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Breaking Barriers to Better Care: A Narrative Review on the Adoption of Single-Fraction Palliative Radiotherapy for Bone Metastases in Low- and Middle-Income Countries

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Abstract

Introduction: Palliative radiotherapy is essential for managing bone metastases, providing effective pain relief, and improving quality of life. While multiple fractions of radiotherapy are commonly used in high-income countries, randomized studies have established single-fraction palliative radiotherapy as an equally effective standard for uncomplicated painful bone metastases. Despite its proven effectiveness, there is still some reluctance to adopt single-fraction palliative radiotherapy in high-income countries. In low- and middle-income countries, single-fraction palliative radiotherapy can address many challenges, such as limited resources and difficulties in delivering cancer care, by reducing the number of treatment sessions and improving patient accessibility. However, barriers to single-fraction palliative radiotherapy adoption in low- and middle-income countries remain.

Materials and Methods: This narrative review examines the barriers to single-fraction palliative radiotherapy adoption for bone metastases in low- and middle-income countries and explores possible solutions.

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Results: It highlights the effectiveness and benefits of single-fraction palliative radiotherapy in resource-limited settings and emphasizes the need for a tailored approach that includes policy development, clinical guidelines, training, research, and community engagement.
Conclusions: Ultimately, this collaborative effort can improve palliative care and patient outcomes, regardless of location or economic conditions.

Keywords: bone metastases; fractionation; low-resourced settings; narrative review; pain relief; palliative radiotherapy

Introduction

Palliative radiotherapy is an effective treatment for patients with bone metastases, offering pain relief and improving quality of life. Traditionally, multiple fractions of radiotherapy have been the standard in high-income countries. However, single-fraction palliative radiotherapy has emerged as an effective alternative for uncomplicated painful bone metastases (painful bone lesions without fractures, spinal cord, or cauda equina compression), providing similar pain relief while offering benefits such as reduced treatment burden, increased convenience, and better resource use.[1,2] Despite these advantages, single-fraction palliative radiotherapy has not been fully embraced in high-income countries, likely due to established treatment practices and concerns about hypofractionated treatments.[3,4] In low- and middle-income countries, the challenges in delivering palliative radiotherapy are pronounced due to limited resources, inadequate infrastructure, and workforce shortages. Single-fraction palliative radiotherapy has the potential to alleviate some of these challenges by reducing the number of treatment sessions, thereby easing the strain on health care systems, improving accessibility for patients with transportation difficulties, and optimizing resource utilization. In addition, the shorter treatment duration of single-fraction palliative radiotherapy can provide quicker pain relief, which is important for patients with advanced disease. However, the adoption of single-fraction palliative radiotherapy faces barriers also in low- and middle-income countries, including clinical concerns, limited dissemination of guidelines, and the need for further research to confirm its safety and efficacy in these settings.[5–8]

This review aims to summarize the evidence on the barriers to single-fraction palliative radiotherapy adoption in low- and middle-income countries and explore potential solutions to integrate single-fraction palliative radiotherapy into palliative care in these regions. By addressing these challenges, we hope to contribute to the broader effort of improving palliative radiotherapy access and enhancing quality of life for patients in low- and middle-income countries.

Materials and Methods

Multidisciplinary review team

This comprehensive review was conducted collaboratively by a multidisciplinary team comprising experts from both high-income countries and low- and middle-income countries. The team consisted of radiation oncologists, experts in palliative care, and radiotherapy technicians, ensuring a diverse range of perspectives and expertise in the field.

Literature search

To identify relevant studies and literature, a thorough search was conducted across multiple databases, including PubMed, Scopus, and the Cochrane Library. The search strategy used various combinations of keywords and phrases related to radiotherapy, radiation, palliative care, symptomatic relief, referral practices, barriers, fractionation, and single fraction radiotherapy. For the PubMed database, the main search strategy is shown in Supplementary Data. To enhance the comprehensiveness of our literature search, we used the snowball technique, which involves reviewing the reference lists of identified articles to uncover additional relevant studies.

Selection process

Two authors (E.G. and C.M.D.) independently screened the search results to identify relevant articles for inclusion in this review. The screening process considered the titles and abstracts of the retrieved articles. Any disagreements between the two reviewers were resolved through discussion and consensus. After the initial screening, the selected articles underwent a full-text review. Two additional authors (M.B. and A.G.M.) were responsible for collecting detailed information from the selected articles. This information included data on the authors of the studies, the materials and methods used in the original

research, the results obtained, and the conclusions drawn by the authors of the respective studies.

Data summarization

The results of the analysis are presented in a narrative format, as the scope and heterogeneity of the reviewed studies precluded a systematic review. A narrative approach allowed for a qualitative synthesis of the findings, enabling an exploration of the barriers to the adoption of single-fraction palliative radiotherapy for bone metastases in low- and middle-income countries.

Narrative review checklist

To maintain transparency and consistency in the narrative review process, a checklist of key components was used. Supplementary Table S1 provides an overview of this checklist, highlighting the critical aspects addressed during the review. The checklist guided the authors in evaluating each selected study and ensured that all relevant information was considered and reported consistently. Moreover, Table 1 shows dose/fractionation regimens used in nonrandomized studies on palliative radiotherapy in bone metastases from low- and middle-income countries, whereas Table 2 shows the characteristics and outcomes of randomized trials from low- and middle-income countries comparing single-fraction palliative radiotherapy and multiple fraction palliative radiotherapy in bone metastases.

Results

Nonrandomized studies

Our search led to finding 11 articles published in low- and middle-income countries on palliative radiotherapy of bone metastases (Table 1).[9–19] In summary, single-fraction palliative radiotherapy was used as the only or one of the treatment options in one and seven studies, respectively, whereas in three studies single-fraction palliative radiotherapy was not included among the possible options.

Randomized trials

From our literature search, four randomized studies from low- and middle-income countries were identified that compared the effect of single-fraction palliative radiotherapy versus multiple fractions in palliative radiotherapy of bone metastases (Table 2).[10,12,14,15] All studies showed similar pain relief between single-fraction palliative radiotherapy and multifraction radiotherapy.

Evidence on single fraction utilization in low- and middle-income countries

In their study, Sharma et al. aimed to investigate the patterns of palliative radiotherapy practice in Africa, focusing on bone metastases and brain metastases. They found that while most centers in Africa utilized radiotherapy for various metastatic cancers, liver and lung metastases were often treated with chemotherapy. Notably, a majority of centers had a single institutional radiotherapy regimen for painful bone metastases, but only a small percentage (23%) used the single fraction regimen of 8 Gy in 1 fraction. This study highlighted the variation in radiotherapy practices across African centers and the limited utilization of single-fraction palliative radiotherapy for bone metastases.[5]

Jeremic et al.[6] revisited patterns of palliative radiotherapy practice in Africa six years after their first analysis. Their investigation revealed that while a significant number of patients were seen and treated in African centers, most institutions still preferred

Table 1. Dose/Fractionation Regimens Used in Studies on Palliative Radiotherapy in Bone Metastases from Low- and Middle-Income Countries

Authors/year [ref]	City/ country	No. of patients	RT dose (Gy)/Fractions
Güden et al./2002[9]	Ankara/Turkey	62	6/1
Amouzegar-Hashemi et al./2008[10]	Tehran/Iran	58	8/1 or 30/10
Hicsonmez et al./2010[11]	Ankara/Turkey	33	30/10 or 20/5 or 8/1
Majumder et al. /2012[12]	Kolkata/India	64	30/10 or 8/1
Kapoor et al./2015[13]	Rajasthan/India	177	8/1 or 30/10
Anter et al./2015[14]	Mansoura/Egypt	100	8/1 or 20/5
Nongkynrih et al./2018[15]	Haryana/India	60	8/1 or 20/5 or 30/10
Duraisamy et al./2018[16]	Kuala Lumpur/Malaysia	162	8/1 or 10/1 or 20/5 or 30/10
Jamre et al./2019[17]	Madhya Pradesh/India	60	30/10 or 20/5
Sakr et al./2020[18]	Cairo/Egypt	22	20/5 (2D-3D RT) or 27/3 (SBRT)
Ahmed et al./2021[19]	Assiut/Egypt	84	30/10

RT, radiotherapy; SBRT, stereotactic body radiation therapy.

Table 2. Characteristics and Outcomes of Randomized Trials from Low- and Middle-Income Countries Comparing Single-Fraction and Multiple-Fraction Palliative Radiotherapy in Bone Metastases

Authors/year [ref]	City/Country	Study Design	Primary end point	No. of patients	RT dose (Gy)/ Fractions	Main outcome	Conclusions
Amouzegar-Hashemi et al./2008[10]	Tehran/ Iran	Random	Pain relief (4-point scale)	58	8/1, 30/10	CR: (8/1): 22%, (30/10):35%. ORR: (8/1): 78%; (30/10): 65%.	Same efficacy
Majumder et al./2012[12]	Kolkata/ India	Random	Pain relief (VAS)	64	Arm A: 30/10, Arm B: 8/1	PR: Arm A: 84.6%, Arm B: 76.9%.	Same efficacy
Anter et al./2015[14]	Mansoura/Egypt	Random	Pain relief (NRS)	100	Arm A: 8/1, Arm B: 20/5	Pain (3 months) CR: Arm A: 18.2%, Arm B: 22.7%. PR: Arm A: 56.8%, Arm B: 52.3%	Same efficacy
Nongkynrihet al./2018[15]	Haryana/India	Random	Pain relief (VAS)	60	Group 1: 8/1, Group 2: 20/5, Group 3: 30/10	Pain CR: Group I: 20%, Group II: 20%, Group III: 20%.	Same efficacy

CR, complete response of pain; NRS, Numerical Rating Scale; ORR, overall response rate of pain; PR, partial response of pain; RT, radiotherapy; VAS, visual analog scale.

fractionated radiotherapy regimens for bone metastases. However, most centers had begun to incorporate single-fraction palliative radiotherapy for re-treatments. The study emphasized the need for improved staffing and equipment resources in African countries and suggested a greater utilization of single-fraction palliative radiotherapy, especially for bone metastases.[6]

In their investigation focused on patients with metastatic breast cancer in Zimbabwe, Mushonga et al.[7,8] conducted a retrospective cohort study. They found that a minority of patients with metastatic breast cancer received radiotherapy (20%). These patients tended to be younger, have advanced tumor stages, and reside in provinces where radiotherapy facilities were available. The most common dose prescription for radiotherapy was 30 Gy in 10 fractions. The study concluded that there is a need to consider palliative radiotherapy as an option for patients with metastatic breast cancer and suggested the use of shorter radiotherapy courses, such as single-fraction palliative radiotherapy, to support this goal.[7,8]

Discussion

Narrative

Effectiveness of single-fraction palliative radiotherapy in low- and middle-income countries. A previous systematic review showed that single-fraction palliative radiotherapy offers similar effectiveness in pain relief even in resource-constrained low- and middle-income countries.[20] However, it is important to note that, despite the proven efficacy, several studies in low- and middle-income countries continue to primarily use multifraction regimens. In addition, findings from three surveys conducted in African countries reveal that multifractionated radiotherapy remains the preferred treatment strategy in these regions, underscoring the need for further initiatives to encourage the adoption of single-fraction palliative radiotherapy in low- and middle-income countries.[5–8]

Limitations and strengths. In our analysis, we recognize certain limitations. Most notably, the number of reports on clinical efficacy originating from low- and middle-income countries was quite limited. Moreover, the majority of the studies included in our review were retrospective in nature, and they typically analyzed a relatively small number of patients. Notably, none of the randomized studies enrolled more than 100 patients. Despite these limitations, there are some strengths in our review. We brought together a

multidisciplinary team from both low- and middle-income countries and high-income countries to conduct a comprehensive assessment. Our literature search strategy and selection process allowed us to provide a qualitative synthesis of the literature on the barriers to single-fraction palliative radiotherapy adoption for bone metastases in low- and middle-income countries.

Advantages of single-fraction palliative radiotherapy in low- and middle-income countries. Single-fraction palliative radiotherapy offers several key benefits for low- and middle-income countries, addressing both patient needs and health care facility constraints. For patients, single-fraction palliative radiotherapy improves accessibility by reducing the number of treatment sessions, which is particularly beneficial for those facing travel challenges due to distance, financial constraints, or limited transportation. This reduction in sessions also lessens the disruption to patients' daily lives, improving adherence to treatment in areas where health care literacy might be low. For health care facilities, single-fraction palliative radiotherapy optimizes the use of limited resources, such as treatment slots, medical staff, and equipment. This is especially important in regions with a shortage of radiation oncologists and medical physicists. Moreover, fewer treatment sessions reduce the impact of equipment downtime, which can be a significant issue in areas with often inadequate maintenance and power supply. Furthermore, the overall reduction in treatment costs allows health care facilities to allocate resources more effectively, potentially expanding access to care for a larger patient population.

General barriers to single-fraction palliative radiotherapy adoption. Despite the benefits of single-fraction palliative radiotherapy, such as convenience and reduced treatment burden, there are challenges that may hinder its widespread adoption.[21–23] One key factor is the complexity of the lesions being treated. Clinicians might prefer multiple fractions for larger or more aggressive metastatic lesions to ensure better pain control. In addition, single-fraction palliative radiotherapy has been linked to higher re-treatment rates compared with multiple fractions,[24–27] which may lead clinicians to favor multifraction regimens, especially for patients with longer life expectancies. Patient preferences also influence decisions, as some may choose multiple sessions for perceived safety and efficacy over the convenience of fewer treatments.

Specific barriers to single-fraction palliative radiotherapy adoption in low- and middle-income countries. In low- and middle-income countries, several factors can hinder the adoption of single-fraction palliative radiotherapy for bone metastases. Outdated or inadequate treatment guidelines can create obstacles, making it essential to establish clear, relevant protocols for decision making. Clinicians in these regions may prioritize tumor control and long-term outcomes, often associating multiple fraction regimens with better management of aggressive or large metastatic lesions. Historical practices also play a role, with a tendency to stick to multiple fractions if they have been the norm. In addition, the training and experience of radiation oncologists, who may be more familiar with multifraction regimens, can heavily influence their treatment choices. This preference is often reinforced by the perceived safety of traditional approaches, especially in settings where follow-up and supportive care are limited. Cultural beliefs and misconceptions about radiotherapy may also affect patient acceptance, particularly when there are concerns about the safety of receiving a high dose in a single session.

Promoting single-fraction palliative radiotherapy adoption in low- and middle-income countries. Addressing the barriers to single-fraction palliative radiotherapy adoption in low- and middle-income countries requires a comprehensive collaborative approach. Key strategies include implementing training programs to educate health care professionals, particularly radiation oncologists, on the benefits and appropriate use of single-fraction palliative radiotherapy. Collaborations with international organizations can help develop clear clinical guidelines that emphasize single-fraction palliative radiotherapy for specific cases, such as palliative care for bone metastases, ensuring its recognition as a valid treatment option. Telemedicine can facilitate remote consultations with experts from high-income countries, aiding local providers in making informed treatment decisions. Supporting research on single-fraction palliative radiotherapy effectiveness in low- and middle-income countries and building a local evidence base is also crucial for its wider adoption. Engaging with local communities to raise awareness and dispel misconceptions about radiotherapy can improve patient acceptance and adherence. Finally, emphasizing patient-centered care by involving patients in treatment decisions and addressing their concerns can enhance

single-fraction palliative radiotherapy acceptance. In conclusion, a holistic approach involving policy, infrastructure, clinical practices, and patient engagement is essential for promoting single-fraction palliative radiotherapy in low- and middle-income countries. This requires the active involvement of governments, health care institutions, nongovernmental organizations, and international collaboration, ultimately leading to better palliative care and patient outcomes in resource-limited settings.

Summary

This review provides a thorough analysis of the adoption of single-fraction palliative radiotherapy for bone metastases, particularly in low- and middle-income countries. The findings are relevant for health professionals, policymakers, and researchers. Health professionals should recognize single-fraction palliative radiotherapy as an effective option for pain management in bone metastases, even in resource-limited settings. Despite its proven efficacy,[20] many regions still favor multifraction regimens,[10–19] often due to established practices. Clinicians should be open to using single-fraction palliative radiotherapy when it is the most appropriate choice. From a policy perspective, low- and middle-income countries can benefit from updated and relevant treatment guidelines. Clear clinical recommendations that emphasize single-fraction palliative radiotherapy for specific cases, such as palliation of bone metastases, can help standardize its use. Telemedicine can also play a role by enabling remote consultations with experts from high-income countries, helping local providers make informed decisions. Policies should adapt to support single-fraction palliative radiotherapy adoption, recognizing its advantages in accessibility, cost-effectiveness, and resource optimization. Future research should aim to generate local evidence on the effectiveness of single-fraction palliative radiotherapy in low- and middle-income countries. The limited data available highlight the need for studies that evaluate single-fraction palliative radiotherapy in different clinical settings, which can build a strong evidence base for its broader adoption.

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Authors' Contributions

V.K.B., E.G., M.B., and A.G.M. conceived of the idea for the article; V.K.B., E.G., C.M.D., M.B., and M.V. performed the literature search and data collection and analysis; V.K.B., E.G., M.M., and A.G.M. drafted the article; and all authors critically revised the work.

Author Disclosure Statement

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Supplementary Material

Supplementary Data
Supplementary Table S1

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