Journal of Radiotherapy in Practice

cambridge.org/jrp

Case Study

Cite this article: Pires AM, Borges F, Dias AG, Joana L, Matos M, and Gonçalves J. (2023) Paraffin gauze bolus as tissue compensator in photon irradiation for mycosis fungoides – regarding a case study. *Journal of Radiotherapy in Practice*. **22**(e82), 1–4. doi: 10.1017/S1460396923000109

Received: 14 November 2022
Revised: 13 January 2023
Accepted: 7 February 2023

Key words:
bolus; *in vivo* dosimetry; paraffin gaze; radiotherapy; superficial tumour; treatment planning

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Paraffin gauze bolus as tissue compensator in photon irradiation for mycosis fungoides – regarding a case study

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Abstract

Introduction: Total skin electron beam therapy is a treatment option in patients with mycosis fungoides (MF) affecting a significant amount of the body surface. For patients with involvement of soles and interdigital folds, however, this approach is ineffective, requiring alternatives such as localised radiotherapy (RT). Although electron beams are well suited for superficial lesions, on irregular surfaces it provides inadequate tumour coverage and excess dose variance, requiring photon irradiation with tissue compensation.

Methods: We present the case of a patient with extensive cutaneous MF with skin lesions spread over both lower limbs and treated on these affected areas with photon beam RT. Long sheets of paraffin gauze dressings were used to create a 0·5-cm-thick bolus. The patient received a single fraction of 8 Gy. *In vivo* dosimetry using Gafchromic films was performed.

Results: After 3 months, a complete response was achieved. In this case, paraffin gauze bolus proved to be an inexpensive, convenient, effective and flexible method for irregular superficial cancer irradiations.

Conclusion: Paraffin gauze bolus is a suitable option for irregular contours.

Introduction

Cutaneous T-cell lymphoma is a heterogeneous group of T-cell neoplasms involving the skin.[1] Mycosis fungoides (MF) is the most common subtype, with an annual incidence of 5·6 per 1·000·000 people.[2] Most patients present with early-stage disease,[3] classically with discrete and indolent skin lesions that resemble eczema or widespread erythema. Some patients, eventually, progress to an advanced stage, where they may present with fungating tumours, erythroderma, and involvement of lymph nodes and viscera.[4] Treatment is dependent on the stage and extent of the disease. For early stage, the treatment concept relies on skin-directed therapies (topical therapies, phototherapy and radiotherapy [RT]), while in advanced stage, systemic therapy is used alone or combined with skin-directed therapies.[5]

For unifocal small extensions of disease, local RT provides effective palliative remission. But when a significant amount of body surface is involved such that the entire skin surface requires irradiation, total skin electron beam therapy (TSEBT) is employed. TSEBT provides a relatively homogenous RT dose to almost the entire skin (dose uniformity ± 15[6] to 25%[7,8]). The Stanford technique is the most commonly TSEBT method used, which relies on a large electron 6-field technique (anterior, posterior and four opposed oblique fields). Here, patients stand in an upright position on a static base during irradiation.[9] However, this positioning makes certain areas of the body to be 'shadowed', including the top of the scalp, perineum, upper inner thighs and soles of the feet (up to 40% underdosage).[8] For patients presenting lesions in these underdosed regions, TBSET becomes ineffective, requiring alternatives. Various types of localised RT techniques for skin irradiation are available, such as electrons, kilo and megavoltage photons with tissue compensation.[10] Although electron beams are well suited to the treatment of these superficial targets, for regions with highly irregular surfaces, electron field setup can prove challenging with inadequate tumour coverage and excess dose variance. Photon irradiation with tissue compensation can be an option.

Materials used as bolus vary from commercial to handmade, as plasticine, natural rubber, paraffin wax, Play-Doh®, propylene glycol, water-soaked gauze sponges, aquaplast, gels, and polypropylene.[11–13] No strong evidence exists regarding the best bolus, so the choice is determined by institutional preferences, availability and the characteristics of the area to be irradiated. In our institution, for irregular surfaces whose RT treatment requires bolus, we use paraffin

Figure 1. Patient photographs at initial presentation.

Figure 2. Clinical setup of the paraffin gauze dressing and radiochromic films for *in vivo* dosimetry.

gauze. We present the case of extensive involvement of MF treated with photon beam RT and paraffin gauze compensator.

Case Presentation

An 87-year-old man was referred to our department in October 2021. The patient was diagnosed with MF in 2003, with a long history of multiple relapses and therapies. Three months prior, he experienced clinical worsening and thus was referred to our department for RT. The patient showed plaques across the thigh and left leg, and across the right leg, both feet and soles, including the interdigital folds (Figure 1). Due to the locations of the skin lesions and the need of using custom-made bolus, a single fraction treatment was chosen.

Long sheets of paraffin gauze dressings were used to create a 0·5-cm thick bolus in the affected areas. The sheets of gauze were overlapped as evenly as possible, with particular attention to remove any air bubbles between the gauze and the skin (Figure 2). In addition, *in vivo* dose measurement of the surface dose was performed using the methodology commonly used in the hospital for similar cases (for further details, see Dias et al, 2019[14] and Santos et al, 2021[15]).

A computer tomography (CT) scan was performed for planning purposes. The clinical target volume was created by applying an isotropic expansion of 3 mm inside the body (none of the MF lesions revealed deep infiltration; thus, 3 mm encompasses the entire disease and skin). For the planning target volume (PTV), an additional 2-mm isotropic margin was added to the outer CTV (this allowed for the optimisation of the dose on the skin), resulting in a 5-mm-thick rim. A computerised dosimetric plan was generated using intensity-modulated radiation therapy (IMRT) with 6 MV photons (Figure 3), and 8 Gy to the PTV mean was prescribed.

Results

The mean calculated dose to the skin of both legs was 8,1 Gy (D_{min} = 2,9 Gy, D_{max} = 10,5 Gy). The results of *in vivo* dosimetry, using EBT3™ (Ashland Inc., Wayne, NJ, USA) with the local protocol for film analysis, had the mean measured value of 7,8 Gy (D_{min} = 6,6 Gy, D_{max} = 9,3 Gy). This difference is justified by the location of the films on the skin surface which does not reflect the dose on the whole skin volume (a skin thickness of 3 mm was considered). The value of the mass density of the paraffin gauze was estimated from the Hounsfield Units of the CT images carried out in prior institutional studies, with this estimated value being 0·92 g/cm^3.

Five weeks after irradiation, the patient presented at our office referring complete resolution of the local pain and pruritus and

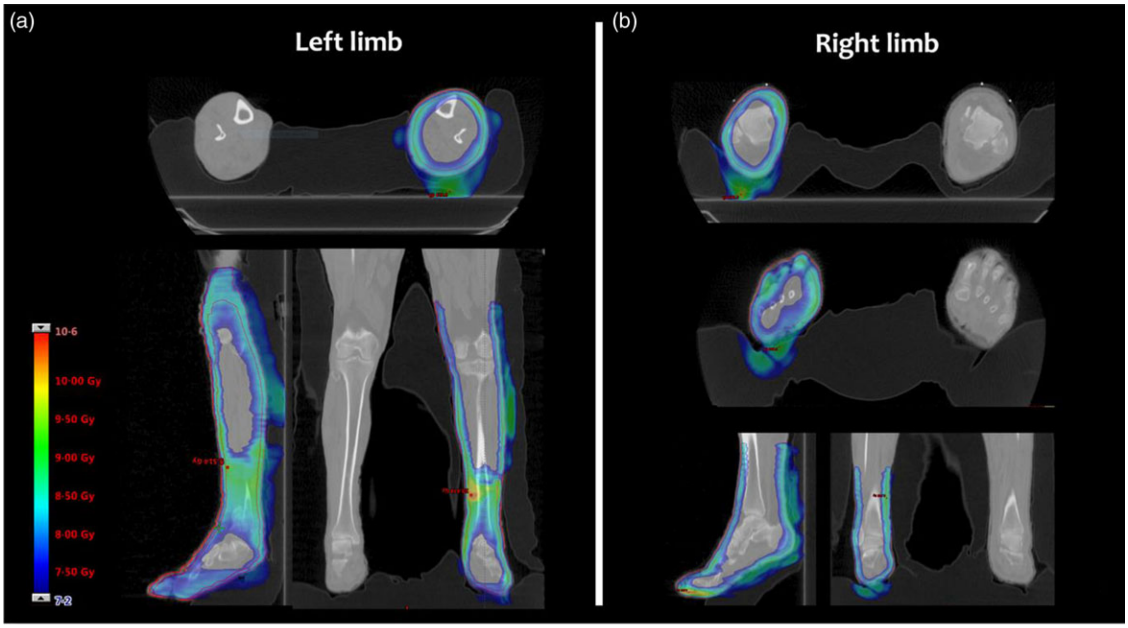

Figure 3. PTV (red contour) dose coverage shown in colour wash for the left (a) and right (b) lower limbs.

Figure 4. Photos of the patient 1 and 3 months after the RT showing a partial and complete response, respectively.

presented with only vestigial plaques in a healing phase (Figure 4). Three months post-RT, the patient presented without any skin lesions. No acute or late toxicity was reported. Eleven months after receiving the treatment, the patient remains without any lesion on the treatment fields and asymptomatic, consistent with a complete response.

Discussion

Though irradiation of superficial lesions is challenging, due to the dose build-up effect from megavoltage X-ray,[16] the surface dose can be increased by adding a tissue equivalent material.

From our knowledge, this is the first report on the use of paraffin gauze as a tissue compensator, which limits the

https://doi.org/10.1017/S1460396923000109 Published online by Cambridge University Press

comparison of our results. A few other clinical reports using handmade bolus with different materials exist (using peroxide-soaked gauze[17] and rice[18]), and all refer complete remissions of the lesions. Furthermore, paraffin gauze is not included in any of the existent studies regarding the dosimetric properties of handmade bolus.[11–13,19–22]

Paraffin gauze bolus proved to be an inexpensive, convenient and effective method for superficial cancer therapies when uneven body contours are involved. This material also possesses the main features that are intended for a bolus.[12,13] Unwanted dose heterogeneity[23,24] owing to the presence of an air gap between the bolus and the patient's skin was satisfactorily accomplished by the paraffin gauze, due to the flexibility and capacity of the paraffin to infiltrate into all the folds of the patient's skin. It has, however, some limitations as it is a time-consuming method that may be too laboured-intensive to be applied for fractionated radiation schemes.

Conclusion

Single-fraction IMRT using a paraffin gauze bolus for skin dose coverage was, in this case, effective for the treatment of MF lesions of the lower limbs, feet soles and interdigital folds. Care should be taken to the selection of bolus material in patients referred to irradiate superficial lesions. Considering the physical properties of the paraffin gauze, such as its availability, flexibility and ease of application to irregular surfaces, this material proved to be a suitable option to provide conformance to irregular contours. Further research is warranted to develop superior alternatives in scenarios like we stated in our case.

Acknowledgements. **Ethics approval and consent to participate.** Written informed consent for the publication of clinical details and photographs was obtained from the patient. Per our institutional demands, no ethical approval is required for the publication of a clinical case.

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