Imaging of Spinal Hydatid Disease

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Introduction

Hydatid disease (echinococcosis) is a parasitic infection caused more frequently by *Echinococcus granulosus* and less frequently by *E. multilocularis* (*E. alveolaris*), the liver and lungs being the most commonly involved organs (Turgut 1997). Involvement of the spine is rare but it is clinically challenging (Fig. 12.1). Alveolar echinococcosis of the spine is much rarer, and imaging findings, such as inhomogeneous osteolysis of vertebral bodies without loss of intervertebral disk height with an associating paravertebral mass, may be nonspecific (Toussaint et al. 2001).

Patients with hydatid disease usually present with symptoms caused by spinal cord or nerve root compression (Akhan et al. 1991; Pandey and Chaudhari 1997; Işlekel et al. 1998; Hilmani et al. 2004; Layadi et al. 2005; Adilay et al. 2007; Gopal et al. 2007; Kaen et al. 2009; Limaiem et al. 2010). Hydatid disease can be seen at any level of the spine (Bouras et al. 1984; Mathuriya et al. 1985; Göçer et al. 1994; von Sinner and Akhtar 1994; Pandey and Chaudhari 1997; Turgut 1997; Singh et al. 1998; Layadi et al. 2005; Adilay et al. 2007; Song et al. 2007; Arif and Zaheer 2009; Senoglu et al. 2009), but thoracic vertebrae are more commonly involved (Polat et al. 2003; Gopal et al. 2007), sometimes misleading to the diagnosis of Pott's disease (Bouras et al. 1984; Turgut 1997; Song et al. 2007) and mimicking tuberculous spondylodiscitis (Tabak et al. 2007). Intradural hydatid at the foramen magnum was reported with all features

M. Turgut (ed.), *Hydatidosis of the Central Nervous System: Diagnosis and Treatment*,
DOI 10.1007/978-3-642-54359-3_12,

of spinomedullary compression including respiratory distress, so hydatid disease should be considered in the differential diagnosis of compressive lesions at the foramen magnum (Mathuriya et al. 1985).

Hydatid cysts were classified according to their relationship with the dura mater, spinal canal, and spinal cord (Pamir et al. 1984; Fahl et al. 1994; von Sinner and Akhtar 1994; Berk et al. 1998; Turgut 2002; Polat et al. 2003; Adilay et al. 2007; Gopal et al. 2007; Arif and Zaheer 2009; Güneş et al. 2009) as intramedullary hydatid cysts, intradural extramedullary hydatid cysts, extradural-intraspinal hydatid cysts (Fig. 12.2), hydatid cysts of the vertebrae (Figs. 12.3, 12.4, 12.5, 12.6, and 12.7), and paravertebral hydatid cysts (Figs. 12.4, 12.8 and 12.9) (Polat et al. 2003). Intradural hydatid cysts are rare (Pamir et al. 1984; Kahilogullari et al. 2005; Arif and Zaheer 2009; Güneş et al. 2009).

Lack of osteoporosis and sclerosis in involved bone, absence of damage to intervertebral disk spaces and vertebral bodies, paraspinal extension, and (in the thoracic spine) involvement of contiguous rib are the most common features of spinal hydatid disease (Polat et al. 2003). Hydatid disease of the spine usually begins in the vertebral body. The cysts show slow growth in the direction of least resistance (Polat et al. 2003; Phatak 2006). With time, the parasite replaces the osseous tissue and destroys the cortex. It then spreads from bone to surrounding tissue such as muscle and the spinal cord (Polat et al. 2003). Extension into the spinal canal results in spinal cord and neural compression (Gopal et al. 2007). Hydatid cysts that lack the typical radiographic appearance may be mistaken for arachnoid cysts (Secer et al. 2008).

Plain X-rays are routinely obtained as a part of initial imaging but radiographic findings of spinal hydatid disease are nonspecific (Fig. 12.3). Plain X-rays may show bone destruction (Fig. 12.4) and sometimes abnormal soft tissue masses in the paravertebral region (Phatak 2006). However, they may show no bony abnormalities (Gopal et al. 2007; Arif and Zaheer 2009). It should be remembered that, radiographically, no sclerosis or periosteal reaction is evident in the early stages of the disease (Farzan et al. 2006).

Computed tomography (CT) and magnetic resonance imaging (MRI) demonstrate cystic cerebral hydatid disease effectively (Bükte et al. 2004) and they also serve for imaging of spinal hydatid disease (Figs. 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7, and 12.9). After obtaining plain X-rays, CT and MRI should be used for further imaging as diagnostic tools of choice (Göçer et al. 1994; Turgut 1997; Gopal et al. 2007). CT and/or MRI techniques were found to be extremely useful, both for reaching the correct diagnosis and for proper surgical management of hydatid disease (Turgut 2002). CT and MRI have revolutionized neurosurgical practice for the diagnosis of hydatid cysts and allowed early diagnosis of the disease and provided localization of the lesions more accurately than we could do with plain X-ray, and also they could show multiple lesions (Turgut 1997); therefore, they are of value in preoperative planning of the surgical approach to hydatid lesions of the skeleton.

On CT and MRI, the appearance of the cystic fluid resembles that of cerebrospinal fluid (CSF) (Figs. 12.2, 12.3, 12.8, and 12.9) (Polat et al. 2003; Layadi et al. 2005; Gopal et al. 2007; Senoglu et al. 2009). In the past, myelography and CT myelography were used in the diagnosis of spinal hydatid disease (Işlekel et al. 1998), but now MRI has replaced the need for invasive myelography procedures.

Computed Tomography Scan

CT scan is effective in demonstrating the destructive hydatid lesions in vertebrae (Figs. 12.3, 12.4, 12.5, and 12.7), in determining their spread, and in establishing the presence of other hydatid cysts in adjacent soft tissues (Bouras et al. 1984; von Sinner and Akhtar 1994). CT could show multiple hydatid cysts in the ipsilateral psoas (Figs. 12.8) and quadratus lumborum muscles,

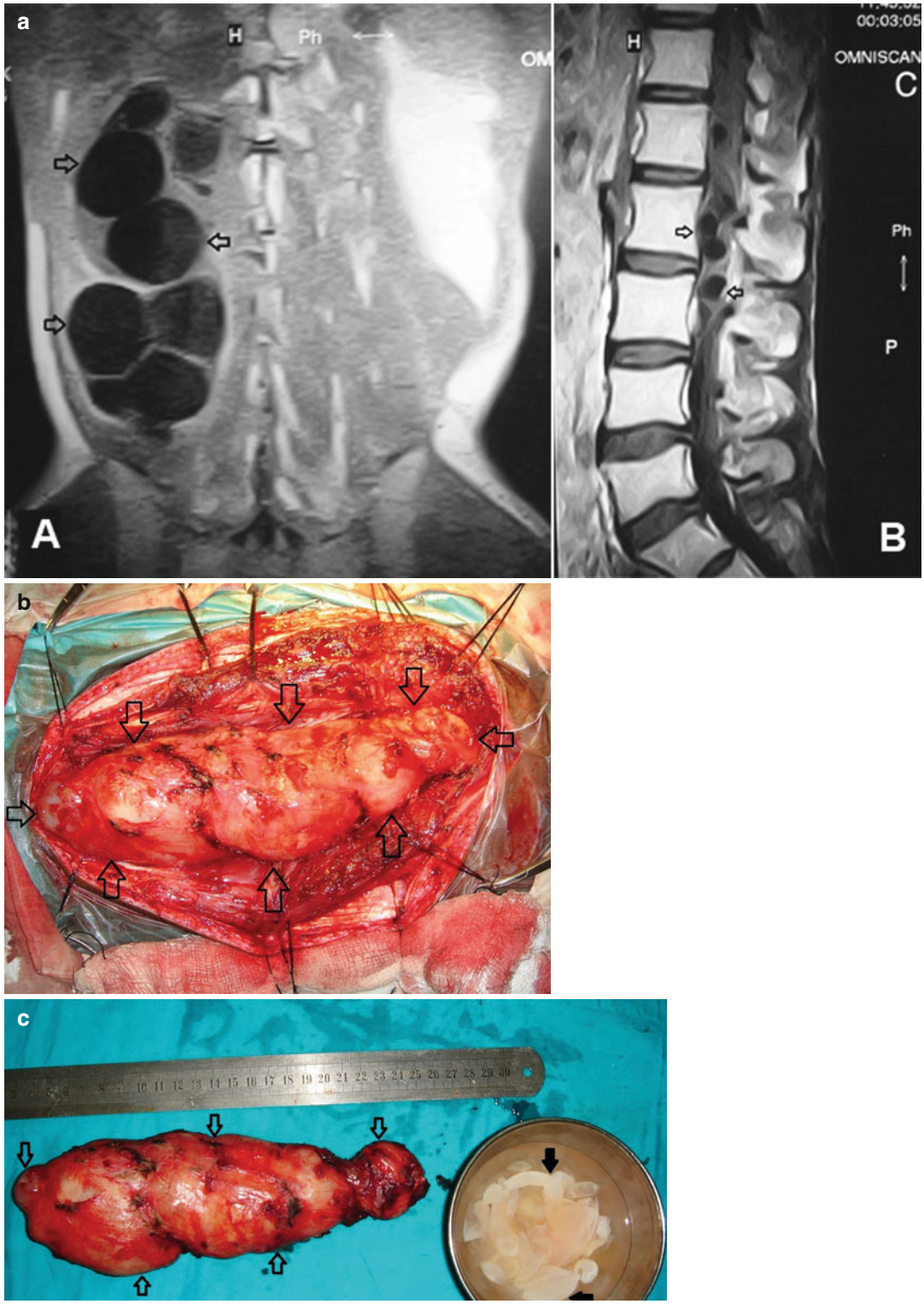

Fig. 12.1 (**a**) Spinal hydatid cysts (*arrows*). (**b**) Spinal hydatid preoperative view (*arrows*). (**c**) Spinal hydatid resected specimen (*arrows*) (Courtesy of D. Chowdhury, MD)

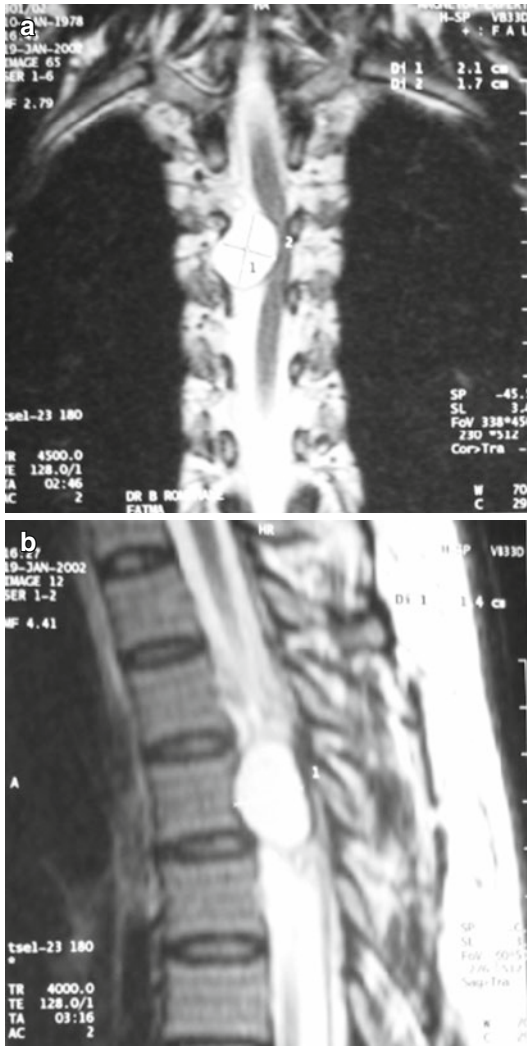

Fig. 12.2 (**a**, **b**) A 24-year-old male patient with extradural hydatid cyst at T4 vertebra corpus level (Courtesy of F. Limaiem, MD)

widening of the neural foramen, and extension of cyst into the neural canal compressing the spinal cord (Phatak 2006).

In a 73-year-old man with sacral/retroperitoneal hydatid disease, CT could demonstrate a large, multiloculated, lytic lesion that expanded anteriorly causing extensive destruction of the sacrum and extending into the sacral canal. CT shows the cystic nature of the lesions which are isodense to CSF (Senoglu et al. 2009), but it is not possible to differentiate an extramedullary hydatid cyst from an arachnoid cyst by using only the CT views (Tuncel 2008).

Usually no rim enhancement is evident after injection of contrast material, but there may be some exceptional cases. CT could show peripheral rim enhancement in a case with an infected intradural hydatid cyst at the foramen magnum (Mathuriya et al. 1985). In a 45-year-old woman with lumbar vertebral hydatid disease, axial contrast-enhanced CT could demonstrate increased contrast enhancement peripheral to the secondary lesions in the erector spinae muscles and spinal canal (Polat et al. 2003).

Contrast enhancement may be seen in alveolar echinococcosis. Contrast-enhanced CT images of an 80-year-old man with primary extrahepatic alveolar echinococcosis showed a multilobulated cystic mass in the right retroperitoneum originating from the psoas muscle, where the cystic components had fluidlike density and thickened septae with mild contrast enhancement. Besides, the lumbar spine presented lytic lesions of the first and second lumbar vertebra with partial cortical destruction (Nell et al. 2011).

Calcification is rare in spinal hydatid disease (Polat et al. 2003). However, on CT scan, the existence of calcification in the cyst wall, appearance of microvesicular polycystic vertebra, or the development of vertebral compression fracture can be observed in the last stage of involvement of the spine (Turgut et al. 2007).

CT was also used for the treatment where CT-guided needle aspiration and hypertonic saline irrigation of a multilocular extradural cervical spinal hydatid cyst causing severe spinal cord compression eliminated the need for emergency surgery and provided complete resolution of the patient's quadriplegia (Spektor et al. 1997).

Magnetic Resonance Imaging

More recently, MRI became the first imaging modality in patients with myelopathy and/or radiculopathy, with multiple daughter cysts within a parent cyst in spinal hydatidosis (Turgut

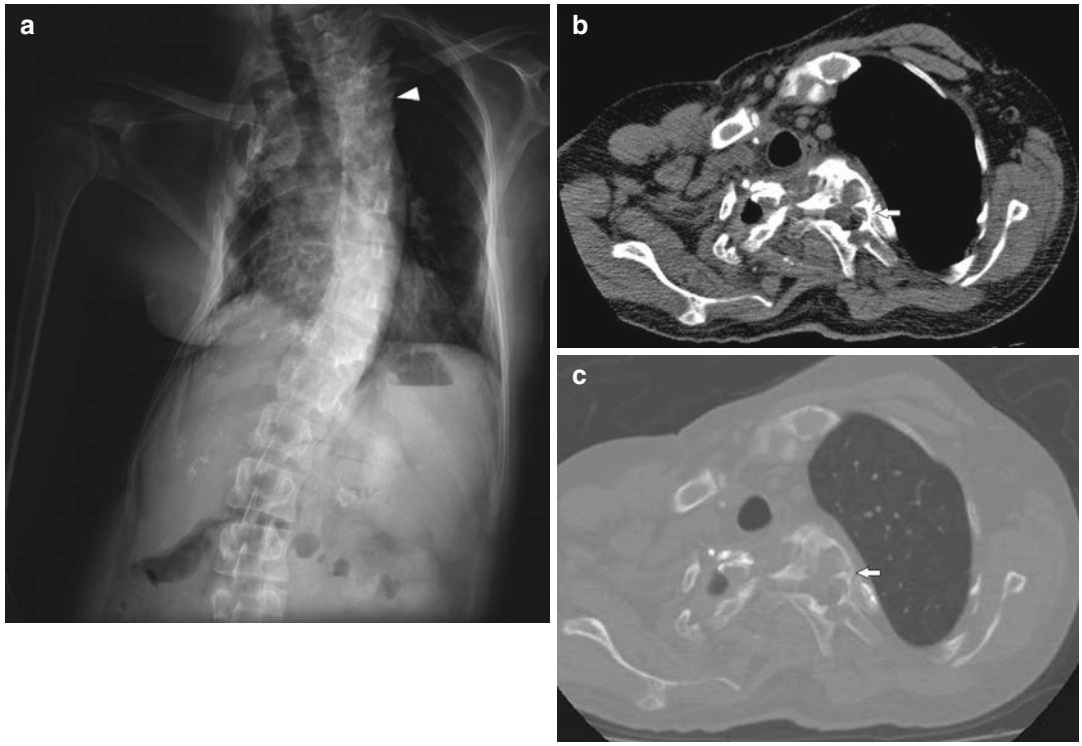

Fig. 12.3 Anteroposterior plain X-ray (**a**) of a 54-year-old male patient with thoracic spinal hydatid disease. There is marked kyphoscoliosis (*arrowhead*). Subtle radiolucent areas can be seen in the upper thoracic vertebrae. Unenhanced axial chest CT images with soft tissue window (**b**) and bone window (**c**) settings demonstrate hypodense cystic lesion in the vertebral corpus, which is isodense to cerebrospinal fluid, causing bone destruction and extending into the upper thoracic spinal canal (*arrow*). Chest deformities and subsequent tracheal deviation are prominent

et al. 2007). Although X-ray or CT images of spinal echinococcosis are similar to tuberculosis, metastases, giant cell tumors, or cysts of the bone, MRI was reported to show distinctive diagnostic features of spinal hydatid disease (Song et al. 2007).

MRI confirms the multicystic/multiloculated/multiseptated nature of the lesion (Figs. 12.1, 12.4, 12.8 and 12.9) (Gopal et al. 2007; Song et al. 2007; Güneş et al. 2009; Kaen et al. 2009; Senoglu et al. 2009; Turan Süslü et al. 2009) and is useful in the demonstration of complications such as spinal cord and/or nerve root compression (Gopal et al. 2007; Kaen et al. 2009).

MRI was stated to be the diagnostic procedure of choice in the face of neurological deficit (Turgut 1997). MRI characteristically shows a lesion resembling a bunch of grapes (Figs. 12.1, 12.8 and 12.9) which can help in distinguishing hydatid infestation from spinal tuberculosis. In spinal hydatid disease, cyst walls are thin and regular (Figs. 12.2 and 12.8); the presence of a markedly hypointense cyst wall on T1-weighted and T2-weighted images and the absence of wall enhancement with gadolinium are characteristic of hydatid disease (Limaiem et al. 2010).

On lumbar MRI of a 36-year-old man with extradural-intraspinal and paravertebral hydatid disease secondary to the spread of vertebral lesions, axial spin-echo T1-weighted image through the L3 vertebra showed multiple hypointense masses in the vertebral body and in the paravertebral and extradural-intraspinal areas, and corresponding axial fast spin-echo T2-weighted image showed multiple areas of increased signal intensity.

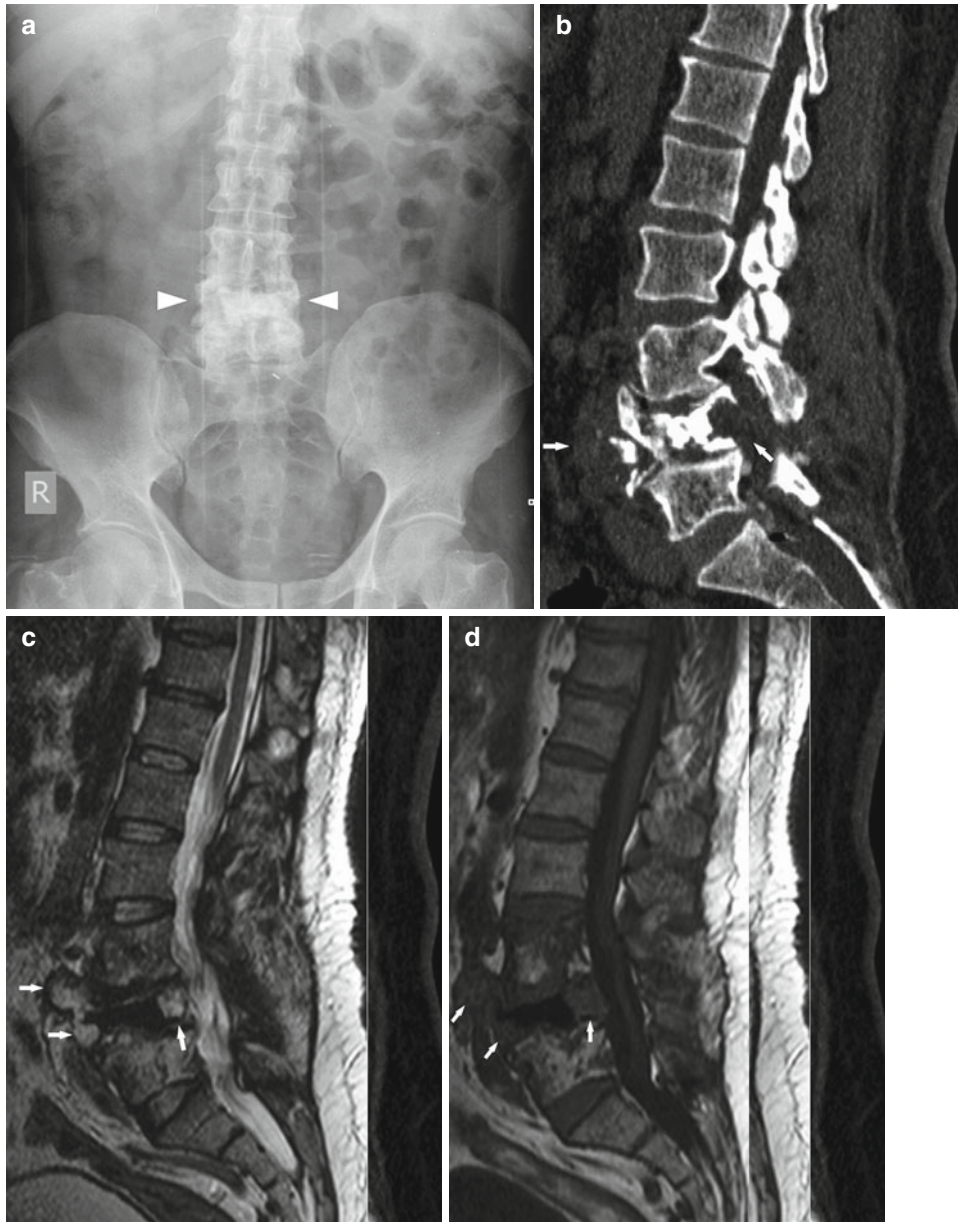

Fig. 12.4 Anteroposterior plain X-ray (**a**) of a 43-year-old male patient with lumbar spinal hydatid disease. Decreased vertebral height and diffuse sclerosis is noticed at L4 vertebra (*arrowheads*). Sagittal reformatted CT image with bone window settings (**b**) demonstrates expansion and destruction at L4 vertebra with both sclerotic and lytic areas (*arrows*). Anterior paravertebral lesions with soft tissue density can also be seen. Sagittal spinal MRI demonstrates loss of height and destructive appearance with associating cystic lesions, hyperintense on T2-weighted image (**c**) and hypointense on T1-weighted image (**d**) (*arrows*), some of which extend into anterior paravertebral areas

Extradural-intraspinal masses had low-signal-intensity rims, and there was also marked destruction of the right anterolateral portion of the vertebral body (Polat et al. 2003). On MRI of another patient, multiple hydatid cysts in ipsilateral psoas and quadratus lumborum

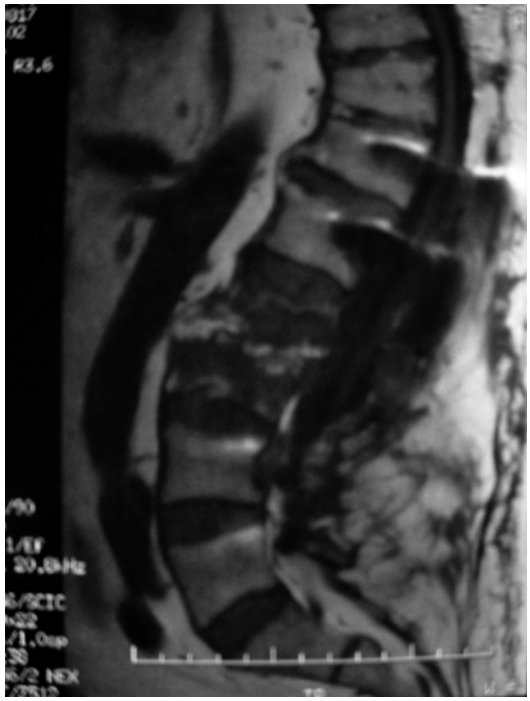

Fig. 12.5 A 59-year-old male patient who was operated 2 years ago had anterior debridement with partial corpectomy and grafting, posterior fusion. Despite the recurrence of disease, chemotherapy was not followed by the patient (Courtesy of A. Herrera, MD, PhD)

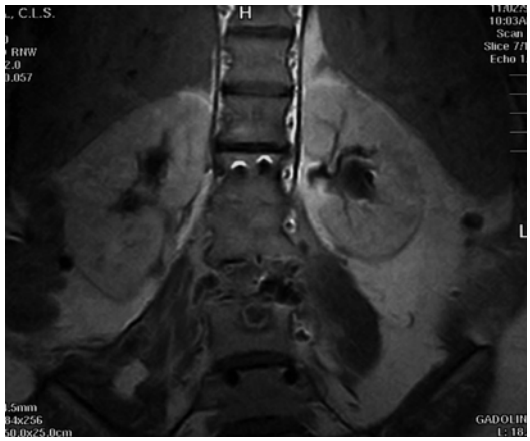

Fig. 12.6 A 46-year-old female patient. MRI lumbar spine hydatid lesions in L3 (Courtesy of A. Herrera, MD, PhD)

muscles were hypointense on T1-weighted images and hyperintense on T2-weighted images (Phatak 2006). In a 73-year-old man with sacral/retroperitoneal hydatid disease, MRI demonstrated a multilobular cystic lesion with thin and regular cyst walls, compressing the nerve roots. The cyst contents were hypointense on T1-weighted images and hyperintense on T2-weighted images, with an intensity similar to that of CSF (Senoglu et al. 2009). In a 25-year-old female, intradural lesions without vertebral involvement at lumbar level demonstrated low-intensity signal on T1-weighted images without enhancement after gadolinium injection and high-intensity signal on T2-weighted images (Hilmani et al. 2004).

In a pediatric case, an intradural, extramedullary cystic lesion which was seen to extend from L1 to L4 spine was hypointense on T1-weighted images and hyperintense on T2-weighted images (Arif and Zaheer 2009). In a 15-year-old male patient with a primary solitary hydatid cyst of the sacral spinal canal, plain X-rays and MRI revealed a widened sacral canal with pressure changes, and MRI confirmed the cystic nature of the lesion which had intensities that were similar to those of CSF (Pandey and Chaudhari 1997).

It should be kept in mind that MRI findings in alveolar echinococcosis of the spine may be nonspecific, unusual, or confusing. In an 80-year-old man with primary extrahepatic alveolar echinococcosis, T2-weighted axial images showed multiple small hyperintense lesions in the right psoas muscle, and corresponding fat-suppressed T1-weighted image after gadolinium administration confirmed the diagnosis of a multicystic mass and delineated the thickened, contrast-enhancing septations around the cystic components. T1-weighted image and T2-weighted STIR image of the lumbar spine in sagittal orientation showed the bone marrow replacement within the first, second, and third lumbar vertebrae (Nell et al. 2011).

MRI has been used postoperatively both to demonstrate recurrent cysts (Fig. 12.5) (Adilay et al. 2007; Arif and Zaheer 2009; Papakonstantinou et al. 2011) and to follow up the patient in order to show no recurrence of spinal cystic lesion (Fig. 12.10) (Arif and Zaheer 2009; Senoglu et al. 2009). On MRI, recurrent

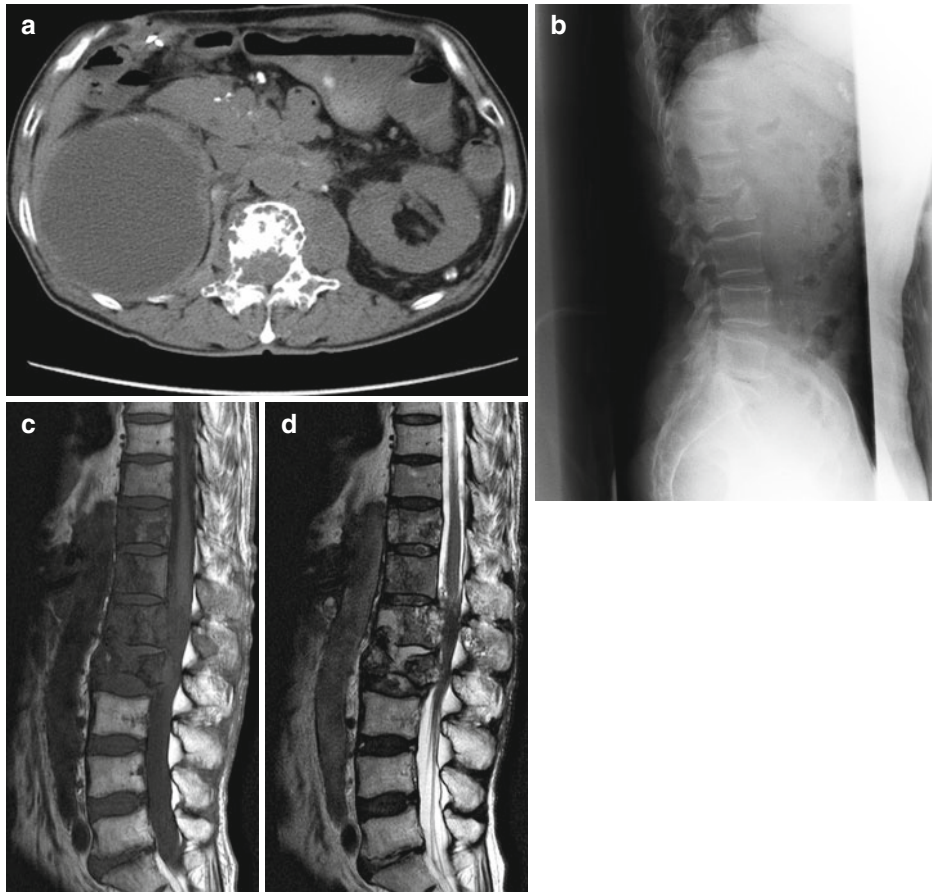

Fig. 12.7 (**a**–**d**) A 73-year-old male patient. He underwent palliative posterior decompression and instrumentation but died 2 years postoperatively (Courtesy of H. Sudo, MD)

hydatid disease is characterized by extensive involvement of the paravertebral soft tissues, soft tissues of the back at the site of previous laminectomies, and extradural space; extension into the intervertebral disk and iliopsoas muscles and skip lesions in the extradural space are not uncommon (Papakonstantinou et al. 2011).

Diffusion-weighted MRI (DW-MRI) can help differentiate complicated hydatidosis from other cystic lesions (Doganay and Kantarci 2009; Bhake and Agrawal 2010). Conventional MRI and DW-MRI were reported to be useful not only in the diagnosis of intradural extramedullary hydatid disease of the spine but also in determining a treatment protocol. Presence of restricted diffusion shows that the cystic lesions are complicated and infected, which require urgent surgery (Doganay and Kantarci 2009). In a 14-year-old boy, conventional MRI showed cystic multiloculated lesions in the lumbosacral spinal canal which were hypointense on T1 and hyperintense on T2-weighted images. DW-MRI of the boy showed hypointensity in the cystic lesions, and apparent diffusion-coefficient map images showed hyperintensity at the same level, without any evidence of restricted diffusion in the spinal canal (Doganay and Kantarci 2009).

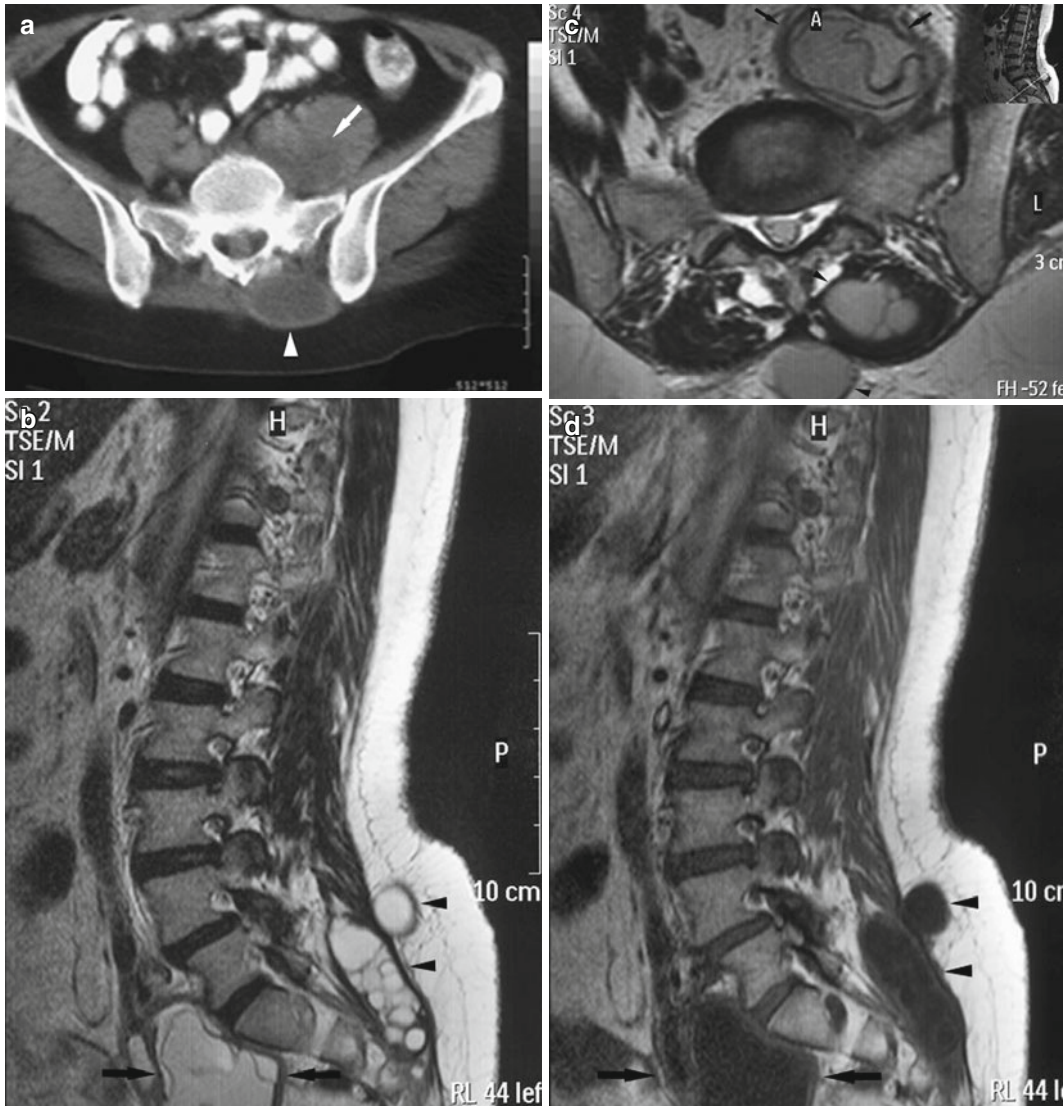

Fig. 12.8 In a 46-year-old female with multiple sacral paraspinal hydatid cysts on the left side, unenhanced axial pelvic CT image (**a**) demonstrates a hypodense hydatid cyst (*white arrow*) in the left psoas muscle which shows a close relation with left sacral neural foramina and nerves. Posterior to the sacrum, another hydatid lesion (*white arrowhead*) is located in the erector spinae muscle. MRI reveals multicystic-multiloculated sacral paraspinal hydatid lesions (*black arrows*: lesion anterior to the sacrum, *black arrowheads*: lesions posterior to the sacrum) as sharply demarcated hyperintense lesions on sagittal T2-weighted (**b**) and axial T2-weighted (**c**) images, which are hypointense on sagittal T1-weighted image (**d**). One of the posteriorly located cysts protrudes into subcutaneous fat (*black arrowhead*). On sagittal (**b**) and axial T2-weighted images (**c**), collapsed germinative membranes inside the cyst in the left psoas muscle were clearly demonstrated (*black arrows*). All the cysts are isointense to cerebrospinal fluid

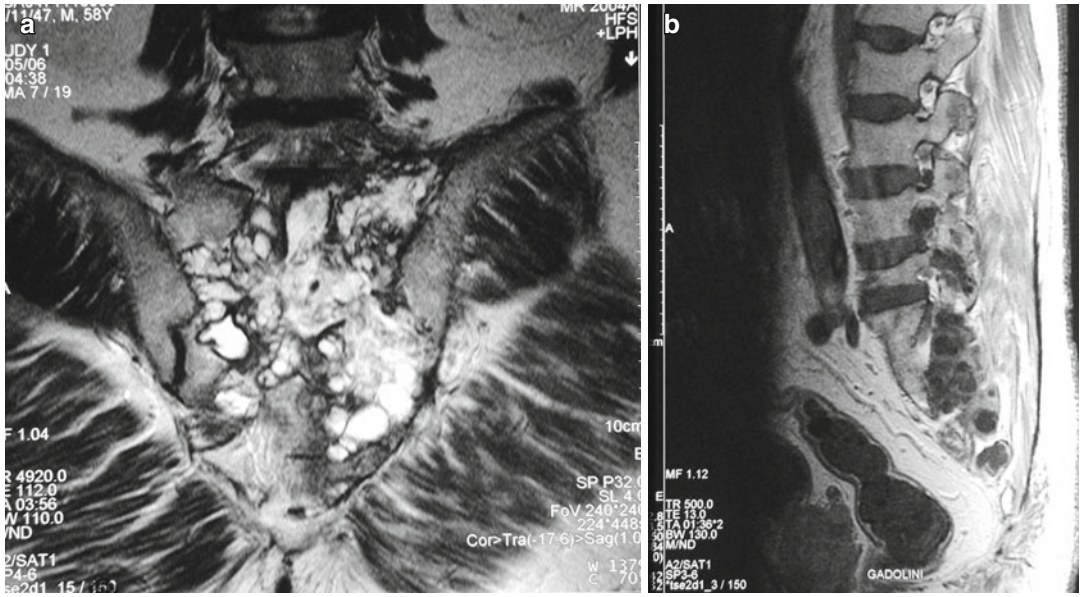

Fig. 12.9 (**a**, **b**) Sacral hydatidosis without accompanying neurological injury in a 61-year-old male patient. The patient with lung and liver hydatid cysts was not treated and transferred to his country of origin, Morocco (Courtesy of A. Herrera, MD, PhD)

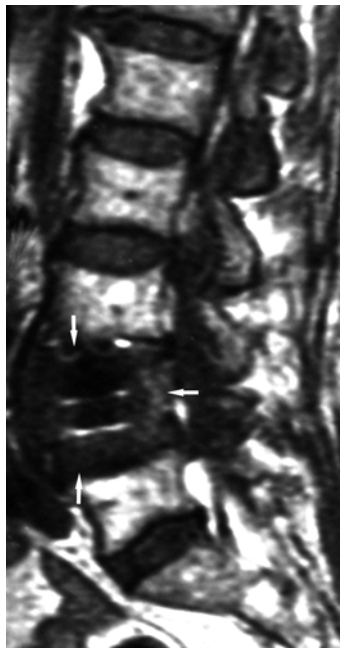

Fig. 12.10 Follow-up imaging of a 56-year-old male patient who was previously operated for lumbar spinal hydatid disease. Sagittal T2-weighted MRI demonstrates loss of height and decreased signal intensity in the operated lumbar vertebra (*arrows*). Neighboring disk spaces are fairly preserved. Despite the unfavorable effects of few metallic artifacts, there is no evidence of recurrent hydatid cyst

Conclusion

In the areas where the disease is endemic, hydatid disease should be considered in the differential diagnosis of a cystic lesion in the spine. In countries where tuberculosis is common, it should be known that spinal hydatidosis simulates tuberculosis spondylitis or chronic osteomyelitis (Turgut et al. 2007). There are ongoing MRI investigations to differentiate alive and fertile cysts from the inactive forms of hydatidosis and to monitor drug therapy (Turgut and Turgut 2010). It seems that MRI is the most efficient imaging modality in diagnosis of spinal hydatid disease and in demonstration of its complications.

Acknowledgments We thank Assistant Professor Ahmet Oguz Hasdemir, MD, Assistant Professor Halil Dönmez, MD, Mehmet Gümüş, MD, and Rukiye Dilli for their assistance.

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