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MINI-FOCUS ISSUE: PROCEDURAL COMPLICATIONS: PART 2

ADVANCED

CASE REPORT: CLINICAL CASE

Coronary Artery Embolism Caused by BioGlue Surgical Adhesive After Type A Acute Aortic Dissection Repair

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ABSTRACT

Coronary artery embolism due to BioGlue surgical adhesive after repair of type A acute aortic dissection is a rare condition. We report a case of BioGlue coronary artery embolism after type A acute aortic dissection repair confirmed using intravascular ultrasound imaging and pathological examination. It was successfully treated with percutaneous coronary intervention. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2021;3:53–7) © 2021 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

A 65-year-old woman was referred to our hospital for emergency surgery to treat type A acute aortic dissection (TAAAD). On arrival, her blood pressure was 104/64 mm Hg and her heart rate was 67 beats/min. Physical examination was unremarkable. Initial echocardiography revealed normal left ventricular function with severe aortic valve regurgitation (AR). During emergency surgery, the ascending aorta was replaced with a prosthetic graft after injection of BioGlue (CryoLife, Inc., Kennesaw, Georgia) surgical adhesive in the false lumen to reinforce the proximal and distal anastomotic sites. Her postoperative course was uneventful. On postoperative day 12, she suddenly developed severe chest pain. Blood pressure was 110/70 mm Hg and heart rate was 46 beats/min. Physical examination was normal. Electrocardiography showed ST-segment elevation in the precordial leads. Echocardiography demonstrated new hypokinesis of the anteroseptal segments without AR or pericardial effusions. Shortly thereafter, she developed ventricular fibrillation, which was immediately treated with cardioversion that led to return of spontaneous circulation. Informed consent was obtained for this case.

LEARNING OBJECTIVES

- To recognize BioGlue as a nonthrombotic cause of CE.
- To understand the important role of IVUS and pathological examination of specimens obtained via thrombectomy during PCI as well as conventional angiographic features to confirm and identify the cause of CE.
- To demonstrate the utility of PCI using an aspiration device and coronary stenting in the treatment of BioGlue CE.

MEDICAL HISTORY

She had a history of hypertension and was taking antihypertensive medications.

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ABBREVIATIONS AND ACRONYMS

AR = aortic valve regurgitation

CAG = coronary angiography

CE = coronary artery embolism

IVUS = intravascular ultrasound

LAD = left anterior descending artery

PCI = percutaneous coronary intervention

PDA = posterior descending artery

STEMI = ST-elevation myocardial infarction

TAAAD = type A acute aortic dissection

DIFFERENTIAL DIAGNOSIS

Based on the presentation, the most likely diagnosis was ST-elevation myocardial infarction (STEMI) caused by plaque rupture or erosion. Other possibilities included non-atherosclerotic STEMI due to coronary artery embolism (CE), spontaneous coronary artery dissection, coronary artery spasm, and aortic root dissection leading to coronary malperfusion.

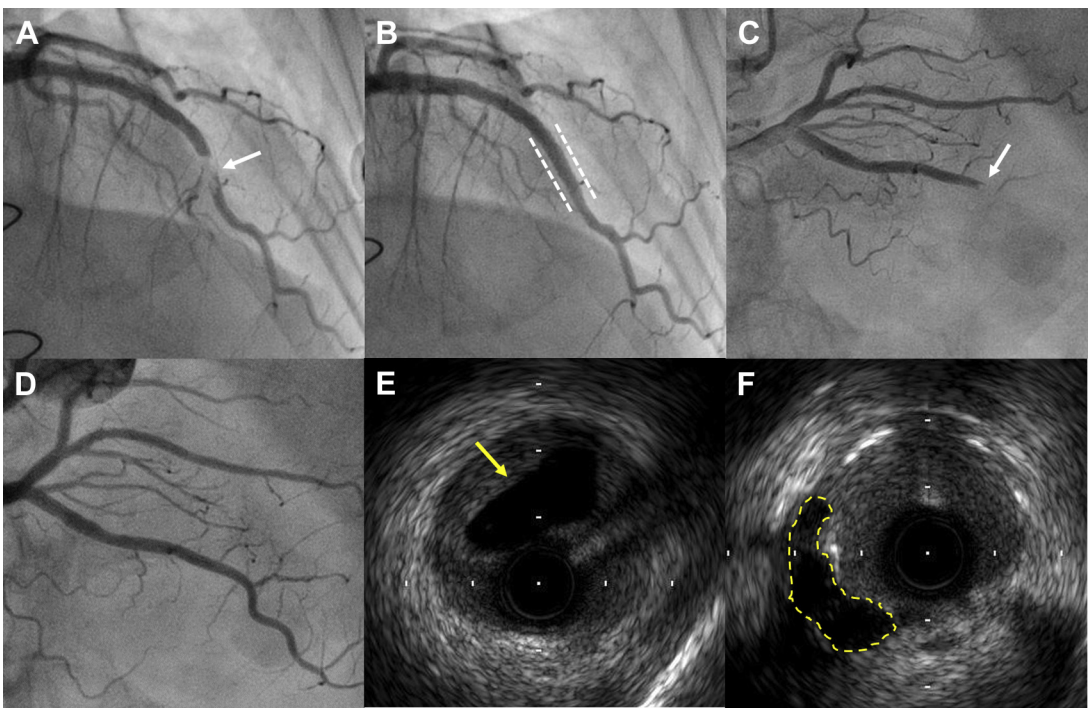
INVESTIGATIONS

We suspected STEMI and decided to perform emergency coronary angiography (CAG).

MANAGEMENT

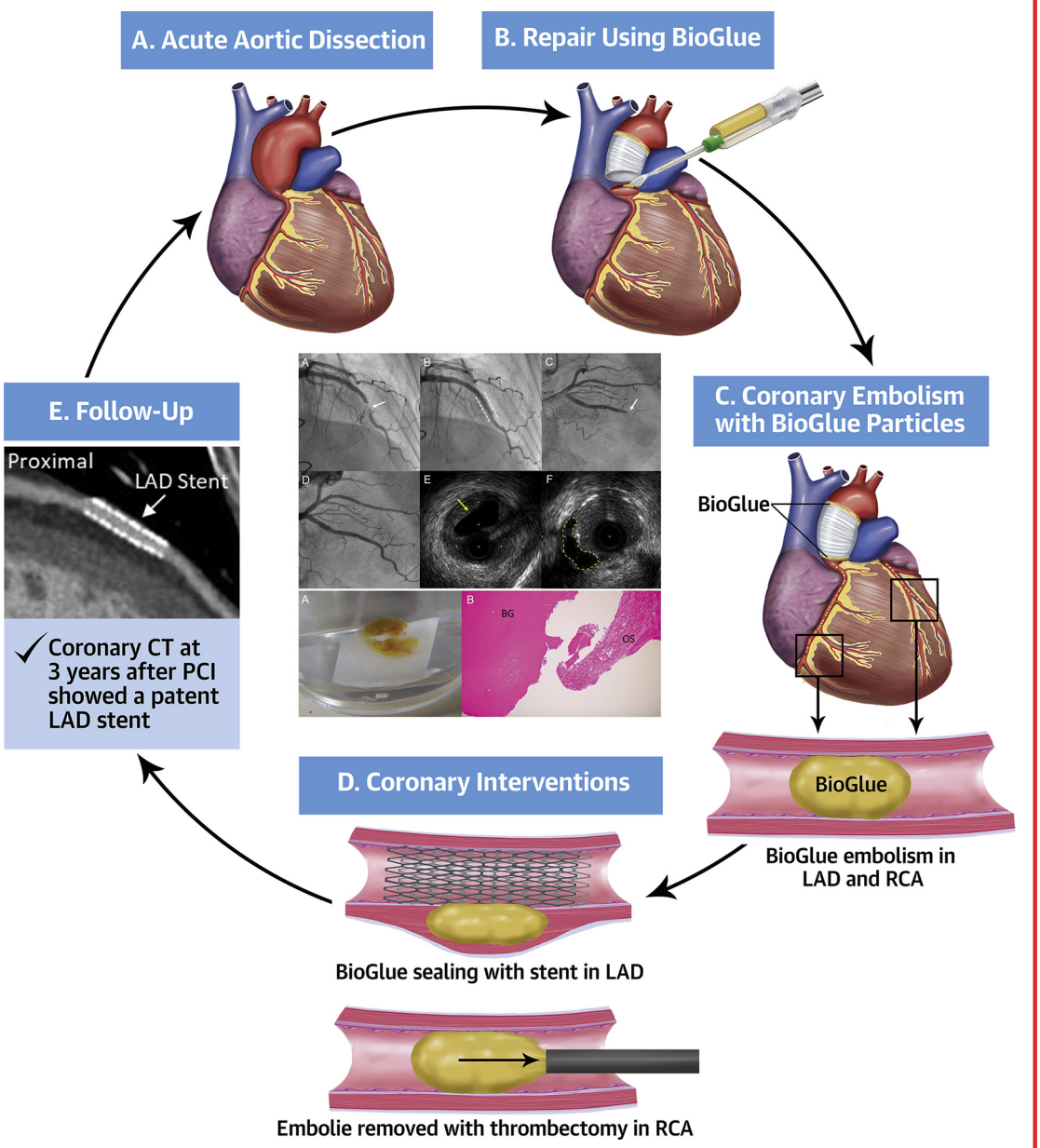
CAG showed subtotal occlusion of the mid-left anterior descending artery (LAD) with a large filling defect that had a railroad track appearance and no atherosclerotic findings (**Figure 1A**, Video 1), which was suggestive of an embolic event. After discussion with the surgeon in the catheterization laboratory, we proceeded with percutaneous coronary intervention (PCI). Thrombectomy was attempted with an aspiration catheter. A small amount of thrombus was collected, but the angiographic appearance remained essentially unchanged. Intravascular ultrasound (IVUS) imaging demonstrated a mobile structure with a homogeneous echolucent appearance and sharp margins, which we had never encountered before (**Figure 1E**, Video 2). We failed to aspirate it even after changing to an aspiration catheter with a larger lumen. We decided to seal it to the vessel wall with coronary stenting. A drug-eluting stent was successfully implanted in the mid-LAD, resulting in angiographically complete resolution of the filling defect (**Figure 1B**, Video 3) and a fully expanded stent on IVUS imaging (**Figure 1F**, Video 4). Near the end of the LAD-PCI, ST-segment elevation in the inferior leads appeared. We immediately performed CAG of

FIGURE 1 Emergency CAG and IVUS Imaging of the Mid-LAD



(A) CAG showed a filling defect with a railroad track appearance **(white arrow)** in the mid-LAD without atherosclerotic findings. **(B)** After stenting of the mid-LAD **(white broken lines)**, there was resolution of the filling defect. **(C)** Total occlusion of the distal PDA **(white arrow)**. **(D)** Restoration of normal flow with thrombectomy of the PDA. **(E)** IVUS imaging demonstrated a mobile structure **(yellow arrow)** in the mid-LAD, suggestive of BioGlue material. **(F)** After stenting of the mid-LAD with compressive BioGlue material outside of the stent **(yellow broken line)**. CAG = coronary angiography; IVUS = intravascular ultrasound; LAD = left anterior descending artery; PDA = posterior descending artery.

CENTRAL ILLUSTRATION **BioGlue as a Cause of Coronary Embolism, and the Utility of PCI and Multimodality Imaging in Management**



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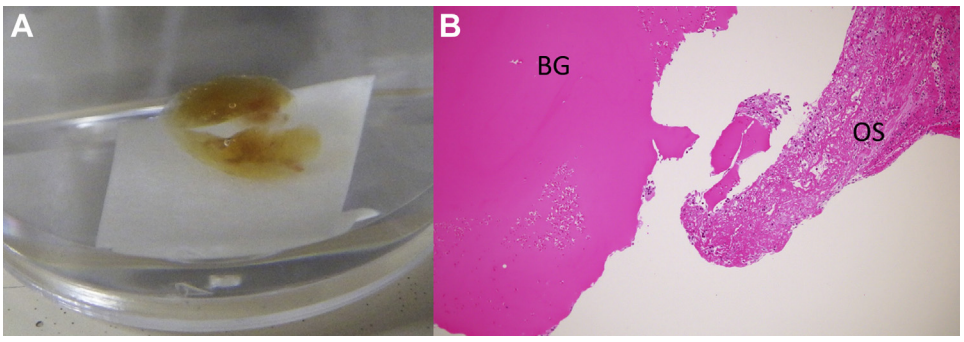
Coronary angiography and intravascular ultrasound images **(upper and center)**, and macroscopic and pathological findings of BioGlue particles **(bottom)**. CT = computed tomography angiography; LAD = left anterior descending artery; PCI = percutaneous coronary intervention; RCA = right coronary artery.

the right coronary artery, which showed total occlusion of the distal posterior descending artery (PDA) (**Figure 1C**, Video 5), also suggestive of CE. Thrombectomy was performed. Aspiration of yellow-brown material (**Figure 2A**) from the PDA led to angiographic restoration of normal flow (**Figure 1D**, Video 6). No angioplasty or coronary stenting was undertaken. Transesophageal echocardiography performed 5 days after PCI showed no intracardiac sources of emboli. Pathological examination

FIGURE 2 Pathological Examination of Material Aspirated From the Posterior Descending Artery



(A) Gross examination showed a translucent solid amber fragment similar to a gummy candy. **(B)** Microscopic examination confirmed a BioGlue (BG) fragment superimposed with organized thrombus (OS) (hematoxylin and eosin stain, 100x original magnification).

revealed that material aspirated from the PDA consisted of unstructured, dense, colloidal agglomerates without atherosclerotic components. There was organized thrombus on the surface (Figure 2B). It was confirmed to be a fragment of the BioGlue used for TAAAD repair. Based on the IVUS findings, we concluded that the mobile structure in the mid-LAD might be also BioGlue emboli. The patient made an excellent recovery and was discharged home on postoperative day 25.

DISCUSSION

CLINICAL FEATURES OF BioGlue CE AFTER TAAAD REPAIR. CE is recognized as an important non-atherosclerotic cause of acute myocardial infarction. Recently, Shibata et al. (1) proposed diagnostic criteria for CE. Our case fulfills the criteria for definite CE with 2 major criteria present. In the majority of patients, embolic materials are thrombotic in nature. Less frequently, emboli may consist of non-thrombotic materials such as infected vegetations, calcified valvular fragments, cardiac tumors, or even iatrogenic materials such as BioGlue, a widely used surgical adhesive, mostly in TAAAD repair. Systemic BioGlue embolism has been previously reported (2). BioGlue CE is very rare; there are only 4 reports, which included probable cases (3–6). Including our patient (Table 1), patient age varied from 59 to 86 years, all were female, and all received graft

TABLE 1 Clinical Features of Reported Cases of BioGlue CE

First Author Year (Ref. #)	Age (yrs)/ Sex	Index Dx/ Surgery	CE Onset	Initial Presentation of CE	Clinical Status at CE	Acute Complication During CE	Imaging Modality	Coronary Arteries With Embolization	PCI Procedure	Method of CE Confirmation	Outcome
Mahmood 2004 (3)	74/F	TAAAD/graft replacement	POD 6	Chest pain	STEMI	Shock	None	LAD LCX RCA	None	Autopsy	In-hospital death
Hoschtitzky 2004 (4)	59/F	TAAAD/graft replacement	POD 4	Back pain	STEMI	Shock	CAG	LAD	Stenting	Clinical (probable case)	Survive to discharge
Shah 2014 (5)	76/F	TAAAD/graft replacement	POD 2	VF	NA	Shock VF	CAG	LMT LAD LCX	Thrombectomy Stenting IABP use	Clinical (probable case)	Survive to discharge
Matsutera 2014 (6)	86/F	TAAAD/graft replacement	During surgery	Shock	STEMI	Shock	CAG	LAD LCX	Thrombectomy POBA IABP use	Pathological examination	Survive to discharge
Current case 2021	65/F	TAAAD/graft replacement	POD 12	Chest pain	STEMI	VF	CAG IVUS	LAD RCA	Thrombectomy Stenting	Pathological examination IVUS	Survive to discharge

CAG = coronary angiography; CE = coronary artery embolism; Dx = diagnosis; ECG = electrocardiography; F = female; IABP = intra-aortic balloon counterpulsation; IVUS = intravascular ultrasound; LAD = left anterior descending artery; LCX = left circumflex artery; LMT = left main trunk; NA = not available; NSTEMI = non-STEMI; PCI = percutaneous coronary intervention; POBA = plain old balloon angioplasty; POD = postoperative day; RCA = right coronary artery; STEMI = ST-elevation myocardial infarction; TAAAD = type A acute aortic dissection; VF = ventricular fibrillation.

replacement for TAAAD. Most patients developed CE more than 2 days after surgery. Our patient had the longest interval, 12 days. All patients presented with shock or ventricular fibrillation shortly after the onset of BioGlue CE and 2 required intra-aortic balloon counterpulsation support. Despite the critical presentation, all patients who underwent emergency PCI were discharged alive. Our patient had a similar clinical course.

MECHANISM OF BioGlue CE: WHY DO PARTICLES GO AGAINST AORTIC FLOW? BioGlue may embolize to peripheral organs when applied directly in the true lumen due to technical error or through a suture site. LeMaire et al. (7) demonstrated through in vitro experiments that BioGlue leaks through needle holes in the aortic tissue and prosthetic grafts. However, the coronary ostia are usually located below the sinotubular junction. Thus, the anastomotic site from which BioGlue particles may leak into the lumen is distal to the coronary ostia. Nevertheless, why do BioGlue particles go against aortic flow and into the coronary trees as retrograde emboli? Possible mechanisms include: 1) diastolic regurgitation with concomitant AR; 2) formation of prominent vortexes in a dilated sinus of Valsalva; and 3) accelerated helical and retrograde flow along the wall of a diseased aorta or graft. These complex blood flow alterations in the proximal aorta may cause retrograde CE. Indeed, several studies have found aberrant aortic flow patterns such as vortexes and reversed flow in patients with aortic disease with dynamic flow visualization using 4-dimensional magnetic resonance imaging (8,9). More investigations are needed to better understand the mechanisms of retrograde BioGlue CE.

UTILITY OF PCI FOR BioGlue CE. Thrombectomy devices have been used widely in recent years in acute myocardial infarction, including CE. Importantly, pathological examination of aspirated materials provides valuable information for clarifying the cause of CE, including BioGlue CE. However, it is necessary to keep in mind the possibility that, unlike thrombus, BioGlue particles may not be removed entirely by thrombectomy because they are larger and more elastic. If they are difficult to remove despite changing to an aspiration catheter with a larger lumen, bail-out coronary stenting as a sealing method must be considered to restore coronary flow. The stent we implanted was fully expanded and well apposed on IVUS imaging (**Central Illustration**).

FOLLOW-UP

Computed tomography coronary angiography at 3 years after PCI revealed a patent LAD stent (**Central Illustration**). She has remained well without any cardiovascular events during subsequent follow-up in our clinic.

CONCLUSIONS

This case report emphasizes the need for awareness of BioGlue as a cause of CE. It also illustrates the importance of IVUS imaging and pathological examination as well as conventional angiographic features to identify the cause of CE. If there is difficulty in removing BioGlue via thrombectomy, coronary stenting is a potentially useful treatment strategy for BioGlue CE.

AUTHOR DISCLOSURES

The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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KEY WORDS BioGlue, coronary artery, embolism, intravascular ultrasound, pathological examination, retrograde embolism

APPENDIX For supplemental videos, please see the online version of this paper.