of spines			
- absence of prevertebral soft tissue	0.53	1	0.00004
- partial pattern of prevertebral soft tissue	1.0	0.77	0.0007
- focal bony destruction	0.67	0.86	0.004
- presence of posterior element involvement	0.84	0.61	0.014
- seperated levels of spinal involvement	0.25	1.0	0.042
- absence of disc involvement	1.0	1.0	–