Case Report
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Thermal-Induced Osteonecrosis of Adjacent Vertebra after Intradiscal Electrothermal Therapy

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A 42-year-old man was admitted to our hospital with complaints of low back pain and intermittent right thigh pain. Twelve weeks before admission, the patient received intradiscal electrothermal therapy (IDET) at a local hospital. The patient still reported low back pain after the procedure that was managed with narcotic analgesics. Follow-up magnetic resonance imaging (MRI) was performed, and his referring physician thought the likely diagnosis was spondylodiscitis at the L4–5 spinal segment with a small epidural abscess. At admission to our department, the patient reported aggravated low back pain. Blood test results, including the erythrocyte sedimentation rate and C-reactive protein levels, were slightly elevated. Biopsy samples of the L4, L5 vertebral bodies and disk were obtained. The material underwent aerobic, anaerobic, fungal, mycobacterial cultures and histologic examination. Results of all cultures were negative. Histologically, necrosis of the bone was evident from the number of empty osteocyte lacunae. In addition, there was no evidence of infection based on biopsy results. No antibiotic treatment was administered on discharge. Repeat computed tomography and MRI performed 12 months after IDET showed a bony defect in the L4 and L5 vertebral bodies, and a decrease in the size of the L4–5 intervertebral disc lesion. We report a case of lumbar vertebral osteonecrosis induced by IDET and discuss etiology and radiologic features.

Key Words : Intradiscal electrothermal therapy · Osteonecrosis · Complication · Discogenic back pain.

INTRODUCTION

Intradiscal electrothermal therapy (IDET) is a minimally invasive procedure that is an intermediate, safe, and effective intervention in the continuum of care for patients with discogenic low back pain[1,7,12]. IDET has been a popular choice for the treatment of chronic discogenic back pain since its introduction in the year 2000[7,12]. Since the IDET procedure uses a fluoroscopically guided thermal catheter to heat the intervertebral disc, several complications related to thermal injury have been reported[1,7,12]. Thermal nerve injury is especially common, and thermal bone injury can also be induced rarely by IDET. Only two case reports of osteonecrosis after IDET have been previously reported[6,13]. We report a case of lumbar vertebral osteonecrosis induced by IDET, and discuss etiology and radiologic features as well as a review of relevant literature.

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CASE REPORT

A 42-year-old man was admitted with complaints of low back pain and intermittent right thigh pain. Three months previously, he fell from the stairs and reported immediate pain with intermittent right thigh pain. Initial L-spine magnetic resonance imaging (MRI) showed left central disc herniation at the L4–5 level (Fig. 1), and the patient received IDET at a local hospital. The patient continued to report low back pain that was managed with narcotic analgesics after the IDET procedure. Seven weeks after the IDET procedure, the patient reported aggravated low back pain. Blood test results, including the erythrocyte sedimentation rate and C-reactive protein levels, were slightly elevated. Follow-up MRI was performed, and his referring physician thought the likely diagnosis was spondylodiscitis at L4–5 with a small epidural abscess. Antibiotic treatment with ciprofloxacin was administered for 3 weeks, but the patient reported no improvement. Finally, he was transferred to our institute 3 months after the intradiscal procedure.

At admission, the patient still reported moderate low back pain with intermittent right thigh pain. The patient had no history of hypertension, diabetes, hepatitis, tuberculosis, or allergy. There were no constitutional signs or symptoms such as fever or chills. Physical examination findings were unremarkable except for low back pain. Neurologic examination results were normal. Laboratory findings, including erythrocyte sedimentation rate and C-reactive protein levels, were slightly elevated.

Radiographic findings were non-specific. Computed tomography (CT) showed a smooth, round-shaped, multilobulated bony defect at the L4–5 spinal segment with a sclerotic margin (Fig. 2A). Follow-up MRI showed an approximate signal change of the lesion at the L4–5 intervertebral disc and L4–5 vertebral bodies. The lesion had markedly increased in size and had an increased T2 signal. In addition, contour bulging of the epidural space was present at the L4–5 intervertebral disc (Fig. 2B). The T1-weighted MRI showed diffuse marrow edema at the L4–5 intervertebral disc (Fig. 2C). To rule out an infectious etiology, bone biopsies were obtained

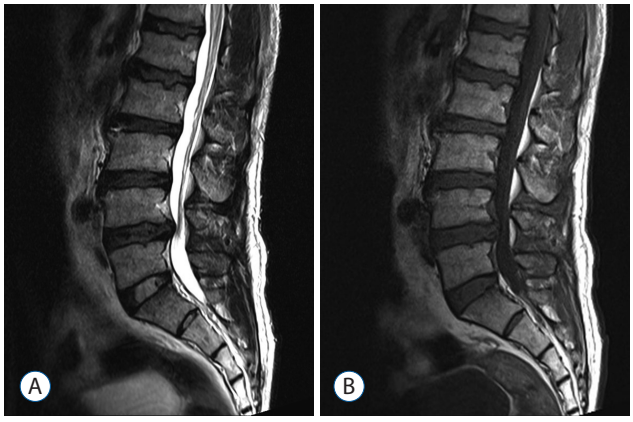

Fig. 1. Initial (A) T2-weighted and (B) T1-weighted magnetic resonance images demonstrating central disc protrusion from an underlying bulging disc with facet osteoarthritic changes and mild central canal stenosis at the L4–5 spinal segment.

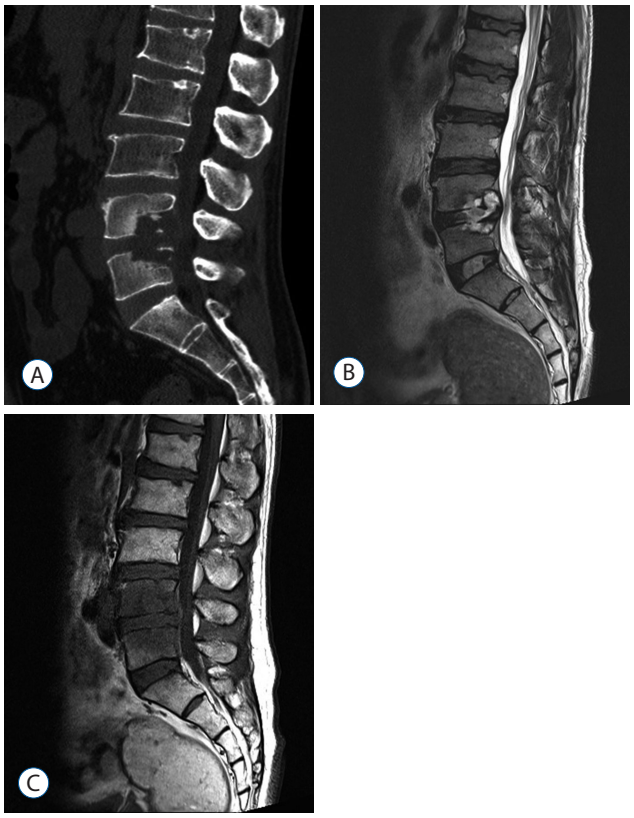

Fig. 2. A : Computed tomography image shows a smooth, round-shaped, multilobulated bony defect at the L4–5 spinal segment with sclerotic margins. B : T2-weighted and (C) T1-weighted magnetic resonance (MR) images 3 months after intradiscal electrothermal therapy at the L4–5 intervertebral disc. The L4–5 intervertebral disc and L4 and L5 vertebral body lesion shows a marked increase in size with an increased signal at the L4–5 intervertebral disc. Note the contour bulging in the epidural space at the L4–5 spinal segment. The MR image shows diffuse marrow edema at the L4–5 spinal segment.

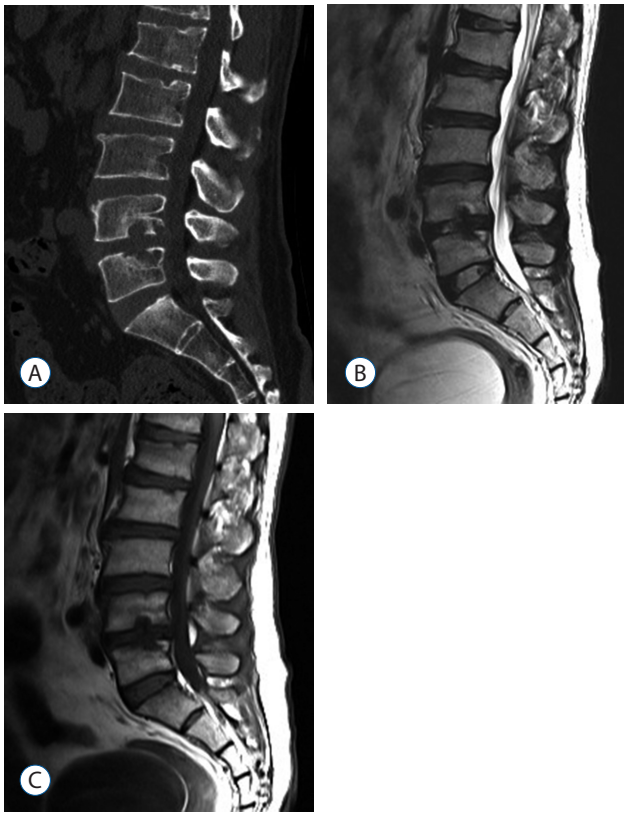

Fig. 3. A : Computed tomography obtained 12 months after the patient' s intradiscal electrothermal therapy (IDET) shows a bony defect decrease in size of the L4–5 lesion. B : Follow-up T2-weighted and (C) T1-weighted magnetic resonance (MR) images 12 months after IDET showing improvement of signal change at the L4–5 intervertebral disc and marrow edema at the L4 and L5 vertebral bodies.

from the L4 and L5 vertebral bodies and the L4–5 intervertebral disc. The material underwent aerobic, anaerobic, fungal, mycobacterial cultures and histologic examination. Histologically, necrosis of the bone with focal fibrosis was seen with empty osteocyte lacunae. There was no evidence of infection, including granuloma, based on biopsy results. Result of all cultures were also negative. No antibiotic treatment was administered on discharge.

During follow up, sedimentation rate, C-reactive protein level, and complete blood count were unchanged and within normal limits. At the 1-year follow-up, although the patient continued to report radiating leg pain, the low back pain had much improved. Repeat CT and MRI 12 months after IDET showed a bony defect at L4–5 and a decrease in size of the L4–5 intervertebral disc lesion (Fig. 3).

DISCUSSION

Treatment of discogenic low back pain remains an area of controversy[13]. Rigid fusion of the spine is invasive, costly, and appears to propagate adjacent-level vertebral degeneration. IDET has been advocated as an alternative to both conservative care and rigid fusion surgery in patients with discogenic low back pain because of its minimally invasive nature and low morbidity[6]. Also, IDET is an intermediate step in the continuum of care and has the advantage of preserving the native disc structure[1]. The procedure has become popular very rapidly with more than 60000 treatments performed to date, and several studies have reported on the clinical efficacy of IDET[3,7].

Recently, a study reported by Assietti et al. reported that IDET resulted in long-term clinical improvement in selected surgical candidates with mild disc degeneration, confirmatory imaging evidence of annular disruption, and highly concordant pain provocation on low-pressure discography[1]. They reported no complications associated with IDET. However, the actual risk of complications associated with IDET is unknown, and more clinical series studies with long-term follow-up are needed. A multicenter study of 1675 patients reported complications such as nerve root injury, post-procedure disc herniation, and catheter breakage in a few patients[13]. Because the IDET procedure uses thermal energy for the treatment of discogenic back pain, thermal injury is a particularly important complication. Thermal nerve injury is a representative example of thermal injury. Heary[8] described thermal nerve root injuries after IDET, and similar observations were made by Cohen et al.[4]

The effects of electrothermal energy on cortical and cancellous bone are also well known[13]. Sustained temperatures of 90°C for 4 minutes are used in radiofrequency ablation of osteoid osteomas[5,11]. In-vitro histological studies following radiofrequency ablation have shown bone and bone marrow necrosis in a 1-cm sphere regardless of the probe tip configuration or the duration of heating[14]. Thermally induced bone necrosis has been studied in rabbits and was found to occur at temperatures exceeding 70°C[2], and the thermal necrosis

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caused by the polymerization of polymethylmethacrylate has been shown to extend 2–3 mm in exposed cancellous bone[9,10]. There have been many reports related to the development of osteonecrosis induced by knee arthroscopic interventions using laser or radiofrequency[15]. These reports suggest that patients undergoing a procedure using thermal energy can develop bony thermal injury as a complication.

This case highlights a potential complication of IDET. MRI findings and biopsy results demonstrate cortical and cancellous bone necrosis. Djurasovic et al.[6] reported a case of osteonecrosis after IDET and similar observations were made by Scholl et al.[13] The patient in Djurasovic et al.'s case underwent anterior interbody fusion surgery as a salvage procedure after an unsuccessful IDET procedure.[6] In the case of Scholl et al.[13], the patient was treated by conservative management and a repeat MRI showed an interval decrease in size and signal at the L2 lesion, but the patient's symptoms remained unchanged. In our case, an additional period of observation was recommended before salvage surgery, and fortunately, the patient stated the pain has been tolerable.

CONCLUSION

This case study highlights a potential complication of intradiscal electrothermal therapy. In this patient, osteonecrosis developed in the adjacent vertebral bodies after IDET. Catheter placement may expose cortical and cancellous bone to temperatures within the range reported to induce necrosis.

References

1. Assietti R, Morosi M, Block J : Intradiscal electrothermal therapy for symptomatic internal disc disruption: 24-month results and predictors of clinical success. **J Neurosurgery Spine 12 :** 320-326, 2010
2. Berman AT, Reid JS, Yanicko DR Jr, Sih GC, Zimmerman MR : Thermally induced bone necrosis in rabbits: Relation to implant failure in humans. **Clin Orthop Relat Res (186) :** 284-292, 1984
3. Biyani A, Andersson G, Chaudhary H, An H : Intradiscal electrothermal therapy: a treatment option in patients with internal disc disruption. **Spine (Phila Pa 1976) 28(15 Suppl) :** S8-S14, 2003
4. Cohen S, Larkin T, Abdi S, Chang A, Stojanovic M : Risk Factors for Failure and Complications of Intradiscal Electrothermal Therapy: A Pilot Study. **Spine (Phila Pa 1976) 28 :** 1142-1147, 2003
5. de Berg J, Pattynama P, Obermann W, Bode PJ, Vielvoye GJ, Taminiau AH : Percutaneous computed-tomography-guided thermocoagulation for osteoid osteomas. **Lancet 346 :** 350-351, 1985
6. Djurasovic M, Glassman SD, Dimar JR 2nd, Johnson JR : Vertebral osteonecrosis associated with the use of intradiscal electrothermal therapy: a case report. **Spine (Phila Pa 1976) 27 :** E325-E328, 2002
7. Freeman BJ : IDET: a critical appraisal of the evidence. **Eur Spine J 15 :** 448-457, 2006
8. Heary RF : Intradiscal electrothermal annuloplasty: the IDET procedure. **J Spinal Disord 14 :** 353-360, 2001
9. Mjöberg B, Pettersson H, Rosenqvist R, Rydholm A : Bone cement, thermal injury, and the radiolucent zone. **Acta Orthop Scand 55 :** 597-600, 1984
10. Rock M, Capanna R : The treatment of giant cell tumor of bone in Stauffer R, Ehrlich M, Fu F, et al. (eds) : **Advances in Operative Orthopaedics.** St. Louis, MO : Mosby-Year Book, 1993, pp367-390
11. Rosenthal DI, Alexander A, Rosenberg AE, Springfield D : Ablation of osteoid osteomas with a percutaneously placed electrode: a new procedure. **Radiology 183 :** 29-33, 1992
12. Saal JS, Saal JA : Management of chronic discogenic low back pain with a thermal intradiscal catheter. A preliminary report. **Spine (Phila Pa 1976) 25 :** 382-388, 2000
13. Scholl BM, Theiss SM, Lopez-Ben R, Kraft M : Vertebral osteonecrosis related to intradiscal electrothermal therapy: a case report. **Spine (Phila Pa 1976) 28 :** E161-E164, 2003
14. Tillotson CL, Rosenberg AE, Rosenthal DI : Controlled thermal injury of bone. Report of a percutaneous technique using radiofrequency electrode and generator. **Invest Radiol 24 :** 888-892, 1989
15. Türker M, Çetik Ö, Çırpar M, Durusoy S, Cömert B : Postarthroscopy osteonecrosis of the knee. **Knee Surg Sports Traumatol Arthrosc 23 :** 246-250, 2015