Correction

Clinics in diagnostic imaging (181)
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Singapore Med J 2017; 58(11): 636-641

On Page 638 of the printed journal, the image captions for Figs. 5 and 6 are incorrect. The caption on the left should be Fig. 5 and the caption on the right should be Fig. 6. The online version of the article reflects the correct caption.

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CME ARTICLE

Clinics in diagnostic imaging (181)

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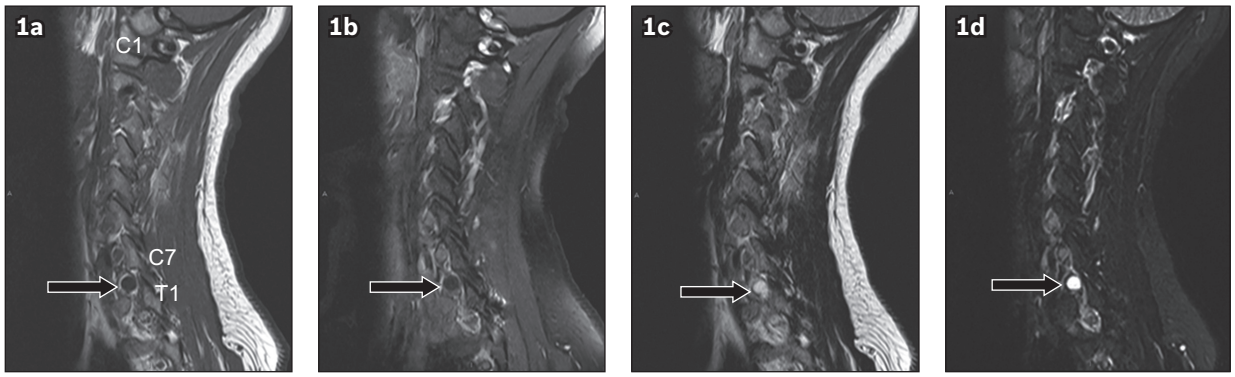

Fig. 1 Left parasagittal MR images of the cervical spine on the same plane: (a) precontrast T1-W; (b) postcontrast T1-W; (c) T2-W; and (d) turbo inversion recovery magnitude (TIRM) sequences.

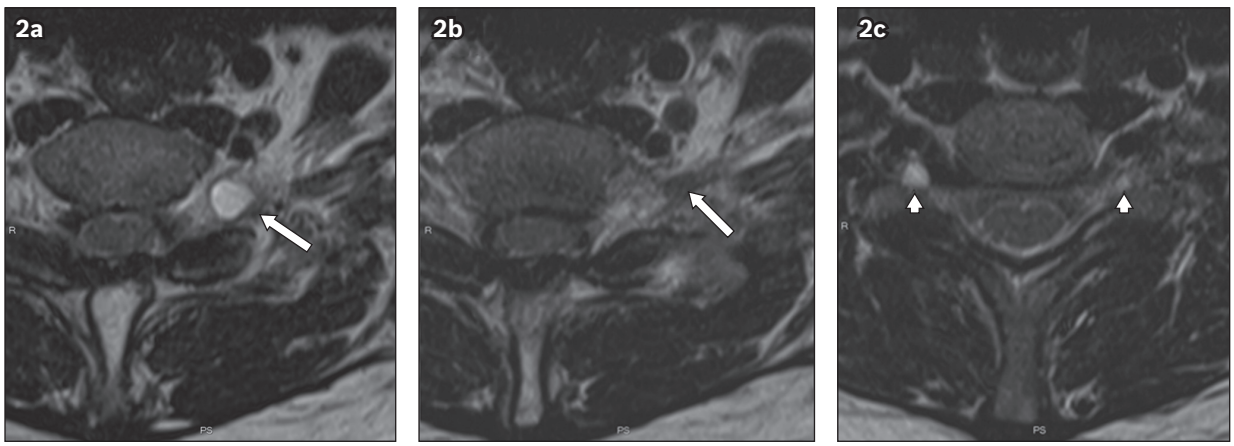

Fig. 2 Contiguous axial T2-W MR images at the level of (a & b) C7–T1 and (c) C6–7.

CASE PRESENTATION

A 47-year-old woman underwent elective surgery to resect a known intradural tumour at the T1 level. Histology confirmed the diagnosis of spinal meningioma. On follow-up, the patient was well and magnetic resonance (MR) imaging of the cervical spine was performed. What do the images show? What is the diagnosis?

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IMAGE INTERPRETATION

The thin-walled structure (black arrows in Fig. 1) in the left neural exit canal at the C7–T1 level returns a low signal on the T1-weighted image (Fig. 1a), and a raised signal on the T2-weighted and turbo inversion recovery magnitude images (Figs. 1c & d, respectively). No enhancement is seen following contrast enhancement (Fig. 1b). The overall imaging features are in keeping with those of a cystic structure. On the axial T2-weighted images at the C7–T1 level, the left exiting C8 nerve root is detected on the cyst wall (white arrows in Figs. 2a & b). Findings are compatible with a left C8 transforaminal perineural cyst. Additional small perineural cysts are seen in the bilateral neural exit canals at the C6–7 level (white arrowheads in Fig. 2c).

DIAGNOSIS

Cervical spine perineural cysts.

CLINICAL COURSE

In keeping with the most common presentation of perineural cysts, those found in the patient were asymptomatic and unlikely to be related to prior spinal surgery. They were incidentally detected and remained stable in size, morphology and signal intensities in subsequent surveillance MR imaging studies.

DISCUSSION

Meningeal dilatation of the posterior spinal nerve root sheaths gives rise to perineural cysts, which contain cerebrospinal fluid (CSF) and nerve fibres. When occurring in the lumbosacral spine, they are colloquially known as Tarlov cysts, after Isadore Tarlov, who first described them during a cadaveric study of 30 specimens of filum terminale in 1938.[1] The aetiology of these lesions remains contentious. Some believe that they are congenital in nature,[2,3] while others proposed prior surgery,[2,4] haemorrhage[4] and increased CSF hydrostatic pressure as the possible pathogenesis.[2,5]

It was estimated that 4.6%–9.0% of the adult population has perineural cysts.[5] They are most common in the lower lumbar and sacral segments, particularly the S2 and S3 nerve roots (Figs. 3 & 4).[6] Perineural cysts are often multiple and bilateral (Fig. 4).[1] They can be preforaminal, transforaminal or postforaminal in location – the latter being the least common location. On imaging, perineural cysts appear as circumscribed, thin-walled cystic lesions. Owing to their content, the cysts are isointense to CSF on all MR sequences. The demonstration of a traversing spinal nerve root through the cyst or along the cyst wall is a distinctive feature of perineural cysts (Figs. 4 & 5).[7] Diagnosis is more difficult in instances where the spinal nerve roots are at the periphery of the cyst wall (Fig. 6). When perineural cysts become large enough, they widen and remodel the neural exit canals or sacral foramina (Figs. 3 & 6).

Cervical spine perineural cysts were thought to be rare; a literature search found only three case reports on symptomatic lesions[8-10] and one of a cervical spine perineural cyst masquerading as a tumour.[11] There is likely to be underreporting of such cases, as most cervical spine perineural cysts are asymptomatic. We postulate that the development of perineural cysts in our patient may be related to her underlying spinal meningioma. The presence of the meningioma may have hindered CSF flow, possibly resulting in increased CSF hydrostatic pressure, which is one of the proposed pathogeneses

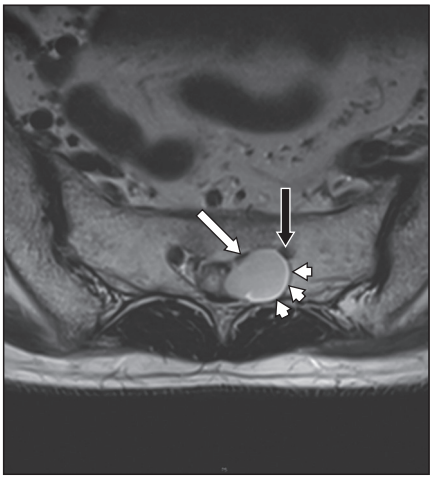

Fig. 3 Axial T2-W MR image of the sacrum shows a left S3 preforaminal perineural cyst, with the S3 nerve root on the cyst wall (white arrow), a distinctive MR imaging feature of a perineural cyst. The perineural cyst enlarges and remodels the left side of the sacral canal (white arrowheads). It is also exerting mass effect by pushing the adjacent S2 nerve root (black arrow) against the borders of the left second sacral foramen.

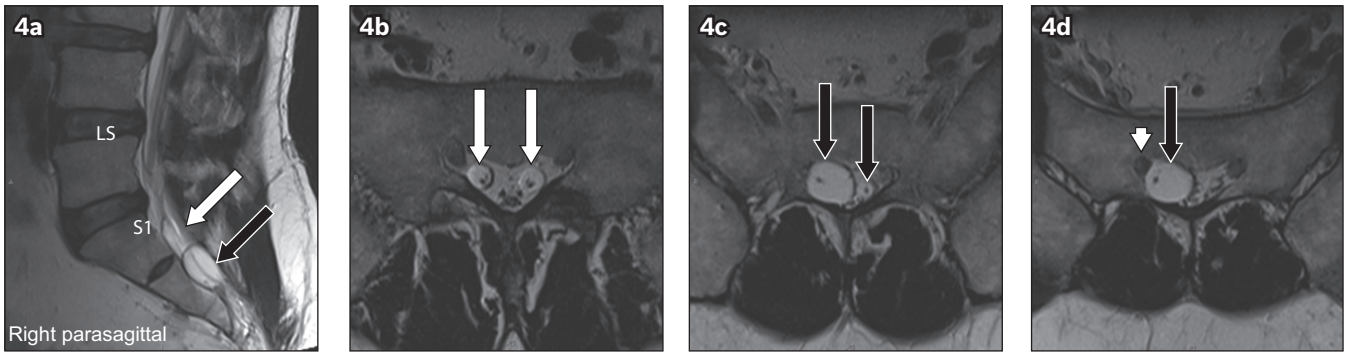

Fig. 4 (a) Sagittal and (b–d) axial T2-W MR images of the lumbosacral spine show perineural cysts that are multiple and bilateral, and involve the S2 and S3 nerve roots. S2 (white arrows) and S3 (black arrows) perineural cysts demonstrate traversing nerve roots within the cysts – another distinctive MR imaging feature of perineural cysts. These are preforaminal in location. Similar to the lesion demonstrated in Fig. 3, the largest right S3 perineural cyst is exerting mass effect on the adjacent right S2 nerve root (white arrowhead).

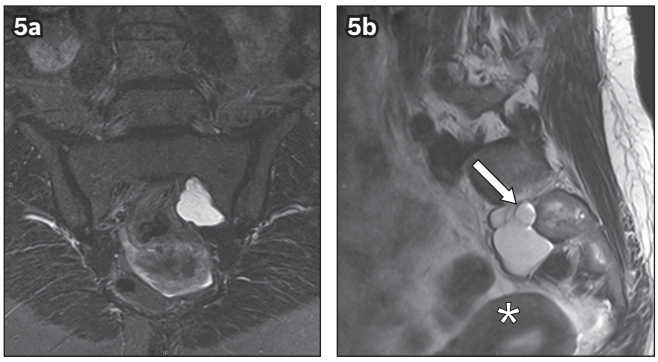

Fig. 5 (a) Coronal TIRM and (b) sagittal T2-W MR images of the lumbosacral spine show a left S1 postforaminal perineural cyst that is multilobulated in appearance. It is entirely within the pelvic cavity and seen close to the uterus (*). The traversing nerve root is better appreciated on the sagittal image (white arrow).

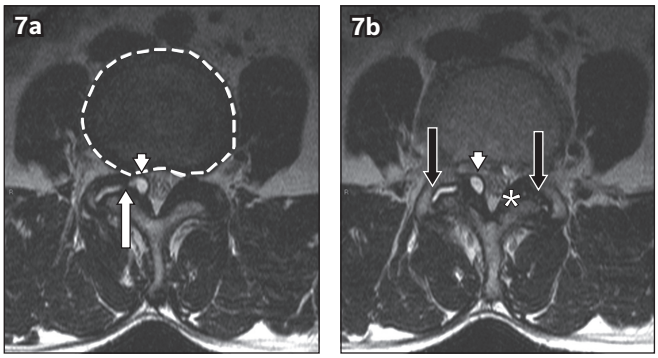

Fig. 7 (a & b) Contiguous axial T2-W MR images at the L3–4 level of a 67-year-old man with lower back pain and right-sided radiculopathy. Findings that are related to degeneration are seen, including diffuse disc bulge (broken lines), bilateral facet arthropathy (black arrows) and bilateral thickening of the ligamentum flavum (*). A cystic structure (white arrowhead) with raised T2 signal occupies the right lateral recess, and is likely to impinge on the right descending L4 nerve root. This could explain the patient's symptoms. In rare instances, communication with the synovial fluid of the facet joint is demonstrated (white arrow), allowing for the diagnosis of juxtafacet synovial cyst to be made with confidence.

mentioned earlier. Due to the lack of cervical spondylosis, these are unlikely to be juxtafacet synovial cysts. Another differential diagnosis is pseudomeningocoele formation from iatrogenic dural tear. However, the multiplicity of lesions seen at different levels makes this differential diagnosis less likely. The main differential diagnoses of perineural cysts are juxtafacet synovial cysts (Fig. 7), peripheral nerve sheath tumours (Fig. 8), and less commonly, meningocoeles, traumatic dural tears with formation of pseudomeningocoele (Figs. 9 & 10), cystic metastases and others.

Synovial cysts mimic perineural cysts and vice versa. It is widely accepted that the development of synovial cysts is associated with spondylosis and segmental instability.[12] This is supported by the fact that synovial cysts most frequently occur at the L4–5 level (the site of highest biomechanical spinal motion) followed by the L5–S1 and L3–4 levels, with decreasing frequency.[12] As expected, no synovial cyst has been described in the sacrum,[12] which allows the diagnosis of sacral perineural cysts to be made with confidence. Not surprisingly, synovial cysts are most often seen in the older population (mean age > 60 years).[12] Arising from the facet joint, synovial cysts are

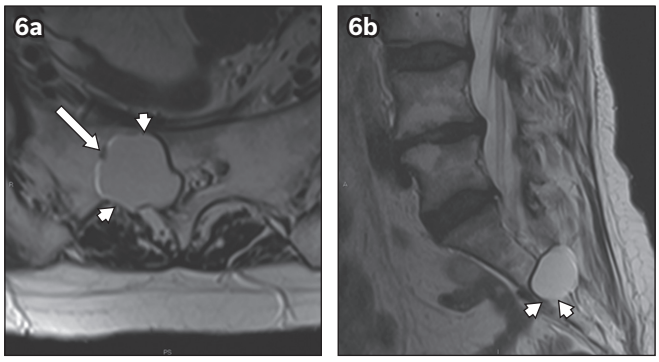

Fig. 6 (a) Axial and (b) sagittal T2-W MR images of the sacrum show a large right S2 transforaminal perineural cyst, with the nerve root seen on the cyst wall (white arrow). Remodelling of the right S2 sacral foramen is demonstrated (white arrowheads). Detection of nerve roots on the cyst wall is understandably more difficult when compared with detection of nerve roots within the cyst (see Fig. 4). Multiplanar MR imaging allows for the detection of nerve roots most of the time; hence, it is considered the imaging modality of choice in the diagnosis of perineural cysts.

seen close to degenerated facet joints, but may extend in any direction.[13] The MR signal intensity of synovial cysts is similar to that of perineural cysts, unless there is proteinaceous or haemorrhagic content present. Infrequently, synovial cysts may calcify and appear hypointense on T1-weighted and T2-weighted images.[14]

Spinal peripheral nerve sheath tumours (PNST) include schwannomas and neurofibromas, which may be benign or malignant. Although schwannomas are more likely to undergo cystic degeneration than neurofibromas, this appearance is rarely seen in the spinal cohort.[15] Nonetheless, the cystic appearance may simulate the imaging appearance of synovial or perineural cysts.[15] Arising from the dorsal sensory roots, the majority of these lesions (70%–75%) are intradural-extramedullary in location, 15% are purely extradural, and a further 15% have both intradural and extradural components – the classic 'dumbbell' lesions.[16] In this instance, the administration of MR contrast allows PNST to be distinguished from synovial and perineural cysts. Varying degrees of enhancement have been described, ranging from uniform or heterogeneous to rim enhancement.

The majority (80%) of patients with perineural cysts are asymptomatic.[17] These cysts are often incidentally diagnosed on MR imaging. Commonly encountered symptoms of perineural cysts include sciatica, and bowel and bladder dysfunction.[18] A rare case of sacral insufficiency fracture due to pronounced bone remodelling/thinning has been described by Peh and Evans.[19] Unfortunately, there is no established imaging criterion at present for identifying cysts that are likely to be symptomatic, although some authors opine that larger cysts are more likely to cause symptoms due to stretching of the nerve root filaments or compression against adjacent bone or nerve roots.[2] For symptomatic cases, there is currently no consensus regarding optimal treatment. However, Voyadzis et al observed that patients with perineural cysts that are larger than 1.5 cm and have associated radiculopathy or cauda equina syndrome are likely to benefit the most from surgery.[18]

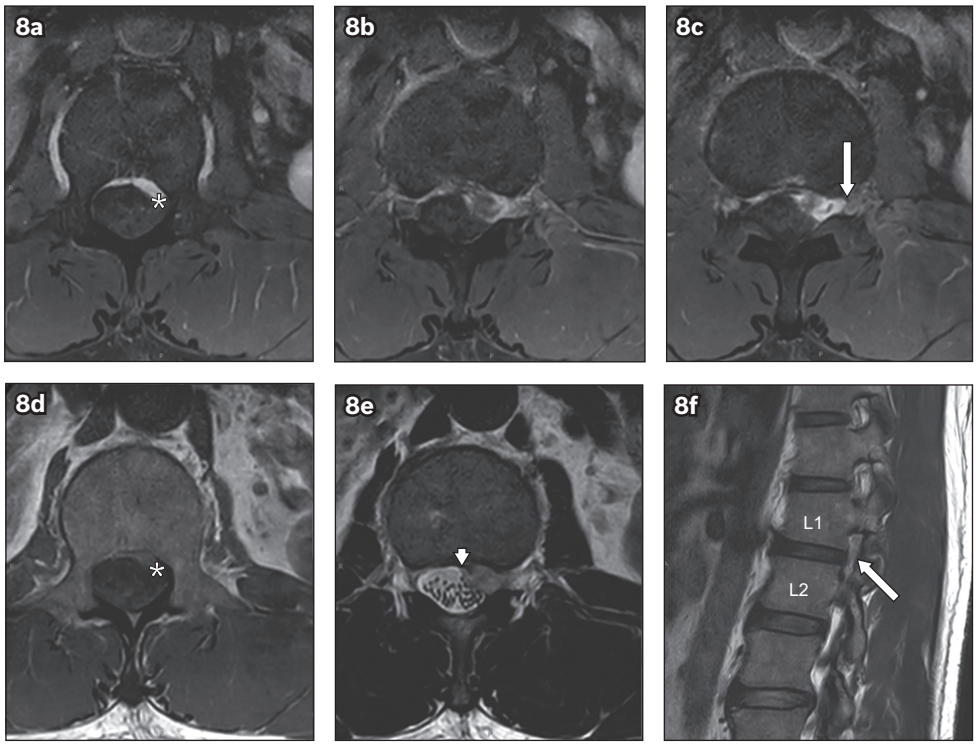

Fig. 8 (a–c) Contiguous postcontrast axial T1-W images at the L1–2 level show a heterogeneously enhancing extradural lesion that occupies the left lateral recess (* in a & d). The lesion returns a mildly raised signal on (d) precontrast T1-W and (e) T2-W images. It extends into the thecal sac (white arrowhead in e), suggesting a neural origin. Laterally, the lesion extends into the left neural exit canal at the L1–2 level (white arrow in c & f). The MR imaging features favour a tumour of neural origin, such as a peripheral nerve sheath tumour (neurofibroma or schwannoma). In some instances, a cystic schwannoma may show a raised T2 signal, which is greater than that demonstrated in this case, simulating the appearance of a cyst. Contrast enhancement is an important distinguishing imaging feature, as both perineural cysts and juxtafacet synovial cysts do not show enhancement.

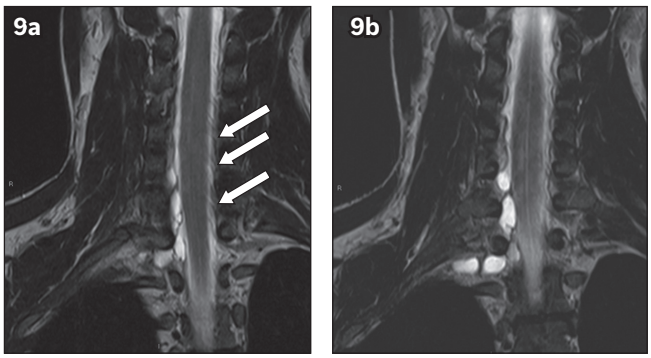

Fig. 9 A 23-year-old motorcyclist involved in a road traffic accident sustained multiple injuries and fractures (including to the bilateral humeri and right distal radius). The patient described diminished sensation, numbness and weakness in the right upper limb. (a & b) Contiguous coronal T2-W images of the right brachial plexus reveal cerebrospinal fluid-containing pouches along the right neural foramina at the C5–6, C6–7 and C7–T1 levels with no exiting nerve root seen within them. This contrasts with the contralateral side, which shows normal exiting nerve roots (arrowheads in a). MR imaging findings are suggestive of post-traumatic pseudomeningocoele with nerve root avulsion. In this setting, MR imaging is also useful to assess for cord abnormality (oedema, haemorrhage, myelomalacia) and associated muscle atrophy or oedema.

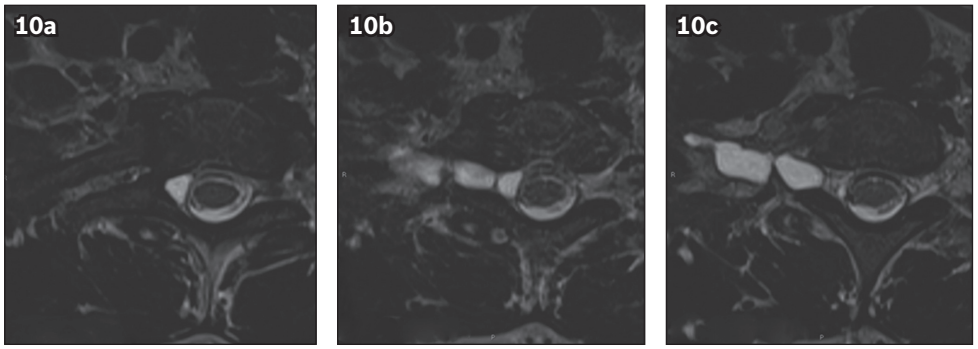

Fig. 10 (a–c) Contiguous axial T2-W images at the C7–T1 level show the pseudomeningocoele along the expected course of the right C8 nerve root. Note that the appearance of Fig. 10a is similar to that of Fig. 2a. The presence of a traversing nerve root in Fig. 2a and the absence of a nerve root in Fig. 10a are useful distinguishing features for these two entities. However, in clinical practice, this is less likely to pose a diagnostic challenge, since the presentation is vastly different.

CONCLUSION

Perineural cysts are incidental findings that are commonly seen in the lumbar and sacral spine. Juxtafacet synovial cysts, the main differential diagnosis, are associated with degenerative facet joints. Care must be taken to distinguish between synovial and perineural cysts, as management of these would differ. The other differential diagnosis is PNST. If this is suspected, the administration of MR contrast is helpful.

ABSTRACT A 47-year-old woman who underwent resection of known spinal meningioma at the T1 level returned for postoperative magnetic resonance imaging of the cervical spine. Incidentally, thin-walled structures with signal intensities that are similar to those of cerebrospinal fluid were found to be present in the left neural exit canal at the C7–T1 level and bilateral neural exit canals at the C6–7 level. Imaging findings were in keeping with perineural cysts. Cervical spine perineural cysts are likely underreported, as most of them are asymptomatic. The imaging features and differential diagnoses of perineural cysts are discussed in this article.

Keywords: diagnostic imaging, perineural cyst, spine

REFERENCES

1. Tarlov IM. Perineural cysts of the spinal nerve roots. Arch Neurol Psychiatr 1938; 40:1067-74.
2. Strully KJ. Meningeal diverticula of sacral nerve roots (perineural cysts). J Am Med Assoc 1956; 161:1147-52.
3. Lombardi G, Morello G. Congenital cysts of the spinal membranes and roots. Br J Radiol 1963; 36:197-205.
4. Schreiber F, Haddad B. Lumbar and sacral cysts causing pain. J Neurosurg 1951; 8:504-9.
5. Paulsen RD, Call GA, Murtagh FR. Prevalence and percutaneous drainage of cysts of the sacral nerve root sheath (Tarlov cysts). AJNR Am J Neuroradiol 1994; 15:293-7.
6. Seaman WB, Furlow LT. The myelographic appearance of sacral cysts. J Neurosurg 1956; 13:88-94.
7. Goyal RN, Russell NA, Benoit BG, Belanger JM. Intraspinal cysts: a classification and literature review. Spine (Phila Pa 1976) 1987; 12:209-13.
8. Zibis AH, Fyllos AH, Arvanitis DL. Symptomatic cervical perineural (Tarlov) cysts: a case report. Hippokratia 2015; 19:76-7.
9. Bayrakli F, Kurtuncu M, Karaarslan E, Ozgen S. Perineural cyst presenting like cubital tunnel syndrome. Eur Spine J 2012; 21 Suppl 4:S387-9.
10. Kim K, Chun SW, Chung SG. A case of symptomatic cervical perineural (Tarlov) cyst: clinical manifestation and management. Skeletal Radiol 2012; 41: 97-101.
11. Joshi VP, Zanwar A, Karande A, Agrawal A. Cervical perineural cyst masquerading as a cervical spinal tumor. Asian Spine J 2014; 8:202-5.
12. Howington JU, Connolly ES, Voorhies RM. Intraspinal synovial cysts: 10-year experience at the Ochsner Clinic. J Neurosurg 1999; 91(2 Suppl):193-9.
13. Steiner E, Steinbach LS, Schnarkowski P, Tirman PF, Genant HK. Ganglia and cysts around joints. Radiol Clin North Am 1996; 34:395-425.
14. Liu SS, Williams KD, Drayer BP, Spetzler RF, Sonntag VK. Synovial cysts of the lumbosacral spine: diagnosis by MR imaging. AJNR Am J Neuroradiol 1989; 10:1239-42.
15. Borges G, Bonilha L, Proa M Jr, et al. Imaging features and treatment of an intradural lumbar cystic schwannoma. Arq Neuropsiquiatr 2005; 63(3A):681-4.
16. Osborn AG. Diagnostic Neuroradiology. St Louis: Mosby Inc, 1994.
17. Mummaneni PV, Pitts LH, McCormack BM, Corroo JM, Weinstein PR. Microsurgical treatment of symptomatic sacral Tarlov cysts. Neurosurgery 2000; 47:74-8.
18. Voyadzis JM, Bhargava P, Henderson FC. Tarlov cysts: a study of 10 cases with review of the literature. J Neurosurg 2001; 95(1 Suppl):25-32.
19. Peh WC, Evans NS. Tarlov cysts--another cause of sacral insufficiency fractures? Clin Radiol 1992; 46:329-30.

SINGAPORE MEDICAL COUNCIL CATEGORY 3B CME PROGRAMME

(Code SMJ 201711B)

	True	False
Question 1. Regarding perineural cysts:		
(a) They are meningeal dilatations of the posterior spinal nerve root sheath.	☐	☐
(b) They are frequently seen in the cervical spine.	☐	☐
(c) The S2 and S3 nerve roots are commonly affected.	☐	☐
(d) They are most often seen in the postforaminal location.	☐	☐
Question 2. Regarding perineural cysts:		
(a) In the lumbosacral spine, they are also known as Tarlov cysts.	☐	☐
(b) They can cause remodelling of the neural exit canal or sacral foramen.	☐	☐
(c) Most of them are symptomatic.	☐	☐
(d) Symptoms include radiculopathy and cauda equina syndrome.	☐	☐
Question 3. On magnetic resonance imaging, perineural cysts show:		
(a) Raised signal intensity (bright) on T1-weighted images.	☐	☐
(b) Raised signal intensity (bright) on T2-weighted images.	☐	☐
(c) Visualisation of the spinal nerve root within or along the cyst wall, which is a distinctive imaging feature.	☐	☐
(d) Enhancement following contrast administration.	☐	☐
Question 4. The differential diagnosis of perineural cysts includes:		
(a) Meningocoeles.	☐	☐
(b) Juxtafacet synovial cysts.	☐	☐
(c) Cystic schwannomas.	☐	☐
(d) Cystic metastases.	☐	☐
Question 5. Regarding the treatment of perineural cysts:		
(a) There is no consensus on the definitive treatment for symptomatic perineural cysts.	☐	☐
(b) Imaging can accurately identify cysts that are likely to be symptomatic.	☐	☐
(c) Patients with radiculopathy or bowel/bladder dysfunction are likely to benefit the most from surgery.	☐	☐
(d) Lesions that are larger than 1.5 cm are likely to benefit the most from surgery.	☐	☐

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