

## **Radiation Heart Disease**

Announcer: Welcome to the Mayo Clinic Cardiovascular Continuing Medical Education podcast. Join us each week to discuss the most pressing topics in cardiology and gain valuable insights that can be directly applied to your practice.

Dr. Bell: I'd like to welcome our viewers and our listeners, to another in our series of Interviews with the Experts. And I'm very pleased today, to have my colleague, Dr. Juan Crestanello, who is the Chair of Cardiovascular Surgery, here at Mayo Clinic, Rochester and a Professor of Surgery. And he's here to discuss, you know a very important topic and one that is a devastating cardiac disease, particularly found in younger patients, who've had radiation therapy. So we're here to talk about radiation heart disease. So welcome, Juan.

Dr. Crestanello: Thank you, Malcolm.

Dr. Bell: You know, I think maybe just to set the scene here. We know that radiation to the chest is used to various, you know tumors and particularly the ones, that we're concerned about, are in that sort of mediastinal area. So, you know breast cancer and lymphomas, lung cancer, et cetera. But as I said, just to set the scene, maybe you could just briefly outline, what are the the most common manifestations, of radiation heart disease?

Dr. Crestanello: Well, as you probably say, radiation heart disease is one of the most devastating, cardiac conditions that we deal with. The patients who receive radiation to the chest, to treat mediastinal malignancies, they have all the mediastinal structures affected and particularly in terms of the heart, they develop pericarditis, constricted pericarditis. They develop coronary artery disease, they develop a valvular heart disease. They develop the radiation affects the myocardium, leading to non-ischemic cardiomyopathy and restricted cardiomyopathy. They also develop a conduction of abnormalities, as well as calcifications of the ascending aorta and other vessels. And in addition to that, the radiation not only affect, the mediastinal structures, but also can affect the lungs, leading to pulmonary problems, that increase the risk of the surgery.

Dr. Bell: So before we get into the details of, you know how you evaluate these patients? In particular how you treat them? In these patients I mean, typically, what is the latency between the radiation and the development of the cardiac consequences, of that radiation? And does it happen in a particular order? I mean, is it coronary disease? Is it the myocardium pericardium? What's your experience and observations of how it presents and when it presents?

Dr. Crestanello: Well, that's a very good question. This normally, there's a big latency, between the mediastinal standard radiation and the development of a radiation induced heart disease. It usually, it is in the 20 to 30 year range. And now we're seeing patients, who receive radiations in the 60s and 70s and early 80s, at that time, the techniques of mediastinal radiation, were not as sophisticated as they are now. They didn't use a targeted radiation, isolating the heart from the radiation field and they use much larger doses of radiation, than what is it is used now. And it was very effective on treating the malignancy, but led to significant side effects in the heart. And this is slow smoldering process, that over 20 to 30 years or sometimes longer, developed and lead to the radiation heart disease. And in terms of what's first, normally the coronary artery

disease, is the initial manifestation of radiation heart disease and valvular heart disease and pericardial disease occurs at a later stage.

Dr. Bell: So I think you mentioned some important points there, particularly about the increasing sophistication, of delivering, you know x-ray therapy, to these patients with malignancy. And I suspect that, you know, it's probably fair to say that over the last few decades, it's been getting safer and safer and hopefully in the future, you know, we'll see this, you know, these cardiac manifestations, you know, much less frequently. But keeping that in mind then, are we seeing less radiation induced cardiac disease today, than we might have you know, 10 or 15 years ago with respect to that? And then secondly, are there risk factors, of patients your who even today, having radiation therapy who might be at higher risk, of having cardiac disease as a result of that treatment?

Dr. Crestanello: Yeah, well the question in terms of the incidence and prevalence of radiation heart diseases, is really hard to answer exactly, because patients are living longer and patients who had radiation, for treatment of their malignancy in the 70s are, you know most of them are still alive and they're getting into the 50s and 60s and 70s and are presenting with the radiation heart disease now. I suspected as the radiation techniques improve, 20 to 30 years from now, we're not gonna see as many patients, with radiation heart disease that we see now. In terms of the risk factors, the young age, the presence of older cardiovascular risk factors, like atherosclerosis or hypertension, hypercholesterolemia, et cetera, are risk factors for developing of radiation, heart disease. The larger dose of radiation, the radiation that is delivered in an AP direction, not tangential to the heart and concomitant chemotherapy with cardiotoxic drugs, are also risk factors, for the developing of radiation heart disease.

Dr. Bell: Yeah in fact the chemotherapy would be a, you know a double insult of course. And in, of course in these patients, I mean the treatment that they've received, that radiation therapy and chemotherapy, in most cases has been you know, lifesaving, in those patients. And we often think about, you know the propensity to have second tumors, you know, in the future. But cardiac disease is what we're here to talk about today. And as I said at the beginning, can really be a devastating, you know, illness. So let's just think about this. I mean, pretty much every cardiac structure, I mean, you talked about it, you know, the pericardium, the myocardium, the valves, the arteries, the conduction system are all at risk. And then of course, you can have concomitant lung disease and chest wall inflammation and scarring which obviously very important to the surgeon, if they come along and operate later. But maybe just, you know, walk us through the various parts of the heart, that are affected. So let's just start with the coronary arteries. So in patients who have radiation induced coronary disease, how do you distinguish that, from typical garden variety atherosclerosis? And maybe as you answered that, you know, what is the role for your PCI and then particularly for surgery, in terms of arterial revascularization? So let's just focus on the coronaries first.

Dr. Crestanello: Well, in terms of the coronary artery disease, the prevalence of the disease depends or the localization of the disease, depends on the the way that the radiation was delivered. And in general, the areas that are closer or the arteries that are closer, to the front of the chest, which if the radiation was delivering an AP direction, is the ones that are affected more permanently. And therefore the right coronary artery, the LAD and the left main, usually they

have a higher incidence of disease, as in patients with, radiation induced coronary artery disease. In terms of how to decide what to do or how to treat these patients. The decision processes is the same as in patients, who don't have they have, garden variety coronary artery disease and it's based on the extension of their disease, the technical aspects in terms of the suitability, for PCI, the size of the distal targets, the availability of conduits, the overall presence of comorbidities and age of the patients and the life expectancy and other risk factors, that we normally use to make the determination, whether to proceed with a PCI, versus surgery on patients with coronary artery disease.

Dr. Bell: Is there a way of assessing, the health of the mammary artery? I mean, obviously this is key for successful outcomes, long-term outcomes for surgical revascularization.

Dr. Crestanello: Yeah, sometimes it is important, that's an a very important consideration, as we all know, the mammary artery is the best conduit, that we have for revascularization and really provide the greater benefit from bypass surgery. And if that's, sometimes that can be affected, by the radiation since it's located, in the anterior chest wall. So it is important, to make sure that the mammary artery is patent and we use a CT angiogram, in order to determine that. The CT angiogram also provides information, about the calcification of other heart structures, like the ascendant aorta and help us, to plant the operation. And it's not uncommon to have, the calcifications in other areas of the mediastinal, particularly on patients who had Hodgkin's or non-Hodgki'n disease where all these lymph nodes, after the radiation becomes calcified.

Dr. Bell: Well, let's talk about the valves. Which valves are most commonly involved? And again how do you assess that, in terms of are they suitable for repair? Do they need to be replaced? And if they replaced your, what type of prosthesis, is it gonna be a bioprosthetic valve or mechanical?

Dr. Crestanello: Yeah, so the, again the anterior location of the valves, is basically will determine, the prevalence of the affection of those valves. So the aortic and the mitral valve, are the most common valves affected in patients, with radiation heart disease. And they have this particular type of involvement, which is the calcification of the intervalvular fibrosa. And that's something that we, it is very commonly seen on patients, with radiation heart disease and often requiring the replacement of both valves and even the performance of a big operation, which is called a commander operation, where we have to resect the whole continuity, between the aortic valve and the mitral and the general leaflet of the mitral valve and resect and reconstruct all that, that makes the operation more challenging and technically complex. In terms of the repair versus replacement and the choice of the valve bioprosthesis, versus mechanical valve. So normally we repair the mitral valve and to a lesser degree, we are starting now to do a more and more, aortic valve repairs. These patients in general for the mitral, for the aortic valve, they present in general with stenosis, with retraction of the leaflets. And therefore repair is not advisable. For the mitral valve, we have a study that extensively and we have demonstrated that the repair, we lose the survival advantage of repair, over replacement on of the mitral valve, on patients with radiation heart disease. For patients who have no radiation heart disease, repair over replacement, for degenerative mitral valve disease, is associated with a survival advantage, as well as freedom from re-operation. However, that survival advantage is lost, on patients with radiation heart disease, of the mitral valves. So normally would recommend to replace the mitral valve, rather

than repair it. And in terms of the type of valve, these patient's life expectancy is compromised, because of the heart disease, as well the other systemic problems, that the patients may have. And if you compare the outcomes, of patients who had a garden variety mitral valve disease or coronary artery disease or mitral valve disease or a combination of all. With patients who had the same degree of disease, with induced by radiation, the long-term survival of the radiation patients is worse, than similar disease similar cardiac disease, in patients who had no radiation. So in general because of those, that compromise long-term survival of those patients, we tend to recommend tissue valves, at the younger age, than what we normally do in other patients.

Dr. Bell: I see. So just in the last couple of minutes here. When you're faced with a patient, you know who needs surgical revascularization, valve replacement, sometimes this may need to be done concomitantly. We haven't talked about restrictive cardiomyopathies and you know, the pericardial, you know disease you know, in this session in any detail. But could you maybe just summarize them, what your approach is to the evaluation of these patients? How extensive is that you know, in preparing the patient and yourself and your team for the surgery is? Do you go above and beyond what you typically would do, for valvular disease, for example, in a non radiation induced cardiac disease? So just that preoperative workup is really, what I think our listeners and viewers, would like to hear about.

Dr. Crestanello: Well in addition to the standard workup, that include echocardiogram and coronary angiogram. We always ask for our CT of the chest. And that has several purposes. Number one, evaluate the patency of the mammary artery, in case that we are gonna do coronary vascularization. Number two, evaluate the calcifications, of the ascending aorta and that allowed us to determine, the ability of cross clamp or cannulate the aorta. And also the CT provides us information, in terms of the calcification of the pericardium or other mediastinal structures. We also on the echocardiogram, we wanna pay a particularly attention, to any evidence of restrictive cardiomyopathy and more importantly, to any evidence of constricted cardiomyopathy. And it's not unusual, that on patients with who had previous radiation and even if they don't have evidence of constriction, at the time of the surgery, we normally do at least an anterior pericardiectomy, to prevent constrictions down the road, because one of the one is not uncommon, that after surgery these patients will, over time develop a constricted pericarditis. And the re-operations on patients, with previous radiation heart disease and previous cardiac surgery, are really are probably the highest risk operations, that we do.

Dr. Bell: What's your threshold for doing, you know, so-called your prophylactic pericardiectomy, in your terms of a full pericardiectomy, in patients who may not have any obvious avert signs, of constricted pericarditis at a time of surgery?

Dr. Crestanello: Well we don't do the full radical pericardiectomy, that we do on patients, who had constricted pericarditis prophylactically. But we do the anterior pericardiectomy, where we remove the anterior pericardium, from phrenic to phrenic. And that prevents, or we believe that, it prevents the developing of, constricted pericarditis in the future.

Dr. Bell: And then finally, Juan, you know when we think about this disease, I mean it could obviously affects, can affect all the structures of the heart and the surrounding organs. I mean the lungs and the chest wall. And you've already emphasized, you know, the risks of your re-

operation and in such a patient, who may be facing the prospect of your re-operation or, you know progression of disease, you know, that only manifests itself after surgery maybe, you know, a few years after surgery. Is transplantation ever an option in these patients? You're assuming that, you're that in an appropriate age range?

Dr. Crestanello: Yes, transplantation is a good solution, particular for those patients, who had had previous operations and they have developed now a restrictive cardiomyopathy or very substantial valve disease, that they have no options for or coronary artery disease and they have no options for conventional treatment, yes.

Dr. Bell: So Juan, thank you so much, you know, for sharing your knowledge and experience, in what we've described as a very devastating, you know cardiac condition, that we said you may also involve the lungs and with a hostile chest. So I'm sure our viewers and listeners, have really gained a lot from listening to you today. So thank you so much, for taking the time to be with us today.

Dr. Crestanello: Thank you, thank you Malcolm and thank you for listening.

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