Title

SCAI expert consensus statement: Evaluation, management, and special considerations of cardio-oncology patients in the cardiac catheterization laboratory (Endorsed by the Cardiological Society of India, and Sociedad Latino Americana de Cardiologıa In...

Journal

Catheterization and cardiovascular interventions : official journal of the Society for Cardiac Angiography & Interventions, 87(5)

ISSN

1522-726X

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Publication Date

2016-04-23

Peer reviewed

Original Studies

SCAI Expert Consensus Statement—Executive Summary Evaluation, Management, and Special Considerations of Cardio-Oncology Patients in the Cardiac Catheterization Laboratory

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In the United States alone, there are currently approximately 14.5 million cancer survivors, and this number is expected to increase to 20 million by 2020. Cancer therapies can cause significant injury to the vasculature, resulting in angina, acute coronary syndromes (ACS), stroke, critical limb ischemia, arrhythmias, and heart failure, independently from the direct myocardial or pericardial damage from the malignancy itself. Consequently, the need for invasive evaluation and management in the cardiac catheterization laboratory (CCL) for such patients has been increasing. In recognition of the need for a document on special considerations for cancer patients in the CCL, the Society for Cardiovascular Angiography and Interventions (SCAI) commissioned a consensus group to provide recommendations based on the published medical literature and on the expertise of operators with accumulated experience in the cardiac catheterization of cancer patients.

Key words: catheterization; diagnostic; stent thrombosis; stent restenosis; right heart catheterization; percutaneous coronary intervention; complex PCI; percutaneous coronary intervention

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Conflict of interest: Neither myself nor any of your co-authors have a conflict of interest.

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Received 9 November 2015; Revision accepted 28 November 2015

DOI: 10.1002/ccd.26375
Published online 00 Month 2015 in Wiley Online Library (wileyonlinelibrary.com)

INTRODUCTION

Advances in cancer therapy have resulted in a steady decline in cancer-related mortality since 1990s. In the United States alone, there are currently approximately 14.5 million cancer survivors, and this number is expected to increase to 20 million by 2020. In view of these trends, as well as the cardiovascular toxicity potential of radiation and chemotherapy, cancer patients are exposed to cardiovascular morbidity and mortality more than ever before, thus generating the call for "onco-cardiology" or "cardio-oncology." The American College of Cardiology (ACC) recognized cardio-oncology as one of the "top cardiology stories for 2014," and several healthcare institutions have founded onco-cardiology/cardio-oncology departments and fellowship training programs focusing on these issues.

Anticancer therapies can cause significant injury to the vasculature, resulting in angina, acute coronary syndromes (ACS), stroke, critical limb ischemia, arrhythmias, and heart failure, independently from the direct myocardial or pericardial damage that might occur. Moreover, cancer is generally associated with a hypercoagulable state, which increases the risk of acute thrombotic events. Consequently, the need for invasive evaluation and management in the cardiac catheterization laboratory (CCL) for such patients has been increasing. Unfortunately, there are few data on this patient population because cancer patients have been excluded from national percutaneous coronary intervention (PCI) registries and most randomized PCI trials.

In recognition of the need for a document on special considerations for cancer patients in the CCL, the Society for Cardiovascular Angiography and Interventions (SCAI) commissioned a consensus group to define the landscape and to provide recommendations (level of evidence C) based on the published medical literature and on the expertise of operators with accumulated experience in the cardiac catheterization of cancer patients. As this document is focused on diagnostic and interventional CCL considerations, chemotherapy- and radiotherapy-induced myocardial dysfunction will not be extensively covered.

CARDIOVASCULAR SCREENING RECOMMENDATIONS FOR CANCER PATIENTS ON CHEMOTHERAPY OR RADIATION THERAPY

- Recommended screening of cancer patients on chemotherapy or radiation therapy is outlined in Figures 1 and 2.

CARDIOVASCULAR SCREENING RECOMMENDATIONS FOR CANCER SURVIVORS

- Referral to a survivorship center/cardio-oncology program is recommended for cancer survivors who are not being actively followed by hematology/oncologist.
- Medical record documentation of the patient's chemotherapy and radiotherapy treatment course with cumulative doses should be retrieved.
- Transthoracic echocardiography (TTE) should be performed on patients with a history of significant anthracycline dose exposure (>240 mg/m^2) or chest radiation exposure (>30 Gy) starting no later than 2 years after completion of therapy, at 5 years after diagnosis, and continued every 5 years thereafter.
- In high-risk groups (known coronary artery disease, age >60, one or more CV risk factors), screening after chest radiation therapy should be initiated 2 years after radiation therapy as outlined in Figure 2.
- Coronary angiography is indicated for patients with a history of radiotherapy, risk factors for RIHD, and noninvasive testing (i.e., stress MPI/echo/MRI, CCTA) that suggest a high likelihood of severe ischemic heart disease.
- Coronary angiography is reasonable to consider for the evaluation of LV systolic dysfunction after chest radiation and to evaluate for radiation-induced ischemic heart disease.
- Right- and left-heart catheterization is reasonable to evaluate the presence of pericardial constriction and restrictive cardiomyopathy if noninvasive imaging (echocardiography, CT, MR) is insufficient to provide a diagnosis.
- Right- and/or left-heart catheterization and coronary angiography is reasonable to perform as per ACC/AHA guidelines for preoperative planning for patients with severe RIHD.
- There is a known association between accelerated coronary artery disease and elevated cardiovascular events and mortality after chest radiation, particularly in high-risk populations such as those with Hodgkin's lymphoma who have undergone mantle field radiation. For these patients, functional imaging and/or coronary artery calcium scoring/CCTA is reasonable to perform ≥ 5 years postradiotherapy, and further workups (e.g., coronary angiography, functional testing) is indicated for risk stratification if there is concern for severe ischemic heart disease.

SPECIAL CONSIDERATIONS FOR CANCER PATIENTS WITH THROMBOCYTOPENIA UNDERGOING CARDIAC CATHETERIZATION

- There is no minimum platelet count to perform a diagnostic coronary angiogram.

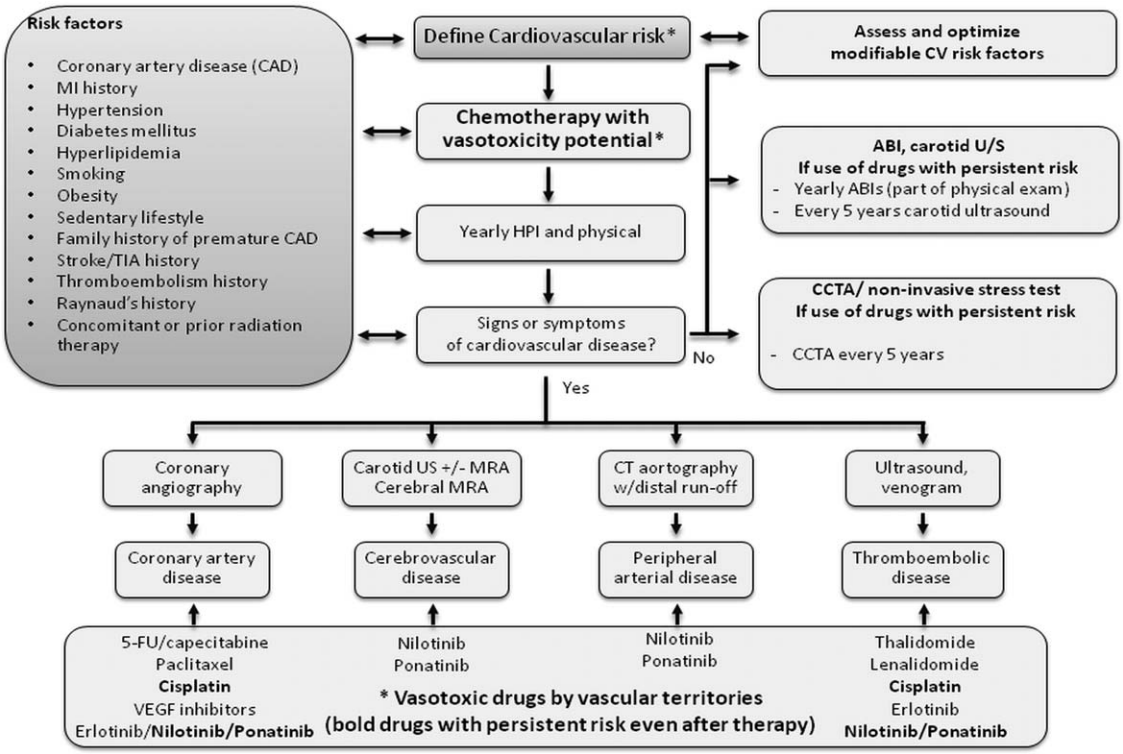

Fig. 1. Suggested SCAI algorithm for the cardiovascular screening of patients on chemotherapy. HPI: history of present illness; TIA: transient ischemic attack; ABI: ankle-brachial index; U/S: ultrasound; CCTA: cardiac computed tomography angiography. *Pivotal to the sequence is the determination of baseline cardiac risk, including presence of ischemic heart disease, history of myocardial infarction, cardiovascular risk factor profile, and calculated atherosclerotic cardiovascular disease risk, e.g., AHA/ACC ASCVD risk calculator, Framingham risk score, or ESC Score. *Pivotal to the sequence is the determination of baseline cardiac risk, including presence of ischemic heart disease, history of myocardial infarction, cardiovascular risk factor profile, and calculated 10 year atherosclerotic cardiovascular disease (ASCVD) risk (http://tools.cardiosource.org/ASCVD-Risk-Estimator/), which remain the cohorts at highest risk for overall and early (<5 years) presentation of acute coronary events during follow-up; if established IHD/CAD or 10-year ASCVD risk ≥5.0% and/or patient >60 years, consider further testing and treatment (moderate-high-intensity statin) to define the burden of disease prior to radiation therapy. **Potential sequelae of radiation therapy to the head/neck and abdomen/pelvis should also be assessed as outlined in Table 2 of the main consensus statement document.

- Prophylactic platelet transfusion is not recommended in patients undergoing cardiac catheterization with thrombocytopenia, unless recommended by the oncology/hematology team for one of the following indications:
  a. Platelet count <20,000/ml and one of the following: (a) high fever, (b) leukocytosis, (c) rapid fall in platelet count, and (d) other coagulation abnormality.
  b. Platelet count <20,000/ml in solid tumor patients receiving therapy for bladder, gynecologic, or colorectal tumors, melanoma or necrotic tumors.
- Therapeutic platelet transfusions are recommended in thrombocytopenic patients who develop bleeding during or after cardiac catheterization.
- Repeat platelet counts are recommended after platelet transfusions.
- 30–50 U/kg unfractionated heparin is the initial recommended dose for thrombocytopenic patients undergoing PCI who have platelets <50,000/ml. ACT should be monitored.
- For platelet counts <30,000/ml, revascularization and DAPT should be decided after a preliminary multidisciplinary evaluation (interventional cardiology/oncology/hematology) and a risk/benefit analysis.
- Aspirin may be used when platelet counts are >10,000/ml.
- DAPT with clopidogrel may be used when platelet counts are 30,000–50,000/ml. Prasugrel, ticagrelor, and IIB-IIIA inhibitors should not be used in patients with platelet counts <50,000.
- If platelet counts are <50,000, the duration of DAPT may be restricted to 2 weeks following PTCA alone,

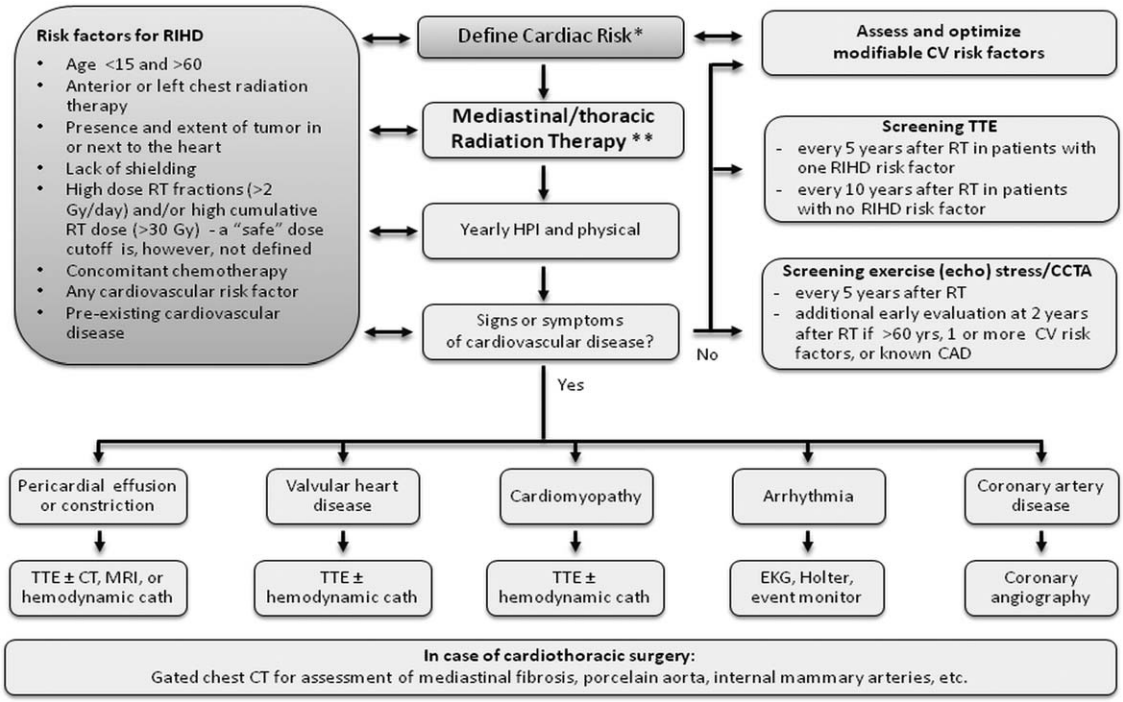

Fig. 2. Suggested SCAI algorithm for the cardiovascular screening of patients on radiation therapy. RIHD: radiation-induced heart disease; HPI: history of present illness; TTE: transthoracic echocardiogram; CCTA: cardiac computed tomography angiography; EKG: electrocardiogram; RT: radiation therapy.

4 weeks after bare-metal stent (BMS), and 6 months after second or third generation drug-eluting stents (DES) if optimal stent expansion was confirmed by IVUS or OCT in low-risk patients of stent thrombosis and high risk of bleeding.
- There is no minimum platelet count to perform a diagnostic coronary angiogram.

ACCESS CONSIDERATIONS FOR CANCER PATIENTS UNDERGOING CARDIAC CATHETERIZATION

- For cancer patients who are excellent candidates for both access types, the radial artery is preferred.
- Femoral access is the preferred approach for cancer patients on hemodialysis, those with abnormal Allen's tests in both arms, multiple radial procedures, or a-lines, bilateral mastectomy or when a complex intervention is anticipated.
- The use of smaller sheath sizes, prompt removal of sheaths, and early ambulation is recommended.
- A lower dose of intra-arterial or intravenous unfractionated heparin at a dose of 50 u/kg or 3,000 units is recommended for cancer patients with thrombocytopenia and platelet count <50 k undergoing cardiac catheterization via radial access.
- A femoral angiogram is recommended after transfemoral access to promptly identify and address potential access complications.

SPECIAL CONSIDERATIONS FOR CANCER PATIENTS UNDERGOING CARDIAC CATHETERIZATION FOR CAD

- Decision making regarding revascularization in patients with active cancer must take into consideration the overall prognosis of the patient.
- For cancer patients with an acceptable prognosis, the general revascularization criteria for appropriate use must be carefully evaluated and only the most appropriate indications (scores 7 and above) should be considered.
- For cancer patients with an expected survival <1 year, percutaneous revascularization may be considered for patients with acute STEMI and high-risk NSTEMI. For patients with stable angina, every effort must be made to maximally optimize medical therapy before resorting to an invasive strategy. This approach must include addressing other cancer-related comorbidities that potentially exacerbate ischemia, such as anemia, infection, hypoxia, and so on. Should the patient continue to experience persistently severe angina (Class III

or IV), consideration may be given to percutaneous revascularization as a palliative option.
- FFR is recommended before nonurgent PCI to justify the need for revascularization.
- When invasive approach is indicated:
  - Balloon angioplasty should be considered for cancer patients who are not candidates for DAPT (platelets <30,000/ml) or when a noncardiac procedure or surgery is necessary as soon as possible.
  - BMS should be considered for patients with platelet counts >30,000/ml who need a noncardiac procedure, surgery, or chemotherapy which can be postponed for >4 weeks.
  - Newer generation DES should be considered for patients with platelet counts >30,000/ml who are not in immediate need for a noncardiac procedure, surgery, or chemotherapy.
  - Bivalirudin and/or radial approach should be considered to minimize the risk of bleeding.
- Postintervention.
- Intravascular imaging such as IVUS or optical coherence tomography (OCT) is recommended after stent placement to ensure optimal expansion and an absence of complications given the potential for early DAPT interruption.

INDICATIONS FOR NONCORONARY INTEVENTIONAL PROCEDURES IN CANCER PATIENTS

- Right-heart catheterization: Evaluation of heart failure, constrictive or restrictive cardiomyopathy, valvular heart disease, pulmonary hypertension, and pericardial disease.
- Endomyocardial biopsy: Evaluation of intracardiac tumors, unexplained heart failure associated with suspected anthracycline cardiomyopathy, infiltrative cardiomyopathies, and myocarditis.
- Pericardiocentesis: Evaluation of pericardial effusion and symptomatic relief.
- Balloon pericardiotomy: Prevention of large malignant pericardial effusion, especially in poor surgical candidates.
- Balloon aortic valvuloplasty and TAVR: Palliative measure for symptomatic AS (or as a bridge for SAVR/TAVR).

CONCLUSION

The cardio-oncology patient population has been increasing in recent years, with better quality of life and improved survival rates. Invasive cardiac assessment is important for the evaluation and management of concomitant heart disease. This SCAI consensus document aims to indicate special considerations to be addressed by interventional cardiologists when managing this frail patient subgroup. Collaboration between cardiologists and hematologists/oncologists is of prime importance. Further research involving cancer patients is also needed to optimize the care of oncology patients in the cardiac catheterization laboratory.