Pathologic Identification of Foreign Materials Associated with Cardiovascular Interventional Devices

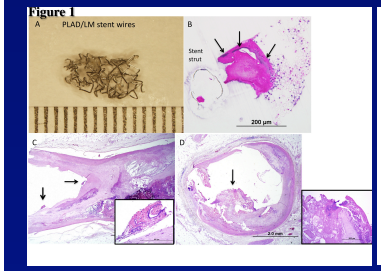
Elena Ladich MD, Naima Carter-Monroe MD, Frank Kolodgie PhD, Michelle Olson MS, Renu Virmani MD
CVPath, Institute Inc, Gaithersburg MD,

Background: Foreign materials associated with cardiovascular interventions include metals and wires, polymers for drug delivery, hydrogel coatings, plastic sheaths, and gauze. Complications associated with embolization of foreign materials have been previously reported (Mehta RI et al., Mod Pathol 2010; 7: 921-30 and Fealey ME et al., Am J Surg Pathol 2008; 9: 1310-6). Herein we describe some pathologic consequences associated with dislodgement and embolization of foreign materials observed in preclinical studies and in human autopsy material. Histopathologic reactions to embolized foreign materials associated with cardiovascular procedures may be under-reported.

Methods: Our laboratory processes a large number of cardiovascular devices in various locations such as coronary arteries, peripheral vasculature, myocardium and other organs. Autopsy case records as well as preclinical studies performed by our laboratory were searched for histopathologic reactions to embolized foreign materials. Multiple sections of distal myocardium and organs were taken to determine the presence or absence of emboli. Histologic evaluation was based on H&E and Movat stained paraffin sections as well as plastic sections stained with toluidine blue/ basic fuchsin. Scanning electron microscopy (SEM) and Fourier transform infrared spectroscopy (FTIR) were performed in select cases to elucidate the composition of the foreign material.

Results: A variety of foreign materials were identified in vascular, myocardial and organ sections following cardiac interventions 1) Fragments of hydrogel were seen in small intramyocardial arteries following coronary stenting (case 1). In addition, hydrogel fragments were identified at autopsy within the cavernous sinus of a carotid artery with a cerebral coil implant (case 2) 2) Plastic fragments, presumably originating from the introducer sheath were identified in myocardial sections associated with granulomatous inflammation 3) Dislodged fragments of stent polymer were found adjacent to struts eliciting a granulomatous reaction as well as within distal myocardium and confirmed on SEM (case 3) 4) Myocardial sections showed small polarizable fragments consistent with cotton fibers (confirmed by FTIR) surrounded by granulomatous inflammation and giant cells (case 4) .

Case 1) 58 year old man with stents implanted in LAD and proximal LCX. Multiple guidewires were used during the procedure.



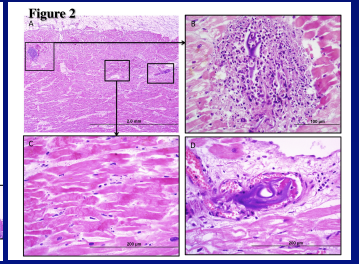
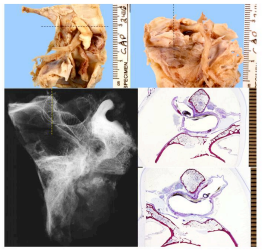
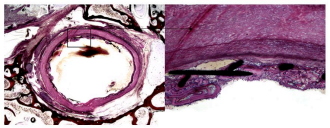


Figure 1A) PLAD stent B) Histologic section with basophilic material (hydrogel) in thrombus C, D) Thrombus with hydrogel in calcified vessel
Figure 2 Histologic sections show hydrogel fragments within small vessels surrounded by neutrophils and macrophages and acute contraction bands.

Case 2 75 year old man with 25 x 5 mm Pipeline Neuroendovascular stent within the cavernous sinus portion of the internal carotid artery

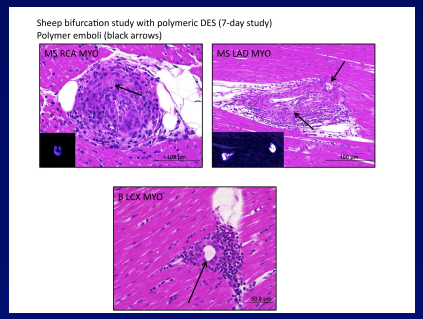


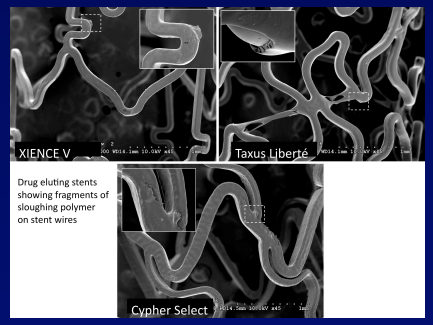


Embolized foreign material consistent with Hydrogel within cavernous sinus portion of internal carotid artery

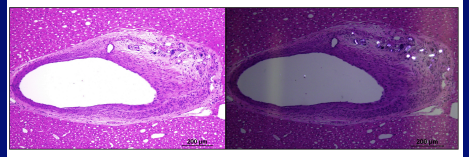
Superior and sagittal views of left internal carotid artery aneurysm. Faxitron X-ray in sagittal plane with dotted line indicating coronal plane of section; whole mount Exakt sections of stented artery and aneurysm

Case 3





Example of intra-myocardial vessel with Birefringent Foreign Material and surrounding inflammation



Case 4 Yukatan mini swine implanted with coronary stents of 90 day duration. H&E stained myocardial sections showed birefringent foreign material. Cellulose particles identified in tissue cross sections on FTIR analysis matched gauze samples from catheter system.

Conclusion—Coronary and peripheral arterial interventions produce morphologic changes that are influenced by the procedure or device used. In approaching such cases, the pathologist must be knowledgeable about the devices and delivery systems used and the potential for foreign materials associated with these technologies to embolize. Special studies such as scanning electron microscopy and spectroscopy may be required to elucidate the composition of foreign materials.