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A Rare Location for Sarcoma Metastasis: The Temporal Bone

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Abstract

Skeletal sarcoma metastasis is relatively rare; moreover, for this type of metastasis, the temporal bone is also a rare location. The temporal bone appears to be affected by metastatic tumors in discrete histopathologic patterns, with characteristic clinical presentations. In this study, we analyzed the records of 6 patients with skeletal sarcoma metastasis to the temporal bone, with an emphasis on histopathologic sections of human temporal bones. The most common site of sarcoma metastasis in the temporal bone was petrous apex in our series. Physicians should keep in mind that a sarcoma patient may manifest with ear findings due to temporal bone metastasis.

Introduction

Skeletal sarcoma metastasis is relatively rare; moreover, for this type of metastasis, the temporal bone is also a rare location. The temporal bone appears to be affected by metastatic tumors in discrete histopathologic patterns, with characteristic clinical presentations. The incidence of skeletal sarcoma metastasis to the temporal bone seems to be increasing, given the generally increasing incidence of cancer as well as the increase in life expectancy.

More effective methods of radiochemotherapy have interrupted the course of sarcoma and allowed more time for metastasis. [1, 2] The mechanism of temporal bone metastasis can be explained by 5 distinct patterns: (1) hematogenous spread of carcinoma, leading to seeding of the marrow spaces of the petrous bone; (2) access by tumor cells to the cerebrospinal

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fluid (CSF) and dissemination through the subarachnoid space into the internal auditory canal (IAC); (3) direct extension; (4) leptomeningeal extension from an intracranial primary tumor; and (5) leukemic or lymphomatous infiltration.[1–5]

The 6 most common primary malignancies that metastasize to the temporal bone are breast, lung, kidney, stomach, bronchus, and prostate.[4–6] And the 5 most common sites of metastasis within the temporal bone are the petrous apex, internal auditory canal (IAC), mastoid cavity, external auditory canal, and middle ear.[4, 5] Because skeletal sarcoma metastasis to the temporal bone is very rare, only a few case reports have been published in the literature, rather than a large case series. Those case reports involved synovial sarcoma, angiosarcoma, histiocytic sarcoma, reticular cell sarcoma, liposarcoma, rhabdomyosarcoma, osteosarcoma, and hemangiopericytoma.[7–11]

Occasionally, the temporal bone is the site of origin of a sarcoma. Several petrosal sarcomas have been found in children and in young adults. Such sarcomas infiltrate rapidly, produce multiple cranial nerve palsies, and usually result in death from intracranial extension.

In this study, we analyzed the records of 6 patients with skeletal sarcoma metastasis to the temporal bone, with an emphasis on histopathologic sections of human temporal bones (HTBs).

Materials and Methods

This study was approved by the University of Minnesota institutional review board (0206M26181).

Using the University of Minnesota temporal bone collection, we analyzed the histopathologic sections of 11 HTBs from 6 patients with different types of skeletal sarcoma metastasis to the temporal bone. All of the HTB specimens were prepared per the standard technique of light microscopy, including fixation, decalcification, and serial 20- μ m sectioning in the horizontal plane; they were then stained with hematoxylin and eosin (H&E). We evaluated each HTB under light microscopy for the presence of tumor cells and noted the site of involvement.

We reviewed the corresponding clinical records and autopsy reports. For each of the 6 patients, we retrieved demographic data and noted the clinical course, otologic and vestibular manifestations, site of primary malignant tumor, and histologic features. The histopathologic diagnoses of tumors metastasized to the ear included Ewing sarcoma (2 patients), rhabdomyosarcoma (1 patient), angiosarcoma (1 patient), liposarcoma (1 patient), and reticular cell sarcoma (1 patient). Of the 6 patients, 4 had bilateral temporal bone metastasis; 2, unilateral. For the patient with reticular cell sarcoma metastasis, the opposite ear was not available for evaluation. Patient characteristics and diagnoses are summarized in Table 1.

Case 1 (Rhabdomyosarcoma)

A 45-year-old white female patient who described a mass on her left tibia underwent a local excision; histopathologic examination revealed alveolar rhabdomyosarcoma. She then underwent a local block excision with skin grafting of the left tibial area.

After 11 months, she was admitted again, because of lower back pain. An open biopsy of the primary lesion detected local recurrence; a myelogram showed complete obstruction due to a large epidural mass on the anterior space of the body of lumbar vertebra 5 (L5). She underwent a mid-thigh amputation of the left leg, followed by radiation therapy (40 Gy) to the lumbar spine.

Then, 2 months after her most recent discharge, she was readmitted with paraplegia. A laminectomy detected metastatic intramedullary rhabdomyosarcoma. Three days after that operation, she became lethargic, with bilateral profound hearing loss, hoarseness, dysphagia, and left facial palsy. Neurologic examination including hearing test revealed complete palsy of the left VII, bilateral VIII, right IX, and right X cranial nerves, as well as stiffness on flexion of the neck.

Despite treatment with steroid and antibiotics, she experienced respiratory arrest and was pronounced dead 7 days after the laminectomy. At autopsy, intracranial examination revealed multiple brain metastases and tumor involvement of meninges at the basal region, especially at the basal cisterns.

Histopathologic findings, left temporal bone—The external auditory canal (EAC) and middle ear were normal, but tumor cells were detected in the labyrinthine segment of the fallopian canal. Serous labyrinthitis was observed in the membranous labyrinth. The organ of Corti was damaged in all sections of cochlea; hair cells were not seen. A few tumor cells were detected in the scala tympani. The stria vascularis was slightly atrophic. The VII and VIII cranial nerves were destroyed by tumor cells; the number of Scarpa's ganglion cells was decreased in the IAC (Figure 1). The maculae of the utricle and saccule were infiltrated by white blood cells and slightly damaged by labyrinthitis. The cristae of the superior semicircular canal (SSC) and lateral semicircular canal (LSC) appeared normal; however, the crista of the posterior semicircular canal (PSC) was infiltrated by white blood cells and partially damaged by labyrinthitis.

Histopathologic findings, right temporal bone—The EAC was normal. The middle ear was also normal, but the tympanic membrane was retracted and attached to the long process of the incus and the head of stapes. Tumor invasion of the labyrinthine segment of the fallopian canal was observed. Purulent labyrinthitis was seen in the perilymphatic spaces of the membranous labyrinth. The organ of Corti was seriously damaged; hair cells had completely disappeared. In the scala tympani, scala vestibuli, and ductus cochlearis, many deformed erythrocytes were present. The stria vascularis was atrophied. The maculae of the utricle and saccule, and the cristae of all of the semicircular canals were infiltrated by white blood cells and showed minor damage caused by labyrinthitis. The IAC was filled with tumor cells, and the VII and VIII cranial nerves in the IAC were destroyed.

Case 2 (Ewing sarcoma)

An 18-year-old male patient was admitted to the hospital with left thigh pain. An x-ray revealed radiolucent areas of upper left femur; a persistently elevated erythrocyte sedimentation rate (ESR) was noted. A biopsy of the left femur revealed Ewing sarcoma. He underwent radiochemotherapy.

After his discharge he noted several small masses in various locations, including the mid upper arm posteriorly on the left, the right inguinal region, and the plantar surface of the right foot. Several biopsies of those locations, including the right inguinal region and the left thigh, confirmed the diagnosis of Ewing sarcoma with distant metastasis. He also had a bilateral decrease in his hearing, without tinnitus, as well as progressive development of severe back pain and upper thoracic pain accentuated by coughing.

Although he underwent radio-chemotherapy, he died 9 months after the diagnosis. Autopsy revealed widespread metastasis of Ewing sarcoma to the heart, lungs, ribs, and bone marrow.

Histopathologic findings, left temporal bone—The EAC, tympanic membrane, and middle ear were within normal limits; the ossicular chain was intact. The facial nerve was normal. The mastoid air cells were well pneumatized, with marked hyperplasia of the mucoperiosteum. The organ of Corti and the spiral ligament were not evaluated, because of some processing artifacts. The SSC, LSC, PSC, utricle and saccule appeared to be normal. The IAC, including the facial nerve in the canal, was unremarkable. Metastatic infiltration of the tumor was noted in the bone marrow of the petrous apex.

Histopathologic findings, right temporal bone—The EAC, tympanic membrane, and middle ear were within normal limits; the ossicular chain was intact. The facial nerve was normal. The mastoid air cells were well pneumatized, with hyperplasia of the mucoperiosteum. Metastatic foci of tumor cells and cholesterol granuloma were seen in mastoid air cells, with slight serous effusion. The SSC, LSC, PSC, utricle and saccule were within normal limits. The organ of Corti and the spiral ligament were not evaluated, because of some processing artifacts. The IAC, including the facial and cochlear nerves, appeared to be normal. The bone marrow of the petrous apex was infiltrated with metastatic malignant cells.

Case 3 (Reticular cell sarcoma)

A 68-year-old female patient came to the hospital with a histiocytic lymphoma (reticular cell sarcoma) involving the posterior skull. After it was surgically removed, she did quite well for a while.

However, she returned with a nodule behind the right ear and a mass in the left lower lobe of the lung. Hearing test results revealed a hearing loss on left ear and right ear was normal. A biopsy of the subcutaneous mass was positive for histiocytic lymphoma (reticular cell sarcoma). She was treated with chemotherapy; the lung nodule subsequently disappeared.

Six years later, she was readmitted with a high fever and a large pelvic mass. Because of metabolic acidosis, she began dialysis before her death. Autopsy revealed tumor invasion in the bone marrow, spleen, and entire lymphatic system.

Histopathologic findings, *left temporal bone*—The EAC, tympanic membrane, and middle ear were within normal limits; the ossicular chain was intact. The facial nerve was normal. Subepithelial hemorrhage in the middle ear were noted. The IAC was within normal limits. The inner ear structures showed damage at removal.

Histopathologic findings, *right temporal bone*—The EAC, tympanic membrane, and middle ear were within normal limits; the ossicular chain was intact. Subepithelial hemorrhage in the middle ear were noted. Reticular cell sarcoma metastasis was seen in the mastoid cavity (Figure 2). The IAC was normal. The inner ear structures were not adequate for evaluation, because of severe damage at removal.

Case 4 (Liposarcoma)

A 74-year-old male patient was seen in the hospital for a recurrent liposarcoma of the left upper arm, 2 years after undergoing a radical operation. He underwent chemotherapy, but 1 year later, had an axillary recurrence of the tumor and was treated with radiation this time. Because of tumor progression, he underwent a forequarter amputation. During the course of treatment, he developed swelling of the lower extremities, dysuria, and pneumonia. Two days before his death, he developed bright-red rectal bleeding and hypotension; he became progressively obtunded (despite initial response of his hypotension).

He died with anuria and shock. Autopsy revealed a lymphoproliferative syndrome, with malignant cells in lymph nodes and in bone marrow, in addition to an incidental pheochromocytoma. Neuropathologic examination also revealed mild, fresh, and patchy subarachnoid hemorrhage.

Histopathologic findings, *left temporal bone*—The EAC and tympanic membrane were within normal limits. The middle ear mucosa was thickened. The facial nerve was normal. The LSC, SSC, PSC, utricle and saccule were within normal limits. The IAC, including the vestibulocochlear and facial nerves, were within normal limits, except for the presence of some erythrocytes. Spiral ganglion cells and the organ of Corti were normal, with a limited serous labyrinthitis in the scala vestibuli. The carotid artery was noted to be dehiscent. Metastatic liposarcoma involvement of the bone marrow was seen in the petrous apex.

The *right* temporal bone was not available for our study.

Case 5 (Ewing sarcoma)

A 23-year-old female patient (with a limited medical record) had massive involvement of Ewing sarcoma on the right pleura. She underwent chemotherapy, which included cisplatin. She experienced tinnitus and gradual hearing loss during the course of the disease.

Histopathologic findings, *left* temporal bone—The EAC, tympanic membrane, and middle ear were within normal limits except for hemorrhage and facial nerve dehiscence. The cochlea was partially damaged during the removal process; however decreased hair cell density was seen. The SSC, LSC, PSC, utricle and saccule were within normal limits. The IAC, including the vestibulocochlear and facial nerves, were within normal limits. Metastatic Ewing sarcoma involvement of the bone marrow in the petrous apex, with necrosis, was noted.

Histopathologic findings, *right* temporal bone—The EAC and tympanic membrane were within normal limits and ossicular chain were intact. The middle ear mucosa was thickened within hemorrhage. The facial nerve was normal. Cochlear hair cell density was decreased. The SSC, LSC, PSC, utricle and saccule were normal. The IAC, including the vestibulocochlear and facial nerves, were within normal limits. Metastatic Ewing sarcoma involvement of the bone marrow in the petrous apex, with necrosis, was noted.

Case 6 (Angiosarcoma)

A 31-year-old female patient had abdominal pain and a back lesion. She underwent resection; the diagnosis was angiosarcoma. Because of persistent abdominal pain, she then underwent an exploratory laparotomy, and subsequently a total abdominal hysterectomy, a bilateral salpingo-oophorectomy, and a mass resection. The tumor was apparently refractory to chemotherapy.

She was discharged to a hospice, where she died of multi-organ system failure caused by metastatic and aggressive angiosarcoma. Autopsy revealed a substantial gross amount of abdominal tumor: a metastatic high-grade angiosarcoma involving the soft tissues of the pelvis, the serosa of the large and small intestine, all identifiable abdominal lymph nodes, the spleen, and the liver, in addition to metastatic vertebral bone marrow involvement. Also noted were bilateral acute bronchopneumonia, bilateral serosanguinous pleural effusion, cholelithiasis (with a single large bilirubin gallstone), hepatic necrosis, left nephrocalcinosis, and serosanguinous abdominal ascites.

Histopathologic findings, *left* temporal bone—The EAC, tympanic membrane, and middle ear were within normal limits and ossicular chain was intact. The facial canal was evaluated as normal. The cochlea was within normal limits, with some serous precipitation in the scala media. Spiral ganglion cells were normal. The SSC, LSC, PSC, utricle and saccule were within normal limits. The IAC, including the vestibulocochlear and facial nerves, was unremarkable. The bone marrow of the petrous apex was infiltrated with metastatic malignant cells.

Histopathologic findings, *right* temporal bone—The EAC, tympanic membrane, and middle ear were within normal limits and ossicular chain was intact. The facial canal was evaluated as normal. The cochlea was within normal limits, except for mild serous labyrinthitis in the scala media. Spiral ganglion cells were within normal limits. The SSC, LSC, PSC, utricle and saccule were within normal limits. The IAC, including the

vestibulocochlear and facial nerves, was unremarkable. The bone marrow of the petrous apex was infiltrated with metastatic malignant cells (Figure 3).

Discussion

The skeleton is the third most frequent site of general metastatic disease. The lungs, breast, prostate, kidney, and thyroid gland account for more than 80% of all skeletal metastases. Skeletal sarcoma metastasis is relatively rare; it is seen more frequently in children.[12]

As part of the skeleton, the temporal bone can be affected by sarcoma metastasis. The metastasis to the temporal bone of other sarcomas has already been reported, including synovial sarcoma, angiosarcoma, histiocytic sarcoma, reticular cell sarcoma, liposarcoma, rhabdomyosarcoma, osteosarcoma, and hemangiopericytoma.[7–11]

In our study, the preferred sites of skeletal sarcoma metastasis to the temporal bone were the petrous apex (4 patients, bilateral in 3 of them), the mastoid cavity (2 patients), and the IAC (1 patient, bilateral). Majority of metastasis in petrous apex addresses the hematogenous spread of the sarcoma. Of our 6 patients, 4 had ear symptoms (3 had bilateral hearing loss, and 1 each had facial palsy, a nodule behind the ear, and bilateral tinnitus). But the other 2 patients had no ear-related symptoms noted in their records.

Despite the symptoms of temporal bone involvement, the diagnosis of temporal bone metastasis is usually a challenge for the otolaryngologist. Temporal bone metastasis usually occurs very late in the course of the disease, and the metastatic lesion stays silent until it extends into areas that cause otologic dysfunction.[13] By the time temporal bone metastasis is diagnosed, patients usually have diffuse metastases throughout the body; temporal bone metastasis is generally overlooked, given the patient's poor general condition and the symptoms in other systems that overshadow the otologic manifestations of metastasis.[14] However, enhanced imaging techniques can help physicians diagnose temporal bone metastasis.

Conclusion

In the light of the histologic findings of skeletal sarcoma metastasis to the temporal bone that we described in this study, physicians should keep in mind that the ear of a sarcoma patient may be the site of temporal bone metastasis. Although skeletal sarcoma metastasis to the temporal bone is rare, this diagnosis must be considered in any sarcoma patient with otologic manifestations.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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References

1. Cureoglu S, Tulunay O, Ferlito A, Schachern PA, Paparella MM, Rinaldo A. Otologic manifestations of metastatic tumors to the temporal bone. *Acta otolaryngologica*. 2004; 124:1117–1123.
2. Berlinger NT, Koutroupas S, Adams G, Maisel R. Patterns of involvement of the temporal bone in metastatic and systemic malignancy. *The Laryngoscope*. 1980; 90:619–627. [PubMed: 7359981]
3. Proctor B, Lindsay JR. Tumors involving the petrous pyramid of the temporal bone. *Archives of otolaryngology*. 1947; 46:180–194. [PubMed: 20260370]
4. Streitmann MJ, Sismanis A. Metastatic carcinoma of the temporal bone. *Otology & Neurotology*. 1996; 17:780–783.
5. Gloria-Cruz TI, Schachern PA, Paparella MM, Adams GL, Fulton SE. Metastases to temporal bones from primary nonsystemic malignant neoplasms. *Archives of Otolaryngology–Head & Neck Surgery*. 2000; 126:209–214. [PubMed: 10680873]
6. Adams GL, Paparella MM, Fiky FME. Primary and metastatic tumors of the temporal bone. *The Laryngoscope*. 1971; 81:1273–1285. [PubMed: 4328134]
7. Kariya S, Cureoglu S, Schachern PA, Paparella MM, Nishizaki K. Histopathological temporal bone study of the metastatic rhabdomyosarcoma. *Auris Nasus Larynx*. 2009; 36:221–223. [PubMed: 18606509]
8. Pfleiderer AG, Molyneux AJ, Tee MK. Metastatic spread of osteosarcoma to the temporal bone in a patient with Paget's disease: a case report. *The Journal of otolaryngology*. 1992; 21:112–114. [PubMed: 1583704]
9. Seo T, Nagareda T, Shimano K, Saka N, Kashiba K, Mori T, Sakagami M. Liposarcoma of temporal bone: a case report. *Auris Nasus Larynx*. 2007; 34:511–513. [PubMed: 17485186]
10. Scott M, Kellett G, Peale A. Angioblastic meningioma (hemangiopericytoma) of the cerebellar fossa with metastases to the temporal bone and the lumbar spine. *Surgical neurology*. 1974; 2:35–38. [PubMed: 4855724]
11. Cross JP Jr, Ladaga LA. Peripheral synovial sarcoma metastatic to the temporal bone. *Otology & Neurotology*. 1986; 7:169–171.
12. Folpe, AL.; Inwards, CY. Bone and soft tissue pathology. Elsevier Health Sciences; 2010.
13. Nelson EG, Hinojosa R. Histopathology of metastatic temporal bone tumors. *Archives of Otolaryngology–Head & Neck Surgery*. 1991; 117:189–193. [PubMed: 1991061]
14. Schuknecht HF, Allam AF, Murakami Y. Pathology of secondary malignant tumors of the temporal bone. *The Annals of otology, rhinology, and laryngology*. 1968; 77:5–22.

Figure 1. Rhabdomyosarcoma metastasis in the internal auditory canal (a) lower magnification image; (b) magnified view of boxed area. IAC: internal auditory canal; U: utricle; C: cochlea. Arrows show tumor cells destructing facial nerve.

Figure 2.
Reticular cell sarcoma metastasis in mastoid air cells. IAC: internal auditory canal. Arrows show metastatic foci.

Figure 3. Angiosarcoma metastasis in the petrous apex: (a) lower magnification image; (b) magnified view of boxed area. IAC: internal auditory canal; U: utricle. Arrows show tumor cells infiltrating fatty bone marrow.

Table 1

Distribution of the histopathologic diagnosis and patient characteristic.

	Histopathologic diagnosis	Age	Sex	Site of the metastasis	Symptoms of ear
1	Rhabdomyosarcoma	45	F	Bilateral internal auditory canal	Bilateral hearing loss Left facial palsy
2	Ewing sarcoma	18	M	Left petrous apex Right mastoid cavity and right petrous apex	Bilateral decrease of hearing
3	Reticular cell sarcoma *	68	F	Right mastoid cavity	A nodule behind the right ear
4	Liposarcoma	74	M	Left petrous apex	-
5	Ewing sarcoma	23	F	Bilateral petrous apex	Bilateral decrease of hearing and tinnitus
6	Angiosarcoma	31	F	Bilateral petrous apex	-

* Only right ear was available for analysis
M: male, F: female