Intracranial extraosseous dural-based Ewing's sarcoma with fluid-haematocrit levels: imaging findings of a rare tumour

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SUMMARY

Extraosseous dural-based primary Ewing's sarcoma of the central nervous system is a rare tumour posing a diagnostic challenge. On cross-sectional radiological imaging, the lesion has an extra-axial location with heterogeneous appearance. These lesions are usually multicystic with internal haemorrhage causing fluid-haematocrit levels. It mimics conditions like an aneurysmal bone cyst, microcystic meningioma, telangiectatic osteosarcoma or cystic metastasis. Exclusion of primary Ewing's sarcoma or malignancy elsewhere in the body is required to rule out a secondary. Surgery along with adjuvant chemotherapy and focal radiotherapy is the preferred mode of treatment. Due to the presence of non-specific small round blue cells on H&E stain, these tumours are also confused with lymphoma, osteosarcoma, rhabdomyosarcoma, Merkel cell carcinoma, ependymoblastoma and neuroendocrine carcinoma. Immunohistochemistry provides a definitive diagnosis. A high degree of suspicion in the preoperative scans is crucial for prognostication and early management of this aggressive tumour leading to improved patient survival.

BACKGROUND

Ewing's sarcoma is a malignant small round cell tumour that can have an osseous or extraosseous origin. It commonly arises from long bones, ribs and pelvis. The extraosseous Ewing's sarcoma most commonly involves the paravertebral regions and rarely the central nervous system (CNS).[1] Meningeal Ewing's sarcoma without bony involvement occurs less frequently, accounting only for 1%–4% of all extraosseous Ewing's sarcoma.[2 3]

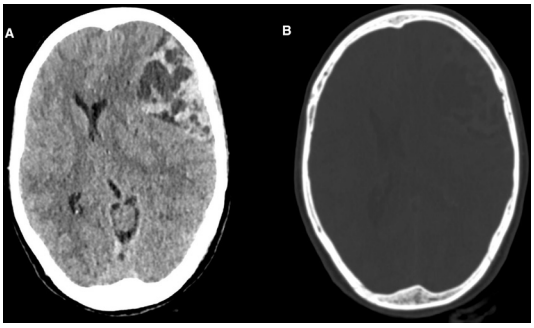

Figure 1 (A) Axial section non-contrast CT (NCCT) image of the brain shows a well-defined heterogeneously hyperdense multicystic broad dural-based extra-axial lesion in the left frontoparietal convexity. It exerts a mass effect in the form of effacement of the underlying cortical sulci and the left lateral ventricle along with the contralateral midline shift. (B) The axial bone window NCCT image of the head shows the normal overlying calvarial bones without evidence of erosion or sclerosis.

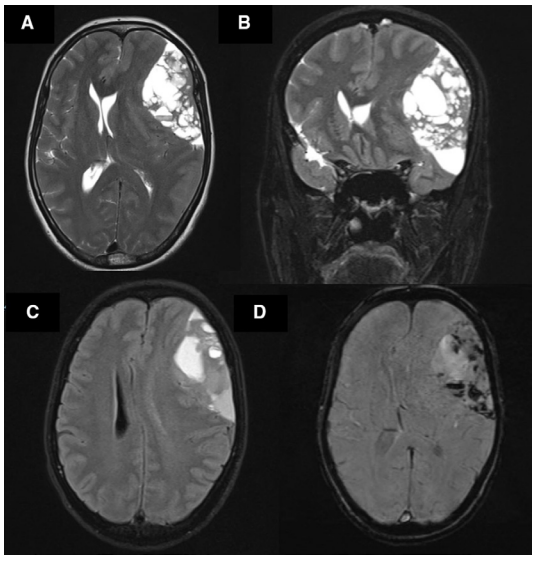

Figure 2 (A) The axial T2 weighted imaging (T2WI) shows a heterointense multicystic dural-based lesion in the left frontoparietal convexity with few fluid-haematocrit levels exerting a significant mass effect. (B) The coronal T2WI shows the heterointense multicystic dural-based left frontoparietal-temporal convexity lesion. (C) The axial fluid-attenuated inversion recovery image shows heterogeneous signal intensity in the lesion. (D) The axial susceptibility-weighted imaging shows areas of blooming suggestive of haemorrhage within the tumour.

Our case was challenging to arrive at a diagnosis from an imaging perspective since it had an atypical presentation of a multiseptated cystic lesion with fluid-haematocrit level mimicking an aneurysmal bone cyst.

CASE PRESENTATION

A woman in her 50s presented to the emergency outpatient department with complaints of moderate-intensity headache associated with projectile vomiting for 15 days and blurred vision for 5 days. There was no history of trauma, fall, loss of consciousness, seizure or limb weakness. She was not a known case of hypertension, diabetes mellitus or bleeding diathesis. She was well oriented with a normal Glasgow Coma Scale (GCS) score, afebrile without any meningeal signs on examination. Pulse,

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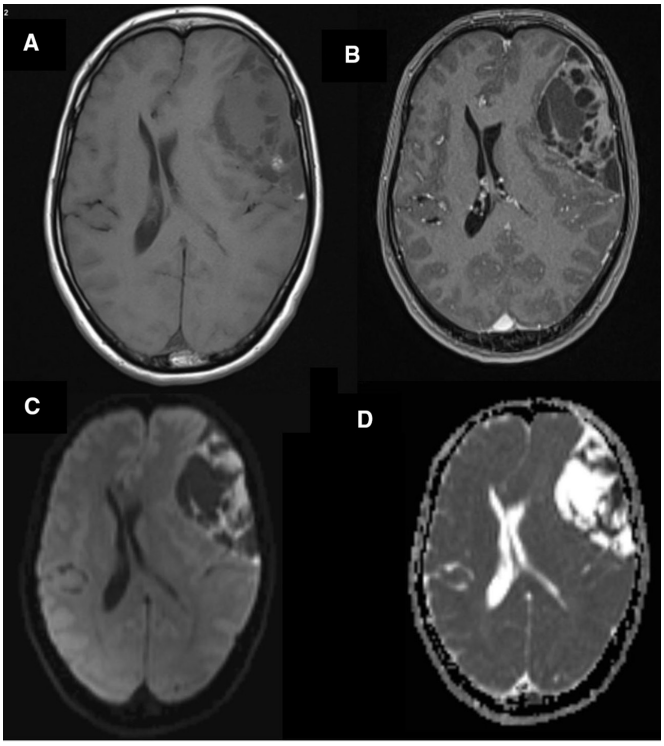

Figure 3 (A) The axial T1 weighted imaging (T1WI) depicts a heterogeneously hypointense multicystic lesion in the left frontoparietal convexity. Few areas of T1 hyperintensity suggestive of subacute haemorrhage are noted within the mass. (B) The axial postgadolinium injection T1 fat-suppressed image shows enhancement of the septations and tumour periphery. Small enhancing dural tail is also noted. (C) Axial diffusion-weighted imaging (DWI) image shows restriction in the thick septations of the left extra-axial mass. (D) Apparent diffusion coefficient image shows the corresponding hypointense signal in the areas of hyperintensity in DWI.

blood pressure and respiratory rate were normal. There was no pallor, icterus, clubbing or pedal oedema.

CNS examination showed normal power and tone in all limbs with normal plantar reflex. Other organ systems examination was within normal limits.

INVESTIGATIONS

A non-contrast computed tomography (NCCT) revealed a relatively well-defined broad dural-based extra-axial multiseptated cystic lesion in the left frontotemporal convexity region. Mass effects in the form of sulcal effacement and contralateral midline shift were noted (figure 1A). The bone window revealed normal overlying calvaria (figure 1B).

A contrast-enhanced magnetic resonance imaging (MRI) of the brain was done for further lesion characterisation. MRI revealed a well-defined multiseptated broad dural-based extra-axial lesion exhibiting heterogeneous T2 weighted imaging (T2WI) and fluid attenuated inversion recovery hyperintense signal with fluid-haematocrit levels on T2WI (figure 2A–C). Areas of blooming were seen on susceptibility-weighted imaging (figure 2D). On T1 weighted imaging (T1WI), it showed predominantly signal hypointensity with small areas of hyperintensity suggestive of haemorrhage (figure 3A). There were septal enhancement and enhancing dural tail on postgadolinium contrast injection T1 fat-suppressed image (figure 3B). The thick septae showed diffusion restriction on diffusion weighted imaging (DWI) with the corresponding hypointensity on apparent diffusion coefficient (figure 3C,D). There was buckling of the underlying cerebral cortex, mass effect on the cortical sulci and left lateral ventricle, and midline shift to the right side.

CT scan of abdomen and thorax was planned to rule out a primary elsewhere which revealed no abnormality. The laboratory investigations like complete blood count, liver function tests, renal function tests and coagulation profiles were normal.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis for an extra-axial cystic lesion with fluid-haematocrit levels includes subdural haemorrhage, cystic schwannoma, cystic meningioma, telangiectatic osteosarcoma of the skull and cystic metastasis. Rare possibilities like a dural aneurysmal bone cyst (ABC) and meningeal Ewing's sarcoma were also considered.[4–8]

Cystic schwannomas can present with fluid-fluid levels. These usually occur along the cranial nerves and most commonly in the cerebellopontine angle. Considering the location of the lesion and without any proximity to the cranial nerve possibility of schwannoma was ruled out.

Cystic metastasis from lung carcinoma, renal cell carcinoma, breast carcinoma, melanoma and gastrointestinal tract adenocarcinomas may present with haemorrhage. There was no apparent primary lesion in the clinical examination or contrast-enhanced CT (CECT) of the thorax and abdomen. Moreover, solitary predominantly cystic, extra-axial lesion without parenchymal involvement is rare for metastasis. So, metastasis was considered but was not kept as the first differential.

Subdural haemorrhage with multiple septations and blood-fluid levels were ruled out due to the absence of trauma/fall or any history of bleeding diathesis. The absence of bone involvement or associated soft tissue lesion ruled out the possibility of telangiectatic osteosarcoma as it is primarily an aggressive bone tumour that presents with a lytic or destructive bone-based lesion.[9]

After referring to the literature, we also considered the rare possibilities like dural ABC and meningeal Ewing's sarcoma.

Few meningeal Ewing's sarcoma cases have been reported, but >60% of cases are seen associated with skull involvement.[8] Haemorrhage is common in dural Ewing's sarcoma. However, a multiseptated cystic lesion with fluid-haematocrit levels on imaging has not been described in the literature. Three documented case reports of an ABC involving the dura without affecting adjacent bone were found in the literature.[4 5] One of the case reports showed a similar extra-axial lesion with haemorrhagic levels—so a dural ABC was our primary differential. Only histopathological analysis revealed the lesion to be an Ewing's sarcoma.

TREATMENT

The patient suddenly deteriorated with dropping GCS due to intratumoural haemorrhage and was intubated. She underwent emergency surgery with excision of the extra-axial tumour under general anaesthesia.

OUTCOME AND FOLLOW-UP

In the postoperative period, she remained in the intensive care unit. On the first post-operative day, an NCCT scan showed left frontoparietal craniotomy with minimal left subdural haemorrhage, underlying cerebral oedema and mild contralateral midline shift (figure 4). On postoperative day 6, the patient

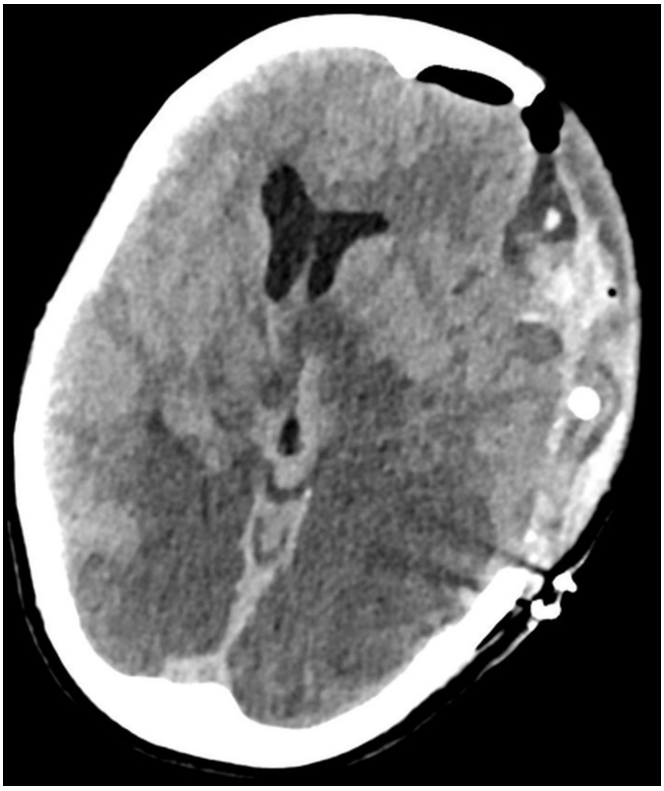

Figure 4 Non-contrast CT scan on first post-operative day shows left frontoparietal craniotomy with minimal left subdural haemorrhage, underlying cerebral oedema and mild contralateral midline shift.

suffered cardiac arrest and could not be revived despite resuscitative measures.

The histopathological examination revealed a highly cellular tumour. The tumour cells were arranged in sheets with focal cystic degenerative changes, a high nucleocytoplasmic ratio, granular chromatin with scant cytoplasm and mitotic activity (figure 4A,B). Due to the presence of non-specific small round blue cells on H&E stain, these tumours are confused with lymphoma, osteosarcoma, rhabdomyosarcoma, Merkel cell carcinoma, ependymoblastoma and neuroendocrine carcinoma. On immunohistochemistry, the cells were positive for CD99 and synaptophysin, negative for CD45, and the MIB-1 labelling index was approximately 12% (figure 5D–F). Based on these radiological and histopathological findings, the tumour was diagnosed as dural Ewing's sarcoma. The cytogenetic study was not performed in our case.

DISCUSSION

Extraosseous Ewing's sarcoma occurs in the second and third decades of life with a slight male predilection.[6] The mean age of presentation of meningeal Ewing's sarcoma is 20 years with a SD of 13 years.[7] Meningeal Ewing's sarcoma could be either primary or, more commonly, metastasis from a distal site. Dural involvement very commonly occurs by direct invasion by a calvarial Ewing's sarcoma. More than 60% of dural Ewing's sarcomas are associated with skull involvement.[8] They fall under the WHO grade IV of mesenchymal tumours having increased recurrence and aggressive growth patterns.[7]

Meningeal Ewing's sarcoma could be falcine, para-falcine, in cerebral convexity, tentorium-based or could occur in the posterior fossa. Nearly 70% of the tumours are supratentorial.[10]

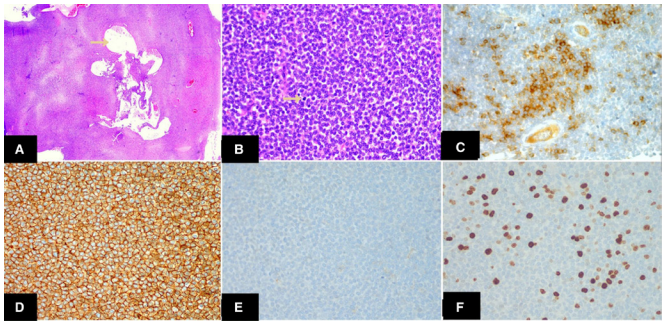

Figure 5 (A) Photomicrograph shows a highly cellular tumour. The tumour cells are arranged in sheets with focal cystic degenerative changes. (H&E ×40). (B) The tumour cells have a high nucleocytoplasmic ratio. There is granular chromatin with scant cytoplasm. mitotic activity was present (arrow) (H&E ×400). (C) The tumour cells are immunopositive for synaptophysin (H & DAB ×400). (D) The tumour cells show strong membranous immunoreactivity for CD99 (H & DAB ×400). (E) Staining for leucocyte common antigen (CD45) is negative (H & DAB ×400). (F) MIB-1 labelling index is approximately 12% (H & DAB ×400).

The clinical presentation is diverse, including headache, vomiting, seizures, double vision, behavioural change and generalised weakness. Swelling is seen in tumours with bony involvement. Dural-based lesions generally show symptoms only when the tumour is large, causing compression or invasion of brain parenchyma.[2]

On CT, the lesion appears heterogeneously hyperdense. These are fusiform lesions that frequently present with a size of more than 3 cm.[10]

On MRI, these tumours are usually iso-to-hypointense on T1WI, and they appear heterointense or hypointense (83.3%) on T2WI. 24% of the lesions present with haemorrhage, and 27.5% show cystic changes. Ramon *et al* reported that extraosseous intracranial Ewing's sarcomas are commonly associated with haemorrhage.[11] The DWI findings are not yet well documented; however, it usually appears hyperintense on DWI.[12]

These lesions show enhancement of variable intensity. These may be associated with a dural tail that is shorter and nodular or irregular.[7]

Diagnosis is confirmed by histopathological examination, immunohistochemistry and cytogenetics. These tumours are composed of small undifferentiated neuroectodermal cells. These cells show glial or neuronal differentiation on immunohistochemistry with markers like CD99, neuron-specific enolase (NSE), synaptophysin and vimentin. The expression of the MIC-2 gene on their cell membranes and detection of t(11,22)(q24;q12) chromosomal translocation in more than 90% of EES help in differentiating it from c-contrast-enhanced CT (PNET (central PNET)) like medulloblastoma.[1]

Ewing's sarcomas are treated with a combination of surgery followed by adjuvant chemotherapy and focal radiotherapy. The Ewing's sarcoma family of tumours shows a 77% 10 year survival.[11]

Thus, in the case of a multicystic extra-axial dural-based lesion with haemorrhage, fluid-haematocrit levels, peripheral and septal enhancement, and without bone involvement, extraosseous Ewing's sarcoma should be considered as a rare possibility in all age groups. A high degree of suspicion in the preoperative scans is crucial for prognostication and management. Other lesions like meningiomas or ABCs are usually benign and need only surgical intervention. Some treatment delay is acceptable in these tumours unless there are features of raised intracranial

tension or malignancy. However, Ewing's sarcoma is an aggressive neoplasm requiring multidisciplinary treatment. Screening of other regions is also needed to rule out a secondary Ewing's sarcoma. Early diagnosis prevents treatment delay and improves patient survival.[8]

Learning points

- The differential diagnoses for an extra-axial cystic lesion with fluid-haematocrit levels include subdural haemorrhage, cystic schwannoma, cystic meningioma, telangiectatic osteosarcoma of the skull, cystic metastasis, dural aneurysmal bone cyst and meningeal Ewing's sarcoma.
- On imaging, an extra-axial lesion with fluid-haematocrit levels should raise a suspicion of Ewing's sarcoma even in the absence of bony involvement.
- Search for primary elsewhere should be done to rule out primary dural Ewing's sarcoma.
- The diagnosis of Ewing's sarcoma is confirmed by histopathological examination, immunohistochemistry and cytogenetics.
- A high degree of suspicion in the preoperative imaging is crucial for prognostication and early management of this aggressive tumour by a multidisciplinary approach.

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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.

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