Managing Radiotherapy Induced Skin Reactions

A Toolkit for Healthcare Professionals
The Princess Royal Radiotherapy Review Team

Supported by:
Introduction

This Toolkit has been developed as an educational resource supporting the assessment and management of radiotherapy induced skin reactions. The toolkit can be adapted to suit the clinical needs of your patients and the healthcare setting in which they are being treated. We hope that you will find it useful.

Princess Royal Radiotherapy Review Team
St James's Institute of Oncology, The Leeds Teaching Hospitals NHS Trust

A Joint Working initiative

NHS organisations and staff are encouraged to consider the opportunities for joint working with the pharmaceutical industry, where the benefits that this could bring to patient care and the difference it can make to their health and well-being are clearly advantageous. A philosophy of developing appropriate partnerships to help achieve high quality patient care could further enhance the objectives of a patient-centred NHS. The development of effective and clinically appropriate joint working with external stakeholders can contribute to building an NHS that is truly a beacon to the world.

The learning from a number of partnership projects has confirmed that joint working can provide real benefits to patients whilst supporting the strategic objectives of the delivery partners. Accordingly, NHS organisations and staff are encouraged to consider joint working as a realistic option for the delivery of high-quality healthcare. Joint working between the pharmaceutical industry and the NHS must be for the benefit of patients or the NHS, preserve patient care and should be of mutual benefit, with the principal beneficiary being the patient.

All content and clinical guidance is drawn from current clinical practice and a review of evidence by the Princess Royal Radiotherapy Review Clinic. Under a joint working initiative, Aspen Medical Europe Ltd, Molnlycke Healthcare Ltd and Smith and Nephew Ltd are supporting the production and wider awareness of this Toolkit.

(Excerpts from Best Practice Guidance on joint working between the NHS and pharmaceutical industry and other commercial organisations, DoH, 2008)

Contents

This toolkit aims to provide Healthcare Professionals with:

1. An understanding of the mechanism of skin damage specific to radiotherapy and factors that can exacerbate the reaction.

2. A guide to care goals and objectives.

3. An assessment framework and the treatment options, with rationale for each stage, including information about the best use of suitable products.

4. A resources section containing:
   • Materials for use when advising patients and other health professionals involved in patients’ continuing care
   • A short post-training assessment
   • Links to information and further advice
Radiotherapy Induced Skin Reactions

- Radiotherapy is a major modality in the management of cancer treatment, along with chemotherapy and surgery.

- One of the most common side effects of radiation is acute skin reaction which can range from mild erythema to confluent moist desquamation and occasionally, ulceration.

- All patients receiving external beam radiotherapy are at potential risk of developing a reaction within the treatment field with approximately 85 – 87% of these patients experiencing a moderate to severe skin reaction\(^1,2,3\) of which 10-15% will progress to moist desquamation\(^4\).

- Radiation skin reactions are not ‘burns’; they occur as a result of damage to the basal cell layer of the skin and the resultant imbalance between the normal production of cells in this layer and the destruction of cells at the skin surface.

- It is essential that any damage is minimised, as far as possible, by ensuring that interventions are based upon best practice and supported by evidence based guidelines\(^5\).

- There is a lack of randomised controlled trials to evaluate prophylactic skin care interventions and treatment of radiotherapy skin reactions. Therefore this guidance has been drawn from available published evidence, expert opinion from specialists within the field of radiotherapy and the Leeds Teaching Hospitals Trust Radiotherapy Skin Care Guidelines.
1. Radiotherapy and the skin

Structure of normal skin

Effect of radiotherapy

- Radiotherapy causes biochemical changes within cells, as the DNA molecules are susceptible to radiation damage during mitosis. Radiobiological damage affects regeneration of the skin by the process of repair, redistribution, repopulation and reoxygenation. Damaged cells are replaced by cells moving from the resting phase into the active cycle (repopulation).

- Skin damage occurs when the rate of repopulation of the basal cell layer (Stratum Germinativum) cannot match the rate of cell destruction by treatment. The inflammatory response activated is a normal physiological reaction to radiotherapy.

- Radiotherapy induced skin damage is seen approximately 10-14 days following the first fraction of radiation, corresponding with the time it takes for the damaged basal cells to migrate to the skin surface. Initially the skin will become warm, and reddened (erythema), and in some patients the area may also feel itchy.

- As the skin is damaged through further exposure to radiation it tries to compensate by increasing mitotic activity in order to replace the damaged cells. However, if the new cells reproduce faster than the old cells are shed then the skin will become dry and flaky (dry desquamation).

- As radiotherapy continues the basal layer cannot produce enough new cells to replace the old ones and therefore the outer layer of the epidermis will become broken, oedematous with exudate (moist desquamation). The exudate is normal and rich in nutrients which helps the growth of new skin cells. Skin necrosis is rarely seen primarily due to the advanced techniques used in the delivery of radiotherapy.

- The severity of skin reactions may increase for 7-10 days after radiotherapy has finished. It can take this amount of time for the cells that have been affected by radiotherapy to reach the outer epidermis. This is often referred to as the ‘peak’, when the side effects can be at their worse. After this time side effects will gradually start to settle down and the condition of the skin will slowly improve.

- 4 - 6 weeks after treatment has been completed, skin should be healing well and may even be fully healed with the exception that the area may still look hyperpigmented (darker). It takes this amount of time for the basal cells of the epidermis to recover and for new skin to start to grow and heal.
Radiotherapy skin reactions differ to burns in terms of cause mechanisms, extent, duration and trajectory. Inaccurate assessment can lead to inappropriate treatment. Understanding the differences is pivotal in implementing correct interventions.

<table>
<thead>
<tr>
<th>Radiotherapy Skin Reaction</th>
<th>Burn Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cause</strong></td>
<td>Absorption of energy from ionising radiation affecting the process of regeneration</td>
</tr>
<tr>
<td><strong>Time to Reaction</strong></td>
<td>Delayed - days</td>
</tr>
<tr>
<td><strong>Skin Layers Affected</strong></td>
<td>Epidermal layers only</td>
</tr>
<tr>
<td><strong>Sequence of Damage</strong></td>
<td>Damaged basal cells migrate upwards to the surface of the skin</td>
</tr>
</tbody>
</table>
2. Intrinsic & Extrinsic Predisposing Factors for Radiotherapy-induced skin reactions

**Intrinsic**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age:</td>
<td>The natural ageing process affects the epidermal cell cycle which can result in extended healing times.</td>
</tr>
<tr>
<td>Nutrition:</td>
<td>Adequate nutritional intake is necessary for optimum repair of tissue damage. The skin of undernourished patients may be at increased risk of damage.</td>
</tr>
<tr>
<td>Smoking and Alcohol</td>
<td>Can decrease capillary blood flow and oxygen levels thus increasing the severity of the skin reaction and impairing the body’s ability to heal damaged tissues and fight infection.</td>
</tr>
<tr>
<td>Co-morbidities:</td>
<td>Other illnesses and some medications can increase the risk and intensity of skin reactions and impact upon the healing process e.g. diabetes, steroids.</td>
</tr>
<tr>
<td>UV exposure / ethnic origin:</td>
<td>There is a suggestion that patients with long term UV exposure will experience a more severe radiation-induced skin reaction and impaired healing. Patients from BME groups have reported more severe post-treatment skin reactions compared to white patients.</td>
</tr>
<tr>
<td>Obesity:</td>
<td>Extra adipose tissue can compromise healing and exacerbate skin toxicity due to the extra skin folds or areas where there is a natural skin fold e.g. natal cleft and inframammary fold.</td>
</tr>
<tr>
<td>Infection:</td>
<td>The presence of bacterial and/or fungal infection can damage the cells in the basal layer resulting in delayed healing.</td>
</tr>
</tbody>
</table>

**Extrinsic**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiotherapy:</td>
<td>Higher doses, larger fields, increased volume and presence of bolus can all lead to increased skin reactions</td>
</tr>
<tr>
<td>Energy of radiotherapy:</td>
<td>The higher the energy the lesser the skin reaction. Megavoltage beams (energies above 1MV) deliver maximum dose underneath the surface of the skin (skin sparing effect) whilst kilovoltage beams (energies below 1 MV) deliver maximum dose to the surface of the skin therefore increasing the skin reaction.</td>
</tr>
<tr>
<td>Radiosensitisers:</td>
<td>Some chemotherapy agents are radiosensitisers (e.g. 5-Fluorouracil, Mitomycin C, Cisplatin) and therefore increase the severity of skin reaction.</td>
</tr>
<tr>
<td>Chemical/Thermal/Mechanical: irritants can exacerbate the skin reaction and delay the healing process.</td>
<td>Chemicals such as deodorants, perfume, talcum powder and aftershave, metal-containing dressings and creams. Extremes in temperature e.g. hot water bottles, ice packs. Friction by rubbing skin or wearing tight fitting clothing.</td>
</tr>
</tbody>
</table>
3. Goals of Care for Skin Reactions During Radiotherapy

- Initially, maintaining integrity and hydration of the skin
- Reducing potential for further exacerbation of the skin reaction
- Promotion of comfort and compliance
- Reduction of pain
- Protection from trauma
- Prevention of infection
- Promotion of a moist wound healing environment, in the stages where skin is broken
- Control of bleeding, odour and excessive exudate, where radiotherapy is being given for symptom management of a fungating lesion

**Post-Radiotherapy**

- The severity of skin reactions can increase and ‘peak’ around 7 - 10 days *after* treatment has finished.
  - Within this 7-10 day period there is a continuing lack of new cells being produced to replace the old cells.

- Within 4 – 6 weeks of completing radiotherapy treatment, skin should be improving significantly, if not fully healed.
  - It takes this amount of time for the basal cells of the epidermis to recover and for these new cells to reach the surface enabling new skin to grow and heal.\(^7,8\)

- The rationales for interventions post radiotherapy are the same as during radiotherapy
  - Comfort, reduce the risk of infection and further trauma and ultimately, promotion of healing.
  - Interventions should be matched to the skin reaction based on continuous assessment of the skin and RTOG score.

- As part of the expected radiotherapy skin reaction the body produces a greenish/yellow exudate within areas of moist desquamation.
  - This should not be cleaned off (unless there are excessive amounts) as it assists with the healing process post treatment and provides pain relief by bathing the exposed nerve endings within the area of moist desquamation.
4. Assessment of Skin Reactions

Skin Assessment

- Assessment of the skin forms an integral part of the patient’s holistic care and starts with asking the right questions:

  WHAT - are we assessing? What do we see? What does the skin look like? What other structures are within the treatment field? What lies beneath the skin reaction? What does the patient report? What has changed? What is the cause?

  WHY - has it happened? Why are things changing - cause and effect?

  HOW - do we treat it? How do we make the right choices about appropriate actions and interventions?

- Predicting the severity of skin reactions can be difficult due to the varying radio-sensitivity of skin and a number of contributing factors. Intrinsic and extrinsic factors may significantly increase the severity of radiotherapy skin reactions which may delay the healing process.

- Individuals with darker skin may notice that the skin in the treatment field becomes darker initially before going through the other stages of the reaction. A study by Ryan et al (2007) reported that patients with dark/black skin reported more severe skin reactions at the treatment site than white skinned patients.

- A consistent approach to skin assessment is essential to ensure that the ‘right interventions’ are implemented at the ‘right time’ in response to ongoing assessment and evaluation. Without accurate assessment and relevant knowledge interventions may be inappropriate, dressing selection is likely to be arbitrary and ineffective, as well as wasteful both in terms of time and resources.

- Most importantly, inaccurate assessment and inappropriate interventions may cause harm and distress to the patient and ultimately, compromise the healing process.

- The use of an acute radiation scoring assessment tool is recommended to promote consistency and continuity of appropriate management and interventions during, and after, radiotherapy, until the reaction has settled.

- The most commonly used framework for objective evaluation of skin reactions is the Radiation Therapy Oncology Group (RTOG) grading system.

- The RTOG scoring criteria does not take account of the subjective aspects of skin damage such as pain and discomfort. If the skin reaction is causing pain or discomfort, our Trust guidelines recommend that the WHO analgesic ladder is used as a framework for appropriate pain management.

RTOG Grading System:

<table>
<thead>
<tr>
<th>Assessment/Observation</th>
<th>Effects of Radiotherapy on Skin Cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTOG 0</td>
<td>No visible change to skin</td>
</tr>
<tr>
<td>RTOG 1</td>
<td>Faint or dull erythema. Mild tightness of skin and itching may occur</td>
</tr>
<tr>
<td>RTOG 2</td>
<td>Bright erythema/dry desquamation. Sore, itchy and tight skin</td>
</tr>
<tr>
<td>RTOG 2.5</td>
<td>Patchy moist desquamation. Yellow/pale green exudate. Soreness and oedema</td>
</tr>
<tr>
<td>RTOG 3</td>
<td>Confluent moist desquamation. Yellow/pale green exudate. Soreness and oedema</td>
</tr>
<tr>
<td>RTOG 4</td>
<td>Ulceration, bleeding, necrosis (rarely seen)</td>
</tr>
</tbody>
</table>

WHO Analgesic Ladder:

| Step 1                  | Non-opioid +/- adjuvant analgesia |
|                        | Paracetamol, aspirin or NSAID      |
| Step 2                  | Opioid for mild to moderate pain  |
|                        | +/- adjuvant analgesia             |
|                        | Codeine, tramadol etc              |
| Step 3                  | Opioid for moderate to severe pain |
|                        | +/- adjuvant analgesia             |
|                        | Morphine, fentanyl etc             |

Adapted from World Health Organization (WHO) analgesic ladder.
5. Management of Radiotherapy
Skin Reactions

- **General advice given to all patients receiving radiotherapy treatment (in relation to the treatment field):**
  - Continue washing/bathing as normal using non-perfumed soap and toiletries
  - Pat skin dry using a soft towel to avoid friction
  - Do not use perfumes, deodorants, talcum powder, creams or gels in the treatment field (other than ones recommended / prescribed by the Clinical Oncologist / Radiotherapy treatment centre)
  - The use of a plain, un-perfumed emollient (e.g. aqueous cream), recommended by the Radiotherapy treatment centre, to cleanse, soothe and soften the skin in the radiotherapy treatment field can help maintain skin moisture levels, skin integrity and patient comfort
  - Advise to wear loose fitting clothing
  - Avoid exposure of skin to sun until healed then use a high factor suncream of SPF30 or above as irradiated skin will always be more sensitive and at increased risk of sun damage. Sunscreens should be used in addition to clothing and shade to offer maximum protection
  - Swimming in chlorinated water can have a drying effect on the skin therefore it is advised that swimming is avoided until the skin reaction has completely settled and the skin is fully intact
  - Avoid applying extremes of temperature e.g. hot water bottle/ice pack (specialist cooling dressings as recommended by the radiotherapy treatment centre can be used for symptomatic relief)
  - Do not ‘wet shave’ or use hair removing products. Electric razors are suitable if used with care

<table>
<thead>
<tr>
<th>Assessment / Observation</th>
<th>Effects of Radiotherapy on Skin Cells</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTOG 0</td>
<td>No visible change to skin</td>
<td>To promote hydrated skin &amp; maintain skin integrity</td>
</tr>
<tr>
<td>RTOG 1</td>
<td>Faint or dull erythema. Mild tightness of skin and itching may occur</td>
<td>To promote hydrated skin, patient comfort and maintain skin integrity. To treat itchy skin. To reduce pain, soreness and discomfort.</td>
</tr>
<tr>
<td>RTOG 2</td>
<td>Bright erythema / dry desquamation. Sore, itchy and tight skin</td>
<td>As RTOG 1</td>
</tr>
<tr>
<td>RTOG 2.5</td>
<td>Patchy moist desquamation. Yellow/pale green exudate. Soreness with oedema</td>
<td>To promote comfort. Reduce risk of complications of further trauma and infection. To reduce pain, soreness and discomfort</td>
</tr>
<tr>
<td>RTOG 3</td>
<td>Confluent moist desquamation. Yellow/pale green exudate. Soreness with oedema</td>
<td>To promote comfort. Reduce risk of complications of further trauma and infection</td>
</tr>
<tr>
<td>RTOG 4</td>
<td>Ulceration, bleeding, necrosis (rarely seen)</td>
<td></td>
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</table>
Appropriate dressings*

- **Atraumatic** - to reduce pain when changed, does not adhere to the area of damaged skin
- **Non-adhesive or silicone-based only** - to avoid further damage to delicate, irradiated skin
- **Absorbent** - able to contain exudate (moist desquamation stage)
- **Conformable** – for difficult to dress areas e.g. neck or pelvic area
- **Comfortable** – for patient compliance and reduced pain while in situ
- **Ease of application and removal** - possible for patients to change their own dressings whilst at home

**Appropriate dressings - Infection**

- Infections are rare in radiotherapy skin reactions, but are possible.
- Infections identified whilst the patient is in the radiotherapy treatment stage will be managed by the specialist radiotherapy staff according to local guidelines.
- It has been documented that the use of metallic-based topical products on the radiation field should be avoided whilst the patient is receiving radiotherapy due to the association with radiation scatter and increased surface dose.\(^{15,21,22}\)
- Once radiotherapy is completed, if the area of skin reaction becomes infected, appropriate local wound infection management policy should be followed, and may then include the use of metallic dressings e.g. silver-containing dressings.

**Intervention guidelines†**

<table>
<thead>
<tr>
<th>Assessment / Observation</th>
<th>Effects of Radiotherapy on Skin Cells</th>
<th>Intervention (action)</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RTOG 0</strong></td>
<td>No visible change to skin</td>
<td>To apply aqueous cream initially twice daily</td>
<td>To promote hydrated skin &amp; maintain skin integrity</td>
</tr>
<tr>
<td><strong>RTOG 1</strong></td>
<td>Faint or dull erythema. Mild tightness of skin and itching may occur</td>
<td>Increase application of aqueous cream as needed. 1% Hydrocortisone cream may also be prescribed for symptomatic relief. Commence analgesia as guided by WHO analgesic ladder</td>
<td>To promote hydrated skin, patient comfort and maintain skin integrity. To treat itchy skin. To reduce pain, soreness and discomfort.</td>
</tr>
<tr>
<td><strong>RTOG 2</strong></td>
<td>Bright erythema / dry desquamation. Sore, itchy and tight skin</td>
<td>Increase application of aqueous cream as needed. Continue as RTOG 1 interventions</td>
<td>As RTOG 1</td>
</tr>
<tr>
<td><strong>RTOG 2.5</strong></td>
<td>Patchy moist desquamation. Yellow/pale-green exudate. Soreness with oedema</td>
<td>Continue aqueous cream on unbroken skin. Stop hydrocortisone on broken skin. Apply an appropriate dressing(^*) to exuding areas (e.g. PolyMem, Mepilex, Allevyn N.A. / Gentle are all suitable options). Analgesia as guided by WHO analgesic ladder. Wear loose fitting clothing</td>
<td>To promote comfort. Reduce risk of complications of further trauma and infection. To reduce pain, soreness and discomfort</td>
</tr>
<tr>
<td><strong>RTOG 3</strong></td>
<td>Confluent moist desquamation. Yellow/pale-green exudate. Soreness with oedema</td>
<td>Stop using aqueous cream on moist/broken skin. Continue with RTOG 2.5 interventions</td>
<td>To promote comfort. Reduce risk of complications of further trauma and infection</td>
</tr>
<tr>
<td><strong>RTOG 4</strong></td>
<td>Ulceration, bleeding, necrosis (rarely seen)</td>
<td>Seek specialist advice (i.e. Clinical Oncologist, Radiotherapy Clinical Nurse/Radiographer Specialist in your area).</td>
<td></td>
</tr>
</tbody>
</table>

* Based on the Princess Royal Radiotherapy Review Team’s experience to date

\(^*\) Based on the Princess Royal Radiotherapy Review Team’s experience to date.
Recommended Reading List


Further information sources:
The Society of Radiographers - www.sor.org

Ellen Trueman
Ellen.Trueman@leedsth.nhs.uk

Resources

Contents
- Advice sheets
- A short post-training assessment
- Information on where to look for further information and advice
- Product information sheets and advice on usage
References

23. The Journal of Medical Imaging and Radiation Oncology. 54, 264-279.
28. Freephone: (UK) 0800 032 3399. Facsimile: +44 (0)1527 65100
29. www.smith-nephew.com/uk
30. www.molnlycke.com
31. www.aspenmedicaleurope.com
32. Smith & Nephew UK Ltd. Telephone: +44 870 60 60 777