Chemotherapy on the Heart: The Process of Chemotherapy-Induced Cardiotoxicity

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BACKGROUND
Chemotherapy is a primary method of cancer treatment that causes a number of detrimental side effects.1 The process of chemotherapy aims to modify the mechanism of cancer cell production and metabolism, which simultaneously modifies the processes of healthy cell production and metabolism. Chemotherapy affects cardiomyocyte function leading to type 1 and type 2 chemotherapy-induced cardiotoxicity.2 The cardiotoxic effects have been known to cause complications involving ischemia, hypertension, cardiomyopathy, and arrhythmias.2,3

PURPOSE
1. Understand the short and long term effects of chemotherapy on the heart.
2. Review the current strategies for improving the heart under chemotherapy-induced cardiotoxicity.

EFFECTS
Chemotherapy-induced cardiotoxicity is defined as a decrease in left ventricular ejection fraction (LVEF) by 5-55% in patients with symptoms of heart failure, or a decrease in LVEF of 10-55% in asymptomatic patients.1 Type 1 chemotherapy-induced cardiotoxicity is non-reversible due to the structural transformations that take place within the cardiac cells.2 The main theory behind type 1 chemotherapy-induced cardiotoxicity is high levels of oxidative stress that lead to damaged cardiac mitochondria which cannot be repaired.1,2 Type 2 chemotherapy-induced cardiotoxicity differs from type 1 in that it is reversible once chemotherapy is stopped.2 Type 2 chemotherapy-induced cardiotoxicity is caused by drugs such as trastuzumab or bevacizumab, which negatively affect endothelial function rather than cardiomyocyte structure.2

CURRENT STRATEGIES
Medical Therapy
• Primary methods of treating type 1 chemotherapy-induced cardiotoxicity include the use of ACE-inhibitors or beta-blockers.2
• ACE-inhibitors were shown to improve left ventricular systolic function in breast cancer patients.5
• Beta-blockers were shown to improve LVEF to >50% in 42% of cancer patients.6
• Type 2 chemotherapy-induced cardiotoxicity is typically not treated, as the cardiotoxic symptoms stop with the cessation of chemotherapy administration.2

Exercise + Medical Therapy
• Randomized controlled trials involving exercise during cancer treatment increase the likelihood of disease-free and progression-free survival along with reduced circulating tumor cells, and show a reduction in the risk of cardiovascular morbidity.7
• After 12 weeks of supervised rehab, aerobic capacity increased by 10-23%; muscular strength improved by 24-40%, and mental health scores improved significantly in cancer survivors.7

CONCLUSION
• As a growing number of patients continue to survive cancer, the growing population of survivors must learn how to cope with the intense side effects of such powerful pharmacotherapy.
• ACE-inhibitors and beta-blockers have shown to be successful in improving symptoms of heart failure in those with type 1 chemotherapy-induced cardiotoxicity.2
• Symptoms of type 2 chemotherapy-induced cardiotoxicity can only improve after cessation of chemotherapy in order for the cardiac myocytes to return to a healthier state.2
• Regular supervised exercise has shown to increase aerobic capacity and muscular strength in cancer patients, improving treatment and survival outcomes.7
• Further research is necessary in order to seek out preventative methods to avoid and/or slow the cardiotoxic effects of chemotherapy on the heart before or while undergoing chemotherapy.

REFERENCES

Figure 1: 4