Egyptian Journal of Radiology and Nuclear Medicine

CASE REPORT Open Access

Collision tumours: a meningioma and not oedema, but an oligodendroglioma

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Abstract

Background Intracranial collision tumours represent a very rare entity. We hereby report a case involving the coexistence of a meningioma and an underlying oligodendroglioma in the adjacent brain, which could be misdiagnosed as oedema if not carefully examined for atypical changes. This study aimed to shed light on the diagnostic challenges associated with intracranial collision tumours, specifically the coexistence of meningioma and oligodendroglioma.

Case presentation A 54-year-old woman presented to the emergency department with seizures and vertigo. Brain CT revealed an expansile extra-axial left frontal lesion with calcifications and homogeneous enhancement after contrast administration, interpreted as a meningioma, with underlying vasogenic oedema. Two months later, MRI revealed a heterogeneous area in the underlying compressed brain with high intensity at T2/FLAIR sequences, initially misconceived as oedema. However, atypical features such as cortex involvement, lower ADC values (compared to vasogenic oedema), an inversion of the choline/NAA ratio, and high rCBV values led to the hypothesis of an underlying oligodendroglioma, later confirmed by histology.

Conclusions The coexistence of histologically different tumours in the same anatomical location is extremely rare and makes the diagnosis more challenging, requiring cautious evaluation and a high suspicion from the radiologist. The look for atypical findings, described in detail in this study, and the use of additional sequences, such as spectroscopy and perfusion, might be the key to the correct diagnosis.

Keywords Synchronous neoplasms, Meningioma, Oligodendroglioma, Brain tumours, Case report

Background

Meningiomas are the most frequent type of primary tumours in the central nervous system (CNS), accounting for approximately 36% of all intra-cranial neoplasms [1]. These lesions are often incidentally detected during CNS imaging and are typically slow-growing, non-malignant, extra-axial tumours with limited metastatic spread or local invasiveness. Meningiomas with benign characteristics and no mass effect may be managed conservatively through observation [1]. In imaging studies, with magnetic resonance imaging (MRI) being the gold standard, these tumours typically present as highly enhancing extra-axial masses with broad-base dural attachment and accompanying peritumoral brain oedema in 50 up to 78% of cases. This oedema is typically vasogenic with a high apparent diffusion coefficient (ADC) signal [1–3].

Oligodendrogliomas, on the other hand, account for only 5% of primary CNS tumours and most commonly occur in the brain, although they can occur at any location within the central nervous system [4, 5]. These tumours are well-characterized in MRI, often displaying a lower T1 signal than that of grey matter and a high heterogeneous T2 signal. Unlike haemorrhage, cystic

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degeneration, and peritumoral oedema, which are not frequent findings, the cortico-subcortical location and the presence of calcifications are reported as distinctive characteristics [5].

Collision tumours—meaning the coexistence of two tumours in the same anatomical region with distinct histologies—represent an exceedingly rare phenomenon [3, 4, 6–10]. The most frequently reported association is that of a meningioma and a glioma [6, 9].

Notably, the coexistence of a meningioma and an oligodendroglioma in such proximity poses a unique diagnostic challenge, as their synchronous appearance can alter the typical radiological features, potentially leading to misinterpretation.

The coexistence of different histologic tumours may change the proposed treatment and surgical approach, making its recognition of utmost importance (Figs. 1, 2, 3).

Our study addresses this diagnostic complexity by presenting a case involving the collision of a meningioma and an oligodendroglioma, emphasizing the importance of recognizing atypical radiological features. The case highlights the potential pitfalls in initial interpretation and underscores the need for advanced imaging techniques to facilitate accurate diagnosis and subsequent treatment planning.

By elucidating the diagnostic challenges and particularities associated with these rare collision tumours, our research aimed to contribute valuable insights to the radiologists.

Case presentation

We present the case of a 54-year-old woman, without previous relevant medical history, admitted at the emergency department with seizures followed by vertigo. The isolated seizure was treated with levetiracetam and never recurred. An EEG was not performed, and laboratory evaluation was unremarkable. Additionally, the neurological examination showed no abnormalities.

A brain computed tomography (CT) was performed, showing an expansile extra-axial left frontal lesion with calcifications and homogeneous enhancement after contrast administration, interpreted as a meningioma, with underlying hypodensity of the parenchyma described as vasogenic oedema.

After 54 days from the brain CT, an MRI was performed to better depict the described lesion characteristics, including the following sequences: Axial

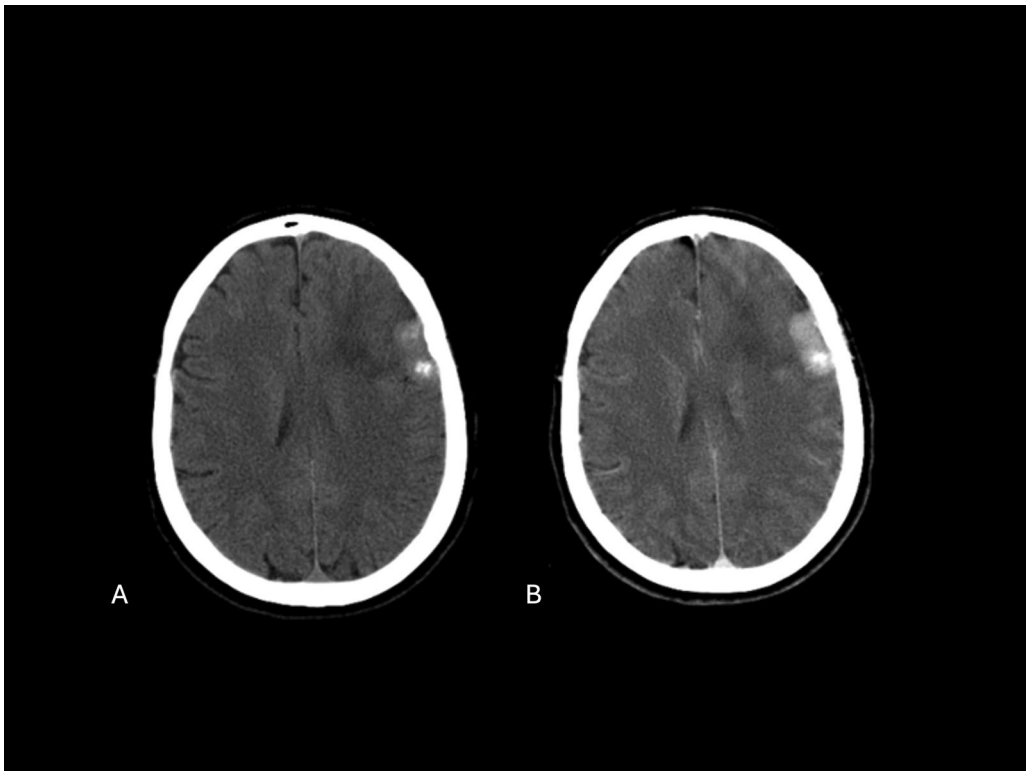

Fig. 1 A 54-year-old female, previously healthy, was admitted at the emergency department with seizures followed by vertigo. Brain CT axial images pre (**A**) and post-contrast (**B**), revealed an expansile extra-axial left frontal lesion with calcifications and homogeneous enhancement after contrast administration with underlying hypodensity of the parenchyma

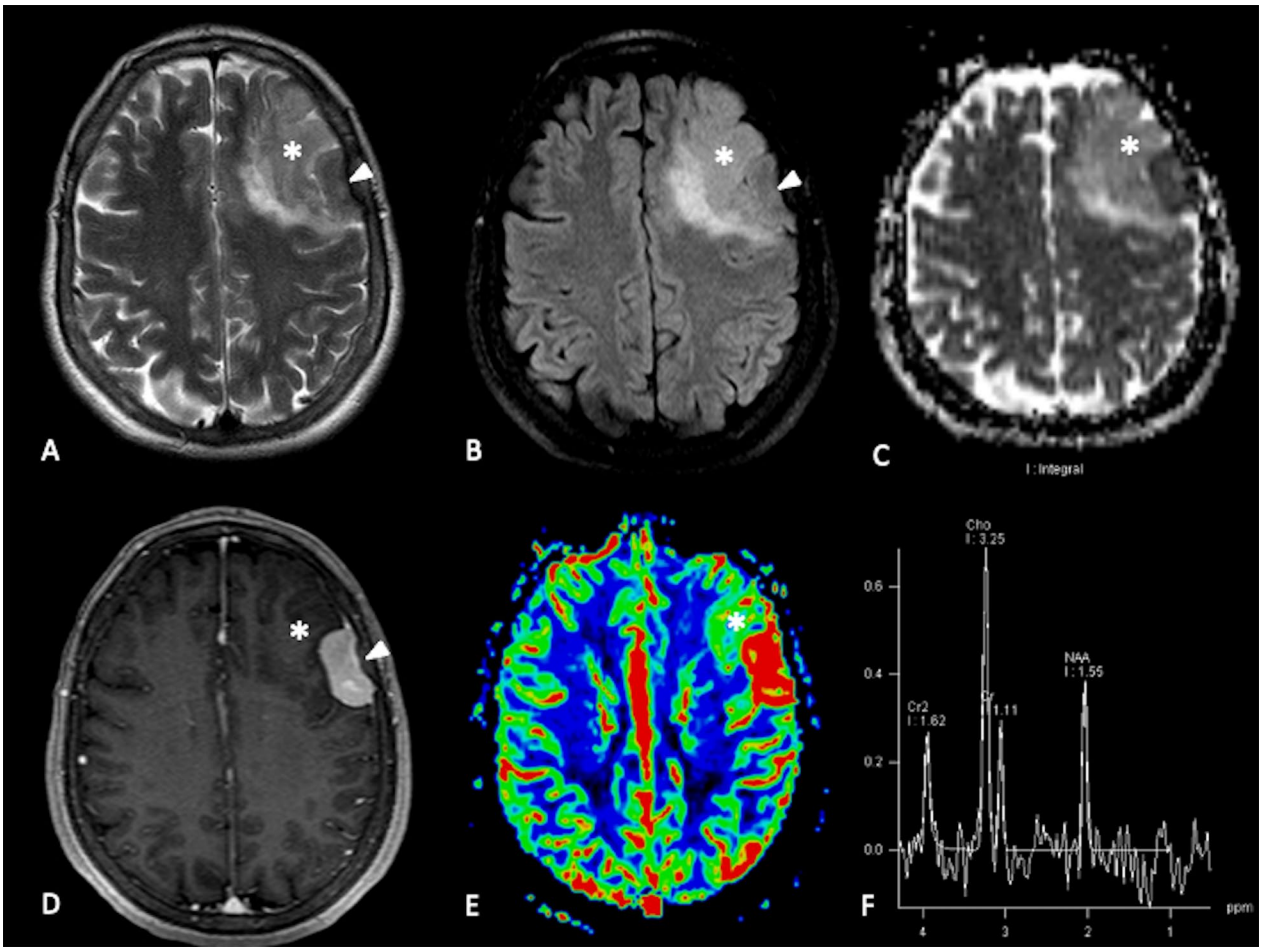

Fig. 2 MRI of the brain was performed using a 1.5 T scanner with the following sequences: **A** Axial T2-weighted imaging (T2WI), **B** Axial T2 FLAIR-weighted imaging (FLAIR), **C** Axial ADC map, **D** Axial T1WI with gadolinium, **E** DSC-perfusion imaging, **F** Multi-voxel spectroscopy with TE 135 ms. Axial T2WI and FLAIR images showed a frontal dural-based mass with a signal intensity similar to the brain parenchyma with strong homogeneous enhancement on T1WI with gadolinium (white arrowheads). On T2WI and FLAIR sequences, there was also a heterogeneous and hyperintense area on the underlying frontal brain parenchyma (*) with cortex affection and without facilitated diffusion. The perfusion imaging showed high rCBV values and the spectroscopy an inversion of the choline/NAA ratio with elevation of choline and NAA reduction

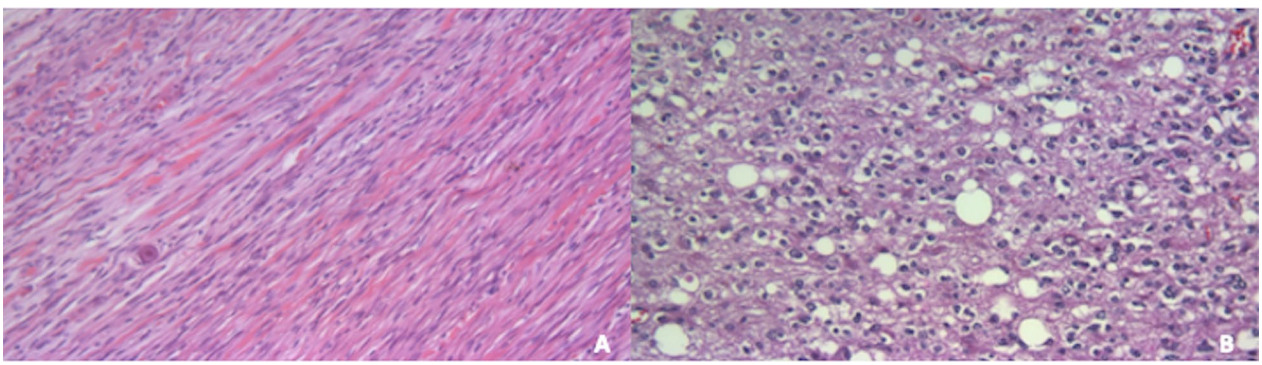

Fig. 3 Hematoxylin and Eosin (HE) staining ×200 (magnification) (**A** and **B**) **A** Fibrous meningioma, WHO Classification Grade I (of III). Elongated cells forming parallel or intersecting bundles with significant collagen fibers in-between. **B** Oligodendroglioma, IDH mutated and with 1p/19q codeletion, WHO Classification Grade II (of III). Glial neoplasm with infiltrative growth pattern, composed predominantly of cells with round and uniform nuclei, sometimes with peri-nuclear halo. There is focal nuclear atypia and rare figures of mitosis, as well as microcystic degeneration and reactive astrocytosis

T2-weighted imaging (T2WI) (TR 4500 ms, TE 121 ms, Thickness 5 mm, Matrix 320×250), Axial T2 FLAIR-weighted imaging (FLAIR) (TR 8500 ms, TE 84 ms, TI 2500 ms, Thickness 5 mm, Matrix 256×205), Axial ADC map (TR 4300 ms, TE 97 ms, Thickness 5 mm, Matrix 128×128), Axial T1WI with gadolinium (TR 1180 ms, TE 3.43 ms, TI 600 ms, Thickness 2 mm, Matrix 320×272), DSC-perfusion imaging (TR 1830 ms, TE 51 ms, Thickness 5 mm, Matrix 128×128), Multi-voxel spectroscopy with TE 135 ms. This study confirmed a frontal dural-based mass with a signal intensity similar to the brain parenchyma on T1 and T2-weighted imaging (WI) and a strong homogeneous enhancement after gadolinium, compatible with a meningioma. Additionally, the underlying compressed brain parenchyma revealed a heterogeneous area with high intensity on T2/FLAIR images, initially misconceived as oedema. However, a second look at the MRI revealed atypical features in the supposedly peritumoral brain oedema area, such as cortical involvement and ADC values not compatible with vasogenic oedema (without facilitated diffusion), even though there was no gadolinium enhancement. Spectroscopy showed in this area an increased choline peak, with an inversion of the choline/N-acetylaspartate (NAA) ratio, and the perfusion study revealed high relative cerebral blood volume (rCBV) values. The combination of these characteristics was interpreted by an oncology-dedicated neuroradiologist (8-year experience), as corresponding to a tumoral lesion underlying the typical meningioma, most probably representing an oligodendroglioma.

Surgery was performed with excision of both tumoral lesions, and subsequently, the histological results confirmed that the extra-axial lesion was a grade 1 meningioma, and the intra-axial lesion was a glial tumour isocitrate dehydrogenase (IDH) mutated with 1p/19q codeletion, compatible with an oligodendroglioma.

Discussion

We described an extremely rare case of intracranial collision tumours coexisting in the same anatomical location with very misleading radiological features that could have hidden the presence of one of the tumours.

Collision tumours are an extremely rare finding, defined as the coexistence, in the same anatomical region, of two tumours with different histologies. Previous studies have underscored the diagnostic and therapeutic challenges posed by collision tumours. In the CNS, the most frequently reported association is that of a meningioma, a very common intracranial tumour, and a glioma [3, 4, 6–10].

The unexpected coexistence of different tumours in the same location may change their appearance and make the diagnosis more challenging, as in the reported case.

Our study aimed to advance the understanding of intracranial collision tumours, particularly the interplay between meningiomas and oligodendrogliomas. By dissecting the diagnostic intricacies and emphasizing the significance of recognizing atypical radiological features, our work contributes to refining diagnostic approaches, with consequences in treatment strategies, for these rare entities.

In the reported case, the location of the oligodendroglioma in the frontal lobe adjacent to the typical meningioma camouflaged it as vasogenic oedema in the initial interpretation. However, atypical aspects in this area were the clue to the correct diagnosis, namely, its extension to the brain cortex, heterogeneity, and low ADC values.

The application of advanced imaging techniques might play a pivotal role in distinguishing tumours from non-tumoral lesions, as it did in our case study [11–13]. Additionally, these techniques prove beneficial in differentiating and grading tumours, as well as in the post-treatment follow-up of patients. Spectroscopy and perfusion valuable roles in the initial diagnosis of brain tumours consist in aiding in the distinction between primary CNS tumours and potential mimics, including metastatic disease, lymphoma, demyelination, and infection [11–13]. Accordingly, the utilization of MRI with spectroscopy and perfusion studies allowed, in our case, for a more comprehensive evaluation of these mentioned atypical features within the peritumoral area. Spectroscopy revealed an increased choline peak and an inversion of the choline/NAA ratio, providing additional evidence of an underlying oligodendroglioma. Moreover, perfusion studies demonstrated elevated rCBV values, further supporting the presence of an additional tumoral lesion.

However, it is crucial to acknowledge the inherent limitations of these imaging techniques. Spectroscopy, while valuable in providing metabolic information, may encounter challenges such as the metabolic profile overlap between different lesions (neoplastic and non-neoplastic), the frequent presence of artifacts and noise, the susceptibility effect of air and bone which limit the study of adjacent regions and the difficulty of studying a small lesion within a large voxel [11]. Similarly, perfusion studies, while offering insights into vascular characteristics, must be interpreted cautiously, considering factors such as it provides relative data, its high sensitivity to regional field inhomogeneities with potential artifacts and the potential leakage effect due to blood–brain barrier disruption [13]. Additionally, variations in equipment and imaging protocols can impact the reproducibility and generalizability of spectroscopic and perfusion findings. Despite these limitations, advanced MRI techniques are invaluable for studying brain tumours, providing crucial

information for their diagnosis and differentiation from other pathologies.

The depiction of a second synchronous neoplasms required a different treatment and surgical approach, and totally changes the survival expectancy and follow-up.

For the radiologist, knowing and recognizing the existence of collision tumours is mandatory, despite their rarity, since their correct diagnosis implies different approaches and disease courses. In addition, even in the presence of a typical and common lesion such as a meningioma, the close look and recognition of atypical features, as we described in the adjacent brain, must motivate a more careful evaluation of those lesions and the employment of advanced techniques, as spectroscopy and perfusion.

Conclusions

In conclusion, we reported an extremely rare case of an oligodendroglioma in the brain parenchyma underlying an extra-axial meningioma, initially posing as vasogenic oedema, a typical finding in these extra-axial lesions with mass effect. The coexistence of two neoplastic lesions in the same anatomical location amplifies the diagnostic challenge, necessitating meticulous evaluation and a high degree of suspicion from the radiologist. Despite the limitations of advanced MRI techniques, they play an indispensable role in studying brain tumours, adding essential diagnostic information and differentiating these from non-tumoral lesions. The recognition and understanding of collision tumours are critical for guiding appropriate clinical interventions and optimizing patient outcomes.

Abbreviations

ADC	Apparent diffusion coefficient
CNS	Central nervous system
CT	Computed tomography
IDH	Isocitrate dehydrogenase
MRI	Magnetic resonance imaging
NAA	N-acetylaspartate
rCBV	Relative cerebral blood volume
WI	Weighted imaging

Acknowledgements

Not applicable

Author contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by GGL and DJP. The first draft of the manuscript was written by GGL and DJP and all authors reviewed and commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Funding

No funding was received for conducting this study.

Availability of data and materials

Not applicable.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Received: 13 November 2023 Accepted: 25 January 2024
Published online: 07 February 2024

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