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Surgery and proton beam therapy for mediastinal extraskeletal osteosarcoma

Running Head: Treatment of mediastinal osteosarcoma

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Abstract

Extraskeletal osteosarcoma (ESOS) arising from the mediastinum is a rare malignant tumor and associated with a poor prognosis. We present the case of a 73-year-old man with a hoarseness. Imaging studies revealed a large calcified tumor of the median mediastinum. Surgery was performed, but complete resection was impossible and about two-thirds of the tumor was excised. The tumor was pathologically diagnosed as ESOS. Proton beam therapy has been performed on the remaining lesion, and the patient is alive without tumor re-growth for 28 months. This is the first case of mediastinum ESOS successfully treated with surgery and postoperative proton therapy.

Introduction

Extraskeletal osteosarcoma (ESOS) arising from the mediastinum is a rare malignant tumor and associated with a poor prognosis [1]. Although only surgical resection has been reported to improve prognosis, complete resection is difficult in most cases because it is infiltrating the surrounding organs at the time of diagnosis.

Case Report

A 73-year-old man was admitted to our hospital for hoarseness and abnormal shadow on his chest radiograph. He underwent a surgery for paraesophageal bronchogenic cyst 25 years ago. Contrast-enhanced computed tomography (CT) of the chest confirmed a large calcified tumor of the median mediastinum, which was suspected to invade the ascending aorta, trachea, and superior vena cava (SVC) (Figure 1A). Whole body 18F-fluorodeoxyglucose (FDG) positron emission tomography (PET)/CT was performed which revealed increased FDG uptake only in the tumor periphery and no distant metastasis was observed (Figure 1B). Laryngoscopy examination confirmed left vocal cord paralysis. During those examinations, facial edema and airway constriction had developed owing to acute expansion of the tumor; therefore, we decided to perform a surgery for diagnostic and therapeutic purposes.

Surgery was performed with median sternotomy incision. The giant tumor was hard, similar to a bone, and surrounded by elastic soft tissues. The surrounding organs were

compressed by the tumor. The tumor was separated from the SVC and trachea; however, it had invaded the ascending aorta and its branches. Hence, complete resection was impossible, and approximately two-thirds of the tumor was excised via volume reduction surgery.

The excised tumor was 7 cm in size. Histologically, the tumor primarily comprised osteoids consisting of round atypical cells, and pathological diagnosis was high-grade extraskeletal osteosarcoma (ESOS). After the surgery, the hoarseness improved, and facial edema and airway constriction disappeared. The postoperative course was well, and proton beam therapy (70 Gy [relative biological effectiveness] in 35 fractions) was performed on the remaining lesion. The patient underwent proton beam therapy (Figure 2) without complications other than Grade1 dermatitis and survived for 29 months after the surgery without tumor regrowth and recurrence of symptoms. CT and PET/CT findings before (Figure 1C, 1D) and after (Figure 1E, 1F) the treatment suggested effectiveness of the treatment.

Comment

ESOS is a rare malignant soft tissue neoplasm that produces osteoblasts, irrespective of the bone or periosteum. It accounts for approximately 1%–2% of soft tissue sarcomas and 2%–4% of osteosarcomas [1]. Among ESOS, mediastinal ESOS is extremely rare, with only 15 cases reported till date in international articles. The prognosis of mediastinal ESOS is poor, and the median survival is 4 months. Most cases of the mediastinal ESOS involve peripheral organ

compression symptoms such as SVC syndrome, hoarseness, respiratory distress, or chest pain. Therefore, the tumor is huge at diagnosis, making complete resection difficult. Long-term survival was obtained in 3 patients who underwent complete resection [2][3]; however, there were no survival reports of ≥8 months in cases who underwent incomplete resection [4]. Although complete resection was impossible in the present case, symptomatic improvement and long-term survival were achieved by the additional treatment of proton beam therapy for the remaining lesion.

Radiation employed for cancer treatment can be classified into photons and charged particles such as protons and carbon ions. Photons emit maximal energy near the body surface, which gradually decreases at deeper points in the body. In contrast, charged particles deposit relatively low-dose energy near the body surface and emit their maximum energy immediately before they stop inside the body. Particle beam therapy has excellent characteristics of dose concentration and cell-killing effect, and the efficacy and safety have been reported in unresectable bone and soft tissue sarcomas [5][6]. In our case, particle beam therapy was performed instead of photon beam therapy because the tumor was located deep in the tissues and the residual lesion was huge.

Regarding the type of particle beam, carbon ion beam is considered to possess higher biological effects than proton beam; however, it may cause strong tissue injuries. Serious

complications such as esophageal fistula and aortic fistula have been reported; therefore, we selected proton beam therapy in the present case.

In conclusion, our case is the first case of high-grade ESOS of the mediastinum that was successfully treated with proton beam therapy after volume reduction surgery. This can be one of the treatment options for unresectable ESOS; however, further investigation is required.

Figure Legends:

Figure 1: A, B; Preoperative PET/CT and chest CT. The huge mediastinal tumor compressed the superior vena cava, ascending aorta, and trachea. 18F-FDG-PET scan showed increased uptake in the periphery of the tumor. C, D; Postoperative PET/CT and chest CT. About two-thirds of the tumor was excised. E, F; PET/CT and chest CT approximately 3 months after proton beam therapy. The tumor slightly shrank, and abnormal 18F-FDG uptake improved.

Figure 2: Dose distribution of proton beam therapy. Proton therapy was performed on the remaining lesion.

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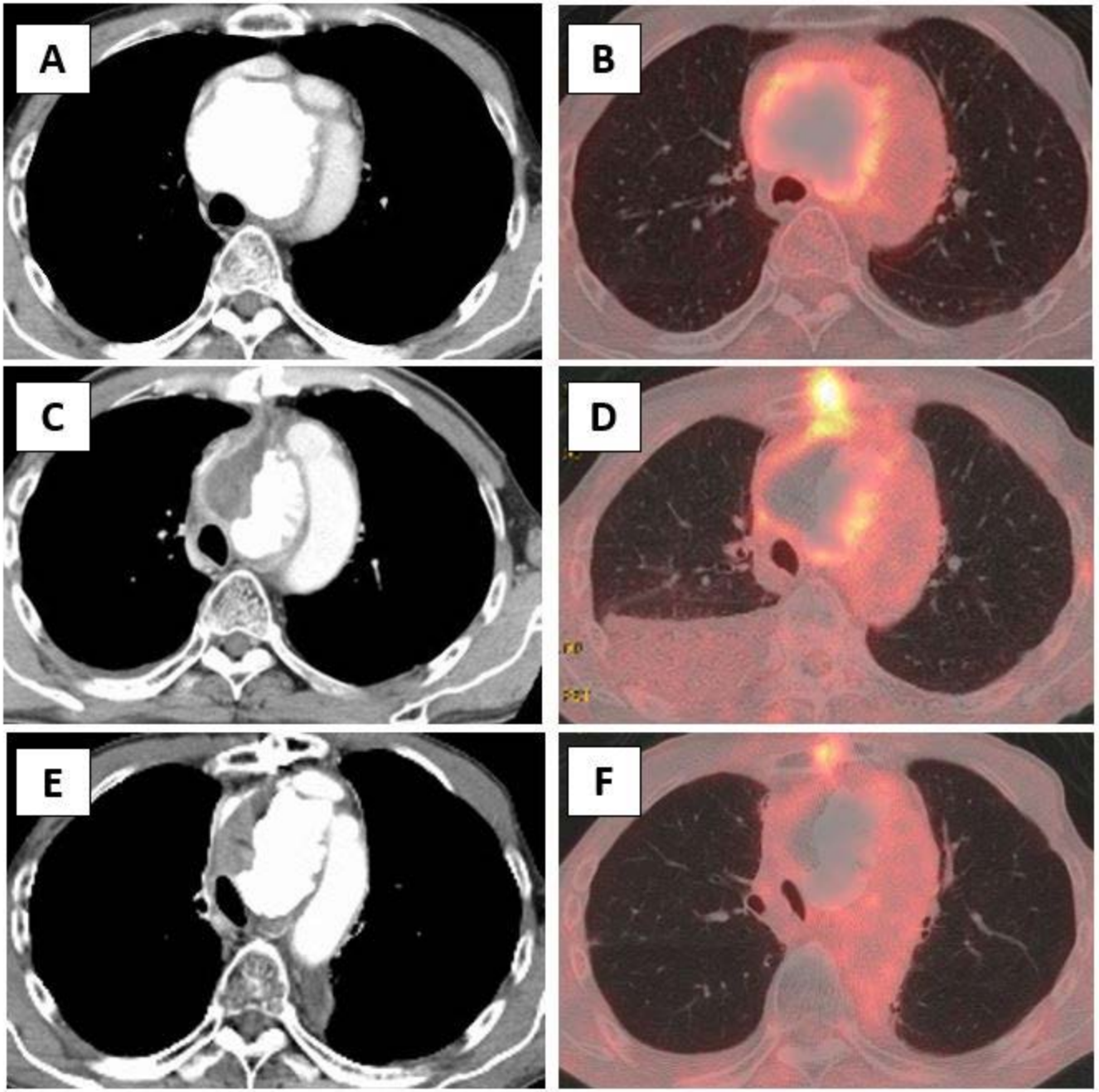
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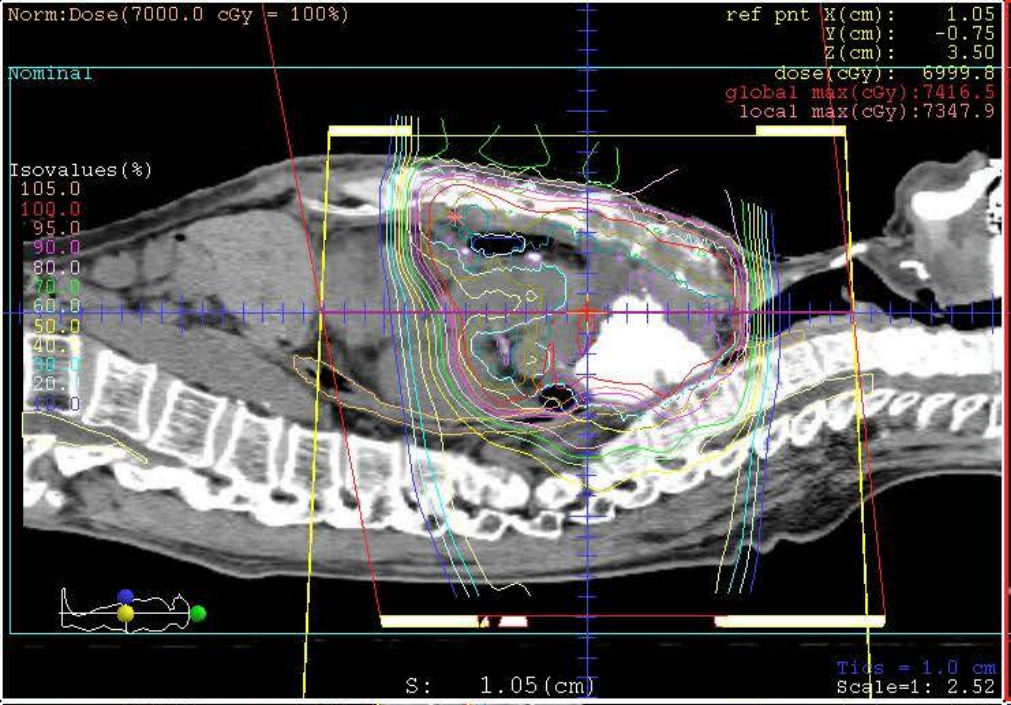
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20.0
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Y(cm): -0.75
Z(cm): 3.50
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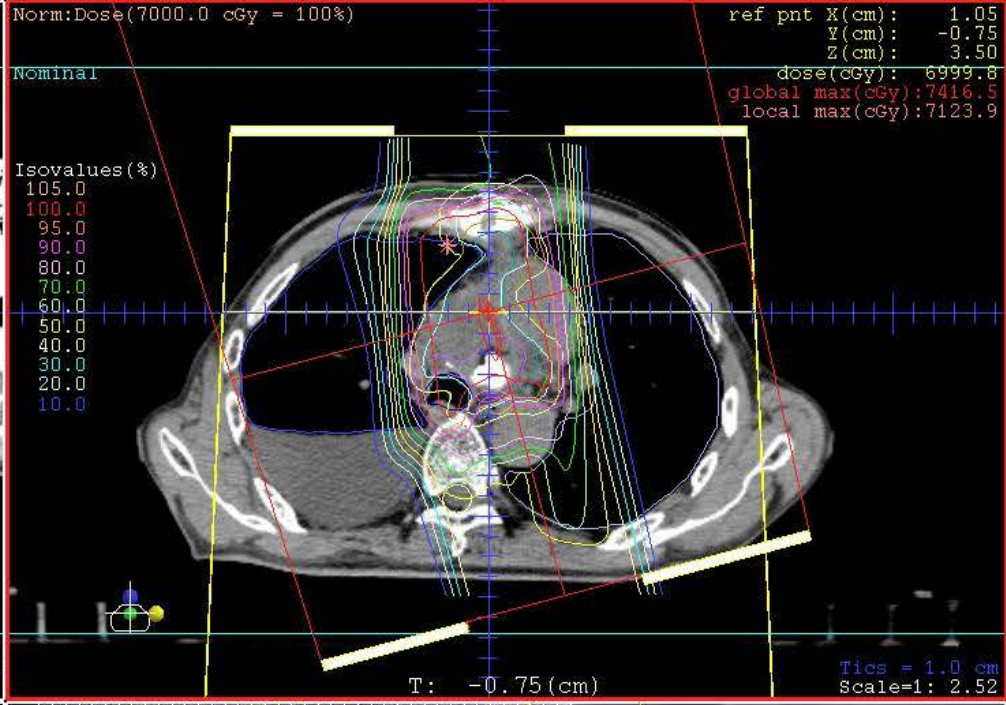
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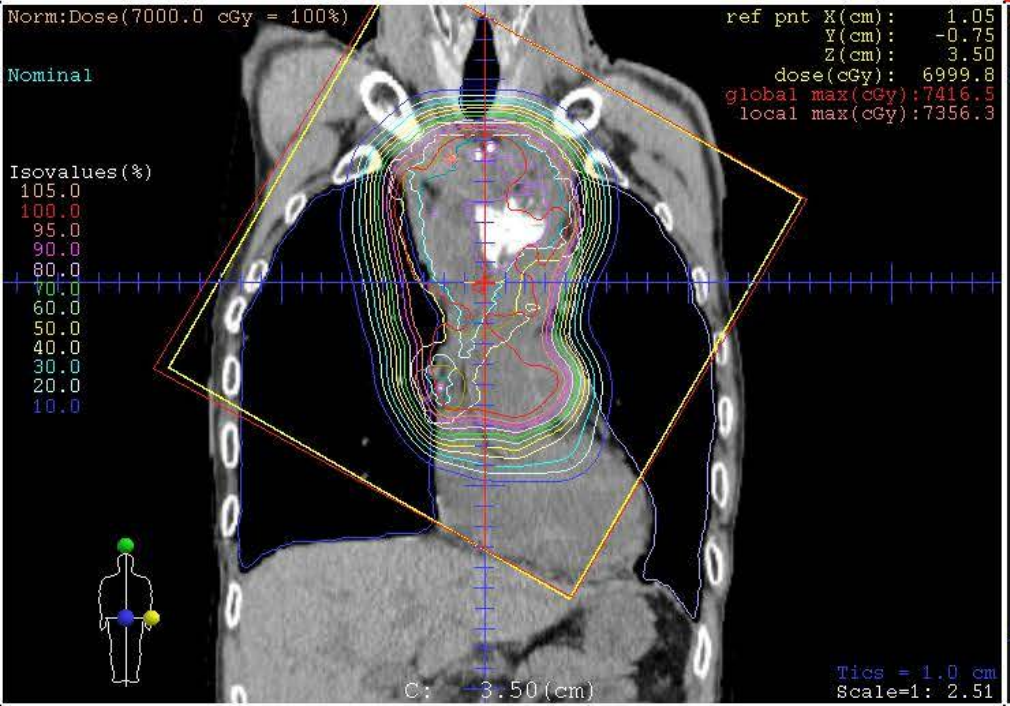
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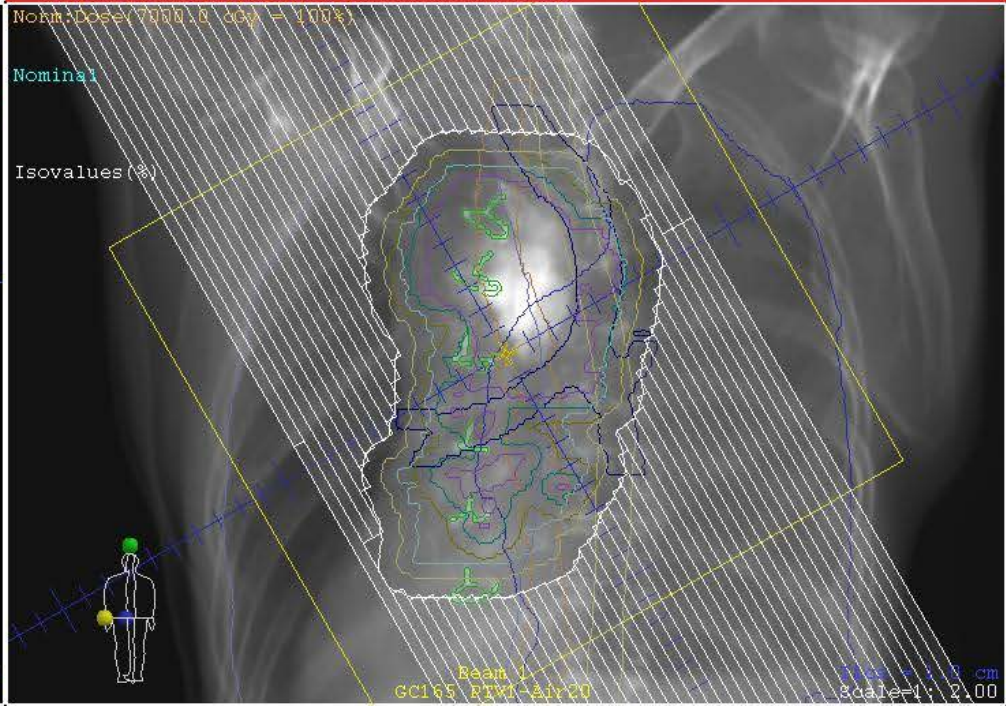
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