Correction

Clinics in diagnostic imaging (181)
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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.
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?

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.
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. The aetiology of these lesions remains contentious. Some believe that they are congenital in nature, while others proposed prior surgery, haemorrhage and increased CSF hydrostatic pressure as the possible pathogenesis.

It was estimated that 4.6%–9.0% of the adult population has perineural cysts. They are most common in the lower lumbar and sacral segments, particularly the S2 and S3 nerve roots (Figs. 3 & 4). Perineural cysts are often multiple and bilateral (Fig. 4). 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). 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 and one of a cervical spine perineural cyst masquerading as a tumour. 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.
In this instance, the mean age of synovial cysts is 60 years. In contrast, perineural cysts are most often seen in the older population (mean age > 60 years). The traversing nerve root is better appreciated on the sagittal image (white arrow).

**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 multiloculated 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 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.**

**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.**

**Fig 8 (a) Coronal TIRM and (b) sagittal T2-W MR images of the sacrum show a left S1 postforaminal perineural cyst that is multiloculated 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 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.**

**Fig 11. 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.**

**As expected, no synovial cyst has been described in the sacrum,**

**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).**

A rare case of sacral insufficiency fracture due to pronounced bone remodelling/thinning has been described by Peh and Evans. Unfortunately, there is no established imaging criterion 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. 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.
**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 pseudomeningocele 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 pseudomeningocele 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
SINGAPORE MEDICAL COUNCIL CATEGORY 3B CME PROGRAMME
(Code SMJ 201711B)

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) Meningoceles.
(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.

Doctor’s particulars:
Name in full: ___________________________ MCR no.: ___________________________
Specialty: ___________________________ Email: ___________________________

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