An evaluation of Flamigel® RT, Hydro-Active Colloid Gel, as a preventative management strategy for radiation-induced skin reactions for proton beam therapy

To evaluate the efficacy of Flamigel® RT (Flen Health) in preventing radiation-induced skin reactions (RISR) during proton beam therapy (PBT), a study was conducted with 19 patients using Flamigel® RT. Results showed that by the end of treatment, 52% (*n*=10) of patients did not experience severe RISR. In children, 55% (*n*=6) and in adults, 38% (*n*=3) experienced severe RISR. The majority of the children, 83% (*n*=5), experienced severe RISR in their last week of treatment, whereas 67% (*n*=2) of adults did so around the midpoint of their therapy. Flamigel® RT was found to delay and, in some cases, prevent the onset of severe RISR in adults and children undergoing PBT.

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Key words
- Radiation
- Radiation-induced skin reactions
- Proton beam therapy

Proton beam therapy (PBT) is a form of external beam radiotherapy that uses high-energy protons to treat malignant tumours. It operates on the principle of damaging cellular DNA. Due to a unique physical characteristic known as the Bragg peak, PBT delivers most of the radiation dose directly to the tumour while minimising the exit dose, thereby reducing exposure to normal and healthy tissues (Möllerberg et al, 2021). In the UK, PBT is only available at two NHS-commissioned sites (NHS England, 2019).

Radiation-induced skin reactions (RISR) are a common side effect of external beam radiotherapy (Lee at al, 2017), with over 95% of patients experiencing some form of skin change (Lee at al, 2017; Behroozian et al, 2021). RISR can occur within the first few hours of treatment and lead to damage to cells within the epidermis and dermis layers (Liao et al, 2017). This thins the skin, causing it to lose its protective function, decreases stem cell production, increases inflammation and causes swelling. Intrinsic and extrinsic factors such as concurrent chemotherapy, smoking and total radiation dose can affect the severity of RISR (Burke et al, 2022). A common toxicity assessment tool, the Radiation Therapy Oncology Group (RTOG; Table 1), is used in the UK to standardise the measurement of RISR in patients (Cox et al, 1999; Chan et al, 2014).

RISR can present differently across various skin tones. Light skin tones typically exhibit redness and pigmentation within the affected area, while dark skin tones often experience subtle darkening, along with colour changes such as grey, yellow or purple within the treatment area (Julka-Anderson, 2023).

Flamigel® RT is a hydro-active colloid gel developed by Flen Health as a solution to manage RISR. It restores moisture balance, reduces the intensity of early symptoms and delays the onset of moist desquamation, reducing its incidence in patients undergoing radiotherapy (Censabella et al, 2014; 2017).

It is applied topically and works by forming a protective barrier over the epidermis and damaged cells, relieving RISR symptoms.

This article aims to evaluate the effectiveness of Flamigel® RT in managing RISR in adults and children undergoing PBT at The Christie Hospital, Manchester.

Methodology

A service evaluation was conducted with 19 patients: eight received PBT alone, while 11 had concurrent chemotherapy with PBT. Of the 19 patients, six had surgery within the treatment area prior to starting PBT. The total radiation dose prescribed and fractionation regimen for this group of participants ranged from 50.4–75.6 Gray over 28–42 fractions. Each patient was immobilised during PBT according to standard local protocols.

Due to the mixed cohort of patients included, they were deemed to be high-risk of developing RISR if undergoing concurrent chemotherapy, treatment for head and neck cancers, or dose escalation for chordoma or chondrosarcoma. All patients were given

Declaration of interest
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Table 1: Radiation Therapy Oncology Group (RTOG) scoring criteria for acute radiation skin reactions (Cox et al, 1999; Chan et al, 2014)

Criteria	Skin changes
0	No change over baseline
1	Follicular, faint or dull erythema, epilation, dry desquamation, decreased sweating
2	2a. Tender or bright erythema 2b. Patchy moist desquamation, moderate oedema
3	Confluent, moist desquamation (other than skin folds), pitting oedema
4	Ulceration, haemorrhage, necrosis

standard skincare advice in accordance with the Society and College of Radiographers' evidence-based guidelines (Society and College of Radiographers, 2020; 2022).

A detailed patient history was obtained to ensure that there were no contraindications to Flamigel® RT. Each consenting patient received two 250g tubes of Flamigel® RT, along with instructions for use and a patient information leaflet. Patients were instructed to apply Flamigel® RT to the treatment area three times daily from the start of their radiotherapy treatment, as recommended by product guidelines. The patients' skin was monitored using the RTOG skin assessment tool **[Table 1]**. If patients experienced RTOG 2a or RTOG 2b with moist desquamation, the medical team intervened with Flaminal® (Hydro or Forte) or PolyMem dressings. RTOG 2b and above were classified as severe as the skin had broken down into moist desquamation.

All patients were evaluated by a senior therapeutic radiographer, a paediatric sister and a senior tissue viability nurse, completing an evaluation form as part of the review **[Figure 1]**.

The service evaluation form was reviewed and approved by the local trust's medical device committee. The committee agreed to proceed with evaluating Flamigel® RT in patients undergoing PBT who are considered at high risk of developing RISR. This decision was then documented in the committee meeting notes and received final approval in the subsequent meeting.

The primary outcome of the evaluation was to measure the time taken for RISR to progress to severe RISR, characterised by moist desquamation. Additionally, clinician opinion on the product and its efficacy in managing RISR were assessed as a secondary outcome.

Results

The evaluation form responses and key observations are summarised in **Table 2**.

By the end of their respective treatments, 52% (*n*=10) of patients did not experience severe RISR. High-risk patients had concurrent chemotherapy, underwent head and neck treatment or received dose escalation for chordoma or chondrosarcoma. Among the patients considered high-risk (*n*=17), 41% (*n*=7) experienced severe RISR. Of the children, 55% (*n*=6) experienced severe RISR and 38% (*n*=3) of adults experienced severe RISR. The majority of children (83%, *n*=5) experienced severe RISR in their last week of treatment, while 67% (*n*=2) of adults experienced severe RISR around halfway through their treatment.

See **Table 3** for the characteristics of the patients who experienced severe RISR. All the children were treated with PBT and chemotherapy, but not with surgery, whereas the adults underwent surgery and received only PBT. Of the children, 50% applied Flamigel® RT twice daily and the other 50% applied it thrice daily. All adults applied the gel twice daily. There was no significant correlation between the frequency of Flamigel® RT application and the RTOG score. However, further evaluation with a larger patient cohort is needed to assess this relationship conclusively.

Discussion

The auditing team found that in nearly all patients, Flamigel® RT minimised the damage to the skin and, in some cases, prevented skin breakdown entirely.

Evidence suggests that severe RISR can develop earlier in a patient's treatment if they have high-risk factors, such as concurrent chemotherapy, treatment for head and neck cancers, or receiving dose escalation for chordoma or chondrosarcoma. However, only 41% (*n*=7) of individuals identified as high-risk experienced severe RISR. Of the nine patients who did experience severe RISR, 67% (*n*=9)

Evaluation review					
Health centre/clinical hospital name					
Assessor		**Patient identifier**		**Physicion**	

General patient background information			
Age	0–18	Nutritional status	No malnourishment
	18–30		Mild malnourishment
	30–45		Moderate malnourishment
	45+		Severe malnourishment
Current skincare treatment		Planned number of Gys	
Planned number of days for proton therapy		28 days ○ 30 days ○ 30+ days ○ Other_____	

HNC Ewings Sarcoma ○	HNC Rhabdomyosarcoma ○	Pelvic Ewings Sarcoma	HNC Rhabdomyosarcoma ○	Other
Proton therapy only ○	Yes ○ No ○	Proton therapy and chemotherapy ○	Yes ○ No ○	

Baseline details before use of 'Flamigel RT' product. Date:					
Post-op	Yes ○	No ○	Are supporting photographs possible?	Yes ○	No ○
Radiation Dermatitis (please tick) using RTOG scale			RTOG 0 ○ RTOG 1 ○ RTOG 2 ○ RTOG 3 ○ RTOG 4 ○		
Informed consent gained	Yes ○	No ○	Photographs taken	Yes ○	No ○

Details: start date					
Date started proton therapy			Date started Flamigel RT		
Protocol explained to the patient	Yes ○	No ○	Instructions 'how to use' Flamigel RT	Yes ○	No ○
Supporting photographs where possible			Yes ○ No ○		
Radiation Dermatitis (please tick) using RTOG scale			RTOG 0 ○ RTOG 1 ○ RTOG 2 ○ RTOG 3 ○ RTOG 4 ○		
Flamigel RT survey given to patient	Yes ○	No ○	Is patient concordant with applying Flamigel RT	Yes ○	No ○

Mid treatment details after number of treatments = ( )			
Date of review		Supporting photographs where possible	Yes ○ No ○
Total number of Gys given at this point in the treatment		_____ ○ ○ ○	
How many times a day is Flamigel RT being applied		1 x per day ○ 2 x per day ○ 3 x per day ○ 4 x per day ○ 4+ per day ○	
Radiation Dermatitis (please tick) using RTOG scale		RTOG 0 ○ RTOG 1 ○ RTOG 2 ○ RTOG 3 ○ RTOG 4 ○	
If Moist Desquamation has occurred at what Gys did this happen		_____	
Is any additional skincare treatment being used		Yes ○ No ○	
If yes, what			

Figure 1

Figure 1. Reproduction of the Flamigel® RT product evaluation form completed by a senior therapeutic radiographer, a paediatric sister or a senior tissue viability nurse

Final detail: After number of treatments = ( )			
Date finished proton therapy		Supporting photographs where possible	Yes ○ No ○
Total number of Gys given over entire treatment	_____		
How many tubes of Flamigel were used	40g x _____ tubes 100g x _____ 250g x _____		
How many times a day was Flamigel RT applied	1 x per day ○ 2 x per day ○ 3 x per day ○ 4 x per day ○ 4+ per day ○		
Was Flamigel RT discontinued before the end of Proton Therapy	Yes ○ No ○	If yes, why	
Radiation Dermatitis (please tick) using RTOG scale	RTOG 0 ○ RTOG 1 ○ RTOG 2 ○ RTOG 3 ○ RTOG 4 ○		
If Moist Desquamation occurred at what Gys did this happen	_____		
Did the patient during the use of Flamigel RT notice a reduction in pain			
Did the patient report a soothing effect during the use of Flamigel RT	Yes ○ No ○		
Is any additional skincare treatment being used	Yes ○ No ○		
If yes, what			
Flamigel RT survey given to patient	Yes ○ No ○	Is patient concordant with applying Flamigel RT	Yes ○ No ○

Health professional's comments		
How would you rate Flamigel RT	Very poor ○ Poor ○ Good ○ Very good ○	Very poor = would not use again Poor = some benefits but not for routine use Good = would use again Very good = first line choice
Health professional's comments		

Figure 1 continued

did so in the final week of their PBT treatment. This outcome can be attributed to the use of Flamigel® RT, which helped delay and prevent the development of severe RISR.

Engagement with the intended application of Flamigel® RT varied, with only 31.6% (*n*=6) applying it three times daily as intended. Of these, 50% (*n*=3) experienced severe RISR but also had concurrent chemotherapy. In contrast, 68% (*n*=13) applied Flamigel® RT only twice daily, with 38% (*n*=5) experiencing severe RISR and 80% (*n*=4) of these patients had one or more of the risk factors. Due to the small sample size and variations in patient risk factors, comparing the frequency of Flamigel® RT application and its impact on skin reactions was beyond the scope of this audit, but this finding highlights the need for further investigation.

There are significant cost savings for patients who do not develop severe RISR, despite having high-risk factors, including reduced staff interventions and a decreased need for specialist dressings (Censabella et al, 2014; Censabella et al, 2017; Society and College of Radiographers, 2020). The impact on a patient's quality of life cannot be underestimated. Reducing the likelihood of patients developing severe RISR can help reduce the possibility of painful treatment areas, minimise disruptions to daily activities and decrease treatment interruptions (Censabella et al, 2014; Censabella et al, 2017; Society College of Radiographers, 2020). Clinicians' and patients' feedback revealed that the application of Flamigel® RT from the time of initiating PBT has improved the patients' quality of life by delaying and, in some cases, avoiding RISR.

Table 2. Patient demographics, diagnosis, treatment regimen and Radiation Therapy Oncology Group (RTOG) score

Patient age range (years old)	Tumour type	Postoperative	Dose (Gy)/ fractions (#s)	Proton beam therapy (PBT) only or PBT/chemotherapy (CTX)	Frequency of application (per day)	RTOG score at mid-point of treatment	Dose (Gy) given for moist desquamation to appear	RTOG score at end of treatment
18–30	Adenoid Cystic Carcinoma	Yes	60.6/30	PBT only	2	1	36.4	3
45+	Chordoma	No	75.6/42	PBT only	2	2a	43.2	2a
30–45	Chordoma	No	75.6/42	PBT only	2	1	63	2a
30–45	Chordoma	Yes	70.2/39	PBT only	2	0	60.1	2a
45+	Chordoma	Yes	70.2/39	PBT only	2	2a	39.6	3
0–18	Clavicle Ewings	No	50.4/28	PBT/CTX	3	1	50.4	2a
0–18	HNC Rhabdomyosarcoma	No	50.4/28	PBT/CTX	3	1	50.4	2a
0–18	HNC Rhabdomyosarcoma	No	55.8/31	PBT/CTX	3	1	55.8	2b
18–30	Mucoepidermoid carcinoma	Yes	60/30	PBT only	2	1	60	2b
18–30	Nasopharyngeal Carcinoma	No	60/35	PBT/CTX	2	2a	48.8	2a
0–18	Nasopharyngeal Carcinoma	No	61.2/34	PBT/CTX	2	0	N/A	1
0–18	Nasopharyngeal Carcinoma	No	61.2/34	PBT/CTX	2	1	61.2	2b
0–18	Nasopharyngeal Carcinoma	No	61.2/34	PBT/CTX	3	1	61.2	2a
0–18	Pelvic Ewings Sarcoma	No	59.4/33	PBT/CTX	3	2a	27	2b
0–18	Pelvic Ewings Sarcoma	No	59.4/33	PBT/CTX	3	0	54	2b
0–18	Pelvic Ewings Sarcoma	No	54/33	PBT/CTX	2	0	47.5	2b
0–18	Pelvic Ewings Sarcoma	No	50.4/28	PBT/CTX	2	0	50.4	2b
18–30	Secretory Carcinoma	Yes	60/30	PBT/CTX	2	0	60	2a
0–18	Spinal Ependymoma	Yes	50.4/28	PBT/CTX	2	1	N/A	1

Table 3. Patient, treatment and Flamigel® RT application characteristics for severe radiation-induced skin reactions (RISR)

Patient age range (years old)	Postoperative	Dose (Gy)/fractions (#s)	Proton beam therapy (PBT) only or PBT/chemotherapy (CTX)	Frequency of application (per day)	Radiation Therapy Oncology Group (RTOG) score at end of treatment
18–30	Yes	60.6/30	PBT only	2	3
45+	Yes	70.2/39	PBT only	2	3
0–18	No	55.8/31	PBT/CTX	3	2b
18–30	Yes	60/30	PBT only	2	2b
0–18	No	61.2/34	PBT/CTX	2	2b
0–18	No	59.4/33	PBT/CTX	3	2b
0–18	No	59.4/33	PBT/CTX	3	2b
0–18	No	54/33	PBT/CTX	2	2b
0–18	No	50.4/28	PBT/CTX	2	2b

Limitations

This evaluation was conducted at a single specialist cancer centre, which limited the sample size. A larger sample size with distinct patient characteristics (e.g. age and skin colour), tumour site, high-risk factors and variations in dose and fractionation could aid in the stratification of intervention with Flaminal® and dressings earlier. Additionally, data collection timing varied slightly for some patients, as they were assessed within a few days of their midway point, potentially impacting the evaluation's consistency.

Ensuring patients applied Flamigel® RT three times daily, recommended by the manufacturer's guidelines, could provide additional evidence on the product's efficacy in preventing severe RISR in patients.

The oncology ward staff did not have access to Flamigel® RT within their ward supplies. Consequently, any patient admitted for specialist support during the evaluation was not provided with the product. Improved communication between PBT and ward staff in the future will ensure that all individuals undergoing PBT receive protocolised care consistently.

Recommendations:

1. Conduct future randomised controlled studies to fully establish the impact of Flamigel® RT Hydro-Active Colloid Gel on preventing RISR
2. Evaluate additional products that may benefit patients with RISR.

Conclusion

Flamigel® RT was found to delay and, in some cases, prevent the onset of severe RISR in adults and children undergoing PBT. This protective effect was also observed in patients with high-risk factors known to influence the severity of RISR. Based on the findings of this evaluation, the use of Flamigel® RT is recommended for patients undergoing PBT. However, a multicentre trial with a larger sample size would help generalise the effectiveness of Flamigel® RT in patients undergoing PBT to minimise or eliminate RISR. ●

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CPD questions

1. Consider how a patient can be affected physically and psychologically by a radiation-induced skin reaction
2. Explore the differences in how radiation-induced skin reactions present across all skin tones
3. Evaluate your local departmental policies and procedures on assessing and managing radiation-induced skin reactions.

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Further reading

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