Radiation Oncology Consultants

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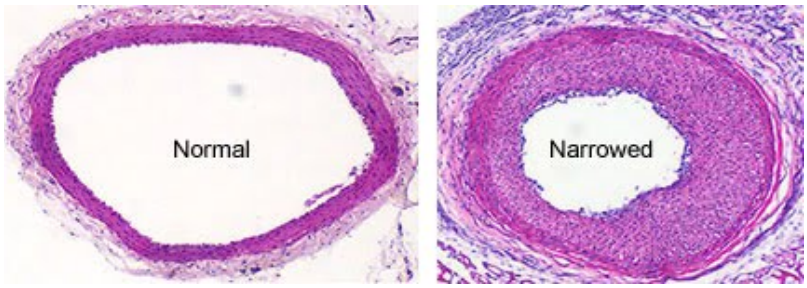
Cardiac Intravascular Brachytherapy (IVB) in Management of Coronary Artery In-Stent Restenosis

For over a century, radiation has been successfully utilized in the management of malignant diseases. Radiation treatment can be administered in various forms, such as externally aimed beams, liquid intravenous injections, as well as with the placement of temporary or permanent implantable sources.

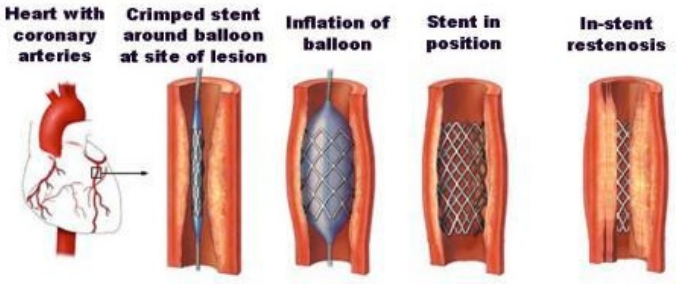
Over the years, through various initial anecdotal reports later confirmed by research, radiation treatment has also been found effective in the management of a variety of benign illnesses. Afflictions that have a component of scar tissue formation as a main pathology pathway have been clinically proven to be impacted by radiation treatment. Examples of this model include prevention of keloid formation of the skin, and prophylaxis of heterotopic ossification after orthopedic surgeries or joint-related trauma. Coronary Artery In-Stent Restenosis is another example of a benign affliction that can be prevented with the judicious use of temporarily placed radioactive sources (brachytherapy) into the affected artery.

In-stent restenosis is a condition that originates from neointimal hyperplasia of the vascular lining of a coronary artery as a result of the physical trauma induced by the placement of a vascular stent after coronary angioplasty. This results in progressive occlusion of the affected vessel, not from atherosclerosis, but from scar tissue developing within the stented region.



A clinical example would include a patient with coronary artery disease presenting with chest pain and undergoes coronary angiography, and is found to have atherosclerosis of a coronary artery resulting in greater than 90% occlusion of the vessel, which necessitates balloon angioplasty followed by placement of a vascular stent to maintain adequate flow. Research supports that this patient is at risk for stenosis within the vascular stent (Hehrlein 1998) as a result of the development of scar tissue from the natural

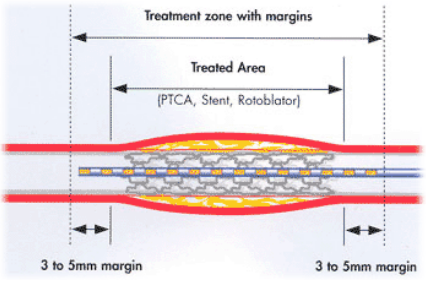
healing process of the vascular intimal lining in the region of the stent, and would manifest as future episodes of chest pain necessitating repeat coronary angiography.



Medication-eluting stents have been developed and are now commonly utilized, but have still found to be susceptible to stenosis (Alfonso 2009, Maluenda 2012). This scar tissue can be managed by repeat balloon angioplasty, but once in-stent stenosis is diagnosed, research indicates that repeat stenosis rates are as high as 40-60% within 1 year (Weinberger 1997, French 2002), resulting in additional repeat angiographies, angioplasties, and possibly ultimately requiring coronary artery bypass graft surgery. Intravascular Brachytherapy at the time of restenosis has been shown to reduce restenosis recurrence by 50%, to rates of 20-30% (Massullo 1996, Teirstein 1998, Waksman 2000), and can thereby stabilize cardiac health and prevent or delay further procedures that would be required to address future vascular occlusion.

IVB is administered in the cardiac catheterization lab operative suite, at the time of coronary angiography. It is delivered by the combined efforts of the Interventional Cardiology and Radiation Oncology teams. Good triage and communication between the teams and departments is paramount, as proper patient selection, consultation, and informed consent is needed. When anticipated in-stent restenosis is confirmed, the radiation oncology team is called into the operative suite. The restenotic site is ameliorated with standard angioplasty techniques, and a specialized catheter is introduced though the now opened region of stenosis within the stent. Based on the physical anatomic dimensions of the affected artery, such as length of stenotic involvement and diameter of the vessel wall, the Interventional Cardiologist and Radiation Oncologist assess, discuss and agree on the required treatment length, and ultimately on the radiation dose to be delivered. This decision is with the guidance of the Medical Physicist, who is in attendance, and is integral in the calibration, calculation and maintenance of the radiation delivery equipment. After all decisions and calculations have been made and verified, a specialized radiation delivery device housing a string of radioactive sources is attached to the previously placed catheter, and a hydraulic mechanism allows the radioactive sources to be advanced to the end of the catheter.

The radioactive source train can be visualized and digitally imaged, documenting accurate positioning for treatment of the site of in-stent restenosis. The source train remains in place for a time calculated to administer the appropriate radiation dose (usually < 5 minutes), after which the sources are retracted back into the housing device and the device is disconnected from the patient. Radiation Safety procedures are strictly followed from start to finish to ensure patient and staff safety, avoiding misadministration. The cardiac catheterization procedure then continues to completion as usual, and the patient is seen in routine follow up by the cardiology team.



Acute side effects from IVB are rare, due to the localized dose delivery within the stent. Long-term radiation risks from this procedure are unusual, but can rarely include localized vascular injury; also, some evidence indicates a delayed but continued stenotic process despite treatment (Viachojannis 2010). However, with a dedicated collaborative Interventional Cardiology and Radiation Oncology team, the potential benefits of Cardiac Intravascular Brachytherapy are significant in the prevention of cardiac in-stent restenosis in selected patients. Physicians with Radiation Oncology Consultants, Ltd. have been providing Cardiac IVB since 1997.

To learn more about Cardiac IVB in management of coronary artery in-stent restenosis, please contact Martin J. Boyer, D.O. at AMITA Alexian Brothers Medical Center, 847-981-5760.