Cerebellar pilocytic astrocytoma differential diagnosis

- High-grade astrocytoma with piloid features in the conus medullaris: a rare presentation of a new World Health Organization diagnosis. Illustrative case
- Calcified cystic lesion in cerebellum: A case report
- Clinicopathological analysis of rosette-forming glioneuronal tumors
- Pilocytic Astrocytoma Presenting with Spontaneous Cerebellar Hemorrhage: A Case Report
- A rare case of cerebellar anaplastic pleomorphic xanthoastrocytoma
- Pediatric posterior fossa tumors
- Differentiation of pilocytic astrocytoma, medulloblastoma, and hemangioblastoma on diffusion-weighted and dynamic susceptibility contrast perfusion MRI
- Application of Apparent Diffusion Coefficient Histogram Metrics for Differentiation of Pediatric Posterior Fossa Tumors : A Large Retrospective Study and Brief Review of Literature

The **differential diagnosis for cerebellar pilocytic astrocytoma (PA)** focuses on distinguishing it from other posterior fossa and cerebellar tumors, as well as cystic lesions that can appear similar on imaging. Pilocytic astrocytoma is a WHO Grade I tumor and typically presents with a cystic mass and an enhancing mural nodule. Here are the main differential considerations:

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1. Medulloblastoma

1. **Key Differences:**
    1. More aggressive, WHO Grade IV tumor.
    2. Frequently arises from the cerebellar vermis.
    3. Appears hyperdense on CT and shows restricted diffusion on MRI (high cellularity).
2. **Clinical Clues:**
    1. Common in children.
    2. Often associated with hydrocephalus due to obstruction of the fourth ventricle.

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2. Hemangioblastoma

1. **Key Differences:**
    1. Commonly seen in adults (third to fifth decades).
    2. Associated with von Hippel-Lindau syndrome.
    3. Typically cystic with a strongly enhancing mural nodule, like PA.
2. **Distinguishing Features:**
    1. Flow voids from vascular supply seen on MRI.
    2. Absence of diffuse astrocytic or glial tumor markers on histopathology.

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3. Ependymoma

1. **Key Differences:**
    1. Tends to arise near the fourth ventricle and extend into foramina of Luschka and

Magendie.
    2. Calcifications may be present.
2. **MRI Findings:**
    1. Heterogeneous enhancement.
    2. May display a “cap” of hypointensity on T2-weighted MRI.

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4. Atypical Teratoid/Rhabdoid Tumor (ATRT)

1. **Key Differences:**
    1. Rare, aggressive tumor typically seen in children younger than 3 years.
    2. May present as a posterior fossa lesion with both solid and cystic components.
2. **Distinguishing Features:**
    1. Shows restricted diffusion on MRI.
    2. Often has hemorrhage or necrosis and a highly malignant histologic profile.

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5. Diffuse Midline Glioma

1. **Key Differences:**
    1. High-grade glioma with diffuse infiltration.
    2. May extend into the cerebellum but lacks a cystic morphology.
2. **MRI Findings:**
    1. Diffuse T2 hyperintensity with minimal or no enhancement.

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6. Brain Metastasis

1. **Key Differences:**
    1. Rare in pediatric populations.
    2. Often multiple lesions with surrounding vasogenic edema.
2. **Clinical Clues:**
    1. History of malignancy (e.g., lung, breast, melanoma).

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7. Cerebellar Abscess

1. **Key Differences:**
    1. Mimics cystic tumors on imaging.
    2. Ring-enhancing lesion with central restricted diffusion (pus).
2. **Clinical Clues:**
    1. Fever, systemic infection, or elevated inflammatory markers.

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8. Dermoid or Epidermoid Cyst

1. **Key Differences:**

    1. Benign congenital lesions.
    2. **Dermoid cyst**: May contain fat or calcifications.
    3. **Epidermoid cyst**: Shows restricted diffusion on MRI.
2. **MRI Findings:**
    1. Bright signal on diffusion-weighted imaging for epidermoid cysts.

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9. Ganglioglioma

1. **Key Differences:**
    1. Rare, low-grade tumor with cystic and solid components.
2. **Distinguishing Features:**
    1. May exhibit calcifications and heterogeneous enhancement.

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Key Imaging Features of Pilocytic Astrocytoma

1. **MRI:**
    1. Cystic lesion with an enhancing mural nodule.
    2. No significant restricted diffusion (unlike medulloblastoma or abscess).
    3. Often sharply circumscribed.
2. **Spectroscopy:**
    1. Elevated choline and reduced N-acetylaspartate (NAA).

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Age and Clinical Context

1. **Pilocytic Astrocytoma:** Common in children and young adults.
2. **Hemangioblastoma and metastases:** More common in adults.

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Definitive diagnosis often requires histopathologic examination after resection or biopsy.

A study aimed to evaluate the diagnostic performance of dynamic susceptibility contrast (DSC) perfusion magnetic resonance imaging and apparent diffusion coefficient (ADC) for differentiating common posterior fossa tumors, pilocytic astrocytoma (PA), medulloblastoma (MB), and hemangioblastoma (HB). Between January 2016 and April 2022, 23 (median age, 7 years [range, 2-26]; 12 female), 13 (10 years [1-24]; 3 female), and 12 (43 years [23-73]; 7 female) patients with PA, MB, and HB, respectively. Normalized relative cerebral blood volume and flow (nrCBV and nrCBF) and normalized mean ADC (nADCmean) were calculated from volume-of-interest and statistically compared. nADCmean was significantly higher in PA than in MB (PA: median, 2.2 [range, 1.59-2.65] vs MB: 0.93 [0.70-1.37], P < .001). nrCBF was significantly higher in HB than in PA and MB (PA: 1.10 [0.54-2.26] vs MB: 1.62 [0.93-3.16] vs HB: 7.83 [2.75-20.1], all P < .001). nrCBV was significantly different between all 3 tumor types (PA: 0.89 [0.34-2.28] vs MB: 1.69 [0.93-4.23] vs HB: 8.48 [4.59-16.3], P = .008 for PA vs MB; P < .001 for PA vs HB and MB vs HB). All tumors were successfully differentiated using an algorithmic approach with a threshold value of 4.58 for nrCBV and subsequent threshold value of 1.38 for nADCmean. DSC parameters and nADCmean were significantly different

between PA, MB, and HB. An algorithmic approach combining nrCBV and nADCmean may be useful for differentiating these tumor types [1].

Posterior fossa ependymoma

Medulloblastoma

MRI images of medulloblastoma (n=59), ependymoma (n=13) and pilocytic astrocytoma (n=27) confirmed by pathology before treatments in Children's Hospital of Nanjing Medical University from January 2014 to February 2019 were enrolled in a retrospective study as well as the clinical data of age, gender and symptoms. Registration was performed among the three sequences and wavelet features of ROI were acquired. Afterward, the top ten features were ranked and trained among groups by using a random forest classifier. Finally, the results were compared and analyzed according to the classification. Results: The top ten contributions three sequences and wavelet features of ROI were acquired from the ADC sequence. The random forest classifier achieved 100% accuracy on training data and was validated best accuracy (86.8%) when combined of first and third wavelet features. The sensitivity was 100%, 94.8%, 76.9%, and the specificity was 97.6%, 88.0%, 98.8% respectively. Conclusions: Features based on wavelet transformation of the ADC sequence of the entire tumor can provide more quantitative information, which could provide help in the differential diagnosis of pediatric posterior fossa brain tumors. The optimum combination to distinguish three pediatric posterior fossa brain tumors is the sixth and twelfth wavelet features of the ADC sequence [2].

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Kurokawa R, Kurokawa M, Baba A, Kim J, Capizzano A, Bapuraj J, Srinivasan A, Moritani T. Differentiation of pilocytic astrocytoma, medulloblastoma, and hemangioblastoma on diffusion-weighted and dynamic susceptibility contrast perfusion MRI. Medicine (Baltimore). 2022 Nov 4;101(44):e31708. doi: 10.1097/MD.0000000000031708. PMID: 36343086; PMCID: PMC9646672.
2)
Wang SJ, Zhang W, He JP, Sun WH, Zhang R, Zhu MJ, Feng ZZ, Yang M, Sun Y. [Classification of the types of pediatric posterior fossa brain tumors based on routine MRI using wavelet transformation analysis of whole tumor]. Zhonghua Yi Xue Za Zhi. 2020 Jan 21;100(3):178-181. doi: 10.3760/cma.j.issn.0376-2491.2020.03.004. Chinese. PubMed PMID: 32008282.