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FULL PAPER

Topical application of a sandal wood oil and turmeric based cream prevents radiodermatitis in head and neck cancer patients undergoing external beam radiotherapy: a pilot study

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Objective: The study objective was to assess the effectiveness of a turmeric- and sandal wood oil-containing cream [Vicco® turmeric cream (VTC); Vicco Laboratories, Parel, India] on radiodermatitis in patients with head and neck cancer undergoing radiotherapy.

Methods: A total of 50 patients with head and neck cancer requiring >60 Gy of curative radiotherapy/chemoradiotherapy were enrolled in the study. The volunteers were randomly divided into two groups of 25 patients. Group 1 was assigned to a topical application of Johnson's® baby oil (Johnson & Johnson Ltd, Baddi, India) and Group 2 for VTC. Prophylactic application of the cream was initiated on Day 1 and continued every day until 2 weeks after the end of treatment. Both agents were symmetrically applied within the irradiated field five times a day, and the acute skin reactions were assessed twice weekly in accordance with the Radiation Therapy Oncology Group scores by an investigator who was unaware of the details.

Results: The incidence of radiodermatitis increased with the exposure to radiation and was the highest in both groups at Week 7. However, a significant reduction in grades of dermatitis were seen in cohorts applying VTC at all time points, including 2 weeks post radiotherapy ($p < 0.015$ to $p < 0.001$). The occurrence of Grade 3 dermatitis was lower in the cohorts using VTC and was statistically significant ($p < 0.01$). Additionally, follow-up observations 2 weeks after the completion of radiotherapy also showed a reduced degree of radiodermatitis in cohorts applying VTC, which was significant ($p = 0.015$).

Conclusion: VTC is shown to be effective in preventing radiodermatitis and needs to be validated in larger double-blind trials.

Advances in knowledge: For the first time, this study shows that the turmeric- and sandal oil-based cream was effective in preventing radiation-induced dermatitis.

Radiotherapy is a widely accepted form of treatment for cancer, and estimates are that nearly 50% of all cancer patients receive radiation therapy during their course of illness and that it contributes towards 40% of curative treatment for cancer.¹ Unfortunately, the use of ionizing radiation also causes severe side effects, decreases quality of life and may necessitate changes in the planned treatment dose and schedule, thereby ultimately affecting the therapeutic response and survival of the individual.^{1,2} One of the common side effects of radiotherapy is dermatitis, and reports indicate that nearly 85% of all patients

undergoing radiotherapy experience a moderate to severe skin reaction, especially when the fractionation dose exceeds 30–40 Gy.^{3–9} Generally, dermatitis manifests within a few days to weeks after the start of radiation therapy, with toxicity increasing in 2–3 weeks and accumulating across the course of radiation treatment.^{3–9} Dermatitis varies in severity from moderate to severe erythema and moist scaling, and the signs and symptoms may include skin dryness, itching, discomfort, pain, warmth and burning, which may persist up to 4 weeks after the end of treatment (Figure 1).^{7,8}

Figure 1. Radiation Therapy Oncology Group grading of dermatitis.

The degree of skin reaction after exposure to ionizing radiation depends on both intrinsic and extrinsic factors.^{3,4,9} The intrinsic factors include age, general health, ethnic origin, co-existing diseases, ultraviolet (UV) exposure, hormonal status, co-morbidities such as diabetes, hypertension and genetic factors,⁹ whereas the extrinsic factors include dose, volume and number of fractions of radiation, radiosensitizers, concurrent chemotherapy and the site of treatment.⁹ In the early stages, the skin changes can include oedema, erythema, dry desquamation and moist desquamation, while in the late stages the adverse effects mostly include pigmentation changes, telangiectasias, hair loss, atrophy, fibrosis and ulceration.³⁻¹⁰ Severe acute dermatitis invariably needs cessation of the planned radiation therapy, as this can aggravate the skin damage and increase chances of topical and systemic infection, all of which can increase the morbidity and complicate the clinical condition of a patient.³⁻¹⁰

Mechanistically, the ionizing radiation-induced skin damage can be attributed to either a direct effect or an indirect effect resulting from the hydrolysis of water and inflammation-induced secondary injury.¹¹ The low linear energy transfer (LET) energy sources commonly used in cancer treatment (such as X-rays and γ irradiation) predominantly mediate the damage via indirect effects, where the superfluous generation of free radicals resulting from the radiolysis of water causes damage to macromolecules such as DNA, proteins and lipids.^{11,12} An exposure to ionizing radiation triggers transcriptional activation of a cascade of cytokines [such as tumour necrosis factor α (TNF- α) and interleukin 1 (IL-1)], which then bind to receptors on leukocytes and endothelial cells to activate the inflammatory response.¹³ Additionally, ionizing radiation also modulates the communication between cells, changes the skin's endothelial cells, triggers skin cell death and affects the process of repopulation by damaging the proliferating stem cells present in the basal layer of the dermis.^{2,9}

Cumulatively, all these concomitant/overlapping events impair the cutaneous integrity and progressively lead to skin damage^{13,14}

The management of radiation dermatitis is very crucial, as this will allow treatment unabated, improve the therapeutic benefit of the radiotherapy, reduce morbidity, decrease infection and prevent or mitigate radiation skin injury and scarring.^{3,8} Currently, there is no effective or standard treatment followed to prevent or mitigate radiation skin injury, and the prescriptions differ considerably between physicians and across hospitals.⁵ A literature study clearly indicates that the use of preventive topical agents is largely anecdotal and the ones recommended for skin care are adopted from the conventional derma and wound care protocols.⁵ Some of the commonly used prophylactic agents include the use of steroidal, non-steroidal and metallic topical preparations and dressings.⁴⁻⁹ Additionally, some centres also use Johnson's® moisturizing baby oil (JBO; Johnson & Johnson Ltd, Baddi, India) to protect the skin from the deleterious effects of radiation.

In the recent past, there has been a growing interest in the use of natural substances that can have a preventive or curative role against radiation-induced dermatitis, and skin care products containing the extracts of plants such as *Aloe vera*,^{15,16} silymarin¹⁷ and marigold¹⁸ have been shown to be beneficial. Ayurveda, the Indian traditional system of medicine, is accepted in many parts of the world as complementary and alternative medicine. Ayurveda has a rich tradition of using plants to treat various skin ailments, and some of them have been commercially used and marketed by pharmaceutical companies.

Vicco® turmeric cream (VTC; Vicco Laboratories, Parel, India), a turmeric (*Curcuma longa* L) and sandal wood oil (*Santalum album* L) based cream, is arguably one of the most popular herbal-based skin care creams in India and has been marketed

for more than 40 years. VTC has been mostly used as an anti-acne cream and to enhance the complexion by rejuvenating the skin. VTC contains turmeric and sandal wood oil, two of the most important dermal care plants used in the various traditional and folk systems of medicine in India. Of these two, turmeric is an important medicinal herb and is referred to as *Varna datri*, which when translated from Sanskrit means to give colour and enhance body complexion.¹⁹ True to this accreditation, turmeric has been shown to be useful in the treatment of various skin diseases, inflammation, abscess, eczema, leucoderma, bruises, wounds, urticaria, psoriasis and acne.¹⁹

Scientific studies carried out during the past three decades have shown that turmeric and its chief phytochemical curcumin possess wound-healing,^{20–30} anti-ageing,^{31,32} anti-psoriatic^{33–35} properties and are also effective against UV-induced skin damage^{36–40} and chemical carcinogenesis^{41–46} and provide remarkable symptomatic relief for cancer patients when applied topically.⁴⁷ Clinical studies have shown that daily intake of 6 g of curcumin during the course of radiotherapy reduces the severity of radiation dermatitis in patients with breast cancer.⁴⁸ Additionally, both sandal wood oil and its principal compound α -santalol have been shown to possess beneficial effects on the skin, and to prevent chemical^{49–51} and UV-induced skin carcinogenesis.^{51–54} VTC and JBO have been regularly used anecdotally in radiation treatment in India. The present study was undertaken to assess the effectiveness of these two agents in preventing severe dermatitis in patients with head and neck cancer requiring curative radiotherapy (70 Gy).

METHODS AND MATERIALS

This was a single-centre, investigator-blinded random sampling study and was conducted from September 2010 to October 2011 in the Department of Radiation Oncology at Father Muller Medical College, Mangalore, India. The subjects comprised histopathologically confirmed adult patients with head and neck cancer who were scheduled to receive radiotherapy or chemo-radiotherapy. The study aimed to recruit subjects into two groups, giving 90% power to detect an estimated 50% difference between the two groups. Each group was calculated to require at least 21 subjects. However, assuming that approximately 20% will be lost to follow-up, an additional 4 were considered in each group for a final total of 50 patients (25 per group). The details of the exclusion and inclusion criteria are given in Table 1, and the study was approved by the institutional ethics committee. VTC and JBO are both branded skin care agents and have been marketed and used in India for more than three decades. VCT is produced by Vicco Laboratories, Parel, India; and JBO, a multi-national product, is produced through its India unit at Baddi, India. Both agents were procured from these agencies and provided to the patient/caregiver according to randomization.

Recruitment and randomization

During the first visit, one of the investigators introduced the purpose of the study to eligible patients and their caregivers in English or in their mother tongue (Kannada, Tulu and Malayalam). The subjects were also informed that they had the right to withdraw from the study at any time during the course of the study and that their non-willingness to be a part of the study would not deprive them of the necessary treatment. The

Table 1. Details on the criteria used for the selection of patients for the study

Inclusion criteria	Exclusion criteria
1. Age more than 18 years	1. Patients who are not willing to be a part of the study
2. Patients who have a definitive diagnosis of head and neck cancer	2. Female patients who were pregnant
3. Patients who are receiving radiotherapy (>50 Gy) or chemo-irradiation either as primary treatment or as post-operative treatment to the head and neck region	3. Patients who had oral surgery within the previous 6 weeks
	4. Patients who had received chemotherapy or radiation treatment previously to the head and neck region
	5. Patients using high doses of non-steroidal anti-inflammatory drugs
	6. Patients with comorbid conditions such as poorly controlled diabetes mellitus and hypertension
	7. Patients with mental illness such as schizophrenia and bipolar disorders
	8. Patients with pre-existing skin rash, ulceration or open wound in the treatment area
	9. Patients with known allergic and other systemic skin diseases even when not directly affecting irradiated fields
	10. Patients with any known allergic reaction towards the cream and who failed the patch tests

willing patients were then requested to undergo a patch test on the back to determine hypersensitivity for JBO and VTC. During their next visit (mould preparation), all participants were verified to have no dermatitis or wound at the site of radiation or hypersensitivity to JBO/VTC. The eligible volunteers were then included in the study and randomized into either of the two groups using opaque envelopes by an investigator unaware of the patient's details. Patients allocated to Group 1 received JBO, whereas those allocated to Group 2 received VTC. Written informed consent was collected from all willing patients satisfying the inclusion criteria.

Radiation therapy treatment

All patients who participated in this study received external irradiation from a linear accelerator (Varian® Medical Systems, Palo Alto, CA) at an average energy level of 6 MV. All planned fields were treated every day with no more than one fraction of

Table 2. Patient, tumour and treatment characteristics

Characteristics	Johnson's® baby oil	Vicco® turmeric cream
Age (years)	54.3 ± 9.86	56.9 ± 7.21
Gender		
Male	20	17
Female	5	8
Site		
Alveolus	2	1
Buccal mucosa	1	2
Floor of the mouth	0	1
Gingivo buccal sulcus	0	4
Glottis	1	0
Larynx	0	1
Maxilla	1	0
Palate	0	1
Pyriform sinus	3	1
Pharynx (oro and hypo)	1	0
Posterior cricoid	2	0
Retromolar trigone	2	0
Supraglottis	3	0
Tongue	9	13
Vallecula	0	1
TNM stage		
Primary		
T1	0	1
T2	15	10
T3	9	10
T4	0	3
TX	1	1
Regional nodes		
N0	5	4
N1	8	10
N2	4	1
N2a	0	3
N2b	3	6
N2c	3	0
N3	2	1
NX		

(Continued)

Table 2. (Continued)

Characteristics	Johnson's® baby oil	Vicco® turmeric cream
Metastasis		
M0	25	25
MX	0	0
Radiation only	4	2
Chemo-irradiation	21	23
Dose of radiation	67.0 ± 7.80	66.0 ± 5.70
Total number of treatment breaks	3	2
Number of days	3.8 ± 3.7	3.5 ± 1.5

Johnson's® baby oil, Johnson & Johnson Ltd, Baddi, India; Vicco® turmeric cream, Vicco Laboratories, Parel, India.

2 Gy per day, five times a week, without any intended gaps for a planned target dose of 70 Gy (seven consecutive weeks). Whenever chemo-irradiation was planned, a carboplatin infusion (70 mg m^{-2} per day intravenously) was administered on a weekly basis, 3 h before exposure to the first weekly radiation.⁵⁵

Application of Johnson's baby oil and Vicco turmeric cream

Before the start of radiation, the volunteers and their caregivers were taught the correct way of applying JBO (2 ml) or VTC (2 g) by one of the investigators. During the course of the treatment, the patients were also instructed to apply VTC five times a day (2 h before, immediately after, 2 h after and 4 and 6 h after radiotherapy). The application of VTC or the oil was recommended to be performed with the ventral surface of the fingers using a rotary motion of the fingers with light pressure to the skin. The oil/VTC was massaged into the skin until the surface of the skin no longer felt greasy. No other prophylactic creams, lotions or gels were allowed during the study period. When moist desquamation occurred, the topical application of JBO or VTC was discontinued in the affected area and 1% gentian violet paint was applied until the wound healed. However, the patients were advised to continue with the topical preparation of JBO and VTC in the fields of radiation that were free of moist desquamation. To preserve the single blinding, patients were instructed not to use the agent for 2 h before radiation and also before the evaluation of dermatitis to ensure the investigator's blinding (Figure 1).

The patients of both cohorts were advised to use lukewarm water, to wash with gentle detergent, to pat the skin dry with a soft towel after washing and to keep the irradiated skin dry. They were also instructed to avoid the use of hair shampoo, razor blades for shaving and to refrain from rubbing or scratching the irradiated skin. Patients who were travelling from their home to the irradiation facility were advised to use a hat or an umbrella to cover the skin from direct sunlight. During the course of the treatment, one of the investigators checked for the

usage of VTC/JBO on a weekly basis and repeatedly instructed the volunteers of both groups to adhere to the application of JBO/VTC. As one point of application was immediately after the irradiation, it was easy for the investigators to keep a record of a patient's adherence to JBO/VTC. The primary caregivers were also requested to monitor the volunteer's diet (protein supplement), medication when prescribed, skin and oral care practice.

Patient evaluation

The patients of both the groups were assessed for radiation-induced dermatitis by a senior cancer physician unaware of the use of JBO/VTC. The assessment was undertaken twice weekly on Tuesdays and Fridays in accordance with the criteria of the Radiation Therapy Oncology Group (RTOG)/European Organization for Research and Treatment Cancer.⁵⁶ The criteria were as follows: Grade 0—no skin redness, ulceration, inflammation or damage; Grade 1—faint erythema or dry desquamation; Grade 2—moderate to brisk erythema, patchy moist desquamation mostly confined to skin folds and creases, moderate oedema; Grade 3—radiation dermatitis consisting of moist desquamation ≥ 1.5 cm in diameter, other than skin folds or creases and bleeding induced by minor trauma or abrasion; and Grade 4—skin necrosis or ulceration of full thickness dermis, spontaneous bleeding from the involved site. This score makes a useful distinction between faint erythema and tender, bright erythema, as well as between patchy and confluent moist desquamation, and is probably the most widely used in practice and research.^{8,56,57} On every investigation, the investigator considered the score for the worst toxicity in the treatment field. Patients who discontinued treatment or succumbed to cancer were not considered for the weekly evaluation for subsequent time points and also at the end of the treatment while assessing the number of individuals with Grade 3 dermatitis. As only one researcher evaluated all patients, calibration of assessors was not

required. The researcher evaluating dermatitis had no knowledge of the randomization. The total number of treatment days lost and the cause(s) were also recorded.

Statistical analysis

The increase in the degree of dermatitis in the same group from the start of the treatment until 2 weeks after treatment was assessed using Friedman's test for comparison, while the Mann-Whitney test was used to compare between the two groups at all time points. The χ^2 -test was used to compare the age, treatment dose and incidence of dermatitis, and the number of treatment days lost. A *p*-value of 0.05 was considered significant.

RESULTS

There were no significant differences with respect to age (mean, 54.3 ± 9.86 years for the JBO group vs 56.93 ± 7.21 years for the VTC group), gender (20:5 and 17:8, males:females for JBO and VTC, respectively) and tumour characteristics in the two groups (Table 2). No allergic reactions were observed in either of these groups, indicating that these agents were safe and devoid of any dermatotoxic effects. Of the total of 50 patients enrolled in this prospective trial, 46 were available throughout the study period until 2 weeks post irradiation. 2 patients succumbed to cancer [one in the JBO group on completion of 15 fractions (30 Gy) and the other in the VTC group on completing 18 fractions (36 Gy)], while 2 in the VTC group discontinued the treatment in Weeks 5 and 7 for personal reasons (Figure 2).

Radiation dermatitis was evaluated in accordance with the RTOG guidelines, and at the end of the first and second weeks, patients of both groups did not show any symptoms of radiodermatitis and had normal skin (Figure 3). The incidence of dermatitis increased with continuation of the treatment in the

Figure 2. Patient flow in the randomized controlled study. JBO, Johnson's® baby oil (Johnson & Johnson Ltd Baddi, India); VTC, Vicco® turmeric cream (Vicco Laboratories, Parel, India).

Figure 3. Graphical representation of the whole incidence of dermatitis through the treatment period and 2 weeks after completion of the radiation. Solid bars represent Johnson's® baby oil (Johnson & Johnson Ltd, Baddi, India) and bricked bars represent Vicco® turmeric cream (Vicco Laboratories, Parel, India) (χ^2 of test: # $p < 0.045$; * $p < 0.028$). IR, irradiation.

third week in both the groups (Figures 3 and 4), and Friedman's test [when compared for every time point with the base line (before radiation)] showed statistically significant values at all time points for both the JBO ($p < 0.002$ to $p < 0.0001$) and VTC groups ($p < 0.046$ to $p < 0.0001$) (Figure 5).

The signs of skin damage appeared in the third week, and 20% of the volunteers in the JBO group and 8% of the individuals in the VTC group developed dermatitis on Days 17 and 19, respectively. At the end of the third week, 41.67% of the JBO group and 12% of the VTC group developed Grade 1 radiodermatitis ($p = 0.045$). Continuation of the radiation treatment increased the incidence to 75% for the JBO group and 37.5% for the VTC group in the fourth week ($p < 0.02$). The incidence of dermatitis and the degree increased in both the groups in subsequent weeks and reached a peak in Week 7 (Figure 3). Grade 3 dermatitis (8.33%) was observed in the JBO group in Week 5,

Figure 4. Graphical representation of the whole incidence of Grade 3 dermatitis through the treatment period and 2 weeks after completion of the radiation. Solid bars represent Johnson's® baby oil (Johnson & Johnson Ltd, Baddi, India) and bricked bars represent Vicco® turmeric cream (Vicco Laboratories, Parel, India) (χ^2 of test: * $p < 0.05$). IR, irradiation.

Figure 5. Vicco® turmeric cream (VTC; Vicco Laboratories, Parel, India) reduces the radiation dermatitis during the course of 7-week radiation treatment when compared with the Johnson's® baby oil (JBO; Johnson & Johnson Ltd, Baddi, India). Solid bars represent JBO and bricked bars represent VTC [Friedman's test: # $p < 0.002$; @ $p < 0.0046$; * $p < 0.0001$ comparison with Week 0 of the respective group; and Mann-Whitney test: ^a $p < 0.015$; ^b $p < 0.02$; ^c $p < 0.002$; ^d $p < 0.0001$ (comparing between VTC and JBO)]. IR, irradiation; RTOG, Radiation Therapy Oncology Group.

12.5% at Week 6 and a peak of 29.2% at Week 7 (Figure 4). The application of VTC reduced the cases of patients with Grade 3 radiodermatitis, and 4.34% and 13.63% incidence were observed at Weeks 6 and 7, respectively (Figure 4). A comparison between the two groups for the degree of radiodermatitis showed that the cohorts using VTC had delayed appearance (Figure 3 and 4) and reduced levels of dermatitis at all time points (Figure 5). Statistical analysis with the Mann-Whitney test showed a statistically significant difference ($p < 0.015$ to < 0.001) at the concomitant time points. Grade 3 toxicity occurred only in 9.5% in the VTC group compared with 37.5% using JBO ($p < 0.01$). No patient developed Grade 4 toxicity in either cohort throughout the study period.

At the end of radiation therapy (Week 7) of the patients who had completed the planned radiation treatment of 7 weeks (70 Gy), 9.52% of patients in the VTC group showed no skin reactions vs 4.17% in the JBO group. The follow-up study at 2 weeks post completion of the treatment showed that, when compared with the JBO group, the cohorts applying VTC had reduced levels of dermatitis (mean, 1.3 for the JBO group vs 0.82 for the VTC group) and was statistically significant ($p < 0.015$) (Figure 5). The treatment was interrupted for three patients in the JBO and two in the VTC group for reasons unrelated to dermatitis (four for oral mucositis and one for pneumonia). The mean length of treatment interruption was 3.8 ± 3.7 and 3.5 ± 1.5 days, respectively, for the JBO and VTC groups and was statistically not significant (Table 2).

DISCUSSION

In cancer treatment, radiation dermatitis is a common side effect, and its mitigation is vital to reduce patients' morbidity and avoid delays in the planned treatment.³⁻⁵ In the present study, we investigated the protective effects of VTC, a turmeric- and sandal wood oil-based cream that has been marketed and used

in India for over 40 years to treat various skin ailments, cuts, wounds, burns and acne, and JBO, a widely acknowledged oil for child care, and its application is supposed to protect the child's skin from dryness. The results showed that the topical application of VTC before and after radiation treatment for nine consecutive weeks delays and reduces the degree of radiation dermatitis, whereas JBO was not as effective as VTC. However, the most important aspect that needs to be acknowledged is that JBO is a moisturizing oil used for babies and is not a phyto-protective or radioprotective dermal agent. VTC contains turmeric and the oil of sandal wood, two of the most commonly used medicinal plants in dermal care in the various traditional and folk systems of medicine in India.^{19,48,51,58,59} As per the knowledge of the investigators, this is perhaps the first report to show the effectiveness of turmeric- and sandal wood oil-based cream in preventing radiation dermatitis.

The process of radiation dermatitis is complex and includes myriad events, most of which are concomitant and some overlapping.^{60–63} At a biochemical level, an exposure to low LET ionizing radiation (such as X-rays and γ radiation) commonly used in the treatment of cancer causes generation of free radicals and DNA strand breaks.^{60–63} Innumerable experiments with cell-free assays have shown that turmeric/curcumin possesses free radical scavenging effects on both reactive oxygen species and reactive nitrogen species.^{19,64–66} Additionally, studies with cultured dermal cells and laboratory animals have also shown that curcumin increases the antioxidants³¹ and decreases the radiation-induced lipid peroxidation⁶⁷ and DNA damage.^{67,68}

Acute radiodermatitis is a primarily inflammatory reaction and pro-inflammatory cytokines, which are rapidly activated after tissue irradiation, have a major role in radiation dermatitis.^{2,69} Previous studies have shown that curcumin possesses anti-inflammatory effects against the 12-O-tetradecanoylphorbol-13-acetate (TPA) and arachidonic acid-induced epidermal inflammation (ear oedema) in mice⁴⁶ and that this effect was mediated by the inhibiting induction of ornithine decarboxylase activity, DNA synthesis, epidermal lipoxygenase and cyclooxygenase activities.^{45,70} Subsequent studies have also shown that topical application of curcumin suppresses the TPA-induced cyclooxygenase 2 expression by inhibiting the activity of extracellular signal-related kinase (ERK) and the activation of NF- κ B.⁷¹ Additionally, experiments have shown that the administration of curcumin, before or after radiation, markedly reduces acute and chronic skin toxicity in mice and mediates these effects by decreasing the mRNA expression of early responding cytokines (IL-1 IL-6, IL-18, TNF- α and lymphotoxin- β) and the fibrogenic cytokine tumour growth factor β (TGF- β) in cutaneous tissues.⁷² Studies with human keratinocyte cell HaCaT have shown that curcumin inhibited the expression of TNF- α -induced IL-1 β , IL-6 and TNF- α and to mediated these effects by inhibiting the activation of mitogen-activated protein kinases (MAPKs) (c-Jun N-terminal kinase, p38 MAPK and ERK) and NF- κ B.⁷³

In the Ayurvedic system of medicine, turmeric has a long history of being useful in healing open wounds and burns, and scientific experiments have validated the ethnomedicinal uses.¹⁹ Pre-clinical

studies by Sidhu et al²³ have shown that, when compared with placebo-treated cohorts, the application of turmeric caused a significant increase in the levels of re-epithelialization of the epidermis; migration of myofibroblasts, fibroblasts and macrophages to the wound bed; promotion of neovascularization and greater deposition of collagen in rats; and the effect was mediated by increased levels of TGF- β 1. Subsequent experiments have also shown that turmeric, with its principal compound curcumin, promotes re-epithelialization,²⁸ and together all these observations validate the ethnomedicinal use of turmeric in skin care.

Seminal studies by Jagetia and Rajanikant^{74–77} have also shown that oral administration of curcumin was effective in enhancing healing of open wounds in mice exposed to whole body and hemibody gamma irradiation. The authors observed that pre-treatment with curcumin significantly enhanced the rate of wound contraction, decreased mean wound-healing time, increased synthesis of collagen, hexosamine, DNA and nitric oxide and improved fibroblast and vascular densities, clearly indicating that curcumin possesses beneficial effects in initiating and supporting the cascade of tissue repair processes in irradiated wounds.^{75,76}

Our observations are in agreement with the recent reports of Ryan et al,⁴⁸ who also have observed that oral administration of curcumin, at 6 g daily, throughout their course of radiotherapy significantly reduced the severity of radiation dermatitis and moist desquamation but not erythema in females undergoing radiation therapy for breast cancer. The investigators also observed that curcumin was not very effective at reducing the severity of radiation dermatitis in patients who had total mastectomy prior to radiation therapy but improved the quality of life in cohorts receiving curcumin.⁴⁸

In our study, it was observed that VTC was effective in reducing Grade 3 dermatitis significantly, indicating that topical application of the turmeric- and sandal wood oil-based cream was effective in patients undergoing radiotherapy for their head and neck cancer (Figure 4). These observations assume great significance as the oral administration of curcumin/turmeric capsules is at times difficult owing to radiation-induced oesophagitis and mucositis, and the topical application of VTC would be beneficial and could be possibly mediated by the anti-inflammatory, antioxidant and wound-healing effects of turmeric.

CONCLUSION

The major observation from this study was that VTC possesses beneficial effects in preventing radiodermatitis in patients with head and neck cancer undergoing radiation therapy and that it also reduced the incidence and occurrence of Grade 3 dermatitis. The major drawback of this study was that it was not a double-blinded study and that the patients were aware of the prophylactic treatment. VTC is a well-known skin care cream and has been used in India for nearly half a century. The investigators plan to undertake double-blinded experiments with suitable organoleptic placebo creams to assess the preventive effects of VTC in ameliorating radiodermatitis and to also ascertain the levels of pain, itching of skin and the quality

of life through structured questionnaires/interviews. Studies are planned to understand the stability of various components in VTC at room temperature as well as to ascertain the effect of radiation on them after exposure to radiation.

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