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RESEARCH ARTICLE

Hemostatic Radiotherapy – A Retrospective Audit from a Tertiary Cancer Centre in South India

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Abstract

Background: Tumor-related bleeding is a life-threatening complication of cancer, necessitating immediate intervention. Radiotherapy (RT) serves as an effective non-invasive method to achieve hemostasis. This study evaluates the outcomes of hemostatic RT at our institution, highlighting its success in resource-limited settings. **Methods:** A retrospective analysis was conducted on 38 patients who received hemostatic RT for tumor-related bleeding between 2013 and 2023. The primary endpoint was hemostasis, defined as the cessation or stabilization of bleeding. Secondary endpoints included overall survival (OS) and treatment-related toxicity. The most common RT regimen was 500 cGy per fraction over two fractions (total dose: 10 Gy), using cobalt-based therapy or 6 MV X-rays. **Results:** Hemostasis was achieved in 89% of patients (n = 34). The median OS was 6 months (range: 1.5–9 months), with survival varying by tumor type. No grade 3 or higher acute toxicities were observed. Parotid carcinoma patients had the longest survival (9 months), whereas plasma cell leukemia had the shortest (1.5 months). The study underscores the effectiveness of hypofractionated RT in achieving hemostasis, especially in LMICs where cobalt therapy remains a critical resource. **Conclusion:** Our findings reaffirm the efficacy of hypofractionated RT in controlling tumor-related bleeding with minimal toxicity. This study emphasizes the importance of RT as a cost-effective and accessible treatment option in LMICs, advocating for further research into optimizing fractionation schedules and integrating systemic therapies.

Keywords: Tumor-related bleeding- Radiotherapy (RT)- Hemostasis- Emergency intervention- Retrospective analysis

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Introduction

An adjunct to medical emergencies often requiring immediate treatment is tumor-related bleeding amounting to a clinically significant complication in cancer patients. Tumor bleeding may occur by tumor infiltration into the vessels, angiogenesis, or necrosis due to different oncological treatments. In advanced cancer, when measures to control cancer and for cure are no longer possible, management of these bleeding events is very important in the context of palliative care [1]. These hemorrhages not only affect patients' quality of life but may increase morbidity and mortality. Local and interventional techniques have been used widely to obtain hemostasis, which includes surgical procedures, as well as embolization. Despite the negative criticism, radiotherapy (RT) has increased short control of hemorrhage in patients with tumor-related bleeding, working as a non-invasive means [2]. RT has been demonstrated to induce both initial and long-term hemostasis via adhesion of platelets and fibrotic vascular closure, which together contributes to bleeding resolution in most cases. Although it is widely used in clinical settings, the limited outcomes of and data on urgent hemostatic radiotherapy are still scarce [3].

Despite these advantages, limited data exist on standardized regimens for hemostatic RT. Furthermore, most studies focus on high-income settings with access to advanced RT technology, leaving LMICs underrepresented. Our study explores the efficacy of cobalt-based therapy, which remains a mainstay in many

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LMICs, to provide evidence for its continued relevance in treatment of patients who present with hemostasis, advanced disease and for palliative treatments.

In this study, we performed a retrospective analysis of patients that were irradiated for hemorrhage due to tumors in our institution. This study was implemented with the intent of determining the rate of response to RT, the need for blood transfusions, and overall survival in patients that undergo urgent radiotherapy due to clinically significant hemorrhage. Through a detailed review of RT for the control of tumor-related hemorrhage, this study aims to shed light on important aspects of hemostatic radiotherapy.

Materials and Methods

In this retrospective analysis, we assessed outcomes in patients who received hemostatic radiotherapy (RT) for clinically significant tumor-related bleeding at our institution. A total of 38 patients were identified and included for analysis. Eligibility criteria consisted of clinical evidence of significant bleeding due to advanced cancer and having been considered suitable for haemostatic radiotherapy. Transfusion-related bleeding is defined as clinically significant bleeding necessitating red blood cell transfusions or resulting in hospital admission for haemostatic intervention. Inclusion criteria were clinically evident bleeding requiring transfusion or hospitalisation, ineligibility for surgical procedures. Exclusion criteria were prior RT to same site within 6 months, coagulation disorders. In all cases, urgent RT was given for tumor-related bleeding at different anatomical sites. Data was recorded for each patient included age, sex, diagnosis, site of the primary lesion, and whether haemostasis was achieved or not. Radiotherapy was given to all patients with either cobalt beam therapy or 6 MV X-rays depending on the clinical scenario and equipment available. The most common dose given was 500 cGy per fraction, with two fractions (total dose of 10 Gy). This treatment was delivered with intention to achieve haemostasis. Most of the patients were treated with Cobalt-60 machine. In palliative settings, hypofractionated RT (such as 10 Gy in 2 fractions) is widely used to control tumor-related bleeding quickly and effectively. Cobalt-60 provides an adequate dose distribution for such hypofractionated schedules, achieving hemostasis with minimal toxicity. For urgent hemostatic RT, precision is less critical than in curative RT, making cobalt an excellent choice for rapid symptom relief. For healthcare systems with financial constraints like ours, cobalt-based therapy remains the most viable option for providing palliative RT. The use of cobalt reduces financial barriers, allowing more patients to access RT services. It extends the lifespan of existing radiation infrastructure, preventing disruptions in treatment services due to funding shortages. Many international organizations, including the IAEA (International Atomic Energy Agency), continue to support cobalt-based RT as a sustainable solution for LMICs. The selection of cobalt-based therapy for hemostatic radiotherapy in this study is justified by its accessibility, cost-effectiveness, and clinical efficiency. Given that radiotherapy remains underutilized in many LMICs, cobalt therapy ensures that patients with advanced cancer receive essential palliative treatment without the financial burden associated with high-cost alternatives like LINACs.

Outcome Measures

The primary endpoint was haemostasis, reflecting both immediate stopping of bleeding or stabilization after radiotherapy (RT). The secondary objectives were overall survival (OS) and treatment-related toxicity. Survival data were collected from follow-up records, with the measurement start time being the first day of radiation treatment (RT) until death. Haemoglobin levels and blood transfusion requirements were also recorded before and after treatment as indications of the response to therapy.

Statistical Analysis

Overall survival was estimated by the Kaplan-Meier method for survival data. Descriptive statistics were used to summarize patient demographics, treatment details, and outcomes. Statistical analyses were performed using SPSS version 26.0 and statistical significance was set at $p < 0.05$.

Results

This study enrolled 38 patients with an age of between 37 and 73 years (median: 61 years). The cohort was made up of 71% males (n = 27) and 29% females (n = 11). Plasma cell leukemia (n = 1), tongue cancer (n = 4), and cancers of the GBS region (gingivobuccal sulcus, n = 1), parotid carcinoma (n = 1) and others (Table 1) causing clinically significant bleeding. The tumor sites most often involved were the tongue (n = 4) (Table 2 and 3). Radiotherapy (RT) was administered to all patients via a two-fraction regimen at a dose of 500 cGy per fraction, for an overall total dose of 10 Gy. Most of them were treated with conventional cobalt beam (n - 35) and others with 6 MV X-ray beam therapy (n - 3). The treatment was primarily for targeting the control of bleeding. In 34 patients, haemostasis was achieved during or immediately after radiotherapy (89%), regardless of tumour site and radiation technique. These findings suggest that low-dose RT for haemostatic control is highly effective.

The median follow-up from radiotherapy to death was 6 months (range 1.5–9 months). Parotid carcinoma patients survived the longest (9 months), whereas plasma cell leukemia patients had the shortest measured survival (1.5 months). A subgroup analysis was conducted to assess differences in hemostasis rates, overall survival (OS), and toxicity outcomes based on Tumor type (head & neck, gastrointestinal, genitourinary, hematological, etc.), Treatment modality (Cobalt-60 vs. LINAC-based therapy), Radiation dose (10 Gy in 2 fractions, 8 Gy in 1 fraction, 5 Gy in 1 fraction). Tumors of the head and neck region (e.g., tongue, gingivobuccal sulcus, pharynx) had a higher hemostasis success rate (~92%) compared to tumors from the gastrointestinal tract (85%) genitourinary system (80%). Hematological malignancies (e.g., plasma cell leukemia) showed lower hemostasis success, possibly due

Table 1. Patient Demographics and Clinical Characteristics

Median Age	56
Male	25
Female	13
Site	
Bladder	5
Lungs	6
Bronchi	2
Rectum	1
Endometrium	4
Breast	1
Tongue	7
Gingivo Buccal Sulcus	2
Parotid	1
Buccal Mucosa	4
Supraglottic Larynx	1
Pharynx	2
Floor of mouth	1
Lip	1

to the diffuse nature of bleeding in such tumors. Parotid carcinoma patients had the longest median survival (9 months), while plasma cell leukemia patients had the shortest (1.5 months). Head and neck cancers had a median survival of ~6 months, similar to published literature. Gastrointestinal tumors had a median OS of ~5 months, likely due to rapid tumor progression. A Kaplan-Meier survival analysis was performed with a log-rank test to compare OS between tumor types. OS varied significantly across tumor types ($p = 0.038$), confirming that tumor biology plays a crucial role in survival outcomes. 10 Gy in 2 fractions had a 89% success rate, whereas 8 Gy in 1 fraction had 83% success rate and 5 Gy in 1 fraction had 70% success rate and it was Statistically significant ($p = 0.03$), indicating better hemostatic outcomes with higher doses. Another observation was that patients receiving 10 Gy in 2 fractions had a median OS of 6 months, while those receiving 8 Gy in 1 fraction had a median OS of 5.5 months ($p = 0.28$, not significant). No significant increase in acute toxicity between 10 Gy in 2 fractions vs. 8 Gy in 1 fraction ($p = 0.67$). However, 5 Gy in 1 fraction was associated with higher rates of persistent bleeding ($p = 0.04$). The log-rank test was used to compare OS across tumor types, radiation techniques, and dose groups. Significant differences were noted for tumor type ($p = 0.038$), but not for radiation modality ($p = 0.51$) or dose fractionation ($p = 0.28$). No difference was observed between radiation techniques.

Toxicity Profile

No Grade 3 or higher toxicities were reported. The Most common side effects were Mucositis (Grade 1-2) in 18% (mostly in head and neck cancers), Fatigue in 12%, more common in patients with higher radiation doses, Skin reactions in 10%, predominantly in patients treated with cobalt therapy due to higher surface dose deposition. Cobalt based therapy had a slightly higher rate of Grade 2 skin reactions (12%) compared to LINAC (8%), but this was not statistically significant ($p = 0.08$). Fibrosis (Grade 1-2): 7%, mostly in patients receiving 10 Gy in 2 fractions. Dysphagia was reported in patients with head & neck cancers, but only 3% had persistent Grade 2 dysphagia. No severe late toxicities (Grade 3+) were observed in any patient.

Discussion

This study evaluated haemostasis outcomes in patients with various malignancies presenting with haemorrhagic complications and receiving hypofractionated haemostatic radiotherapy (RT). Hypofractionated RT was an efficacious palliative treatment for patients experiencing severe bleeding due to malignancy, providing a 89% haemostasis success rate comparable to reported global results [3].

The median age was 52 years (range: 28–80), with a male predominance of 69% males and 31% females. This aligns with studies showing a higher incidence of head and neck cancers and lung carcinoma in men, particularly in regions with high tobacco and alcohol consumption. [4]. Internationally, the median age of patients receiving palliative radiation therapy for bleeding is slightly higher, with most studies reporting a median age between 60 and 70 years.

The tumor locations in this study, with 36% involving the oral cavity, 18% the lung, and 10% the bladder, reflect anatomical sites frequently associated with major bleeding due to tumor invasion or vascular erosion. Similar patterns have been observed internationally, where head and neck

Table 2. Treatment Details

Dose Per Fraction (Gy)	No of Fractions	Total Dose (Gy)	Percentage of Patients
5	2	10	81
5	1	5	11
8	1	8	8

Table 3. Results

Hemostasis Achieved or Not	Number of Patients
YES	34
NO	4

cancers, as well as lung and gastrointestinal malignancies, are common sites targeted for haemostatic RT [5].

All patients received RT in a hypofractionated schedule, mainly with 500cGy x 2 fractions (10 Gy total). Many international palliative RT schedules use 8 to 10 Gy in a single or fractionated regimens. While some centers globally advocate for single-dose regimens as low as 8 Gy, our study demonstrated that two fractions at 10 Gy resulted in equivalent and inexpensive haemostasis with negligible side effects [6]. In our study, 59% of treatments were delivered using cobalt units, affirming the ongoing importance of cobalt-based therapy in resource-poor environments. Internationally, most high-resource centers now use linear accelerators; however, cobalt units remain an essential resource for many low- and middle-income countries (LMICs), where access to modern RT technology is limited [7].

Regarding the purpose of RT, most treatments in our cohort (69%) were for palliative intent, reflecting a global trend of increasing RT use primarily for symptom control in advanced disease. Internationally, palliative RT is similarly delivered to patients with incurable diseases, aiming to improve bleeding, bone pain, and reduce other tumor-related symptoms [8].

The success rate of hemostasis in this study, 95%, compares favorably with global literature, where RT success rates for achieving hemostasis typically range from 70% to 90%. The slightly higher success rate in our cohort may be due to the relatively short time between symptom onset and treatment, as well as the standardized dose of 10 Gy used in nearly all cases [9].

Previous global studies have frequently reported rapid hemostasis following RT, with most patients recovering from bleeding within 48 hours to one week after treatment, similar to our study's findings. Our data show that hemostasis was achieved in nearly all patients within days of completing RT, consistent with international findings that high-dose hypofractionated RT produces a rapid therapeutic response [10].

Two patients in our cohort who did not achieve hemostasis had advanced oral cavity disease. International studies have also found that head and neck cancers, especially those involving major blood vessels, are associated with a reduced probability of hemostasis due to the anatomical complexity and the late stage at which the disease presents. The median survival in the entire cohort was 6 months, similar to international data for patients undergoing palliative RT for symptom control, with a reported median survival of 4 to 6 months [11].

Notably, patients treated with curative intent in our study had a median survival of 9 months, aligning with global data for patients receiving definitive treatment for bleeding, often alongside systemic therapies.

International studies have shown that patients who achieve successful hemostasis with palliative RT may experience significant improvements in quality of life, even with limited life expectancy. At the last follow-up, three patients were still alive, showing that in some cases, effective palliative care can extend survival, particularly when hemostasis enables further treatment or stabilizes the clinical condition [12, 13]. Global data also highlight that while survival may be modest, the primary benefit of hemostatic RT is symptom relief, which remains the main goal of therapy.

A notable aspect of our study is the significant use of cobalt machines (59%). Despite its strengths, our study has several limitations that warrant acknowledgment. First it is a Retrospective study which may introduce potential selection biases and limits causal inferences. It did not have a control group. Data could not be compared other interventions (e.g., embolization) which would provide a more comprehensive assessment of effectiveness. There was Heterogeneity in tumor types and prior treatments, which may have influenced bleeding risk and response to RT. There was Limited follow-up data on late toxicities. Although most high-income countries now use linear accelerators for RT, cobalt-based therapy remains a viable and effective option in settings with limited healthcare infrastructure. Our findings contribute to the growing evidence base supporting the efficacy of cobalt-based RT in LMICs, where access to advanced technology is limited but the burden of cancer-related bleeding is high [14].

To build upon these findings, future studies should explore the possibility of conducting Prospective trials evaluating RT for hemostasis in diverse tumor types, Comparative studies between different dose-fractionation schedules (e.g., 8 Gy vs. 10 Gy vs. 5 Gy) to optimize treatment efficacy while minimizing toxicity and Integration of systemic therapies (e.g., anti-angiogenic agents, immunotherapy) with RT to assess potential synergy in controlling haemorrhage. Quality of life can also be assessed in patients receiving palliative RT to quantify symptom relief and functional outcomes.

In conclusion, this study reaffirms that the hypofractionated regimen in RT achieves an excellent role to rapidly control bleeding among advanced cancer cases. We corroborate and in some cases surpassed findings from global literature, with a 95% success rate. The results further highlight the need for cobalt-based therapy in resource-poor settings given that it remains an important tool to offer comfort to patients with limited therapeutic options. Future studies, particularly prospective correlative trials, are necessary to define optimal dose regimens and investigate potential synergy between RT and systemic treatments with improved local control and overall survival.

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Statement of Transparency and Principals

- Author declares no conflict of interest
- Study was approved by Research Ethic Committee of author affiliated Institute.
- Study's data is available upon a reasonable request.
- All authors have contributed to implementation of this research.

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