Case Report

A radiotherapy technique for palliative total scalp irradiation

Rocchina Caivano[1], Alba Fiorentino[2], Piernicola Pedicini[1], Giorgia Califano[1], Vincenzo Fusco[1]

[1]Radiotherapy Oncology Department, I.R.C.C.S. - C.R.O.B. Rionero in Vulture (Pz), Italy; [2]Radiotherapy Oncology Department, Sacro Cuore Hospital, Negrar-Verona, Italy

Correspondence to: Rocchina Caivano, PhD. Radiotherapy Department, I.R.C.C.S. - C.R.O.B. ,Via S. Pio 1, 85028 Rionero in Vulture (Pz), Italy. Email: rocchina.caivano@gmail.com.

Abstract: A scalp irradiation technique for palliative treatment of a squamous cell carcinoma was discussed. A patient with multiple cutaneous scalp lesions resulting in bleeding and pain was treated with a 3D conformal radiotherapy technique was performed with five 6 MV electron beams without shifting the field borders during the course of the treatment, due to the finality of the treatment (palliative intent). A reduction of planning and delivery complexity has been obtained not considering the junctioning problems. Nevertheless, the 90% of gross tumor volume (GTV) was covered by the 85% of prescription dose with a significant reduction of patient's symptoms (pain and bleeding). Our patient achieved a significant pain response and resolution of bleeding with this technique. Our study revealed that the scalp irradiation by means of electron beam without considering the junction problem is easy and effective for the palliative intent in elderly patients with squamous cell carcinoma.

Keywords: Scalp irradiation; electron beams; radiotherapy; squamous cell carcinoma

Submitted Oct 19, 2014. Accepted for publication Jan 08, 2015.
doi: 10.3978/j.issn.2224-5820.2015.01.02
View this article at: http://dx.doi.org/10.3978/j.issn.2224-5820.2015.01.02

Introduction

Total scalp irradiation is used to treat different conditions: melanoma, lymphoma, angiosarcoma, mycosis fungoides, basal, and squamous cell carcinoma. Treatment of the total scalp is typically reserved for diffuse disease presentations and its intent, therefore, is most commonly palliative. Planning and delivering total scalp irradiation is technically challenging, in order to deliver a homogeneous dose to the scalp and meanwhile sparing the brain and all its healthy structures. Many techniques and different approaches have been described in the literature (1-8). More of these have been developed by photons obtaining a good conformation of dose to target and protection of surrounding normal tissue as well (9-13). However, despite new technology and technical solutions, megavoltage electron beams remain the traditional and most common choice for total scalp irradiation in elderly patients (13). To achieve a homogeneous dose distribution, the latter requires normal incidence with respect to the treatment surface. Thus, because of the scalp's shape does not permit normal incidence by a single electron field, several electron beams techniques have been developed to solve the problem of the electron beam junctions (1-5).

Hereby we describe a 3D conformal radiotherapy technique using electron beams when the treatment has a palliative intent.

Case report

A 77-year-old patient with previous stroke, cardiological and pneumological comorbidities, suffering from squamous cell carcinoma of the scalp (G1 infiltrating the dermis and hypodermis), presented to our department for radiation therapy. Based on the clinical condition and on the spread of tumoral disease, the intent of radiotherapy was palliative.

On clinical examination of the scalp, there was various skin lesions covered with crusts from which confluent serous material and blood emerged.

The patient was placed in prone position with a head holder and the arms along the body. An immobilizer for the feet has been used too. For the treatment planning,

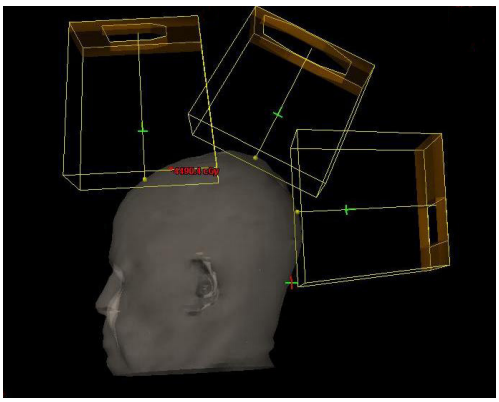

Figure 1 Three out of five electron beam used in this case, from the left to the right: GR 270°, 300°, 0° with CR =270°, 270°, 0°, respectively. CR, couch rotation.

the scalp was divided into five regions, each of which was irradiated with 40 Gy (16 fractions, 2.5 Gy/day). The treatment planning consists in five 6 MV electron fields with 1 cm junction: two lateral fields [gantry angle (GA), 90° and 270° with couch rotation (CR) =0°] and three "apical" fields placed as: GR 270°, 300°, 0° with CR =270°, 270°, 0° respectively (*Figure 1*). The electron beams were delivered by using an A15 applicator and, for each field, personalized lead screens were employed (*Figure 2*). The field junctions were placed in healthy cutaneous tissue, to avoid the GTV underdosage.

Setup and treatment took about 10 minutes per day. Compared to other conformal techniques it is a standard treatment time, while using intensity-modulated radiotherapy techniques the delivery time can be a little higher, even if the volumetric-modulated arc therapy offer a shorter treatment time comparable to conformal techniques (11,13).

Before starting and at the end of radiation, the numerical scale of pain was used: no pain was grade 0, maximum pain was graded 10.

The 90% of the gross tumor volume (GTV) was covered by 85% of the prescribed dose, even if the field borders were not shifted during the course of the treatment. The axial dose distribution is showed in *Figure 3*. The 6 MV electron beams allow the sparing of the whole brain tissue (mean dose: 1.4 Gy).

Before RT, the patient had a normal blood count despite the scalp bleeding but declared a scalp pain (numeric scale 8) and no drugs for pain were used because the patient refused them. At the end of radiation treatment, he experienced a sorrow decrease (numeric scale 5). Moreover, radiotherapy stopped the bleeding and the serous material.

At the first follow-up (3 months after RT), the patient declared a stable of pain (VAS 4) without bleeding and a normal blood count. No drugs for pain were used.

Subsequently we have no more follow ups because the patient died due to cardiological problems.

Discussion

Basal cell and squamous cell carcinomas are common cutaneous epithelial cancers, but the scalp is one of the less common sites of appearance. Usually, the typical patient affected by this tumor is aged over 65 years old. The radiotherapy of the scalp is a very complex technique and different approaches have been described in the literature. Locke *et al*. (9) performed a treatment planning study by comparing the lateral photon-electron technique with serial tomotherapy planned for delivery on the Peacock system (Best Nomos Radiation Oncology, Sewickley, USA). The study concluded that although serial tomotherapy provided a more homogeneous dose distribution throughout the target volume, the doses to the eyes and brain were much higher. Orton *et al*. (10) compared helical tomotherapy (Tomotherapy, Inc., Madison, USA) with the lateral photon-electron technique. This study produced tomotherapy plans with a more uniform dose to the scalp and lower doses to the brain and eyes than the more conventional technique. Bedford *et al*. (11) compared IMRT with five fixed gantry angles to static electron and arcing electron techniques. As expected, the results indicated that IMRT provided superior target coverage of the treatment volume while the doses to the brain and eyes were higher, although clinically acceptable. Recently, Chan *et al*. (12) showed that the combined static electron fields with photon IMRT improved the target coverage homogeneity and reduced normal tissue doses when compared to the electron beam-only approach or photon IMRT alone. Wojcicka *et al*. (13) performed a treatment planning study by comparing the dosimetry of the lateral photon-electron, segmental photon IMRT and helmet mold-based HDR brachytherapy techniques. They found that IMRT provided the best target dose homogeneity and coverage, and delivered clinically acceptable doses to normal structures. HDR produced the most conformal plan, but the total dose delivered was limited by doses to the brain and eyes.

At the moment, although the different available techniques, the electron field radiotherapy is still considered as therapeutic modality (13). In particular, when multiple

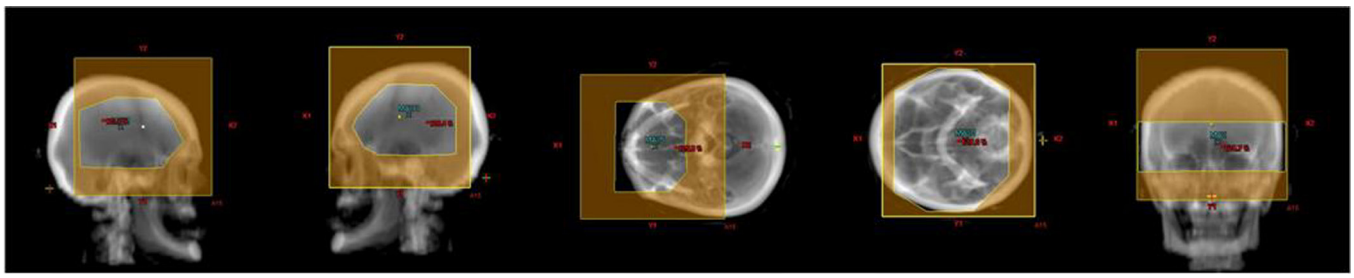

Figure 2 Personalized lead screens used for each electron field; from the left to the right: GA =90°, 270°, 270°, 300°, 0° with CR =0°, 0°, 270°, 270°, 0°, respectively. GA, gantry angle; CR, couch rotation.

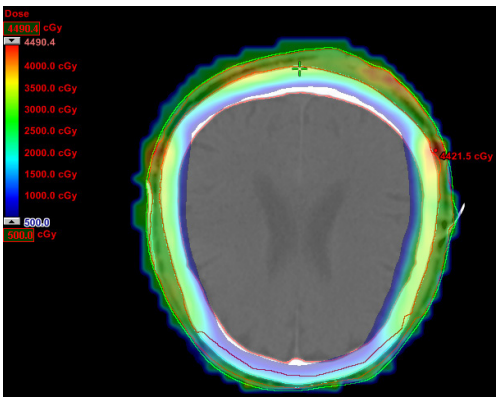

Figure 3 The axial dose distribution: the 90% of the gross tumor volume (GTV) was covered by 85% of the prescribed dose, while the whole brain tissue was spared.

fields are needed, the normal approach is to shift the field borders during the course of treatment to match the adjacent electron fields and avoid target underdosage (2-5). Analyzing the few literature data about that kind of solution, a dose coverage ranging from 75% to 120% of prescribed dose was found (2,14). Zavgorodni *et al.* (14) achieved a dose covering range 85% to 110% by the application of a compensated SXR field eliminating low dose zones in the junction region and reduced high dose zones to 110%.

To our knowledge, this report is the first one that analyzed the palliative irradiation of the scalp, with the aim of reducing symptoms without using a very complex technique (saving time and labor). Thus, due to the palliative intent, the junctioning problems were not considered. Nevertheless, the obtained results demonstrated that the GTV was covered by the 85% of prescription dose and that the patient did not interrupted the planned treatment, experiencing a significant reduction of pain and interruption of bleeding.

Despite the spread of new technologies and the considerable problem of the adjacent fields matching, the scalp irradiation with electron field remains a useful treatment modality. Considering the lack of literature data about the palliative treatment approach, our data revealed that the palliative electron beam scalp irradiation, without considering the junction problem, is easy and effective in elderly patients for treating symptom and improving quality of life. Anyway, it is necessary to pay attention in positioning the field junction: it has not to be placed in critical regions, to avoid the GTV underdosage.

Acknowledgements

Disclosure: The authors declare no conflict of interest.

References

1. Able CM, Mills MD, McNeese MD, et al. Evaluation of a total scalp electron irradiation technique. Int J Radiat Oncol Biol Phys 1991;21:1063-72.
2. Mellenberg DE, Schoeppel SL. Total scalp treatment of mycosis fungoides: the 4 x 4 technique. Int J Radiat Oncol Biol Phys 1993;27:953-8.
3. Sagar SM, Pujara CM. Radical treatment of angiosarcoma of the scalp using megavoltage electron beam therapy. Br J Radiol 1992;65:421-4.
4. Walker C, Wadd NJ, Lucraft HH. Novel solutions to the problems encountered in electron irradiation to the surface of the head. Br J Radiol 1999;72:787-91.
5. Yaparpalvi R, Fontenla DP, Beitler JJ. Improved dose homogeneity in scalp irradiation using a single set-up point and different energy electron beams. Br J Radiol 2002;75:670-7.
6. Akazawa C. Treatment of the scalp using photon and electron beams. Med Dosim 1989;14:129-31.

7. Tung SS, Shiu AS, Starkschall G, et al. Dosimetric evaluation of total scalp irradiation using a lateral electron-photon technique. Int J Radiat Oncol Biol Phys 1993;27:153-60.
8. Kinard JD, Zwicker RD, Schmidt-Ullrich RK, et al. Short communication: Total craniofacial photon shell technique for radiotherapy of extensive angiosarcomas of the head. Br J Radiol 1996;69:351-5.
9. Locke J, Low DA, Grigireit T, et al. Potential of tomotherapy for total scalp treatment. Int J Radiat Oncol Biol Phys 2002;52:553-9.
10. Orton N, Jaradat H, Welsh J, et al. Total scalp irradiation using helical tomotherapy. Med Dosim 2005;30:162-8.
11. Bedford JL, Childs PJ, Hansen VN, et al. Treatment of extensive scalp lesions with segmental intensity-modulated photon therapy. Int J Radiat Oncol Biol Phys 2005;62:1549-58.
12. Chan MF, Song Y, Burman C, et al. The treatment of extensive scalp lesions combining electrons with intensity-modulated photons. Conf Proc IEEE Eng Med Biol Soc 2006;1:152-5.
13. Wojcicka JB, Lasher DE, McAfee SS, et al. Dosimetric comparison of three different treatment techniques in extensive scalp lesion irradiation. Radiother Oncol 2009;91:255-60.
14. Zavgorodni SF, Beckham WA, Roos DE. A method for producing uniform dose distributions in the junction regions of large hinge angle electron fields. Int J Radiat Oncol Biol Phys 1996;35:765-70.

Cite this article as: Caivano R, Fiorentino A, Pedicini P, Califano G, Fusco V. A radiotherapy technique for palliative total scalp irradiation. Ann Palliat Med 2015;4(1):35-38. doi: 10.3978/j.issn.2224-5820.2015.01.02

