Managing radiotherapy-induced skin reactions in the community

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Over 60% of individuals receive radiotherapy as part of their cancer treatment, either with curative or palliative intent. Radiotherapy is usually provided as an outpatient service, which means that community nurses need to understand the most common radiotherapy-induced side-effect, an acute skin reaction, which can range from mild erythema to confluent moist desquamation. All patients receiving external beam radiotherapy are at potential risk of developing this reaction. This article presents information on the assessment and management of what can be a debilitating side-effect.

KEYWORDS: Radiotherapy ■ Skin reactions ■ Cancer treatment

Radiotherapy is a primary treatment for many types of cancer — over 60% of individuals receive it as part of their treatment. Furthermore, 40% of all patients cured of cancer will have received radiotherapy as part of their treatment, with 16% of cures attributed to radiotherapy alone (Department of Health [DH], 2012).

In recent decades, it was thought that the demand for radiotherapy would gradually diminish as advances in chemotherapy and immunotherapy emerged (Cancer Research UK, 2009). However, the opposite has proved to be the case and today radiotherapy is the second most effective cancer treatment after surgery (DH, 2012).

Radiotherapy care pathways not only involve specialist clinicians from within radiotherapy centres, but frequently include colleagues in hospital wards and primary care settings. However, many nurses outside of specialist treatment centres have little or no knowledge of the effect of radiotherapy on tissue viability or wound healing. Similarly, colleagues in the community setting are often involved in patient care post treatment when the skin reaction can be at its worst.

The aim of this article is to increase understanding of radiotherapy-induced skin reactions by offering an insight into their aetiology, assessment and grading, as well as appropriate management strategies.

Whether community nurses are involved in supporting patients and families, providing information, symptom management or administration of treatment, they play an essential role in improving the patient experience and as such, require relevant knowledge and skills. Inevitably, cancer treatments often come with a range of side-effects, and the nursing care for patients being treated with radiotherapy must be aimed not only at problems associated with the disease, but also at minimising and managing the side-effects associated with the treatment.

One of the most common radiotherapy-induced side-effects is an acute skin reaction, which can range from mild erythema to confluent moist desquamation. All patients receiving external beam radiotherapy are at potential risk of developing a skin reaction within the treatment field, with approximately 85–87% experiencing a moderate to severe skin reaction (Sauro et al, 2010) — of these, 10–15% will progress to moist desquamation (Hornsby et al, 2005).

Ensuring these reactions are assessed and managed effectively throughout the pathway is essential to providing optimum patient care. Evidence suggests that radiation-induced skin reactions cannot be prevented (McQuestion, 2006). Therefore, goals of care should focus on:

- Minimising treatment-induced symptoms
- Supporting patients with self-care interventions
- Preventing further trauma and pain from inappropriate management
- Promoting a wound healing environment.

RADIOTHERAPY AND THE SKIN

Skin is composed of the dermis and epidermis. The former contains nerves, lymphatic and blood vessels, glands and hair follicles. The epidermis contains a renewing cell population, in which cell production equals cell loss, creating a continuous cycle whereby new cells from the basal layer replace shedding cells from the outer cornified layer (McQuestion, 2006).

Radiation skin reactions occur as a result of damage to basal cells and the resultant imbalance between new cell production at the basal
Acute radiation damage is most prominent in tissues containing rapidly proliferating cells, such as the epithelial surfaces of the skin and alimentary tract. Radiobiological damage affects the regeneration of the skin through the process of repair, redistribution, repopulation and reoxygenation. Damaged cells are replaced by cells moving from the resting phase into the active cycle (repopulation). However, when the rate of repopulation of basal cells cannot match the rate of cell destruction by treatment, skin damage occurs, resulting in an acute radiation skin reaction (Stone et al, 2003).

The goal of radiation is to find a balance between providing a sufficiently high dose of radiation that will destroy or inactivate cancer cells, while causing minimal damage to surrounding normal tissues. This is becoming increasingly achievable due to ongoing advances in delivery techniques and state-of-the-art equipment (Symonds et al, 2012).

One common misconception is that radiotherapy-induced skin reactions are ‘burns’. However, this implies accidental occurrence, whereas skin reactions are a known side-effect of radiotherapy. Acute radiotherapy-induced skin reactions differ from burns in terms of mechanism, extent, duration and trajectory (Table 1). An understanding of these differences is pivotal in implementing the correct interventions (Byrne et al, 2010; Trueman et al, 2011).

Similarly, the degree of severity of skin reactions is influenced by several intrinsic and extrinsic factors, including (Ryan et al, 2007; Ginot et al, 2010):
- Dose
- Size of treatment field and area being treated
- Age
- Nutritional status
- Smoking and alcohol intake
- Comorbidities
- Ethnic origin

Concurrent treatments such as chemotherapy.

### The Radiotherapy Skin Reaction Cycle

#### Erythema

Basal cells start to be affected and destroyed following the first dose (fraction) of radiotherapy. During the first 24 hours, a transient erythema may occur due to the reactive dilatation of capillaries and vascular permeability. However, visible skin changes in the treatment field are usually not seen until approximately 10–14 days after the first fraction, corresponding with the time it takes for the initial damaged basal cells to migrate to the surface of the skin, causing erythema (Figure 1).

Radiotherapy triggers an inflammatory response caused by the release of histamine-like substances and accompanied by erythrocyte extravasation and capillary dilatation, exhibited as various degrees of erythema (Noble-Adams, 1999). The skin becomes red, may have a rash-like appearance and can feel warm, tight and itchy.

As the cumulative dose of radiation increases, the degree of erythema will range from faint to brisk redness. Pigmentation changes are caused by the migration of melanin to the superficial layers of the epidermis. In darker/black skin, the treatment field will appear darker during the erythematous stages before progressing through the other stages of dry and moist desquamation. Hair follicles, sweat and sebaceous glands in the treatment field will also be affected to differing degrees.

#### Dry desquamation

As the skin becomes more damaged through ongoing radiation exposure, it tries to compensate by increasing mitotic activity and migration of new cells to replace the damaged ones.

The skin will start to get dry around 3–4 weeks after treatment starts. Flaking and scaling of the skin occurs due to the decreasing ability of the basal layer to replace surface layers, shedding of the epidermis, and reduced skin lubrication from damage to the sweat and sebaceous glands. When new cell proliferation occurs before desquamation, the resulting imbalance between cell production and cell loss results in dry desquamation (Figure 2).

#### Moist desquamation

As radiotherapy continues, cell proliferation reduces so that the
basal layer is unable to recover, resulting in exposed dermis and leakage of serous fluid (moist desquamation).

The treatment field now starts to appear blistered, moist and increasingly oedematous, often accompanied by light or heavy exudate — moist desquamation can be partial or confluent (Figure 3). The area can feel extremely tender, sensitive and painful. The exudate is normal and rich in nutrients, helping to provide a moist wound healing environment that supports the growth and migration of new skin cells across the area of the skin reaction.

Additionally, exudate bathes exposed nerve endings within the area of moist desquamation, decreasing discomfort and providing pain relief. Cleansing of the skin reaction to remove exudate is, therefore, not advised. Skin necrosis is rarely seen, primarily due to the advanced techniques used in the delivery of radiotherapy.

**Post treatment**
The severity of skin reactions may increase for 7–10 days after radiotherapy has finished, in line with the time it takes for the damaged basal cells to reach the outer epidermis. This is often referred to as the ‘peak’ period, when the side-effects can be at their worse.

After this, side-effects will gradually start to settle down and the condition of the skin will slowly improve. Between two and three weeks post completion, following the ‘peak’ reaction, the basal layer will be recovering as the balance is restored between new cell production and cell loss. At 4–6 weeks following the completion of radiotherapy, the skin should be healing well and may even be fully healed in a large number of patients, although it may still appear hyperpigmented.

**ASSESSMENT AND MANAGEMENT**
Assessment of the skin forms an integral part of the patient’s holistic care and starts with asking the right questions — what, why and how?
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For example, it is important for clinicians to ask what they are assessing; why the skin damage has happened; and how it should be treated.

Even before radiotherapy begins, it is essential to assess patients’ current skin care practice and the condition of their skin to identify any influential factors that may impact upon the reaction, such as eczema or thinning elderly skin. As with all care, documenting the outcome of any assessments, interventions and evaluations provides a continuous record to ensure consistent and effective treatment.

It is imperative that community nurses have the relevant knowledge and skills, or know where to find guidance, if they are to provide optimum care and a positive patient experience. Predicting the severity of skin reactions can be difficult due to the varying radiosensitivity of the skin and a number of contributing factors, such as age of the skin and site of treatment (Wells and MacBride, 2003).

A consistent approach to skin assessment is essential to ensure that the right interventions are implemented at the right time in response to changing needs and regular evaluation. Without accurate assessment and relevant knowledge, interventions may be inappropriate, ineffective and at worst, harmful to the patient.

The use of an assessment tool to grade radiotherapy skin reactions is recommended to promote consistency and treatment continuity both during, and after, radiotherapy. The most commonly used framework for objective assessment of an acute radiotherapy-induced skin reaction is the Radiation Therapy Oncology Group (RTOG) grading system (Cox et al, 1995), which grades the following stages:

- RTOG 0: no visible change to skin
- RTOG 1: faint or dull erythema; mild tightness of skin and itching
- RTOG 2: bright erythema/dry desquamation; sore, itchy and tight skin
- RTOG 2.5: patchy, moist desquamation; yellow/pale green exudate; soreness with oedema
- RTOG 3: confluent moist desquamation; yellow/pale green exudate; soreness with oedema
- RTOG 4: ulceration, bleeding, necrosis (rarely seen).

However, this framework does not consider the potential patient-reported symptoms such as pain and discomfort, therefore, it is crucial that additional assessments, for example, pain scores, are undertaken and supportive measures, such as analgesia, initiated in response to any findings.

Many approaches to skin care have been advocated over recent decades, resulting in wide variations in protocols and practice across healthcare settings. A recent survey by Harris et al (2011) found that despite emerging evidence recommending changes to guidelines, inconsistencies and differences in practice still exist across the UK. These disparities in clinical practice and a lack of evidenced-based care have created a growing awareness of the need for more research into the management of radiotherapy-induced skin reactions (Faithfull et al, 2002). Although conclusive evidence is lacking, clinicians must attempt to base interventions on the best available evidence, sharing guidelines and best practice statements where possible (NHS; Quality Improvement Scotland [QIS], 2010).

It has been well documented that radiation skin changes cannot be prevented (McQuestion, 2006; Harris et al, 2011), so current research is frequently focused upon delaying the onset of symptoms, minimising the severity of a reaction and effective management. Advanced delivery techniques, such as intensity-modulated radiation technique (IMRT, a radiotherapy technique that allows radiation to be more closely shaped to fit the tumour and spare nearby critical normal tissue), can be less damaging to the skin, however, patients will still experience skin reactions.

**Goals of care**

It is essential that patients understand what can happen to their skin as a consequence of receiving radiotherapy. Patient education is a key component of holistic care and is of particular importance when the patient is receiving treatment as an outpatient. Radiotherapy is commonly delivered within outpatient settings and self-management is pivotal in achieving optimum symptom control.

Preventing the skin reaction is currently not an option, therefore, goals of care should focus upon:

- Patient involvement and education
- Promotion of measures to improve comfort
- Protection of the skin from further trauma
- Reducing potential for further exacerbation of the skin reaction
- Effective pain control
- Support and reassurance

**Five-minute test**

Answer the following questions about this, either to test the new knowledge you have gained or to form part of your ongoing practice development portfolio.

1. What skin reactions are a common side-effect of radiotherapy?
2. What is the most severe?
3. Can radiation-induced skin changes be prevented?
4. How do radiotherapy skin reactions differ from burns?
5. Do radiotherapy skin reactions worsen as treatment progresses?
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SKIN CARE

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Patients require both verbal and written information, which should include:
- How and why reactions occur
- When and where they are likely to appear
- How the reaction may feel and look
- How it will be treated
- Self-care strategies
- Risk factors that can exacerbate the reaction.

Management of a radiotherapy-induced skin reaction is grade specific, with interventions changing in line with progression of the reaction. General skin care information should be given to all patients at the start of treatment to support self-management, including advice on bathing, hygiene, suitable skin care products, exposure of the treatment field and how to avoid further damage.

Grade-specific management and interventions
The primary aim of initial interventions (RTOG 0–2) is to promote comfort, assist hydration and maintain clean, intact skin. From the start of radiotherapy, it is important to keep the area clean and hydrated and patients are encouraged to continue with their ‘normal’ hygiene practices.

However, as the skin becomes more sensitive during the course of radiotherapy, the use of non-irritant toiletries and skin care products (those that are colour-, fragrant- and soap-free) is often recommended to avoid further irritation. A common recommendation is to apply aqueous cream to intact skin at the beginning of treatment to aid hydration and comfort. However, some recent studies involving patients with atopic dermatitis have highlighted potential problems (irritation and stinging at the site of application) associated with the use of aqueous cream as a leave-on moisturiser (Cork and Danby, 2011). Consequently, it has been suggested that this product should no longer be used for radiotherapy-induced skin reactions due to the inclusion of known irritants, i.e. sodium lauryl sulphate (SLS) (Patel et al, 2013).

In light of this, there has been increasing interest in using an SLS-free aqueous cream as a simple, moisturising agent, but more research trials are needed to support this in clinical practice. It is also important to mention that many patients are reassured by the fact that they can participate in their care by ‘doing something’ to help manage potential side-effects and alleviate symptoms. The therapeutic value of proactive management should not be underestimated.

Management of moist desquamation (RTOG 2.5–4) focuses on minimising trauma and discomfort, preventing infection and promoting healing. Once the reaction has progressed to this stage, there are additional considerations in relation to compromised skin integrity. The development of patchy or moist desquamation necessitates the use of appropriate dressings to cover the broken areas.

Grade 4 reactions (ulceration and necrosis) are rarely seen, but require specialist management and advice from a clinical oncologist or specialist practitioner. There is limited evidence to support or refute the use of dressings promoted as suitable for the management of radiotherapy-induced skin reactions. However, to avoid causing the patient further trauma, there are several types of dressing that should be considered (Trueman, 2011):
- Atraumatic: to reduce pain at dressing change
- Non-adhesive or silicone-based: to avoid adhesion and further damage to delicate, irradiated skin
- Absorbent: to contain exudate
- Conformable: for difficult-to-dress areas

Comfortable: to reduce discomfort and friction and promote compliance with treatment
- Easily applied and removed: to support self-care and patient involvement.

Infected skin reactions are rare, although possible. It is widely accepted that the use of metallic-based topical agents and products are not recommended while the patient is receiving radiotherapy due to the association with radiation ‘scatter’ (a secondary radiation which occurs as a result of the beam intercepting an object causing some x-rays to scatter) and increased surface dose (Kumar et al, 2001; Wells and MacBride 2003).

If there are indications of wound infection once treatment has been completed, appropriate infection management should be initiated. This may include antimicrobial products such as silver dressings, however, specialist advice should always be sought.

EDUCATION AND TRAINING

Lack of knowledge and skills can be a barrier to caring for this patient group, purely because staff who are not based in radiotherapy centres rarely encounter these skin reactions.

Additionally, confusion regarding choice of dressings and requests for unfamiliar products can lead to unsuitable alternatives being used, causing further trauma, pain and delayed healing (Harris et al, 2011). To help solve this problem, a joint working initiative with healthcare partners, culminated in the production of an educational toolkit to support and guide healthcare professionals (DH, 2008). The combination of background knowledge and clinical guidance provided a framework to assist clinicians in the assessment and management of radiation-induced skin reactions.

CONCLUSION

Skin reactions are one of the most
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common side-effects of external beam radiotherapy. Modern machinery and advanced delivery techniques have gone some way to reducing the severity of radiation-induced skin reactions. However, they still occur in a large number of patients undergoing radical treatment.

Additionally, many patients have fears and anxieties about these reactions based on historical misconceptions that they will be ‘burnt’. Understanding the effect of radiation on tissue viability and wound healing is pivotal to ensuring a positive patient experience.

The use of an evidence-based skin care protocol and assessment tool can provide a consistent approach to radiation skin reaction management, including appropriate product selection. As radiotherapy is primarily an outpatient treatment, patient education cannot be over-emphasised, and teaching self-management interventions to minimise discomfort, prevent further trauma and promote healing is essential to optimise symptom control.

However, there still remains a paucity of literature and well-designed studies evaluating the effectiveness of interventions for the management of radiation-induced skin reactions and more randomised controlled trials are needed (Harris et al., 2011).

REFERENCES


KEY POINTS

- One of the most common radiotherapy-induced side-effects is an acute skin reaction, which can range from mild erythema to confluent moist desquamation.

- All patients receiving external beam radiotherapy are at potential risk of developing a skin reaction.

- The use of an evidence-based assessment tool can provide consistent radiation skin reaction management.

- As radiotherapy is primarily an outpatient treatment, patient education cannot be over-emphasised.

- Many patients have fears and anxieties about these reactions, based on historical misconceptions that they will be ‘burnt’.

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