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# THE INTERPLAY BETWEEN CARDIOVASCULAR DISEASE AND CANCER: SHARED RISK FACTORS AND THERAPEUTIC IMPLICATIONS

*A interação entre doença cardiovascular e câncer: fatores de risco compartilhados e implicações terapêuticas*

*La interacción entre la enfermedad cardiovascular y el cáncer: factores de riesgo compartidos e implicaciones terapéuticas*

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## ABSTRACT

Cardiovascular disease and cancer are the two leading causes of morbidity and mortality worldwide, and a growing body of evidence has revealed a complex and bidirectional relationship between these conditions. This interaction encompasses the cardiovascular sequelae of anticancer therapies, shared risk factors, and common biological mechanisms, highlighting the need for a comprehensive understanding of this interface. To synthesize current evidence on the interplay between cardiovascular disease and cancer, with emphasis on shared risk factors, cardiovascular toxicities associated with oncologic therapies, and clinical implications for prevention and management, based exclusively on the abstracts provided. This is a narrative literature review developed through the analysis of six abstracts from scientific articles and consensus documents provided by the author. The included publications ranged from 2021 to 2025, were published in English, and addressed epidemiological, mechanistic, clinical, and therapeutic aspects of the relationship between cardiovascular disease and cancer. Data were extracted and qualitatively synthesized using thematic analysis. Epidemiological

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evidence demonstrates that cancer survivors have significantly higher risks of cardiovascular disease (HR: 1.37), heart failure (HR: 1.52), and stroke (HR: 1.22), independent of traditional risk factors, with variation according to cancer type. Metabolic dysregulation emerges as a shared biological mechanism underlying both conditions. Immune checkpoint inhibitors are associated with cardiovascular toxicities, including myocarditis, which typically occurs early, may be fulminant, and requires immediate treatment with high-dose corticosteroids. Standardized definitions for cardiovascular toxicities have been established through international consensus to facilitate research and clinical practice. Multidisciplinary care involving cardiologists, oncologists, and other specialists is essential for optimal patient management. The interplay between cardiovascular disease and cancer is complex and bidirectional, requiring integrated approaches to prevention, monitoring, and treatment. Cancer survivors represent a high-risk population requiring targeted cardiovascular prevention strategies. Future research should focus on elucidating underlying mechanisms, validating standardized toxicity definitions, and developing evidence-based preventive interventions tailored to specific cancer types and therapies.

**Keywords**: Cardio-oncology; Heart failure; Immune checkpoint inhibitors; Metabolic reprogramming; Cancer survivors; Standardized definitions.

## RESUMO

A doença cardiovascular e o câncer constituem as duas principais causas de morbimortalidade em todo o mundo, e um crescente corpo de evidências tem revelado uma relação complexa e bidirecional entre essas condições. Essa interação abrange as sequelas cardiovasculares das terapias anticancerígenas, fatores de risco compartilhados e mecanismos biológicos comuns, destacando a necessidade de uma compreensão abrangente dessa interface. Buscou-se sintetizar as evidências atuais sobre a interação entre doença cardiovascular e câncer, com ênfase nos fatores de risco compartilhados, nas toxicidades cardiovasculares associadas às terapias oncológicas e nas implicações clínicas para prevenção e manejo, com base exclusivamente nos resumos fornecidos. Trata-se de uma revisão narrativa da literatura, desenvolvida por meio da análise de seis resumos de artigos científicos e documentos de consenso fornecidos pelo autor. As publicações incluídas foram dos anos de 2021 a 2025, no idioma inglês, abordando aspectos epidemiológicos, mecanísticos, clínicos e terapêuticos da relação entre doença cardiovascular e câncer. Os dados foram extraídos e sintetizados qualitativamente por meio de análise temática. Evidências epidemiológicas demonstram que sobreviventes de câncer apresentam riscos significativamente maiores de doença cardiovascular (HR: 1,37), insuficiência cardíaca (HR: 1,52) e acidente vascular cerebral (HR: 1,22), independentemente dos fatores de risco tradicionais, com variação de acordo com o tipo de câncer. A desregulação metabólica emerge como um mecanismo biológico compartilhado subjacente a ambas as condições. Os inibidores de checkpoint imunológico estão associados a toxicidades cardiovasculares, incluindo miocardite, que geralmente ocorre precocemente, pode ser fulminante e requer tratamento imediato com corticosteroides em altas doses. Definições padronizadas para toxicidades cardiovasculares foram estabelecidas por consenso internacional para facilitar a pesquisa e a prática clínica. O cuidado multidisciplinar envolvendo cardiologistas, oncologistas e outros especialistas é essencial para o manejo ideal do paciente. A interação entre doença cardiovascular e câncer é complexa e bidirecional, exigindo abordagens

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integradas de prevenção, monitoramento e tratamento. Os sobreviventes de câncer representam uma população de alto risco que necessita de estratégias direcionadas de prevenção cardiovascular. Pesquisas futuras devem focar na elucidação dos mecanismos subjacentes, na validação das definições padronizadas de toxicidade e no desenvolvimento de intervenções preventivas baseadas em evidências, adaptadas a tipos específicos de câncer e terapias.
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**Palavras-chave**: Cardio-oncologia; Insuficiência Cardíaca; Inibidores de Checkpoint Imunológico; Reprogramação Metabólica; Sobreviventes de Câncer; Definições Padronizadas.

## RESUMEN

La enfermedad cardiovascular y el cáncer constituyen las dos principales causas de morbimortalidad en todo el mundo, y un creciente cuerpo de evidencia ha revelado una relación compleja y bidireccional entre estas condiciones. Esta interacción abarca las secuelas cardiovasculares de las terapias anticancerígenas, los factores de riesgo compartidos y los mecanismos biológicos comunes, destacando la necesidad de una comprensión integral de esta interfaz. Sintetizar la evidencia actual sobre la interacción entre la enfermedad cardiovascular y el cáncer, con énfasis en los factores de riesgo compartidos, las toxicidades cardiovasculares asociadas a las terapias oncológicas y las implicaciones clínicas para la prevención y el manejo, con base exclusivamente en los resúmenes proporcionados. Se trata de una revisión narrativa de la literatura, desarrollada mediante el análisis de seis resúmenes de artículos científicos y documentos de consenso proporcionados por el autor. Las publicaciones incluidas abarcan los años 2021 a 2025, en idioma inglés, y abordan aspectos epidemiológicos, mecanísticos, clínicos y terapéuticos de la relación entre la enfermedad cardiovascular y el cáncer. Los datos fueron extraídos y sintetizados cualitativamente mediante análisis temático. La evidencia epidemiológica demuestra que los sobrevivientes de cáncer presentan riesgos significativamente mayores de enfermedad cardiovascular (HR: 1,37), insuficiencia cardíaca (HR: 1,52) y accidente cerebrovascular (HR: 1,22), independientemente de los factores de riesgo tradicionales, con variación según el tipo de cáncer. La desregulación metabólica emerge como un mecanismo biológico compartido subyacente a ambas condiciones. Los inhibidores de puntos de control inmunitario se asocian con toxicidades cardiovasculares, incluida la miocarditis, que generalmente ocurre de forma temprana, puede ser fulminante y requiere tratamiento inmediato con corticosteroides en altas dosis. Se establecieron definiciones estandarizadas de toxicidades cardiovasculares mediante consenso internacional para facilitar la investigación y la práctica clínica. El cuidado multidisciplinario que involucra cardiólogos, oncólogos y otros especialistas es esencial para el manejo óptimo del paciente. La interacción entre la enfermedad cardiovascular y el cáncer es compleja y bidireccional, y exige enfoques integrados de prevención, monitoreo y tratamiento. Los sobrevivientes de cáncer representan una población de alto riesgo que requiere estrategias dirigidas de prevención cardiovascular. Las investigaciones futuras deben centrarse en la elucidación de los mecanismos subyacentes, la validación de las definiciones estandarizadas de toxicidad y el desarrollo de intervenciones preventivas basadas en evidencia, adaptadas a tipos específicos de cáncer y terapias.

**Palabras clave:** Cardio-oncología; Insuficiencia cardíaca; Inhibidores de puntos de control inmunitario; Reprogramación metabólica; Sobrevivientes de cáncer; Definiciones estandarizadas.

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## 1. INTRODUCTION

Cardiovascular disease (CVD) and cancer constitute the two leading causes of morbidity and mortality globally. Historically perceived and managed as distinct disease entities, a growing body of evidence has illuminated a complex and bidirectional relationship between these two conditions, giving rise to the specialized field of cardio-oncology (Karlstaedt *et al.*, 2022; Bloom *et al.*, 2025). This interdisciplinary field is devoted to the cardiovascular care of the cancer patient, focusing on the mitigation and management of cardiovascular complications arising from cancer therapies, which can profoundly influence patient prognosis (Herrmann *et al.*, 2022). The interplay between CVD and cancer is multifaceted, encompassing the cardiovascular sequelae of anticancer treatments, the existence of shared risk factors that predispose individuals to both pathologies, and the emerging concept that cardiac dysfunction may potentiate cancer growth (Karlstaedt *et al.*, 2022).

The improvement in survival rates for adult patients diagnosed with cancer, with more than 80% achieving long-term survival, has brought the long-term complications of cancer and its therapies into sharp focus (Florido *et al.*, 2022). Prospective community-based data from the Atherosclerosis Risk In Communities (ARIC) study have demonstrated that cancer survivors face a significantly higher risk of developing incident CVD, particularly heart failure (HF) and stroke, compared to individuals without a cancer history. This elevated risk persists even after comprehensive adjustment for traditional cardiovascular risk factors, underscoring an independent association. Specifically, breast, lung, colorectal, and hematologic/lymphatic cancers have been identified as significantly associated with subsequent CVD risk, highlighting the variable impact of different malignancies and their treatments (Florido *et al.*, 2022).

Beyond epidemiological associations, fundamental biological mechanisms are increasingly recognized as central to the cardio-oncology connection. Metabolic dysregulation has emerged as a key theme, with processes such as energy metabolism, substrate utilization, and macromolecular synthesis being implicated in both cardiovascular disease and cancer. This concept of "cardio-onco-metabolism" suggests that metabolic reprogramming is a shared feature of both disease processes (Karlstaedt *et al.*, 2022). Furthermore, the presence of pre-existing cardiovascular risk factors or established CVD in a patient with a new cancer diagnosis portends a high risk for adverse oncology

and cardiovascular outcomes, necessitating a thorough understanding of risk stratification and management strategies (Bloom *et al*., 2025).

The rapid evolution of cancer therapeutics, while improving clinical outcomes, has introduced a spectrum of potential cardiovascular toxicities. Modern therapies for breast cancer, for instance, have raised concerns about both short- and long-term adverse cardiovascular effects (López-Fernández *et al*., 2024). Immune checkpoint inhibitors (ICIs), which have revolutionized the treatment of several cancers, can cause a wide range of immune-related adverse events (irAEs). Among these, cardiovascular toxicities, although rare in overall incidence, are associated with disproportionately high rates of morbidity and mortality (Patel *et al*., 2021).

Reported cardiovascular complications of ICIs include myocarditis, stress cardiomyopathy, pericardial disease, and, as recent findings suggest, an increased risk of atherosclerosis. ICI-associated myocarditis typically presents early after treatment initiation and can be fulminant, requiring a high index of suspicion for timely diagnosis and prompt intervention with high-dose corticosteroids to improve outcomes (Patel *et al*., 2021; Herrmann *et al*., 2022). As the use of ICIs expands to include high-risk patients with preexisting cardiovascular risk factors and disease, the relevance and potential risk of such cardiotoxicities are expected to escalate (Patel *et al*., 2021).

A significant challenge in both clinical research and practice has been the lack of uniformity in defining what constitutes cardiovascular toxicity from cancer therapies. This heterogeneity has impeded direct comparisons between studies and has led to substantial variation in patient management and outcomes (Herrmann *et al*., 2022).

To address this critical gap, consensus definitions for the most commonly reported cardiovascular toxicities—including cardiomyopathy/heart failure, myocarditis, vascular toxicity, hypertension, and arrhythmias—have been established by the International Cardio-Oncology Society (IC-OS). This harmonization effort aims to provide a structured framework for clinical practice and future research, facilitating clearer communication across disciplines and ultimately improving patient care (Herrmann *et al*., 2022).

Despite these advances, significant gaps in knowledge persist. The precise biological mechanisms linking cardiac dysfunction to cancer progression remain under investigation (Karlstaedt *et al*., 2022). Furthermore, while the increased risk of CVD in cancer survivors is evident, there is an unmet need to define and implement effective strategies for CVD prevention specifically tailored to

this high-risk and heterogeneous population (Florido *et al.*, 2022). Disparities in the care of patients with cancer and cardiac disease further complicate the landscape, highlighting the necessity for a multidisciplinary and equitable approach involving heart failure specialists, oncologists, palliative care, pharmacy, and nursing teams (Bloom *et al.*, 2025). The long-term cardiovascular sequelae of newer immunotherapies and the optimal management of conditions like ICI-associated atherosclerosis also require further elucidation (Patel *et al.*, 2021).

Therefore, the primary objective of this narrative review is to synthesize the current evidence, derived exclusively from the provided abstracts, on the intricate interplay between cardiovascular disease and cancer. This review aims to explore the shared risk factors and common biological pathways, particularly metabolic dysregulation, that underpin both conditions. It will also examine the spectrum of cardiovascular toxicities associated with key cancer therapies, with a focus on immune checkpoint inhibitors and their implications for patient management. By critically evaluating the available data, this review seeks to highlight the importance of integrated, multidisciplinary care in cardio-oncology and to underscore the critical gaps in evidence that must be addressed to optimize the cardiovascular health and overall well-being of cancer patients and survivors.

## 2. METHODOLOGY

### 2.1 Type of Study

This is a narrative review of the literature, a design that aims to synthesize and discuss current knowledge on a specific topic through the critical analysis of scientific publications. This type of study was selected because it allows a broad and contextualized approach to the complex interface between cardiovascular disease and cancer, integrating findings from epidemiological studies, thematic reviews, and consensus documents, as identified in the provided literature (Karlstaedt *et al.*, 2022; López-Fernández *et al.*, 2024).

The narrative review enables the construction of an interpretive synthesis that can identify consensus, divergences, and knowledge gaps, aligning with the objective of exploring the interrelationship between the two conditions and their therapeutic implications.

### 2.2 Data Sources and Search Strategy

This review was developed based on a set of abstracts of scientific articles provided by the author. The source publications were identified from the following databases referenced in the abstracts: Current Oncology Reports, Nature Reviews Cardiology, Journal of the American College of Cardiology, European Heart Journal, Journal of Cardiac Failure, as well as consensus documents from the Heart Failure Society of America and the International Cardio-Oncology Society.

The abstracts were selected because they directly addressed the themes of cardiovascular toxicity associated with antineoplastic therapies, shared pathophysiological mechanisms between cardiovascular disease and cancer, cardiovascular risk in cancer survivors, and standardized definitions for cardiovascular toxicities. No search strategies with descriptors and Boolean operators were applied, as the selection of bibliographic material was previously defined by the scope of the task.

### 2.3 Eligibility Criteria

All provided abstracts were included in the analysis, as they met the following implicit criteria: (1) articles published between 2021 and 2025, covering the most recent period of scientific production in the field; (2) publications in the English language; (3) studies addressing the relationship between cardiovascular disease and cancer, including epidemiological, mechanistic, clinical, and therapeutic aspects; (4) consensus documents and guidelines from specialized societies. No exclusion criteria were applied, considering that all provided abstracts contributed information relevant to the objective of this review.

### 2.4 Data Collection

The data collection process consisted of a full reading and careful analysis of each provided abstract. Initially, an exploratory reading of all abstracts was conducted to become familiar with the content and identify central themes. Subsequently, an analytical reading was performed, extracting information regarding: the design of the original studies, main findings, populations investigated, types of cardiovascular toxicities reported, identified risk factors, proposed mechanisms, and clinical recommendations. The extracted information was organized into emerging thematic categories, such as epidemiology of cardiovascular risk, shared biological mechanisms, toxicities of specific therapies,

and management strategies. No standardized pre-defined form was used; the extraction was conducted systematically and guided by the objectives of this review.

### 2.5 Data Analysis

Data analysis was performed through qualitative and thematic synthesis of the content of the abstracts. Initially, the findings of each study were individually examined for their contribution to understanding the interface between cardiovascular disease and cancer. Subsequently, a comparison between studies was conducted, identifying points of consensus, such as the recognition of increased heart failure risk in cancer survivors (Florido *et al*., 2022) and the severity of myocarditis associated with immune checkpoint inhibitors (Patel *et al*., 2021; Herrmann *et al*., 2022).

Divergences or nuances, such as the absence of a significant association with coronary heart disease in the study by Florido *et al.* (2022) in contrast to the recognition of vascular toxicity in guidelines (Bloom *et al*., 2025; Herrmann *et al*., 2022), were also recorded. The coherence among findings was evaluated considering the different focuses of each publication. The final organization of the synthesis followed the thematic structure that emerged from the analysis, ensuring that all concepts and data were expressed with fidelity to the original content of the abstracts.

### 2.6 Ethical Aspects

As this is a narrative review of the literature, based exclusively on publicly available data from previously published scientific articles, this study did not involve the direct participation of human subjects, nor the collection of primary data. Therefore, there was no need for submission and approval by a Research Ethics Committee. The conduct of this work respected the ethical principles inherent to scientific production, including the proper attribution of authorship and fidelity in representing the ideas and original results of each cited study, ensuring academic and intellectual integrity.

## 3. RESULTS AND DISCUSSION

### 3.1 Epidemiological Evidence of Cardiovascular Risk in Cancer Survivors

The epidemiological data from the ARIC study provide robust evidence that cancer survivors constitute a population at significantly increased risk for cardiovascular disease. Among 12,414 participants followed for a median of 13.6 years, 3,250 individuals (25%) developed incident cancer.

The age-adjusted incidence rates of CVD per 1,000 person-years were substantially higher among cancer survivors (23.1; 95% CI: 24.7-29.1) compared to those without cancer (12.0; 95% CI: 11.5-12.4). After multivariable adjustment for traditional cardiovascular risk factors, cancer survivors maintained a significantly elevated risk for composite CVD (HR: 1.37; 95% CI: 1.26-1.50), heart failure (HR: 1.52; 95% CI: 1.38-1.68), and stroke (HR: 1.22; 95% CI: 1.03-1.44). Notably, the risk for coronary heart disease was not statistically significant (HR: 1.11; 95% CI: 0.97-1.28). The association with CVD risk varied by cancer type, with breast, lung, colorectal, and hematologic/lymphatic malignancies demonstrating significant associations, whereas prostate cancer did not (Florido et al., 2022).

These findings underscore that the excess cardiovascular risk observed in cancer survivors cannot be attributed solely to the accumulation of traditional risk factors, as the association persisted after comprehensive adjustment. The particularly elevated risk for heart failure, with a hazard ratio of 1.52, suggests that cancer and its therapies may preferentially affect myocardial structure and function. The lack of a significant association with coronary heart disease is intriguing and may reflect different pathogenic mechanisms or a longer latency period for atherosclerotic complications, although such speculation extends beyond the data presented in the abstract. The heterogeneity of risk according to cancer type likely reflects differences in the cardiotoxic potential of specific treatment regimens, as well as possible variations in underlying shared risk factors (Florido et al., 2022).

### 3.2 Shared Biological Mechanisms: The Role of Metabolic Dysregulation

Beyond epidemiological associations, fundamental biological mechanisms linking cardiovascular disease and cancer have been increasingly recognized. Metabolic dysregulation has emerged as a central theme in cardio-oncology, with processes such as energy metabolism, appropriate energy regulation, energy substrate utilization, and macromolecular synthesis and breakdown being fundamental to cellular and organismal survival. The concept of "cardio-onco-metabolism" has been proposed to describe the growing recognition of metabolic reprogramming as a common feature in both cardiovascular disease and cancer. This perspective views the novel area of cardio-oncology through the lens of metabolism, suggesting that shared metabolic alterations may underlie the development and progression of both conditions (Karlstaedt *et al.*, 2022).

The recognition of metabolic dysregulation as a unifying theme provides a mechanistic framework for understanding the bidirectional relationship between cardiovascular disease and cancer. It suggests that the two conditions are not merely coincident or sequentially related through treatment effects, but may share common pathogenic pathways. This perspective has important implications for the development of preventive and therapeutic strategies that target fundamental metabolic processes common to both diseases (Karlstaedt *et al.*, 2022).

### 3.3 Cardiovascular Toxicities of Immune Checkpoint Inhibitors

Immune checkpoint inhibitors have significantly improved survival outcomes for patients with various cancers but are associated with a spectrum of immune-related adverse events. Among these, cardiovascular toxicities, while rare in overall incidence, are notable for their high associated morbidity and mortality. Several cardiovascular toxicities have been reported in association with ICIs, including myocarditis, stress cardiomyopathy, and pericardial disease. Recent findings also suggest an increased risk of atherosclerosis with ICI use. ICI-associated myocarditis typically occurs early after treatment initiation and can be fulminant in presentation, requiring a high index of suspicion for timely diagnosis. Prompt treatment with high-dose corticosteroids has been shown to improve outcomes. As ICIs are increasingly used in high-risk patients with preexisting cardiovascular risk factors and disease, the risk and clinical relevance of ICI-associated cardiotoxicity may become even more significant (Patel *et al.*, 2021).

The International Cardio-Oncology Society (IC-OS) consensus statement has addressed the critical need for uniformity in defining cardiovascular toxicities of cancer therapies. This document provides consensus definitions for the most commonly reported cardiovascular toxicities, including cardiomyopathy/heart failure and myocarditis, vascular toxicity and hypertension, as well as arrhythmias and QTc prolongation. The lack of uniformity in cardiovascular toxicity endpoints has historically made direct comparisons between studies difficult and has led to substantial variation in patient management and outcomes. This harmonization effort aims to provide a structure for definitions of cardiovascular toxicity in both clinical practice and future research, facilitating communication across various disciplines to improve clinical outcomes for cancer patients with cardiovascular diseases (Herrmann *et al.*, 2022).

The convergence of findings from Patel *et al.* (2021) and Herrmann *et al.* (2022) regarding ICI-associated myocarditis is notable. Both sources emphasize the early onset, potential for fulminant course, and the critical importance of prompt diagnosis and treatment with high-dose corticosteroids. The consensus document further contextualizes this toxicity within a broader framework of cardiovascular adverse events, providing standardized definitions that will enable more consistent reporting and comparison across studies. The recognition of potential increased atherosclerosis risk with ICI use (Patel *et al.*, 2021) represents an emerging concern that warrants further investigation, particularly given the long-term survival of many cancer patients treated with these agents.

### 3.4 Cardiovascular Considerations in Breast Cancer Therapy

Modern cancer therapies have greatly improved clinical outcomes for both early and advanced breast cancer patients. However, these therapeutic advances have raised concerns about potential short- and long-term toxicities, including cardiovascular toxicities. Understanding the common risk factors and underlying pathophysiological mechanisms contributing to cardiovascular toxicity is essential to ensure optimal breast cancer outcomes. While cardio-oncology has emerged as a subspecialty to address these challenges, it is essential that all cardiologists recognize and understand the cardiovascular consequences of cancer therapy. A preventive, diagnostic, and therapeutic workflow to minimize the impact of cardiovascular toxicity on patient outcomes has been proposed, with key aspects including regular monitoring of cardiovascular function, early detection and management of cancer therapy-related cardiovascular toxicities, and optimization of cardiovascular risk factor control (López-Fernández *et al.*, 2024).

The emphasis on prevention and monitoring in breast cancer patients aligns with the broader principles articulated in the Heart Failure Society of America scientific statement, which addresses the complexities of heart failure care among patients with active cancer diagnoses and cancer survivors. Risk stratification, monitoring, and management of cardiotoxicity are presented across stages A through D heart failure, with focused discussion on heart failure with preserved ejection fraction and special populations, such as survivors of childhood and young-adulthood cancers. This statement also addresses disparities in the care of patients with cancer and cardiac disease and presents a framework for a multidisciplinary team approach involving heart failure, oncology, palliative care, pharmacy, and nursing teams (Bloom *et al.*, 2025).

### 3.5 Heart Failure as a Central Concern in Cardio-Oncology

Heart failure and cancer remain two of the leading causes of morbidity and mortality, and the two disease entities are linked in a complex manner. Patients with cancer are at increased risk of cardiovascular complications related to cancer therapies, and the presence of cardiomyopathy or heart failure in a patient with a new cancer diagnosis portends a high risk for adverse oncology and cardiovascular outcomes. With the rapid growth of cancer therapies, many of which interfere with cardiovascular homeostasis, heart failure practitioners need to be familiar with prevention, risk stratification, diagnosis, and management strategies in cardio-oncology (Bloom *et al*., 2025).

The Heart Failure Society of America statement provides an overview of the shared risk factors between cancer and heart failure, highlighting heart failure as a form of cardiotoxicity associated with many different cancer therapeutics. This comprehensive perspective integrates the epidemiological evidence of increased heart failure risk in cancer survivors (Florido *et al*., 2022) with the mechanistic understanding of shared risk factors and the clinical imperative for proactive management. The focus on heart failure across all stages, from A (at-risk) to D (advanced), emphasizes the importance of early identification and intervention throughout the cancer care continuum (Bloom *et al*., 2025).

### 3.6 The Need for Standardized Definitions and Multidisciplinary Care

A recurring theme across multiple sources is the critical importance of standardized definitions and multidisciplinary collaboration. The IC-OS consensus statement directly addresses the historical lack of uniformity in cardiovascular toxicity endpoints, which has impeded direct comparisons between studies and led to variation in patient management. By providing consensus definitions for cardiomyopathy/heart failure, myocarditis, vascular toxicity, hypertension, and arrhythmias, this document establishes a foundation for more consistent clinical practice and research. Linking these definitions to outcomes in clinical practice and cardiovascular endpoints in clinical trials will be essential for validating their utility and improving patient care (Herrmann *et al*., 2022).

The multidisciplinary approach is emphasized across several sources. The Heart Failure Society of America statement explicitly calls for critical collaboration among heart failure, oncology, palliative care, pharmacy, and nursing teams in the management of these complex patients (Bloom *et al*., 2025). Similarly, Patel *et al*. (2021) note that cardio-oncologists will need to play an important role not just in the management of acute cardiotoxicity but also in reducing the risk of long-term sequelae. This

multidisciplinary imperative reflects the complexity of patients with concurrent or sequential cardiovascular disease and cancer, who require coordinated expertise from multiple specialties to achieve optimal outcomes.

### 3.7 Synthesis of Evidence and Clinical Implications

The evidence synthesized from the provided abstracts reveals a coherent picture of the interplay between cardiovascular disease and cancer. Epidemiological data demonstrate that cancer survivors face significantly elevated risks of cardiovascular disease, particularly heart failure and stroke, independent of traditional risk factors (Florido *et al.*, 2022). Mechanistic insights point to shared metabolic dysregulation as a fundamental biological link between the two conditions (Karlstaedt *et al.*, 2022). Specific cancer therapies, including immune checkpoint inhibitors and breast cancer treatments, are associated with defined cardiovascular toxicities that require vigilant monitoring and prompt intervention (Patel *et al.*, 2021; López-Fernández *et al.*, 2024).

The clinical implications of these findings are substantial. The elevated cardiovascular risk in cancer survivors necessitates the development and implementation of targeted prevention strategies for this high-risk population (Florido *et al.*, 2022). The potential for severe, early-onset cardiotoxicity with ICIs demands that clinicians maintain a high index of suspicion and be prepared to initiate prompt treatment with high-dose corticosteroids (Patel *et al.*, 2021). The recognition of heart failure as a common form of cardiotoxicity across multiple cancer therapeutics requires heart failure practitioners to be knowledgeable about prevention, risk stratification, and management strategies specific to the oncology population (Bloom *et al.*, 2025).

The establishment of standardized definitions for cardiovascular toxicities represents a critical step forward in enabling consistent reporting, facilitating research comparisons, and improving clinical communication (Herrmann *et al.*, 2022). The emphasis on multidisciplinary care, involving cardiologists, oncologists, and other healthcare professionals, reflects the complexity of managing patients with both cardiovascular disease and cancer and the need for integrated expertise (Patel *et al.*, 2021; Bloom *et al.*, 2025).

## 4. CONCLUSION

This narrative review, based exclusively on the provided abstracts, conclusively demonstrates that the interplay between cardiovascular disease and cancer is multifaceted and bidirectional, extending beyond the direct cardiovascular sequelae of anticancer therapies to encompass shared risk factors and common biological pathways. The evidence unequivocally establishes that cancer survivors face a significantly elevated risk of cardiovascular disease, particularly heart failure and stroke, which persists independently of traditional cardiovascular risk factors. Furthermore, specific cancer therapeutics, notably immune checkpoint inhibitors, are associated with distinct cardiovascular toxicities, including potentially fatal myocarditis that requires prompt recognition and intervention with high-dose corticosteroids. The emergence of metabolic dysregulation as a unifying mechanistic theme, alongside the establishment of standardized definitions for cardiovascular toxicities by international consensus, provides a foundational framework for understanding and addressing this complex clinical interface.

The clinical and scientific relevance of these findings is substantial. The recognition of cancer survivors as a high-risk population mandates the development and implementation of targeted cardiovascular prevention strategies integrated into routine oncology follow-up care. The potentially severe and early-onset nature of ICI-associated cardiotoxicity necessitates that all clinicians involved in cancer care maintain a high index of suspicion and be prepared for urgent multidisciplinary management. The emphasis on standardized definitions and multidisciplinary collaboration, involving cardiologists, oncologists, and allied health professionals, represents an essential paradigm for optimizing outcomes in this vulnerable patient population. These insights collectively underscore that optimal cancer care in the modern era must inherently include comprehensive cardiovascular risk assessment and management throughout the entire cancer continuum, from diagnosis through long-term survivorship.

Despite the advances represented by the evidence synthesized in this review, important knowledge gaps remain that warrant further investigation. The precise biological mechanisms linking specific cancer types and therapies to distinct cardiovascular outcomes require elucidation through mechanistic studies. Prospective studies are needed to validate the consensus definitions for cardiovascular toxicities and to establish their correlation with long-term clinical outcomes. Additionally, the emerging signal of increased atherosclerosis risk with ICI use and the differential risk

observed across cancer types, such as the absence of significant coronary heart disease association in the ARIC study, highlight the need for longer-term follow-up studies and investigations into pathogenesis. Future research should prioritize the development and testing of evidence-based preventive strategies tailored to the specific risks conferred by different cancer diagnoses and treatment modalities, with the ultimate goal of mitigating cardiovascular morbidity and mortality without compromising oncologic efficacy.

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