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Review

Imaging of adult brainstem gliomas

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ABSTRACT

Brainstem gliomas (BSGs) are uncommon in adults accounting for about 2% of all intracranial neoplasms. They are often phenotypically low-grade as compared to their more common paediatric counterparts. Since brainstem biopsies are rarely performed, these tumours are commonly classified according to their MR imaging characteristics into 4 subgroups: (a) diffuse intrinsic low-grade gliomas, (b) enhancing malignant gliomas, (c) focal tectal gliomas and (d) exophytic gliomas/other subtypes. The prognosis and treatment is variable for the different types and is almost similar to adult supratentorial gliomas. Radiotherapy (RT) with adjuvant chemotherapy is the standard treatment of diffuse low-grade and malignant BSGs, whereas, surgical resection is limited to the exophytic subtypes. Review of previous literature shows that the detailed imaging of adult BSGs has not received significant attention. This review illustrates in detail the imaging features of adult BSGs using conventional and advanced MR techniques like diffusion weighted imaging (DWI), diffusion tensor imaging (DTI), MR perfusion weighted imaging (PWI), MR spectroscopy (MRS), as well as ^{18}F-fluoro-ethyl-tyrosine positron emission tomography (^{18}F-FET/PET). We have discussed the pertinent differences between childhood and adult BSGs, imaging mimics, prognostic factors and briefly reviewed the treatment options of these tumours.

Contents

Abbreviations: BSG, brain stem glioma; DWI, diffusion weighted imaging; DTI, diffusion tensor imaging; WM, white matter; MRS, MR spectroscopy; PWI, perfusion weighted imaging; ^{18}F-FDG/PET, ^{18}F-fluoro-deoxy glucose positron emission tomography; ^{18}F-FET/PET, ^{18}F-fluoro-ethyl-tyrosine positron emission tomography; GBM, glioblastoma multiforme; KFS, Karnofsky performance status; ADC, apparent diffusion coefficient; FA, fractional anisotropy; CSF, cerebrospinal fluid; Cho, choline; NAA, N-acetylaspartate; rCBV, relative cerebral blood volume; rCBF, relative cerebral blood flow; MCP, middle cerebellar peduncle; RT, radiotherapy; TMZ, temozolomide; NF1, neurofibromatosis 1.

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1. Introduction

Brainstem tumours are defined as lesions whose epicentre lies in the midbrain, pons or medulla oblongata. This definition excludes tumours arising in the thalamus, cerebellum, cerebellar peduncles and in the upper cervical spinal cord. Gliomas are the most frequent primary tumours of the brainstem. Brainstem gliomas (BSGs) show a bimodal age distribution with one peak in the latter half of the 1st decade and the second in the 4th decade. BSGs account for about 20% of all brain tumours in the paediatric population. Adult BSGs on the other hand, are rarer (1–2% of all brain tumours) and less well investigated [1–8].

Review of literature shows that the detailed imaging of adult BSGs has not received significant attention. We retrospectively reviewed imaging studies performed for newly diagnosed, as well as follow-up cases of adult BSGs (in patients >18 years of age) at our institute over the last 10 years from 2004 to 2014. This review describes the different types of adult BSGs (as seen at our institute) and their imaging features on MRI. We also evaluated the use of advanced imaging techniques like MR diffusion weighted imaging (DWI), diffusion tensor imaging (DTI), perfusion weighted imaging (PWI), MR spectroscopy (MRS) and ^{18}F-fluoro-ethyl-tyrosine positron emission tomography (^{18}F-FET/PET) in assessing the histological grade, prognosis and treatment response of these tumours. We have highlighted the pertinent differences between childhood

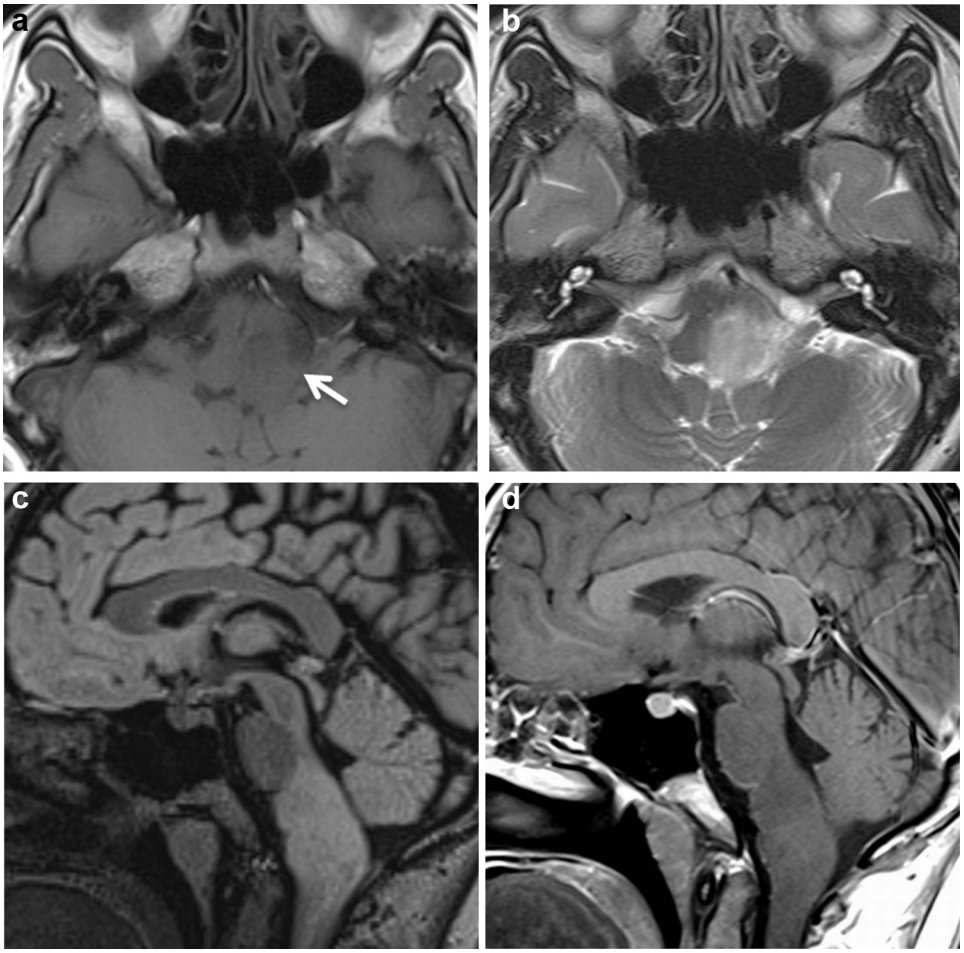

Fig. 1. A 24 year-old female patient presenting with left lower cranial nerve palsies. Baseline MRI findings are compatible with a diffuse low-grade ponto-medullary glioma. (a) Axial T1W MR image shows an expansile poorly demarcated iso-hypointense tumour (arrow) involving the left side of the medulla. (b) Corresponding axial T2W MR image shows the tumour to be hyperintense as compared to the rest of the brain parenchmya. (c) Corresponding sagittal FLAIR MR image shows the tumour to be diffusely infiltrative with hyperintense signal. (d) Corresponding contrast-enhanced sagittal T1W MR image shows no contrast enhancement within the tumour.