

Perfusion sensitive contrast-enhanced magnetic resonance imaging of dysembryoplastic neuroepithelial tumour: a new neuroimaging finding

Badanie perfuzji metodą rezonansu magnetycznego z użyciem środka kontrastowego w diagnostyce dysembrioplastycznego guza neuroepitelialnego: nowe wyniki badań obrazowych

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Neurologia i Neurochirurgia Polska 2012; 46, 2: 184-188

DOI: 10.5114/ninp.2012.28262

Abstract

Dysembryoplastic neuroepithelial tumours (DNTs) are benign lesions affecting young people and are associated with epilepsy. There have been described more than 300 cases in the literature and the clinical, pathological and radiological findings are well known. Recent advances in neuroimaging allow the acquisition of cerebral microcirculation parameters by perfusion weighted imaging, giving additional diagnostic information improving the diagnostic accuracy. The aim of this study is to show the perfusion sensitive contrast-enhanced magnetic resonance imaging findings of a case of DNT as an additional neuroradiological finding. Further investigation of microcirculation parameters may be helpful to establish the correct diagnosis of such tumours.

Key words: dysembryoplastic neuroepithelial tumour, MRI, perfusion MRI.

Introduction

Dysembryoplastic neuroepithelial tumours (DNTs) are rare benign lesions of neuroepithelial origin affect-

Streszczenie

Dysembrioplastyczny guz neuroepitelialny (DNT) to łagodny guz stwierdzany u osób młodych, związany z występowaniem padaczki. Opisano ponad 300 przypadków tego guza; jego cechy kliniczne, patologiczne i radiologiczne są dobrze znane. Postępy w zakresie metod obrazowania układu nerwowego umożliwiają badanie parametrów mikrokrążenia mózgowego za pomocą obrazowania perfuzji i dostarczają dodatkowych informacji zwiększających dokładność rozpoznania. Celem pracy było przedstawienie wyników badania perfuzji za pomocą rezonansu magnetycznego z użyciem środka kontrastowego w przypadku DNT. Wyniki te przynoszą nowe spostrzeżenia. Dokładniejsze badania parametrów mikrokrążenia mogą być przydatne w prawidłowym rozpoznawaniu guzów tego rodzaju.

Słowa kluczowe: dysembrioplastyczny guz neuroepitelialny, RM, badanie perfuzji za pomocą RM.

ing young people and are clinically characterized by drug-resistant partial seizures and normal neurological examination. The clinical, pathological and neuroradiological findings of DNT are well known [1].

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Received: 23.01.2011; accepted: 22.07.2011

Radiological examination is extremely important, especially when pathological findings are inconclusive. To the best of our knowledge, this is the second report of a patient with dysembryoplastic neuroepithelial tumour evaluated by perfusion contrast magnetic resonance imaging (MRI).

Case report

A 17-year-old male was admitted to our institution due to a long history of drug-resistant partial seizures. The seizures started at the age of 12 years and were characterized as frequent complex partial temporal lobe seizures and rare generalized tonic-clonic seizures. The clinical examination revealed no progressive neurological deficit and no other positive findings. Magnetic resonance imaging examination was performed with a 1.5 T MRI Unit (Magnetom Vision, Siemens).

Conventional MRI was performed with the following sequences: T1-weighted images (TR 400 ms, TE 10 ms, distance factor 30 mm, FOV 230 mm, slice thickness 5 mm, matrix 256, TA 2.37 min) in transverse and coronal planes, T2-weighted images (TR 3900 ms, TE 96 ms, distance factor 30 mm, FOV 260 mm, slice thickness 5 mm, matrix 320, TA 2.18 min) in the sagittal plane, and T2 FLAIR sequence (TR 9000 ms, TE 106 ms, distance factor 50 mm, FOV 230 mm, slice thickness 5 mm, matrix 256, TA 4.14 min) in the transverse plane.

A left-temporal tumour was demonstrated involving the cortex and subcortical white matter and it was accompanied neither by oedema nor by the mass effect. The lesion was hypointense on T1-weighted images and slightly hyperintense on T2-weighted images (Fig. 1). Perfusion sensitive contrast enhanced T2*-weighted gradient echo, echo-planar images were acquired during the first pass of contrast agent to form the perfusion weighted images. Contrast medium was injected with a flow rate of 5 mL/s. All images were transferred to the Siemens workstation and analysed. The processing was done automatically with the Siemens Vision software.

The series that included the tumour were selected and regions of interest which measured 2-4 mm² were placed manually in several areas in the tumour and in the contralateral white matter symmetrically.

The lesion showed small septations and multinodular appearance and showed minimal marginal contrast enhancement (Fig. 2). The drop in T2* signal caused by susceptibility effects of gadolinium was calculated

and used to construct a time-versus-intensity curve. To construct regional cerebral blood volume (rCBV) maps, changes in signal intensity (S) were converted to changes in T2* relaxation rate by the formula $(-\ln[S/S_0])/TE$, where S₀ is the baseline signal intensity. The rCBV and regional cerebral blood flow (rCBF) map demonstrated that the ratios of rCBV/rCBF in the tumour were lower than rCBV/rCBF in normally appearing white matter of the contralateral hemisphere (Fig. 3). Additionally, the mean transit time (MTT) and time to peak (TTP) within the lesion were longer than those in contralateral normal brain. This can be explained by the relatively greater cellularity of the tumour compared to the normal white matter of the brain. The lesion was compatible with DNT.

The patient underwent surgical excision and the histological examination was misinterpreted as an oligodendroglioma. Due to a discrepancy between histological and radiological results, a second histological evaluation was done. The final results revealed a DNT. The patient did not undergo additional therapy. Two years later the patient is healthy with normal neurological examination. Additionally, MRI has not shown any evidence of recurrence.

Discussion

Generally, pathological examination leads to the diagnosis of DNT if the specific glioneuronal element (SGNE) is present. However, it appears obvious that this diagnosis must be affirmed cautiously, because some oligodendrogliomas harbouring cystic changes and entrapping neurons may mimic the SGNE [2]. Moreover, the aggressiveness criteria, including mitosis, ischaemic necrosis, capillary proliferation, nuclear atypia, and meningeal involvement, are usually observed in malignant tumours but do not exclude the diagnosis of DNT [2-4]. Additionally, there is a 'non-specific' form of DNT that does not show the SGNE but displays the same clinical and neuroimaging features as complex DNT [4]. On pathological examination, this form may mimic any kind of glioma. For all these reasons, the diagnosis of DNT must be the result of a multidisciplinary discussion including clinicians, neuroradiologists, and pathologists. Nevertheless, it is of the utmost importance to distinguish DNTs from gliomas, because DNTs can be cured by surgery alone. This is of particular interest in children because of the highly deleterious effect of adjuvant therapies.

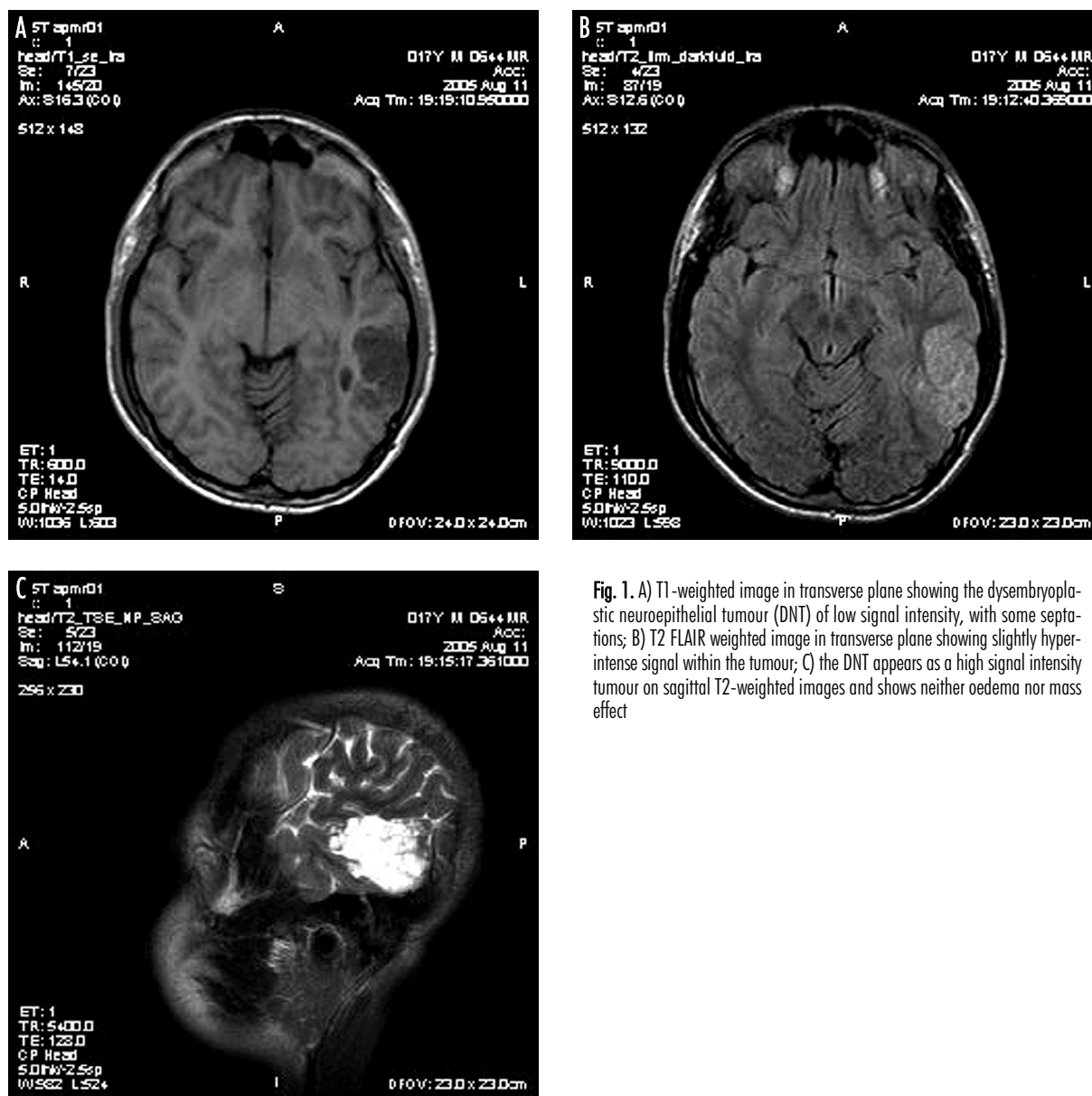


Fig. 1. A) T1-weighted image in transverse plane showing the dysembryoplastic neuroepithelial tumour (DNT) of low signal intensity, with some septations; B) T2 FLAIR weighted image in transverse plane showing slightly hyperintense signal within the tumour; C) the DNT appears as a high signal intensity tumour on sagittal T2-weighted images and shows neither oedema nor mass effect

Specific radiological features such as triangular pattern of the lesion, the presence of septations, no oedema or mass effect, and no enhancement after contrast injection strongly suggest the diagnosis of DNT and may be helpful in distinguishing them from gliomas on the basis of neuroimaging findings [1].

Vascular morphology and the degree of angiogenesis are important characteristics in the evaluation of different tumour types and determination of the biological aggressiveness of intracranial neoplasms. Perfusion sensitive contrast enhanced MRI (perfusion MRI) provides in vivo maps of rCBV that depict the overall tu-

mour vascularity, which allows indirect assessment of tumour angiogenesis and furthermore tumour biology [5]. The use of perfusion MRI based on microvascular permeability evaluation can increase the diagnostic accuracy, providing quantitative estimates of rCBV and microvascular permeability in brain tumours, with the permeability being predictive of pathological grade [6]. Additionally, perfusion MRI enables the measurement of rCBF throughout the brain without the need to apply radioactive tracers or ionizing radiation. The method is more cost-effective, faster, easy to perform, and safer than nuclear medicine techniques for

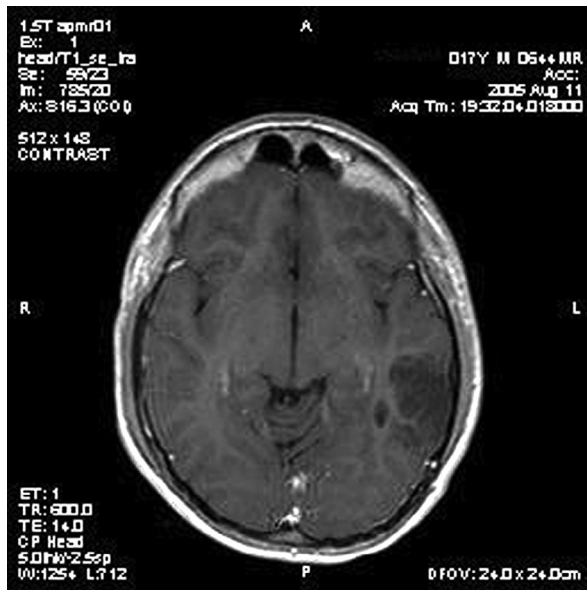


Fig. 2. Post contrast enhancement T1-weighted image in transverse plane: the dysembryoplastic neuroepithelial tumour (DNT) shows minimal marginal contrast enhancement after gadolinium injection

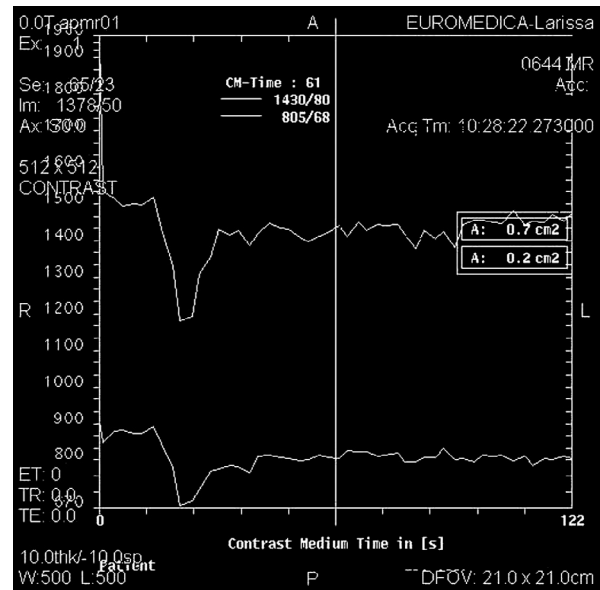


Fig. 3. Signal intensity-time curves show the signal intensity decrease during peak arrival of the contrast agent. The regional cerebral blood flow is proportional to the area under the curve. The lower curve represents the region of interest (ROI) within the dysembryoplastic neuroepithelial tumour (DNT) and the upper curve represents the ROI from contralateral normal brain. The area of the upper curve is larger than the lower one, which indicates the lower blood volume of DNT compared with the contralateral normal brain

monitoring rCBF changes as well as more feasible for monitoring the effects of therapy, and provides additional diagnostic information [7]. However, there is only one case of DNT in the literature evaluated by perfusion MRI [8]. In that report, rCBV and rCBF within the lesion were lower than those in contralateral normal brain. The lower rCBV value indicates the lack of angiogenesis in that DNT. These results are in agreement with ours and correlate well with the fact that the DNT presents a normal appearance in conventional angiography of DNT [9] and reflects the biological characteristics of a benign tumour, but it conflicts with proliferations of delicate branching capillary in histological examination. The possible explanation is that the proliferative capillary in DNT is morphologically and functionally different from those in high grade glioma. However, it should be mentioned that since there are only two reports concerning perfusion MRI of DNT, the relation between the vasculature and blood perfusion still needs to be investigated.

In conclusion, this case illustrates the capability of perfusion MRI to show the benign biological characteristics of a tumour of that type. The possible perfusion MRI features of DNT, including the low rCBV, which are supplemented with conventional MRI findings, can

provide additional neuroimaging information which can aid the diagnosis of DNT, increasing the diagnostic accuracy.

Disclosure

Authors report no conflict of interest.

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