Humeral metastasis of sacrococcygeal chordoma detected by fluorine-18 fluorodeoxyglucose positron emission tomography-computed tomography: A case report

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ABSTRACT
Chordomas are rare, slow-growing, locally aggressive bone tumors arising from embryonic remnants of the notochord. Distant metastases most commonly involve the lung, liver, axial skeleton, skin, and lymph nodes. Humeral metastases are extremely rare. We report the case of a recurrent chordoma with humeral metastasis, complicated with pathologic fracture. Fluorine-18 fluorodeoxyglucose positron emission tomography-computed tomography revealed multiple hypermetabolic skeletal lesions, corresponding to the symptoms. Our report suggests that positron emission tomography-computed tomography is useful for evaluation of recurrence and distant metastases of chordomas.

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Introduction
Chordomas are very rare tumors arising from the remnants of the notochord in the sacrum (50%), skull base (30%), and mobile spine (20%); These tumors are low-grade, locally invasive malignancies. The metastatic potential is relatively low. Distant metastases most frequently involve the lung, liver, axial skeleton, skin, and lymph nodes. However, metastases to the humerus are extremely rare. Metastases usually occur late in the natural course of the disease, mostly after local recurrence [1]. Whole-body fluorine-18 fluorodeoxyglucose positron emission tomography-computed tomography (18F-FDG PET/CT) appears to be useful for evaluation of distant metastases with a single examination. Here we report a case of sacrococcygeal chordoma with humeral metastasis diagnosed by 18F-FDG PET/CT.

Case report
An 84-year-old man presented to our hospital with right arm pain and right shoulder joint impaired mobility after minor activity. The man had a histopathologically proven sacrococcygeal chordoma 3 years ago and had been treated with surgical resection and postoperative radiotherapy.
The patient had 18F-FDG PET/CT for restaging. Transaxial 18F-FDG PET/CT showed an osteolytic destructive lesion with increased tracer uptake, suggestive of local recurrence (Fig. 1A-C). There were also osteolytic destructive lesions in the proximal shaft of the right humerus and the second and third thoracic vertebrae (T2 and T3) with increased tracer uptake, suggestive of metastases (Fig. 1D-I). The patient was treated with surgery thereafter. Based on the histopathologic (Fig. 2), immunohistochemical, and imaging findings, the patient was diagnosed with recurrent sacrococcygeal chordoma with the right humeral and the T2 and T3 metastases. The immunohistochemical staining of the humeral lesion showed S-100 (+), phosphoenolpyruvate carboxykinase (+), epithelial membrane antigen (partly, +), vascular endothelial growth factor receptor 2 (−), vimentin (+), sex determining region Y (SRY)-related high mobility group box 9 (partly, +), integrase interactor 1 (−), CD117 (−), brachyury (−), and mindbomb E3 ubiquitin protein ligase 1 (−) (Fig. 3).

Discussion

Chordomas are rare, low-grade, locally invasive primary bone tumors arising from the embryonic remnants of the notochord, around which the base of the skull and the vertebral column develop. Remnants of the notochord usually remain in or close to the midline. The anatomic distribution of the chordomas mirrors the location of notochord remnants. The sacrum is the most common site of origin, accounting for 50% of all cases, followed by the skull base (30%) and the mobile spine (20%) [1]. The median age at presentation is around 60 years. However, presentation with skull base tumors may occur in a younger population, including children [1-4]. Grossly, chordomas are soft, lobulated, semitranslucent, gray masses that often hemorrhage and permeate and destroy bones. Under the microscope, chordomas display lobules and vacuolated neoplastic cells across a myxoid stroma separated by fibrous bands [4]. The reported incidence of metastatic disease of chordomas is 19%. Metastases usually occur late in the course of the disease. Tumors with local recurrence are more likely to develop metastatic disease, which mostly involves the sacrococcygeal region, lung, liver, axial skeleton, and lymph nodes [5,6]. Large tumor size, inadequate surgical margins, local

Fig. 1 – The fluorine-18 fluorodeoxyglucose positron emission tomography-computed tomography images showing multiple osteolytic destructive lesions with increased fluorine-18 fluorodeoxyglucose uptake in the sacrococcygeal region (A-C), the proximal shaft of the right humerus (D-F), and T2 and T3 (G-I).

Fig. 2 – Biopsy of the humeral lesion showing cords and nests of epithelioid tumor cells in a background of extracellular chondroid material (hematoxylin and eosin, original magnification ×200).
aggressiveness, local recurrence, microscopic tumor necrosis, high Ki-67 labeling index, and invasive diagnostic procedure have been reported to be adverse prognostic factors [7,8].

Humeral metastasis of chordoma is rare. There have been only 2 reports, both originating in the sacrococcygeal region [9,10]. The common primary cancers that metastasize to the humerus are breast, lung, prostate, kidney, and thyroid carcinomas [11]. Chondrosarcomas, malignant fibrous histiocytomas, and osteosarcomas are relatively rare but should also be considered [11,12]. In our case, 18F-FDG PET/CT is helpful in evaluating the local recurrence and metastatic disease of chordoma and in diagnosing metastatic disease based on the tracer uptake.

The therapeutic approach to chordoma has traditionally relied heavily on surgery. Indications for definitive radiation therapy are unresectable disease, inoperable patients, or neurologic impairment not accepted by the patient. Chordomas are usually not sensitive to chemotherapy except for high-grade dedifferentiated tumors [1–3]. Most chordomas strongly express epidermal growth factor receptor and platelet-derived growth factor receptors receptor, and some promising responses to the molecularly target agent imatinib have been reported [13].

Magnetic resonance imaging has been widely used for assessing tumor invasion, especially for central nervous system primary tumors and spinal metastases, because of clear delineation of lesion and adjacent tissue structures. Most chordomas show mild to moderate heterogeneous enhancement on contrast-enhanced magnetic resonance imaging scan. Computed tomography is necessary for surgical planning [1,2,14]. Whole-body 18F-FDG PET/CT is useful for the assessment of chordomas with a single examination, especially when local recurrence or distant metastasis is suspected. Chordomas usually show heterogeneously increased tracer uptake on 18F-FDG PET/CT scan [14–20].

Conclusion

We report a case of sacrococcygeal chordoma with humeral metastasis and T2 and T3 metastases. Although bone is one of the common metastatic sites of chordomas, metastasis to the humerus is extremely rare. 18F-FDG PET/CT is useful for the detection and exact localization of local recurrence and distant metastasis of chordomas with a single examination.

REFERENCES

[1] The ESMO-European Sarcoma Network Working Group. Bone sarcomas: ESMO clinical practice guidelines for diagnosis, treatment and follow-up. Ann Oncol 2014;25:113–23.
[2] Stacchiotti S, Sommer J. On behalf of the Chordoma Global Consensus Group. Building a global consensus approach to chordoma: a position paper from the medical and patient community. Lancet Oncol 2015;16:71–83.
[3] Chugh R, Tawbi H, Lucas DR, Biermann JS, Schuetze SM, Baker LH. Chordoma: the nonsarcoma primary bone tumor. Oncologist 2007;12:1344–50.
[4] Sav A, Karabağlı P. Chordomas: pathology. In: Özek MM, Cinalli G, Maixner W, Sainte-Rose C, editors. Posterior fossa tumors in children. Springer Cham; 2015, p. 693–701.
[5] McPherson CM, Suki D, McCutcheon IE, Gokaslan ZL, Rhines LD, Mendel E. Metastatic disease from spinal chordoma: a 10-year experience. J Neurosurg Spine 2006;5:277–80.
[6] Young VA, Curtis KM, Temple HT, Eismont FJ, DeLaney TF, Hornicek FJ. Characteristics and patterns of metastatic disease from chordoma. Sarcoma 2015;2015.
[7] Vergara G, Belinchón B, Valcárcel F, Veiras M, Zapata I, Torre A. Metastatic disease from chordoma. Clin Transl Oncol 2008;10:517–21.
[8] Bergh P, Kindblom LG, Gunterberg B, Remotti F, Ryd W, Meis-Kindblom JM. Prognostic factors in chordoma of the sacrum
and mobile spine: a study of 39 patients. Cancer 2000;88:2122–34.

[9] Resnik CS, Young JWR, Levine AM, Aisner SC. Case report 544: metastatic chordoma to humeri (originating in sacrum). Skeletal Radiol 1989;18:303–5.

[10] Azarpia N, Solooki S, Seyedbakhsh S, Mardani R. Humeral metastasis from a sacrococcygeal chordoma: a case report. J Med Case Rep 2011;5:339.

[11] Farrish WM. Tumors of the proximal humerus. Curr Opin Orthop 2004;15:274–8.

[12] Gebhart M, Dequanter D, Vandeweyer E. Metastatic involvement of the humerus: a retrospective study of 51 cases. Acta Orthop Belg 2001;67:456–63.

[13] Maio SD, Yip S, Zhiani GAA, Alotaibi FE, Turki AA, Kong E, et al. Novel targeted therapies in chordoma: an update. Ther Clin Risk Manag 2015;11:873–83.

[14] Thornton E, Krajewski KM, O’regan KN, Giardino AA, Jagannathan JP, Ramaiya N. Imaging features of primary and secondary malignant tumors of the sacrum. Br J Radiol 2012;85:279–86.

[15] Lin CY, Kao CH, Liang JA, Hsieh TC, Yen KY, Sun SS. Chordoma detected on 18F-FDG PET. Clin Nucl Med 2006;31:506–7.

[16] Park SA, Kim HS. 18F-FDG PET/CT evaluation of sacrococcygeal chordoma. Clin Nucl Med 2008;33:906–8.

[17] Ochoa-Figueroa MA, Martinez-Gimeno E, Allende-Riera A, Cabello-Garcia D, Munoz-Iglesias J, Cárdenas-Negro C. Role of 18F-FDG PET/CT in the study of sacrococcygeal chordoma. Rev Esp Med Nucl Imagen Mol 2012;31:359–61.

[18] Sabet A, Ahmadzadehfar H, Huertos Lopez HJ, Muckle M, Schmiedel A, Biersack HJ, et al. Detection of chordoma recurrence by 18F-FDG PET/CT. Iran J Radiat Res 2012;10:109–10.

[19] Miyazawa N, Ishigame K, Kato S, Satoh Y, Shinohara T. Thoracic chordoma: review and role of FDG-PET. J Neurosurg Sci 2008;52:117–22.

[20] Rohatgi S, Ramaiya NH, Jagannathan JP, Howard SA, Shinagare AB, Krajewski KM. Metastatic chordoma: report of the two cases and review of the literature. Eurasian J Med 2015;47:151–4.