International Journal of Research in Dermatology
Venkatakrishnan P et al. Int J Res Dermatol. 2021 Mar;7(2):250-254
http://www.ijord.com

DOI: https://dx.doi.org/10.18203/issn.2455-4529.IntJResDermatol20210577

Original Research Article

Study of the various cutaneous adverse reactions to radiotherapy

Priyatharshini Venkatakrishnan, Govardhan Jagadeesh Kumar*, Bhavana Sampadarao

Department of Dermatology, Aarupadai Veedu Medical College and Hospital, Pondicherry, India

Received: 22 December 2020
Accepted: 21 January 2021

***Correspondence:**
Dr. Govardhan Jagadeesh Kumar,
E-mail: gopi3333@yahoo.com

ABSTRACT

Background: Radiation-induced skin toxicity is a widely recorded toxicity of definitive radiation therapy with about half of patients experiencing grade 2 or higher skin reactions. Radiation-specific characteristics include total exposure, fractional dose, beam energy, field size, anatomic of radiation, and subsequent systemic therapy. Aim of the study was to identify and grade the various cutaneous adverse reactions to radiotherapy.
Methods: 25 patients underwent radiation therapy for any type malignancies were included in the study. Skin manifestations due to other systemic/ cutaneous diseases prior to radiotherapy. Detailed history was taken about disease course, cutaneous manifestations with emphasis on treatment (type of radiation, dosage and duration). General physical examination and dermatological examination were done.
Results: In this study 60% of patients were male, the minimum dose of radiation was 30Gy in 13% patients, maximum dose of radiation was 70Gy in 33% patients, 88% of patients were in RTOG grade 2. Hyperpigmentation was the commonest findings 23 (92%), followed by dry desquamation 11 (44%), the next common was epilation 10 (40%).
Conclusions: Radiation toxicity, generally occurring during or shortly after treatment can range from mild (hyperpigmentation, erythema) to severe (moist desquamation).

Keywords: Radiotherapy, Cutaneous reaction, Radiation dermatitis, Adverse reaction

INTRODUCTION

Radiation dermatitis is a typical sequel to radiation therapy. Up to 85 per cent of patients treated with radiation therapy experience mild to extreme skin reactions.[1,2] These adverse skin effects include noticeable changes in the skin, including edoema, erythema, dyspigmentation, and necrosis. Radiation therapy oncology group (RTOG) has developed a standardised grading method to determine acute radiation-induced skin toxicity.[3] Radiation therapy toxicity is complex and secondary to a number of variables, such as total radiation exposure, dose fractionation schedule, and amount of organ or tissue treated, as well as concurrent chemotherapy and comorbid conditions. This injury, along with other structural tissue degradation, production of reactive oxygen species, decreased functional stem cells, initiation of epidermal and dermal inflammatory reactions, and necrosis of skin cells, results in radiation dermatitis.[5] Radiation dermatitis significantly affects the quality of life of patients and the management of their disease.[6]

Aim of the study was to identify and grade the various cutaneous adverse reactions to radiotherapy.

METHODS

In this cross-sectional observational study 25 patients received radiotherapy for various malignancies were included. This study was conducted in department of dermatology and radiotherapy at a tertiary care hospital from January 2018 to June 2018. Inclusion criteria: Patients who are receiving/have received radiotherapy for

cancer. Exclusion criteria: Skin manifestations due to other systemic/cutaneous diseases prior to radiotherapy. Detailed history was taken about disease course, cutaneous manifestations with emphasis on treatment (type of radiation, dosage and duration). General physical examination and dermatological examination were done. Investigations were done as per the skin manifestations.

Table 1: Radiation therapy oncology group (RTOG) toxicity grading.

Grade	Observation
0	No change over baseline
1	Follicular, faint or dull erythema/epilation/dry desquamation/decreased sweating
2	Tender or bright erythema, patchy moist desquamation/moderate edema
3	Confluent moist desquamation other than skin folds, pitting edema
4	Ulceration, hemorrhage, necrosis
5	Any toxicity which causes death

Data were collected using proforma and converted into MS Excel. Data were presented as frequency, percentage.

RESULTS

In this study 25 patients underwent radiotherapy for any malignancies were included. In this study 60% of patients were male and 40% of patients were female (Figure 1). The minimum dose of radiation was 30Gy and 40 Gy in 13% patients respectively; maximum dose of radiation was 70Gy in 33% patients (Figure 2). In this study 88% of patients were in RTOG grade 2 and 12% of patients were in RTOG grade 1 (Figure 3).

In this study hyperpigmentation was the commonest findings 23 (92%), followed by dry desquamation 11 (44%), the next common was epilation 10 (40%). Other cutaneous findings were erythema 7 (28%), moist desquamation 4 (16%), ulceration 2 (8%) and edema 2 (8%) (Figure 4).

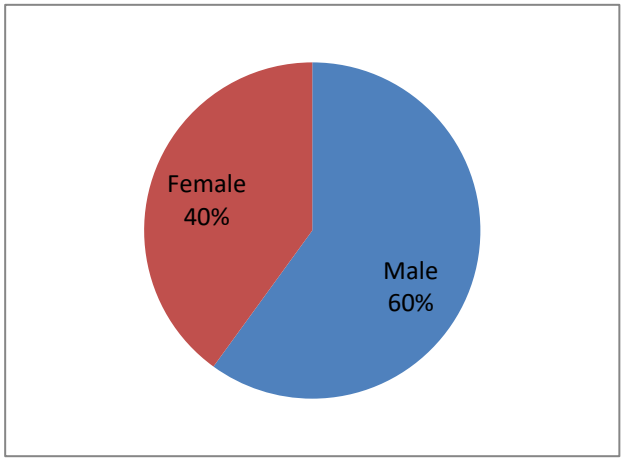

Figure 1: Gender distribution.

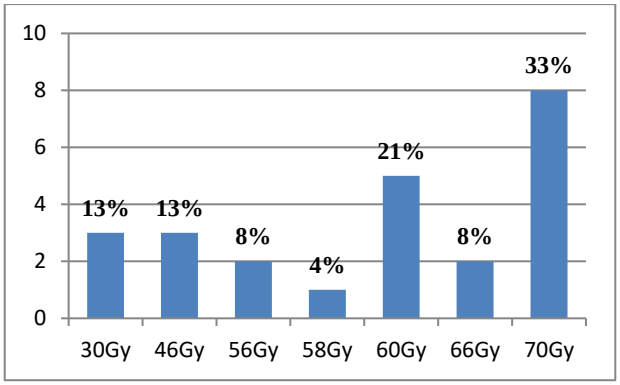

Figure 2: Total radiation dose.

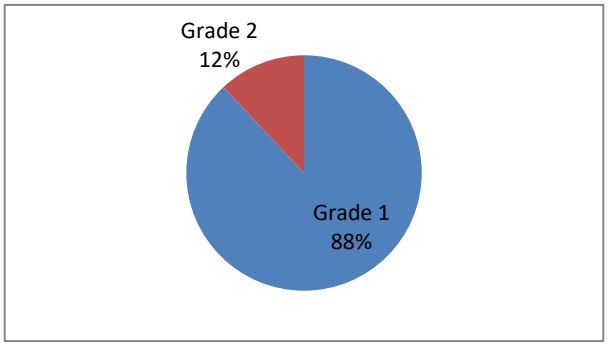

Figure 3: RTOG toxicity grade.

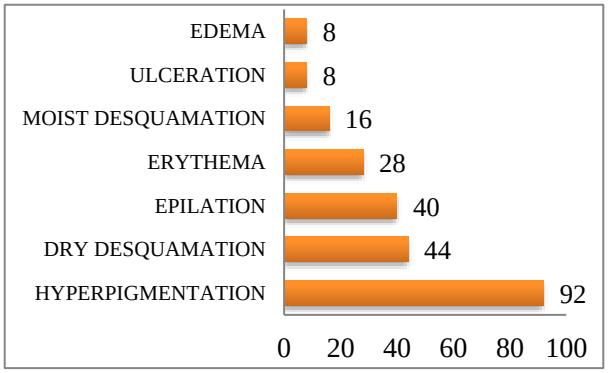

Figure 4: Various cutaneous reactions to radiotherapy.

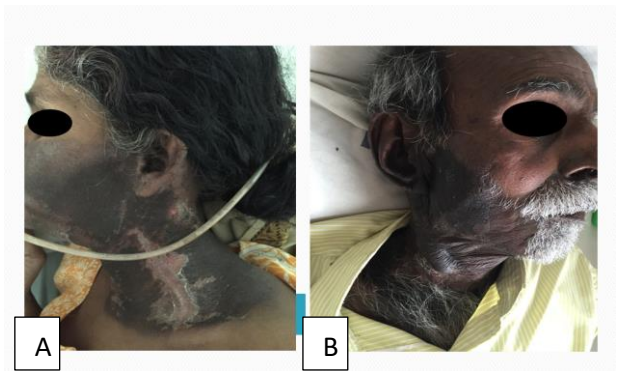

Figure 5: Hyperpigmentation and dry desquamation in the neck area.

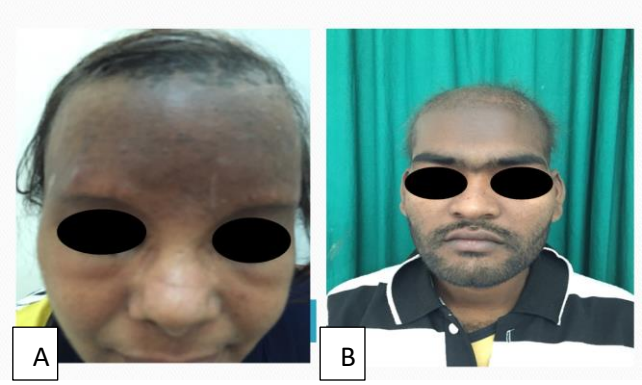

Figure 6: Hyperpigmentation over the forehead.

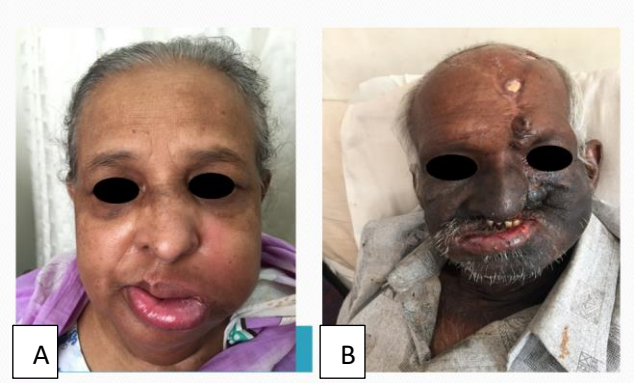

Figure 7: (A) Erythema over the face. (B) Hyperpigmentation and epilation over the face.

DISCUSSION

Radiation therapy (radiotherapy) is a popular and effective procedure used to treat many different forms of cancer. From its very precarious origins after the discovery of x-rays by Roentgen in 1895, the discipline of radiotherapy has progressed enormously from novel treatment to the mainstay of oncology.[8] While the purpose of radiotherapy is to provide maximum treatment with a minimum of side effects, it is still predicted that about 87 per cent of people would have mild to serious skin reactions.[9]

As the treatment beams penetrate through the skin to reach their target tissue, some degree of damage is considered as a side effect. In brief, radiotherapy works on cellular DNA, thus preventing cell replication and the resulting development of free radicals, which then destroys healthy tissue, including the skin.[8,10] The amount of harm sustained is directly equal to the amount of radiation exposure, and in serious situations, such as after nuclear power plant incidents, it can result in death.[11,12] Long-term complications include altered organ function, suppression of splenocytes and thymocytes, and cataract development.[13-17] Skin reactions to therapeutic radiation rely on a variety of therapies and conditions for patients, including the location of radiation therapy (moist areas are the most vulnerable areas), the type of radiation and energy used, the use of mechanical and chemical skin irritants by the patient, the patient's dietary intake, the presence of skin folds and concomitant chemotherapy.[10,18-20] Changes that occur can start within hours of beginning treatment and may continue for several months or even be permanent.

There are broad differences in the treatment of skin disorders internationally; however, there appears to be a consistency in the general guidelines for skin care. These include: (1) Keeping area clean and dry (2) Mild soap with a pH of 7.5 or less (3) No skin rubbing (4) No irritants (5) No starch-based products (risk of infection) (6) Wearing and using natural fibres next to the skin (7) Preventing temperature extremes,[19-21] moisturization tends to be essential to the prevention of skin reactions and guidelines included barrier creams, lanolin, steroid cream, Aloe vera and other hydrophilic substances.[8,19,20,22]

Moist desquamation can be managed with hydrocolloidal dressings to increase epithelial proliferation and reduce exposure to external pathogens. These should not be used if there is infection and they may also damage friable skin on removal.[22-24] Steroid creams such as 1% hydrocortisone are often routinely recommended for mild reactions.[19,25] Whilst it is known that steroid creams act through a number of biochemical pathways, primarily to lower eicosanoid production, it is unknown whether their effect on radiotherapy-induced skin reactions is primarily through moisturisation or as an anti-inflammatory agent. There is even concern whether there may be delayed healing with steroid use.[26-28] Certainly steroids are contraindicated in the presence of infection as they mask the signs and symptoms and can worsen the infection.[19]

Moist desquamation can be handled with hydrocolloid dressings to improve epithelial proliferation and minimise exposure to external pathogens. They cannot be used if there is an infection and they can even cause damage to the friable skin after removal.[22-24] Steroid creams such as 1% hydrocortisone are also prescribed for moderate reactions.[19,25] Although it is understood that steroid creams work through a variety of biochemical mechanisms, mainly to reduce the development of eicosanoids, it is not known if their effect on radiotherapy-induced skin reactions is primarily due to hydration or as an anti-inflammatory agent. There is also concern as to whether healing with steroid use may be delayed.[26-28] Certainly, in the case of infection, steroids are contraindicated as they obscure signs and symptoms and can exacerbate the infection.[19]

CONCLUSION

Radiation toxicity, generally occurring during or immediately after treatment, can vary in severity (hyperpigmentation, erythema) to extreme (moist

desquamation). There is a range of products available to help prevent and treat acute radiation dermatitis, but more research on the effectiveness of these products is required. Similarly, more research is also required to help prevent and treat late radiation exposure occurring months to years after radiation.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

1. Fisher J, Scott C, Stevens R, Marconi B, Champion L, Freedman GM et al. Randomized phase III study comparing best supportive care to Biafine as a prophylactic agent for radiation-induced skin toxicity for women undergoing breast irradiation. Int J Radiat Oncol Biol Phys. 2000;48(5):1307-10.
2. Salvo N, Barnes E, Van Draanen J, Stacey E, Mitera G, Breen D et al. Prophylaxis and management of acute radiation-induced skin reactions: a systematic review of the literature. Curr Oncol. 2010;17(4):94-112.
3. Trueman E. Managing radiotherapy induced skin reactions in the community. J Community Nurs. 2013;27(4):16-24.
4. Constine LS, Milano MT, Friedman D. Late effects of cancer treatment on normal tissues. In: Halperin EC, Perez CA, Brady LW, eds. Principles and Practice of Radiation Oncology Philadelphia (PA): Lippincott Williams and Wilkins. 2007:320-55.
5. Hymes SR, Strom EA, Fife C. Radiation dermatitis: clinical presentation, pathophysiology, and treatment 2006. J Am Acad Dermatol. 2006;54:28-46.
6. Bolderston A, Lloyd NS, Wong RK, Holden L, RobbBlenderman L. Supportive Care Guidelines Group of Cancer Care Ontario Program in Evidence-Based Care. The prevention and management of acute skin reactions related to radiation therapy: a systematic review and practice guideline. Support Care Cancer. 2006;14(8):802.
7. McQuestion M. Evidence-based skin care management in radiation therapy. Semin Oncol Nurs. 2006;22(3):163-73.
8. Hassey Dow K, Dunn Bucholtz J, Iwamoto R, Fieler VK, Hilderley LJ. Nursing care in radiation oncology, 2nd ed. W.B. Saunders: Pennsylvania. 1997.
9. Fisher J, Scott C, Stevens R, Marconi B, Champion l, Freedman GM et al. Randomised phase III study comparing best supportive care to biafine as a prophylactic agent for radiation-induced skin toxicity for women undergoing breast irradiation: radiation therapy oncology group. Int J Radiat Oncol Biol Phys. 2000;48(5):1307-10.
10. Sitton E. Early and late radiation-induced skin alterations, part I: mechanisms of skin changes. Oncol Nurs Forum. 1992;19(5):801-7.
11. Nenot JC. Medical and surgical management for localised radiation injuries. Int J Radiat Biol. 1990;57(4):783-95.
12. Guskova AK, Baranov AE, Barabaranova AV, Moiseev AA, Paitken EK. The diagnosis, clinical picture and treatment of acute radiation sickness in the victims of Chernobyl Atomic Electric Power Station, II, non-bone marrow syndromes of radiation lesions and their treatment. Ter Arkh. 1989;61(8):99-103.
13. Brown JB, Fryer MP. High energy electron injury from accelerator machines (cathode rays): radiation burns of chest wall and neck: 17-year follow up of atomic burns. Ann Surg. 1965;162(3):426-37.
14. Saevets NV, Povstianoi NE. Radiation burns located in the area of major blood vessels (experimental study). Klin Khir. 1980;3:24-7.
15. Steidley KD, Stabile RJ, Sanfilippo LJ. A case history of severe radiation burns from 50 kVC X-rays. Health Physician. 1981;40(3):399-405.
16. Ciko Z, Antic M, Jokic N, Brajovic D, Radovic M. Acute radiation sickness associated with radiation burns. Vojnosanit Pregl. 1986;43(4):311-3.
17. Gogin EE. Combine radiation exposures and their immediate and late sequelae. Ter Arkh. 1990;62(7):11-5.
18. Hopewell JW. The skin: its structure and response to ionising radiation. Int J Radiat Biol. 1990;57(4):751-73.
19. Sitton E. Early and late radiation-induced skin alterations part II: nursing care of irradiated skin. Oncol Nurs Forum. 1992;19(6):907-91.
20. Barkham AM. Radiotherapy skin reactions and treatments. Prof Nurse. 1993;8(11):732-6.
21. Campbell IR, Illingworth MH. Can patients wash during radiotherapy to the breast or chest wall? A randomised controlled trial. Clin Oncol. 1992;4:78-82.
22. Heenan ALJ. Emollient applications for chronic skin problems. Prof Nurse. 1996;11(11):743-8.
23. Margolin SG, Breneman JC, Denman DL, La Chapelle P, Weckback L, Aron BS. Management of radiation induced moist skin desquamation using hydrocolloid dressing. Cancer Nurs. 1990;13(2):71-80.
24. Strunk B, Maher K. Management of multifactorial moist desquamation in a patient undergoing radiotherapy. J ET Nurs. 1993;20:152-7.
25. Bjornberg A, Hellgren L, Magnusson B, Mattsson I, Rosenberg B. Topical treatment of radiation dermatitis with betamethasone- 17 -valerate, Vaseline and eucerine-.a doubleblind comparison. Clin Radiol 1967;18:463-4.
26. Potera ME, Lookingbill DP, Stryker JA. Prophylaxis of radiation dermatitis with a topical cortisone cream. Ther Radiol. 1982;143:775-7.

27. Hotter AN. Wound healing and immuno-compromise. Nurs Clin N Am. 1990;25:139-203.
28. Michalowski AS. On radiation damage to normal tissues and its treatment. Acta Oncol. 1994;33:139-57.

Cite this article as: Venkatakrishnan P, Kumar GJ, Sampadarao B. Study of the various cutaneous adverse reactions to radiotherapy. Int J Res Dermatol 2021;7:250-4.