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Case Report

BioGlue® coronary embolism during open heart surgery

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ABSTRACT

In cases of iatrogenic coronary embolism during cardiac surgery or percutaneous coronary intervention, small air bubbles or foreign bodies are directly injected, which usually result in serious adverse events if not treated promptly. We herein describe the case of a patient who developed acute myocardial infarction resulting in shock due to BioGlue® (CryoLife, Atlanta, GA, USA)-induced coronary embolism during the surgical repair of aortic dissection and was treated for retrieval of the material using a thrombectomy catheter.

<**Learning objective:** Coronary embolism caused by surgical adhesives is a rare but potentially life-threatening complication. It is important for surgeons to promptly recognize and treat this serious condition in consultation with cardiologists.>

Introduction

Iatrogenic coronary embolism during invasive cardiovascular procedures usually results in serious adverse events if not treated promptly. BioGlue® (CryoLife, Atlanta, GA, USA) surgical adhesive is widely used to support the hemostasis of suture-lines, reinforce or strengthen fragile tissues, and adhere tissues in cardiovascular surgery [1]. Systemic embolism caused by BioGlue has been reported [2–4]. In this case report, we present the case of coronary embolism due to BioGlue during the surgical repair of aortic dissection in an 86-year-old woman.

Case report

An 86-year-old woman was referred to the internal medicine outpatient department of our hospital with a complaint of general malaise. She had a history of three episodes of cerebral infarction. A 12-lead electrocardiogram showed no ischemic changes. A chest X-ray revealed enlargement of an upper mediastinal shadow, suggesting aortic dissection. Echocardiography demonstrated preserved left ventricular contractions and a dilated aortic root without significant aortic regurgitation. Contrast-enhanced thoraco-abdominal computed tomography showed type A aortic dissection with a maximum length of the ascending aorta of 52 mm that began in the distal ascending aorta and ended in the sinotubular junction. The aortic arch and descending aorta did not appear to be involved. The patient underwent elective surgery to repair the aortic dissection within 1 month after admission. The ascending aorta was replaced with a prosthetic graft under cardiopulmonary bypass and deep hypothermic circulatory arrest using femoral artery and right atrium cannulation. The proximal and distal suture-lines were reinforced via the injection of BioGlue surgical adhesive in the false lumen, and the protruded BioGlue was carefully trimmed with covered wet gauze on the aortic valve cusps so as not to spill the fragments of BioGlue into the true lumen. Prosthetic graft replacement of the ascending aorta was performed using 4-0 prolene sutures. During rewarming, the patient developed shock following the discontinuation of cardiopulmonary bypass. She was returned to the coronary care unit with an inserted intra-aortic balloon (IABP) because she did not respond to inotropic support. A 12-lead ECG showed ST-segment elevation in the precordial leads, and echocardiography demonstrated an anteroseptal wall motion abnormality. Surgeons diagnosed her with acute myocardial infarction and consulted cardiologists for coronary angiography. The patient underwent urgent coronary angiography, which revealed abrupt occlusions in the proximal

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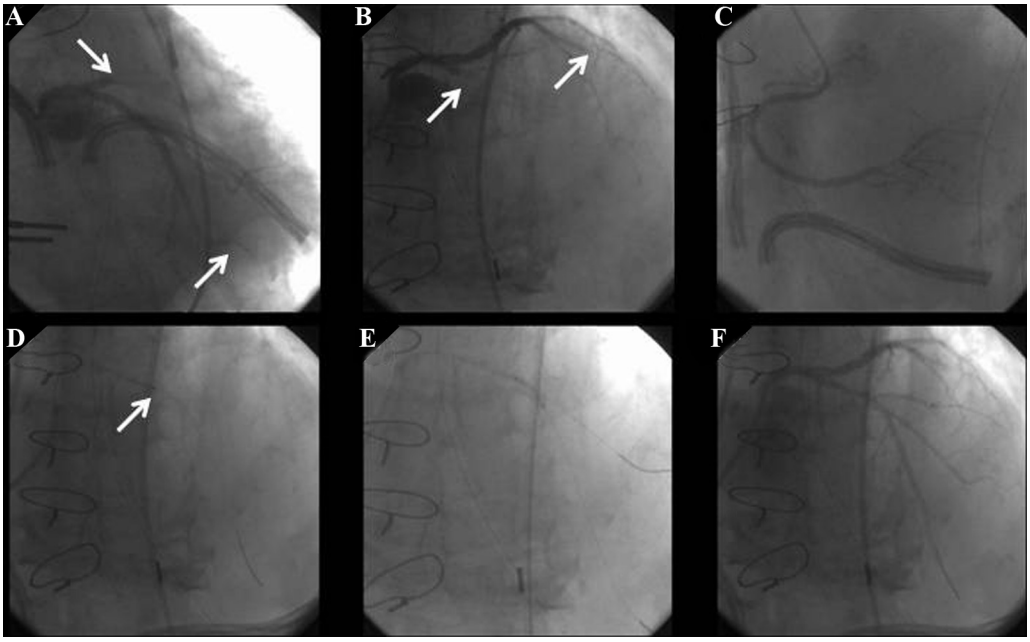

Fig. 1. Diagnostic coronary angiography showing abrupt occlusion (arrows) in the proximal LAD and distal left circumflex artery with no collateral vessels (A–C). Coronary aspiration via a thrombectomy catheter was performed (the arrowhead indicates the tip of the thrombectomy catheter) (D). The middle portion of the LAD was inflated with a 2.0 mm × 12 mm balloon (MINI TREK®, Abbott Vascular, Abbott Park, IL, USA) (E). Final coronary angiography showed successful reperfusion of the LAD (F).

portion of the left anterior descending coronary artery (LAD) and the distal portion of the left circumflex artery caused by possible thrombi, with no significant collateral vessels (Fig. 1A–C, Video 1). A 6-Fr Judkins-type catheter was inserted via the femoral artery approach into the left coronary artery. A 0.014-in. floppy guidewire (Runthrough NS Floppy®, Terumo Corp., Tokyo, Japan) was advanced into the LAD, easily crossing the distal LAD. We immediately performed thrombus aspiration with a thrombectomy catheter (Fig. 1D, Eliminate™, Terumo Clinical Supply, Gifu, Japan) and retrieved a tiny amount of material (Fig. 2A); however, the thrombus was not completely removed. Following aspiration, blood pressure was observed to increase and the patient recovered from the cardiogenic shock. Coronary angiography after aspiration revealed the presence of moderate stenosis in the middle portion of the LAD. Another 0.014-inch guidewire (Neo's Rinato, Asahi Intecc Co, Aichi, Japan) was inserted into the diagonal branch of the LAD to avoid the occluded branch, then an additional balloon angioplasty with a 2.0 mm × 12 mm balloon (MINI TREK®, Abbott Vascular, Abbott Park, IL, USA) for the mid-LAD was performed at 8 atm (Fig. 1E). Final coronary angiography demonstrated successful reperfusion of the LAD (Fig. 1F, Video 2, thrombolysis in myocardial infarction flow grade 3). Histologic examinations revealed that no atherosclerotic components, such as cholesterol or foam cells, were present in the embolic materials (Fig. 2B) and they were consistent with histologic specimens of BioGlue (Fig. 2C). As a result, the removed material was confirmed to be possibly fragments of the BioGlue that had been used to repair the aortic dissection. Subsequently, the patient's creatine kinase (CK) level rose to 5787 U/L, CK-MB level rose to 421 U/L and Q waves developed in the precordial leads. Although broad anteroseptal wall motion abnormalities with a reduced left ventricular ejection fraction (34%) remained, IABP was withdrawn on the fifth postoperative day, and the patient's hemodynamics gradually stabilized. Subsequently, other surgical procedures, including the treatment of a strangulated femoral hernia and left hip fracture, were performed during hospitalization, and the patient was discharged on foot 7 months after the open-heart surgery.

Fig. 2. The retrieved embolic materials (A) measuring approximately the size of the tip of an 18-gauge needle. The histologic specimens of the embolic materials (B) revealed no atherosclerotic components and were consistent with histologic specimens of BioGlue® (C) (hematoxylin and eosin staining, original magnification 100×).

Discussion

The coronary embolism leading to myocardial infarction has been recognized to be an uncommon entity exhibiting normal coronary findings since Virchow first reported the condition in 1856. The prevalence of coronary embolism was 5.2% among patients identified to have myocardial infarction on postmortem coronary angiography [5]. Coronary embolism occurs infrequently as the coronary arteries have unique anatomical features, including (a) a smaller caliber than that of the aorta, (b) right angle emergence inside the sinuses of Valsalva, and (c) protection of the coronary ostium by aortic valve cusps against the aortic jet during systole, and physiological features, such as (d) the bulk and swiftness of the aortic blood current around the coronary ostium and (e) the filling blood of the coronary arteries during diastole [6]. On the other hand, in cases of iatrogenic coronary embolism during invasive cardiovascular procedures, small air bubbles or foreign bodies are directly injected.

BioGlue, one of the surgical adhesives, is a biological protein matrix consisting of 45% bovine serum albumin and 10% glutaraldehyde mixed within the delivery tip, which is believed by surgeons to facilitate the support of suture-lines for hemostasis, reinforce fragile tissues, and adhere such tissues [1]. However, some reports have described complications of systemic embolism caused by BioGlue [2–4]. There are two previous cases of BioGlue-induced coronary embolism that occurred within a few days after the surgical repair of aortic dissection: one was an autopsy case in which embolism due to surgical adhesive were identified in the right and left coronary arteries [3], and the other involved a patient with acute coronary syndrome treated with stent deployment in the middle LAD [4]. To the best of our knowledge, this is the first report of the successful retrieval of BioGlue leading to coronary embolism using a thrombectomy catheter in which the material was confirmed to be BioGlue based on histologic examinations conducted during the patient's life. The use of aspirating coronary embolic materials with a thrombectomy catheter has been reported, whereas this procedure can potentially be complicated by systemic embolism [7]. Therefore, cardiologists must take care not to dislodge the retrieved materials when recovering them from the coronary arteries.

The mechanisms underlying this complication in the present case suggest that particles of BioGlue, which may have unfortunately fallen into the left coronary cusp of the aortic valve, moved into the left coronary artery just after the patient was separated from cardiopulmonary bypass. The problem highlighted in this case is how the BioGlue is spilled into the true lumen. With the exception of accidental dislodgement, Carrel et al. [2] speculated that BioGlue may leak into the true lumen via suture-line needle holes. In addition, LeMaire et al. [8] demonstrated an in vitro incidence of BioGlue leakage of 10%, with no correlations between the suture size and the frequency of such leaks. Establishing the exact mechanism of leakage in the present case based on a conference with the surgeons was not possible; however, it cannot be denied that the fragments of BioGlue used in the surgery spilled into the true lumen even though the BioGlue was used carefully.

We have continued to use BioGlue even after the occurrence of this adverse event, with no further complications. There are no reliable preventive measures other than to use BioGlue carefully, being precise so as not to spill it into the true lumen. In addition, this complication may occur with other surgical adhesives and is not specific to BioGlue. Based on published data by the Japanese Association of Thoracic Surgery, the number of surgical replacements of ascending aorta for aortic dissection performed was 2601 cases in Japan during 2011 [9]. Surgical adhesives would probably be used in most cases. On the other hand, according to the results of research from a post-marketing survey in Japan from June 2011 to March 2012, serious adverse events associated with the use of BioGlue occur in approximately 0.15% (6 of around 4000 cases) of the cases. It is important for surgeons not to perform surgery without BioGlue, but to promptly recognize and treat this serious condition in consultation with cardiologists.

Conflict of interest

The authors declare no conflict of interest.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at http://dx.doi.org/10.1016/j.jccase.2014.05.007.

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