Case report

Breast carcinoma metastasis to meningioma in the thoracic spine: A case report and review of the literature

Eijiro Okada¹, Masaya Nakamura², Yoshitomo Koshida¹, Kiyoshi Mukai¹, Yoshiaki Toyama², Morio Matsumoto²

¹Saiseikai Central Hospital, Mita Minato-ku, Tokyo, Japan, ²Department of Orthopaedic Surgery, Keio University School of Medicine, Tokyo, Japan

Context: Systemic metastasis to a primary tumor of the central nervous system is uncommon. Breast carcinomas metastasizing to a possibly preexisting meningioma in the spine are reported very rarely.

Study design: Case report.

Findings: A 69-year-old female was referred to us with progressive gait disturbance. She had undergone a total mastectomy for carcinoma of the right breast 11 years previously. A magnetic resonance imaging of the thoracic spine showed an intra- and extradural spinal cord tumor. The patient underwent resection of the tumor via laminectomy from T2 to T4. After the operation, the patient's neurological status improved significantly, and she was able to walk without assistance. Histological examination showed the tumor to be a fibrous-type meningioma within a metastatic breast cancer tumor. The patient underwent 40 Gy radiation treatment for local control of the tumor. However, the tumor recurred locally 7 months after the surgery. The patient died of carcinomatous pleurisy 13 months after the surgery.

Conclusion: This case illustrates that a primary meningioma in the thoracic spine can be a recipient of breast cancer metastasis, which may alter the treatment strategy.

Keywords: Breast carcinoma, Metastasis, Meningioma, Thoracic spine

Context

Advanced cancer metastases to a central nervous system tumor are rare. When it happens, the metastatic tumor is most often a meningioma.^{1–11} Several hypotheses explaining the mechanism of distant metastases to a pre-existing central nervous system tumor have been proposed, and include the rich vascularity of the pre-existing tumor or hormonal or immunologic factors, but the underlying mechanism remains unclear. Most papers published on this subject have been case reports or a small case series,^{2–4,7–11} and the clinical features and distinctive radiological characteristics of this condition have not been described in detail. There are few case reports of cancer metastasizing to an intracranial meningioma; however, only two cases of metastasis to a spinal meningioma appear in the literature.^{2,9} Here,

we present the very rare case of breast cancer metastasis to a possibly preexisting thoracic meningioma.

Case presentation

A 69-year-old female was referred to our department with a 1-month history of progressive gait disturbance and back pain. The patient had undergone total mastectomy for carcinoma of the right breast (T2N0M0: stage IIA) 11 years previously. Histological examination had revealed the breast cancer to be invasive ductal carcinoma. Estrogen and progesterone receptors were negative. The patient was treated with four cycles of adjuvant chemotherapy.

Seven years after the mastectomy, a chest radiograph revealed a right lung metastasis, and the patient underwent apical segmentectomy to remove the metastatic carcinoma. The lung metastasis had transformed into a metaplastic carcinoma, consisting of malignant bone and cartilage in addition to ordinary ductal carcinoma.

Correspondence to: Eijiro Okada, Saiseikai Central Hospital, Mita Minato-ku, Tokyo, Japan. Email: eijiro888@gmail.com

Figure 1 Post-contrast computed myelography shows an extramedullary and intra-extradural mass at the T2–3 level (arrow).

Four years later, the patient began to experience numbness starting above the nipples and radiating down both legs to the top of the feet. She had no bowel incontinence. Her upper extremities had normal strength; however, the muscles of her lower extremities had weakness, graded at MMT 3. She had difficulty standing or walking without a support. Hyperactive deep tendon reflexes and Babinski's sign were present on both sides.

Upon referral to our department, contrast computed tomographic scan of the thoracic spine showed a space-occupying lesion within the spinal canal (Fig. 1). Magnetic resonance imaging (MRI) of the thoracic spine showed a diffusely enhanced extramedullary, intradural, and extradural T1 iso-intense and T2 hypointense-to-hyperintense mass on the right side at the T2–3 level (Fig. 2). The patient underwent tumor resection following laminectomy from T2 to T4. Intraoperatively, the tumor was present in the extradural space along the T3 nerve root. An intradural portion of the tumor was found after the dura was opened longitudinally under a surgical microscope. The tumor was white, smooth, and similar to cartilaginous tissue in appearance. It

Figure 2 MRI of the thoracic spine shows an enhancing T1 isointense and T2 hypointense-to-hyperintense mass with a ragged outline at the T2–3 level. (A) Sagittal T1-weighted image. (B) Sagittal T2-weighted image. (C) Sagittal enhanced image. (D) Axial image at the T2–3 level.

Figure 3 Histologic examination of the resected T2-3 intradural mass shows a nest of carcinoma cells in a background of fibrous meningioma.

was resected piecemeal, using a Cavitron Ultrasonic Surgical Aspirator (Valleylab, Boulder, CO, USA). The nerve root attached to the tumor was coagulated and resected. Gross total resection of the tumor was achieved, as viewed under a surgical microscope. Dura mater defects were repaired with artificial Gore-Tex dura.

The pathological examination of the resected tumor showed it to consist mostly of malignant bone and cartilage, with a few carcinoma cells similar to the metastatic carcinoma previously found in the lung. There was also a small amount of meningioma, composed of slender spindle cells, and a few psammoma bodies within the tumor (Fig. 3). The meningioma was subtyped as fibrous meningioma, and carcinoma nests were found within it. An immunohistochemical analysis showed that the carcinoma cells were positive for keratin

Figure 4 Immunohistochemistry showed carcinoma cells positive for keratin (A) and gross cystic disease fluid protein-15 (B), and meningioma cells that were 1 negative for these proteins.

and gross cystic disease fluid protein-15 (GCDFP-15), but the meningioma cells were negative for these proteins (Fig. 4), confirming the presence of metastatic breast cancer in the meningioma.

Postoperatively, the patient showed significant neurological improvement. She was treated with 40 Gy radiation for local disease control. She was walking without a cane or walker at the 3-month follow-up, but 7 months after the surgery she again complained of progressive gait disturbance, this time with severe back pain, which progressed to total paraplegia. A thoracic MRI showed that the tumor had recurred locally at the T2-3 level and was compressing the spinal cord (Fig. 5). The patient died of carcinomatous pleurisy 13 months after the surgery.

Discussion

Fried reported “a systemic metastasis to cranial meningioma” in 1930.¹ Subsequently, cases of advanced cancer metastasizing to central nervous system tumors, mostly intracranial tumors, have been reported.³⁻⁸ Recently, Aghi *et al.*⁹ reported that the majority of cancers metastasizing to central nervous system tumors originated from the breast (59.5%), lung (17.6%), and genitourinary organs (8.1%). Most of the recipient tumors reported were slow-growing meningiomas with rich vascularity; less frequently, the recipient tumor was a neurilemmoma.¹²

Factors contributing to metastases to meningioma include high vascularity, slow growth, hormonal influences, and cell-to-cell interactions. The hematogenous and hypervascular nature of meningioma is suspected to contribute positively to hematogenous metastases. In addition, the slow growth of meningioma may serve as a noncompetitive metabolic environment.⁸ Breast cancer and meningioma occur commonly in females in their fifth and sixth decades. Estrogen and progesterone receptors are often expressed, not only in breast tumors, but also in meningiomas,¹³ and the similar hormonal background may enhance metastasis. However, in the present case, neither the metastatic cancer nor the meningioma contained estrogen or progesterone receptors.

Including the present case, 32 cases of breast cancer metastasis to a central nerve meningioma have been published in English²⁻¹¹ (Table 1); all of the patients were female. The most frequent meningioma subtype is the psammomatous (34.4%) followed by the transitional (31.3%). Recent cases were diagnosed by histological analysis of the surgical specimen; in early reports, metastasis was found at autopsy.^{1,5} With regard to intramedullary metastatic tumors, Kalayci¹⁴ reported that surgical resection improved neurologic deficits and prolonged mean survival periods. Other authors reported good outcomes for

Figure 5 Postoperative MRI. Local tumor recurrence was found at the 7-month follow-up. (A) Sagittal image. (B) Axial image at T2–3 level.

surgical treatment for breast cancer metastasis to meningioma, but it is not clear whether the positive outcomes reflected the very short follow-up periods.^{2,3,9,11} Some reports did not comment on postsurgical survival.^{5,7,8} Furthermore, none of the reports have mentioned a local recurrence of the cancer. Recurrence rates after surgical

resection of spinal meningioma vary from 1.3 to 22%¹⁵; the recurrence rates of metastatic tumors should be even higher.¹⁶ There has been no report regarding a local recurrence of metastatic tumor in the meningioma despite aggressive surgery and adjuvant radiation therapy. The present case underwent gross total resection under a surgical microscope followed by radiation therapy, but had aggressive recurrence only 7 months after surgery. It is speculated that microscopic residual metastatic tumor in the meningioma can more easily re-grow, and may be more radio-resistant than usual metastatic spinal tumors. This should be investigated by a larger case series in future. Although recent six of the 32 cases of breast cancer metastasis to a central nerve meningioma (18.8%) underwent postsurgical radiation, no report described radiation doses. Due to the potential risk of recurrence after incomplete tumor resection, postoperative adjuvant radiotherapy is often indicated for spinal metastasis. Stereotactic body radiation therapy for spinal metastasis has been reported to be highly effective for pain relief (reported pain improvement rate; 85%) and for local control of the tumor (local control rate; 90%).^{17,18}

Table 1 Summary of previously reported systemic metastatic breast cancer to meningioma

Number	Author	Date	Sex	Age	Location	Treatment	Prognosis	Subtype of meningioma
1	Hockley	1975	F	72	Cervical spine C2	S	Alive 3 weeks	Psammomatous
2	Nunnery	1980	F	53	Frontal	S	Alive 1Y	Meningothelial
3	Bucciero	1992	F	63	Frontal	S	ND	ND
4	Dibonito	1993	F	85	Vault	ND	ND	Psammomatous
5			F	73	Parietal	ND	ND	Transitional
6			F	85	Middle cranial fossa	ND	ND	Transitional
7			F	82	Unknown	ND	ND	Psammomatous
8			F	85	Unknown	ND	ND	Meningothelial
9			F	74	Vault	ND	ND	Psammomatous
10			F	84	Vault	ND	ND	Transitional
11			F	56	Vault	ND	ND	Psammomatous
12			F	95	Vault	ND	ND	Psammomatous
13			F	66	Parasellar	ND	ND	Psammomatous
14			F	62	Parietal	ND	ND	Transitional
15			F	52	Vault	ND	ND	Psammomatous
16	Salvati	1996	F	47	Sphenoid	S	Alive 11Y	Transitional
17			F	54	Frontal	S	Alive 4Y	Psammomatous
18			F	53	Sphenoid	S	Alive 5Y	Transitional
19			F	48	Sphenoid	S	Alive 3Y	Psammomatous
20			F	55	Parietal	S	Alive 1Y	Meningothelial
21			F	49	Sphenoid	S	Alive 2Y	Transitional
22			F	61	Sphenoid	S	Alive 3Y	Meningothelial
23			F	58	Frontal	S	Alive 2Y	Transitional
24			F	50	Sphenoid	S	Alive 7Y	Transitional
25	Elmaci	2001	F	51	Occipital	S	ND	ND
26	Watanabe	2002	F	49	Parasagittal	S + C	ND	Transitional
27	Aghi	2005	F	55	Cervical spine C3–4	S + C + R	Alive 1M	Psammomatous
28	Calori	2006	F	65	Parietal	S + C + R	Alive 7M	Meningothelial
29			F	53	Parietal	S + R	ND	Meningothelial
30			F	59	Sphenoid	S + C + R	Die 15M	Fibrous
31	Lanotte	2009	F	64	Frontal	S + C + R	Alive 6M	ND
32	Present case	2014	F	69	Thoracic spine T2–3	S + C + R	Die 13M	Fibrous

F, female; S, surgery; ND, not described; S + C, surgery + chemotherapy; S + C + R, surgery + chemotherapy + radiation; S + R, surgery + radiation.

Including this case, there have been three reported cases of breast cancer metastasizing to spinal meningioma. In the previous cases,^{2,9} metastasis occurred in the upper cervical spine, at C2 and at C3–4. Myelopathy gradually developed in all cases. The interval from the breast cancer diagnosis to the metastasis to meningioma was 6 years² in 1 case and 11 years in the present case. In the third case, the spinal cord metastasis was the first clinical manifestation of breast cancer.⁹

Tumors found on MRI typically appear as a mass ventral to the spinal cord with T1 isointensity, high T2 intensity, and strong gadolinium diethylenetriaminepentaacetic acid (DTPA) enhancement. Watanabe *et al.*¹⁹ reported that enhancement on MRI changed from homogeneous to inhomogeneous with slow tumor enlargement after metastasis. Although the present case also showed diffuse enhancement, a preoperative MRI-based diagnosis was not possible. Importantly, the meningioma was located partly in the extradural and partly in the intradural space. In all three cases of breast cancer metastatic to spinal meningioma, including the present one, the patients were treated surgically and obtained a degree of neurological improvement, at least temporarily. While adjuvant therapy was given in the previous two cases, the very short follow-up periods – only 3 weeks² for one and 1 month⁹ for the other – did not allow the patients' neurological status to be fully evaluated.

Breast cancer survival rates have improved recently because of multi-disciplinary treatment modalities. Our case illustrates that while rare, it is possible for a metastatic breast cancer to develop in a thoracic spinal meningioma.

The patients were informed that data from the case would be submitted for publication, and gave her consent.

Acknowledgment

For their help and useful comments during the preparation of this manuscript, we would like to thank Kiyoshi Inoue M.D., Kazuki Takeda M.D., Masaki Tezuka M.D., Shigeru Yanagimoto M.D., of the Department of Orthopaedic Surgery, Saiseikai Central Hospital, Hirobumi Maruiwa, M.D., of the Keiyu Orthopaedic Surgery clinic; and Kota Watanabe, M.D., of the Department of Advanced Treatment for Spine and Spinal Cord Disorders, Keio University School of Medicine.

Disclaimer statements

Contributors EO, MN and MM have made a substantial contribution to the concept and design, acquisition of data or analysis and interpretation of data. EO

drafted the article or revised it critically for important intellectual content.

Conflicts of interest There is no conflict of interest on this report.

Ethics approval None.

Funding None.

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