OPEN ACCESS

Rare intravascular large B-cell lymphoma (IVLBCL) can cause atypical intracerebral haemorrhage and mislead diagnostics

Clemens Oerding ,[1] Olaf Niederstrasser,[1] Ingmar Kaden,[2] Adina Lepadatu,[3] Eberhard Sorge,[4] Daniel Bethmann,[5,6] Kai Wohlfarth,[1] Anja Harder[4,6,7]

[1]Department of Neurology, BG-Hospital Bergmannstrost, 06112 Halle (Saale), Germany
[2]Institute of Radiology and Neuroradiology of Radiology, BG-Hospital, Bergmannstrost, 06112 Halle (Saale), Germany
[3]Institute of Neuropathology, University Medical Center, 55131 Mainz, Germany
[4]Cure NF Research Group, Medical Faculty, Martin Luther University Halle-Wittenberg, 06108 Halle (Saale), Germany
[5]Institute of Pathology, Sana-Klinikum, Berlin-Lichtenberg, 10365 Berlin-Lichtenberg, Germany
[6]Institute of Pathology, Faculty of Medicine, Martin Luther University Halle-Wittenberg, 06120 Halle, Germany
[7]Institute of Neuropathology, University of Münster, 48149 Muenster, Germany

Correspondence to
Clemens Oerding;
clemens.oerding@bergmannstrost.de

KW and AH are joint senior authors.

Accepted 21 August 2024

To cite: Oerding C, Niederstrasser O, Kaden I, *et al*. *BMJ Case Rep* 2024;**17**:e260498. doi:10.1136/bcr-2024-260498

SUMMARY

Intravascular large B-cell lymphoma (IVLBCL) is a rare type of non-Hodgkin's lymphoma. Common neurological symptoms are cognitive impairment and dementia. Only a few cases have been published reporting intracranial haemorrhage due to IVLBCL. We present a case of a female patient in her late 60s who presented with an atypical intracerebral haemorrhage as the first major complication of an IVLBCL. The patient's condition declined rapidly. She died several weeks later due to haemorrhagic shock. The definitive diagnosis was achieved postmortem. Due to aggressive disease progression, the diagnosis of IVLBCL is still challenging and can therefore lead to incorrect or delayed treatment, especially in cases of unusual manifestations like lobar intracranial haemorrhage.

BACKGROUND

Intravascular large B cell lymphoma (IVLBCL) is a rare and aggressive extranodal large B cell lymphoma. The disease is characterised by the selective growth of lymphoma cells within the lumen of vessels,[1] affecting specifically capillaries and other small vessels.[2] The incidence of IVLBCL is reported to be less than one person per million.[3] Neurological manifestations of IVLBCL are common; central nervous system (CNS)-related symptoms have been described to occur in 27 up to 42% of affected cases,[1 4] which demonstrated that the CNS is the most frequently involved organ according to at least one case series.[1] Due to the occlusion of small vessels, IVLBCL affects the CNS mainly through ischaemic injury. Most patients exhibit cognitive impairment, dementia, paralysis and visual disturbances.[1 4] The clinical presentation depends on the affected location. Both meninges and all CNS regions can be involved, including the myelon. An extensive manifestation of cranial nerves was reported recently.[5] Diagnostics are highly challenging. Symptoms can also be misleading: cases presented with embolic cerebral lesions, demyelinating disease, cerebral autosomal dominant arteriopathy with subcortical infarcts and leucoencephalopathy[3] or early deafness.[6] Mimicry of CNS vasculitis has been described several times.[7 8] Interestingly, cerebral lobar haemorrhage is very rare among the presentations and is reported only infrequently.[9–11]

CASE PRESENTATION

A woman in her late 60s presented to the emergency room with a sudden onset of palsy of the left side, including the face, arm and leg. She was in a soporous state, showed an incomplete conjugate gaze palsy to the left side and had a positive Babinski's sign on the left side. Prior to that event, the patient's medical history was unrevealing. There was no sign of cognitive or physical decline during the months before admission to the hospital. A CT scan of the brain revealed a large haemorrhage of the right frontoparietal lobe (figure 1A). During surgical removal of the haemorrhage, a small superficial biopsy of the haemorrhage and meninges was performed, which was suspicious for a-beta-related angiitis by histological analysis. This suspected diagnosis is based on the report of mononuclear cell infiltrates, CD4- and CD8-positive T cells and only sporadic CD20-positive B cells within the wall of vessels. Beta-amyloid was detected in the vessel's walls in a spotted distribution. No tumour

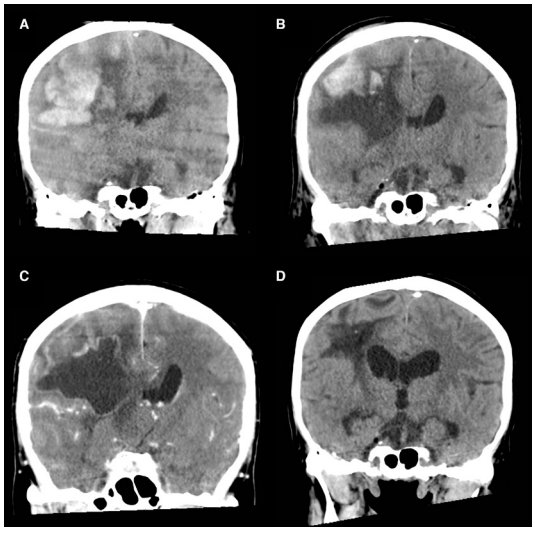

Figure 1 Presurgery and postsurgery CT scans. A CT scan on the day of hospital admission showing a large right-sided lobar haemorrhage causing a midline shift (A). CT scan performed 6 days after the initial imaging and after surgical evacuation of the haemorrhage leaving a relatively large oedema, mass effect and constant midline-shift (B). Contrast-enhanced CT scan 16 days after evacuation of the haematoma showing a more cystic lesion with a constant mass effect and a marginal contrast agent enhancement (C).CT scan performed 2.5 months after the initial imaging showing a shrinking transformation of the cystic lesion, leaving an area of gliosis with an atypical finger-shaped morphology (D).

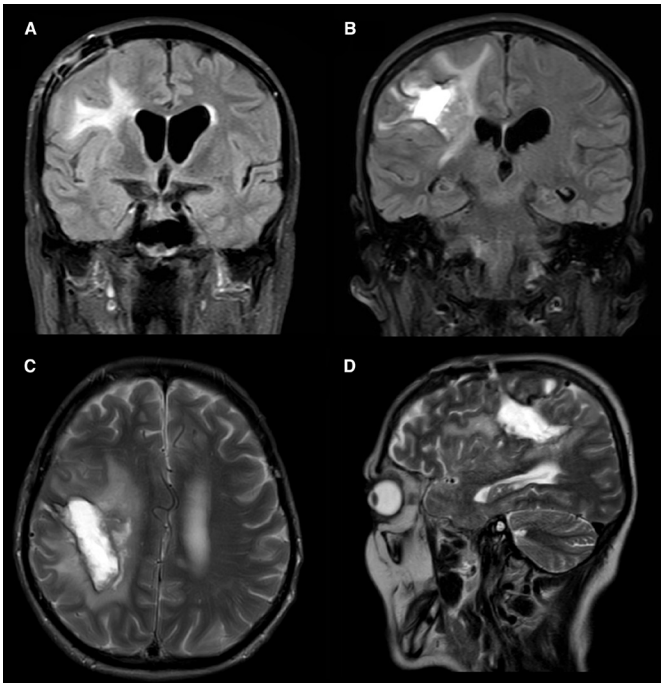

Figure 2 Postsurgery MRI analysis. MRI performed 1 month after hospital admission, showing residual gliosis around the evacuated right-sided frontoparietal haemorrhage (A and B: coronal view of fluid-attenuated inversion recovery imaging; C: axial T2 imaging and D: sagittal T2 imaging). The finger-shaped morphology is unusual.

cells were reported. Conventional angiography showed normal vessels. The patient recovered quickly and regained a larger part of the activities of daily life. Further CT scans and MRI showed a marginal contrast agent enhancement and shrinking transformation of the cystic lesion ((figure 1B-D and figure 2A-D). About 3 months later, her status suddenly declined. Within the course of several days, she demonstrated reduced vigilance as a major sign. MRI showed new disseminated hyperintense T2-lesions in the left basal ganglia, brainstem and cerebellum, as well as in the hemispheres close to the cortex (figure 3). The left basal

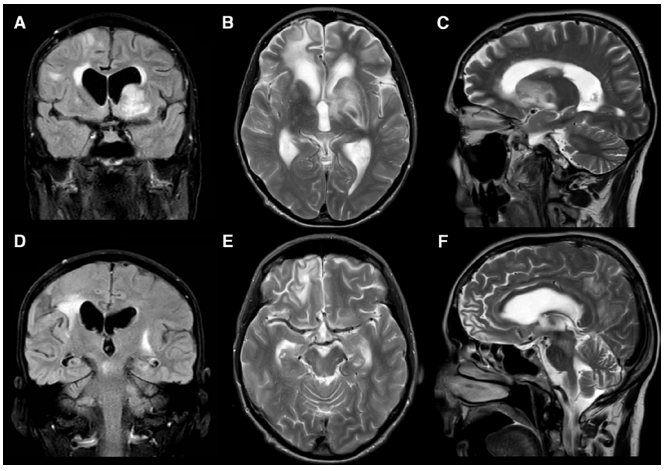

Figure 3 Repeated MRI analysis. MRI performed 3 months after hospital admission showing new hyperintense lesions with swelling in the left basal ganglia (A: coronal view FLAIR imaging; B: axial T2 imaging and C: sagittal T2 imaging), midbrain and around the right-sided gliosis (D: coronal view FLAIR imaging; E: axial T2 imaging and F: sagittal T2 imaging). FLAIR, fluid-attenuated inversion recovery.

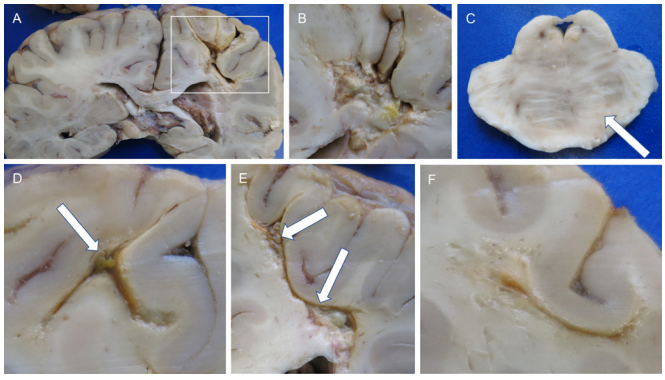

Figure 4 Macroscopic neuropathological analysis. We dissected the formalin-fixed brain of 1420 g by our routine neuropathological workup. Dura mater showed a right-sided, larger defect due to the operation combined with flat haemorrhagic coverings and granulation. Global brain oedema induced markedly flattening of the cerebral gyri. Leptomeninges were soft and inconspicuous. The arteries of the circle of Willis, parahippocampal gyri, brain stem and cerebellum appeared normal. Many supratentorial and infratentorial brain sections were without any changes, demonstrating sharp boundaries between the white and grey matter and normal ventricles. However, the right parietofrontal lobe showed a larger necrosis and cystic tissue rarefication of about 4 cm in diameter associated with resorption of the older mass bleeding, leading to a partial yellowish to orange appearance (A and B). Starting from this lesion of the right frontal white matter, there was a discontinuous process progressing to the occipital lobe. This lesion demonstrated a crumbly white matter with a slight orange colour and left the neighbouring cortical areas intact. Although we detected plenty of intravascular large B-cell lymphoma in the brain stem by microscopy, macroscopy of the brain stem was often unsuspicious in many regions; for example, the pons showed only discrete white spots that were hard to recognise (C). Other brain regions, such as the right hemisphere, were severely affected and demonstrated rarefied necrotic white matter lesions, such as in the parietal lobe (D) and the occipital lobe (E and F).

ganglia appeared swollen and showed a contrast enhancement. Considering a relapse of the initially suggested inflammatory vascular disease, intravenous high-dose corticosteroid treatment was started, which was followed by a tapering dose of oral corticosteroid treatment. In the beginning, the patient's condition improved, but after a few weeks, vigilance decreased. Quickly, the patient needed to be transferred to the intensive care unit to receive machine ventilation. The laboratory findings included significant hyperlactataemia and hypercalcaemia. Calcium-regulating hormone balance was normal. Only a few days later, the patient needed massive blood transfusions due to haemorrhagic shock. A CT scan of the abdomen revealed a spontaneous splenic rupture and massive abdominal bleeding. The patient died shortly after.

INVESTIGATIONS

Neuropathological findings

A CNS autopsy examination revealed a massive intracerebral IVLBCL (figure 4). The macroscopic findings reflected the previous right frontoparietal haemorrhage but there were no macroscopic signs of inflammation or tumour mass. Here, the area is characterised by extensive, orange-coloured lesions with a crumbly consistency that reached from the frontoparietal area of the original bleeding to the occipital lobe (figure 5). Detailed microscopic examination (figures 5 and 6) demonstrated an

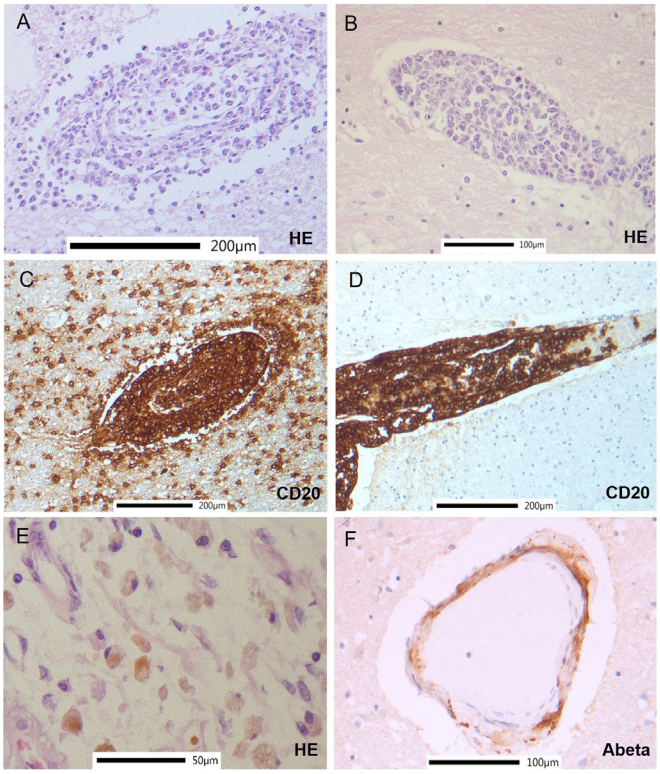

Figure 5 Microscopic neuropathological analysis In many H&E sections of the supratentorial and infratentorial brain (frontal, basal ganglia, temporal, occipital, cerebellum and brain stem) and of the leptomeninges, small- and medium-sized, and arterial vessels were padded with polymorphic lymphoma cells starting to cross the vessel wall to enter diffusely the parenchyma in some locations (A and B). CD20-positive tumour B cells had a tiny cytoplasm and showed irregular chromatin and some mitotic figures (C and D). The larger frontoparietal area displayed necroses of different ages and advanced resorption by macrophages (E). Some haemosiderophages were seen, as well as hematoidin (E). Besides these major findings, we detected microangiopathy and arteriolosclerosis, slight beta-amyloid deposits of vessel walls (Vonsattel grade 1) (F) and some minor diffuse chronic lymphocyte infiltrates and astrogliosis.

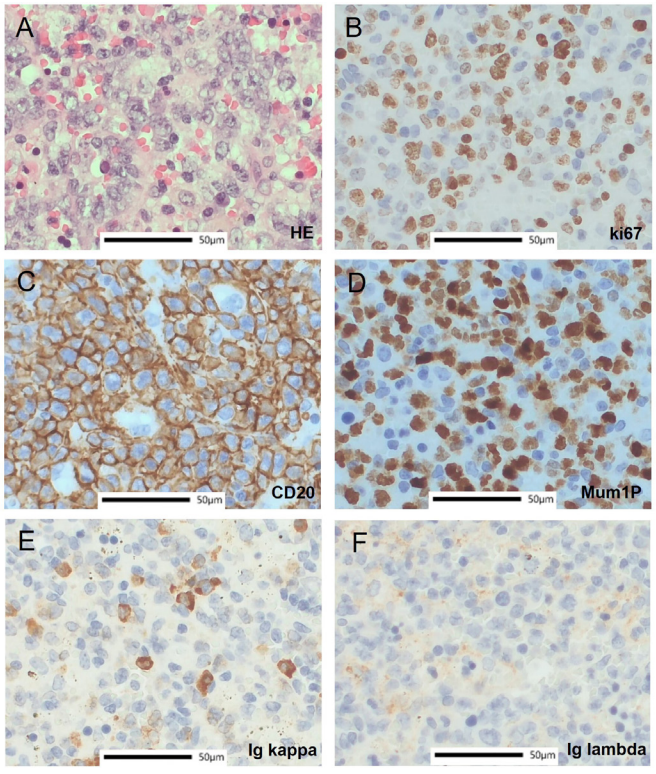

Figure 6 Histology and immunohistochemical characterisation of the lymphoma. Lymphoma cells were characterised by immunohistochemistry in more detail in the spleen, which was resected prior to death and therefore showed better tissue preservation than our autopsy material. Diffusely infiltrative blasts (H&E) (A) showed a high Ki-67 index (B), a strong CD20 expression proving B-cell differentiation (C), a strong Mum1 expression demonstrating postgerminal centre differentiation (D). Tumour cells showed expression for immunoglobulin kappa (E) and no expression for immunoglobulin lambda (F) equalling an Ig kappa light chain restriction as a marker for a monoclonal tumour cell population (all at 200-fold magnification).

intense infiltration of tumour cells localised within small- and medium-sized arteries in different parts of the brain, including the brainstem. Partly, transmural penetration was leading to disseminated infiltration into parenchyma such as the pons. There was also a leptomeningeal diffuse involvement. The malignant cells were polymorphic with irregular chromatin. The intravascular tumour cells were strongly immune-positive for CD20 antigen. The area of the initial bleeding was characterised by necrotic tissue of varying age and the accumulation of haemosiderophages. This was consistent with the massive brain bleeding. Furthermore, in this region, lymphoma cells were also seen within blood vessels. Arteries demonstrated atherosclerosis and, in part, a minimal deposition of a-beta amyloid detected only by immunohistochemistry. No conclusive signs of vasculitis or giant cell-associated inflammation were found, although they were described in the initial small biopsy.

As the spleen was directly prepared after the operation and was in a better state of preservation for the pathologist's purposes than the autopsy tissue, the lymphoma was further characterised. Blasts show a high nucleus-to-cytoplasm ratio. Lots of mitoses and cell debris were seen. These infiltrates showed a high proliferation (Ki-67 index of up to 75%), positive immunolabelling for an *MYC*-expressor type (about 35% myc expression), an immunoglobulin kappa light chain restriction, as well as a non-germinal centre type (Mum1+, CD10− and CD30−) according to the Hans classification. To conclude, a highly disseminated, primarily IVLBCL was diagnosed. The IVLBCL of the CNS was associated with a larger necrosis due to the previous massive haemorrhage as well as a leucoencephalopathy and a minimal a-beta amyloid deposition being strictly limited to the vessel walls.

DIFFERENTIAL DIAGNOSIS

Differential diagnoses of cerebral lobar haemorrhages include cerebral amyloid angiopathy, vascular malformations, coagulopathies, neoplasm and cerebral vasculitis.

TREATMENT

Due to a postmortem diagnosis, no lymphoma-specific treatment could be performed.

OUTCOME AND FOLLOW-UP

The postmortem biopsy revealed highly disseminated IVLBCL in different organs, including the lung, heart, bone marrow, kidneys, spleen and, most significantly, the brain.

Table 1 Synopsis of published patient's characteristics with intravascular large B cell lymphoma and brain haemorrhage

Reference	Age	Sex	Symptoms	Initial radiological findings	Histological findings	Cerebrospinal fluid findings
10	0	M	Consciousness disturbances and sudden convulsions	CT showing bilateral multiple haemorrhages. MRI in susceptibility- weighted imaging showing more widespread microbleeds	Atypical lymphoid cells in the bleeding vessels showing CD20 expression	Not mentioned
11	56	F	2-week history of headache, nausea and appetite loss	CT showing haemorrhage in the left cerebellum	Surgical specimen showing the presence of atypical lymphocytes in a cerebellar vein. Intravascular lymphoma cells (CD20 and CD5) are positive	Elevated protein level (220 mg/dL) and cell count (18); cytological examination was normal.
9	75	F	Episodes of slurred speech, spastic movements of the upper extremities and facial droop	MRI showing haemorrhagic lesions of the left anterior frontal lobe and right fronto-parietal lobe.	Proliferation of malignant lymphocytes within the lumina of both large and small with large, irregular, vesicular nuclei and prominent nucleoli, frequent mitotic figures in part completely filling and obstructing the lumen of the vessel	Not mentioned
12	73	M	1 week of progressive cognitive deterioration, disorientation, reduced attention- judgement and memory capacities and bradykinesia	MRI with non-enhancing periventricular leucoencephalopathy. 3 weeks later, a CT scan showing multiple cerebral haemorrhages	Multiple areas of brain haemorrhage and atypical lymphoid cells confined to the lumen of vessels both in leptomeninges and in cerebral parenchyma. with pleomorphic large nuclei and occasional mitotic figures. CD20 pos., not to CD3 or Ki-1. No lymphomatous involvement of the brain parenchyma or in the rest of the body	Elevated protein (2.1 g/L), normal cell count
14	41	F	Blurred vision in the left eye with a dilated and non-reactive pupil, almost total gaze palsy. Later coma	Diffuse-spotty subcortical haemorrhages (CT)	Atypical lymphoid cell population within the blood vessels in the leptomeninges, around the optic nerves, lungs, kidneys, thyroid and liver, with large nuclei and prominent nucleoli. Expression of leucocyte common antigen and CD20 but not CD3 or Ki-1	No evidence of infection

DISCUSSION

This case report depicts a common problem in IVLBCL-associated patient courses. Due to a varying and unspecific presentation and aggressive disease progression, the diagnosis of IVLBCL is often challenging and can lead to incorrect or delayed treatment.

Concerning the presented patient initially, there was no evidence or proof of a lymphoma, neither from a superficial biopsy nor from the clinical presentation, including angiography. This missing information made an early diagnosis of IVLBCL very problematic. At least, we suggest that high contamination of blood cells and/or a relatively low expansion of lymphoma cells at the time of the first intracranial haemorrhage biopsy might have hampered an early lymphoma diagnosis in histology as well as in image analysis.

CNS involvement in IVLBCL is a robust predictor of shorter survival.[1] In a meta-analysis comprising 654 cases, the most common symptom by far was cognitive decline or dementia in 60.9% of the patients, followed by 22.1% of the patients with paralysis or plegia.[4] However, a distinction concerning the cause of paralysis, such as cerebral haemorrhage or ischaemic stroke, was missing.

Only a few reports describe intracranial haemorrhage in patients with IVLBCL (see table 1). In two cases, haemorrhage was accompanied by disseminated intravascular coagulopathy.[12 13] Accurate percentage of occurrence of intracranial haemorrhage in IVLBCL is still unknown. The mechanism of haemorrhage is discussed as an interplay between degenerative or inflammatory changes of the vessel wall, including hyalinisation, fibrosis and fibrinoid necrosis,[11 14] and direct damage to the vessel wall by tumour infiltration leading to a rupture of a medium-sized cerebral artery.[10 13] Yaura and co-workers presented an IVLBCL case of a woman in her early 50s with IVLBCL and radiologically and histologically detected multiple cerebral haemorrhages and suggested that IVLBCL should not only be suspected in patients with multiple infarct lesions but also multiple cerebral haemorrhages.[15] Interestingly, in a recent case series, including four patients with IVLBCL, the authors pointed out that in two cases, many haemorrhagic lesions were detected at autopsy.[16] This highlights the assumption that vascular damage in CNS IVBLCL might be associated with cerebral haemorrhages.

T2-weighted MRI signals indicative of haemorrhage have been described in some cases with CNS IVLBCL but have not yet reached awareness as an important differential diagnosis for CNS IVLBCL.[17] Another important CNS manifestation of IVLBCL is ischaemic stroke. In line with haemorrhage, ischaemic stroke in patients with IVLBCL is mostly based on case reports and series, which makes an exact evaluation of its frequency difficult and is rather based on estimations.[18] Repeated stroke symptoms in patients with IVLBCL were described as unspecific or non-classic.[19 20] In a recent case series, classic lateralising stroke symptoms were only found in 69% of the 58 cases. For example, symptoms like altered sensorium, rapidly progressive cognitive impairment and seizures were present.[21] Bhagat *et al* made assumptions about the MRI morphology of IVLBCL-associated ischaemic stroke lesions being mostly located in the subcortical regions. Symmetrical confluent white matter lesions were described as apparent in IVLBCL, which can be differentiated from ischaemic leukoaraiosis or Binswanger's disease from associated diffusion-weighted imaging hyperintensity.[21] In a case series of 58 patients with IVLBCL-associated strokes, a high mortality rate was noticed, and lesions were not always associated with restricted diffusion in brain MRI.[19]

The distinction between a classical variant with a median age of 70 years at the time of diagnosis, a mostly rapid deterioration in performance status and a cutaneous variant with

a younger age of onset and a less aggressive disease progression, as well as a haemophagocytic syndrome-associated variant[22] is defined. Historically, a distinction that recognised the localisation of the lesion was made but not implemented into the recent WHO classification.[23] In the classical variant, cutaneous involvement is common and might be present in up to 40% of the cases. Those patients present numerous skin manifestations, such as plaques, eruptions, ulcerated nodules or tumours, among others.[24] In our case, we specifically did not find any skin involvement.

IVLBCL is often diagnosed after, rather than prior to, death. Due to its rarity, aggressive disease progression and mimicry of other diseases, it might not be circumvented in several cases, although substantial progress is evident. Antemortem diagnosis is made in only 80% of cases.[25] The challenge is not to miss minor signs since pathognomonic ones are so rare.[22] The combination of fever of unknown origin and neurological as well as skin involvement is considered to be the most characteristic.[22] Haninger *et al* described the typical feature of IVLBCL as being found exclusively in the tissue of the vessels but not in circulation, which makes it harder to diagnose.[9] Furthermore, lymphadenopathy is relatively rare compared with other types of non-Hodgkin's lymphoma.[26–28] But involvement of the bone marrow, liver or spleen is common.[26] Testing cerebrospinal fluid (CSF) in IVLBCL for neoplastic malignant cells or signs of vasculitis as the most common differential diagnosis, especially in earlier stages, is often unrevealing.[29] This also holds true for the presented case. Patients are more likely to have an elevated CSF protein level.[22 30] Interestingly, even a biopsy of an affected organ is often unrevealing.[12] When a specimen is affected by IVLBCL, this can be easily detected by standard histopathological diagnostics. The intravascular growth of tumour cells leads to ischaemia being dependent on affected vessels. This might therefore lead to smaller cerebral infarcts as well as leakage. To conclude, due to its rare manifestation, the neuropathologist must be very careful not to miss this aggressive type of lymphoma, which initially grows only within vessels.

Patient's perspective

The patient's husband recalled his impressions of his wife's disease in an interview: at the day of hospital admission, he noticed his wife falling and presenting a half-sided palsy, including the face. She was then admitted to the hospital. Because of visiting regulations due to COVID-19 at that time, regular visits were not possible. Only when the patient received treatment at the intensive care unit did he witness a constant decline in his wife's condition.

Learning points

- Diagnosing intravascular large B cell lymphoma (IVLBCL) is challenging due to its rarity, quick progression and mostly unspecific symptoms.
- Neurological involvement of IVLBCL is common.
- Atypical lobar haemorrhage is a potential neurological manifestation. Unusual haemorrhage transformation with a cystic lesion or finger-shaped morphology should raise suspicion for IVLBCL.
- Disease progression is mostly rapid. Early detection using repeated and thorough clinical, radiological and histological workups could help establish an early diagnosis.

Contributors The following authors were responsible for drafting of the text, sourcing and editing of clinical images, investigation results, drawing original diagrams and algorithms, and critical revision for important intellectual content: CO, ON, IK, AD, ES, DB, KW and AH. The following authors gave final approval of the manuscript: CO, ON, IK, AD, ES, DB, KW and AH.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Case reports provide a valuable learning resource for the scientific community and can indicate areas of interest for future research. They should not be used in isolation to guide treatment choices or public health policy.

ORCID iD

Clemens Oerding http://orcid.org/0000-0002-2088-0266

REFERENCES

1 Liu Z, Zhang Y, Zhu Y, *et al*. Prognosis of Intravascular Large B Cell Lymphoma (IVLBCL): Analysis of 182 Patients from Global Case Series
2 Newman J. A Neurological Presentation of Intravascular Large B-cell Lymphoma: a Rare Cause of Multi-Territory Strokes. *JOJCS* 2021;12.
3 Yunce M, Muganlinskaya N, Selinger S. Intravascular large B-cell lymphoma presenting as multiple stroke: A case report. *Medicine (Baltimore)* 2018;97:e12793.
4 Fonkem E, Dayawansa S, Stroberg E, *et al*. Neurological presentations of intravascular lymphoma (IVL): meta-analysis of 654 patients. *BMC Neurol* 2016;16:9.
5 Porzionato A, Pelletti G, Barzon L, *et al*. Intravascular large B-cell lymphoma affecting multiple cranial nerves: A histopathological study. *Neuropathology* 2021;41:396–405.
6 Miyake Z, Tomidokoro Y, Tsurubuchi T, *et al*. Intravascular large B-cell lymphoma presenting with hearing loss and dizziness: A case report. *Medicine (Baltimore)* 2019;98:e14470.
7 Rayfield C, Mertz L, Kelemen K, *et al*. Vasculitis on brain angiography is not always vasculitis: intravascular large B-cell lymphoma mimicking central nervous system vasculitis. *BMJ Case Rep* 2019;12:e230753.
8 Prayson RA. Intravascular lymphoma mimicking vasculitis. *J Clin Neurosci* 2016;34:224–5.
9 Haninger DM, Davis TA, Parker JR, *et al*. Intravascular large B-cell lymphoma presenting as acute hemorrhagic cerebral infarct with delirium. *Ann Clin Lab Sci* 2013;43:305–10.
10 Kimura M, Fujiwara S, Tanaka A, *et al*. Multiple Cerebral Hemorrhages With Microbleeds in Intravascular Large B-Cell Lymphoma. *J Stroke Cerebrovasc Dis* 2020;29:104798.
11 Uzuka T, Higuchi F, Matsuda H, *et al*. Intravascular Lymphoma with an Acute Course of Cerebellar Hemorrhage: A Case Report. *Neurol Med Chir (Tokyo)* 2018;58:96–100.
12 Stahl RL, Chan W, Duncan A, *et al*. Malignant angioendotheliomatosis presenting as disseminated intravascular coagulopathy. *Cancer* 1991;68:2319–23.
13 Lui PCW, Wong GKC, Poon WS, *et al*. Intravascular lymphomatosis. *J Clin Pathol* 2003;56:468–70.
14 Passarin MG, Wen PY, Vattemi E, *et al*. Intravascular lymphomatosis and intracerebral haemorrhage. *Neurol Sci* 2010;31:793–7.
15 Yaura K, Watanabe G, Nakamura T, *et al*. Intravascular large B-cell lymphoma with multiple intracranial hemorrhages diagnosed by brain biopsy. *Rinsho Shinkeigaku* 2020;60:206–12.
16 Bentivenga GM, Baiardi S, Righini L, *et al*. Rapidly progressive dementia due to intravascular lymphoma: A prion disease reference center experience. *Eur J Neurol* 2024;31:e16068.
17 Ishikawa T, Ogata Y, Tsuda J, *et al*. Intravascular large B-cell lymphoma with low signal intensity lesions on T2 weighted spinal magnetic resonance image that were suspected to be hemorrhages. *Rinsho Shinkeigaku* 2012;52:344–50.
18 Anbil S, Fenerty K, Feng Z, *et al*. Intravascular Large B Cell Lymphoma as a Cause of Multifocal Cryptogenic Stroke. *Am J Med* 2021;134:1236–7.
19 Sapkota M, Shahab A, Karki Y, *et al*. Stroke and Intravascular Lymphoma: A Systematic Review of Case Reports and Series (P3-5.030). *Neurology (ECronicon)* 2024;102:17_supplement_1.
20 Popiolek C, Gupta K, Huff ML, *et al*. Intravascular large B-cell lymphoma masquerading as stroke successfully treated with R-Hyper-CVAD. *Leuk Res Rep* 2024;21:100401.

21 Bhagat R, Shahab A, Karki Y, *et al*. Intravascular Lymphoma-Associated Stroke: A Systematic Review of Case Studies. *Cureus* 2023;15:e50896.
22 Ponzoni M, Campo E, Nakamura S. Intravascular large B-cell lymphoma: a chameleon with multiple faces and many masks. *Blood* 2018;132:1561–7.
23 Swerdlow SH, Campo E, Harris NL, *et al*. World health organization classification of tumours. In: *WHO classification of tumours of haematopoietic and lymphoid tissues*. Lyon: International Agency for Research on Cancer, 2017: 585.
24 Ponzoni M, Ferreri AJM. Intravascular lymphoma: a neoplasm of "homeless" lymphocytes? *Hematol Oncol* 2006;24:105–12.
25 Brunet V, Marouan S, Routy J-P, *et al*. Retrospective study of intravascular large B-cell lymphoma cases diagnosed in Quebec: A retrospective study of 29 case reports. *Medicine (Baltimore)* 2017;96:e5985.
26 Ferreri AJM, Campo E, Seymour JF, *et al*. Intravascular lymphoma: clinical presentation, natural history, management and prognostic factors in a series of 38 cases, with special emphasis on the "cutaneous variant." *Br J Haematol* 2004;127:173–83.
27 Shimada K, Kinoshita T, Naoe T, *et al*. Presentation and management of intravascular large B-cell lymphoma. *Lancet Oncol* 2009;10:895–902.
28 Murase T, Nakamura S, Kawauchi K, *et al*. An Asian variant of intravascular large B-cell lymphoma: clinical, pathological and cytogenetic approaches to diffuse large B-cell lymphoma associated with haemophagocytic syndrome. *Br J Haematol* 2000;111:826–34.
29 Ossege LM, Postler E, Pleger < B, *et al*. Neoplastic cells in the cerebrospinal fluid in intravascular lymphomatosis. *J Neurol* 2000;247:656–8.
30 Vieren M, Sciot R, Robberecht W. Intravascular lymphomatosis of the brain: a diagnostic problem. *Clin Neurol Neurosurg* 1999;101:33–6.