Foreign Body Granulomatous Change from Absorbable Gelatin Sponge and Microcoil Embolization after a Guidewire-induced Perforation in the Distal Coronary Artery

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Abstract

We report an autopsy case of treatment by absorbable gelatin sponge and microcoil embolization after perforation of the distal coronary artery by guidewire. Histological examination revealed a foreign body granuloma in the coronary artery with embolization. Foreign body reaction to absorbable gelatin sponge seemed to be stronger than that to the microcoil.

Key words: gelatin sponge, complication, minicoil, pathology, percutaneous coronary intervention, perforation

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Introduction

Coronary artery perforation from percutaneous coronary intervention is a rare occurrence in 0.3-0.6% (1-4), but it may cause serious complications including cardiac tamponade, myocardial infarction, and so on.

Management of perforation at the dilatation site in larger vessels usually includes reversal of anticoagulation and intervention to seal the perforation with prolonged balloon, perfusion balloon inflation, autologous vein, or polytetrafluoroethylene (PTFE)-covered stents (5-7).

In the distal small coronary artery, embolization of alcohol foam (8), microcoil (9, 10) or absorbable gelatin sponge (11) is used to seal the perforation. However, there has been no report on the histological information on occlusion of the small coronary artery by microcoil and absorbable gelatin sponge embolization. We report here an autopsy case of guidewire-induced perforation, which was treated by absorbable gelatin sponge and microcoil embolization, in the distal coronary artery.

Case Report

An 82-year-old man was admitted to our hospital because he had congestive heart failure due to ischemic cardiomyopathy after the coronary artery bypass surgery from the left internal thoracic artery to the left anterior descending coronary artery for myocardial infarction. He had already been medicated with enalapril 2.5 mg, furosemide 80 mg, spironolactone 25 mg, carvedilol 1.25 mg, isosorbide mononitrate 40 mg, aspirin 100 mg, clopidogrel loading 75 mg, and atorvastatin 20 mg per day. He underwent elective percutaneous coronary intervention for chronic total occlusion of the right coronary artery (RCA) (Fig. 1A). A 7Fr MAC1 right guide catheter (Boston Scientific, Boston, MA) was engaged in RCA after administration of 5,000 units intra-arterial unfractionated heparin. The occlusion was crossed with a 0.014-inch Runthrough NS guidewire (Terumo, Tokyo). Dilatation was performed with an Ottimo Rosso balloon catheter (Japan Lifeline, Co., Ltd., Tokyo), followed by a Hiryu balloon catheter (Terumo). A 3.0×13 mm Cypher® drug-eluting stent (Cordis Corp., Bridgewater, NJ) was deployed into the mid-RCA, and a 4.0×12 mm...
Multi-link Vision stent (Abbott Vascular, Santa Clara, CA) was also deployed into the RCA proximal to the Cypher® drug-eluting stent, followed by dilatation with a Quantum balloon catheter (Boston Scientific). An intraarterial bolus with 5,000 units unfractionated heparin was given during the procedure.

Angiography then revealed TIMI grade 3 flow with extravasation of blood through the distal 4AV branch of RCA (Fig. 1B-1, 1B-2). Urgent transthoracic echocardiography (TTE) showed a mild pericardial effusion. Reversal of heparin with protamin was deferred.

Several pieces (approximately 2 mm in diameter) of Gel-foam® sponge (Pfizer Inc., New York, NY), absorbable gelatin sponge were soaked in contrast for 20 sec and injected through the catheter with contrast into the distal 4AV branch of RCA. However, the extravasation was not completely stopped. Therefore, a VortX 18 fibered platinum coil (Boston Scientific) was delivered through a 3 Fr ACROVA microcatheter (Japan Lifeline). Cease of extravasation was confirmed by angiography 15 minutes after the microcoil embolization (Fig. 1C-1, 1C-2).

The following day, TTE demonstrated a trivial residual pericardial effusion. Medication of aspirin and clopidogral were continued. Creatine kinase level was normal and there was no significant change of ECG. Repeated angiography also demonstrated the patent RCA stents without extravasation. The patient was discharged about one month after the coronary stent implantation.

However, he was admitted again because of congestive heart failure. He died of heart failure about 7 months after the coronary intervention. An autopsy was performed with the agreement of his family. The distal segment of 4AV branch with microcoil and gelatin sponge embolization was examined microscopically after the microcoil was removed. There was a granulation tissue with giant cells and mononuclear cell infiltration in the coronary artery (Fig. 2A, 2B). There were several pieces of small gelatin sponge surrounded by granulation tissues with giant cells and mononuclear cells (Fig. 2C, 2D). The spaces, in which the microcoil was present, were surrounded by endothelial cells and rod-shaped giant cells with fewer mononuclear cells (Fig. 2C).

**Discussion**

Although the mechanism of action is not fully understood, gelatin sponge can absorb up to 45 times its weight in whole blood and promotes hemostasis by forming an artificial clot and by providing a mechanical matrix that facilitates clotting (12). In the present case, gelatin sponge embolization was not able to cease the extravasation completely. This may have been related to the size of coronary artery because gelatin sponge embolization is suited for arteries with a small diameter (<1 mm) and the diameter of the perforated artery was about 1.5 mm.

Histological studies in rabbits have shown that gelatin sponge implanted intraperitoneally initially absorbs blood...
and becomes surrounded by an acute inflammatory reaction that is followed by infiltration of mononuclear and giant cells and fibrosis (13). In these animal studies, smaller pieces of sponge were absorbed by phagocytosis in 4-6 weeks (13). There has been no report on the histological study of gelatin sponge embolization into the human coronary artery. The present report demonstrated that the gelatin sponge is still present about 7 months after the procedure.

The previous histological study of other human tissues demonstrated that gelatin sponge induced foreign body granuloma formation in the brain 2 to 7 months after brain tumor operation (14), and it is similar to the histopathologic change of gelatin sponge treatment in the coronary artery in the present case. Trans-arterial gelatin sponge embolization, that was performed 14 days before surgical resection, produced granulomatous arteritis with massive infiltration by eosinophilic leukocytes and histiocytes for hepatic cavernous hemangioma (15). In the present case, there were giant cells and mononuclear cells surrounding the gelatin sponge pieces to make granulation tissue in the coronary artery although specific inflammation was not seen. These results suggest that a gelatin sponge usually induces a foreign body granuloma, and excessive reaction against the gelatin sponge may occur in special cases with allergic reaction.

On the other hand, the microcoil treatment for cerebral aneurysm revealed organized fibrous tissue with little inflammatory cellular reaction and neointima partially covering the coils in two cases at 2 weeks and 20 months after the procedure, respectively (16). In the present case, thin fibrous tissue and giant cells with a small inflammatory cellular reaction were recognized around the microcoil in the coronary artery. It is similar to the histopathologic change of minicoil treatment in cerebral aneurysm.

In the present case, we were able to compare the histopathologic changes between the reaction to the gelatin sponge and to the minicoil in the coronary artery. The findings indicated that there is less reaction for minicoil compared to gelatin sponge in the human coronary artery. Strong foreign
body reaction and chronic inflammation are possible to enhance granuloma formation, which may narrow the lumen of coronary artery proximal to the embolized small coronary artery or may prevent from recanalization after the seal of coronary perforation. Enhanced inflammation induced by gelatin sponge may provoke granulomatous arteritis that occludes the arterial lumen. Thus, in terms of foreign body reaction, microcoil embolization would be better than gelatin sponge embolization for the treatment of guidewire-induced perforation of the distal coronary artery. Further study is needed to elucidate the best materials for the cessation of guidewire-induced extravasation of the distal coronary artery during coronary intervention for a long period.

References