CASE REPORT

Contrasting natural histories of thoracic spine pneumatocysts: resolution *versus* rapid enlargement

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ABSTRACT. An intraosseous pneumatocyst is an unusual cause of gas in a vertebral body and is rarely reported in the thoracic spine. We report the evolution of thoracic spine pneumatocysts, one that enlarged rapidly with resorption of fluid and one that resolved. A 65-year-old female with lower back and left leg pain underwent MRI of the lumbar spine, which demonstrated a well-defined lesion in a T10 vertebral body of low-signal on T_1 and T_2 weighted imaging. CT confirmed this as a gas-containing cyst. Review of previous imaging showed that this lesion had initially contained fluid and had expanded rapidly over 14 months. It also showed smaller pneumatocysts, which had resolved. The variable natural history and imaging features of pneumatocysts make them an important differential diagnosis of an intravertebral lesion. Their aetiology is not known, but previous case reports suggest that they can occur spontaneously or in association with vacuum phenomenon in adjacent discs or facet joints. Previous reports have observed that they can fill with granulation tissue or fluid, and the case we report demonstrates that this fluid can be resorbed and that the pneumatocyst can undergo rapid enlargement. A pneumatocyst is a differential diagnosis for an expanding intravertebral lesion of indeterminate MRI characteristics. The diagnosis can be made with CT if the lesion is gas or gas and fluid filled.

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Intravertebral gas is an infrequent finding, occurring in infection, osteonecrosis (Kummell disease) and penetrating trauma. A rare cause is an intravertebral pneumatocyst. An intraosseous pneumatocyst is characterised by a gas-filled cavity in a bone.

Pneumatocysts were first described by Ramirez et al [1] adjacent to the sacroiliac joint, where they have been commonly described since; however, they are uncommon in the spine. Although there have been previous reports of pneumatocysts in the spine [2–15], there are only two reported cases of thoracic pneumatocysts [7, 12]. Most vertebral pneumatocysts occur in the cervical spine, with less occurring in the lumbar spine.

The natural history of pneumatocysts is unclear, with only five of the reported cases describing it [2–5, 10]. They frequently, but not exclusively, develop in close proximity to degenerative joints and can progress from a gas-filled cavity within the bone to a fluid-containing cyst. The gas can also be replaced with granulation tissue. Pneumatocysts have been observed to enlarge, on one occasion in a vertebral body and also when located in the sacroiliac region. The long-term outcome is not known.

This case reports the evolution of pneumatocysts in adjacent thoracic vertebral bodies over a 26 month period and will discuss the possible implications for what is

known about the natural history of these lesions. The larger pneumatocyst demonstrated more rapid enlargement than has been previously described, reaching the largest size recorded in the English language literature. It also demonstrated the progression from a fluid-containing cyst to a completely pneumatised lesion. This phenomenon has not been previously described. The lesion then partly filled with soft tissue. The second lesion demonstrated the resorption of air and resolution of a small pneumatocyst. A third tiny lesion also appeared to resolve.

Case report

A 65-year-old female presented with worsening lower back pain and left anterior thigh, leg and foot pain. An MRI of the lumbar spine showed multilevel degenerative change and discovered a lesion in the T10 vertebral body, which was of very low signal on T_1 weighted and T_2 weighted imaging.

An MR scan performed 6 months earlier to investigate left-sided sciatica was reviewed and the lesion was identified on this imaging. It had increased in size, over the intervening 6-month period, from 6×5 mm to 13×10 mm (Figures 1–4).

A CT scan was arranged to characterise the lesion further (Figure 5). The CT demonstrated a well-defined lucency in T10 vertebral body, extending just into the left pedicle. The average HU measurement of the lesion was -889 , which was consistent with air. The lesion now

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Figure 1. Sagittal T_1 weighted image from the earliest MR scan demonstrating a low-signal lesion in T10 vertebral body.

measured $17 \times 10 \times 11$ mm. The imaging findings were considered to be consistent with an intraosseous pneumatocyst (Figure 6).

On subsequent review of a CT of the pancreas performed 14 months earlier for follow-up of a pancreatic pseudocyst, the T10 lesion was identified, but was very small at this time, measuring only 4 mm maximum diameter. It contained fluid in the dependent portion of the cyst (Figure 7). This earlier CT image demonstrated air in the intervertebral disc, extending to the inferior end plate of the T9 vertebral body where there were two tiny pneumatocysts. One of the T9 pneumatocysts contained

Figure 2. Sagittal T_2 weighted image from the earliest MR scan demonstrating a low-signal lesion in T10 vertebral body.

Figure 3. Sagittal T_1 weighted image from the second MR scan 6 months later shows the T10 lesion to have increased significantly in size.

gas, whilst the second contained fluid or soft-tissue attenuation. Unfortunately, it was too small for accurate measurement of HU. Both of these T9 lesions had resolved by the time of the subsequent CT scan.

A follow-up CT scan of the thoracic spine was performed 26 months after the first CT. This demonstrated that the large T10 pneumatocyst had not altered in size since the preceding CT 12 months earlier. It was, however, no longer completely pneumatized. The non-dependent, anterior portion of the pneumatocyst now

Figure 4. Sagittal T_2 weighted image from the second MR scan 6 months later demonstrating the low-signal T10 lesion which has increased in size.

contained soft tissue. The dependent portion still contained air (Figure 8).

This case describes the natural history of thoracic vertebral body pneumatocysts. The smallest was initially of fluid or soft-tissue attenuation and was no longer visible on the second CT. The second appeared to contain air on the first CT and again appeared to have resolved on the second CT. The third and largest lesion was the one noted on the MRI, prompting further investigation with a second CT scan. It enlarged from 4 mm to 17 mm maximal diameter over a 14 month period and changed from containing both air and a fluid level to being completely pneumatized. 12 months later it had not altered in size, but contained soft tissue.

Discussion

Pneumatocysts in the vertebral bodies are uncommon, but are important to differentiate from other lesions of the spine, as they can be seen to enlarge and may contain soft tissue, which together with their indeterminate MR appearance can cause unnecessary anxiety.

The aetiology of pneumatocysts is not certain, but it has been proposed that they could occur spontaneously, relate to Schmorl's nodes or relate to degeneration of a cyst or ganglion [1, 3, 6–8].

It has been reported that pneumatocysts frequently occur in association with the vacuum phenomenon in adjacent intervertebral discs or facet joints [12] and it has been proposed that the gas could extend into the vertebral body through a defect in the end plate [8]. Ulu et al [5] propose that trauma may facilitate the passage of air from intervertebral discs into the vertebral body. Pneumatocysts have been described with [2, 5, 12] and without [4, 7, 14] communication with adjacent joints. Communication between a pneumatocyst and the spinal canal has also been reported [10, 11, 13]. Whilst it seems plausible that adjacent joints or the spinal canal are the source of the intravertebral gas, even when no definite connection through the vertebral cortex is seen, this does not explain the aetiology of a pneumatocyst reported in a spinal process [7].

Kitagawa et al [2] propose that pneumatocysts affect two different patient groups; younger patients have smaller lesions and older patients have larger cavities, owing to degenerative change. Our case would fit the pattern of the second, more commonly reported group, where there is associated degenerative disease of the spine and demonstrated vacuum phenomenon in the adjacent disc. The aetiology of pneumatocysts in the younger group is more difficult to explain and perhaps this is the group in whom they occur spontaneously.

The natural history of pneumatocysts of the spine has only recently been reported [2–5]. Kitagawa et al [2] reported the first case of an enlarging pneumatocyst of the spine, a phenomenon previously described in pneumatocysts of the ilium [16]. We describe the third reported case of a thoracic vertebral pneumatocyst and the second reported case of an enlarging vertebral pneumatocyst. Pneumatocysts have also been reported to become fluid filled and to fill with granulation tissue [3–5]. Nakayama et al [4] described an aerated pneumatocyst filling with fluid and speculated that the resorption of fluid and

Figure 5. Axial CT image through T10 vertebral body shows a gas-containing lesion.

re-accumulation of gas may be expected with longer follow-up. The case we report is the first to confirm their hypothesis. The authors proposed that the diffusion of nitrogen and accumulation of fluid in the pneumatocyst may be due to negative pressure within the lesion compared with the surrounding bone marrow. The accumulation of fluid and its subsequent drainage to leave a gas-filled pneumatocyst in the case we report suggests a dynamic process, in which the positive pressure from the

Figure 6. Coronal reformat from the CT scan 14 months earlier showing a 4 mm pneumatocyst in T10. Two further cysts adjacent to the inferior endplate of T9 are shown. One appears to be of soft-tissue or fluid attenuation.

Figure 7. Sagittal reformat from the earliest CT scan demonstrating a fluid level in the T10 pneumatocyst. Intervertebral gas is shown.

loaded disc may be transmitted to the pneumatocyst cavity encouraging its enlargement during phases when it is fluid filled.

Conclusion

The case we report caused alarm owing to the rapid growth of the pneumatocyst. There was concern that if it continued to enlarge and affect a larger proportion of the vertebral body, then the vertebra would be at risk of fracture and collapse. If it continues to enlarge on subsequent follow-up then vertebroplasty may be considered.

The diagnosis of a vertebral pneumatocyst can easily be made on CT and should be considered in indeterminate vertebral lesions found on MR, even if the lesion is enlarging or filling with fluid. Pneumatocysts filled with fluid or granulation tissue can have different MR signal characteristics and can therefore cause diagnostic difficulties. If they enlarge at a significant rate then follow-up may be required owing to a potential fracture risk if they progress to involve a significant proportion of a vertebral body.

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Figure 8. Axial image through T10 from the CT 26 months after the first CT. The patient was scanned supine and soft-tissue is demonstrated in the non-dependent portion of the cyst, with air shown posteriorly.

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