Immunotherapy combined with anti-angiogenic therapy, radiotherapy and chemotherapy for the treatment of giant pelvic osteosarcoma: A case report and literature review

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Abstract. Current therapeutic strategies for pelvic osteosarcoma remain limited, primarily relying on chemotherapy and surgery. Patients ineligible for surgery or those who develop chemoresistance generally have a poor prognosis. The present study reported the case of a 25-year-old female with giant pelvic osteosarcoma who missed the initial surgical window and developed lung metastases. Through a multimodal regimen incorporating chemotherapy, radiotherapy, anti-angiogenic therapy and immunotherapy, sufficient tumor control was successfully achieved to permit surgical resection. The patient maintained a stable condition with no signs of recurrence during follow-up until August 2025. This case underscores the potential of combining novel immunotherapeutic and anti-angiogenic agents with conventional modalities to convert inoperable pelvic osteosarcoma into a resectable state, thereby improving patient outcomes.

Introduction

Osteosarcoma is a highly malignant and aggressive bone tumor with a bimodal age distribution, predominantly affecting children, adolescents and adults >60 years of age (1,2). Approximately 80% of patients initially present with localized disease. Historically, amputation surgery was once the primary treatment for osteosarcoma. Since the 1970s, the advent of neoadjuvant chemotherapy has significantly improved the limb-salvage rate in patients with osteosarcoma. The standardized application of postoperative adjuvant chemotherapy has markedly enhanced the overall prognosis of osteosarcoma. High-dose methotrexate (MTX), cisplatin (DDP), doxorubicin (ADM), doxorubicin hydrochloride liposomal (PLD) and ifosfamide (IFO), as the main chemotherapeutic agents, have increased the clinical cure rate of osteosarcoma patients to 65-70%. Nevertheless, ~30-40% of patients with localized osteosarcoma ultimately develop metastasis or local recurrence, and few new drugs have been successfully used for recurrent or metastatic cases. Osteosarcoma primarily occurs in the metaphysis of long bones, particularly the distal femur, proximal tibia and humerus, with ~5-10% of cases arising in the pelvis (3,4). Due to the unique anatomical location, regional distribution and large tumor volume of pelvic osteosarcoma, surgical resection poses significant challenges, leading to poor patient prognosis (5).

The purpose of this report is to conduct a comprehensive analysis of the clinical manifestations and treatment outcomes of a patient diagnosed with pelvic osteosarcoma who missed the time window for surgical resection, whose surgical resection was delayed from the scheduled period (late 2021) to June 2023. Through chemotherapy, targeted therapy, immunotherapy and radiotherapy, the patient was successfully given the opportunity for surgery, extending survival while ensuring quality of life. With the patient's consent, relevant case data has been disclosed, providing valuable experience for the treatment of massive pelvic osteosarcoma.

Case report

A 25-year-old female with no previous medical history presented to The Second Affiliated Hospital, Zhejiang University School of Medicine (Hangzhou, China) in August 2021 with recurrent right hip pain. Pelvic magnetic resonance imaging (MRI) revealed bone destruction involving the right ilium, acetabulum and sacrum, accompanied by multiple surrounding soft tissue masses (Fig. 1A). A chest computed tomography (CT) scan showed a small solid nodule in the right middle and lateral segments (Fig. 2A), and positron emission tomography/CT imaging indicated no evidence of distant metastasis (Fig. 3). The diagnosis of osteosarcoma was confirmed via needle biopsy (Fig. 4A). Biopsy samples were fixed in formalin, paraffin-embedded and subjected to routine H&E and immunohistochemical staining. Histologically,

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Abbreviations: MTX, methotrexate; DDP, cisplatin; ADM, doxorubicin; PLD, doxorubicin hydrochloride liposomal; IFO, ifosfamide; MRI, magnetic resonance imaging; CT, computed tomography; PET, positron emission tomography; m-PFS, median progression-free survival; ORR, objective response rate; DCR, disease control rate

Key words: pelvic osteosarcoma, chemotherapy, anlotinib, case report

malignant epithelioid tumor cells with prominent nuclear atypia and focal minimal tumoral osteoid were identified, confirming epithelioid osteosarcoma. Immunohistochemistry revealed the following: Integrase interactor-1(+++) (cat. no. RMA-1149; 1:200 dilution; Fuzhou Maixin Biotechnology Development Co., Ltd.), Vimentin(+++) (cat. no. ZM-0260, 1:200), Cytokeratin(AE1/AE3)(++) (cat. no. ZM-0069; 1:200 dilution; both from Beijing Zhongshan Jinqiao Biotechnology Co., Ltd.), partial special AT-rich sequence-binding protein 2 positivity (cat. no. ZM-0163; 1:200 dilution), weak smooth muscle actin (cat. no. ZM-0003; 1:200 dilution) and cluster of differentiation (CD)99 (cat. no. ZM-0296; 1:200 dilution; all from Beijing Zhongshan Jinqiao Biotechnology Co., Ltd.) staining, while Desmin (cat. no. ZA-0610; 1:200 dilution), CD34 (cat. no. ZA-0550; 1:200 dilution), epithelial membrane antigen (cat. no. ZM-0095; 1:200 dilution) and friend leukemia integration 1 transcription factor (cat. no. ZM-0108; 1:200 dilution; all from Beijing Zhongshan Jinqiao Biotechnology Co., Ltd.) were negative, with a Ki-67 (cat. no. ZM-0167; 1:200 dilution; Beijing Zhongshan Jinqiao Biotechnology Co., Ltd.) proliferation index of 5-10%. The ultraView Universal DAB Detection Kit (cat. no. 05269806001; ready-to-use; Roche Diagnostics) was employed as the secondary antibody and detection system. All immunohistochemical procedures, including antigen retrieval, primary antibody incubation, secondary antibody labeling and DAB chromogenic development, were performed in accordance with a standard laboratory immunohistochemistry protocol (6). The patient's complete blood cell count and serum biochemical indicators were within normal ranges (data not shown). Subsequently, the patient received two cycles of neoadjuvant chemotherapy with the MIAP regimen at Hangzhou Third People's Hospital (Hangzhou, China) (IFO: 15 g/m^2 for 5 days; on days 1-5, HD-MTX: 8 g/m^2; on day 12, DDP: 100 mg/m^2; on day 19, PLD: 45 mg/m^2; and on day 21. The cycle was repeated every 35 days). Follow-up MRI conducted in October 2021 indicated stable disease (Fig. 1B). Unfortunately, due to the COVID-19 pandemic, the patient had to interrupt treatment. Beginning in December 2021, the patient received two treatments with albumin-bound paclitaxel 300 mg combined with bevacizumab 300 mg at a local hospital. Subsequent pelvic CT demonstrated significant mass enlargement (Fig. 1C), while concurrent lung CT (Fig. 2B) showed stable pulmonary lesions, accompanied by a recurrent unexplained fever. In March 2022, the patient returned to our hospital and received two cycles of treatment with the same dosage of the MIAP regimen. To enhance the effectiveness of antitumor therapy, the anti-angiogenic drugs Endostar and Bevacizumab were sequentially combined once apiece during chemotherapy. Endostar was given at 30 mg intravenously from day 1 to 7, and bevacizumab 200 mg was infused on day 1. Grade IV myelosuppression occurred during chemotherapy, resulting in interruption and delay of the scheduled chemotherapy cycles. With timely administration of recombinant human granulocyte colony-stimulating factor and recombinant human thrombopoietin, the patient successfully completed the full course of chemotherapy. After surgical evaluation suggested no surgical indications, the patient underwent a total of 30 Gy (300 cGy per time, 10 times in total) of radiation therapy. A repeat chest CT in August 2022 revealed an increase in the number and size of pulmonary nodules (Fig. 2C) and pelvic MRI showed further lesion enlargement (Fig. 1D). Although the lung lesion was not confirmed by pathology, the increased and enlarged nodules were considered pulmonary metastases by experienced radiologists and oncologists, as the lesions were solid pulmonary nodules. Multidisciplinary team consensus again concluded the patient was not a surgical candidate. Therefore, anlotinib was administered at 12 mg once daily on a 2-week on and 1-week off basis, and the patient also received chemotherapy (Gemcitabine: 700 mg/m^2 on days 1 and 8; Docetaxel: 75 mg/m^2 on day 8. The cycle was repeated every 21 days) combined with immunotherapy (Envafolimab 400 mg per treatment cycle, the cycle was repeated every 21 days). Subsequent CT scans of the lungs showed a reduction in the lesion (Fig. 2D), and thus, the patient received 4 cycles of the same dose of chemotherapy combined with immunotherapy. During the sixth cycle of chemotherapy, routine peripheral blood tests were performed every 2-3 days, and severe bone marrow suppression was confirmed based on abnormal hematological parameters. The patient developed grade IV myelosuppression, which improved after treatment with human granulocyte colony-stimulating factor and recombinant human thrombopoietin. Due to severe bone marrow suppression, the patient received one cycle of gemcitabine combined with nab-paclitaxel (Gemcitabine: 700 mg/m^2 on day 1 and 1,000 mg/m^2 on day 8; nab-paclitaxel: 240 mg/m^2 on day 8. The cycle was repeated every 21 days). Preoperative lung CT and pelvic MRI showed that the patient's condition was stable and the surgeon determined that surgery was acceptable (Figs. 1E and 5A and B). In June 2023, the patient received a series of procedures at intervals of 1 and 2 weeks, respectively, including inferior vena cava angiography with filter placement, resection of the right sacral lamina with disconnection of the right sacral nerve, as well as resection of the right pelvic lesion, exploration of the right lower limb arteries, release of the right femoral nerve and abdominal aortic balloon occlusion. Postoperative pathological examination revealed a tumor measuring 13.2x13.6x15.5 cm, with a necrosis rate of 99.2%. The specimen was graded as Huvos IV, which means no viable tumor (7) and all surgical margins were negative (Fig. 4C). After the inferior vena cava filter was removed, the patient received 5 cycles of chemotherapy (Gemcitabine: 1,000 mg/m^2 on days 1 and 8; nab-paclitaxel: 240 mg/m^2 on day 8. The cycle was repeated every 21 days), and the patient continued to receive maintenance therapy with the same dose of anlotinib, with regular pulmonary CT (Fig. 5C and D) and pelvic MRI examinations every 3 to 4 months (Fig. 1F). Follow-up to date (August 2025) has shown no signs of recurrence, enlargement of pulmonary nodules or distant metastasis. The treatment course of this patient is presented in Fig. 6.

Discussion

Pelvic osteosarcoma typically presents as large, high-grade tumors. Due to the late onset of potential symptoms, widespread metastasis at the time of diagnosis and the inherent difficulties associated with extensive surgical resection secondary to the complex and critical anatomical structures of the pelvis, the treatment of pelvic osteosarcoma is challenging (8). Chemotherapy plays a crucial role in improving survival in patients with osteosarcoma. DDT, ADM, MTX and IFO are first-line drugs for the treatment of osteosarcoma. In addition, clinical second-line chemotherapy drugs such as docetaxel, gemcitabine and cyclophosphamide are also used for refractory, multi-drug resistant and recurrent osteosarcoma (9). Compared

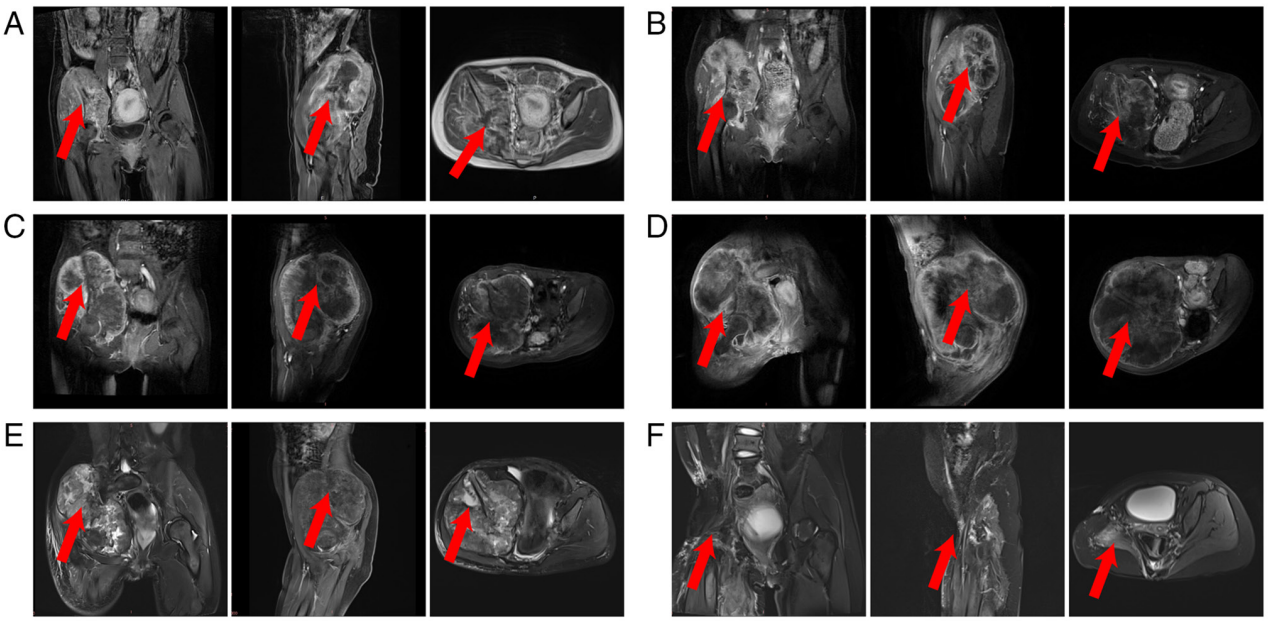

Figure 1. MRI images. The left panel shows a coronal view, the middle panel shows a sagittal view and the right panel shows an axial view of the pelvis. The red arrows point to the primary malignant lesion of the right iliac bone. (A) Before treatment, pelvic MRI (performed in September 2021) showed a lesion of the right iliac bone, the tumor size was ~116x90x125 mm, the lesion involved the right ilium, acetabulum and sacral vertebrae, showing osteolytic bone destruction, and multiple soft tissue masses were formed around. (B) After 2 cycles of chemotherapy with MIAP (high-dose methotrexate, ifosfamide, cisplatin combined with liposomal doxorubicin), pelvic MRI performed in March 2022 showed that although the mass was not significantly small, the central necrosis increased significantly. (C) The mass enlarged after the treatment was interrupted, as revealed by MRI performed in August 2022, due to the spread of the COVID-19 pandemic. (D) After chemotherapy and radiotherapy, the pelvic lesions were significantly enlarged. (E) Pelvic MRI performed in May 2023 showed that, after gemcitabine combined with docetaxel or nab-paclitaxel chemotherapy combined with immunotherapy and targeted therapy, the patient's lesions were stable and ready for surgery. (F) There was no tumor recurrence after surgery, as indicated by pelvic MRI performed in April 2024.

to osteosarcoma of the limbs, pelvic osteosarcoma has a poor response to chemotherapy and the presence of large-volume tumors can further reduce the response to chemotherapy (10). Tumor size and pathological response have been proven to affect the metastasis-free survival of patients with localized osteosarcoma (11). Studies have shown that the incidence of lung metastasis in tumors >371 cm^3 (approximate volume of an ellipsoid is 4/3 r^3) is twice that of smaller tumors and an increase in tumor volume during neoadjuvant chemotherapy also indicates an increased risk of local recurrence (12,13). The Huvos grading system quantifies the degree of tumor necrosis in patient tumor specimens, where a tumor necrosis rate of >90% is defined as high necrosis and <90% is defined as low necrosis (14). Radiotherapy is primarily used as an adjuvant therapy to eliminate residual tumor cells or alleviate symptoms such as pain, but its role in osteosarcoma treatment remains controversial. One study indicated that patients receiving adjuvant radiotherapy had poorer survival rates (15). Retrospective analyses suggest that preoperative radiotherapy can achieve higher necrosis rates and may enable the resection of otherwise unresectable lesions when treating osteosarcoma (16). Radiotherapy may be an underestimated treatment modality for patients with locally advanced or metastatic osteosarcoma (17).

Both immunotherapy and anti-angiogenic therapy have emerged as promising strategies for the treatment of solid tumors. Endostar, developed in 2005, is used to treat malignant tumors of the lung, nasopharynx and digestive system. Studies have shown that Endostar can provide clinical benefits when combined with other chemotherapeutic drugs (18). In osteosarcoma, Endostar treatment significantly inhibited chemotherapy-induced VEGF expression and the presence of microvessels, improved event-free survival rates and reduced metastasis occurrence (19). For patients with osteosarcoma with lung metastases and pleural effusion, the combination of Endostar with etoposide and IFO has been reported to markedly reduce effusion volume and shrink pulmonary lesions (20). The recombinant human VEGF monoclonal antibody bevacizumab was the first VEGF inhibitor approved for cancer treatment. *In vitro* and *in vivo* experimental studies demonstrated that bevacizumab prevents osteosarcoma cell proliferation and angiogenesis by inhibiting serum-derived extracellular vesicle-encapsulated MIAT and inducing microRNA-613-mediated G protein-coupled receptor 158 suppression (21). A retrospective study found that in children and young adults with recurrent or refractory osteosarcoma treated with bevacizumab combined with sorafenib and cyclophosphamide, prolonged disease stabilization was observed in over half of the patients (22).

Anti-angiogenic tyrosine kinase inhibitors, such as sorafenib, apatinib and regorafenib, have been clinically employed in the targeted therapy of osteosarcoma, demonstrating certain therapeutic efficacy with median progression-free survival (m-PFS) ranging from 3.6 to 6 months (23-27). Anlotinib is a newly developed oral small molecule receptor tyrosine kinase (RTK) inhibitor targeting VEGF receptor (VEGFR)1, VEGFR2/KDR, VEGFR3, c-Kit, platelet-derived growth factor receptor-α and fibroblast growth factor receptor 1, -2 and -3, with more targets than other RTK inhibitors, including sorafenib, sunitinib and pazopanib (28). In advanced soft tissue sarcoma, anlotinib has shown good efficacy and safety (29). In a retrospective analysis by Wang *et al* (30), gemcitabine

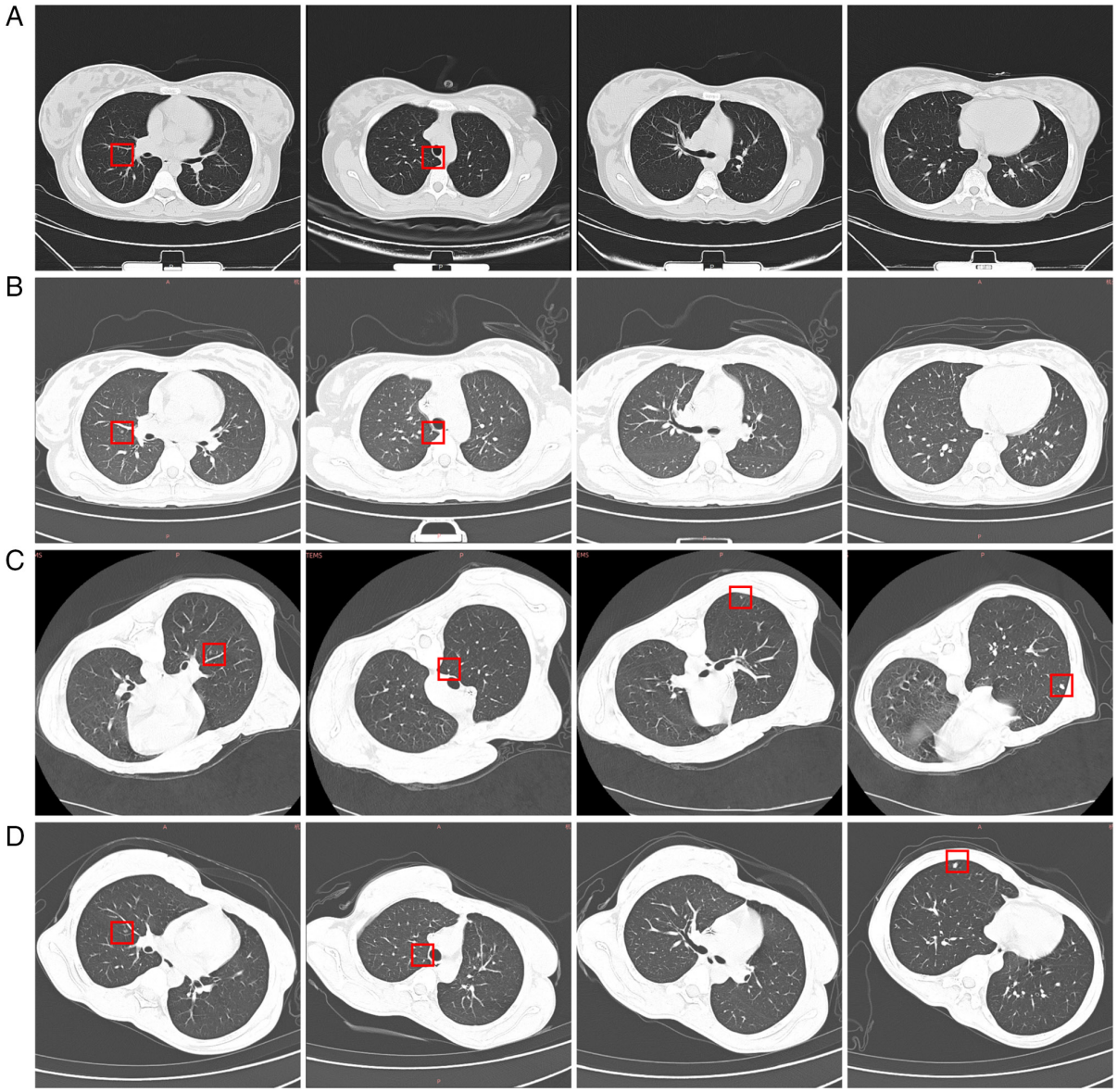

Figure 2. Lung CT images. (A) Baseline pre-treatment chest CT performed in September 2021. The four panels show representative axial slices at different levels of the lungs. Scattered solid small nodules can be seen in the lungs before treatment. Red boxes highlight scattered solid pulmonary nodules and the larger ones are ~4x3 mm, which are not considered to be lung metastases based on the results of positron emission tomography-CT; (B) Chest CT performed during treatment interruption in March 2022. The four panels show axial slices at comparable levels to baseline. Red boxes mark the previously noted nodule. despite treatment interruption, there were no signs of metastases in the patient's lungs and the larger nodules were ~4 mm in diameter; (C) Chest CT performed after chemoradiotherapy in August 2022. The four panels show axial slices at comparable levels to baseline. Red boxes indicate new and enlarged bilateral pulmonary nodules. After chemoradiotherapy, the patient had multiple nodules in both lungs, the largest of which was ~6x4 mm, and the nodules were enlarged and new. (D) Chest CT performed after chemotherapy, immunotherapy and targeted therapy in September 2022. The four panels show follow-up axial slices at different lung levels. Red boxes highlight the previously identified nodules. After chemotherapy, immunotherapy and targeted therapy, the lung lesions shrunk.

combined with docetaxel (GD) and anlotinib was evaluated in patients with metastatic osteosarcoma who had failed first-line chemotherapy. The combination therapy, used as second-line or later treatment, resulted in an objective response rate (ORR) of 38.4%, a disease control rate (DCR) of 69.2% and an m-PFS of 9.0 months. By contrast, the GD-alone group achieved an ORR of 15.8%, a DCR of 38.1% and an m-PFS of 5.0 months (30). *In vitro* and *in vivo* studies further demonstrated that anlotinib suppresses mesenchymal-epithelial transition factor and VEGFR2 phosphorylation and downstream signalling activation, thereby inhibiting hepatocyte growth factor-induced cell migration and invasion as well as VEGF-driven angiogenesis. Furthermore, in an orthotopic 143B-Luc osteosarcoma model, anlotinib significantly impeded primary tumour growth and pulmonary metastasis (31).

Immune checkpoint inhibitors such as pembrolizumab and nivolumab have achieved great success in various types of cancer, including malignant melanoma, lung cancer and gastrointestinal tumors. However, the results in osteosarcoma have been disappointing (32,33). Envafolimab is a subcutaneously administered single-domain anti-programmed death ligand 1 antibody developed in China for treating various solid tumors and chronic hepatitis B, and in the United States for treating soft tissue sarcoma and biliary tract cancer (34). In patients with unresectable or metastatic liposarcoma, the combination of anlotinib and envafolimab demonstrated a

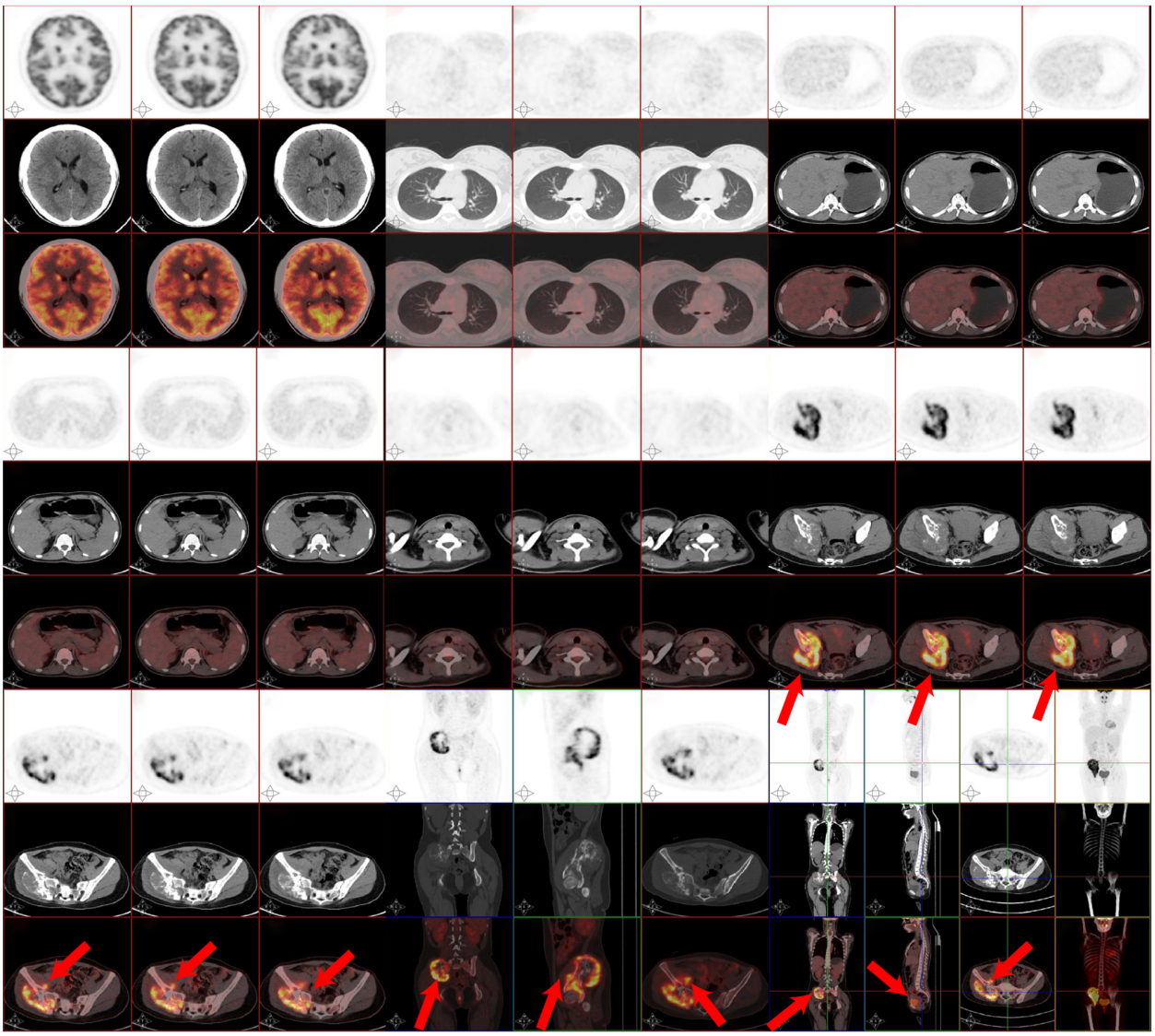

Figure 3. PET-CT images. PET-CT showed bone destruction of the right iliac bone with the formation of a soft tissue mass, abnormally increased glucose metabolism and no obvious tumor metastasis. All red arrows specifically point to the lesion in the right iliac bone: The site presents osteolytic bone destruction, adjacent soft tissue mass formation and markedly elevated glucose metabolism on PET, confirming a primary malignant tumor lesion at this site. All cranial, thoracic and upper abdominal subpanels of this composite PET-CT grid display unremarkable anatomical structures and physiological glucose metabolism, with no additional suspicious metastatic or primary lesions detected outside the right iliac bone. PET, positron emission tomography.

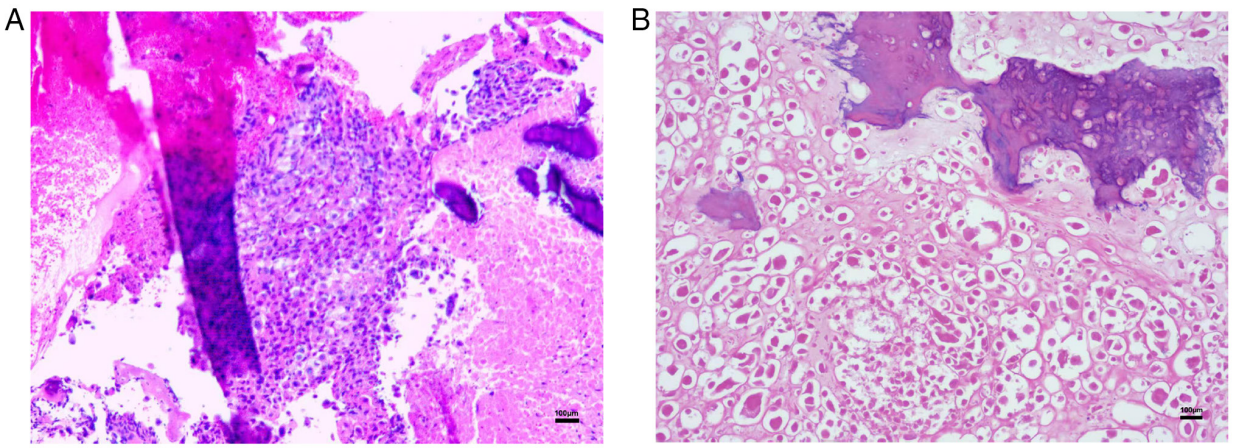

Figure 4. Pathological images. (A) Needle biopsy specimens obtained before treatment. Prior to treatment, pathology showed that the right pelvic tumor cells were epithelial, with large nuclear atypia, and a small amount of neoplastic bone-like tissue formation was seen in the focal area, and epithelioid osteosarcoma was considered. (B) Postoperative pathology showed that the tumor necrosis rate was 99.2%, Huvos grade IV, and the margins were negative at six weeks (scale bars, 100 μm).

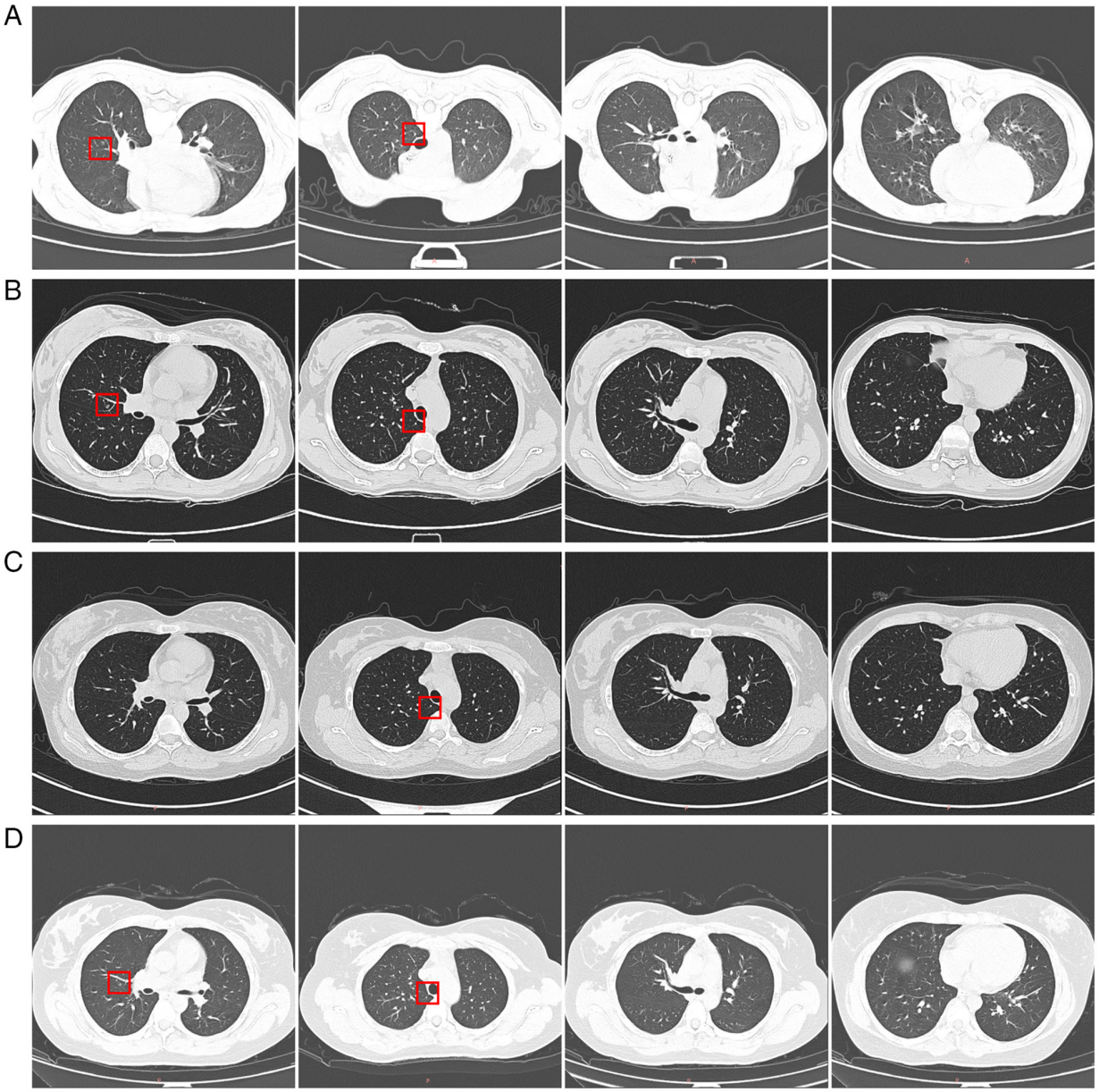

Figure 5. Lung CT. (A) Chest CT performed after receiving 2 cycles of anlotinib, envafolimab and gemcitabine combined with docetaxel chemotherapy in November 2022. The four panels show representative axial slices at different levels of the lungs. Red boxes highlight the target pulmonary nodule for longitudinal follow-up. Compared with the chest CT performed in September 2022, partial pulmonary lesions visible at baseline had resolved, while the marked target lesion remained observable. The maximum diameter of this target nodule is 4 mm. The nodule is composed of predominantly solid and ground-glass components. (B) Preoperative chest CT performed in June 2023. The four panels show axial slices at comparable levels to prior scans. Red boxes mark the previously noted target pulmonary lesion. Compared with the November 2022 chest CT, the nodule maintained stable maximum diameter of 4 mm and unaltered morphology consisting of solid and ground-glass components. (C) Early follow-up chest CT after completion of main-course treatment, during anlotinib targeted maintenance monotherapy, performed in June 2024. The four panels show axial slices at comparable levels to prior scans. Red boxes highlight the previously identified target pulmonary nodule. The lesion demonstrated sustained stability under maintenance therapy. (D) Later follow-up chest CT under continued anlotinib maintenance therapy, performed in March 2025. The four panels show follow-up axial slices at different lung levels. Red boxes highlight the previously identified target pulmonary nodule. The target lesion remained stable without obvious progression or regression.

disease control rate of 73.3%, indicating promising antitumor activity and a manageable safety profile (35). Penpulimab is a humanized anti-programmed cell death 1 monoclonal antibody developed by Akeso Biopharma, in collaboration with Chia Tai Tianqing (a subsidiary of SinoBiopharm). It aims to completely eliminate Fcγ receptor binding and Fc-mediated effector functions, thereby exerting anti-tumor effects (36). A phase 3 clinical trial has confirmed that the combination of piaxumab monoclonal antibody with paclitaxel and carboplatin significantly improved the PFS of patients with advanced squamous non-small cell lung cancer, and the treatment was safe and well-tolerated (37). Several studies have reported that the combination of pembrolizumab and anlotinib shows promising anticancer activity and manageable safety in the treatment of small cell lung cancer, which is worthy of further investigation (38,39).

The treatment course of the patient of the present study was prolonged and challenging. However, surgical resection was consistently prioritized as the primary goal, considering tumor removal essential for long-term survival despite

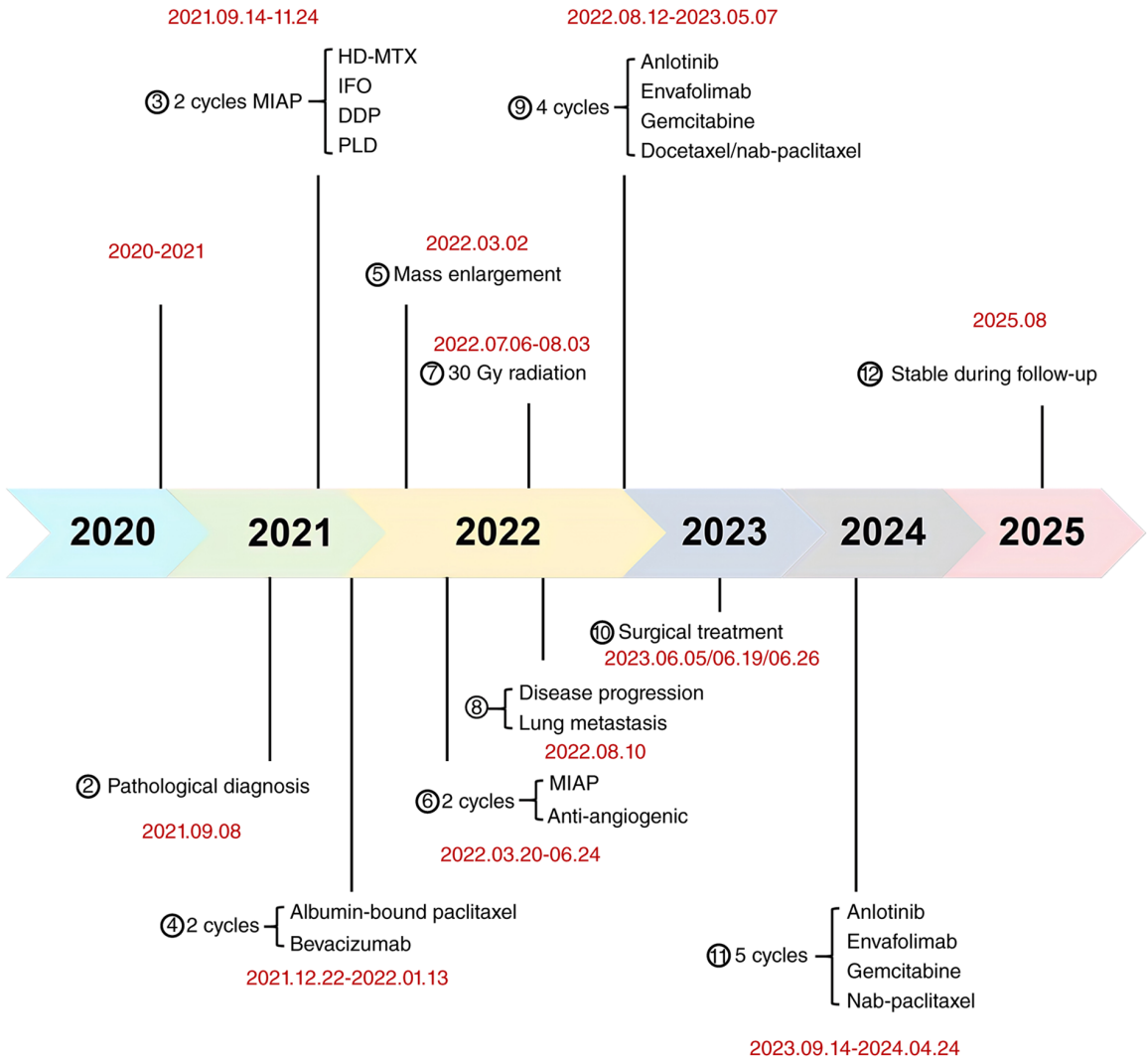

Figure 6. Treatment flow chart.

potential compromises in quality of life. Surgical intervention is critically important in pelvic osteosarcoma and directly impacts long-term survival (40). It has been demonstrated that wide or wide margins (complete tumor resection with adequate surrounding normal tissue) or marginal margins (tumor resection along the pseudocapsule without macroscopic residual disease) contribute to better local control and for cases with intralesional margins or unresectable lesions, adjuvant radiotherapy can favorably improve prognosis (41). A Japanese study on pelvic osteosarcoma also demonstrated that the prognosis of patients treated with surgical resection was significantly better than that without surgical resection (42). Preliminary research by our group found that pelvic osteosarcoma without primary lesion resection exhibited poorer survival rates (43). Previous departmental studies revealed that a 4-cycle multi-drug chemotherapy regimen consisting of high-dose MTX, ADM, DDT and IFO combined with surgical resection could effectively improve survival rates in patients with osteosarcoma (44).

The patient of the present study was diagnosed with massive pelvic osteosarcoma before treatment, with imaging showing a tumor size of 116x90x125 mm. After MIAP neoadjuvant chemotherapy, the patient should have qualified for surgical intervention. However, due to external circumstances and the patient's own lack of attention, tumor progression occurred and this opportunity was lost. Meanwhile, osteosarcoma, particularly pelvic osteosarcoma, has a relatively low incidence, making standardized treatment protocols unavailable at all hospitals and departments. After the first enlargement of the pelvic mass, the standard first-line MIAP chemotherapy regimen was still adopted upon evaluation. During treatment, Endostar and bevacizumab were added to prevent pulmonary metastasis. During high-dose MTX, DDT, IFO and PLD therapy, the patient developed grade IV myelosuppression, leading to chemotherapy interruption. With timely administration of human granulocyte colony-stimulating factor and recombinant human thrombopoietin, the patient successfully completed neoadjuvant chemotherapy. Following radiotherapy, the pelvic tumor became enlarged again and pulmonary metastasis occurred. Considering the patient's bone marrow function and the effective clinical experience of penpulimab and envafolimab in patients with advanced sarcoma, the National Comprehensive Cancer Network-recommended second-line chemotherapy regimen GD was selected (45). Meanwhile, anlotinib targeted therapy was continued, and after consultation, envafolimab immunotherapy was added,

successfully securing the surgical opportunity for the patient, with a stable condition maintained to date. Current research suggests that nab-paclitaxel exhibits preclinical activity against osteosarcoma and may cause less myelosuppression than docetaxel (46). Given the current patient's history of multiple high-dose chemotherapies and significant myelosuppression, docetaxel was replaced with nab-paclitaxel after discussion. The most common adverse drug reactions of anlotinib include hypertension (64.6%), hand-foot syndrome (43.2%), elevated thyroid-stimulating hormone (44.6%) and fatigue (46.3%) (47). During maintenance therapy, the patient experienced diarrhea and elevated thyroid-stimulating hormone, which were manageable with medication. Fortunately, the patient did not develop hand-foot syndrome or pneumothorax, resulting in a good quality of life. Cancer-associated thrombus caused by osteosarcoma is rare (48). The patient of the present study developed inferior vena cava thrombosis during treatment and underwent filter placement. For an extended period post-surgery, the patient experienced postoperative pain and was treated with pregabalin. Over time, the symptoms gradually alleviated and medication was discontinued.

In conclusion, the current study presented a case of a giant pelvic osteosarcoma that was successfully treated with multimodal therapy, achieving surgical resection and maintaining stable disease. This case provides insights into the efficacy of neoadjuvant chemotherapy, second-line treatment regimens and targeted therapy for inoperable pelvic osteosarcoma. For patients with unresectable pelvic osteosarcoma, this strategy may be considered to pursue surgical opportunities. The patient remains alive with no disease progression and maintains a good quality of life.

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Availability of data and materials

The data generated in the present study are included in the figures and/or tables of this article.

Authors' contributions

QY performed writing of the original draft, visualization, project administration, formal analysis, data curation and conceptualization. JY was involved in project administration, data curation and conceptualization. YL contributed to data curation, supervision and investigation (reviewing the imaging data and cross-checking them against the patients' detailed treatment histories). MC and ZW performed visualization, formal analysis and data curation. JC was involved in data curation, formal analysis and visualization. YX contributed to review and editing, project administration, formal analysis, data curation and conceptualization. Data curation included sorting clinical follow-up data, organizing imaging and pathological records and collating medication administration information. Visualization involved extracting CT and MRI images from the electronic medical record system and integrating/processing them into a single comprehensive figure. Formal analysis and investigation refers to reviewing the imaging data and cross-checking them against the patients' detailed treatment histories. QY and YX independently reviewed and verified all raw clinical data to confirm data authenticity and integrity. All authors have read and approved the final manuscript.

Ethics approval and consent to participate

This study was approved by the Institutional Review Board of Hangzhou Third People's Hospital (Hangzhou, China; approval no. 2025KA231).

Patient consent for publication

Written informed consent has been obtained from the patient to publish relevant clinical information and imaging data.

Competing interests

The authors declare that they have no competing interests.

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