

Preoperative Gadolinium-enhanced Magnetic Resonance Images on Infectious Spondylitis

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Objective : The purpose of this study is to analyze the patterns of intervertebral disc enhancement seen in infectious spondylitis, differentiate between two groups (tuberculous vs pyogenic spondylitis).

Methods : Between January 1994 and December 2002, 83 patients underwent operative procedure with confirmed histopathologic evaluation. Magnetic resonance (MR) images were obtained in all patients and were analyzed retrospectively. 57 patients had tuberculosis and 26 patients were infected by pyogens. The patterns of gadolinium enhancement of disc were classified into 4 types (post's classification) : Type I, non-enhancing; Type II, enhancement of the peripheral rim; Type III, Type II with central area and partial endplate; Type IV, general enhancement.

Results : The enhancement patterns observed were as follows : Common pattern of tuberculous spondylitis was Type II, and pyogenic spondylitis was Type III. ($p < 0.01$) This difference may result from pathophysiologic varieties of organisms.

Conclusion : Careful preoperative MR analysis of the patterns of disc enhancement occurring in infectious spondylitis can be useful for differentiating between the tuberculous and pyogenic spondylitis.

KEY WORDS : Infectious spondylitis · Pyogenic spondylitis · Tuberculous spondylitis · Gd-enhanced MR images.

Introduction

Infectious spondylitis is an infrequent disease that may cause severe complications such as irreversible neurological deficits, the vertebral deformity, and etc. For appropriate treatment, accurate diagnosis and identification of the causing pathogen is required⁹⁾. In other words, as the treatment mode is different depending on the causing pyogens of spondylitis, their identification is important for appropriate treatment. However, in vertebral diseases, the appropriate study on the association with the enhancement of intervertebral disc pattern in preoperative magnetic resonance imaging that is routinely performed as well as the causing pyogens identified accurately has not been reported yet.

Hence, the aim of this study is to differentiate tuberculous and pyogenic spondylitis by analyzing the enhancement of intervertebral disc pattern of magnetic resonance imaging, and thus assess the findings that may help differentiate these two diseases.

Materials and Methods

This study was performed on 83 patients who were diagnosed as infectious spondylitis from January 1994 to December 2002. The diagnosis was confirmed by bacterial culture and pathological tests on the specimens obtained during operation. In addition, magnetic resonance imaging results were analyzed retrospectively.

The mean age of patients was 46.3 years (19~72 years), and the ratio of male to female was 1.5 : 1. As the causing pyogens of spondylitis, tuberculous group was 57 cases, pyogenic group was 26 cases, and any combined infection was not detected. As histological diagnosis, 63 cases were diagnosed by open surgical treatment and 20 cases were diagnosed by percutaneous histological test performed by the diagnostic radiology department. Among 26 cases diagnosed as pyogenic spondylitis, bacteria was isolated from 21 cases, among which, staphylococcus aureus was 14 cases, being most frequent. In addition, in all tuberculous spondylitis patients, simple chest X-ray was

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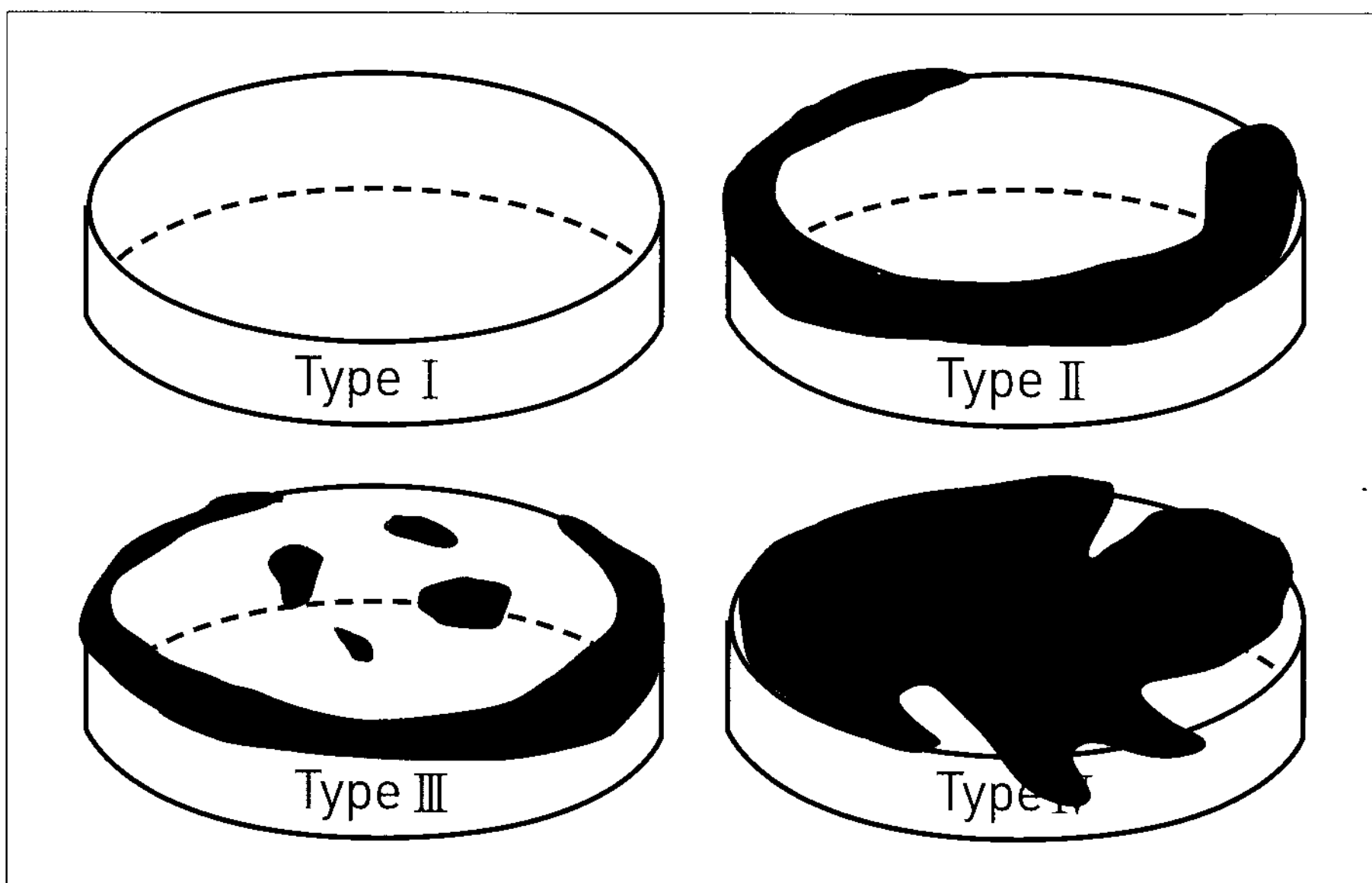


Fig. 1. Post's classification. Type I : No enhancement, Type II : enhancement of peripheral margin of intervertebral disc, Type III : enhancement of margin and center of disc adjacent to endplate, Type IV : general enhancement or destruction of disc.

on the axial and sagittal plane of Gd-DTPA enhancement imaging and T1-weighted imaging. The imaging enhancement pattern of the discs between the infected vertebral body was classified into 4 stages and was analyzed such as Type I : No enhancement, Type II : enhancement of peripheral margin of intervertebral disc, Type III : enhancement of margin and center of disc adjacent to endplate, Type IV : general enhancement or destruction of disc (Fig. 1)^{2,6}. In addition, the statistical significance of each of the imaging pattern was examined. The data were evaluated by the unpaired student's T-test using the SPSS program, with a significance level of P value < 0.01.

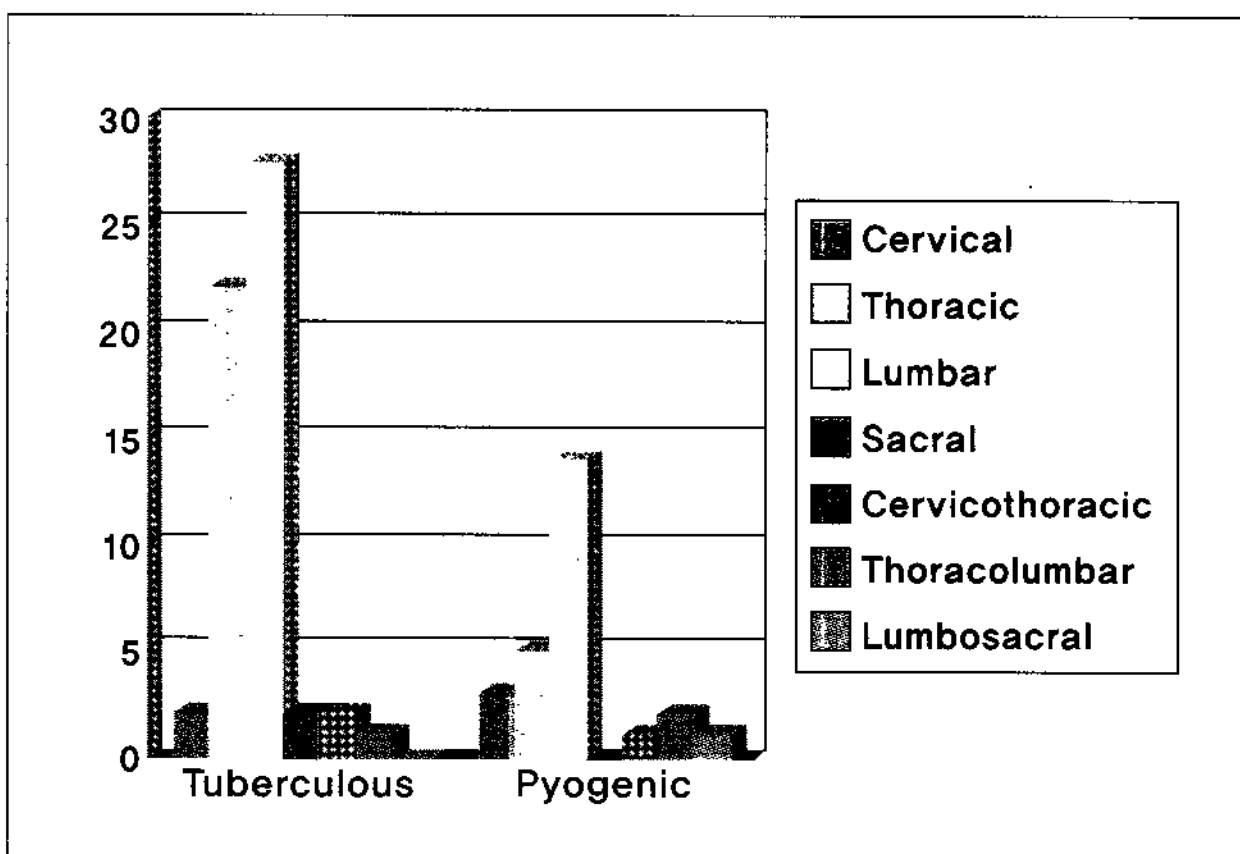


Fig. 2. Involved vertebral level.

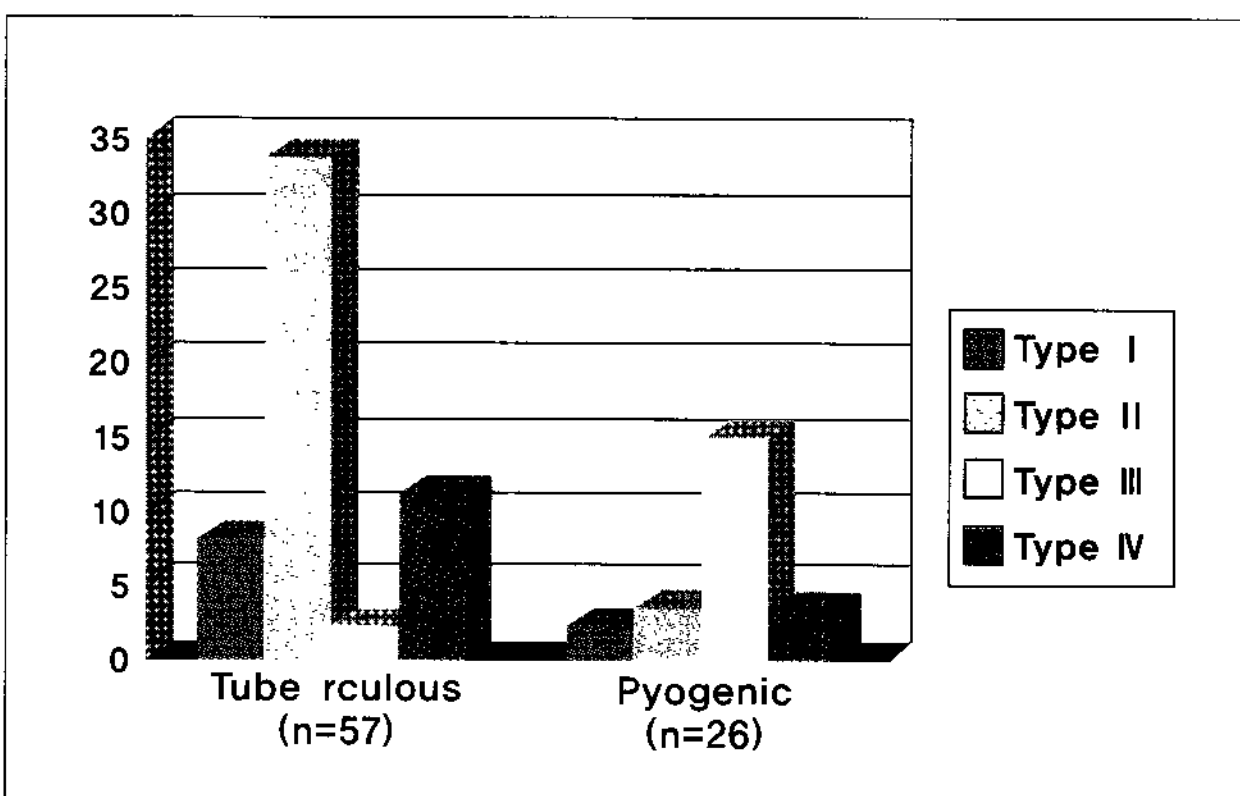


Fig. 3. Patterns of disc enhancement.

performed to diagnose accompanied pulmonary tuberculosis.

The infectious activity and severity of spondylitis was evaluated more accurately through the results of the MRI⁸, based

Results

Among 83 patients diagnosed as infectious spondylitis, tuberculous spondylitis was 70 vertebral bodies and pyogenic spondylitis was 34 vertebral bodies. The involved levels in both groups was the lumbar vertebra and the thoracic vertebra preferably (Fig. 2).

The pattern according to the enhanced image of the intervertebral disc was that in tuberculosis spondylitis, it occurred preferably in the order of type II, type IV, and type I, and in pyogenic spondylitis, it occurred preferably in the order of type III, type I and type II (Fig. 3). In other words, tuberculosis and pyogenic spondylitis occurred most frequently in type II (Fig. 4) and type III, respectively (Fig. 5). Such difference was statistically significant (P < 0.01) and can be attributed to the different pathophysiology of the two groups.

Discussion

The causing pathogens of infectious spondylitis is pyogenic and tuberculosis in most cases. Irreversible neurological deficits or the vertebral deformity may occur without proper treatment. Therefore early diagnosis and treatment is very important⁹. Recently however, with the increase of various techniques such as epidural block in the vicinity of the spine, the incidence of pyogenic spondylitis is on rise. Furthermore, the incidence of tuberculosis is decreasing without a change in the frequency of tuberculosis in the spine and joint¹⁰. The concomitant infection with tuberculosis and pyogenic infection

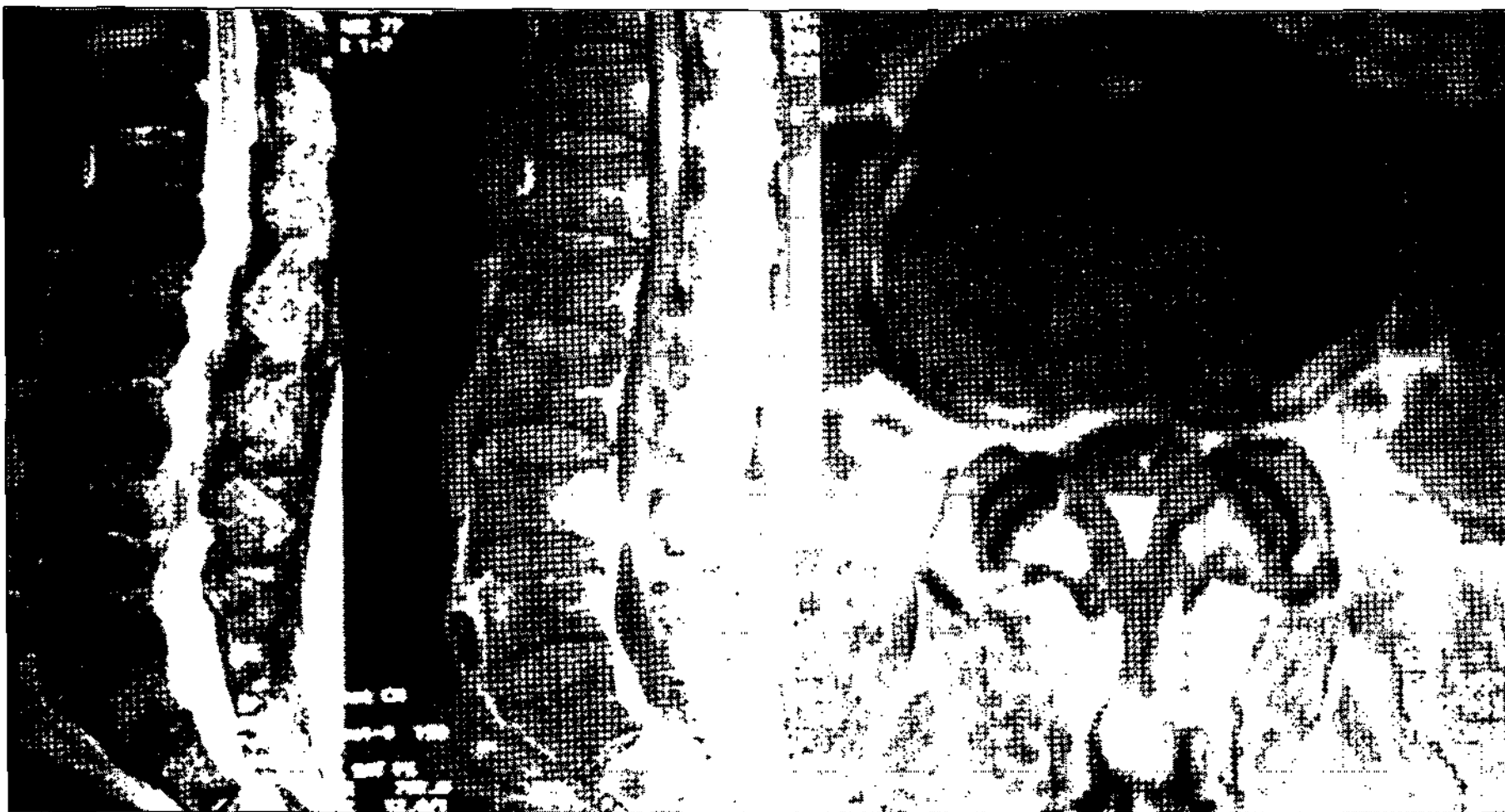


Fig. 4. Tuberculous spondylitis (Type II). Magnetic resonance (MR) sagittal images demonstrate slight increase in the signal intensity of L4-5 intervertebral disc. Axial MR image demonstrate type II enhanced pattern.



Fig. 5. Pyogenic spondylitis (Type III). Magnetic resonance (MR) sagittal images demonstrate typical findings of L5-S1 discitis and a large epidural mass suggesting epidural abscess. Axial MR image demonstrate type III enhanced pattern.

has been infrequently reported, and thus the necessity of differentiation of the causing pathogens and its appropriate treatment has been emphasized.

Infectious spondylitis is the infection of structures forming the spine, the vertebral body is most frequently invaded. The preferably involved lesions have been reported as the thoracic and lumbar area. Similar results were obtained in our study. The most frequent causing pyogens was *Staphylococcus aureus*, and others following are *Streptococcus*, *E. coli*, *Tubercle bacillus*, fungus, etc. Among them, *tubercle bacillus* is the most frequent pathogen of infectious spondylitis in Korea. Hematogenous propagation is most frequent⁸⁾. However, direct propagation by invasive treatment technique and propagation to the adjacent areas may also occur.

The difference of the invasion pattern due to pathophysi-

ological differences between tuberculosis and pyogenic spondylitis showed the radiological findings that can be differentiating points from each other. Occasionally, the differentiation between the two groups is difficult. Tuberculous spondylitis is initiated from the anterior area of the vertebral body, causing the vertebra to collapse with deformity, and invades the intervertebral disc later. In addition, as it forms the abscess with evident boundaries accompanying calcification, upon the injection of dye, it shows a thin and even enhancement in the vicinity of the vertebra^{1,6,7,11)}. In contrast, in pyogenic cases, the intervertebral disc is invaded early. The collapse of the vertebral body is scarce. As the posterior part of the vertebral body is invaded, the propagation to the vertebra area is relatively rare¹⁾. Thus, it may be explained that radiological clinical differences between tuberculous and pyogenic spondylitis are due to the fact that *Tubercle bacillus* does not secrete proteolytic enzymes, and consequently maintaining the cartilage in the vertebral end plate for a long time, and thus the maintained disc relatively^{1, 3-5)}.

Hence, focused on the facts that tuberculous spondylitis progresses slowly and the invasion to the intervertebral disc occurs lately due to the absence of proteolytic enzymes, we examined whether enhanced MR imaging is of help in differentiating these two diseases by the classification of the enhancement pattern of the disc. In our study, the most frequently enhanced type of tuberculous spondylitis was type II which was 34 cases (60%), and type III was detected in only 1 case (1.75 %). In contrast, type III was most prevalent with 15 cases in pyogenic spondylitis. Such results may be due to the difference of the propagation pathway between these two groups. In other words, the intervertebral disc is invaded primarily from the afferent propagation gradually from the inflammation in the vicinity of the vertebra and from the pathogen in the lateral edge area, and in pyogenic spondylitis, in contrast, not only the invasion to the edge of intervertebral

disc, but also the direct invasion to the intervertebral disc through the vertebral end plate occurs.

However, in the cases without the invasion to the intervertebral disc at all, and in the cases invaded the intervertebral disc, particularly, after the disease progressed substantially and destroyed completely, the differentiation of these two groups is difficult, and furthermore, in tuberculous spondylitis patients, except the patients with pulmonary tuberculosis, it was difficult to assess the accurate duration, and thus the comparative analysis with pyogenic spondylitis that invades the intervertebral disc relatively early was difficult.

Conclusion

Morphological classification through the understanding of the propagation pathway of these two groups may become a non-invasive differential point, together with careful analysis of numerous reports on the invasion of intervertebral disc, the size, shape and the imaging pattern.

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