CASE REPORT

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PRIMARY EWING SARCOMA OF THE PETROUS TEMPORAL BONE: AN EXCEPTIONAL CAUSE OF FACIAL PALSY AND DEAFNESS IN A NURSLING

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Abstract: Background. Primary Ewing sarcoma affecting the skull base in general and the petrous bone in particular is extremely rare with only 4 reports of Ewing sarcoma arising in the petrous temporal bone in the international medical literature.

Methods. The authors report for the first time a case of a primary Ewing sarcoma of the petrous temporal bone in a 5-month-old nursling, which became apparent with a complete peripheral facial palsy and ipsilateral surdity.

Results. The neoformation was treated by systemic chemotherapy and radiation of the tumor region. The diagnostic steps, therapy, and development of the child are described in detail; the literature concerning Ewing sarcoma originating from the skull in general and from the petrous temporal bone in particular is reviewed.

Conclusions. The highlights of this case are an extremely uncommon location, an unusual age of presentation, as well as a unique set of symptoms.

Keywords: Ewing sarcoma; temporal bone; facial paralysis; bone neoplasms; skull base neoplasms

Ewing sarcoma is a highly malignant bone tumor that accounts for approximately 8% of all malignant bone tumors and that typically arises within the extremities or pelvis of a child or adolescent.1–4 From 1% to 6% of all Ewing sarcomas arise in the skull.5 Primary Ewing sarcoma affecting the skull base in general and the petrous bone in particular is extremely rare.5–8 Data from former case reports suggest that the biological behavior of primary Ewing sarcoma of the skull seems to be different from extracranial Ewing sarcoma with regard to the frequency of distant metastases and the response to radiation and chemotherapy. The prognosis of primary cranial Ewing sarcoma in the absence of surgery is uncertain. We present this case report to provide data concerning the clinical and therapeutic course of an extensive primary Ewing sarcoma of the petrous temporal bone, which was treated without performing surgery.

CASE REPORT

A 5-month-old male nursling was referred to our department for evaluation of a complete peripheral facial palsy. There had already been a period of temporary left-sided facial weakness after a gastrointestinal infection at the age of 2 months. When the boy was referred to our department 3 months later with the recurrence of the complete peripheral left-sided facial palsy, CT and MRI of the skull were carried out and showed a destruc-
tively growing neoformation, 5 cm in diameter, originating from the left petrous temporal bone (Figure 1). The demarcation of the tumor was unsharp and accumulation of contrast medium was inhomogeneous, indicating internal tumor necrosis. The tumor extended from the pyramidal apex to the sigmoid sinus knee and it also reached the foramen magnum. On the top, the tentorium was attached and displaced.

Staging examinations were carried out for evaluation of metastatic spread. No metastases were found in the chest, abdomen, or spine on CT, MRI, and scintillation imaging studies. No tumor cells were found in either the bone marrow or cerebrospinal fluid. For a period of 10 months, the child underwent systemic chemotherapy and radiation of the tumor region.

Cytostatic therapy was carried out with vincristine, actinomycin D, ifosfamid, doxorubicin, and etoposid analogous to the therapeutic scheme of the EURO-EWING-99-protocol. Antineoplastic therapy was tolerated well with a grade 3 to 4 hematologic toxicity, according to the common toxicity criteria of the National Cancer Institute (NCI). Because of the young age of this patient, radiation had to be performed under general anesthesia, with a daily dose of 1.8 Gray and a cumulative radiation dose of 45 Gray.

The course of disease and treatment was supervised by radiological control investigations for a period of 25 months. MRI and CT scans of the skull were carried out at regular 3 months intervals and revealed increasing internal tumor necrosis as well as ossification of the tumor matrix and regression of tumor size. At 25 months after the diagnosis, imaging studies showed a remnant of ossified tumor matrix, about 1.5 cm in diameter, in the left petrous bone, and revealed no indication for metastatic spread. Clinical investigations showed the persistence of deafness and the complete peripheral facial palsy on the left. To date, the general development of the child is in accordance with the age.

DISCUSSION

The primary Ewing sarcoma is a highly malignant bone tumor of neuroectodermal origin that accounts for approximately 8% of all malignant bone tumors.\textsuperscript{2–6} It is included in the group of small, round cell tumors that arise from neural elements, soft tissue, or bone, including neuroblastoma, rhabdomyosarcoma, mesenchymal chondrosarcoma, undifferentiated lymphoma, and peripheral primitive neuroectodermal tumor (pPNET). The precise origin of Ewing sarcoma continues to elude investigators, and the relationship between classic Ewing sarcoma of bone and PNET of bone remains controversial. It is not yet clear whether they are variants of the same tumor or completely different tumors with some similarities.\textsuperscript{6,9,10} Ewing sarcoma typically arises in the second and third decade affecting in first line the diaphysis of

![FIGURE 1. Magnetic resonance imaging (MRI) of the skull with and without contrast medium. A destructively growing neoformation, 5 cm in diameter, originating from the left petrous temporal bone. The demarcation of the tumor is unsharp and accumulation of contrast medium is inhomogeneous, indicating internal tumor necrosis. The tumor extends from the pyramidal apex to the sigmoid sinus knee and it also reaches the foramen magnum. On the top, the tentorium is attached and displaced.](image-url)
long tubular bones and the pelvis. When originating in these sites, Ewing sarcoma has a marked propensity for dissemination and metastatic spread.2–6,10,11 Leading clinical symptoms of the tumor are local pain and local swelling as well as signs of inflammation like anemia, leukocytosis, accelerated erythrocyte sedimentation rate (ESR), and intermittent febrile attacks.2–4,10 Mimicking osteomyelitis and other malignant tumors affecting the adolescent bone within clinical presentation, radiological findings, and sometimes even histological investigations, the diagnosis of Ewing sarcoma is often difficult to establish.2–4,6,10 Histo-pathologically, primitive monomorphic round cells are arranged in sheets and pseudo-rosettes with a high nuclear-to-cytoplasmic ratio and few defining characteristics.2–4,6,10 The diagnosis of Ewing sarcoma was facilitated by using cytogenetics and molecular biological markers. As accurate and rapid diagnosis of Ewing sarcoma is essential for clinical management, these techniques now play a predominant role in establishing the diagnosis. By immunohistochemistry overexpression of CD 99, a transmembrane protein encoded by the MIC-2 gene, is a helpful adjunct.6,12 Cytogenetic analysis demonstrates a consistent chromosomal translocation t(11;22)(q24;q12) with rearrangement of a EWS/FLI1 fusion transcript in 85% of cases of primary Ewing sarcoma.3,4,6,13 For Ewing sarcoma involving the extremities, pelvis, or nonaxial skeleton, traditional treatment consists of induction chemotherapy after biopsy, followed by radical surgery and adjuvant radiochemotherapy.6,10,14,15 In contrast to other malignant bone tumors, especially osteosarcoma, Ewing sarcoma shows, to a great extent, sensitivity to radiation therapy.6,11,16 The addition of chemotherapy in the treatment of Ewing sarcoma was first introduced by Rosen et al. in 1974 and has improved the rates of long-term survival from 5% to 10% to 50% to 60% during the past 30 years.3,4,6,10,11,15

From 1 to 6% of all Ewing sarcomas arise in the skull; these usually occur in the frontal and parietal convexities as well as in the mandible.5,10,11 Primary Ewing sarcoma of the skull usually grows as an extradural tumor which rarely breaches the dura, and therefore, often grows to an extremely large mass lesion before detection.6,10,12,18 The most common symptoms associated with Ewing sarcoma of the skull are signs of accelerated intracranial pressure. Local headaches, scalp swelling, papil-
ledema, and vomiting are reported signs in more than 50% of cases. Therapeutic principles for Ewing sarcoma primarily arising in the skull differ from the traditional treatment scheme for extracranial Ewing sarcoma, as patients with primary cranial Ewing sarcoma frequently present with large lesions, raised intracranial pressure, and impending neurological deficits demanding urgent surgical intervention. In contrast, local control of tumor in Ewing sarcoma of the skull by aggressive surgical resection is incomplete in most cases, as the neoformation often abuts vital structures, and radical surgery may lead to limited quality of life from mutilation and loss of function. Therefore, the completeness of resection will be a function of the site of the primary tumor's origin as well as the tumor size.

Nevertheless, the data appear to indicate that the prognosis of this subgroup may be similar to that of Ewing sarcoma arising from the extremities or pelvis, as distant metastasis from primary Ewing sarcoma of the skull is extremely uncommon and cranial Ewing sarcoma lesions seem to respond more favorably to radiation and polychemotherapy.

Although up to 6% of primary Ewing sarcomas arise in the skull, primary Ewing sarcoma affecting the skull base in general and the petrous bone in particular is extremely rare, with only 4 reports of Ewing sarcoma arising in the petrous temporal bone in the international medical literature. Steinbok et al in 1986 and Desai et al in 1998 reported 2 cases of Ewing sarcoma involving the petrous bone in a 3 year old girl and in an 18-month-old, that were both treated by radical surgery followed by adjuvant radiation and chemotherapy. In the case of a 5-month-old boy reported by Carlotti et al in 1999, surgical intervention and chemotherapy were performed without radiation. Interestingly, in all described cases of primary petrous bone Ewing sarcoma, exceptionally young infants were affected, who presented with very large lesions and signs of raised intracranial pressure requiring urgent surgical intervention. Nevertheless, despite aggressive surgery, the lesions were resected subtotally in all the cases but showed favorable response to polychemotherapy and radiation. None of the children showed signs of metastatic spread.

We present an additional case of a primary cranial Ewing sarcoma involving the petrous temporal bone in a 5-month-old, which is only the fourth reported case for the past 20 years. To the best of our knowledge, this is the first report of a case of primary petrous bone Ewing sarcoma, which became symptomatic with a peripheral facial palsy and ipsilateral surdity but without signs of raised intracranial pressure. As in former reported cases our patient was a child of exceptional young age that presented with a lesion of enormous size but did not show signs of metastatic spread. As the nursling did not present with accelerated intracranial pressure and impending neurological deficits urgent surgical intervention was not necessary. Furthermore, the possibility of achieving complete tumor-resection was doubtful and, in consideration of the young age of the patient as well as tumor size and localization, aggressive surgical resection may have led to limited quality of life from mutilation and loss of function of vital structures. For the first time tumor control was therefore achieved by radiochemotherapy without performing surgery.

To date, the child's general development is in accordance with his age, but he remains susceptible to possible chronic side effects secondary to his treatment, such as brain atrophy, growth retardation, hypopituitarism, and sarcomatous transformation due to high-dose radiation, as well as sterility and cardiomyopathy that may occur after chemotherapy. Severe craniofacial abnormalities are noted in about two thirds of children who received radiotherapy during their growing years, due to growth disturbances or growth arrest of the craniofacial skeleton.

Although the prognosis of Ewing sarcoma in general is often poor because of early metastasis to the lung and other bones, the data indicate that the same tumor occurring in the cranium can often be successfully managed by intensive combination therapy, obviously even without performing surgery. The literature suggests that the biological behavior of primary cranial Ewing sarcoma is somewhat different from that of extracranial Ewing sarcoma. In contrast to frequent metastases in Ewing sarcoma in general, almost none of the reported cases of primary cranial Ewing sarcoma demonstrated distant metastases, although the infants often presented with lesions of enormous size. Whether there is any difference in the outcome of primary cranial Ewing sarcoma between nearly total and total excision is unknown and the prognosis in the absence of surgery is uncertain. But because primary cranial Ewing sarcoma shows an excellent response to radiation and chemotherapy, a less aggressive surgical approach should probably be considered.
ences were supported by the case reported here, but further cases have to be studied for evaluation of the biological behavior of primary petrous bone Ewing sarcoma.

REFERENCES