A Case Report of Radiation Therapy as Definitive Treatment for Desmoid Tumor in a Young Girl

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INTRODUCTION

Desmoid tumor is benign growth with diverse aggressiveness and growth pattern with an incidence rate of 3.2 per 1,000,000 populations in Denmark [1]. The girl-to-boy ratio was 3:1, and the median patient age was 38 [2]. Desmoid tumor is rare in children, with very erratic behavior and morbidity [3].

The therapy for desmoid tumors includes active surveillance and intervention, such as surgery, radiotherapy, and medical treatment. Treatment decision-making should involve an experienced multidisciplinary team to minimize operational surveillance risk and avoid unnecessarily adverse events [4]. In a case where surgery produces significant morbidity, radiation therapy is the rational treatment option. This therapy provided excellent local control and symptoms relieved without compromising the organ function. In this study, an in-depth radiological and pathological examination was presented to establish a definite diagnosis and propose further treatment. The success of radiation therapy was also presented as a definitive treatment for a young girl who refused limb amputation for organ preservation.

CASE PRESENTATION

A 13-year-old girl with a lump in her left arm complained of a bump three years ago. Initially, it was marble-sized but gradually increased, accompanied by pain, specifically during movement. There was no history of weight loss, lump in another body site, chronic disease, cough, or experience of trauma or surgery. The patient also denies a history of a tumor in her family.
On physical examination, a fixed solid mass was found on the patient’s left arm with tenderness. Furthermore, the circumferential size of the left arm was longer than the other, accounting for 45 and 31 cm, respectively, with a limited range of motion. The forward flexion and abduction-adduction of the patient’s active shoulder were 0 to 60 and 0 to 70 degrees, respectively.

The complete blood count, renal function test, and LDH are within normal limits. An x-ray examination showed a soft tissue mass on the left proximal humerus with bony involvement and a lytic lesion on the left humeral head due to a suspected metastatic process. Chest x-ray showed no evidence of lung metastasis.

The Magnetic Resonance Imaging (MRI) of the left shoulder showed a solid soft tissue mass on the deltoid muscle with the necrotic component, measuring 8 x 9 x 17 cm. This mass extends to the adjacent cutaneous and subcutaneous tissue, involving the left humerus, attaching to the deep brachial artery and vein, indicating the presence of a malignant lesion. Multiple lymphadenopathies were identified on the left axillary and supra-infracavicular region with an immense short-axis distance of 19 mm. For more information on this imaging data, please see Figure 1.

The examination of the core biopsy showed a solid tumor arranged in long sweeping fascicles of bland fibroblasts and myofibroblasts, infiltrating the surrounding tissue and prominent thin-walled elongated vessels with variable perivascular edema. The result of Immuno-Histochemistry tests supports desmoid fibromatosis, as indicated by a positive outcome in Smooth Muscle Actin and β catenin staining. However, the tumor cells were negative for S100 and Desmin.

The diagnosis of the young girl showed a stage IV desmoid tumor with massive extension and attaching to the deep brachial artery and vein. In cases of this nature, limb amputation was the surgical approach. The patient refused limb amputation and desired that the lump on her arm shrink in size, become pain-free, and restore normal range of motion. Patients are afraid of surgery, specifically those involving the loss of an arm, a concern majorly for young patients. In younger patients, therapeutic decisions extend beyond the individual, necessitating the crucial involvement of the family.

In this study, the selected alternative procedure was radiotherapy as a definitive treatment due to the preference of the patient. The patient planned to receive radiation therapy with a total dose of 56 Gy in 28 fractions over six weeks. A 3 mm slice thickness CT simulation was carried out with the arm next to the body in the supine position. Gross Tumor Volume (GTV) was the primary tumor, as seen by MRI. The definition of Clinical Tumor Volume (CTV) was GTV plus 1–1.5 cm radial and 2 cm longitudinal and the Planning Target Volume (PTV) that received at least 95% prescribed dose was 95%. The mean dose for heart, left, and right lungs were 5.59, 8.74, and 3.63 Gy, respectively. The spinal cord received a maximal dose of 7.27 Gy.

**Figure 1.** A solid soft tissue mass of 8 x 9 x 17 cm on the left deltoid muscle with the necrotic component that expands to adjacent cutaneous and subcutaneous tissue, involving the left humerus, attaching to the deep brachial artery and vein, suggesting a malignant lesion.

**Figure 2.** Three-dimensional conformal radiotherapy was delivered using a 6 MV x-ray of an anterior, lateral, and posterior field in-field technique. The PTV that received at least 95% prescribed dose was 95%. The mean dose for heart, left, and right lungs were 5.59, 8.74, and 3.63 Gy, respectively. The spinal cord received a maximal dose of 7.27 Gy.
In this patient, limb amputation was the surgical approach because of the massive extension of the disease, attaching to the deep brachial artery and vein. However, the patient refused the surgical option after receiving the information about limb amputation and desired pain relief and lump reduction without sacrificing her limb. Radiotherapy is the reasonable and adequate initial approach for specific conditions, such as unresectable disease, elder age, patient intolerance/preference, comorbidity, rapidly growing tumor, and threatening vital organs [4,8]. The result is worse in younger patients because the tumor is associated with radio resistance and risk of secondary malignancy [7]. In the study, the combination of surgery and radiotherapy did not show a lower recurrence rate than surgery or radiotherapy alone. The recurrence rate after radiotherapy was higher than surgery but not statistically significant [4]. The musculoskeletal tumor board at the hospital decided to deliver definitive radiotherapy for this case after discussing the benefits and risks. In addition to the preservation of organs and functions, radiation oncologists should provide comprehensive explanations about potential treatment because of tumor radioresistance and treatment toxicity, such as radiation-induced malignancy and growth disorder. Radiation oncologists should also explain the poor outcome of treatment because of tumor radioresistance and treatment toxicity, such as radiation-induced malignancy and growth disorder. Weighing the benefits and late effects is very useful in decision-making. Furthermore, younger patients and families must be involved in making therapeutic decisions. The radiotherapy doses used in several studies for definitive and adjuvant treatment are 55–65 Gy and 50–60 Gy, respectively. The recommended dose is above 54 Gy because of the optimal dose-response relationship. However, increasing the dose level beyond 60 Gy is not associated with better outcomes. The local control rate with RT varies from 71 to 93% [9], and 56 Gy in 2 Gy daily doses was used for over six weeks to avoid toxicity when irradiating large tumors.

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DISCUSSION

The most common site of desmoid tumor included extra-abdominal (49%), abdominal wall (40%), and intra-abdominal or retroperitoneal area (8%) [2]. Furthermore, the most common location for upper extremity desmoid tumors is the shoulder. The patients in previous studies reported a painful mass as a frequent symptom with an average tumor size of 189 cm³ [5]. Over half of patients used chemotherapeutic agents, tyrosine kinase inhibitors, NSAIDs, opioids, antidepressants, or steroids three years before their diagnosis [2].

A combination of CT and MRI could improve diagnostic accuracy. In MRI examination, the lesions were more extensive than 5 cm, round or fusiform in shape, unclear boundary, uniform signal, inhomogeneous enhancement, and “root” or “claw” infiltration. Neurovascular tract invasion was also reported in 30.77% of cases. CT examination showed that desmoid tumors had a lower density, higher enhancement, and unclear boundary. A CT value < 50 Hu was observed in half of the lesions, and the enhancement was rough [6].

According to the guidelines of the National Comprehensive Cancer Network (NCCN), the treatment of new desmoid tumors is active surveillance. Several studies showed regression or stable disease in the untreated desmoid tumor, specifically in patients < 50 years old. Intervention is considered when the tumor progresses or causes significant symptoms or morbidity [7]. In this study, the indications for active treatment were progressive pain and limited range of motion.

Surgery is the first line of desmoid tumor treatment, but radiotherapy and medical treatment may be a part of the management strategy when it shows higher morbidity, such as extremity/girdles/chest wall tumor.
gross tumor to define the CTV. A High-resolution contrast-enhanced MRI examination is critical to delineating gross tumors and organs at risk. Pre- and post-operative MRI is also essential for co-registration with CT simulation to define tumor bed or residual disease after surgery [9]. In this case, a smaller margin was used because of the proximity to the growth plate and joint.

The radiation-induced toxicity reported from a systematic review was skin-related, joint-related, pain, lymphedema, fracture, and neuropathy, accounting for 9.1%, 7.4%, 6.9%, 6%, 2.2%, and 0.1%, respectively [8]. The toxicity increased in patients who received radiotherapy after surgery. According to a previous study, radiation-induced malignancy is the late radiation toxicity that influenced the treatment decision [9]. The independent prognostic factors for a worse 5-year local control were age ≤30 years (57% vs. 75% > 30; HR 1.73, p=0.004), extremity location (57% vs. 71% non-extremity; HR 1.77, p=0.004), and large tumor (>10 cm: 59%; HR 2.17, p=0.004; 5–10 cm: 65%; HR 1.71, p=0.02; vs ≤5cm 76%) [10].

Other treatment options that are unavailable in the hospital include percutaneous cryo-ablation, radiofrequency ablation (RFA), and high-intensity focused ultrasound (HIFU). Percutaneous cryo-ablation has a limitation on small tumors and desmoids in non-critical structures despite the high clinical response rate. RFA and HIFU have promising outcomes but are also related to skin toxicity and cellulitis. The guidelines of NCCN recommend several systemic agents stratified for treatment urgency, distinguishing between critical and less critical response times. Selected agents under “time to respond more critical” include sorafenib, imatinib, pazopanib, liposomal doxorubicin, doxorubicin and dacarbazine. On the other hand, the preferred regimens under “time to respond less critical” include methotrexate/vinblastine and methotrexate/vinorelbine [7]. These systemic agents are available in the hospital but not approved by universal health insurance. Chemotherapy is indicated for the patient in this study, but its outcome is inferior to radiotherapy. A retrospective analysis of 262 patients over 30 years by Testa et al. [11] showed that chemotherapy administration had a 5-year progression-free survival (PFS) rate of 24.9%. Time to next treatment chemotherapy is also the shortest compared to other modalities. The study from Heidelberg University Hospital in Germany reported a two-fold higher 5-year PFS in patients undergoing radiotherapy [12]. Although there are currently no studies directly comparing these two modalities, radiotherapy has the more promising result.

CONCLUSIONS

Radiotherapy showed promising results and reduced symptoms in desmoid tumors of the extremities. This modality was considered definitive therapy for young girls who preferred organ preservation.

DECLARATIONS

Competing of Interest
The authors declare no competing interest in this study.

Acknowledgment
Not applicable

REFERENCES