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CASE REPORT

Central Neurocytoma of the Fourth Ventricle: a Patho-radiological Correlation

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ABSTRACT

Central neurocytoma is an uncommon neuronal tumour that usually originates from the lateral ventricle or septum pellucidum. We present a rare case of central neurocytoma arising from the fourth ventricle and compare its imaging features with those of 6 other cases described in the literature. This report attempts to correlate the imaging with the pathological findings of the tumour, with an emphasis on immunohistochemistry as a means of establishing the diagnosis.

Key Words: *Cerebral ventricle neoplasms; Fourth ventricle; Immunohistochemistry; Magnetic resonance imaging; Neurocytoma*

中文摘要

第四腦室中樞神經細胞瘤：病理學與放射學的相互關係

何東瀚、蘇銳新、吳恆堅

中樞神經細胞瘤是一種罕見的腦內神經腫瘤，通常起源自側腦室或透明隔。本文報告一宗第四腦室中樞神經細胞瘤，並將此病例與文獻報導的其餘六個病例的影像學特徵作比較。本文討論中樞神經細胞瘤的病理學與放射學的相互關係，並強調免疫組織化學技術可為此病的診斷提供依據。

INTRODUCTION

Central neurocytoma (CN) is a rare benign tumour of neuronal origin that typically affects young adults and arises from lateral ventricle or the septum pellucidum.[1-3] Since it was first described by Hassoun et al in 1982,[4] more than 450 articles about it have been published. It has a good prognosis; after complete surgical excision, its 5-year survival exceeds 90%.[5-7] Patients with CN usually present subacutely with symptoms of raised intracranial pressure secondary to obstructive hydrocephalus (headache, nausea, vomiting, and gait disturbances). We describe an unusual case of CN originating from the 4th ventricle with peri-tumoural haemorrhage that presented with acute neurological deterioration. We also summarise other cases of CNs arising from the 4th ventricle reported in the literature and attempt to correlate imaging features with gross histopathology.

CASE REPORT

A 30-year-old woman presented to emergency with acute onset of severe occipital headache in April 2005. She was intubated due to decreasing level of consciousness. Non-contrast cranial computed

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tomography (CT) demonstrated a rounded homogenous mass of 2 cm in diameter in the 4th ventricle. This appeared to have resulted in hydrocephalus for which urgent decompression was carried out by insertion of an extraventricular drain. Magnetic resonance imaging (MRI) revealed the intraventricular mass with mixed but predominantly high signals in T2-weighted sequences. The lesion showed mild contrast enhancement (Figure 1). Marked T2* shortening was seen in the adjacent ventricular wall, indicating recent haemorrhage (Figure 2). Provisionally the lesion was diagnosed as an ependymoma and excised through a suboccipital approach.

The tumour consisted of uniform round cells with clear cytoplasm but without necrosis or mitosis; it resembled an oligodendroglioma (Figure 3a). The cells were arranged in sheets within a vascular fibrillary stroma (Figure 3b) showing extensive haemorrhage (Figure 3c). The cells displayed strong immunoreactivity for synaptophysin (Figure 4a) and chromogranin, as well as some glial fibrillary acid protein (GFAP) staining (Figure 4b) and a low proliferative Ki-67 index (<2%) [Figure 4c]. Thus, the pathological diagnosis was CN.

DISCUSSION

CN is a World Health Organization grade II[8] neuronal tumour in the central nervous system (CNS) first described and distinguished from oligodendroglioma using electron microscopy by Hassoun et al in 1982.[4] Although often regarded as rare (0.1-0.5% of all CNS neoplasms),[1,2,5,6,9] we have noted over 350 cases of CNs, and its variants have been reported in PubMed since the 1980s.

Typically, CN has no gender predilection, and occurs in the 2nd to 3rd decade[1,10-12] (as in our case), but many present later[13-15] and are possibly associated with a worse prognosis.[16] The majority are located in the lateral ventricles, septum pellucidum, and foramen of

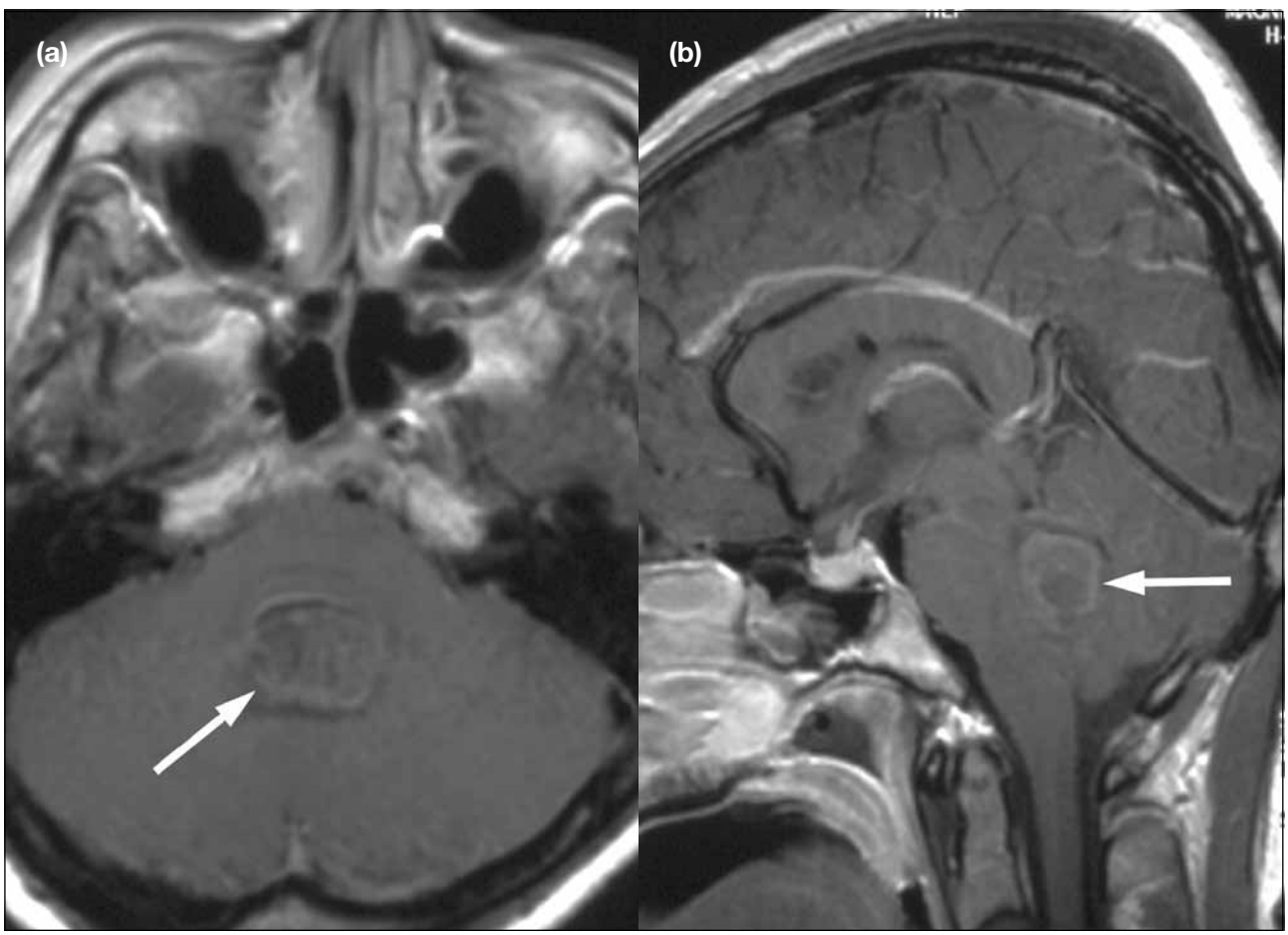

Figure 1. (a) Axial and (b) sagittal post gadolinium T1-weighted magnetic resonance images showing mild enhancement of the 4th ventricular lesion.

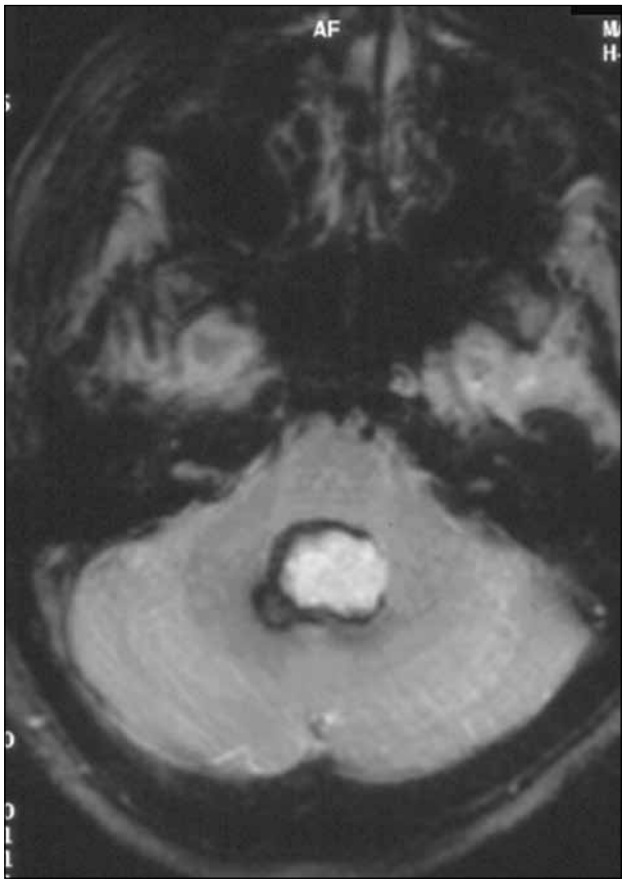

Figure 2. Axial T2-weighted fast-low angle shot magnetic resonance image demonstrating hyperintense mass surrounded by markedly hypointense T2* signal indicating haemorrhage.

Monro,[1,17-21] but increasingly extraventricular[22] and even extracranial[23] locations are being reported. To date, there have been 6 cases of CN occurring in the 4th ventricle,[24-30] and our case can be considered the 7th. The clinical and radiological features of these cases are summarised in the Table.

The origin of CNs remains controversial. They are thought to arise from cells in the periventricular matrix that are either committed to a neuronal or to both neuronal and glial differentiation.[16,31] A rare case of pigmented CN was most intriguing.[21] Electron microscopy reveals prominent mitochondria, thin cell processes, dense core neurosecretory vesicles, and well-formed synapses consistent with neuronal differentiation.[4,20,32]

Light microscopy reveals uniform small rounded cells, with central nuclei and clear cytoplasm within a fibrillary stroma; mitoses, vascular proliferation, and necrosis are typically absent[4,16,19,32-34] and there is a low

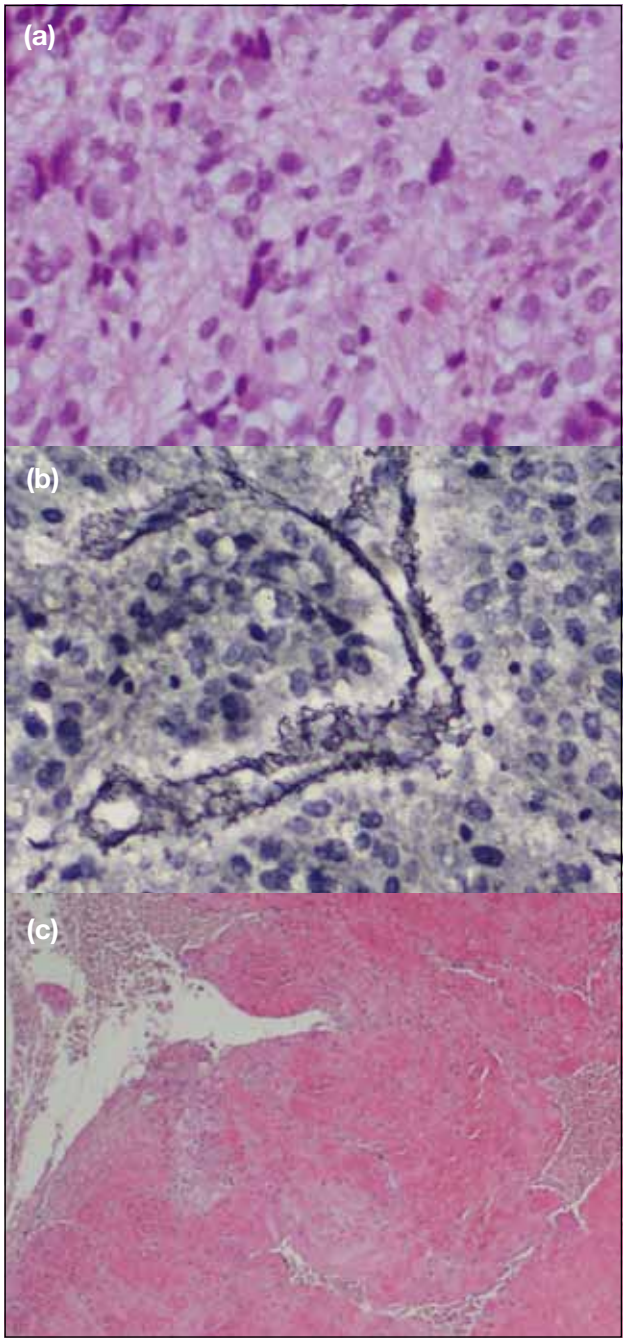

Figure 3. Histopathological specimen showing (a) characteristic sheets of round cells with no calcifications, necrosis, mitoses, or anaplastic features (haematoxylin and eosin stain; original magnification, x 200); (b) vascular stroma (reticulin stain; original magnification, x 200); and (c) extensive haemorrhage (haematoxylin and eosin stain; original magnification, x 20).

Ki-67 proliferative index of less than 2%. Atypical CN subtypes have an index of more than 2%.[35] Our case and 4 of the 6 cases of 4th ventricular CN had a Ki-67 index of less than 2%. The differential diagnosis of this "clear cell" appearance includes: oligodendroglioma, clear cell meningioma, and clear cell ependymoma. Given

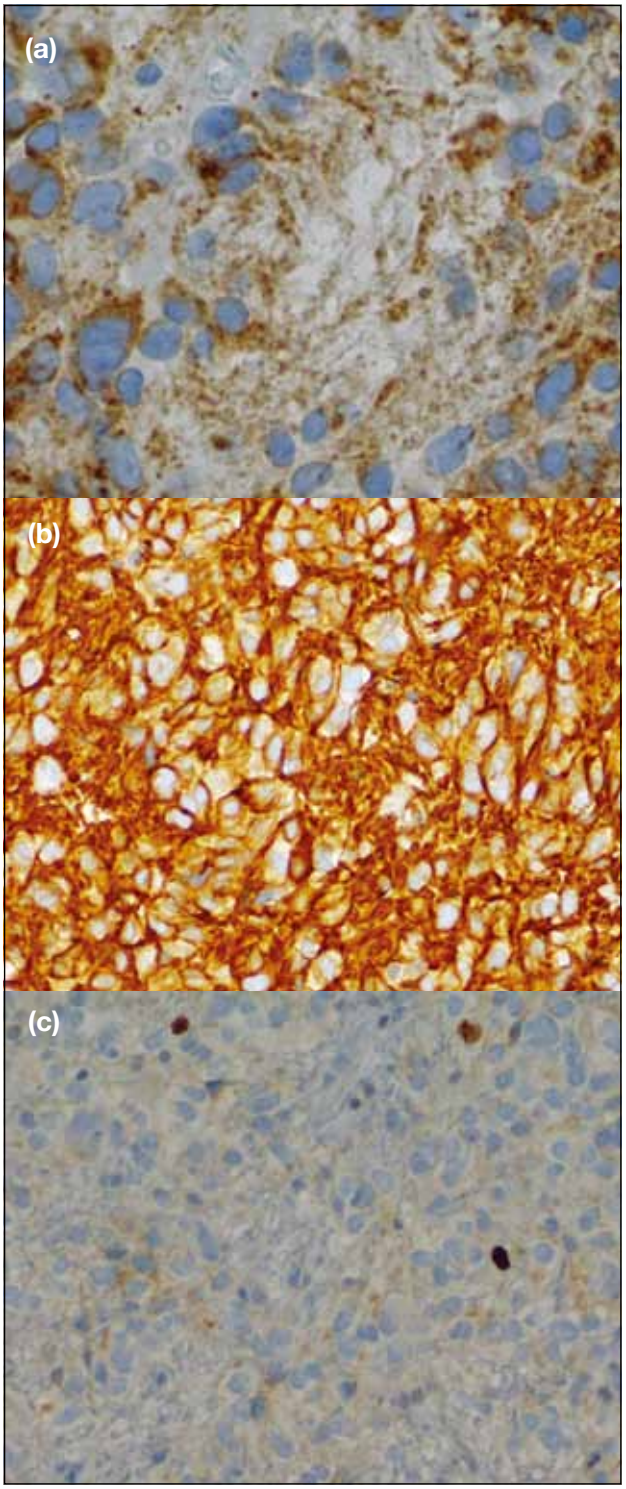

Figure 4. Immunohistochemistry stains demonstrating (a) diffuse synaptophysin immunoreactivity indicating the tumour's neuronal origin (original magnification, x 200); (b) mild glial fibrillary acid protein immunoreactivity indicating its glial origin (original magnification, x 200); and (c) low Ki-67 proliferative marker (<2%) [original magnification, x 100].

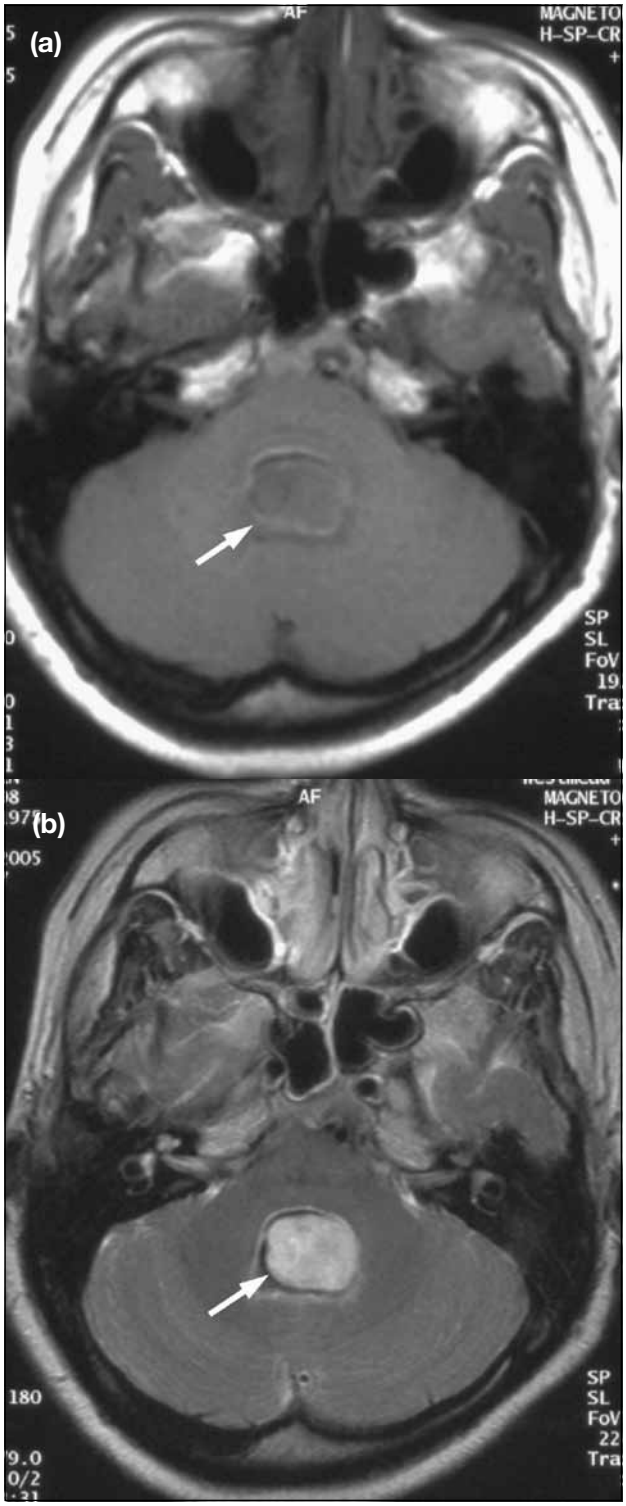

Figure 5. Axial (a) T1-weighted (a) and T2-weighted magnetic resonance images showing respectively isointense T1 and hyperintense T2 signal characteristics of the 4th ventricular lesion.

their neuronal origin, there is a strong immunoreactivity with synaptophysin and neuronal specific enolase[1,2,36] (as occurred in our case and 5 of the 6 aforementioned cases), in contrast to oligodendrogliomas, which are of glial origin. Recently, NeuN was found to be a reliable

Table. Summary of the current and previous cases of central neurocytoma arising in the 4th ventricle.

Study	Age (years)	Sex	Presentation	Size (cm)	Computed tomography	MRI			Outcome
						T1-W	T2-W	Gad	
Current case	30	F	Acute severe headache; decreasing level of consciousness	2	Isodense with surrounding haemorrhage; hydrocephalus	Iso	High	Mild	Complete resection; lost to follow-up
Böhm et al,[25] 2006	8	M	Acute deterioration in vision during chemotherapy for leukaemia	2.5	Heterogeneous density; calcification; hydrocephalus	Iso	High	No	Incomplete resection; small residual tumour at 6 months
Cultrera et al,[26] 2005	28	M	1 month of diplopia and gait disturbance	2	N/A	N/A	N/A	Moderate	Complete resection; no recurrence at 1 year
Gallina et al,[27] 2005	68	F	Decreasing level of consciousness	N/A	Calcification; hydrocephalus; intralesional haemorrhage	N/A	N/A	Mild	Complete resection; improving cranial nerve palsies at 6 months
Cook et al,[28] 2004	58	F	Headache, nausea, nystagmus, impaired gait	1.5	N/A	N/A	N/A	Mild	Incomplete resection followed by radiotherapy; asymptomatic at 4 months
Hsu et al,[29] 2002	35	M	2 months of headache and blurred vision and papilloedema	N/A	Slightly enhanced lesion hydrocephalus	Low	High	Mild	Complete resection; no follow-up data
Warmuth-Mets et al,[30] 1999	17	M	3 years of neck pain, headache and slight ataxia, visual disturbances and papilloedema	N/A	Homogenous hyperdense with irregular calcification; hydrocephalus	Iso	High	Moderate	Incomplete resection followed by radiotherapy; regression of tumour and improvement of symptoms at 4 months

Abbreviations: MRI = magnetic resonance imaging; T1-W = T1-weighted; T2-W = T2-weighted; Gad = gadolinium enhancement; Iso = Isointense; N/A = not available.

neuronal marker.[37] However, some CNs also stain positive to GFAP (as in our case), and the presence of neurofilaments indicates a glial origin from the bipotential cells. Unlike CN, both clear cell meningioma and ependymoma react to epithelial membrane antigen.

Macroscopically, CN is greyish in colour, ranging from soft to gritty in consistency with focal calcification and haemorrhage.[10,38]

The patho-radiological correlation of CN is readily apparent. Being of neuronal origin, the tumour is often isodense to grey matter on CT,[4,17-19,39] isointense to cortex on T1-weighted and hyperintense on T2-weighted MRI,[4,6,18] as in our case (Figure 5). This was also noted in 3 of the 6 already-mentioned cases of 4th ventricular CN, if such information is available. Intratumoural calcification is seen as high densities in CTs and signal voids in MRIs. The presence of micro- and macro-cysts results in a heterogeneous appearance.[4,38-40] This feature is typical of CN arising from the septum pellucidum/lateral ventricle, but was not seen in our case. However, 3 of the 6 cases arising from the 4th ventricle showed calcification on CT, and an equal number had cystic components on MRIs. The tumour is often lobulated but well demarcated,[17,20] as in our case and in the other 6 cases; their size is 3 cm or smaller in diameter, given their location in the relatively small 4th ventricle.

Although the tumour is often vascular on microscopy, commonly there is only mild-to-moderate enhancement with contrast,[4,6,18,19] as in most of the 6 cases. However, post-gadolinium enhanced MRIs often reveal their origin from the septum pellucidum in typical CNs.[3,41] Intralesional or peritumoural haemorrhage is uncommon; our patient being the 2nd case of bleeding into the 4th ventricle after that reported by Gallina et al.[27]

Although there were no pathognomonic features to distinguish CN from intraventricular oligodendroglioma

on CT and MRI, current research with MR spectroscopy indicated that CN produces a typical glycine peak at 3.55 parts per million, which may be an aid in pre-surgical diagnosis.[42] The radiological differential diagnosis of a 4th ventricular tumour includes medulloblastoma, ependymoma, and pilocytic astrocytoma.

CONCLUSION

CN is an uncommon neuronal tumour of the CNS and even more rarely arises from the 4th ventricle. However, given its good prognosis, distinguishing it from malignant tumours is crucial. Recognising its imaging features is important. The diagnosis is ultimately dependent upon histopathology and immunohistochemistry.

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