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Original Article

Tumefactive multiple sclerosis versus high-grade glioma: A diagnostic dilemma

Heath David French

Department of Neurosurgery, Westmead Hospital, Westmead, New South Wales, Australia

E-mail: *Heath David French - heathfrench84@gmail.com

***Corresponding author:**
Heath David French,
Department of Neurosurgery,
Westmead Hospital, Westmead,
New South Wales, Australia.

heathfrench84@gmail.com

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ABSTRACT

Background: Tumefactive demyelinating lesions (TDLs) share similar clinical features and MRI characteristics with high-grade glioma (HGG). This study develops an approach to navigating this diagnostic dilemma, with significant treatment implications as the management of both entities is drastically different.

Methods: A retrospective analysis of 41 TDLs and 91 HGG with respect to demographics, presentation, and classical MRI characteristics was performed. A diagnostic pathway was then developed to help diagnose TDLs based on whole neuraxis MRI and cerebrospinal fluid (CSF) examination.

Results: The diagnosis of TDL is more likely than HGG in younger females who present with subacute or chronic symptoms. MRI characteristics favoring TDL over HGG include smaller size, open rim enhancement, little or no associated edema or mass effect, and the presence of a T2 hypointense rim. MRI of the whole neuraxis for detection of other lesions typical of multiple sclerosis (MS), in combination with a lumbar puncture (LP) showing positive CSF-specific oligoclonal bands (OCB), was positive in 90% of the TDL cohort.

Conclusion: The diagnostic pathway, proposed on the basis of specific clinicoradiological features, should be followed in patients with suspected TDL. If MRI demonstrates other lesions typical of MS and LP demonstrates positive CSF-specific OCBs, then patients should undergo a short course of IV steroids to look for clinical improvement. Patients who continue to deteriorate, do not demonstrate other lesions on MRI or where the LP is negative for CSF-specific OCB, should be considered for biopsy if safe to do so. This pathway will give the patients the best chance at neurological preservation.

Keywords: Biopsy, Diagnostic dilemma, Diagnostic pathway, High-grade glioma, Tumefactive demyelinating lesion, Tumefactive multiple sclerosis

INTRODUCTION

Gross total resection is considered best practice for high-grade glioma (HGG) surgery, however, it may lead to an unnecessary neurological deficit if the histopathology proves to be a tumefactive demyelinating lesion (TDL).[20] Tumefactive multiple sclerosis (MS) is an atypical form of MS that can mimic HGG, both clinically and radiologically.[11] This study aims to demonstrate a clinicoradiological distinction between the two separate entities and presents a diagnostic pathway to help diagnose TDL promptly, thereby aiming to minimize surgery on TDL and ultimately minimize the risk of potential neurological deficits.

TDL is classically characterized on MRI by a large solitary lesion with ring enhancement, associated mass effect, and perilesional edema.[5,6,11] This is in contrast to conventional MS which

commonly appears as multiple well-demarcated ovoid lesions lacking mass effect.[11] Clinical features can be similar to brain tumors, including focal sensorimotor deficits, seizures, and/or symptoms of raised intracranial pressure.[11] Differential diagnosis is challenging as MRI characteristics and clinical presentation are not yet pathognomonic.[1]

A number of MRI characteristics have been shown in the literature to favor TDL over cerebral neoplasms. These include incomplete rim enhancement, a higher number of lesions, mild or the absence of mass effect and edema, a T2 hypointense rim, and smaller size.[10,13,23] However, other larger studies have indicated that these MRI characteristics are nonspecific in TDL.[11,25] In conjunction with conventional MRI, higher apparent diffusion coefficient (ADC) values on MR diffusion and CT hypoattenuation of the contrast-enhancing portion of the lesions have assisted in the diagnosis of TDL.[8,13]

Using the 2017 McDonald criteria for MS in patients with suspected TDL may help with the differential diagnosis of TDL and HGG. According to the 2017 McDonald criteria, one of the diagnostic imaging hallmarks of MS is that active lesions break the blood brain barrier and enhance when contrast is given, while indolent lesions do not, allowing the identification of disease progression with only one scan.[3,17] Dissemination in time (DIT) is demonstrated if MRI of the whole neuraxis demonstrates both enhancing and nonenhancing lesions.[15,18] In addition, the presence of cerebrospinal fluid (CSF)-specific oligoclonal bands (OCB) in conjunction with an MRI demonstrating two or more lesions characteristic of MS favors the diagnosis of MS.[24] CSF-specific OCBs are positive in 30-80% of patients with TDL.[1,2,11,14] These could be powerful adjunctive investigations in the diagnosis of patients with potential TDL.

Magnetic resonance spectroscopy (MRS) and positron emission tomography (PET) using either fluorodeoxyglucose (FDG) or fluoroethyltyrosine (FET) may be helpful in the diagnosis of TDL, but drawbacks include increased cost and limited availability. In addition, false positives may occur due to the hypercellularity and hypermetabolism of TDL.[1,21] Interpretation of biopsy specimens is also challenging as hypercellularity and the presence of atypical reactive astrocytes can be seen in both TDL and neoplasms.[1,11]

CSF aquaporin 4 antibodies (AQP4-IgG) have been shown to be positive in patients with TDLs in both the CSF and the serum and allow for the alternate demyelinating differential diagnosis of neuromyelitis optica or NMO spectrum disorder (NMO/NMOSD), however, these patients are more likely to have extensive spinal cord lesions.[19]

This study specifically compares the clinical features and conventional MRI characteristics of TDL with HGG. Knowledge of these key clinicoradiological differences is essential to ensuring the accurate and timely diagnosis of both TDL and HGG. As such, we have developed a diagnostic pathway that allows for identification of patients with TDL, minimizing the risks of unnecessary surgical intervention.

MATERIALS AND METHODS

Aims

The primary aim of this study is to develop a clinicoradiological distinction between TDLs and HGGs. The second is to develop a diagnostic pathway allowing earlier identification of TDLs, in turn, preventing resection associated neurological deficit.

Study design

A retrospective analysis of patients with TDLs was conducted, managed at both the Royal North Shore Hospital (RNSH) and North Shore Private Hospital (NSPH) in Sydney, Australia. The study was approved by the National Health and Medical Research Council. Patients with TDL were drawn from a database of all patients with TDLs managed at the RNSH and NSPH from November 2015 to present. Patients with HGG were randomly drawn from the Sydney Neuro-Oncology Group database of gliomas treated at RNSH from 2014 to present and matched with the TDL group with respect to demographics, presentation, and MRI characteristics. Clinical, laboratory, and radiological data were retrospectively collected.

Demographic characteristics of the cohort pertain to gender and age at the time of first presentation with the cerebral lesion. Symptom type and onset were also recorded. Onset was delineated as acute (<7 days), subacute (>7 days–<3 weeks), and chronic (>3 weeks).

The MRI images were evaluated independently by two neuroradiologists, K.B and C.S.Y.N; with 4 and 5 years of experience in neuroimaging, respectively. Conventional MRI characteristics were standardized in accordance with the previous literature[8,13,22] and agreement between the two radiologists. They were defined as enhancement border (none, irregular, and regular), enhancement patterns (open, closed, and heterogeneous), mass effect: none, mild (sulcal effacement), moderate (subfalcine and uncal herniation <1 cm and/or midline shift <0.5 cm), and severe (subfalcine and uncal herniation >1 cm and/or midline shift >0.5 cm), perilesional edema: none, mild (<1 cm from the lesion), moderate (1–3 cm from the lesion), and severe (>3 cm from the lesion), size of the lesion (largest diameter), T1 intensity (hypointense, hypointense, and mixed), and T2 hypointense rim, if the lesion crosses the corpus callosum. MRI images were also evaluated for other lesions characteristic of MS neuraxis including periventricular and juxtacortical lesions and spinal cord lesions.

Diagnostic criteria for TDL database

Patients over the age of 15 at the time of presentation with at least one lesion on the MRI brain that is larger than 2 cm and with either the presence of mass effect or edema or atypical gadolinium (Gd) enhancement pattern. Patients were excluded if they had a previous diagnosis of MS.

Surgical technique for biopsy of TDL

Tissue biopsies were performed through a focused lesional biopsy technique, using either a stereotactic Cosman-Roberts-Wells frame or a "frameless" navigated biopsy technique for localization.

Statistical analysis

Data were analyzed using Microsoft Excel. Descriptive statistics were mean and percentages for parametric data and median and interquartile range for nonparametric data. Chi-square test and Fisher's exact test were used to test correlation between categorical variable and Mann–Whitney rank-sum test was used to test correlation between ordinal variables and those without a normal distribution.

Interclass correlation coefficients for radiological assessments were analyzed on the total cohort (n = 132) using a two-way random effects model for absolute agreement with an alpha set at 95%. An ICC value >0.80 was considered as an excellent agreement. Edema and mass effect were considered as ordinal variables.

A logistical regression model was performed to determine the effects of demographics (age, gender, and symptom duration) and radiological characteristics (T2 hypointense rim and edema) to differentiate between HGG from TDL. Hosmer and Lemeshow goodness-of-fit test was used to test the model.

In all tests, statistical significance was defined as $p<0.05$. All statistical analyses were completed using SPSS v25.0 (IMB, Armonk, NY).

RESULTS

Clinicoradiological diagnosis of TDLs

Forty-one TDLs were compared to the 91 HGGs. Univariate analysis of both demographics and clinical features revealed that TDLs were significantly more likely to be present in younger patients and in female patients. Acute presentation was significantly more likely in patients with HGG compared with subacute and chronic in TDLs [Table 1].

Generalized tonic–clonic (GTC) seizures and dysphasia were more common in patients with HGGs, whereas ataxia, hemi-sensory disturbance, and diplopia were more common in patients with TDLs. Only 1 (3%) patient had a GTC seizure in the TDL group compared with 17 (19%) in the HGG group. Only 3 (7%) patients in the TDL group presented with dysphasia compared with 19 (21%) in the HGG group. Nine (22%) patients presented with ataxia in the TDL group compared with 1 (1%) in the HGG group. Eight (20%) patients with TDLs presented with hemi-sensory disturbance, compared with 5 (5%) in patients with HGG. Three (7%) patients with TDL presented with diplopia compared with 2 (2%) patients with HGG [Figure 1].

Locations of the lesions were similar between TDLs and HGGs. The most common location was in the frontal lobe followed by the temporal lobe. The brain stem was a more common location in TDLs compared with HGG. Four (10%) TDLs presented in the brainstem compared with 1 (1%) HGG [Figure 2].

Univariate analysis of conventional MRI characteristics revealed that TDLs, compared with HGGs, were significantly smaller, more likely to have regular and open rim enhancement and demonstrated significantly less associated mass effect and edema [Table 2, Figures 3-5].

TDLs were also more likely to have a T2 hypointense rim and a hypointense T1 signal [Table 2, Figures 5 and 6].

Using the aforementioned MRI characteristics described, high inter-rater reliability between radiologists was demonstrated. All demonstrated high interclass correlation coefficients [Table 3].

A logistical regression model was created using the clinicoradiological characteristics that would best differentiate TDLs from HGGs. The logistic regression model was statistically significant χ^2 (5) = 107.819, $P < 0.001$. The model correctly classified 88.5% of cases and correctly diagnosed TDLs 82.5% of the time. Using the regression coefficients from the logistical regression analysis, an equation that predicts patients who are more likely to have TDLs compared with HGGs based on the clinicoradiological characteristics in the model was created. It was then simplified to make it easy to work with and apply in the outpatients setting. Variables are binary except age, that is, female 1 and male 0,

Table 1: Demographic and clinical features characteristics.

Demographic	Total cohort (n=132)	HGG (n=91)	Tumefactive demyelinating lesions (n=41)	P-value
Mean age (years)	60	63	38	<0.001
Gender (>female)	70 (53)	39 (43)	31 (75)	<0.001
Acute presentation (%)	61 (46)	48 (53)	13 (32)	<0.001
Subacute/chronic presentation (%)	70 (53)	41 (47)	27 (66)	<0.001

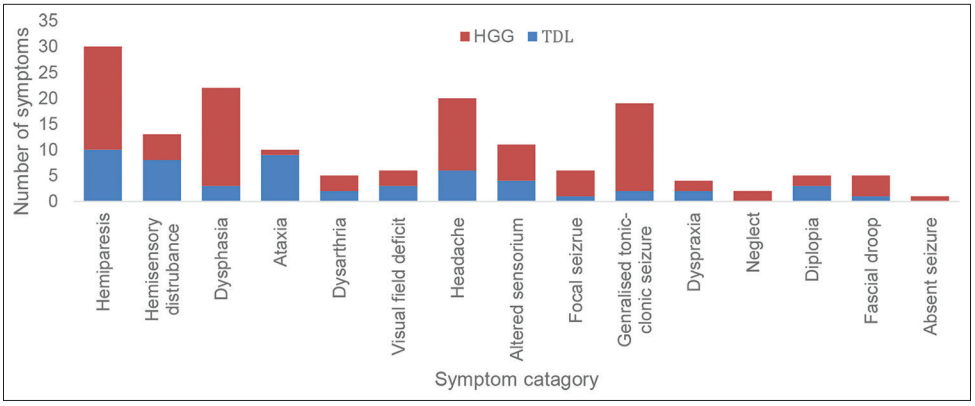

Figure 1: Symptom type at presentation.

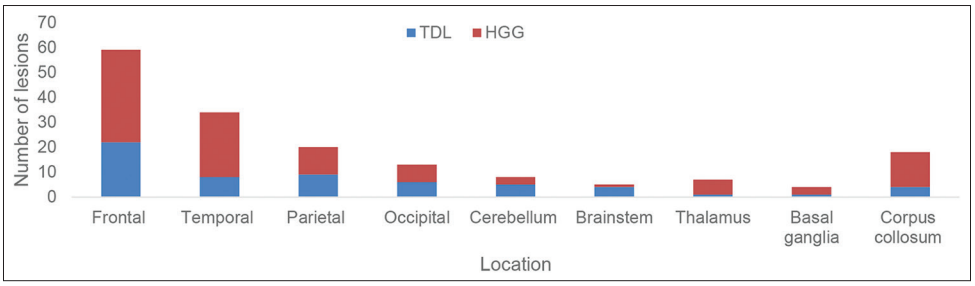

Figure 2: Location of lesions.

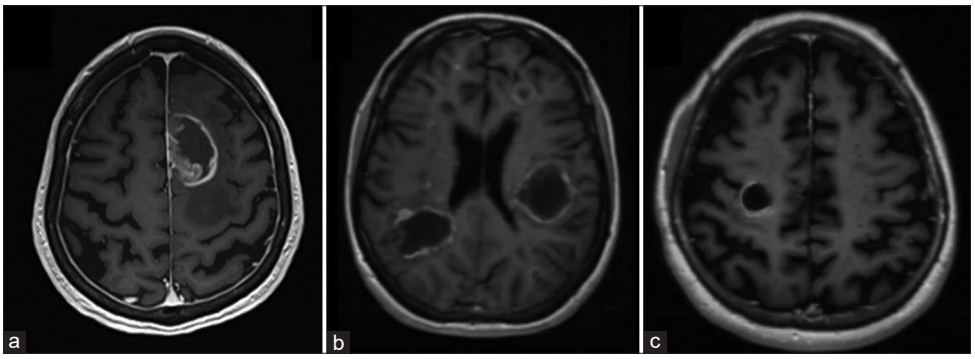

Figure 3: (a) Post contrast axial T1 MRI demonstrates irregular closed enhancement of a left frontal high-grade glioma with mild mass effect characterized by sulcal effacement without midline shift. (b) Post contrast axial T1 MRI demonstrates multiple lesions with the right parietal lesion demonstrating open rim enhancement. All lesions demonstrating no mass effect. (c) Post contrast axial T1 MRI demonstrates regular open enhancement of a right frontal TDL with no mass effect or edema.

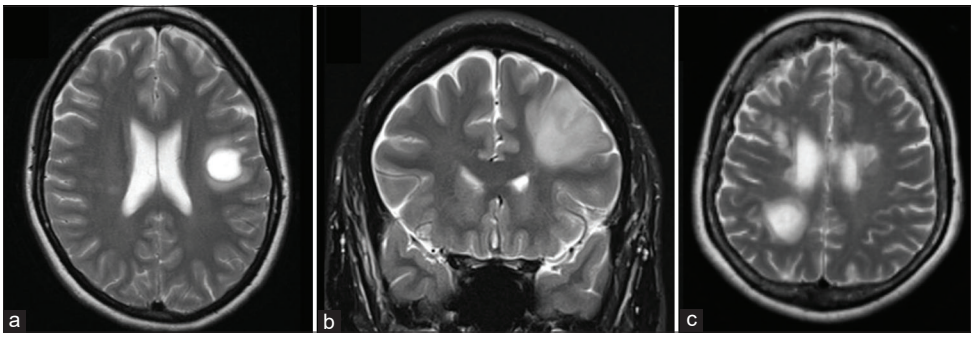

Figure 4: (a) Post contrast axial T1 MRI demonstrates close rim enhancement in a left occipital tumefactive demyelinating lesions (TDLs) with no mass effect or edema. (b) Post contrast axial T1 MRI demonstrates a close regular rim enhancement pattern in a right frontal TDL with minimal mass effect and no edema. (c) Post contrast axial T1 MRI demonstrates irregular closed rim enhancement pattern in a left temporal high-grade glioma with no mass effect.

presentation >7 weeks 1 and presentation <7 weeks 0, none to mild edema 1 and moderate to severe edema 0, and presence of T2 hypointense rim 1 and if absent 0. If x in the equation is positive, then the patient is more likely to have a TDL and if negative the patient is more likely to have an HGG.

Equation to predict TDL over HGG

(gender x 2) – (age x 0.05) + (presentation > 7 weeks x 2) + (none or mild edema x 5) + (T2 hypointense rim x 2) – 4 = x

Table 2: MRI characteristics.

Characteristic	Total cohort (*n*=132)	HGG (*n*=91)	Tumefactive demyelinating lesions (*n*=41)	*P*-value
Number of lesions (IQR)	1 (1–6)	1 (1–6)	2 (1–5)	<0.001
Mean size (mm)	39.9+16.6	42.0+16.2	27.4+14.3	<0.001
Open rim enhancement	13 (10)	1 (1)	12 (29)	<0.001
Regular enhancement pattern	22 (17)	4 (4)	18 (44)	<0.001
None or mild edema	54 (41)	27 (30)	27 (66)	<0.001
None or mild mass effect	65 (49)	29 (32)	36 (88)	<0.001
DWI restriction	54 (41)	45 (49)	9 (22)	0.004
Hypointense T1 signal	85 (64)	53 (58)	32 (78)	0.011
T2 hypointense rim	24 (18)	7 (8)	17 (41)	<0.001
Crossing corpus callosum	18 (14)	14 (15)	4 (10)	0.584

Diagnostic pathway in patients with suspected TDLs

Thirty-one (76%) patients with TDLs had other lesions characteristic of MS on the MRI brain (periventricular, juxtacortical, infratentorial, and spinal cord) [Figure 7]. Spinal cord MRI was performed in 35 (85%) patients, depicting spinal lesions classical of MS in 15 (43%) patients. Out of the 31 patients that underwent lumbar puncture (LP), 25 (81%) were positive for CSF-specific OCB.

Thirty-seven (90%) patients out of the cohort satisfied the McDonald criteria for the diagnosis of MS. For every patient in the cohort, it was their first presentation and therefore no patient satisfied the criteria by DIT clinically. In five patients that did not demonstrate lesions typical of MS, the presence of CSF-specific OCB satisfied the McDonald criteria. In three patients, the CSF was not examined. Only one patient who did not have lesions typical of MS on their whole neuraxis was negative for CSF-specific OCBs.

Chi-squared test between three variables (CSF-specific OCB, other lesions typical of MS on brain MRI, and spinal lesions on MRI) showed no correlation between the variables and that each variable was sufficiently independent.

CSF protein was elevated above 0.45 g/L in two patients to 0.62 g/L and in all patients, glucose was within normal limits (2.5–5.6 mmol/L). The occasional monocyte was seen in all patients. In 13 patients, the CSF was examined for aquaporin four antibodies and only 2 (15%) were positive. In the four patients, where the CSF was tested for myelin oligodendrocyte glycoprotein antibodies, all were negative.

Three patients underwent an FDG PET study, with only one case depicting mildly increased FDG avidity. FET PET was performed in one patient and the TDL did not demonstrate avidity.

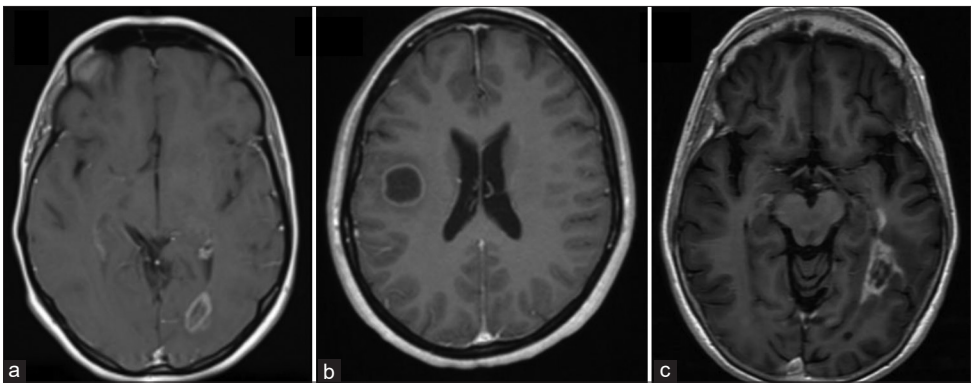

Figure 5: (a) Axial T2 FLAIR of a left frontal tumefactive demyelinating lesion (TDL) showing minimal perilesional edema. There are lesions characteristic of MS in the right periventricular region. (b) Axial T2 FLAIR in a high-grade glioma in the right temporal lobe with mixed T2 signal reflecting a combination of lesional necrosis, hemorrhage, and neovascularity. There is moderate perilesional edema. (c) Axial T2 MRI of a right frontal TDL demonstrating no neovascularity, minimal perilesional edema, and no mass effect.

Biopsy

Five patients underwent biopsy. The hematoxylin and eosin stains revealed foamy macrophage infiltrate and perivascular lymphocytic inflammation of the white matter. Luxol fast blue, myelin basic protein, and neurofilament protein stain revealed demyelination. Glial fibrillary acidic protein shows gemistocytic cells (reactive gliosis). Tumor markers such as isocitrate dehydrogenase 1 were not seen. No malignant cells or organisms were identified in any of the biopsies [Figure 8].

All biopsied patients in our cohort satisfied the McDonald criteria. Out of these five patients, four underwent LP and only two patients were positive for CSF-specific OCB. Reasons for biopsy in these cases were negative CSF-specific OCB, lack of awareness of TDL by the treating clinician, profound neurological deficit on presentation, and to rule out infection in one patient.

Management and outcome

Thirty-three (79%) patients were treated with intravenous methylprednisolone for 5–7 days, and one patient was treated with a course of oral steroids. Of the patients who received methylprednisolone, most (82%) showed a partial or significant improvement in their symptoms. Five (12%) patients showed complete resolution of their symptoms. One patient developed significant improvement despite no specific treatment.

DISCUSSION

Clinicoradiological diagnosis of TDLs

TDL shows a predilection for females and tends to occur in middle-aged individuals.[2,11,12,26] In contrast, HGG tends to be more common in the elderly and in males.[16] Our study found these demographic differences to be statistically significant with 75% of patients with TDL being female with a mean age of 38 years, compared with only 43% of patients with HGG being female with a mean age of 63 years. Using the demographic distinction can help in the diagnostic pathway in patients with suspected TDL and help in the differential diagnosis of TDL and HGG.

Symptomatology in TDLs is distinctly different to classical MS and more commonly seen in patients with HGG.[1,5,11,14] However, this study demonstrated distinctions in the presentation of TDL compared with HGG. TDL was significantly more likely to present as subacute or chronic whereas HGG presented acutely. There were also differences in symptom type as TDL more commonly presented with

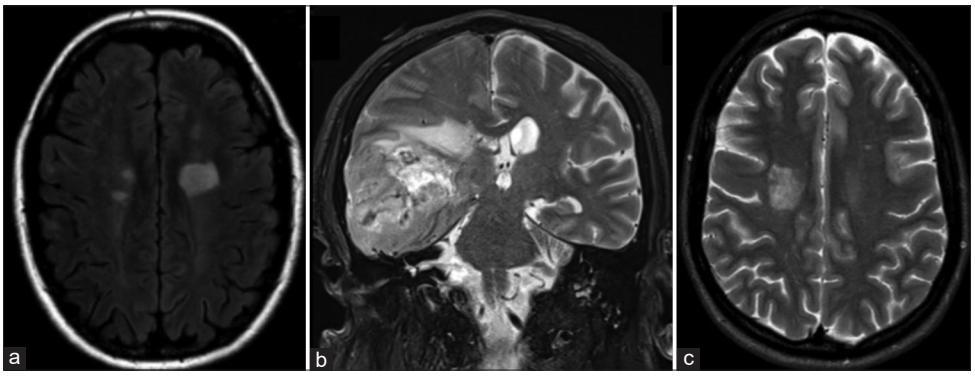

Figure 6: (a) T2 axial MRI demonstrates a T2 hypointense rim in a left frontal tumefactive demyelinating lesion (TDL) with mild edema and no mass effect. (b) T2 corona MRI demonstrates the absence of a T2 hypointense rim in the left frontal high-grade glioma. (c) T2 axial MRI demonstrates a 0–2 hypointense rim in a right parietal TDL with mild edema and mass effect.

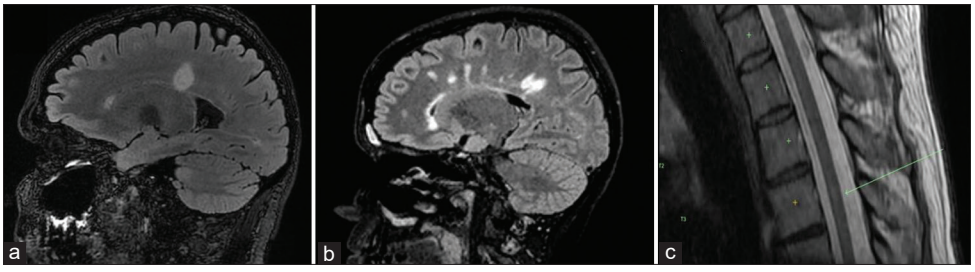

Figure 7: (a) FLAIR sagittal MRI demonstrates lesions typical of tumefactive demyelinating lesions (TDLs) periventricular lesions. (b) T2 FLAIR sagittal MRI demonstrates lesions typical of TDL and MS (Dowson's fingers). (c) T2 spine MRI demonstrates subtle T2 hyperintense lesion in the thoracic spinal cord typical of a patient with an TDL.

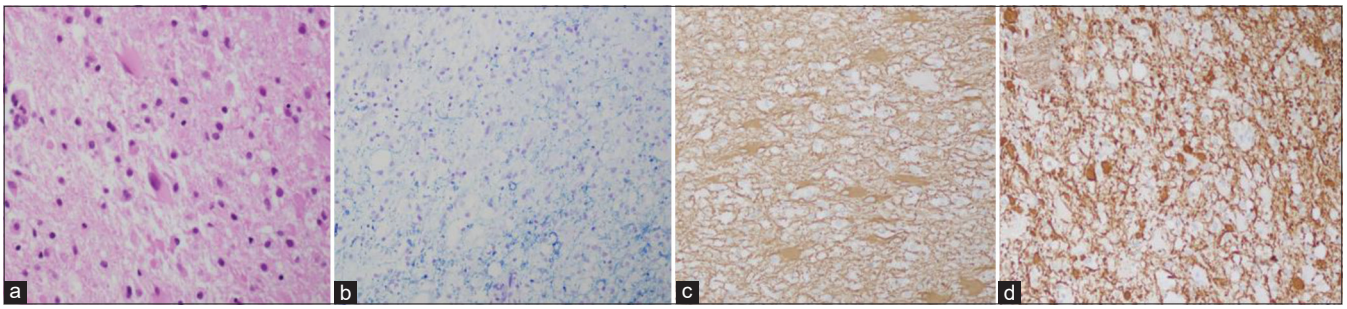

Figure 8: (a) H&E stain that demonstrates foamy macrophages with reactive gliosis. (b) Luxol fast blue stain that demonstrates the absent of myelin (blue). (c) Glial fibrillary acidic protein stain that demonstrates reactive gliosis (gemistocytes). (d) Neurofilament protein stain that demonstrates demyelination.

Table 3: Reliability of MRI characteristics.

n=132	$ICC_{2,1}$	95% CI	*P*-value
Number of lesions (IQR)	0.993	0.991-0.995	<0.001
Mean size (mm)	0.998	0.998-0.999	<0.001
Enhancement border	0.952	0.931-0.966	<0.001
Enhancement pattern	0.938	0.909-0.957	<0.001
Edema severity	0.951	0.931-0.966	<0.001
Mass effect	0.987	0.982-0.991	<0.001
DWI restriction	0.968	0.955-0.978	<0.001
T1 signal	0.986	0.980-0.990	<0.001
T2 hypointense rim	0.747	0.643-0.821	<0.001

ataxia, hemi-sensory disturbance, and diplopia, whereas GTC seizures and dysphasia were more common in patients with HGG. Previous research has found no difference in the presentation of patients with TDL and HGG,[9] but this study demonstrated significant differences in the presentation of both entities. This aids with differentiating between TDL and HGG, although the differences are not pathognomonic.

The most common imaging modality for both TDL and HGG is a conventional MRI.[11] This study showed that TDLs were statistically smaller, showed open rim enhancement, no or mild mass effect and associated edema, and a T2 hypointense rim. These conventional MRI characteristics were shown to be reliable and reproducible. The previous studies with limited numbers of TDL have shown these characteristics to help differentiate TDLs from other brain tumors including HGG.[8,10,13,23] We recommend clinicians use these specific MRI characteristics in routine practice when TDL is suspected, with such features prompting workup for TDL.

TDL and HGG both demonstrate a predilection for the frontal and temporal lobes, which is consistent with our findings in this study. Consequently, the locations do not add value when attempting to differentiate between TDL and HGG.[2,11,26] Other studies have shown utility in hypoattenuation of CT in areas of MRI enhancement and lower ADC values in TDL.[8,13] While these imaging modalities are useful in the diagnosis of TDL, they are not always examined in the first instance.

Diagnostic work-up of patients with suspected TDL

About 90% of patients met the 2017 McDonald criteria in our cohort. Out of these, 76% of patients had other lesions classical for MS on the MRI brain, including white matter lesions around the ventricles and juxtacortical, in the brainstem, and/or in the cerebellum.[26] About 43% of patients who had spine MRI in this series had MRI characteristics of MS at the time of the index event. The identification of demyelinating lesions in more than 2 different areas of the neuraxis supports the diagnosis of MS.[15,18] Therefore, the first step in the pathway should be to obtain an MRI of the whole neuraxis with contrast administration to look for lesions characteristic of MS.

A LP, to allow for CSF analysis, is a simple outpatient investigation that should accompany full imaging studies in patients with suspected TDL, if safe to do so. About 74% of patients with TDL were positive for CSF-specific OCBs. In the literature, CSF-specific OCB has been demonstrated in 30–80% of patients with TDL.[2,14] Importantly, in four patients who did not have lesions typical of MS, CSF-specific OCB helped satisfy the 2017 McDonald criteria and only one patient who did not have lesions typical of MS had CSF that was negative for OCBs.

CSF-AQP4 IgG has been shown to help diagnose NMO/NMOSD in patients with TDL.[19] It was positive in 15% of patients who were tested in our cohort and was not a major factor in differentiating TDL from HGG. This is most likely secondary to a limited number of patients being tested for CSF-AQP4 and also because all of our TDL cohort presented with brain TDL, whereas tumefactive spinal cord lesions are more common in patients with TDL secondary to NMO/NMOSD.[19] The utility of CSF-AQP4 in differentiating TDLs from HGG is worthy of further research.

FDG-PET and FET-PET were done on a limited number of patients in this cohort and did not help differentiate TDL from HGG. This is in part due to their cost, availability, and novelty in our centers for the work-up of TDL. As aforementioned,

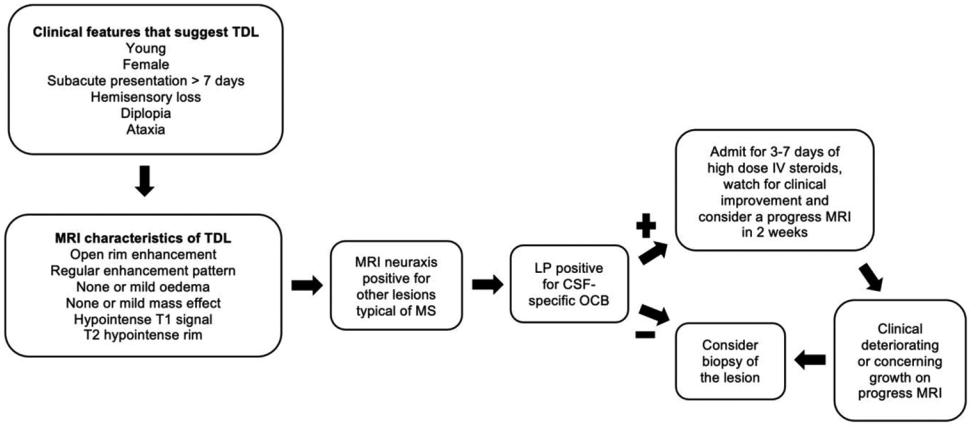

Figure 9: Preliminary pathway to diagnose tumefactive demyelinating lesions.

TDL has been shown to demonstrate avidity on FDG-PET and FET-PET secondary to hypercellularity and inflammation, thus resulting in false positives.[4] HGG may exhibit higher avidity on FET-PET compared with TDL, however, evidence is limited to case reports.[7] The utility of PET in the work-up of patients with suspected TDL may be better elucidated in the future.

Biopsy should be reserved for diagnostically challenging cases in which, despite the aforementioned investigations, the diagnosis of demyelinating lesion cannot be made. Should a pathological diagnosis be required, biopsy should ideally precede resection to give the patient the best chance at neurological preservation, especially when resection may result in permanent neurological deficits.[11]

Preliminary diagnostic pathway for patients with a suspected TDL

The findings of our study support further research into a pathway that will assist clinicians in the diagnosis of TDL [Figure 9]. Although this current study is not powered to investigate the diagnostic accuracy of this pathway, it should stimulate further investigation. The utility of this pathway and previous equation is also illustrated through a clinical case.

Case report

A 30-year-old, previously healthy female, presented with a three days history of right homonymous hemianopia. MRI revealed a 3 cm lesion in the left occipital lobe. The lesion demonstrated mild oedema, but no mass effect with a T2 hypointense rim. Open rim enhancement was depicted after contrast. Complete neuraxis imaging revealed no other lesions characteristic of MS. However, a LP confirmed CSF-specific OCBs. A seven day-course of 1g IV methylprednisolone was administered and the patient improved during the admission. A repeat MRI performed two-weeks later showed partial resolution of the rim enhancement. The patient has remained stable since.

Using the equation aforementioned
(1 x 2) – (30 x 0.09) + (0 x 2) + (1 x 5) + (1 x 2) – 4 = +2 which suggests she is more likely to have a TDL. She then went down the pathway to diagnose an TDL and was treated appropriately.

This prevented this patient from receiving radical resection of the occipital lobe mass, which would have likely caused a permanent visual defect.

Limitations

This study is limited by the retrospective design and data collection being dependent on medical records. Limitations of medical record review include chart ambiguity, omissions, and data entry error. An attempt to minimize these limitations was sought through a simple, exact, nonambiguous data collection tool, and an attempt to define ambiguous terms. This study did not analyze other neoplasms or infections that TDL could mimic and therefore cannot be generalized to this differential diagnosis. In an attempt to minimize the effect of selection bias secondary to comparing diseases with different incidences, a random selection of 91 patients from the SNOG database treated from 2014 to present was compared with 41 TDL accumulated in the same timeframe.

CONCLUSION

TDLs are an unusual manifestation of MS that shares a number of clinicoradiological features with HGGs. This has made TDL diagnosis historically difficult. This study demonstrates a clinicoradiological distinction between TDLs and HGGs. Specifically, a TDL is a more likely diagnosis in younger females presenting with subacute or chronic symptoms, with a lesion on MRI that demonstrates no to mild edema and a T2 hypointense rim. As demonstrated in the proposed diagnostic pathway, these features should prompt clinicians to image the whole neuraxis and perform a LP. If the MRI demonstrates other lesions typical of MS and the LP demonstrates oligoclonal bands, then the patient should undergo a short course of IV steroids. In patients who do not meet criteria for a trial of steroids, or in those patients who deteriorate despite steroid therapy, a biopsy should be considered. Adoption of this pathway is likely to minimize unnecessary resection, with its associated neurological sequelae.

Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

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Conflicts of interest

There are no conflicts of interest.

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