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]

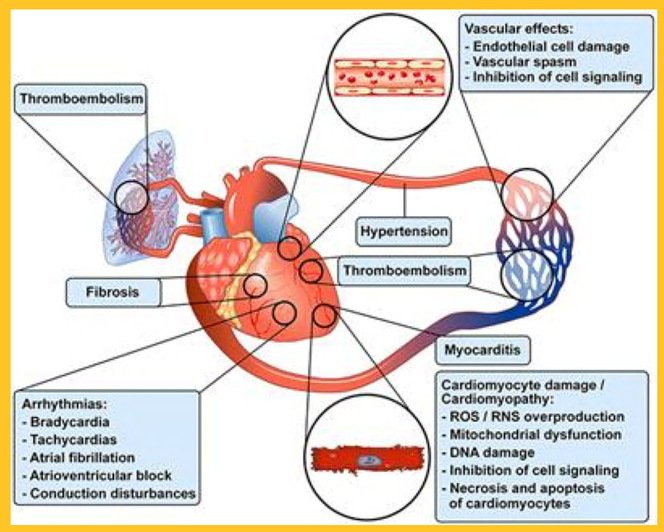

Figure 1: 4

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.

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