

General recommendation
CAYA cancer survivors treated with anthracyclines, chest RT, or both (high-quality evidence), and their health care providers should be aware of the risk of cardiomyopathy (strong recommendation).
Who needs cardiomyopathy surveillance?
<i>Anthracyclines and/or mitoxantrone (as doxorubicin equivalent dose) alone</i>
Cardiomyopathy surveillance is recommended for CAYA cancer survivors treated with high dose (≥ 250 mg/m ²) anthracyclines (high-quality evidence, strong recommendation)
Cardiomyopathy surveillance is reasonable for CAYA cancer survivors treated with moderate dose (≥ 100 to < 250 mg/m ²) anthracyclines (high-quality evidence, moderate recommendation).
Cardiomyopathy surveillance is not recommended for survivors treated with low dose (< 100 mg/m ²) anthracyclines (high-quality evidence, strong recommendation).
<i>Chest-directed radiotherapy alone</i>
Cardiomyopathy surveillance is recommended for CAYA cancer survivors treated with high dose (≥ 30 Gy) chest RT (high-quality evidence, strong recommendation).
Cardiomyopathy surveillance is reasonable for CAYA cancer survivors treated with moderate dose (≥ 15 to < 30 Gy) chest RT (high-quality evidence, moderate recommendation).
Cardiomyopathy surveillance is not recommended for CAYA cancer survivors treated with low dose (< 15 Gy) chest RT with conventional fractionation (high-quality evidence, strong recommendation).
<i>Anthracyclines and chest-directed radiotherapy</i>
Cardiomyopathy surveillance is recommended for CAYA cancer survivors treated with moderate to high dose anthracyclines (≥ 100 mg/m ²) and moderate to high dose chest RT (≥ 15 Gy) (high-quality evidence, strong recommendation).
<i>Dexrazoxane</i>
No recommendation can be formulated to change cardiomyopathy surveillance in CAYA cancer survivors who received dexrazoxane cardioprotection with anthracycline administration (low-quality evidence).
<i>Pregnancy</i>
Cardiomyopathy surveillance is reasonable before pregnancy or in the first trimester for all female CAYA survivors treated with anthracyclines or chest RT (moderate-quality evidence, moderate recommendation).
Continuing cardiomyopathy surveillance is reasonable during pregnancy for female CAYA survivors treated with anthracyclines or chest RT who had a history of prior left ventricular systolic dysfunction that has resolved even in the presence of a normal baseline ejection fraction in the first trimester (moderate-quality evidence, moderate recommendation).
<i>Genetic variants</i>
No recommendation can be formulated for cardiomyopathy surveillance in CAYA cancer survivors carrying a genetic variant that increases or decreases the risk of developing cardiomyopathy (low-quality evidence).
What surveillance modality should be used?
Left-ventricular ejection fraction measured with 2D or 3D echocardiography is recommended as the primary cardiomyopathy surveillance modality for assessment of left-ventricular systolic function in CAYA cancer survivors treated with anthracyclines or chest RT (moderate-quality evidence, strong recommendation).
Cardiac magnetic resonance imaging may be reasonable for cardiomyopathy surveillance in at-risk CAYA cancer survivors for whom echocardiography is not technically feasible or optimal (expert opinion, moderate recommendation).
Assessment of cardiac blood biomarkers (e.g., natriuretic peptides) in conjunction with imaging studies may be reasonable in instances where symptomatic cardiomyopathy is strongly suspected or

in CAYA cancer survivors who have borderline cardiac function during primary surveillance (expert opinion, moderate recommendation).

Assessment of cardiac blood biomarkers (e.g., natriuretic peptides and troponins) is not recommended as the only strategy for cardiomyopathy surveillance in at-risk CAYA survivors (low- to moderate-quality evidence, strong recommendation).

At what frequency should cardiomyopathy surveillance be performed?

High-risk CAYA cancer survivors

Cardiomyopathy surveillance is recommended for high-risk CAYA cancer survivors to begin no later than 2 years after completion of cardiotoxic therapy and continued every 2 years thereafter (moderate-quality evidence, strong recommendation).

Lifelong cardiomyopathy surveillance is reasonable for high-risk CAYA cancer survivors (expert opinion, moderate recommendation).

Moderate-risk CAYA cancer survivors

Cardiomyopathy surveillance is reasonable for moderate-risk CAYA survivors to begin no later than 2 years after completion of cardiotoxic therapy, repeated at 5 years after diagnosis, and continue every 5 years thereafter (low-quality evidence, moderate recommendation).

Lifelong cardiomyopathy surveillance is reasonable for moderate-risk CAYA cancer survivors (expert opinion, moderate recommendation).

Low-risk CAYA cancer survivors

Cardiomyopathy surveillance is not recommended in low-risk CAYA cancer survivors (moderate-quality evidence).

What should be done when abnormalities are identified?

Cardiology consultation is recommended for CAYA survivors with asymptomatic left-ventricular systolic or diastolic dysfunction** following treatment with anthracyclines or chest RT (expert opinion, strong recommendations).

Treatment with heart failure medications (e.g. ACE inhibitors, ARBs, beta-blockers) is recommended in CAYA cancer survivors with asymptomatic left-ventricular ejection fraction <40%, according to guidelines from the general population (low- to high-quality evidence in the general population, strong recommendation).

No recommendations can be formulated about treatment with heart failure medications in CAYA cancer survivors with asymptomatic borderline cardiac function (left-ventricular ejection fraction between 40% and the upper limit of normal) (no studies in CAYA cancer survivors, no evidence in the general population).

Advice regarding physical activity and modifiable cardiovascular risk factors

Cardiology consultation is recommended for CAYA survivors with asymptomatic cardiomyopathy to define limits and precautions for exercise (expert opinion, strong recommendation).

Cardiology consultation is reasonable for high-risk CAYA survivors who plan to participate in high intensity exercise to define limits and precautions for physical activity (expert opinion, moderate recommendation).

Screening for and management of modifiable cardiovascular risk factors (hypertension, diabetes, dyslipidemia, obesity, smoking, alcohol intake) is recommended for all CAYA survivors treated with anthracyclines or chest RT to help avert the risk of symptomatic cardiomyopathy (evidence-based guidelines, strong recommendation).

*LV systolic and diastolic dysfunction as defined by the American Society of Echocardiography (ASE) and the European Association of Cardiovascular Imaging (EACVI) (Appendix D).

Abbreviations: 3D=three-dimensional; 2D=two-dimensional; ACE=angiotensin converting enzyme; ARB=angiotensin receptor blocker; CAYA=childhood, adolescent and young adult; chest RT=chest-directed radiotherapy.

Green representing a strong recommendation with low degree of uncertainty; Yellow representing a moderate recommendation representing a higher degree of uncertainty; Red representing a strong recommendation not to do.

Publication

Ehrhardt MJ, Leerink JM, Mulder RL, Mavinkurve-Groothuis A, Kok W, Nohria A, Nathan PC, Merx R, de Baat E, Asogwa OA, Skinner R, Wallace H, Lieke Feijen EAM, de Ville de Goyet M, Prasad M, Bárdi E, Pavasovic V, van der Pal H, Fresneau B, Demoor-Goldschmidt C, Hennewig U, Steinberger J, Plummer C, Chen MH, Teske AJ, Haddy N, van Dalen EC, Constine LS, Chow EJ, Levitt G, Hudson MM, Kremer LCM, Armenian SH. Systematic review and updated recommendations for cardiomyopathy surveillance for survivors of childhood, adolescent, and young adult cancer from the International Late Effects of Childhood Cancer Guideline Harmonization Group. *Lancet Oncol.* 2023;24(3):e108-e120.