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REVIEW

Risk and Management of Patients with Cancer and Heart Disease

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ABSTRACT

Cancer and cardiovascular disease are two of the leading causes of global mortality and morbidity. Medical research has generated powerful lifesaving treatments for patients with cancer; however, such treatments may sometimes be at the expense of the patient's myocardium, leading to heart failure. Anti-cancer drugs, including anthracyclines, can result in deleterious cardiac effects, significantly impacting patients' functional capacity, mental well-being, and quality of life. Recognizing this, recent international guidelines and expert papers published recommendations on risk stratification and care delivery, including that of cardio-oncology services. This review will summarize key evidence with a focus on anthracycline therapy, providing clinical guidance for the non-oncology professional caring for a patient with cancer and heart failure.

Keywords: Cardiotoxicity; Anthracycline; Risk stratification; Heart failure

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Key Summary Points

Cardiotoxicity can disrupt cancer treatment, resulting in adverse patient outcomes.

Recently published international guidelines outline strategies for risk stratification and care delivery.

Communication and collaborative working across cardiology and oncology specialisms, with input from medical, nursing and allied professionals, can promote a tailored patient- and family-centred experience.

This review aims to provide a holistic, multidisciplinary overview of the most common issues in cardio-oncology.

INTRODUCTION

Cardiovascular disease and cancer are the two main causes of morbidity and mortality worldwide [1]. Medical treatment for patients with cancer has significantly improved survival; however, some treatment modalities can lead to the development of serious cardiovascular complications, including heart failure (HF). The occurrence of such complications may result in temporary or permanent cessation of cancer treatment, depending on severity, with consequential short and long-term health implications [2–4]. Over the last decade there has been growing interest in the unique specialism known as cardio-oncology, with professionals seeking to ensure patients receive optimum cardiac treatment following a cancer diagnosis. Early identification of risk, with the introduction of integrated care provided by multidisciplinary cardio-oncology teams, was recommended in recent expert guidelines and a position statement [4–6]. The aim of this review is to provide non-oncology specialists with practical guidance on risk stratification with a focus on surveillance pathways for patients who have received anthracycline. In addition, an overview of pertinent topics, including the valuable contributions of cardio-oncology services, exercise rehabilitation and patient-reported outcomes, will be presented. This article is based on previously conducted studies and does not contain any new studies with human participants or animals performed by any of the authors.

SCALE OF THE PROBLEM

A causal relationship has been noted between HF and cancer; they share not only common risk factors, such as ageing, male sex and diabetes mellitus, but also pathophysiological mechanisms, including inflammation, neurohormonal activation, oxidative stress and a dysfunctional immune system [1]. A proportion of today's patients who survive a cancer diagnosis proceed to develop HF due to their chemotherapy, radiotherapy or immunotherapy.

Several chemotherapy drugs are recognized as being 'cardiotoxic' or causing cardiovascular injury affecting myocardial function [7, 8]. Differing definitions of cardiotoxicity have been used over the past 3 decades, leading to heterogeneity in diagnosis and treatment [9, 10]. To harmonize definitions, the International Cardio-Oncology Society released a consensus statement in 2022 classifying cancer-therapeutics-related cardiac dysfunction (CTRCD) into symptomatic heart failure (including a reduced ejection fraction and supportive diagnostic biomarkers in line with current HF guidance) and asymptomatic categories [11].

Mild asymptomatic CTRCD was defined as a new relative decline in global longitudinal strain (GLS) of more than 15% from baseline and or a new rise in biomarkers (with a preserved ejection fraction of 50% or more). Moderate asymptomatic CTRCD is defined as a reduction in ejection fraction of 10 percentage points or more to an ejection fraction of 40–49%. Alternatively, moderate asymptomatic CTRCD is diagnosed in patients with a reduction of less than 10 percentage points (to an

ejection fraction of 40–49%) with a new decline in global longitudinal strain of more than 15% from baseline and/or a new rise in cardiac biomarkers. Severe asymptomatic CTRCD is defined as a new ejection fraction reduction to below 40%. The implementation of these definitions is supported by guidance from the European Haematology Association (EHA), the European Society for Therapeutic Radiology and Oncology (ESTRO), the International Cardio-Oncology Society (IC-OS) and the task force on cardio-oncology of the European Society of Cardiology (ESC) [4]. Well-known cardiotoxic drugs include anthracyclines, as well as many targeted therapies such as small molecule tyrosine kinase inhibitors (sunitinib) and proteasome inhibitors (carfilzomib). The position statement from the Cardio-Oncology Study Group of the Heart Failure Association of the ESC in collaboration with the IC-OS provides a table outlining cancer therapy classes and their associated cardiovascular toxicities [5].

Anthracyclines are the most studied cardiotoxic drugs, accomplishing their effective antitumour activity by infiltrating DNA, impairing transcription and cell division, inhibiting topoisomerase II activity, producing reactive oxygen species, and damaging DNA as well as cell membranes and mitochondria [12]. Human epidermal growth factor receptor-2 (HER2) is therefore required for cell proliferation, differentiation and survival when HER2-targeted therapies such as trastuzumab bind to these receptors and cause downregulation of action [13]. In a population study including over 12,000 females, those treated with anthracycline plus trastuzumab had an increased risk of HF and or cardiomyopathy [14]. Furthermore, Bowles found that cardiotoxic treatments, such as anthracycline and trastuzumab, were more likely to be administered to young healthy females [14] (see "Clinical Case 1" below).

Clinical Case 1

Mrs MT, a 45-year-old lady, was diagnosed with left breast ductal carcinoma in situ (DCIS) in 2006, which became recurrent invasive ductal carcinoma in 2017. She underwent a left mastectomy and chemotherapy with agents including anthracycline, followed by long-term letrozole.

In 2019 she presented to her GP with abdominal distension and dyspnea and was immediately referred to a cardiologist. Investigations at the cardiac consultation included ECG, showing sinus tachycardia, and echo, showing severe systolic dysfunction (EF: 30%) with severe mitral regurgitation. She was prescribed evidence-based HF medication (ACE inhibitor, B-blocker, spironolactone and loop diuretic) and referred to the regional cardio-oncology clinic.

Mrs MT was not initially informed about possible cardio-toxicity due to chemotherapy for cancer and therefore did not recognize symptoms. She was traumatized by the heart failure diagnosis. Comprehensive education and psychological support were provided, albeit late, to help her adapt to and manage this diagnosis.

In 2020, the European Society of Medical Oncology (ESMO) consensus guidance recommended surveillance for potentially cardiotoxic anticancer treatments, including radiotherapy, chemotherapy drugs or targeted therapies [15]. Indeed, cardio-oncology surveillance can improve cancer outcomes by minimizing therapy delays and treating cardiotoxicity at an early, potentially reversible stage.

MONITORING AND ASSESSING RISK

Cardiotoxicity risk changes with time and, as such, an assessment of risk should be conducted periodically. Baseline stratification aims to facilitate timely mitigation of potential risk factors and individualize cancer therapeutic and cardiotoxicity surveillance strategies without imposing any delay on treatment. This requires a comprehensive clinical history (including previous cancer treatments) and examination. Pareek et al. and, more recently, Cuomo et al. showed the importance of risk stratification prior to commencing cancer treatment, enabling high rates of oncologic treatment with

improved health outcomes, i.e. improvements in ejection fraction and functional New York Heart Association (NYHA) classification. In 2020, the Heart Failure Association (HFA) and the International Cardio-Oncology Society (ICOS) published a formal risk stratification tool based on both expert consensus and contemporary data [4]. The tool stratified patients into low (< 2%), moderate (2–9%), high (10–19%) or very high (≥ 20%) cardiovascular risk [29]. The ESC 2022 cardio-oncology guidelines formally advocated the use of this HFA-ICOS tool, on which it based a detailed surveillance programme spanning from a pre-treatment baseline to post-treatment and long-term surveillance [4]. This guidance informs Fig. 1, which consolidates baseline assessment and scoring along with end of treatment, 1 year post-treatment and long-term follow-up. The American Heart Association also recommended the monitoring of cardiac function, supporting the use of key investigations for risk stratification—serum biomarkers (troponin) and imaging [3].

Serum Biomarkers

Troponins and natriuretic peptides are the most widely studied, informing risk stratification, diagnosis, and prognosis. In 2020, the Cardio-Oncology Study Group of the HFA collaborated with the Cardio-Oncology Council of the ESC to review evidence on the role of troponin and natriuretic peptides before, during and after cardiotoxic cancer therapies [16].

Troponin

Troponins are markers of acute cardiomyocyte injury and can help identify toxicity in the early stages of cancer treatment. Cardinale et al. studied over 200 breast cancer patients treated with high-dose chemotherapy and observed that large elevations in troponin I could predict significant and persistent deteriorations in LVEF up to 1 year [17, 18]. High and ultrasensitive troponins can improve the prediction of early cardiotoxicity and mortality in patients receiving anthracyclines and HER2-targeted therapies [19–21]. Their increased sensitivity is, however, associated with reduced specificity, as multiple non-cardiovascular complications during cancer therapy (i.e. renal dysfunction, pulmonary embolism, sepsis) can elevate troponin levels [22].

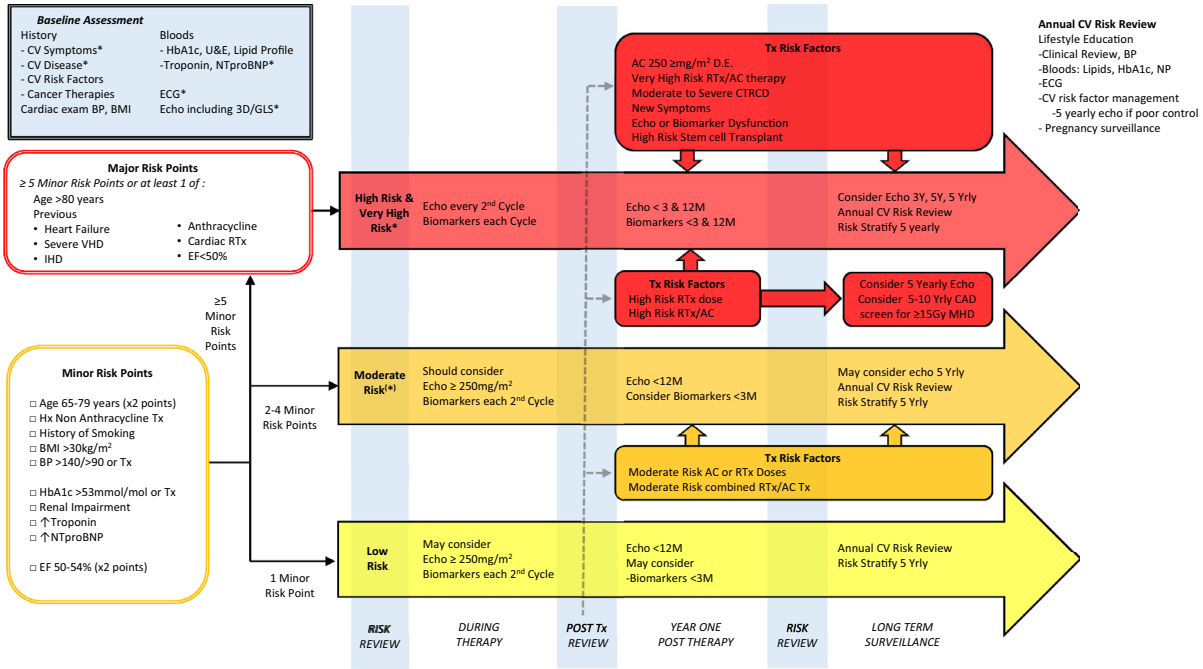
Peri-therapeutic biomarker assessment has been shown to facilitate the planning of successive downstream therapies. The Herceptin Adjuvant Study Cardiac Marker Substudy (HERA) included 452 patients, with results demonstrating that an elevated ultrasensitive troponin post-anthracycline therapy could identify patients at risk of cardiotoxicity prior to subsequent HER2-targeted treatment [23].

Evidence is less convincing on the use of troponin monitoring for long-term surveillance of cardiotoxicity. In a meta-analysis of childhood cancer survivors involving 1651 survivors, Leerink et al. demonstrated echocardiographic evidence of LV dysfunction in approximately 12% of the population. However, in five of the relevant studies, elevated troponin levels were not associated with left ventricular dysfunction [24, 25].

Natriuretic Peptides

Natriuretic peptides are produced from the heart in response to increased myocardial wall strain, typically due to systolic dysfunction. This may therefore be used to identify at-risk patient groups [21]. Specifically in cardio-oncology populations, there is some evidence that persistent peri-treatment elevations of B-type natriuretic peptide (BNP) and N-terminal pro-B-type natriuretic peptide (NT-proBNP) are associated with cardiac dysfunction at 1 year [26, 27]. In a large Danish study of 333 patients, Skovgaard et al. demonstrated an association between elevated peri-treatment BNP and late congestive HF and mortality [26]. Similarly, persistently increased NT-proBNP was associated with abnormal diastolic function in a study by Sandri et al. [27]. Conversely, in a study by Daugaard et al., BNP levels at baseline or during therapy failed to predict dysfunction [28].

Evidence for NT-proBNP is therefore heterogeneous, with a moderate predictive ability in adult and childhood cancer survivors [24, 25, 29]. Furthermore, as natriuretic peptide levels may be affected by patients with



Treatment Risk	RTx (Gy MHD)	AC dose (mg/m^2)	Combination RTx and AC (Gy MHD) mg/m^2)
Very High	>25	≥400	>15 and ≥100
High	15-25	250-399	5-15 and ≥100
Moderate	5-15	100-249	<5 and ≥100
Low	<5	<100	

Fig. 1 Surveillance strategy for anthracycline-treated patients. Adapted from the ESC 2022 cardio-oncology guidelines. If Mean Heart Dose (MHD) is not available from patient records, the prescribed dose may be utilised. A MHD ≥15 Gy equates to ≥35Gy prescribed dose; A MHD 5-15 Gy equates to 15-34Gy prescribed dose; A MHD <5 Gy equates to <15 Gy prescribed dose [4]. *AC* anthracycline, *BP* blood pressure, *BMI* body mass index, *CV* cardiovascular, *D.E.* doxorubicin equivalent, *ECG* electrocardiogram, *Gy* grays, *Hx* history, *M* months, *MHD* mean heart dose, *NP* natriuretic peptide, *RTx* radiotherapy, *Tx* treatment, *U&E* urea and electrolytes, *Y* years. * If abnormal, refer to cardio-oncology;(*) consider cardio-oncology referral

metastatic disease, as well as in those with an elevated or low body mass index, imaging should fundamentally be a part of a surveillance programme [30]. Based on current evidence, the ESC recommended an annual assessment of natriuretic peptides alone for long-term post-treatment surveillance [4].

Combined blood and imaging biomarker approaches have also been explored. For example, Sawaya et al. studied 43 patients treated for breast cancer. Concurrent global longitudinal strain imaging and ultrasensitive troponin-I assessment during treatment with anthracycline and trastuzumab were found to predict subsequent cardiotoxicity [20].

Imaging

Echocardiogram

Echocardiography is the mainstay of imaging techniques in cardiotoxicity surveillance. The LVEF is measured by tracing the endocardial border in diastole and systole using 2D images in two planes; however, this method can be susceptible to high temporal variability [31]. Newer techniques such as three-dimensional (3D) echocardiography are more sensitive than the two-dimensional (2D) measures and have superior accuracy and reproducibility [31]. Furthermore, abnormalities in myocardial strain, a measure of deformation, precede deteriorations

in ejection fraction, and values have been found to correlate with fibrosis [32, 33]. In a systematic review of 1504 patients, Thavendiranathan et al. found that a peri-therapeutic strain decline of 10–15% was predictive of subsequent cardiotoxicity [32]. Whilst evidence remains limited on the long-term outcomes in chemotherapy patients with abnormal strain, abnormal strain in *non-cancer* populations is an independent predictor of cardiovascular morbidity and mortality [34, 35]. In addition to the 3D ejection fraction and strain imaging, there is emerging evidence on the role of additional indicators such as diastolic function and right heart assessment.

Historic guidelines advocated echocardiographic screening when a threshold dose of anthracycline had been reached; however, dose thresholds varied widely, therefore resulting in variance of screening practice [5, 21, 24]. Consensus guidelines recommend risk stratification for childhood cancer survivors according to the dose of anthracycline and radiotherapy. Accordingly, echocardiography should be considered every 2 and 5 years for those at high and moderate risk respectively [36]. In addition to cardiomyopathy, patients who have received radiation to the mediastinum are at risk of valvular disease. ESC guidelines recommend that asymptomatic patients who have received more than 15 Gy mean heart dose or combination therapy of more than 5 Gy mean heart dose and 100 mg/m^2 doxorubicin equivalent have an echocardiogram at 5-yearly intervals after treatment [4].

In 2020, the HFA, the European Association of Cardiovascular Imaging (EACVI) and the Cardio-Oncology Council of the ESC called for the development of treatment algorithms for all patients receiving anthracycline and HER2 therapies to inform clinical practice [37]. The following year, the British Society of Echocardiography (BSE) and British Cardio-Oncology Society (BCOS) provided targeted imaging surveillance protocols for use during cancer treatment [38].

Cardiac Magnetic Resonance Imaging (MRI)

As the gold standard for function and volumetric assessment, cardiac MRI offers an alternative imaging modality, especially for patients with poor-quality images. Mapping techniques and MRI-derived strain imaging may offer additional imaging biomarkers of cardiotoxicity in the future [39–41]. Early decreases in T1 times after an initial anthracycline dose were found by Muehlberg et al. to predict the subsequent cardiotoxicity in 30 patients treated for sarcoma [40]. Conversely, Jordan et al. showed that a late increase in T1 times may predict cardiotoxicity, reflective of interstitial fibrosis [39]; however, such techniques are in an early phase of investigation. MRI, whilst being the gold standard for evaluating myocardial function and volumes, remains expensive and not widely available, and is therefore recommended when echocardiographic imaging is suboptimal [38].

HFA-ICOS Risk Stratification Tool

This HFA–ICOS tool risk stratifies patients based on their cardiovascular history, cardiovascular risk profile, previous chemotherapy and baseline imaging/biomarker status (see Fig. 1) [5]. This risk categorization enables decisions regarding cardiology input, cancer therapeutic strategy and use of cardioprotective agents. In high and very high risk patients, minimizing the use of cardiotoxic agents is advised where possible, along with the initiation and use of specific chemotherapeutic cardioprotective agents, such as dexrazoxane and liposomal anthracyclines, alongside cardioprotective agents, for example angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, beta blockers and statins. Cardiovascular disease and modifiable risk factors should be treated as outlined within the guidelines [4].

The first year post cancer therapy is believed to be of particular importance in cardiotoxicity surveillance. Research by Cardinale et al. noted that the majority (98%) of cardiotoxicity occurs within this first year (median follow-up 5.2 years) [10]. In addition, for a patient group considered to be relatively treatment resistant, early initiation of treatment was frequently found to be associated with recovery of cardiac function. At the end of treatment, repeat risk

stratification should consider the treatment strategy along with the dose used and biomarker and imaging data, in addition to baseline risk.

Due to the high rates of early cardiotoxicity, risk stratification should be repeated at 1 year post treatment and repeated 5-yearly until end of life. In addition, due to the elevated risk of proximal coronary artery disease, patients who have received high-dose radiotherapy may be considered for non-invasive coronary artery disease surveillance at 5- to 10-year intervals [4].

There is no safe dose of anthracycline therapy, and every cancer survivor, regardless of age at treatment, who has received potentially cardiotoxic treatment should have an annual clinical review that includes a cardiovascular risk factor assessment [4].

Regarding childhood cancer survivors, it is important to remember that a 'developing' heart is at particular risk of toxicity, which sometimes occurs decades after the initial treatment. Lifelong surveillance of children who undergo cancer treatment should be considered. Moderate risk patients should be considered for echocardiographic screening at least every 5 years and high risk patients should be screened at least every 2 years [36]. The ESC use anthracycline and radiotherapy dose alone to classify childhood cancer survivor (CCS) risk (see treatment risk factors in Fig. 1); however, other risk calculators exist, such as those developed from the Childhood Cancer Survivor Study (CCSS) data (N = 22,643) and validated in additional multinational childhood cancer cohorts (https://ccss.stjude.org/cvcalc) [4, 42]. Similar to the HFA-ICOS proforma, this risk calculator incorporates treatment strategy, demographics, and traditional cardiovascular risk factors; however, it is only validated for patients currently aged below 40 years [42]. Each point of contact offers an opportunity for patient education, lifestyle education and management of risk factors, which are fundamental to optimal patient care.

CARDIOPROTECTIVE TREATMENT

The early initiation of cardioprotective medication is particularly important as recovery in myocardial function appears to be limited and temporary in patients with established cardiomyopathy [43, 44]. There is evidence from several small, randomized control trials suggesting that angiotensin-converting-enzyme inhibitors (ACEi), angiotensin receptor blockers (ARB), or selected beta blockers (BBs, such as carvedilol and nebivolol) administered during anthracycline chemotherapy (with or without subsequent trastuzumab treatment) can reduce the risk of significant left ventricular dysfunction during follow-up [4, 15, 45]. A period of subclinical cardiotoxicity often precedes overt cardiotoxicity, providing an important opportunity to introduce cardioprotective medications. As with all patients with HF, evidence-based medication (including ACEi and BB) can be initiated at a low dose in the acute phase. At a later stage, patients should be reviewed and uptitrated to optimal tolerated doses, with additional renin-angiotensin-aldosterone therapies added [6].

CANCER PATIENTS AND EXERCISE REHABILITATION

A central component of cardiac rehabilitation programmes for patients with HF is exercise training. Acknowledged in a class 1, level A recommendation within recent European HF guidelines, the benefits of exercise are well known: it improves cardiovascular reserve capacity, leading to concomitant reductions in cardiovascular morbidity, symptoms and quality of life [6, 46]. Patients presenting with HF following cancer treatment experience similar effectiveness [47, 48]. Exercise training can improve the patient's functional capacity, reliably assessed by measuring peak oxygen consumption (VO_2max) [49, 51]. However, improved functional capacity can also be identified by reduction in the patient's heart rate [47] or performance in a 6 minute walking test [52]. Evidence is commonly related

to breast cancer, colorectal cancer, lung resection, some leukaemias and lymphomas [52–55]. The recently published Breast Cancer Randomized Exercise Intervention study (BREXIT) included 104 females, with results concluding that exercise training can improve VO_2peak and cardiac reserve [56]. Finally, in an observational study conducted by Williamson et al., the 361 patients who completed a 12-week exercise-based cardiac rehabilitation programme experienced an improvement in their cardiorespiratory fitness and survival [57]. This emphasizes the need for improved access to and support for patients with HF and cancer from multidisciplinary cardio-oncology teams.

Exercise prior to [58] or after a cancer diagnosis, both during the chemotherapy period [48, 59] and in the following weeks [47, 49], was associated with preventing cardiovascular disease, including HF and coronary heart disease [51]. Tsai et al. conducted a feasibility study of a home-based and clinic-based exercise intervention. Results found the intervention to be safe, with adherence and satisfaction improving when it was provided in the patient's home [49]. Further longitudinal studies are warranted [60]; however, for many patients, exercise can ameliorate the functionality lost as a side-effect of cancer itself (such as sarcopenia and cachexia) and as a result of cardiotoxicity [61–63].

Aerobic exercise training at a moderate intensity performed at least 3 to 4 times a week for 30–45 min appears to be the best type and quantity to improve patients' functional capacity [49, 50, 53, 54]. Supervised exercise training is the most common delivery; however, home-based training can provide equally good results [49, 54]. Some studies indicate the inclusion of strength training to improve patients' muscle mass during and after chemotherapy [52, 64, 65]. Other studies, mainly including patients with breast cancer, found that high-intensity interval training (HIIT) had positive results [66, 67]; however, further supportive studies are needed. Finally, in a systematic review and meta-analysis of 33 studies, Chen et al. concluded the potential benefit of tai chi in improving physical ability in patients with four chronic conditions, one of which was HF [68].

As stated for other populations of patients, exercise training for cancer patients must be individualized [69] and take account of the patient's previous history of exercise, their current fitness state, and their motivation and preferences.

CONTRIBUTION OF CARDIO-ONCOLOGY SERVICES

In recognition of the interplay between cardiovascular disease and cancer treatments, specialized cardio-oncology services have emerged with a view to providing an integrated multidisciplinary approach to cancer patients at risk of cardiotoxicity. The primary goal of cardio-oncology services is to deliver potentially life-saving cancer therapies whilst mitigating cardiovascular disease risk and the provision of cardioprotective agents [70].

The scope of cardio-oncology services is wide ranging, including the prevention and early identification of cardiotoxicity, timely cardiovascular risk factor modification, serial monitoring with imaging and/or biomarkers, and the provision of evidence-based medical therapy for existing or emerging cardiovascular disease [4]. Lancellotti et al. outlined that the central tenets of cardio-oncology service are expert specialized multidisciplinary teams (including medical and radiation oncologists, haematologists, cardiologists, and specialized nurses) collaborating within a partnership network using established referral pathways, care protocols, effective communication tools and administrative resources [71]. This is described visually in Fig. 2. Unfortunately, the availability and structure of current cardio-oncology services remain globally diverse [71, 72], which can be attributed to limited organizational structures and competence of professionals to manage cardiovascular issues that arise in cancer patients. This can ultimately lead to poorer health outcomes for patients [73–75].

Nevertheless, the benefits of a dedicated cardio-oncology service have been reported by studies conducted in Italy and the United Kingdom [76, 77]. Collaboration among cardiology and oncology specialists is integral prior

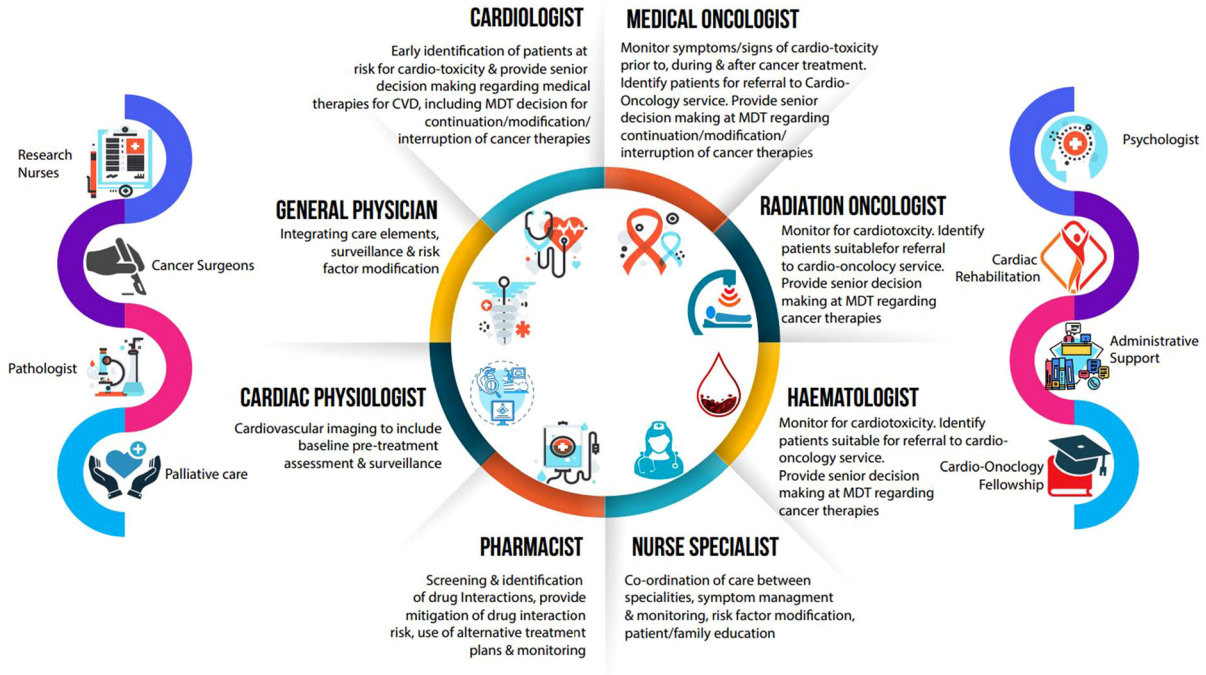


Fig. 2 Specialized multidisciplinary teams embedded within the cardio-oncology service

to the delivery of any cancer therapy to enable early recognition, management, support and optimal care of cardiac toxicity [78–80]. Patients emphasized the need for more personalized care and multi-disciplinary collaboration to ensure more tailored and holistic care [74, 80, 81].

An interpretative qualitative study conducted by White et al. [82] involved 15 patients who attended a newly established cardio-oncology clinic in a large regional city in Australia. The aim of the study was to explore the patients' perceptions of cardio-oncology services and the impact of such a service on an integrated approach to care. The study found that access to a cardio-oncology service promoted feelings of personalized patient-centred care and improved patients' understanding of the association between cancer treatment and cardiotoxicity. In contrast, some patients reported difficulty prioritizing cardiovascular risk factor modification (weight management, diet, alcohol, engaging in physical activity) during their cancer treatment as limited education and support were received from healthcare professionals. The findings from this study underline the need for the development of dedicated cardio-oncology rehabilitation programmes [4].

OPTIMIZING PATIENT-REPORTED OUTCOMES

Several recent publications have focused on the importance of health-related quality of life (HR-QoL) for patients living with both a cancer and HF diagnosis [80, 83]. In general, perceived HR-QoL can vary according to the time the assessment was carried out (prior to diagnosis, patient undergoing treatment or as a cancer survivor), the unique symptoms (functional, psychological, or social) as well as the priorities of each patient. However, a variety of instruments have been used to assess quality of life in this cohort of patients, ranging from the EQ-5D to the SF-36 and the European Organization for the Research and Treatment of Cancer Quality-of-Life Questionnaire C30 (QLQ-C30 or QLQ) [84]. Harrison et al. carried out a population study in America, recruiting females aged > 65 years with a history of breast cancer. The authors reported that those who developed HF showed

an impairment in all HR-QOL domains (SF-36 instrument) and a resultant negative impact on daily activities. Additional analysis found that those females who had a HF and cancer diagnosis experienced more physical HR-QOL deficits across all cancer stages and mental HR-QOL deficits in females specifically with stage I/II cancer. Of particular interest was that females at an earlier stage of the cancer journey experienced the worst impact on HR-QOL associated with a diagnosis of HF [85].

Regular patient self-assessment and reporting of HR- QoL status can significantly improve physical and mental well-being, reduce emergency room visits, and extend mean survival in patients with solid tumours [83]. Notably, barriers such as a lack of knowledge by health professionals and misconceptions that cardiac monitoring is not a necessity in oncology patients delayed cancer treatment, adversely affecting patients' cardiac surveillance and HR-QoL [74]. The development and validation of a specific patient-reported outcome tool to assess quality of life is urgently required. Furthermore, a multidisciplinary team of physicians and nurse practitioners working across cardiology and oncology specialisms should aim to integrate short- and long-term follow-up appointments, enabling a holistic care approach that enhances patients' physical, spiritual, and psychosocial well-being [81].

CONCLUSION

The increasing global prevalence of cancer and likelihood of HF make the early identification and risk stratification of patients a clinical priority. Tools such as the HFA-ICOS tool have been developed to prompt tailored cancer therapies and early initiation of cardioprotective agents. Patient information and support is required to promote self-management and improve health-related quality of life. This would best be facilitated within a cardio-oncology clinic, enabling short- and long-term follow-up of this vulnerable cohort of patients.

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Compliance with Ethics Guidelines. This article is based on previously conducted studies and does not contain any new studies with human participants or animals performed by any of the authors.

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