CASE REPORT

Morphological and functional MR imaging of Lhermitte–Duclos disease with pathology correlate

Imagerie par résonance magnétique nucléaire morphologique et fonctionnelle de la maladie de Lhermitte-Duclos avec corrélation pathologique


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KEYWORDS
Lhermitte–Duclos disease; MRI; Diffusion-weighted imaging; Perfusion; Gadolinium

Summary
Lhermitte–Duclos disease (LDD) is a rare benign lesion of uncertain pathogenesis characterised by distortion of the normal cerebellar laminar cytoarchitecture. We report a case of LDD thoroughly characterized by advanced magnetic resonance imaging techniques, with diffusion-weighted, perfusion-weighted and post-gadolinium sequences. Imaging showed restricted diffusion consistent with high cellularity, high degree of vascularity and preserved blood-brain barrier permeability, correlating with pathology.

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MOTS CLÉS
Maladie de Lhermitte-Duclos ; IRM ; Imagerie de diffusion ; Perfusion ; Gadolinium

Résumé
La maladie de Lhermitte-Duclos (LDD) est une lésion bénigne rare d’origine incertaine, caractérisée par une distorsion de la cytoarchitecture laminaire normale du cervelet. Nous rapportons un cas de LDD qui fut l’objet d’un examen par résonance magnétique, avec séquences de diffusion, perfusion et séquences après injection de gadolinium. L’imagerie démontra une diffusion restreinte suggérant une cellularité augmentée, une augmentation de la vascularisation et une barrière hémato-encéphalique préservée, en corrélation avec la pathologie.

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Introduction

Lhermitte–Duclos disease (LDD), or dysplastic gangliocytoma, is a rare benign condition involving the cerebellum of uncertain nature [1,2]. LDD is characterized by overgrowth of cerebellar ganglion cells which replace granular cells and Purkinje cells [2]. This results in gross thickening of the cerebellar folia [2]. In recent years, several cases have been reported involving the association between LDD and Cowden’s disease (CD). CD is a rare autosomal dominant disease that usually presents with multiple mucocutaneous lesions. Patients with CD are prone to multiple systemic malignancies, the most common of which is breast cancer. Recent studies have demonstrated an association between LDD and CD [1,3]. Genetic studies suggest that LDD may be a developmental abnormality [3], while the association with multiple systemic malignancies in CD favors the hypothesis of a hamartomatous or neoplastic disorder [1].

The goal of this article is to report the advanced magnetic resonance imaging (MRI) findings in a case of LDD associated with CD.

Case report

A 46-year-old Caucasian woman presented with progressively worsening headache. Neurological examination documented pluridirectional swaying at the Romberg test. MRI of the brain (Fig. 1 and 2) demonstrated a 5 cm left cerebellar mass, with preserved but thickened, distorted, and of increased T2-signal, foliar pattern, with a pathognomonic “tiger striped” appearance. There was mild mass effect, but no hydrocephalus. The lesion was bright on diffusion-weighted images (DWI) and the corresponding apparent diffusion coefficient (ADC) maps showed patchy mixed pattern of truly restricted diffusion and “T2-shine through” effect. Enhanced T1-weighted images revealed no clear parenchymal enhancement, but vascular enhancement within dilated and tortuous slow-flow blood vessels, most likely veins, deeply in the tumor and along its surfaces.

Perfusion-weighted imaging (PWI) showed increased area over the time–intensity curve within the tumor compared to the contralateral normal-appearing cerebellar cortex, with good return to baseline, consistent with elevated relative cerebral blood volume (rCBV) and preserved blood-brain barrier. A presumptive radiological diagnosis of LDD was posed.

The patient underwent suboccipital craniotomy and subtotal removal of the lesion.

Histological examination (Fig. 3) showed diffuse replacement of tightly packed, small neurons of granule cell layer by large cells, with ganglion cell-like features. Abnormally myelinated axons extended from granular layer to the overlaying molecular layer, which appeared expanded. Synaptophysin immunoreactivity was present in the large neuronal cells. These findings confirmed the diagnosis of LDD. Immunohistochemistry for endothelial markers revealed numerous venular spaces in leptomeninges, granular and molecular layers.

Postoperative course was uneventful and at six months follow-up the patient was in good conditions; headaches had resolved.

Evidence of LDD in an adult patient raised suspicion for CD, which was diagnosed based on one major criteria (LDD) and one pathognomonic criteria (presence of cutaneous papules and oral mucosal nodules) [3].

Discussion

We report on an adult patient with pathology proven LDD in CS, whose brain MRI showed the typical “tiger striped” appearance, restricted diffusion, high vascularity and preserved blood-brain barrier permeability on PWI, correlating with pathology findings.

Conventional MRI findings in our case were typical for LDD. The lesion demonstrated mild mass effect and, on T2-weighted images, had a unique striated pattern consisting of alternating hyper- and iso-intense bands [1,4,5] resulting from a persistent, although distorted, foliar architecture.

![Figure 1](image_url)

**Figure 1** Brain MRI in a patient with Lhermitte–Duclos disease (LDD). Sagittal T1-weighted image (A), coronal (B) and axial (C) T2-weighted images, axial diffusion-weighted image (DWI) (D), and correspondent ADC map (E). The mass-lesion in the left cerebellar hemisphere is hyperintense on T2-weighted images, with alternating hyper- and iso-intense bands, referred to as a “tiger striped” appearance (B and C). The lesion demonstrates high signal intensity on DWI (D), with patchy mixed diffusion pattern on corresponding ADC map (E).
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Beyond morphological imaging, advanced functional neuroradiology added interesting diagnostic elements.

The lesion was bright on DWI, with patchy mixed diffusion pattern on the ADC maps. Restricted diffusion within LDD lesion has been reported before [4–7] and likely reflects hypercellularity [8] and dense collection of axons, also seen at pathology.

PWI revealed an increased rCBV within the lesion, suggesting hypervascularity and likely related to the dilated veins seen on post-gadolinium images, deeply in the tumor and along its surfaces. Pathology examination confirmed hypervascularity, with dilated venules in the altered granular and molecular layers, and along the leptomeninges, as previously described [9]. Previous studies, using nuclear medicine, xenon-CT and PWI, have shown an elevated metabolic rate [4,10]. While these vascular and metabolic profiles are consistent with a lesion with growth potential, 1H–MR-spectroscopy reports normal Cho/Cr ratios in LDD, due to the absence of significant membranes’ turnover [11], opposed to what is commonly seen in aggressive, proliferative neoplastic processes. Proliferation of blood vessels per se is not a sign of malignancy, as seen in some pilocytic astrocytomas and meningiomas that are WHO grade I [12]. These complex imaging findings are in line with the debate around the origin of LDD (developmental abnormality versus hamartoma or low-grade tumor).

Our findings remark the value of a comprehensive imaging approach when facing with possible LDD for a more thorough understanding of this entity. Our LDD lesion showed some features of developmental or hamartomatous abnormalities, and displayed restricted diffusion, and increased rCBV as more aggressive tumors do. These findings can be more correctly interpreted taking in consideration the morphological aspects shown by imaging, surgical observation and pathology, of thickened cortex and dilated venules within the lesion, in absence of mitosis and necrosis.

Conclusion

LDD is characterized by atypical, ‘tiger striped’ pattern on conventional MRI, and by high cellularity and high vas-

Figure 2  Perfusion-weighted images (PWI) (A–C), and post-gadolinium axial T1-weighted image (D). PWI shows increased relative cerebral blood volume (rCBV) in the lesion (increased area over the purple signal intensity/time curve recorded in the purple region of interest), compared to contralateral normal appearing cerebellar hemisphere (green ROI and curve), as displayed by the rCBV color map (C). Axial enhanced T1-weighted images (D) shows vascular enhancement related to dilated veins within and around the mass.

Imagerie de perfusion (PWI) (A–C), et image T1 axiale après injection de gadolinium (D). La PWI montre une augmentation du volume sanguin cérébral relatif (rCBV) dans la lésion (augmentation de l’aire sur la courbe temps–intensité violette enregistrée dans la région d’intérêt violette) par comparaison avec l’hémisphère cérébelleux controlatéral normal (ROI et courbe verte) en cartographie couleur du rCBV (C). Les images axiales T1 avec contraste (D) montrent une prise de contraste vasculaire impliquant des veines dilatées dans et autour de la masse.

Figure 3  Pathology. Haematoxylin-eosin at low (A) and higher magnification (B) shows replacement of internal granular layer by large, tightly packed neuronal cells typical of LDD. Numerous vascular venous spaces are present in cerebellar tissue (C). CD31 immunostaining (D) clearly outlines the abundant vasculature.

Pathologie. La coloration par hématoxyline-eosine à faible (A) et fort grossissement (B) montre un remplacement de la couche des cellules granulaires interne par de larges cellules neuronales disposées de façon dense, typiques de la LDD. De nombreux espaces vasculaires veineux sont présents dans le tissu cérébelleux (C). L’immunomarquage CD31 (D) démontre clairement l’abondante vascularisation.
cularity. These can be identified reliably using advanced MRI techniques, including DWI and PWI, in agreement with pathology.

References