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The value of MRI in the diagnosis of postoperative spondylodiscitis

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Abstract We evaluated the role of MRI in the diagnosis of postoperative spondylodiscitis. Spondylodiscitis is a serious complication of surgery, and the diagnosis frequently depends on a combination of clinical, laboratory and imaging findings. We compared the MRI findings in six patients with biopsy- or surgery-proven spondylodiscitis with those in 38 asymptomatic postoperative patients. Contrast enhancement and signal changes in the intervertebral disc or the vertebral endplates are not specific for spondylodiscitis, being also seen in the asymptomatic patients. However, absence of Modic type 1 changes, of contrast enhancement of the disc or of enhancing paravertebral soft tissues suggests that the patient does not have spondylodiscitis. MRI appears more useful for exclusion than for confirmation of postoperative spondylodiscitis.

Key words Spine, surgery · Infection · Magnetic resonance imaging

Introduction

Spondylodiscitis, discitis with vertebral osteomyelitis, is a rare but well-known complication of lumbar disc surgery, seen not only after surgery or chemonucleolysis [1, 2], but also after diagnostic procedures such as discography [3, 4] and even myelography [5]. Postoperative spondylodiscitis occurs in 0.1–3 % of patients [6–9]; although the incidence may be decreasing due to better technical and prophylactic measures it can not be completely eliminated. The disc-space infection is probably due to intraoperative contamination rather than haematogeneous spread [10, 11]. Pre- or perioperative infections and compromised patient immunology may be predisposing factors. The infection is most frequently caused by *Staphylococcus epidermidis* or *Staphylococcus aureus* [11–13].

Spondylodiscitis is a serious complication which may lead to longlasting and sometimes permanent morbidity [11, 14–17]. It is commonly accepted that early, adequate treatment is capable of shortening its course and reducing severe sequelae.

The diagnosis of postoperative spondylodiscitis depends on a combination of clinical, laboratory and

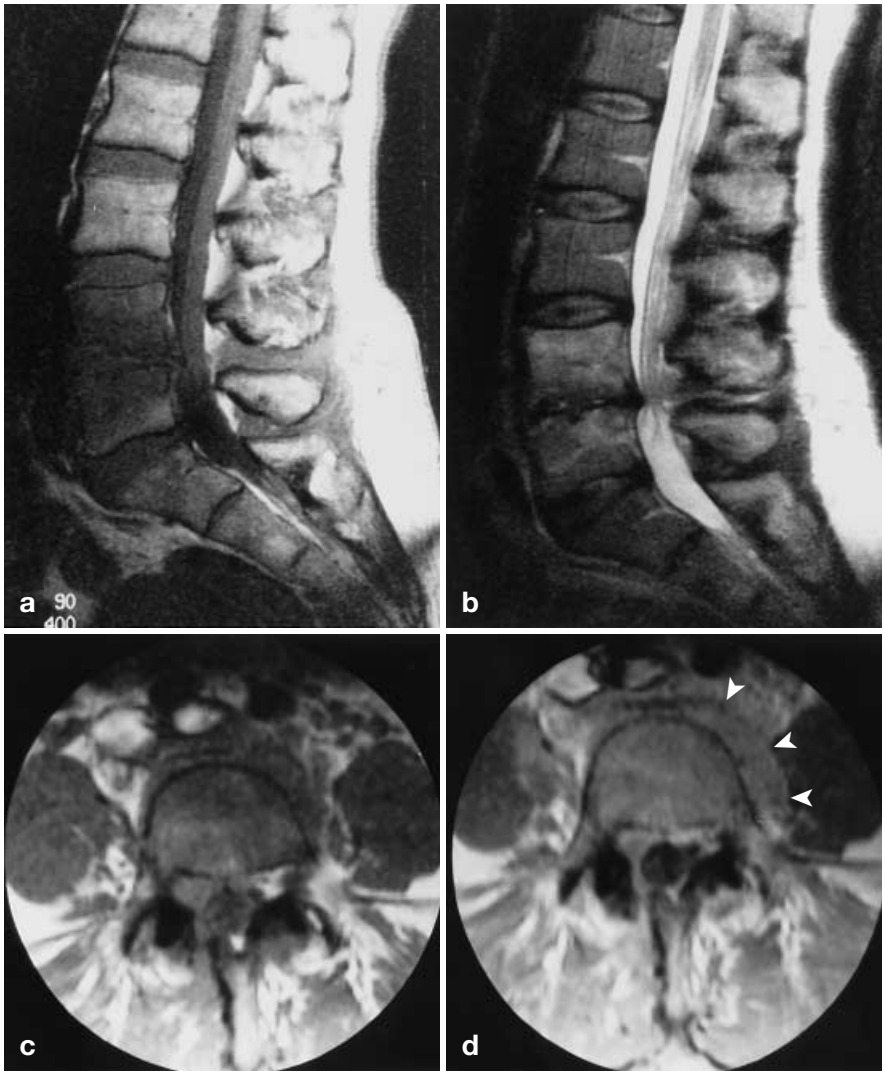

Fig. 1 a–d Postoperative spondylodiscitis in a 47-year-old woman, 3 weeks after surgery. **a, b** Sagittal T1- and T2-weighted images show Modic type 1 alterations [30] in the vertebrae next to the operated disc. Note partly increased intervertebral disc signal on the T2-weighted image. **c, d** Axial images before and after contrast enhancement show a typical enhancing soft-tissue rim *(arrowheads)* in the anterolateral paravertebral space, contralateral to the operation site. Note intervertebral enhancement

imaging findings. Clinically, severe low back pain, with or without sciatica, appears 7–28 days after surgery [16, 18], at an average of 16 days postoperatively [13]. There may be a typical posture in extended position with an inability to bend and with tapping or jolting pains [19]. Clinical findings and classical screening methods such as white blood cell count, erythrocyte sedimentation rate and elevated temperature are, however, not reliable and have a high failure rate in detecting spondylodiscitis [14, 15, 20, 21]. C-reactive protein (CRP) has proved a much more reliable screening test for infectious complications after lumbar disc surgery [22]. PMN-elastase assay has a 100% negative predictive value and can be used to exclude spondylodiscitis in the early stage [23].

Conventional imaging techniques such as plain films, tomography and CT are not reliable for detecting spondylodiscitis in the early stages [6, 7, 12, 16, 18]. Scintigraphy may be negative in the early stages and, even if positive, is nonspecific. Few studies have investigated the role of MRI in the diagnosis of postoperative spondylodiscitis; as the sole method unreliable, according to some workers [12, 24]. One study suggests that a combination of MRI findings is characteristic of postoperative discitis [27], but these findings are not confirmed in a more recent study [12].

Biopsy of the disc and isolation of the organism may yield the definite diagnosis [11, 14]. Since fine-needle aspiration is often negative in cases of septic spondylodiscitis [12, 26], biopsy with a nucleotome is recommended [27].

We examined the value of MRI in the diagnosis of postoperative spondylodiscitis.

Fig. 2 a–d Postoperative spondylodiscitis in a 47-year-old man; compare with Fig. 1. **a, b** Sagittal T1- and T2-weighted images also show Modic type 1 changes, but to a lesser extent, and more focal. Some parts of the disk give increased signal on the T2-weighted image. **c, d** Axial images before and after contrast enhancement, however, again demonstrate the typical enhancing soft-tissue rim *(arrowheads)* in the anterolateral paravertebral space, contralateral to the operation site. The intervertebral space also shows clear enhancement

Methods

We reviewed the MRI examinations of all patients in our hospital with surgically or biopsy proven postoperative spondylodiscitis over a 2 year period. We compared these with the examinations of a control group of 38 asymptomatic postoperative patients [28]. Informed consent was obtained from all asymptomatic patients, and permission to perform the study with intravenous contrast medium on asymptomatic operated volunteers was obtained from the hospital Ethics Committee.

All patients had preoperative radiating leg pain refractory to conservative therapy. The operations consisted of flavectomy with or without partial hemilaminectomy for extirpation of a lumbar disc herniation (extraligamentous nuclear extrusion) at a single level and with maximal removal of the nucleus pulposus. Patients with previous back surgery were excluded.

Six patients with septic discitis after lumbar discectomy underwent MRI on a 1.5 T imager, including at least sagittal T1- (TR 430 TE 15 ms or TR 1350 TE 19 ms) and T2-weighted (TR 5500 TE 91 ms) images and axial T1-weighted (TR 600 TE 15 ms) images before and within 10 minutes of single-dose intravenous gadolinium-containing contrast medium. Imaging was performed 6 weeks after surgery in the asymptomatic control group and at the onset of symptoms in the patients with discitis.

All examinations were reviewed independently, blinded to all other data, according to a standard protocol. Those of patients with spondylodiscitis were mixed at random with those of asymptomatic patients. The review protocol included semi-quantitative assessment of intervertebral signal intensities, disc structure and contrast enhancement; vertebral endplate signal intensities and enhancement; paravertebral and paradiscal soft tissues and enhancement at the operated level; anterior epidural enhancement and mass effect on the dural sac or nerve roots. The operated level was compared with the adjacent levels if possible.

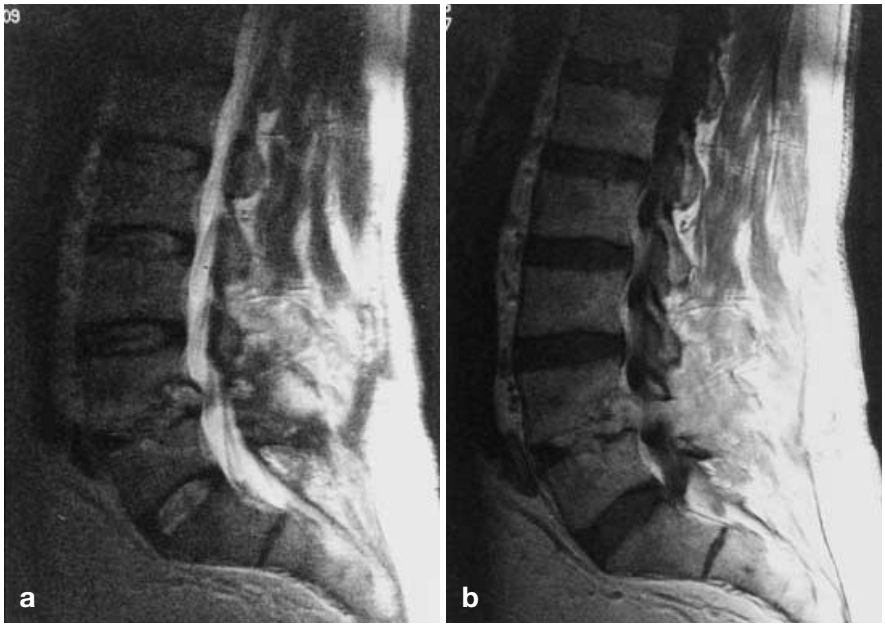

Fig. 3 a, b 60-year-old asymptomatic postoperative patient. Modic type 1 changes are seen at the operated level (L4–L5), with **a** high signal on the T2-weighted images. **b** After contrast medium there is clear enhancement of the disc. However, no enhancing tissue is seen outside the intervertebral space

Results

In one patient with spondylodiscitis the intervertebral disc was destroyed. In the other five there was contrast enhancement of the disc (Figs. 1, 2). In the asymptomatic group disc enhancement was seen in 67% of asymptomatic patients (Fig. 3). Partly increased signal from the disc on the T2-weighted images was found in three of six patients with spondylodiscitis (Fig. 1), and in 13 of 38 asymptomatic patients. The disc structure remained normal, with a (partly) normal intranuclear cleft in two of six patients with spondylodiscitis and in 20 of 38 asymptomatic patients.

In all patients with spondylodiscitis vertebral bone marrow changes were seen, consisting of decreased signal on T1-, at least partly increased signal intensity on T2-weighted images (Figs. 1, 2) and contrast enhancement. This type of bone marrow change was also seen in 14 of 38 asymptomatic patients (Fig. 3).

In all patients with spondylodiscitis there were paravertebral soft tissue changes at the operated level, consisting of a moderately enhancing rim lateral and anteriorly (Figs. 1, 2). This was found in none of the asymptomatic patients.

Enhancing tissue in the anterior epidural space was seen in all patients of both groups. A centrally nonenhancing portion and deformation of the thecal sac were seen in three of six patients with spondylodiscitis and in almost half the asymptomatic patients.

Table 1 When should postoperative spondylodiscitis be suspected?

Clinical	Severe low back pain Muscle spasm Extended posture, decreased motion
Laboratory	Fever Elevated white blood cell count Elevated sedimentation rate Positive C-reactive protein Positive PMN-Elastase
MRI	Endplate changes (low on T1-, high on T2-weighted images) Enhancing intervertebral space Enhancing paravertebral soft tissue rim

Discussion

Of all imaging techniques only MRI contributes significantly to the diagnosis of postoperative spondylodiscitis [6, 7, 13, 16, 18]. Although diagnosing spondylodiscitis with the help of MRI in the unoperated patient may be straightforward, it is more challenging in the postoperative spine. The operated disc always shows more or less extensive changes due to the surgical intervention itself and a normal postoperative aseptic inflammatory response [12, 28, 29].

Vertebral endplate changes, consisting of decreased signal on T1- and increased signal intensity on T2-weighted images are also seen in degenerative disc disease, and sometimes termed Modic type 1 changes [30].

Contrast enhancement can also be seen in the intervertebral space and the vertebral endplates [28, 31, 32]. The intranuclear cleft sign [33] is usually not reliable

since the nucleus pulposus may be removed by the surgeon.

However, absence of Modic type 1 changes has an important negative predictive value. All our patients with spondylodiscitis had this type of vertebral endplate change, with bone marrow contrast enhancement. Others also confirm this finding [12, 25].

The presence of an enhancing soft-tissue rim around the affected intervertebral space was highly suggestive of spondylodiscitis. All patients with proven septic spondylodiscitis and none of the 38 asymptomatic patients had this finding. However we did not investigate symptomatic postoperative patients (the failed back syndrome) without septic spondylodiscitis. In another study, three of six patients with aseptic spondylodiscitis (postoperative inflammatory changes without infection) also showed enhancing paravertebral soft tissues [12].

Our study indicates that MRI may contribute to the diagnosis of postoperative septic spondylodiscitis. 1. The absence of vertebral endplate changes with low signal on T1- and high signal on T2-weighted images makes septic spondylodiscitis highly unlikely. 2. The same holds true for absence of contrast enhancement of the intervertebral space. 3. An enhancing rim of soft tissue around the affected intervertebral space is suggestive of septic spondylodiscitis, although more studies of the failed back syndrome are required. 4. If MRI can neither exclude nor confirm septic spondylodiscitis, one should try to confirm the diagnosis with disc biopsy. With a negative culture and high clinical and biochemical suspicion of spondylodiscitis (Table 1), but inconclusive MRI, it is appropriate to administer antibiotics effective against *Staphylococcus (epidermidis* or *aureus),* the most likely organism.

References

1. Fraser RD, Osti OL, Vernon-Roberts B (1986) Discitis following chemonucleolysis: an experimental study. Spine 11: 679–687
2. Deeb ZL, Schmiel S, Daffner RH (1985) Intervertebral disc-space infection after chymopapain injection. AJR 144: 671–674
3. Guyer RD, Collier R, Stith WJ (1988) Discitis after discography. Spine 13: 1352–1354
4. Fraser RD, Osti OL, Vernon-Roberts B (1987) Discitis after discography. J Bone Joint Surg Br 69: 26–35
5. Scherbel AL, Gardner WJ (1960) Infections involving the intervertebral disks: diagnosis and management. JAMA 174: 370–374
6. Lindholm TS, Pylkkanen P (1982) Diskitis following removal of intervertebral disk. Spine 7: 618–622
7. Fernand R, Lee CK (1986) Post-laminectomy disk space infection: a review of the literature and a report of three cases. Clin Orthop 209: 215–218
8. Dauch WA (1986) Infection of the intervertebral space following conventional and microsurgical operation on the herniated lumbar intervertebral disc. A controlled clinical trial. Acta Neurochir 82: 43–49
9. Bircher MD, Tasker T, Crawshaw E, Mulholland RC (1988) Discitis following lumbar surgery. Spine 13: 98–102
10. Tronnier V, Schneider R, Kunz U, Albert F, Oldenkott P (1992) Postoperative spondylodiscitis: results of a prospective study about the aetiology of spondylodiscitis after operation for lumbar disc herniation. Acta Neurochir 117: 149–152
11. Peruzzi P, Rousseaux P, Scherpereel B, Bernard MH, Bazin A, Baudrillard JC, Graftieaux JP, Colmet Daage JF (1988) Spondylodiscitis after surgery of lumbar disc hernia. Neurochirurgie 34: 394–400
12. Grane P, Josephsson A, Seferlis A, Tullberg T (1998) Septic and aseptic postoperative discitis in the lumbar spine – evaluation by MR imaging. Acta Radiol 39: 108–115
13. Iversen E, Nielsen VA, Hansen LG (1992) Prognosis in postoperative discitis. Acta Orthop Scand 63: 305–309
14. Fouquet B, Goupille P, Jattiot F, Cotty P, Lapierre F, Valat JP, Amouroux J, Benatre A (1992) Discitis after lumbar disc surgery, features of "aseptic" and "septic" forms. Spine 17: 356–358
15. Puranen J, Mäkelä J, Lähde S (1984) Postoperative intervertebral discitis. Acta Orthop Scand 55: 461–465
16. Rawlings CE, Wilkins RH, Gallis HA, Goldner JL, Francis R (1983) Postoperative intervertebral disc space infections. Neurosurgery 13: 371–376
17. Rohde V, Meyer B, Schaller C, Hassler WE (1998) Spondylodiscitis after lumbar discectomy. Spine 5: 615–620
18. Dall BE, Rowe DE, Odette WG, Batts DH (1987) Postoperative discitis. Clin Orthop 224: 138–146
19. Frank AM, Trappe AE (1983) Die spondylodiscitis nach lumbaler Bandscheibenoperation. Neurochirurgia 26: 12–17
20. Grollmus J, Perkins RK, Russell W (1974) Erythrocyte sedimentation rate as a possible indicator of early disc space infection. Neurochirurgia 17: 30–35
21. Kapp JP, Sybers WA (1979) Erythrocyte sedimentation rate following uncomplicated lumbar disc operations. Surg Neurol 12: 329–330
22. Meyer B, Schaller K, Rohde V, Hassler W (1995) The C-reactive protein for detection of early infections after lumbar microdiscectomy. Acta Neurochir 136: 145–150
23. Schneider T, Wildförster U, Diekmann J (1995) PMN granulocyte elastase – an early indicator of postoperative spondylodiscitis? Acta Neurochir 136: 16–20
24. Schulitz KP, Assheuer J (1994) Discitis after procedures on the intervertebral disc. Spine 19: 1172–1177
25. Boden SD, Davis DO, Dina TS, Sunner JL, Wiesel W (1992) Postoperative diskitis: distinguishing early MR imaging findings from normal postoperative disk space changes. Radiology 184: 765–771
26. Demaerel P, Van Ongeval C, Wilms G, Lateur L, Baert A (1994) MR imaging of spondylitis with gadopentate dimeglumine enhancement. J Neuroradiol 21: 245
27. Onik G (1996) Automated percutaneous biopsy in the diagnosis and treatment of infectious discitis. Neurosurg Clin North Am 7: 145
28. Van Goethem JWM, Van de Kelft E, Biltjes IGGM, van Hasselt BAAM, van den Hauwe L, Parizel PM, De Schepper AMA (1996) MR findings after successful lumbar discectomy. Neuroradiology 38: S90–96

29. Van De Kelft E, Van Goethem JWM, De La Porte C, Verlooy J (1996) Early postoperative gadolinium-DTPA-enhanced MR imaging after successful lumbar discectomy. Br J Neurosurg 10: 1; 41–49
30. Modic MT, Steinberg PM, Ross JS, Masaryk TJ, Carter JR (1988) Degenerative disk disease. Assessment of changes in vertebral body bone marrow with MR imaging. Radiology 166: 193
31. Grand CM, Bank WO, Balériaux D, Matos C, Levivier M, Brotchi J (1993) Gadolinium enhancement of vertebral endplates following lumbar disc surgery. Neuroradiology 35: 503–505
32. Ross JS, Zepp R, Modic MT (1996) The postoperative lumbar spine. Enhanced MR evaluation of the intervertebral disk. AJNR 17: 223
33. Aguila LA, Piraino DW, Modic MT, Dudley AW, Duchesneau PM, Weinstein MA (1985) The intranuclear cleft of the intervertebral disk. Magnetic resonance imaging. Radiology 155: 155