

FEATURE ARTICLE

# Cardiac Toxicity Related to Cancer Treatment

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Cardiac toxicity is a dose-limiting toxicity that may occur during treatment or as a late effect of therapy. Chemotherapy, radiation therapy (RT), biotherapy, and targeted therapy contribute to cardiovascular compromise that can result in cardiomyopathy, congestive heart failure (CHF), dysrhythmias, and myocardial ischemia. Advances in treatment using limited multiagent chemotherapy and reduced volume of radiation treatment to the heart contribute to minimizing late cardiac toxicity. However, cardiac toxicity remains a cause of major morbidity and mortality among childhood, adolescent, and some adult cancer survivors (Chronowski et al., 2003; Donaldson, Hancock, & Hoppe, 1999; Mertens et al., 2001).

Data from the Childhood Cancer Survivors Study indicate that childhood and adolescent cancer survivors who lived more than five years after treatment were 8.8 times more likely to die from cardiac-related events (Mertens et al., 2001). Adults who receive high-dose chemotherapy for breast cancer or lymphoma and standard treatment for non-small cell lung cancer, as well as women who receive treatment for advanced breast cancer, also may experience cardiac dysfunction following treatment. Given the growing number of long-term cancer survivors, nurses must be informed about the potential for treatment-induced cardiotoxicity. This article reviews cardiotoxic treatments, signs and symptoms of cardiotoxicity, cardioprotective measures, and clinical implications.

Cardiac toxicity is a dose-limiting toxicity that may occur during cancer treatment or several years after therapy ends. Cardiac toxicity may be caused by chemotherapy, biotherapy, and radiation therapy and may result in cardiomyopathy, congestive heart failure, dysrhythmias, and myocardial ischemia. The risk for developing cardiac toxicity varies based on type of treatment, patient age, presence of preexisting or concurrent heart disease, and concomitant treatment. Patients at high risk require careful evaluation and monitoring during and in the years following therapy to detect cardiac changes. Fortunately, cardioprotective agents and newer radiation therapy techniques decrease the risk for treatment-related cardiac toxicity. Oncology nurses can become more informed in the assessment of cardiac toxicity and can arm themselves with knowledge about early identification of symptoms as well as specific agents and treatments that increase risk for cardiac toxicity.

**Key Words:** cardiotoxin, anthracyclines, radiotherapy

treatment that damage myocytes (cells of the myocardium). This damage leads to loss of myocardial contractility and eventual cell death (Hochster, Wasserheit, & Speyer, 1995; Shan, Lincoff, & Young, 1996; Speyer & Freedberg, 2000). Recent evidence indicates that oxidative stress and mitochondrial dysfunction also may be key factors in the pathogenic process (Santos, Moreno, Leino, Froberg, & Wallace, 2002).

Although acute anthracycline-induced toxicity is rare (Shan et al., 1996), chronic conditions such as cardiomyopathy and CHF may develop over time and may be severe. Thomas, Le, and Fiere (2002) described three long-term survivors of acute promyelocytic leukemia who developed anthracycline-induced CHF that required cardiac transplantation.

Doxorubicin has been the most widely studied cardiotoxic agent in adult and pediatric patients. Daunorubicin, an agent primarily used in treating acute leukemia, has a cardiotoxic risk profile similar to doxorubicin. However, epirubicin and idarubicin, analogs similar to doxorubicin, are associated with cardiac toxicity to a lesser degree than doxorubicin.

## Chemotherapy-Induced Cardiac Toxicity

Anthracyclines, alkylating agents, 5-fluorouracil (5-FU), and paclitaxel are the drugs most often associated with cardiac toxicity. These agents are associated with cardiomyopathy, CHF, dysrhythmias, and myocardial ischemia.

## Anthracyclines

Anthracyclines are used to treat a variety of cancers and are the agents most widely associated with irreversible cardiomyopathy. Cardiotoxicity is thought to result from the release of free radicals during

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