Invited Commentary

Avoiding Topical Agents Before Daily Radiotherapy
Debunking Dogma

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The clinical science of radiotherapy (RT) has evolved considerably since the early use of low-energy (150- to 300-kV) orthovoltage x-rays, which deposit much of their energy at the skin surface. Indeed, the skin "erythema dose" was the primary means of standardizing radiation doses given the limited tangible criteria for documenting radiation effects at the time.[1] Contemporary RT uses high-energy photons that deposit their maximum dose several centimeters below the skin surface. Nevertheless, in 90% to 95% of cases, moderate to high doses of this megavoltage radiation can lead to acute radiation dermatitis, which begins as erythema during the first 2 weeks of treatment before progressing to dry desquamation, and, in some cases, on to moist desquamation.[2] Management of these reactions varies; preventive and interventional strategies have included frequent washing with mild soap and using topical dressings and corticosteroidal and noncorticosteroidal topical agents.

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In the orthovoltage era, the 1920s through the 1950s, radiation oncologists often proscribed the use of topical agents or emollients immediately before daily RT sessions out of concern for increased toxic effects to the skin, purportedly arising from a bolus effect or from the x-rays interacting with metal salts in the topical agents that could raise the surface dose.[3] A bolus is a tissue-equivalent material used to shift the maximum dose closer to the surface, reducing the dose deeper in the tissues. The bolus effect is helpful when desired but can be deleterious when unexpected.

In this issue of *JAMA Oncology*, Baumann et al[4] evaluate the validity of the popular recommendation to avoid applying topical agents before external-beam RT. Anonymous online surveys of patients and clinicians revealed that 83.4% of patients had been advised to avoid topical agents immediately before RT, and 54.1% were advised to wipe off any residual topicals before the RT session. These numbers correspond to the 91.4% of clinicians who advised patients to avoid applying topical agents immediately before RT, with 84.3% of respondents citing concern for the bolus effect; 93.3% of clinicians advised patients to avoid using metal-containing topical agents immediately before RT, citing both the bolus effect and electron scatter from metals.

Next, Baumann and colleagues used dosimeters and a tissue-equivalent phantom to measure the dose from radiation beams of 4 energy levels (6-MV or 15-MV photons and 6-MeV or 9-MeV electrons) delivered at 5 beam angles (0°, 15°, 30°, 45°, and 60°), with or without a petroleum-based ointment (petrolatum, 41% [Aquaphor, Beiersdorf AG]) or silver sulfadiazine cream, 1%, at thicknesses of 1 to 2 mm vs 3 mm or greater. Doses were measured at the surface and at a depth of 2 cm. When either topical agent was applied at a thickness less than 2 mm, no difference in radiation dose was found at either depth when appositional (0°) photons or electrons were used, regardless of beam energy. However, a thicker layer of either topical agent (≥3 mm) led to a bolus effect at the surface for all appositional beams, with dose increases of 2% to 5% for electrons and, according to our calculations of data they provided, 15% to 35% for photons relative to controls. The only scenario in which 1 to 2 mm of topical agent led to an increased surface dose was when the beam angle was 60° (an increase of 7%), and that was true only for the silver sulfadiazine cream. The effects of nonappositional beam angles on surface RT dose when topical agents were applied thickly (≥3 mm) were not reported. The topical agent thicknesses were verified in several patient scenarios and even among patients with advanced dermatitis who were applying copious amounts of topicals; none had applied a topical agent thickness of greater than 2 mm. Therefore, the author's definition of a "very thick" application (≥3 mm) seems to represent an atypical clinical scenario.

In parallel studies using a C57BL/6 mouse model, use of the petroleum-based ointment did not affect the surface dose or the extent of DNA damage (phosphorylated histone [γ-H2AX] foci) or apoptosis (by terminal deoxynucleotidyl transferase dUTP nick end labeling [TUNEL] assay) during 24 hours after either a 2-Gy or 15-Gy dose regardless of ointment thickness. The silver sulfadiazine cream was not tested in this model.

The authors' conclusion was that thinly or moderately applied topical agents have a minimal effect on dose to the skin when applied immediately before RT. However, "moderately applied" (<2 mm) silver sulfadiazine cream was associated with an increase in surface dose only when the photon beam angle incidence was 60°, but no such increase was noted with the non-metal-containing petroleum-based ointment. Two mechanisms could account for this modest increase in surface dose: the oblique beam incidence, which is known to increase surface doses, especially with beam angles >50°,[5] and increased scatter dose in the presence of silver. The concern that metallic-containing topical agents would increase surface dose and enhance toxic effects to the skin is prevalent, especially among radiation oncologists who treat breast cancer. Use of deodorants containing aluminum during RT for breast cancer had been discouraged for this reason, until recent studies showed no link between deodorant use and toxic effects to the skin.[6]

Although the authors are to be commended for investigating an issue that affects many patients undergoing RT, theirs was not the first study to evaluate the association of topical agents with surface dose. In 1997, investigators at the Medical College of Georgia measured the association of 15 metallic and nonmetallic topical agents (deodorants, powders, and creams/lotions)

with surface dose after irradiation with a 6-MV photon beam. Using 2 field sizes, they compared a set of samples representing normal patient application vs "caked-on" applications of roughly 5 times the normal amount of the same product on the surface before radiation exposure.[7] Their findings, like those in the Baumann study, were that surface doses were increased only when products were applied much more thickly than patients would normally use. Moreover, high-atomic-number components (eg, talcum powder with magnesium or deodorant with aluminum and zirconium) did not lead to increased surface doses relative to other nonmetallic products.[7]

These study findings suggest that the common recommendation to avoid using topical agents immediately before RT is not applicable in many situations. The "normal" application of 1 to 2 mm of topical agents with low or no metallic content does not notably increase the surface dose from modern-day high-energy x-rays. Unusually thick topical applications, however, can result in a bolus effect that increases surface dose and should be avoided. Per Baumann et al, "Allowing patients to apply topical agents as needed without restriction on the timing of application is likely to improve patient quality of life." [4] This study is a welcome reminder to challenge norms despite their popularity and to be aware of the evidence (or lack thereof) when recommending interventions. We applaud their efforts to debunk a prevalent myth in radiation oncology.

ARTICLE INFORMATION

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