

The Application of Aquaplast Thermoplastic as a Bolus Material in the Radiotherapy of a Patient with Classic Kaposi's Sarcoma at the Lower Extremity

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Abstract. *Background: The classic Kaposi's sarcoma (KS) patients usually present with progressive skin lesions over the lower extremities, following an indolent course. Although radiotherapy is an effective treatment for KS, radiation over these lesions is not without difficulty. The intrinsic difficulty resides in how a homogenous radiation dose over superficial lesions involving large areas and irregular surface is properly delivered. Several bolus techniques have thus been invented. Materials and Methods: The Aquaplast RT™ Thermoplastic is a new type of bolus material that can be easily molded and conformed to the curvature of skin, with the equivalence to soft tissue in radiation interaction. Results: This material was applied as the bolus for the irradiation of a classic KS patient, whose disease involved multiple skin areas over the right heel and ankle. Large parallel-opposed irradiation fields delivered by ⁶⁰Co were used. Computed tomography demonstrated a close conformity of the bolus built-up by Aquaplast RT™ Thermoplastic to the surface of the ankle and foot. A dosimetry measurement further confirmed an adequate and homogenous distribution of desired dose around the lesions of the lower extremity. After a total dose of 39 Gy, divided in 13 fractions, the lesions remitted completely. Conclusion: Our data suggest that the use of Aquaplast RT™ Thermoplastic as a bolus material is helpful in delivering adequate dose to skin lesions of the lower extremities.*

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Classic Kaposi's sarcoma (KS), a rare and slow-growing vascular neoplastic disease, is particularly prevalent in elderly men of Mediterranean or Eastern European Jewish origin (1, 2). Compared to the KS related to acquired immunodeficiency syndrome (AIDS) due to human immunodeficiency virus (HIV) infection, classic KS usually follows an indolent course, predominantly affecting the skin of the lower extremities (3, 4). Although profound immunodeficiency is rarely seen in the majority of classic KS patients, these patients might be affected with subtle immunodeficiency due to old age, diabetes mellitus or chronic renal insufficiency (1-4).

Many drugs, including immuno-modulating agents and cytotoxic agents, have been successfully used in the treatment of AIDS-related KS patients (4-6). However, the application of these agents in patients with classic KS is usually limited by the relatively poor general condition of these patients and the palliative nature of the treatment. Radiation therapy, with the nature of local therapy and few unwanted systemic side-effects, has long been considered as the standard therapy for classic KS (7-10).

Previous reports have demonstrated that various types of energy, such as ⁶⁰Co or electron beams and various doses and fractions are capable of inducing good tumor response in classic KS (7-10). The major challenge in radiotherapy for this disease resides in the inherent difficulty in the irregular contour of the lower extremity, which prohibits a homogenous dose distribution. Several strategies have thus been invented. The water bolus system, which employs a water-filled container and requires the patient to immerse the affected extremity in the water-bath, has provided a homogenous dose distribution and good clinical outcome (11, 12). Another invention, which converted the air splints to a bolus by replacing the air with water, has also been shown to provide accurate delivery of a homogenous dose to the surface of extremity (13).

Herein, we report our experience with a new material that is highly shapeable and has the equivalence of soft tissue in radiation interaction, the Aquaplast RT™ Thermoplastic, in the treatment of a patient with classic KS at the lower extremity. Our experience suggested that this is an easily applied and reliable way of delivering adequate skin dose to lower extremities.

Materials and Methods

Materials. Aquaplast RT™ Thermoplastic is 2-oxepanone, polymer with 1,4-butanediol (synonyms: Caprolactone, 1,4-butanediol polymer epsilon-Caprolactone, or 1,4-butanediol polyester) (WFR/Aquaplast Corp., Wyckoff, NJ, USA). This material has been shown as an effective bolus material; with thicknesses of 0.5 cm or 1 cm, Aquaplast RT™ Thermoplastic shows less than 2% of difference in comparison with polystyrene or superflab boluses, two commonly used bolus materials, when irradiated with 6 to 12 MV photon using a 10 cm x 10 cm field size (14).

Bolus technique. The patient was asked to position himself as comfortably as possible while the lesions were amenable to irradiation. With the support of Base Plate (MED-TEC, Orange, IA, USA), several 0.2-cm thick Aquaplast RT™ Thermoplastic sheets, after heating at around 60~70°C, were gathered to fit the contour of the lower extremity of the patient. After cooling at room temperature, a more than 0.5-cm thick Aquaplast RT™ Thermoplastic sheet was solidified like a "shell" with a nearly perfect fit to the surface of the lesion in order to offer adequate electron scattering. The support of the base plate and the set-up shell made of Aquaplast RT™ Thermoplastic helped to position the leg/foot reliably for daily radiation delivery.

Results

Case presentation. In Feb 2005, a 73-year-old man was referred to the Division of Radiation Oncology, Department of Oncology, National Taiwan University Hospital, Taipei, Taiwan, for multiple KS lesions over the right foot and ankle. The patient had been taking medications for several systemic diseases, including hypertension, diabetes mellitus, coronary arterial disease, hyperlipidemia, hyperuricemia and benign prostate hypertrophy, for more than 10 years. He had received an angioplasty for coronary arterial disease complicated with an episode of acute myocardial infarction 7 years before and had another operation for gall stone 6 years before.

A gradual appearance of purplish-pigmented skin lesions over the right lower extremity had been noted for half a year. At the Dermatology Clinic, he was found to have more than 40 discrete lesions with sizes varying from pinhead to rice-grain over the skin around right heel and right ankle. Mild tenderness was perceived. There was no obvious lymphedema. An excision biopsy of the skin lesion confirmed KS. The serology of anti-HIV was negative.

Radiation of skin lesions. The radiation field was planned to cover the whole right foot and the very lower part of the right leg, including the entire ankle. A 0.5-cm thick sheet of Aquaplast RT™ Thermoplastic was molded to enclose the whole right foot and ankle. As shown in Figure 1, the foot was "shelled" with a sheet of Aquaplast RT™ Thermoplastic. In order to have a quick, accurate and repeatable positioning of the lesion foot as well as a better immobilization during the radiation therapy, a MED-TEC base plate (MED-TEC) was also employed in conjunction with the "shell" or the bolus made of Aquaplast RT™ Thermoplastic (Figure 1). A follow-up computed tomography (CT) demonstrated a very close conformity of the bolus made of Aquaplast RT™ Thermoplastic and the contour of the foot (Figure 2).

The radiation was given with ⁶⁰Co as source of energy delivered by Theratron1000 (Theratron, Ottawa, Canada), with 2 opposing fields from lateral tangent and medial tangent approaches. The field size was 11 cm x 14 cm. The treatment consisted of 13 fractions of 3 Gy per day for a total dose of 39 Gy.

Treatment outcomes. A dosimetric evaluation was performed. As revealed in Figure 2, the dose at the skin surface around the ankle and heel was equally distributed, with 100% or more of the planned dose.

The patient was treated throughout the planned course uneventfully. Except a very mild erythema of the irradiated skin, there was no obvious toxicity. Three months after completion of radiation the KS lesions remitted completely.

Discussion

A water-based bolus technique using a water bath tank has been one of the most commonly used methods to deliver radiation for superficial skin lesions of the extremities (11, 12). However, in our experience, the water bath technique is cumbersome and sometimes impractical for patients with poor performance status to immerse the affected limb in the tank. During the treatment, it is also often messy due to water spillage. Furthermore, when lesions are complicated with wounds or ulcerations, the potential infection of the wound itself and the contamination from the water in case of the spillage can be problematic. Our technique, which avoids the above-mentioned drawbacks, is relatively neat. In addition, the easy and reliably high reposition made this approach "user-friendly" for patients under treatment.

Similar approaches like this have been commonly applied for patients with head and neck cancers receiving radiation therapy. The application of plastic shell in treating patients with head and neck cancers is mainly based on a better and reliable repositioning for radiotherapy. The Aquaplast RT™ Thermoplastic used in this report had dual benefits in treating skin lesions over



Figure 1. Clinical set-up for the treatment of KS lesions of the lower extremity using Aquaplast RT™ Thermoplastic with the support of a Base Plate.

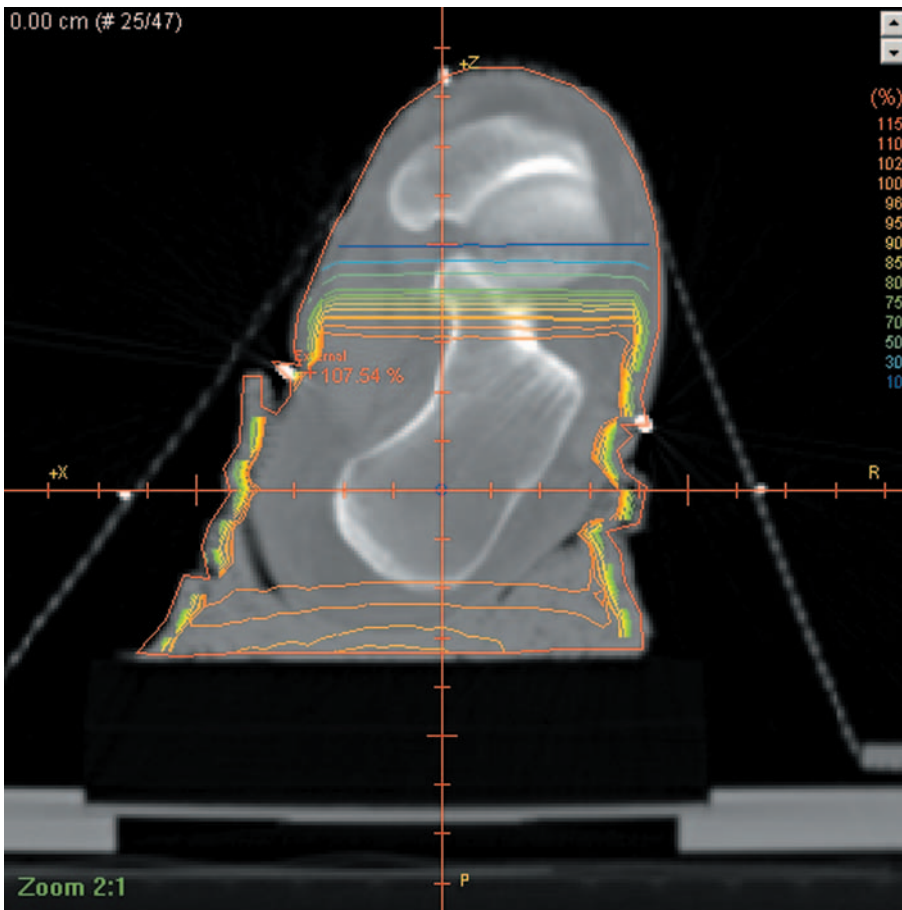


Figure 2. CT imaging of the foot covered with a bolus of Aquaplast RT™ Thermoplastic with dose calculation.

the lower extremities. First, it served as a typical "shell" for repositioning of the irradiated region. Second, it acted as a bolus material for skin lesions because of a perfect equivalence to the soft-tissue interacting with radiation.

The good conformity and good bolus characteristic of this material provided a homogenous radiation distribution at the surface of skin in a relatively large area with uneven contour, as in our case.

Finally, although radiation for KS is often reported to have very high response rate, several issues require further investigations. It is generally believed that irradiation of patients with KS of the extremities need a generous margin. However, it seems no clear guideline indicates how far the margins should go. The benefit of a generously large irradiation field may be compromised not only by complications due to irradiation of unnecessary intact skins, but also by dosimetric problems associated with the large irradiated area. Moreover, in previous studies total doses of radiation ranging from 8-12 Gy in one exposure to 24-30 Gy fractionated over 2 to 3 weeks can achieve significant palliation in KS lesions (9). In an analysis of the long-term outcome of classic KS patients treated with radiation therapy, it was found that doses of 27.5 Gy or more which delivered in 10 fractions over 2 weeks, or their equivalent, were associated with significantly better long-term local control (10). As depicted in the presented case, with a proper position and better bolus technique, radiation with standard fraction to a relatively higher total dose can be given without significant side-effects. Therefore, this strategy has now become the current practice for patients with KS or other superficial lesions of the extremity at our center.

In conclusion, Aquaplast RT™ Thermoplastic is an effective bolus material for the treatment of patients with classic KS of the extremities because of its tissue-equivalence and the easy conformity to the shape of extremity.

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