Dysembryoplastic neuroepithelial tumours

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Abstract

Dysembryoblastic neuroepithelial tumour (DNET) are rare, benign WHO grade I glioneuronal tumours that mainly affect children and adolescents, commonly presenting with drug-resistant seizures. They typically arise in the temporal lobe cortex and show characteristic MRI features of cortical based, multicystic lesions without significant oedema or mass effect. Histologically, DNETs have a multinodular architecture with glioneuronal components and are classified into simple, complex, and nonspecific subtypes. Gross total resection is the treatment of choice, offering excellent seizure control and prognosis, while incomplete resection increases the risk of recurrence. Though malignant transformation is uncommon, reported cases highlight the importance of long-term follow-up. Early diagnosis, complete excision, and sustained surveillance are essential to achieving favourable outcomes.

Keywords: Dysembryoblastic neuroepithelial tumour (DNET), Seizures, Outcomes

DOI: https://doi.org/10.47391/JPMA.25-80

Introduction

Dysembryoblastic neuroepithelial tumours (DNET) are glioneuronal in origin and are classified as grade 1 according to the WHO classification of brain tumours. They are benign tumours that follow a slow-growing pattern with gradual progression only. These are rare tumours with an incidence of 0.03 person-years per 100,000, with a peak age of 10 to 14 years.[1] The incidence decreases with age, accounting for < 0.2 percent of the cases over 20 years.[2] Characteristically, these tumours are associated with childhood epilepsy, accounting for an incidence of 23.4% of all cases.[3]

These are cortical-based tumours with a strong predilection to arise in the temporal lobe, however they can also be found in the frontal, parietal, and occipital lobes less commonly. As per the literature, DNET are also found in the corpus callosum, basal ganglia, and brain stem.[4] They typically present as complex epileptic seizures that are resistant to multiple antiepileptic drugs (AED). Although DNET usually present as an isolated lesion, there have been cases reported that involve the presence of multifocal lesions, particularly associated with syndromes such as neurofibromatosis type.[1,5]

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Review of evidence

Dysembryoblastic neuroepithelial tumours (DNET) have an indolent course; therefore, they may grow slowly and may be large enough at the time of diagnosis. Individuals are brought to attention usually after an episode of seizure. Ataseven et al. reported their results of 17 patients with DNET, and all of them had seizures as their primary complaint. 13 patients had complex-partial seizures, 2 patients had simple partial seizures, and 2 had generalized tonic-clonic seizures.[6] Additionally, patients reported auditory and visual hallucinations, syncope, headache, and numbness as other symptoms. In a retrospective analysis of 51 patients, Daghistani et al., reported that seizure was the most common presentation, although patients also presented with motor and sensory deficits.[7]

These tumours may have few radiological features that are unique and may suggest the diagnosis. Typically, the lack of perilesional oedema and mass effect, along with the cortical location without extension to the subcortical zone, is seen.[8] A CT scan may show a cystic or multi-cystic lesion with calcifications.[8,9] MRI is the definitive imaging of choice, which shows multiple pseudocysts, appearing hypointense on T1WI and hyperintense on T2WI and FLAIR sequence[10] (Fig. 1a,b). Daghistani et al., reported variable patterns seen on contrast imaging, including nodular, patchy, peripheral ring or a combination of enhancement.[7] A diffusion-weighted imaging (DWI) shows high apparent diffusion coefficient (ADC). This suggests low cellular density of the lesion.[11]

These tumours are microscopically well-defined nodular masses located within the cortical matter and may extend into the subcortical white matter. (Fig. 2a,b)They may also appear as a multinodular lesion with cystic changes.[12] There are three histological subtypes: simple, complex, and nonspecific form. Glioneuronal cells are present in the simple form in a confluent focus. In comparison, complex form is associated with glial nodules with

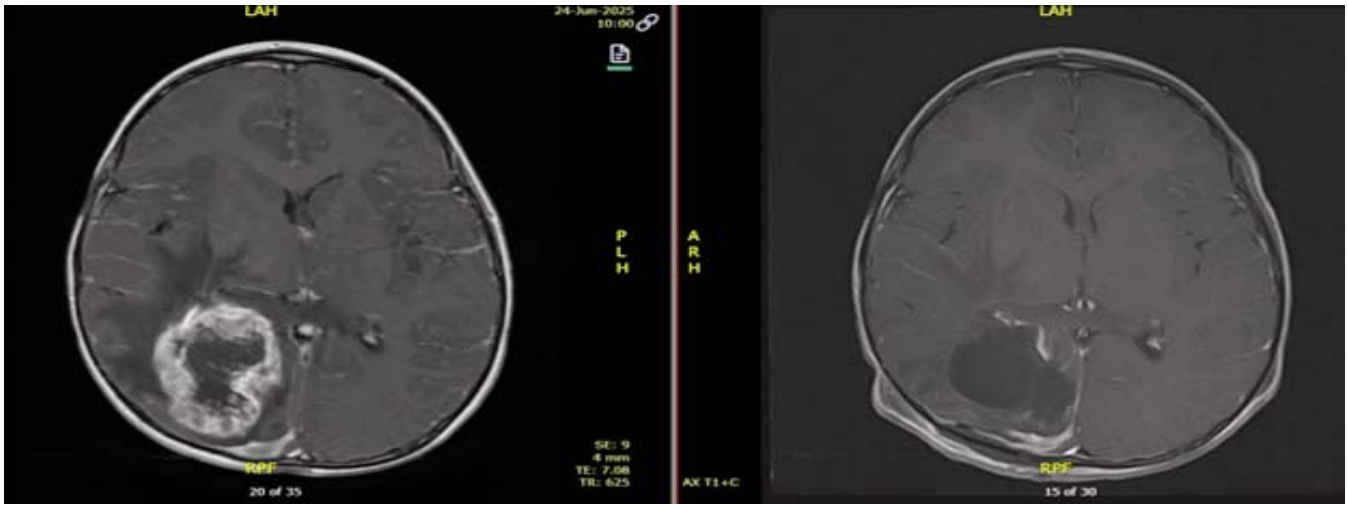

Figure-1a and 1b: Preoperative and postoperative MRI brain T1WI with contrast of a patient with DNET, who underwent complete excision of the tumour.

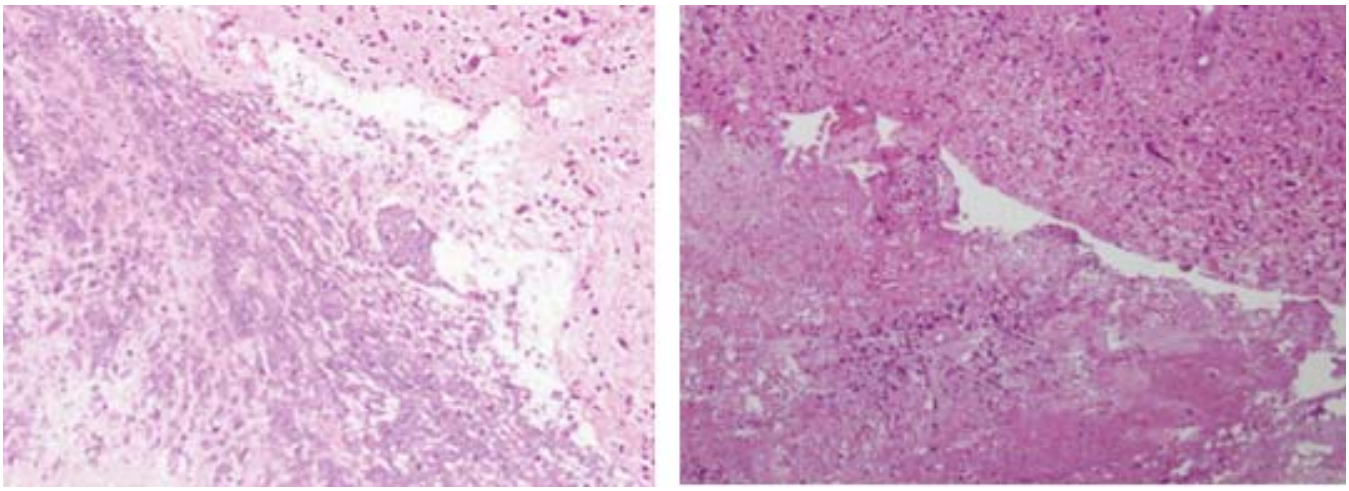

Figure-2a and 1b: Microscopic appearance of the tumor showing moderately pleomorphic nuclei arranged against fibrillary background.

astrocytic and oligodendrocytic differentiation. Additionally, the nonspecific form has no recognizable pattern.[13] The features of nuclear atypia, high mitotic index, and high cellularity are rarely present. On immunostaining, IDH and 1p19q codeletion is usually absent, however positive staining may be seen in complex form.[14]

The primary treatment is surgical resection, with gross total resection as the standard of care, with an overall better prognosis. Partial resection of the tumour results in a higher recurrence rate and poor seizure control.[1] According to a retrospective analysis by Cai et al., factors that were associated with poor prognosis in patients with DNET included old age at the time of seizure onset, prolonged seizure duration, and temporal location of the tumour.[15] Another analysis of 756 patients revealed a seizure-free outcome of 86 percent over a median follow-up period of 4 years. The factors that were associated with a seizure-free outcome included complete resection and adequate removal of the epileptogenic focus.[16]

Although DNET are benign tumours, malignant transformation has been reported in the literature. According to a case report, a 14-year-old patient with malignant transformation in the previous DNET tumour bed, who had received chemotherapy and radiation due to a subtotal resection. A redo surgery was done, and the histopathology report suggested a grade 3 astrocytoma.[17] Another case report suggested recurrence 5 years following the surgery for DNET, and the biopsy report was suggestive of glioblastoma, for which a redo surgery was done, followed by adjuvant radiotherapy.[18] This highlights the need for follow-up imaging to detect recurrence, providing an early intervention for better overall outcomes.

Conclusion

DNET are rare, typically benign lesions that most often present with seizures, especially in younger individuals. Their distinct radiological and histopathological features help distinguish them from other cortical tumours, guiding appropriate management. While gross total resection offers excellent long-term seizure control and prognosis, incomplete removal increases the risk of recurrence and persistent symptoms. Although malignant transformation is uncommon, reports of progression to high-grade gliomas underscore the importance of long-term surveillance. Continued follow-up and timely intervention remain essential to ensure favourable outcomes for patients diagnosed with DNET.

Disclaimer: None.

Conflict of Interest: None.

Source of Funding: None.

References

1. Nguyen HS, Doan N, Gelsomino M, Shabani SJWn. Dysembryoplastic neuroectodermal tumor: an analysis from the surveillance, epidemiology, and end results program, 2004-2013. World Neurosurg. 2017 ;103:380-385. doi: 10.1016/j.wneu.2017.04.093. Epub 2017 Apr 21. PMID: 28438654. 2004–2013. 2017;103:380-5.
2. Rosemberg s, Vieira gsjadn-p. Dysembryoplastic neuroepithelial tumor: an epidemiological study from a single institution. Arq Neuropsiquiatr. 1998;56:232-6. Portuguese. doi: 10.1590/s0004-282x1998000200011. PMID: 9698733 1998;56:232-6.
3. Blumcke I, Aronica E, Urbach H, Alexopoulos A, Gonzalez-Martinez JAJAn. A neuropathology-based approach to epilepsy surgery in brain tumors and proposal for a new terminology use for long-term epilepsy-associated brain tumors. Acta Neuropathol. 2014;128:39-54. doi: 10.1007/s00401-014-1288-9. Epub 2014 May 25. PMID: 24858213; PMCID: PMC4059966. 2014;128:39-54.
4. Fujimoto K, Ohnishi H, Tsujimoto M, Hoshida T, Nakazato Y. Dysembryoplastic neuroepithelial tumor of the cerebellum and brainstem. Case report. J Neurosurg. 2000 ;93:487-9. doi: 10.3171/jns.2000.93.3.0487. PMID: 10969950.
5. Lellouch-Tubiana A, Bourgeois M, Vekemans M, Robain O. Dysembryoplastic neuroepithelial tumors in two children with neurofibromatosis type 1. Acta Neuropathol. 1995;90:319-22. doi: 10.1007/BF00296517. PMID: 8525807.
6. Ataseven E, Özcan M, Ölçülü CB, Bolat E, Ertan Y, Kitiş Ö, et al. Dysembryoplastic neuroepithelial tumors of childhood: Ege University experience. Childs Nerv Syst. 2022;38:1699-706. doi: 10.1007/s00381-022-05565-w. Epub 2022 Jun 6. PMID: 35666284.
7. Daghistani R, Miller E, Kulkarni AV, Widjaja E. Atypical characteristics and behavior of dysembryoplastic neuroepithelial tumors. Neuroradiol. 2013;55:217-24.
8. Luzzi S, Elia A, Del Maestro M, Elbabaa SK, Carnevale S, Guerrini F, et al. Dysembryoplastic neuroepithelial tumors: what you need to know. World Neurosurg. 2019;127:255-265. doi: 10.1016/j.wneu.2019.04.056. Epub 2019 Apr 11. PMID: 30981794.
9. Baisden BL, Brat DJ, Melhem ER, Rosenblum MK, King AP, Burger PCJTAjosp. Dysembryoplastic neuroepithelial tumor-like neoplasm of the septum pellucidum: a lesion often misdiagnosed as glioma: report of 10 cases. World Neurosurg. 2019 ;127:255-265. doi: 10.1016/j.wneu.2019.04.056. Epub 2019 Apr 11. PMID: 30981794.
10. Arfuso M, Kuril S, Shah H, Hanson D. Pediatric Neuroglial Tumors: A Review of Ependymoma and Dysembryoplastic Neuroepithelial Tumor. Pediatric Neurol. 2024;156:139-46.
11. Bulakbasi N, Kocaoglu M, Sanal TH, Tayfun C. Dysembryoplastic neuroepithelial tumors: proton MR spectroscopy, diffusion and perfusion characteristics. Neuroradiology. 2007;49:805-12. doi: 10.1007/s00234-007-0263-8. Epub 2007 Jul 14. PMID: 17632714.12. Suh YL.
12. Dysembryoplastic Neuroepithelial Tumors. J Pathol Transl Med. 2015;49:438-49.
13. Louis DN, Perry A, Reifenberger G, von Deimling A, Figarella-Branger D, Cavenee WK, Ohgaki H, Wiestler OD, Kleihues P, Ellison DW. The 2016 World Health Organization Classification of Tumors of the Central Nervous System: a summary. Acta Neuropathol. 2016;131:803-20. doi: 10.1007/s00401-016-1545-1. Epub 2016 May 9. PMID: 27157931.
14. Rivera B, Gayden T, Carrot-Zhang J, Nadaf J, Boshari T, Faury D, et al. Germline and somatic FGFR1 abnormalities in dysembryoplastic neuroepithelial tumors. Acta Neuropathol. 2016;131:847-63. doi: 10.1007/s00401-016-1549-x. Epub 2016 Feb 26. PMID: 26920151; PMCID: PMC5039033.
15. Cai Y, Liu D, Yang Z, Chen X, Liu J, Zhang J, et al. Factors associated with prognosis of dysembryoplastic neuroepithelial tumors patients after surgical resection: a retrospective observational study. Br. J. Neurosurg.2024;38:372-7.
16. Bonney PA, Boettcher LB, Conner AK, Glenn CA, Briggs RG, Santucci JA, et al. Review of seizure outcomes after surgical resection of dysembryoplastic neuroepithelial tumors. J Neuro-Oncol. 2016;126:1-10.
17. Rushing EJ, Thompson LD, Mena HJAodp. Malignant transformation of a dysembryoplastic neuroepithelial tumor after radiation and chemotherapy. Ann Diagn Pathol. 2003;7:240-4. doi: 10.1016/s1092-9134(03)00070-4. PMID: 12913847.
18. Heiland DH, Staszewski O, Hirsch M, Masalha W, Franco P, Grauvogel J, et al. Malignant transformation of a dysembryoplastic neuroepithelial tumor (DNET) characterized by genome-wide methylation analysis. J Neuropathol Exp Neurol. 2016 ;75:358-65. doi: 10.1093/jnen/nlw007. Epub 2016 Feb 27. PMID: 26921879.