8 Open Access Full Text Article

CASE REPORT

Synthetic treatment of intracranial peripheral primitive neuroectodermal tumor with multiple metastasis: a case report

Yang Zhang^{1,2} Hongsheng Li² Zongjuan Li³ Ming Liu^{1,2} Linke Yang² Liyuan Fan² Chengsuo Huang² Baosheng Li²

School of Medicine and Life Sciences, Jinan University-Shandong Academy of Medical Sciences, ²Department of Radiation Oncology, Shandong Cancer Hospital Affiliated to Shandong University, Shandong Academy of Medical Sciences, Jinan, Shandong, ³Department of Radiation Oncology, The Second Hospital of Dalian Medical University, Dalian, Liaoning, People's Republic of China

Correspondence: Baosheng Li Department of Radiation Oncology, Shandong Cancer Hospital Affiliated to Shandong University, Shandong Academy of Medical Sciences, No 440, Jiyan Road, Jinan, Shandong 250117, People's Republic of China Tel +86 531 6762 6162 Fax +86 531 8798 4079 Email baoshli1963@163.com



Abstract: Ewing sarcomas (ES) and peripheral primitive neuroectodermal tumors (pPNET) are now thought to belong to the same tumor family. Ewing sarcoma family tumor (ESFT) members commonly originate in bones and soft tissues. However, a few published articles describe ESFT arising from cranial cavities. Pathologically, ES/pPNET are composed of small round cells. Unambiguous distinction between pPNET and other small round cell tumors, in particular central PNET, is of clinical significance. Definitive diagnoses of pPNET can be obtained through CD99 (MIC2 gene product) membrane positivities and molecular identifications of chromosomal rearrangements between EWS and ETS family genes. Multimodal approaches comprising surgical resections, radiotherapies, and chemotherapies are required for the treatment of ESFT. Decompressive medical measures are preferentially performed when epidural masses are compressing spinal cords. In cases of ES-induced brain herniations, emergent radiotherapies may serve as effective tools. We report a case of multiple disseminated intracranial ES/pPNET for which synthetic treatments were used.

Keywords: primitive neuroectodermal tumors, brain neoplasms, spinal tumors, neoplasm metastases

Introduction

Ewing sarcomas (ES) and peripheral primitive neuroectodermal tumors (pPNET) are currently classified as a tumor family because they share unifying histopathological, immunohistochemical, and molecular features.^{1,2} Typical sites of occurrence for ESFT are in bones and soft tissues. However, rare cases have reported pPNET originating from cranial cavities. Here, we report a case of intracranial pPNET with multiple metastases.

Case

Informed consent was obtained from the patient and her family. The study was approved by the Institutional Review Board of Radiation Oncology, Shandong Cancer Hospital Affiliated to Shandong University. A 28-year-old female presented with progressive back pains occurring over 2 months' duration with pain radiating to the ipsilateral shoulder. She also had a 1-month history of upper-extremity weaknesses and a recent onset of slight headaches. No antecedent trauma had occurred in these areas. She denied having a history of nausea, vomiting, seizures, or losses of consciousness. Physical examination upon hospital admission revealed grade 4/5 power (Medical Research Council Scale) in the left upper limb and two palpable masses in the bilateral frontal regions (5 cm above the eyebrows). Further neurological examinations revealed no positive signs.

OncoTargets and Therapy 2016:9 3327-3333 Control of the field of the set of the



Figure 1 Magnetic resonance imaging of the spine demonstrating a mass located in the C7 epidural space (arrow).

Lactate dehydrogenase and alkaline phosphatase levels were both increased (353 and 478 U/L, respectively).

Magnetic resonance imaging (MRI; Figure 1) confirmed the presence of an extradural lesion at the spinal C7 level. The mass compressed the spinal cord, and a distinct heterogeneous enhancement was observed in the tumor. The MRI also revealed patch-like lesions with high signal intensity (in T2 images) on the C2–5, C7, T2–5 level vertebra. Further brain MRI evaluations (Figure 2) showed two extramedullary meningioma-like masses with bone involvements and frontal brain parenchymal compressions. A metastatic workup with a positron emission tomography and computed tomography scan was subsequently performed, and no other abnormalities were observed.

In view of the severe spinal cord compression of the C7 level extradural lesion, the patient was subjected to laminectomy and mass removal. At laminectomy, a dark red mass was found in the epidural space. The mass had adhered slightly to the dura mater, compressing the adjacent dural sac and spinal cord. The tumor was easily separated from the adjoining dura mater, allowing a gross total resection to be performed. Postoperatively, symptoms of back pain and upper-extremity weakness were dramatically resolved. After the surgery, therapeutic agents were administered, including dehydrants, steroids, lansoprazole, and neuro nutrition. Gross visualizations by histopathological analyses showed that the epidural tumor was composed of dark-red soft tissue, which measured ~1.2 cm at its largest diameter. Upon microscopic analyses of hemotoxylin and eosin stained sections, the neoplasm displayed monotonous, closely packed small round blue cells with high nuclear-to-cytoplasmic ratios (Figure 3A). Typical Homer Wright rosettes were not observed. Using immunohistochemical analyses, the cells strongly expressed CD99 (Figure 3B), vimentin, and Bcl-2. Stains for neuron specific enolase (NSE), synaptophysin (Syn), and epithelial membrane antigen (EMA) were negative. For this case, further



Figure 2 Axial (A) and sagittal (B) magnetic resonance imaging of the brain showing two extra-axial intracranial masses in the bilateral frontal regions



Figure 3 Hematoxylin and eosin staining (A) showing small round blue cells with a high nuclear-to-cytoplasmic ratios, and immunostaining (B) demonstrating positivity for CD99. Magnification $\times 100$.

chromosomal translocation studies were not performed. Based on the collective histopathological and immunochemical findings, a diagnosis of ES/pPNET was made.

On day 10 after the surgery, the patient's consciousness level deteriorated gradually and headache intensity increased. Upon examination, her right pupil was dilated to 5 mm, and bilateral papilledema was detected. A subsequent head computed tomography scan indicated cerebral hernia with ventricle compression. The patient was immediately transferred to our treatment center.

When arriving at our unit, the patient was in a state of stupor. Given the special symptoms she presented and the radiosensitivity of ES, the oncology team performed emergent radiotherapy. One hour later, the first four Gy were given to the whole brain. Concomitant infusion treatment strategies were also given, and included dehydrants, hormones, and parenteral and neuro nutritions. After the delivery of eight Gy/two fractions to the whole brain, her consciousness level gradually improved. Therefore, subsequent boosts of 21 Gy/seven fractions were carried out on the cerebral epidural masses. After implementation of radiation therapies, the patient underwent eight total cycles of multiagent chemotherapy treatments (ie, vincristine, cyclophosphamide, and doxorubicin) every 21 days. The patient tolerated these treatments well with the exception for myelosuppression. A complete response was observed after four cycles of chemotherapy. Subsequently, the patient has been on regular follow-up and, 13 months after diagnosis, has remained disease-free.

Discussion

ES and pPNET are now commonly considered to be one tumor family because they share histopathological features and molecular properties and have been renamed Ewing sarcoma family tumor (ESFT).^{1,2} ESFT preferentially afflicts children and adolescents, exhibiting a slight predilection for females. Typically, ESFT occur in bones or soft tissues; origination from cranial cavities is rare. To our knowledge, only 29 cases have been reported in the body of English ESFT literature (Table 1). Despite the present case acts as multifocal disease, it was still reasonable to regard the intracranial lesions as the primary sites, because 1) size discrepancy surely exists between the intracranial masses and the spinal epidural lesion, 2) most spinal PNETs are caused by "drop" metastasis from an intracranial tumor through cerebrospinal fluid circulation,³ 3) 2 years prior to symptom of spinal tumor development, frontal masses had been palpated, and 4) at laminectomy, the spinal epidural mass was only slightly adhered to the surrounding tissue and could be easily separated. Conversely, the cerebral lesions were significantly invasive, as indicated by MRI.

Unambiguous distinction between pPNET and other small round cell tumors, in particularly central PNET, is of clinical significance. CD99-positive membrane staining is detected in nearly all cases of pPNET, which is a highly reliable biomarker, but on no account pathognomonic; CD99 also identifies other small round cell tumors, albeit with staining patterns that diverge from those observed in pPNET.⁴ Advanced molecular detection of EWS–ETS gene fusions are confirmatory for final pPNET diagnoses.⁵

Multimodal strategies, including surgery, radiation therapy, and chemotherapy, are required for the treatment of intracranial ESFT with epidural space metastases.⁶ Priority must be given to laminectomies and tumor removals when epidural masses present with spinal cord compressions. These techniques aim to obtain specimens for pathologic diagnoses and avoid permanent neurological dysfunctions.^{7,8} In these cases, close attention should be made to intracranial

Right occipital parafalcine No R+CT+RT region No PR+CT+RT region No PR+CT+RT Right frontal lobe Lung Surgery removal+CT+RT Tentonium No NUA Rift frontal lobe Lung NUA Bifrontal tumor Sphenoid sinus GTR+RT+CT Right frontal tumor Sphenoid sinus MUA Right frontal dura mater No GTR+RT+CT Right frontal dura mater <th>Author</th> <th>Case</th> <th>Age/sex</th> <th>Symptoms</th> <th>Location(s)</th> <th>Meta</th> <th>Treatment(s)</th> <th>Follow-up</th>	Author	Case	Age/sex	Symptoms	Location(s)	Meta	Treatment(s)	Follow-up
e.gli 3 Headohe-nusis, vonting Tertorium No No e.gli Headohe-nusis, vonting Right frontal (bis log) No No No e.gli Headohe-nusis, vonting Right frontal (bis log) No No No e.gli Headohe-nusis, vonting Right frontal (bis log) No No No e.gli 2 Headohe-siggih-pupility responses Effortal (non) No No No e.gli 2 4 Headohe-vontig Right frontal (bis log) No Singer removal-CHAT e.gli 2 4 Headohe-vontig Right frontal (bis cond) No Singer removal-CHAT e.gli 2 4 Headohe-vontig Right frontal (bis cond) No CHA-CHAT vontage 2 6 Mo No CHA-CHAT Constant vontage 2 8 Right frontal (bis cond) No CHA-CHAT vontage 1 2 6 Mo No CHA-CHAT	Mobley et al ¹⁷	_	21/M	Headache, double vision, hemianopia	Right occipital parafalcine	No	PR+CT+RT	18 months after surgery:
et all bet in the interval of the interval et all et all et all et all it in the interval et all et all e					region			recurrence and metastasis
3 71F Haddohe vonting and 5 Reprise Lung 5 Current 7 Lung 5 Current 7 Lung 5 Current 7 Lung 7 Current 7 Current 7	Mazur et al ^{is}	2	8/F	Headache, nausea, vomiting	Tentorium	No	PR+CT+RT	2 years after diagnosis: NED
et al. BF Headache, numera, vonting masses Term in numera Not Not et al. 7 7 Headache, numera, vonting masses Birontal runno Right print Right prin Right print		m	7/F	Headache, vomiting	Right frontal lobe	Lung	Surgery removal+CT+RT	N/A
ct/limit T/F Headerbe. suggist pupillary responses Medial right fromtal lobe Lung NM A etal 7 4/H Headerbe. suggist pupillary responses Extending on both sides Spheroid sinus STR-RT+CT if i 7 4/H Headerbe. suggist pupillary responses Extending on both sides Spheroid sinus STR-RT+CT if i 2 6/H Headerbe. vertige Right fromtal dum mater No STR-CT-RT see eal ¹¹ 1 2 5/H Headerbe. conting, ataxia Constant mater No STR-CT-RT see eal ¹¹ 1 2 5/H Headerbe. conting, ataxia Constant mater No STR-CT-RT see earl ¹¹ 1 2 5/H Headerbe. conting, ataxia Constant mater No STR-CT-RT see earl ¹² 1 2 6/H State conting No STR-CT-RT see earl ¹² 1 2 6/H Headerbe. conting Rt State conting State-CT-RT see earl ¹² 1	Pekala et al ¹⁹	4	8/F	Headache, nausea, vomiting	Tentorium cerebelli	No	N/A	N/A
et also 6 7/F Headabe, sluggish puplibry responses Efformati unor of fax, cerebin Sphenold sinus GTR+RT+GT It 2 4/H Headabe, vorniting, ataxia Cerebelium Cousa add GTR+RT+GT It et also 30F Headabe, vorniting, ataxia Cerebelium Cousa add GTR+RT+GT set al 30 GT Headabe, vorniting, ataxia Right frontal dura mater No GTR+RT+GT note all 10 17/M Headabe, vorniting, drowsiness Right frontal dura mater No GTR+RT note all 13 6/F Headabe, vorniting, drowsiness Right frontal dura mater No GTR+RT-GT note all 13 6/F Headabe, vorniting, drowsiness Right frontal dura mater No GTR+RT-GT note all 13 6/F Headabe, vorniting, drowsiness Right frontal dura mater No GTR+RT-GT note all 13 14/F Multiple, borns GTR+RT-GT Right frontal dura mater No GTR+RT-GT note all 13		S	7/F	Headache, vomiting, nausea	Medial right frontal lobe	Lung	N/A	N/A
III III Headedee, vortieng azoaa Exercinal conton sides Cours and conton sides (e.a. ¹¹) 8 30F Headedee, vortieng azoaa Cours and conton sides Crus and conton sides (e.a. ¹¹) 10 17M Headedee, vortieng azoaa Right frontal dura mater No Crus and conton sides see al ¹¹ 10 17M Headedee, vortieng azoaa Right frontal dura mater No Crus and conton sides oot et al ¹¹ 13 46F Headedee, vortieng drowsines Right frontal dura mater No Crus and conton sides oot et al ¹¹ 13 46F Headedee, vortieng drowsines Right frontal dura mater No Crus And oot et al ¹¹ 13 46F Headedee, vortieng drowsines Right frontal dura mater No Crus And oot al ¹¹ 13 46F Headedee, vortieng drowsines Right frontal dura mater No Crus And oot al ¹¹ 13 46F Headedee, vortieng drowsines Right frontal dura mater No Crus And oot al ¹¹ 14F	Kazmi et al ²⁰	9	7/F	Headache, sluggish pupillary responses	Bifrontal tumor	Sphenoid sinus	GTR+RT+CT	N/A
III 7 4M Headache, vonting azoia Cerebelum Conus and cuick equina CTR-RT-FC ie al ¹¹ 8 7 6M Headache, vertgo Right frontal meninges Mulpie boons GTR-ACT-RT se tal ¹¹ 9 6M Lethargy, vonit Right frontal dura mater No GTR-ACT-RT se tal ¹² 10 17M Headache, left neck, arm, chest paresthesia Right frontal dura mater No GTR-ACT-RT onio et al ¹² 13 84F Headache, voniting drowsiness Right frontal dura mater No GTR-ACT-RT onio et al ¹² 13 84F Headache, voniting drowsiness Right frontal dura mater No GTR-ACT-RT onio et al ¹² 13 84F Headache No GTR-ACT-RT or et al ¹⁰ 14 3M Headache No GTR-ACT-RT or et al ¹⁰ 16 11/F Headache No GTR-ACT-RT or et al ¹⁰ 17 17 Right frontal dura mater No GTR-ACT-RT					Extending on both sides of falx cerebri			
Iteral ¹² B 30F Headche, vertigo Right frontal meninges duate quina se et al ¹³ 9 6/M Lethargy, vonit Right frontal dura mater No GTR+CT+RT meardere 10 17/M Headache, vonit Right frontal dura mater No GTR+CT+RT more ct al ¹³ 11 12/M Severe headache, left neck, ann, chest paresthesia Right frontal dura mater No GTR+CT+RT noite et al ¹³ 13 46F Headache, voniting drowsiness Right frontal dura mater No GTR+CT+RT noite 13 46F Headache, voniting drowsiness Right frontal dura mater No GTR+CT+RT noite 13 46F Headache, voniting Right remoral mater No GTR+CT+RT nater 0 Right remoral mater No GTR+CT+RT No nater 0 Right remoral mater No GTR+CT+RT nater 11 17/F Headache, voniting lift remoral mater No GTR+RT+CT nater	Jay et al ²¹	7	4/M	Headache, vomiting, ataxia	Cerebellum	Conus and	GTR+RT+CT	N/A
I ctain 8 30P Headache, vertego Kight frontal dura mater No GTR-CT-RT sseera ¹⁰ 9 6/M Lethargy, vomit Right frontal dura mater No GTR-CT-RT maerdere 10 17/M Headache, vomiting, drowsiness Right frontal dura mater No GTR-CT-RT nol ectal ¹⁰ 12 50F Headache, vomiting, drowsiness Right frontal dura mater No GTR-CT-RT ot et al ¹⁰ 13 48F Headache, vomiting, drowsiness Right frontal dura mater No GTR-CT-RT ot et al ¹⁰ 13 48F Headache, vomiting, drowsiness Right frontal dura mater No GTR-CT-RT ot et al ¹⁰ 13 48F Headache, somiting, drowsiness Right frontal dura mater No GTR-CT-RT ot et al ¹⁰ 13 48F Headache, somiting, drowsiness Right frontal dura mater No GTR-CT-RT ot et al ¹⁰ 13 48F Freeson sinus No GTR-CT-RT ot et al ¹⁰ 16 11/F Headache, somiting, drowsiness No GTR-CT-RT atavej et al ¹⁰ 16 11/F Headache, somiting, drowsines No GTR-RT-CT atavej et al ¹⁰ 17/F H	<u>:</u>	¢	1,00			cauda equina		
se tal ³ 9 6/M Lethargy, vonit Right frontal dura mater, contralateral CP ange No GTR+RT norecrider 10 17M Headache. Right frontal dura mater, contralateral CP ange No GTR+RT nore ctal ³² 12 S0F Headache. Jefn neck, arm, chest paresthesia Right frontal dura mater No GTR+RT ore tal ³² 13 48F Headache. vonting, drowsiness Right frontal dura mater No GTR+RT ore tal ³² 13 48F Headache. vonting, drowsiness Right frontal dura mater No GTR+RT-GT ore tal ³² 14 Targe No GTR+RT-GT No off adache. vonting, drowsiness Right temporal region No GTR+RT-GT off adache. vonting left temporal scalp svelling Right temporal region No GTR+RT-GT attal ³¹ 17 T/T Distrest left unubness waktores headache. Right temporal region No GTR+RT-GT attal ³¹ 16 11/F Distrest left unubness waktores headache. Right temporal region No </td <td>Papotti et al²²</td> <td>œ</td> <td>30/F</td> <td>Headache, vertigo</td> <td>Right frontal meninges</td> <td>Multiple bones</td> <td>GTR+CT+RT</td> <td>/ years after diagnosis: NED 10 years after diagnosis:</td>	Papotti et al ²²	œ	30/F	Headache, vertigo	Right frontal meninges	Multiple bones	GTR+CT+RT	/ years after diagnosis: NED 10 years after diagnosis:
Total Control	A	c	M		D :			succumb to the disease
maerdere ID I/M Headache Right frontal dura mater, No GTR+RT nio et al ³ 12 50F Headache, vomiting, drowsiness Right frontal dura mater, No GTR+RT nio et al ³ 13 48F Headache, vomiting, drowsiness Right frontal dura mater, No GTR+RT o et al ³ 13 48F Headache, vomiting, drowsiness Right frontal dura mater, No GTR+RT-CT o et al ³ 13 48F Headache, vomiting, drowsiness Right tentorium extending No GTR+RT+CT o et al ³ 15 56/F Headache, confusion, hemparesis Right temporal region No GTR+RT+CT imfraetonicial and No Timferentorial and No GTR Subtotal removal+RT+CT atavej et al ¹⁰ 17 17 Distress tentorial and No GTR Subtotal removal+RT+CT atavej et al ¹⁰ 17 17 Distress tentorial and No GTR Suptoral removal+RT+CT atavej et al ¹⁰ 17 17 Distress tentorial scalp swelling Right temporonial reg	Antunes et al	~ .	1.1/0	Letnargy, vomit	Nghu ironlai dura mater		פוצ+רו+צו	
11 12M Severe headache, left neck, arm, chest pareachteria Right frontal dura mater No GTR+CT+RT 0nio et al ³ 12 50F Headache, vomting, drowsiness Right parietotemporal dura No GTR 0 et al ³ 13 46F Headache, vomting, drowsiness Right parietotemporal dura No GTR 0 et al ³ 13 46F Headache, vomting, drowsiness Right tentorium extending No GTR 0 et al ³ 14 3M Headache, contusion, hemiparesis Right tentorial and infraentorial compartments No GTR attering 17 17F Dizziness, left numbness weakness, headache, emesis Right fremporal region No GTR attering 17 17F Dizziness, left numbness weakness, headache, emesis Right fremporal region No GTR attering 17 17F Dizziness, left numbness weakness, headache, emesis Right fremporal region No GTR attering 17 17F Dizzines, left numbness weakness, headache, emesis <td>Dedeurwaerdere</td> <td>0</td> <td>M// I</td> <td>Headache</td> <td>Kight frontal dura mater,</td> <td>No</td> <td>GTR+RT</td> <td>8 years: recurrence</td>	Dedeurwaerdere	0	M// I	Headache	Kight frontal dura mater,	No	GTR+RT	8 years: recurrence
1112MSevere headache, left neck, arm, chest paresthesiaRight frontal dura materNoGTR+cT+RTon e t al?1348FHeadache, vomiting, drowsinessRight parietotemporal duraNoGTR+To et al?1348FHeadache, vomiting, drowsinessRight temtorian andNoDebulking+RT+cTo et al?1556FHeadache, vomiting, left temporal scalo swellingNoDebulking+RT+cTo et al?1556FHeadache, vomiting, left temporal scalo swellingNoSubtotal removal+RT+cTnury1611/FHeadache, comfusion, hemparesisRight temporal regionNoGTR+RTnury1611/FHeadache, comiting, left temporal scalo swellingRight temporal regionNoGTR+RTatavej et al?171717/FDizziness, left numbness weakness, headache, emesisRight fromoparietal lunctionNoGTR+RTatavej et al?1717/FDizziness, left numbness weakness, headache, emesisRight fromoparietal lunctionNoGTR+RTatavei et al?1717/FDizziness, left numbness weakness, headache, emesisRight fromotal regionNoGTR+RTatavei et al?1717/FDizziness, left numbness weakness, headache, emesisRight fromotal regionNoGTR+RTatavei et al?1717/FDizziness, left numbness weakness, headache, emesisRight fromotal regionNoGTR+RTatavei et al?205/MForoitig eft actal witching, inpairedRight fromotal	et al 24				contralateral CP angle			12 months after retreatment of recurrence: NED
noise et al ¹⁵ 1250FHeadache, vomiting, drowsinessRight parietotemporal duraNoGTR \circ et al ¹⁶ 1348FHeadache, vomiting, drowsinessCavernous sinusNoGTR \circ et al ¹⁷ 143/MHeadache, vomitingCavernous sinusNoDebulking+MT+GT \circ et al ¹⁸ 1556FHeadache, confusion, hemiparesisRight tentorium extendingNoSubtoral removal+RT+GT \circ et al ¹⁸ 1556FHeadache, confusion, hemiparesisRight tentorium extendingNoSubtoral removal+RT+GThury1611/F11/FHeadache, confusion, hemiparesisRight temporal regionNoGTRhury1717/FDizrines, left numbness weakness, headache, emesisRight fromoparietal regionNoGTR+RTatevej et al ¹⁸ 1717/FDizrines, left antonoral scaleNoGTR+RTatevej et al ¹⁹ 1717/FDizrines, left antonoral scaleNoGTR+RTateral ¹¹ 195/MVomiting left abducens nerve palsyLeft temporal legionNoGTR+RT+GTatal ¹² 216/TFacial pain, deterioration of hearing, headacheRight frontal regionNoGTR+RT+GTtet al ¹⁹ 216/T6/TTemoral scaleNoGTR+RT+GTtet al ¹⁹ 216/T6/TFacial pain, deterioration of hearing, headacheNoGTR+RT+GTtet al ¹⁹ 216/T77NoGTR+RT+GTtet al ¹⁹ </td <td></td> <td>=</td> <td>12/M</td> <td>Severe headache, left neck, arm, chest paresthesia</td> <td>Right frontal dura mater</td> <td>No</td> <td>GTR+CT+RT</td> <td>27 months: NED</td>		=	12/M	Severe headache, left neck, arm, chest paresthesia	Right frontal dura mater	No	GTR+CT+RT	27 months: NED
$5 \text{ et a}^{1/2}$ 1348/FHeadacheHeadacheCurrous sinusNoDebulking-RT+CT $\circ \text{ et a}^{1/2}$ 143/MHeadache, vomitingRight rentorium extendingNoDebulking-RT+CT $\circ \text{ et a}^{1/2}$ 1556/FHeadache, vomitingRight remtorial andinfratentorial compartments $\operatorname{teta}^{1/2}$ 1556/FHeadache, vomiting, left temporal scalp swellingNoSubtoral removal+RT+CT $\operatorname{teta}^{1/2}$ 1717/FDizziness, left numbness weakness, headacheNoGTR $\operatorname{teta}^{1/2}$ 1717/FDizziness, left numbness weakness, headache, emesisRight fromoparietal inuctionNo $\operatorname{teta}^{1/2}$ 195/MVomiting, left abducens nerve palsyLeft temporal lobeNoGTR+RT+CT $\operatorname{teta}^{1/2}$ 205/MVomiting, left abducens nerve palsyTemtoriumNoGTR+RT+CT $\operatorname{teta}^{1/2}$ 216//FFacial pain, deterioration of hearing headacheCrebellopontine angleNoGTR+RT+CT $\operatorname{teta}^{1/2}$ 216//FFacial pain, deterioration of hearing headacheCrebellopontine angleNoGTR+RT+CT $\operatorname{teta}^{1/2}$ 216//FFacial pain, deterioration of hearing headacheRight frontal lobeNoGTR+RT+CT $\operatorname{teta}^{1/2}$ 216//FFacial pain, deterioration of hearing headacheRight frontal lobeNoGTR+RT+CT $\operatorname{teta}^{1/2}$ 216//FFacial pain, deterioration of hearing headacheRight frontal lobeNo<	D'Antonio et al ²⁵	12	50/F	Headache, vomiting, drowsiness	Right parietotemporal dura mater	No	GTR	12 months after surgery: NED
o et al ¹² 14 3/M Headache, vomiting Right tentorium extending No Subtotal removal+RT+TCT et al ¹² 15 56/F Headache, confusion, hemiparesis Right tentorial and No Subtotal removal+RT+TCT hury 16 11/F Headache, confusion, hemiparesis Right temporal region No Supery removal+RT+TCT atavej et al ¹³ 17 17/F Dizziness, left numbness weakness, headache, emesis Right fromtoparietal innoction No GTR atavej et al ¹³ 19 5/M Vomiting, left abducens nerve palsy Left temporal lobe No GTR+RT+CT ma et al ¹³ 19 5/M Vomiting, left abducens nerve palsy Bilateral frontal region No GTR+RT+CT ma et al ¹³ 20 5/M Vomiting, left abducens nerve palsy Bilateral frontal region No GTR+RT+CT na et al ¹³ 21 6/T Foroital guet frontal lobe No GTR+RT+CT na et al ¹³ 21 6/T Foroital guet frontal lobe No GTR+RT+CT na et al ¹³ 21 6/T Foroital parietal lobe No GTR+RT+CT na et al ¹³ 21 6/T Foroital parietal lobe No Fornellopariter	Attabib et al ²⁶	13	48/F	Headache	Cavernous sinus	No	Debulking+RT+CT	14 months after surgery: stable
at ala 15 56/F Headache, confusion, hemiparesis infratentorial compartments infratentorial compartments hury 16 11/F Headache, confusion, hemiparesis Right temporal region No GTR atavej et al ³⁰ 17 17/F Dizziness, left numbness weakness, headache, emesis Right frontoparietal junction No GTR+RT+CT atavej et al ³⁰ 17 17/F Dizziness, left numbness weakness, headache, emesis Right frontoparietal junction No GTR+RT+CT atavej et al ³⁰ 17 17/F Dizziness, left numbness weakness, headache, emesis Right frontoparietal junction No GTR+RT+CT atavej et al ³⁰ 20 5/M Vomiting, left abducens nerve palsy Tentorium No GTR+RT+CT ma et al ³¹ 21 6/1 Facial pain, deterioration of hearing, headache Cerebellopontine angle No GTR+RT+CT ns et al ³³ 21 6/1/F Facial pain, deterioration of hearing, headache Cerebellopontine angle No GTR+RT+CT nheuvel 22 3/F Tongue smacking left facial twitching, impaired Right frontal lobe No GTR+RT+CT <t< td=""><td>Navarro et al²⁷</td><td>4</td><td>3/M</td><td>Headache, vomiting</td><td>Right tentorium extending</td><td>No</td><td>Subtotal removal+RT+CT</td><td>14 months after surgery: NED</td></t<>	Navarro et al ²⁷	4	3/M	Headache, vomiting	Right tentorium extending	No	Subtotal removal+RT+CT	14 months after surgery: NED
et al ³⁶ 15 56/F Headache, confusion, hemiparesis Right temporal region No GTR hury 16 11/F Headache, vomiting, left temporal scalp swelling Left temporal region No GTR+RT atavej et al ³⁰ 17 17/F Dizziness, left numbness weakness, headache, emesis Right frontoparietal junction No GTR+RT+CT atavej et al ³¹ 19 5/M Vomiting, left abducens nerve palsy Left temporal lobe No GTR+RT+CT ma et al ³¹ 19 5/M Vomiting, left abducens nerve palsy Entonium No GTR+RT+CT ma et al ³² 20 5/M Vomiting, left abducens nerve palsy Entonium No GTR+RT+CT ma et al ³² 21 6/J Fontal negion No GTR+RT+CT ma et al ³³ 21 6/J Fontal pariet frontal region No GTR+RT+CT ma et al ³³ 21 6/J Fontal pariet frontal region No GTR+RT+CT ma et al ³³ 21 6/J Fontal pariet frontal region No GTR+RT+CT areal ³² 3/J Ongue smacking le					into both supratentorial and infratentorial compartments			5
Ihury 16 11/F Headache, vomiting, left temporal scalp swelling Left temporoparietal region No Surgery removal+RT+CT atavej et al ³⁰ 17 17/F Dizziness, left numbness weakness, headache, emesis Right frontoparietal junction No GTR+RT atavej et al ³¹ 19 5/M Vomiting, left abducens nerve palsy Left temporal lobe No GTR+RT+CT ma et al ³¹ 19 5/M Vomiting, left abducens nerve palsy Temtorium No GTR+RT+CT ma et al ³¹ 10 5/M Vomiting, left abducens nerve palsy Temtorium No GTR+RT+CT tata ³² 20 5/M Vomiting, left abducens nerve palsy Temtorium No GTR+RT+CT tata ³² 21 6//F Facial pain, deterioration of hearing, headache Cerebellopontine angle No GTR+RT+CT nheuvel 22 3/F Tongue smacking, left facial twitching, impaired Right frontal lobe No GTR+RT+CT 23 2/M Increasing number of falls Frontal parietal lobe No Surgery+CT	Mellai et al ²⁸	15	56/F	Headache, confusion, hemiparesis	Right temporal region	No	GTR	14 months after surgery: NED
atavej et al ¹⁰ 17 Tiff Dizziness, left numbness weakness, headache, emesis Right frontoparietal junction No GTR+RT+CT 18 17/M Emesis, headache Left temporal lobe No GTR+RT+CT ma et al ¹¹ 19 5/M Vomiting, left abducens nerve palsy Tentorium No GTR+RT+CT ma et al ¹¹ 19 5/M Vomiting, left abducens nerve palsy Tentorium No GTR+RT+CT ma et al ¹² 20 5/M Vomiting, left abducens nerve palsy Bilateral frontal region No GTR+RT+CT ms et al ¹³² 21 67/F Facial pain, deterioration of hearing, headache Crebellopontine angle No GTR+RT+CT nheuvel 23 3/F Tongue smacking, left facial twitching, impaired Right frontal lobe No GTR+RT+CT 23 2/M Increasing number of falls Frontal parietal lobe No Surgery+CT 24 6/I/M Depresed mood, poor concentration, decreased Right temporal lobe No Surgery+CT 24 6/I/M Depresed mood, poor concentration, decreased Right temporal lobe No Surg	Choudhury et al ²⁹	16	11/F	Headache, vomiting, left temporal scalp swelling	Left temporoparietal region	No	Surgery removal+RT+CT	N/A
18 17/M Emesis, headache Left temporal lobe No GTR+RT+CT ma et al ³¹ 19 5/M Vomiting, left abducens nerve palsy Tentorium No GTR+RT+CT et al ³² 20 5/M Vomiting, left abducens nerve palsy Bilateral frontal region No GTR+RT+CT at al ³² 21 67/F Facial pain, deterioration of hearing, headache Cerebellopontine angle No GTR nHeuvel 23 3/F Tongue smacking, left facial twitching, impaired Right frontal lobe No GTR+RT+CT 23 2/M Increasing number of falls Frontal parietal lobe No Surgery+CT 24 6//M Depressed mood, poor concentration, decreased Right temporal lobe No Surgery+CT 24 6//M Depressed mood, poor concentration, decreased Right temporal lobe No Surgery+CT 24 6//M Depressed mood, poor concentration, decreased Right temporal lobe No Surgery+CT 25 2/M Depressed mood, poor concentration, decreased Right temporal lobe No Surgery+CT 29 6//M <td>Bunyaratavej et al³⁽</td> <td></td> <td>17/F</td> <td>Dizziness, left numbness weakness, headache, emesis</td> <td>Right frontoparietal junction</td> <td>No</td> <td>GTR+RT</td> <td>24 months: NED</td>	Bunyaratavej et al ³⁽		17/F	Dizziness, left numbness weakness, headache, emesis	Right frontoparietal junction	No	GTR+RT	24 months: NED
ma et al ¹¹ 19 5/M Vomiting, left abducens nerve palsy Tentorium No GTR+RT+CT st al ¹² 20 5/M Exophthalmos, bloody nasal discharge Bilateral frontal region No GTR+RT+CT ns et al ¹³ 21 67/F Facial pain, deterioration of hearing, headache Cerebellopontine angle No Palliative RT nHeuvel 22 3/F Tongue smacking, left facial twitching, impaired Right frontal lobe No GTR+RT+CT 23 2/M Increasing number of falls Frontal parietal lobe No Surgery+CT 23 2/M Depressed mood, poor concentration, decreased Right temporal lobe No Surgery+CT 24 61/M Depressed mood, poor concentration, decreased Right temporal lobe No Surgery+CT 24 61/M Depressed mood, poor concentration, decreased Right temporal lobe No Surgery+CT 24 61/M Depressed mood, poor concentration, decreased Right temporal lobe No Surgery+CT		81	17/M	Emesis, headache	Left temporal lobe	No	GTR+RT+CT	12 months after surgery: NED
et al ³² 20 5/M Exophthalmos, bloody nasal discharge Bilateral frontal region No GTR ns et al ³³ 21 67/F Facial pain, deterioration of hearing, headache Cerebellopontine angle No Palliative RT hHeuvel 22 3/F Tongue smacking, left facial twitching, impaired Right frontal lobe No GTR+RT+CT coordination 23 2/M Increasing number of falls Frontal parietal lobe No Surgery+CT 24 61/M Depressed mood, poor concentration, decreased Right temporal lobe No Surgery appetite, slumping of speech, word-finding difficulty,	Katayama et al ³¹	61	5/M		Tentorium	No	GTR+RT+CT	7 years after surgery: NED
 are ta¹³ 21 67/F Facial pain, deterioration of hearing, headache Cerebellopontine angle No Palliative RT Arheuvel 22 3/F Tongue smacking, left facial twitching, impaired Right frontal lobe No GTR+RT+CT 23 2/M Increasing number of falls 24 61/M Depresed mood, poor concentration, decreased Right temporal lobe No Surgery+CT 24 61/M Depresed mood, poor concentration, decreased Right temporal lobe No Surgery+CT 	Niwa et al ³²	20	5/M	Exophthalmos, bloody nasal discharge	Bilateral frontal region	No	GTR	20 days after surgery: died of
 and et al³³ b 67/F Facial pain, deterioration of hearing, headache Cerebellopontine angle No Palliative RT b 67/F Facial pain, deterioration of hearing, impaired Right frontal lobe No GTR+RT+CT coordination 23 2/M Increasing number of falls Frontal parietal lobe No Surgery+CT 24 61/M Depressed mood, poor concentration, decreased Right temporal lobe No Surgery+CT appetite, slumping of speech, word-finding difficulty, 								renal failure
nHeuvel 22 3/F Tongue smacking, left facial twitching, impaired Right frontal lobe No GTR+RT+CT coordination 23 2/M Increasing number of falls Frontal parietal lobe No Surgery+CT 24 61/M Depressed mood, poor concentration, decreased Right temporal lobe No Surgery appetite, slumping of speech, word-finding difficulty,	Simmons et al ³³	21	67/F	Facial pain, deterioration of hearing, headache	Cerebellopontine angle	No	Palliative RT	13 months after surgery: succumb to the disease
 23 2/M Increasing number of falls 24 61/M Depressed mood, poor concentration, decreased Right temporal lobe No Surgery appetite, slumping of speech, word-finding difficulty, 	VandenHeuvel et al ³⁴	22	3/F	Tongue smacking, left facial twitching, impaired coordination	Right frontal lobe	No	GTR+RT+CT	6 years after diagnosis: NED
61/M Depressed mood, poor concentration, decreased Right temporal lobe No Surgery appetite, slumping of speech, word-finding difficulty,		23	2/M	Increasing number of falls	Frontal parietal lobe	No	Surgery+CT	21 months after diagnosis: NED
		24	61/M	Depressed mood, poor concentration, decreased appetite, slumping of speech, word-finding difficulty,	Right temporal lobe	No	Surgery	Lost to follow-up

Dovepress

				gnosis: NED				
N/A	N/A	N/A		6 months after diagnosis: NED	24 months: NED			И, male; F, female.
Subtotal resection	Surgery+CT	Tumor biopsy+CT+RT		GTR+RT+CT	GTR+RT			, partial resection; RT, radiotherapy; l
No	No	No		No	No			of disease; PR
Anterior falx	Dura and frontal lobe	Right cavernous sinus		Right frontotemporal region No	Left temporoparietal and	occipital regions attached	to tentorium	, not available; NED, no evidence
Midline trontal scalp swelling, headache, giddiness, epiphora, diplopia	Generalized tonic-clonic seizure, headache, vomiting Dura and frontal lobe	Headache, nausea, vomiting, right ophthalmoplegia,	ptosis	Headache	Occipital headache, blurred vision			Abbreviations: CP, cerebellopontine; CT, chemotherapy; GTR, gross total resection; Meta, metastasis; N/A, not available; NED, no evidence of disease; PR, partial resection; RT, radiotherapy; M, male; F, female.
11/F	3/N/A	46/M		I 5/M	13/F			oontine; CT,
25	26	27		28	29			, cerebellop
Bano et al ³⁵	Amita et al ³⁶	ldrees et al ³⁷		Furuno et al ³⁸	Velivela et al ³⁹			Abbreviations: CP

tumor masses to prevent disease progression due to cure delays and surgical stressors. In the present case, symptoms and signs of intracranial neoplasms became suddenly severe with subsequent development of herniation. For such cases, typical care includes immediate surgical measures to relieve cerebral hernias. Under certain circumstances, feasibility and safety of such surgeries may be dramatically limited (eg, tumors are in high-risk locations or patient rejections of further traumatic treatments). Thus, in some cases, nonsurgical methods may be useful treatment modalities. In this case, radiotherapy was chosen, with some uncertainty, as the primary treatment modality given the highly radiosensitivity of ES. In addition to radiation, other therapies, in particular dehydrants and hormone treatments, were also clinically crucial. First, they directly reduced intracranial pressures. Moreover, cellular edema occurring in initial stages of radiotherapy was alleviated by these adjuvant therapies. Overall, this case provided a novel demonstration of emergent radiation as a feasible treatment for intracranial radiosensitive tumor-induced hernias. Given that this study presents a single case, there are limitations that warrant further investigations.

Prognostication of localized pPNET has been markedly improved by multidisciplinary collaboration in the development of therapeutic proposals. However, patients with primary disseminated multifocal ES still harbor very low survival rates. Previous reports revealed that sites of metastasis were overt, independent prognostic factors. Conversely, primary disseminated ES with single pulmonary metastases often have had much better outcomes compared with metastases to other sites.9-11 Additionally, negative prognoses for primary disseminated multifocal ES have correlated with relatively older patient ages (>14 years old, 10 >15 years old⁹), larger primary masses volumes (>200 mL), bone marrow involvements, the presence and number of bone lesions, additional lung metastases, and fevers at diagnosis.^{9,10} ES are routinely characterized by gene fusions between EWS and ETS family genes. Retrospective studies have demonstrated different types of chromosomal rearrangements predicting divergent outcomes.^{12,13} One recent prospective cohort study found no prognostic value for characterization of any gene fusions.¹⁴ van Doorninck et al¹⁵ attributed these discrepancies regarding the value of type 1 fusions in ES prognostication to current intensive treatment proposals. Additionally, new biomarkers and molecularly detectable minimal disseminated diseases are completely novel areas for prognostication.¹⁶ Although, these new directions have potential promise, their clinical utilities require further study.

Conclusion

Intracranial pPNET are rare, but serious, diseases. Classifications of pPNET and central PNET should be completely differentiated as they display unique treatment proposals and prognostications. Emergent medical measures ought to be performed when metastatic neoplasms present as spinal cord compressions. Radiotherapy may be an effective choice to alleviate brain herniations induced by radiosensitive intracranial pPNET.

Acknowledgments

This work was supported by the Taishan Scholars Program of Shandong Province, People's Republic of China (Grant No Ts20120505) and Shandong Province Natural Science Foundation (ZR2012HL33, ZR2013HL049).

Disclosure

The authors report no conflicts of interest in this work.

References

- 1. Delattre O, Zucman J, Melot T, et al. The Ewing's family of tumors: a subgroup of small-round-cell tumors defined by specific chimeric transcripts. *N Engl J Med.* 1994;331(5):294–299.
- Ijichi K, Tsuzuki T, Adachi M, Murakami S. A peripheral primitive neuroectodermal tumor in the larynx: a case report and literature review. *Oncol Lett.* 2016;11(2):1120–1124.
- Pezeshkpour GH, Henry JM, Armbrustmacher VW. Spinal metastases. A rare mode of presentation of brain tumors. *Cancer*. 1984;54(2): 353–356.
- Hasegawa SL, Davison JM, Rutten A, Fletcher JA, Fletcher CD. Primary cutaneous Ewing's sarcoma: immunophenotypic and molecular cytogenetic evaluation of five cases. *Am J Surg Pathol.* 1998;22(3):310–318.
- Navarro R, Laguna A, de Torres C, et al. Primary Ewing sarcoma of the tentorium presenting with intracranial hemorrhage in a child. *J Neurosurg*. 2007;107(5 Suppl):411–415.
- Musahl V, Rihn JA, Fumich FE, Kang JD. Sacral intraspinal extradural primitive neuroectodermal tumor. *Spine J*. 2008;8(6):1024–1029.
- Kobayashi S, Takahashi J, Sakashita K, Fukushima M, Kato H. Ewing sarcoma of the thoracic epidural space in a young child. *Eur Spine J*. 2013;22:S373–S379.
- Tong X, Deng X, Yang T, et al. Clinical presentation and long-term outcome of primary spinal peripheral primitive neuroectodermal tumors. *J Neurooncol.* 2015;124(3):455–463.
- Oberlin O, Rey A, Desfachelles AS, et al. Impact of high-dose busulfan plus melphalan as consolidation in metastatic Ewing tumors: a study by the Société Française des Cancers de l'Enfant. *J Clin Oncol.* 2006; 24(24):3997–4002.
- Ladenstein R, Pötschger U, Le Deley MC, et al. Primary disseminated multifocal Ewing sarcoma: results of the Euro-EWING 99 trial. *J Clin* Oncol. 2010;28(20):3284–3291.
- Luksch R, Tienghi A, Hall KS, et al. Primary metastatic Ewing's family tumors: results of the Italian Sarcoma Group and Scandinavian Sarcoma Group ISG/SSG IV study including myeloablative chemotherapy and total-lung irradiation. *Ann Oncol.* 2012;23(11):2970–2976.
- Zoubek A, Dockhorn-Dworniczak B, Delattre O, et al. Does expression of different EWS chimeric transcripts define clinically distinct risk groups of Ewing tumor patients? *J Clin Oncol.* 1996;14(4):1245–1251.
- de Alava E, Kawai A, Healey JH, et al. EWS-FL11 fusion transcript structure is an independent determinant of prognosis in Ewing's sarcoma. J Clin Oncol. 1998;16(4):1248–1255.

- 14. Le Deley MC, Delattre O, Schaefer KL, et al. Impact of EWS-ETS fusion type on disease progression in Ewing's sarcoma/peripheral primitive neuroectodermal tumor: prospective results from the cooperative Euro-E.W.I.N.G. 99 trial. *J Clin Oncol.* 2010;28(12):1982–1988.
- van Doorninck JA, Ji L, Schaub B, et al. Current treatment protocols have eliminated the prognostic advantage of type 1 fusions in Ewing sarcoma: a report from the Children's Oncology Group. *J Clin Oncol.* 2010;28(12):1989–1994.
- Gaspar N, Hawkins DS, Dirksen U, et al. Ewing sarcoma: current management and future approaches through collaboration. *J Clin Oncol.* 2015;33(27):3036–3046.
- Mobley BC, Roulston D, Shah GV, et al. Peripheral primitive neuroectodermal tumor/Ewing's sarcoma of the craniospinal vault: case reports and review. *Hum Pathol.* 2006;37(7):845–853.
- Mazur M, Gururangan S, Bridge J, et al. Intracranial Ewing's sarcoma. *Pediatr Blood Cancer*. 2005;45(6):850–856.
- Pekala JS, Gururangan S, Provenzale JM, Mukundan S Jr. Central nervous system extraosseous Ewing sarcoma: radiologic manifestations of this newly defined pathologic entity. *AJNR Am J Neuroradiol*. 2006;27(3):580–583.
- Kazmi SA, Perry A, Pressey JG, et al. Primary Ewing sarcoma of the brain: a case report and literature review. *Diagn Mol Pathol*. 2007;16(2):108–111.
- Jay V, Zielenska M, Lorenzana A, Drake J. An unusual cerebellar primitive neuroectodermal tumor with t(11;22) translocation: pathological and molecular analysis. *Pediatr Pathol Lab Med.* 1999;16(1):119–128.
- 22. Papotti M, Abbona G, Pagani A, et al. Primitive neuroectodermal tumor of the meninges: an histology, immunohistochemical, ultrastructural and cytogenetic study. *Endocr Pathol.* 1998;3(1): 275–280.
- Antunes NL, Lellouch-Tubiana A, Kalifa C, et al. Intracranial Ewing sarcoma/'peripheral' primitive neuroectodermal tumor of dural origin with molecular genetic confirmation. *J Neurooncol*. 2001;51(1):51–56.
- Dedeurwaerdere F, Giannini C, Sciot R, et al. Primary peripheral PNET/ Ewing's sarcoma of the dura: a clinicopathologic entity distinct from central PNET. *Mod Pathol.* 2002;15(6):673–678.
- D'Antonio A, Caleo A, Garcia JF, Marsilia GM, De Dominicis G, Boscaino A. Primary peripheral PNET/Ewing's sarcoma of the dura with FISH analysis. *Histopathology*. 2004; 45(6):651–654.
- Attabib NA, West M, Rhodes RH. Peripheral primitive neuroectodermal tumor of the cavernous sinus: case report. *Neurosurgery*. 2006; 58(5):E992.
- 27. Navarro R, Laguna A, de Torres C, et al. Primary Ewing sarcoma of the tentorium presenting with intracranial hemorrhage in a child. *J Neurosurg*. 2007;107(5):411–415.
- Mellai M, Caldera V, Comino A, Fortunato M, Bernucci C, Schiffer D. PNET/ESFT of the cranial vault: a case report. *Clin Neuropathol*. 2010;29(6):372–377.
- 29. Choudhury KB, Sharma S, Kothari R, Majumder A. Primary extraosseous intracranial Ewing's sarcoma: Case report and literature review. *Indian J Med Paediatr Oncol*. 2011;32(2):118–121.
- Bunyaratavej K, Khaoroptham S, Phonprasert C, Tanboon J, Shuangshoti S. Primary intracranial peripheral primitive neuroectodermal tumor/Ewing's sarcoma presenting with acute intracerebral hemorrhage. *Clin Neuropathol.* 2005;24(4):184–190.
- Katayama Y, Kimura S, Watanabe T, Yoshino A, Koshinaga M. Peripheral-type primitive neuroectodermal tumor arising in the tentorium: case report. *J Neurosurg.* 1999;90(1):141–144.
- Niwa J, Shimoyama N, Takahashi Y. Primitive neuroectodermal tumor involving the frontal skull base in an infant. *Childs Nerv Syst.* 2001;17(9):570–574.
- Simmons MA, Luff DA, Banerjee SS, Ramsden RT. Peripheral primitive neuroectodermal tumour (pPNET) of the cerebellopontine angle presenting in adult life. *J Laryngol Otol*. 2001;115(10):848–852.
- VandenHeuvel KA, Al-Rohil RN, Stevenson ME, et al. Primary intracranial Ewing's sarcoma with unusual features. *Int J Clin Exp Pathol*. 2015;8(1):260–274.

- Bano S, Yadav SN, Garga UC. Case Report: Intracranial peripheral primitive neuroectodermal tumor-Ewing's sarcoma of dura with transcalvarial–subgaleal extension: An unusual radiological presentation. *Indian J Radiol Imaging*. 2009;19(4):305–307.
- Amita R, Sandhyamani S, Nair S, Kapilamoorthy TR. Intracranial ewings sarcoma/peripheral primitive neuroectodermal tumor. *Neurol India*. 2014;62(4):432–433.
- Idrees M, Gandhi C, Betchen S, Strauchen J, King W, Wolfe D. Intracranial peripheral primitive neuroectodermal tumors of the cavernous sinus: a diagnostic peculiarity. *Arch Pathol Lab Med.* 2005;129(1): e11–e15.
- Furuno Y, Nishimura S, Kamiyama H, et al. Intracranial peripheraltype primitive neuroectodermal tumor. *Neurol Med Chir (Tokyo)*. 2008;48(2):72–76.
- Velivela K, Rajesh A, Uppin MS, Purohit AK. Primary intracranial peripheral PNET-a case report and review. *Neurol India*. 2014;62(6): 669–673.

OncoTargets and Therapy

Publish your work in this journal

OncoTargets and Therapy is an international, peer-reviewed, open access journal focusing on the pathological basis of all cancers, potential targets for therapy and treatment protocols employed to improve the management of cancer patients. The journal also focuses on the impact of management programs and new therapeutic agents and protocols on

Submit your manuscript here: http://www.dovepress.com/oncotargets-and-therapy-journal

Dovepress

patient perspectives such as quality of life, adherence and satisfaction. The manuscript management system is completely online and includes a very quick and fair peer-review system, which is all easy to use. Visit http://www.dovepress.com/testimonials.php to read real quotes from published authors.