CASE REPORT

Perfusion MR imaging and 1H spectroscopy: Their role in the diagnosis of microcystic and lipomatous meningiomas


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Summary Microcystic and lipomatous meningiomas represent two of the recognised rare subtypes of meningiomas. We describe the CT and MR findings in one adult case of each subtype with emphasis on the diagnostic benefits of perfusion-weighted MR imaging (PWI) and/or proton magnetic resonance spectroscopy (MRS).

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Meningiomas are common benign tumours of the central nervous system originating from meningothelial cells, accounting for 13 to 26% of all primary intracranial neoplasms. These tumours are typically well-circumscribed slowly-growing lesions attached to the dura. The characteristic imaging finding is a homogeneous, well enhancing extra-axial mass with a tail sign. During the preoperative assessment of such lesions, variations in radiological appearance can be misleading. We describe two adults presenting with rare histological subtypes of meningiomas and atypical neuroradiology findings for whom the use of MR perfusion and of 1H spectroscopy proved invaluable.

Case reports

Case 1

A 48-year-old woman presented with a 6-month history of worsening headaches on a background of chronic headaches over several years. Computerised tomography (CT) showed a right-sided, hypo-dense parietal mass (Fig. 1A). The MR
Figure 1  Post-contrast axial CT image demonstrates a hypo-dense septated parietal lesion (A). The mass is hyper-intense on T2-weighted imaging, pleating the adjacent cortex (B). The tumour is hypo-intense on T1-weighted imaging and shows faint reticular enhancement after intravenous injection of gadolinium (C). The CBV map demonstrates a marked, localised tumour hypervascularity (D) with a maximal rCBV greater than 10. The tumour is represented by the blue curve and the reference marker (green curve) is positioned within the contralateral white matter (WM) (E). Spectroscopy at TE = 136 shows a negative resonance at 1.3 ppm corresponding to lactate. The predicted high peak of choline is absent (F). There are multiple intercellular spaces with scattered pleomorphic nuclei. Insert: Marked hyaline thickening of blood vessel walls (G).

The study demonstrated an extra-axial lesion that appeared hyper-intense on T2-weighted imaging (Fig. 1B) and hypo-intense on T1-weighted imaging with slight enhancement after Gadolinium (Fig. 1C). Pleating of the adjacent cortex with extension to the calvarium and surrounding oedema were observed. The PWI demonstrated the presence of scattered foci of hypervascularity within the mass. Cerebral blood volume (CBV) mapping (Fig. 1D) revealed a high colour-coded area and a high rCBV ratio (> 10) corresponding to a thin septum inside the lesion. The blue curve represents the tumour, the green curve (reference curve) is positioned within the contra-lateral white matter (WM) (Fig. 1E). A negative doublet of lactate was identified on the 1H spectroscopic data acquired with a PRESS sequence (TE = 136 ms) in addition to a small peak of choline (Fig. 1F). The cerebral angiography demonstrated a mainly avascular mass. However, a small and slight blush could retrospectively be distinguished within the depth of the lesion on the late arterial phase, persistent during the capillary and venous phases. The diagnosis of microcystic meningioma was evoked. Complete macroscopic excision of a well-delineated non-invasive tumour attached to the dura over the right parietal convexity was subsequently performed.

On histological examination (Fig. 1G), the neoplasm displayed a predominant microcystic pattern with rare meningothelial whorls and a few psammomas preferentially localised near the meningeal sheaths. Distinctive microscopic features included abundant mucin-containing microcysts, hyalinsed and thickened blood vessels and vacuolated cells with scattered large and dark nuclei. Mitoses were absent. Immunophenotyping of the neoplastic cells showed predominantly vimentin and Epithelial Membrane Antigen (EMA); MIB1 labelling index was less 1%. The histological and immunohistochemical characteristics of the neoplasm were consistent with the diagnosis of microcystic meningioma (WHO grade I).

Case 2

A 77-year-old woman presented with memory loss, attention disorder and depression. CT demonstrated a hypo-dense left intracranial (parietal) mass. MRI showed an extra-axial mass without oedema, which was hyper-intense on T2-weighted imaging (Fig. 2A). The T1-weighted image (Fig. 2B) was predominantly hyper-intense with some hypo-intense foci and enhanced after gadolinium injection (Fig. 2C). The PWI showed a hypovascularised tumour (Fig. 2D). The first-pass curve undertaken in the tumoral tissue (red curve) crossed over the baseline and the rCBV was less than 1 (Fig. 2E). The reference curve (green curve) is derived from the contra-lateral white matter. 1H spectroscopy using single voxel (TE = 30 ms) and imaging (TE = 136 ms) studies revealed a double lipid peak centered at 0.9 and 1.3 ppm (Fig. 2F). A fatty tumour with dural attachments was excised at operation. The resected specimen consisted of a well-
circumscribed, homogeneous beige nodule without necrosis that measured 2 cm in diameter. On histology (Fig. 2G), the tumour appeared preferentially composed of lipid-laden round cells resembling mature adipocytes. Typical meningothelial elements could be rarely identified, however, there was evidence of transition between adipocytes and meningothelial cells. Mitoses, necrosis and psammomas were absent. In the vast majority of the tumoral tissue, the vascular network remained unremarkable. Only some rare tumoral areas located near the meningeal sheaths showed some ectatic blood vessels with a frequent fibrous perivascular thickening. The immunohistochemical profile was distinctive; neoplastic cells exhibiting a diffuse membrane immunoreactivity for EMA and Vimentin. Rare cells resembling lipoblasts were also S-100 protein positive. The MIB1 labelling index was low (2%). The histological and immunohistochemical features were representative of the lipomatous (lipidised) variant of metaplastic meningioma (WHO grade I).

Discussion

Meningiomas are classified according to 15 subtypes [1] (WHO classification) and may have atypical features on both CT and MRI studies.

Microcystic meningioma

Microcystic meningioma is an unusual type of meningioma characterised by meningothelial cells surrounded by a loose, mucinous background, giving the appearance of multiple small cysts. It comprises only 1.6% of intracranial meningiomas [2]. Few series [3—5] report the imaging characteristics. The largest case series (n = 16) [4] proposes three principal diagnostic criteria; low signal intensity on T1-weighted imaging, high signal intensity on T2-weighted imaging and presence of peri-tumoral oedema. A recent publication of eight cases [6] supports the validity of these three characteristics, all of which may reflect the abundance of the microcystic component. Strong enhancement post-injection is typically observed on CT and MRI images [4,5,7,8]. Weak peripheral and septated enhancement [4,9,10], as seen in our case, has been reported in the literature and can result in diagnostic errors. This unusual radiological appearance of microcystic meningioma must be differentiated from other intracranial tumors (glioma, metastases), epidermoid cyst and cerebral abscess. In the present case, perfusion data proved useful in demonstrating a high relative cerebral blood volume (rCBV) within the tumour while the portion of the curve above the baseline after the first pass corresponds to the extravasation of the contrast media via the microcirculation. The extremely low rCBV documented in our case as never been described in case reports of various subtypes of meningiomas [26]. Lipomatous meningioma is included within metaplastic meningioma group; according with this classification, the metaplasia might explain the unusual first pass curve, the meningioma losing its regular hypervascularization. The MRS findings are characteristic of fatty tissue and could prove interesting in the future. To date, only one article has reported the spectroscopic study of a lipomatous meningioma [17].

Conclusion

These two cases of meningioma demonstrate the utility of PWI and 1H spectroscopy in the diagnosis of two rare histological variants; the microcystic and lipomatous forms of this intracranial neoplasm.

Conflicts of interests

None.

References