DWI Findings in a Iatrogenic Lumbar Epidermoid Cyst

A Case Report

G. MANZO¹, A. DE GENNARO¹, A. COZZOLINO³, E. MARTINELLI³, A. MANTO²

¹ Department of Biomorphological and Functional Sciences, Federico II University of Naples; Naples, Italy

² Department of Neuroradiology, Umberto I Hospital; Nocera Inferiore, Salerno, Italy

³ Department of Oncology, Second University of Naples; Naples, Italy

Key words: spinal epidermoid cyst, MRI, DWI

SUMMARY – *Epidermoid cysts comprise less than 1% of intraspinal tumors. They can be congenital, frequently associated with other spinal malformations, or iatrogenic, resulting from the implantation of epidermal cells within the spinal canal during the execution of a variety of procedures such as spinal puncture. At MR imaging epidermoid tumors can mimic cystic lesions with fluid content such as arachnoid cysts. DWI can help obtain a correct diagnosis. We describe a case of iatrogenic lumbar epidermoid cyst with DWI findings in a young woman who had undergone epidural anesthesia for Cesarean section three years before the onset of symptoms.*

Introduction

Spinal epidermoid cysts are rare intradural extramedullary lesions that comprise less than 1% of intraspinal tumors. They can be congenital, frequently associated with other spinal malformations, or iatrogenic, resulting from the implantation of epidermal cells within the spinal canal during the execution of a variety of procedures such as spinal puncture^{1,2}. At MR imaging epidermoid tumors can mimic cystic lesions with fluid content such as arachnoid cysts³. Even if not widely used in spine imaging because of technical difficulties, diffusion-weighted imaging (DWI) can help differentiate these kinds of lesions⁴. We describe the case of a iatrogenic lumbar epidermoid cyst with DWI findings in a young woman who had undergone epidural anesthesia for Cesarean section three years before the onset of symptoms.

Case Report

A 36-year-old woman came to our observation with a four-month history of low back pain radiating to both buttocks. The pain was more

intense at night and had slowly increased. She did not report history of bowel or bladder dysfunctions. Three years earlier the patient had undergone epidural anesthesia for Cesarean section. Neurological examination and laboratory findings were normal. Flexion and extension of the lumbar spine were limited due to pain. Spine X-ray was normal. An MRI scan of the lumbar spine was performed with a 1.5 T MR scanner (Philips Intera) using a spine phase-array coil. The study consisted of turbo spin-echo T1-weighted (TR/TE 400/7.4 ms), T2-weighted (TR/TE 3500/120 ms), STIR (TR/TE 2500/60 ms) and FLAIR (TR/TE 6000/100 ms) sequences on the sagittal plane, a turbo spin-echo T2-weighted (TR/TE 2055/120 ms) sequence on the axial plane and a spin-echo T1-weighted sequence after IV administration of gadopentetate dimeglumine (0.1 mmol/kg) on axial, sagittal and coronal planes. The examination demonstrated an intraspinal intradural mass at the level of L1, located just below the conus medullaris, between the nerve roots of cauda equina. The mass was slightly hyperintense on T2-weighted images (Figure 1B) and showed a low signal on T1-weighted images (Figure 1A), similar to the cerebrospinal

Figure 1 Spinal MR sagittal images demonstrating an intraspinal intradural mass at the level of L1, located just below the conus medullaris, as hypointense on T1-weighted (A) and hyperintense on T2-weighted (B) images, similar to the cerebrospinal fluid, without contrast enhancement after gadolinium injection (C).

Figure 2 Spinal MR axial (A) diffusion-weighted image with ADC map (B) demonstrating the upper lumbar mass had a high-signal and restricted diffusion.

fluid (CSF). There was no significant contrast enhancement after gadolinium injection (Figure 1C). Axial DWI was also performed with a single-shot EPI (the only sequence available)

with three orthogonal diffusion gradients with b values of 1000 s/mm² and 0 s/mm². The imaging parameters were TR 2280 ms TE 89 ms, NSA 1; slice thickness 3 mm; FOV 29×19 cm;

matrix 128×128; acquisition time was 24s. DWI demonstrated the mass had a discrete high signal (Figure 2A) with restricted diffusion and reduced apparent diffusion coefficient (ADC) (Figure 2B). The ADC of the lesion was 0.79×10^{-3} mm²/s (Figure 3A) while those of the spinal cord and CSF were 1.30 (Figure 3B) and 3.1×10^{-3} mm²/s (Figure 3C), respectively. These findings suggested an epidermoid cyst. The patient underwent L1 total laminectomy and D12 and L2 partial laminectomy; a 1.5×1 cm encapsulated tumor was found and completely removed. The histological examination confirmed the diagnosis of epidermoid cyst. The patient had no clinical evidence of skin abnormalities in the lumbosacral region or spinal dysraphism to indicate a congenital etiology of the epidermoid cyst so the history of lumbar puncture for epidural anesthesia suggested a iatrogenic origin. A four-month post-operative MRI scan revealed no residual or recurrent tumor (Figure 4A,B); DWI with a single-shot EPI on the axial plane was also performed with the same parameters used in the pre-operative examination and showed no signal alterations (Figure 5A,B).

Discussion

Spinal epidermoid tumors are uncommon lesions represented histologically by a mass of desquamated cells encapsulated by a layer of well-differentiated stratified squamous epithelium⁵. Most of these tumors arise from ectodermal cells of the central nervous system displaced in the spinal canal during embryogenesis. They are often associated with spinal malformations such as spina bifida or other dysraphic conditions⁶. The clinical association of epidermoid cysts with lumbar puncture was first described by Choremis et al. in 1956. They reported six children treated for three/five months with multiple intrathecal injections of streptomycin for tuberculous meningitis who underwent surgery to remove these tumors between three and seven years later⁷. Two years later, in 1958, Gibson and Norris demonstrated that almost 70% of spinal needles not equipped with stylets contained epidermal tissue after skin penetration⁸. In 1962, Manno et al. reviewed the literature and found a history of lumbar puncture in 37 patients with epidermoid spinal tumors⁹. From then on, many other cases have been reported. During skin puncture of the spinal region a hollow needle can easily transport epidermal cells into the spinal canal. The implanted

skin fragments grow slowly until they cause symptoms of nerve compression. The formation of these masses is usually attributed to the use of unstyletted needles that are easier to use, especially in newborns^{1,2}. Recently, however, a case of spinal epidermoid cyst that developed 26 months after several lumbar punctures using needles with stylet in an eight-year-old boy was reported¹⁰. In all the cases described in the literature there was a delay between the time of lumbar puncture and the onset of symptoms varying from two to 40 years². At MR imaging epidermoid cysts usually have a low signal on T1- and high signal on T2-weighted images, but their signal characteristics can be variable, according to the chemical state of cholesterol, and show some internal heterogeneity, which is best seen in the proton-density and FLAIR images¹¹. They usually do not enhance but can sometimes present a minimal and peripheral contrast enhancement. These findings can mimic those of cystic lesions with fluid content such as arachnoid cysts¹².

DWI can help differentiate these kinds of lesions as it reflects the molecular diffusion of water in the examined tissues. This diffusion can be quantitatively evaluated by the ADC, that is inversely correlated to a tissue's diffusion-weighted signal intensity and, moreover, is independent from proton density, T1 and T2 relaxation effects¹³. In 1990, Tsuruda et al. reported that DWI could differentiate epidermoid tumors from other cystic lesions because the ADCs of epidermoid tumors were similar to that of nervous tissue, indicating their solid non-free water nature, whereas the ADCs of cystic lesions were similar to that of CSF¹⁴. In 2001, Chen et al. reported eight cases of intracranial epidermoid tumors in which the mean ADC values were significantly lower than that of CSF but higher than that of the gray matter. These findings indicated more active diffusion in the tumors than in the healthy parenchyma but the DW signal of the lesions was hyperintense. This was explained by the fact that DW imaging basically is a T2-weighted sequence whose contrast also depends on the T2 values of the examined tissues¹⁵.

Thanks to a combination of T2 and diffusion effects, epidermoid tumors appear markedly hyperintense compared with CSF and brain tissue on DW images. By contrast, arachnoid cysts or other cystic lesions do not show restricted diffusion and follow the CSF signal on DWI and ADC maps¹⁶.

DWI has been widely used to characterize

Figure 3 ADC map with ROI analysis demonstrating the ADC of the lesion is $0.79 \times 10^{-3} \text{ mm}^2/\text{s}$ (A) while those of the spinal cord and CSF are 1.30 (B) and $3.1 \times 10^{-3} \text{ mm}^2/\text{s}$ (C), respectively.

intracranial lesions^{13,14}. Its application to the evaluation of spinal lesions has been limited because it is technically more challenging. As demonstrated by the presence of severe noise in our axial DW images (Figures 2A and 5A), it is very difficult to obtain high-resolution images of the spine using standard SS-EPI. Poor quality images are obtained because of technical problems such as the small size of the spinal cord, long acquisition time, magnetic-field inhomogeneities, susceptibility gradients, chemical shift and motion-induced artifacts caused by breathing and CSF pulsatile flow^{17,18}. To overcome these difficulties, alternative methods have been tested including navigated fast spin-echo¹⁹ and interleaved and parallel EPI approaches²⁰. In recent years, good results have been obtained reducing the effective FOV²¹.

Conclusions

Spinal epidermoid cysts are very rare tumors that can be incorrectly diagnosed as arachnoid cysts, especially when iatrogenic and presenting in an adult with no evidence of spine malformations or other dysraphic defects.

Thanks to the high signal presented by epidermoid tumors, DWI is very helpful to identify and differentiate them.

As shown in our case, diffusion-weighted imaging can also be useful for postoperative follow-up of these lesions, especially if not completely removed.

However a technical improvement in DWI application to the spine is required to overcome the artifacts due to magnetic field inhomogeneities.

Figure 4 Spinal MR sagittal (A) and axial (B) T2-weighted images acquired 4 months after L1 total laminectomy and D12 and L2 partial laminectomy demonstrating no residual or recurrent tumor.

Figure 5 Spinal MR axial (A) diffusion-weighted image with ADC map (B) acquired 4 months after L1 total laminectomy and D12 and L2 partial laminectomy demonstrating no signal alterations.

References

- 1 Park JC, Chung CK, Kim HJ. Iatrogenic spinal epidermoid tumor. A complication of spinal puncture in an adult. *Clin Neurol Neurosurg.* 2003; 105 (4): 281-285.
- 2 Ziv ET, Gordon McComb J, Krieger MD, et al. Iatrogenic intraspinal epidermoid tumor: two cases and a review of the literature. *Spine (Phila Pa 1976).* 2004; 29 (1): E15-E18.
- 3 Kukreja K, Manzano G, Ragheb J, et al. Differentiation between pediatric spinal arachnoid and epidermoid-dermoid cysts: is diffusion-weighted MRI useful? *Pediatr Radiol.* 2007; 37 (6): 556-560.
- 4 Teksam M, Casey SO, Michel E, et al. Intraspinal epidermoid cyst: diffusion-weighted MRI. *Neuroradiology.* 2001; 43 (7): 572-574.
- 5 Gardner DJ, O'Gorman AM, Blundell JE. Intraspinal epidermoid tumour: late complication of lumbar puncture. *CMAJ.* 1989; 141 (3): 223-225.
- 6 Carré S, Sanoussi S, Dietemann JL, et al. [Intraspinal epidermoid cyst]. *J Neuroradiol.* 1997; 24 (1): 65-67.
- 7 Choremis C, Economos D, Gargoulas A, et al. Intraspinal epidermoid tumours (cholesteatomas) in patients treated for tuberculous meningitis. *Lancet.* 1956; 271 (6940): 437-439.
- 8 Gibson T, Norris W. Skin fragments removed by injection needles. *Lancet.* 1958; 2 (7054): 983-985.
- 9 Manno NJ, Uihlein A, Kernohan JW. Intraspinal epidermoids. *J Neurosurg.* 1962; 19: 754-765.
- 10 Issaivanan M, Cohen S, Mittler M, et al. Iatrogenic spinal epidermoid cyst after lumbar puncture using needles with stylet. *Pediatr Hematol Oncol.* 2011; 28 (7): 600-603.
- 11 Timmer FA, Sluzewski M, Treskes M, et al. Chemical analysis of an epidermoid cyst with unusual CT and MR characteristics. *Am J Neuroradiol.* 1998; 19 (6): 1111-1112.
- 12 Tang L, Cianfoni A, Imbesi SG. Diffusion-weighted imaging distinguishes recurrent epidermoid neoplasm from postoperative arachnoid cyst in the lumbosacral spine. *J Comput Assist Tomogr.* 2006; 30 (3): 507-509.
- 13 Bergui M, Zhong J, Bradac GB, et al. Diffusion-weighted images of intracranial cyst-like lesions. *Neuroradiology.* 2001; 43 (10): 824-829.
- 14 Tsuruda JS, Chew WM, Moseley ME, et al. Diffusion weighted MR imaging of the brain: value of differentiating between extraaxial cysts and epidermoid tumors. *Am J Neuroradiol.* 11: 925-931.
- 15 Chen S, Ikawa F, Kurisu K, et al. Quantitative MR evaluation of intracranial epidermoid tumors by fast fluid-attenuated inversion recovery imaging and echo-planar diffusion-weighted imaging. *Am J Neuroradiol.* 2001; 22 (6): 1089-1096.
- 16 Aribandi M, Wilson NJ. CT and MR imaging features of intracerebral epidermoid--a rare lesion. *Br J Radiol.* 2008; 81 (963): e97-e99.
- 17 Bammer R, Fazekas F, Augustin M, et al. Diffusion-weighted MR imaging of the spinal cord. *Am J Neuroradiol.* 2000; 21 (3): 587-591.
- 18 Manara R, Severino M, Mandari R, et al. Chronic cystic lesion of the sacrum: characterisation with diffusion-weighted MR imaging. *Radiol Med.* 2008; 113 (5): 739-746. Epub 2008 Jun 3.
- 19 Kikuchi K, Miki H, Nakagawa A. The utility of diffusion-weighted imaging with navigator-echo technique for the diagnosis of spinal epidermoid cysts. *Am J Neuroradiol.* 2000; 21 (6): 1164-1166.
- 20 Bammer R, Augustin M, Prokesch RW, et al. Diffusion-weighted imaging of the spinal cord: interleaved echo-planar imaging is superior to fast spin-echo. *J Magn Reson Imaging.* 2002; 15: 364-373.
- 21 Zaharchuk G, Saritas EU, Andre JB, et al. Reduced field-of-view diffusion imaging of the human spinal cord: comparison with conventional single-shot echo-planar imaging. *Am J Neuroradiol.* 2011; 32: 813-820.

Andrea Manto, MD
U.O.D. Neuroradiologia
Ospedale Umberto I
Viale S. Francesco 2
84014 Nocera Inferiore
Salerno, Italy
Tel.: +390819213875
Fax: +390819213874
E-mail: and.manto@libero.it