Negative results - Cardiac general

Acute limb ischemia due to embolization of biological glue after repair of type A aortic dissection

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Abstract

Objective: We present two cases of type A aortic dissection repaired with the help of biological glue, that were followed by acute limb ischemia due to embolism of glue. Methods and Results: A 30-year-old man was diagnosed with aortic dissection from left coronary sinus to right subclavian artery. Under deep hypothermic circulatory arrest (DHCA), distal aortic anastomotic site was reconstructed with injection of Bioglue® between dissected layers, and a valve sparing inclusion technique was performed using a straight dacron graft. On postoperative day 14, he presented acute limb ischemia due to femoral artery glue embolism that required surgery. A 76-year-old woman with the diagnosis of type A dissection ending proximal to the celiac trunk was operated under cardiopulmonary bypass and DHCA. The ascending aorta was replaced with a straight dacron tube, with resuspension of aortic valve and reinforcement of proximal and distal anastomosis with Bioglue® between the diseased layers. Absence of previously patent radial pulse was detected intraoperatively, solved with humeral thromboembolectomy. Conclusions: Management of the diseased aortic wall in acute dissections is a surgical challenge for the cardiac surgeon. Despite our group having a positive experience with biological glue in type A aortic dissection, this report reminds us that the use of bioadhesives to reinforce anastomotic sites may be an important tool but it is not free of problems.

Keywords: Aortic dissection; Glue; Embolism

1. Introduction

Although improvements have been made in diagnosis and management, type A aortic dissection is still a surgical challenge. Technical difficulties arise from dealing with a ruptured aortic wall. Several techniques have been described in order to reconstruct and reinforce anastomotic sites to limit intraoperative and postoperative bleeding. These techniques include the use of biological glue to seal the dissected layers. Clinical use of biological glue began in 1977, after experimental studies by Bachet and Guilmet. Since then, several glues have been introduced for this purpose, such as gelatine-resorcinol-formaldehyde (GRF) glue (Cardial, Technopole, Sainte-Etienne, France), Fibringlue® (Aventis Behring GmbH, Marburg, Germany) and, most recently, Bioglue® (Cryolife International Inc., Kennesaw, GA) [1,2].

Several complications following the use of biologic glue have risen in recent years. Some reports have pointed an increased risk of aortic wall necrosis and redissemination after GRF was used for anastomotic sites reinforcement [2,3]. Embolization of biological glue during repair of acute type A aortic dissection was first described in 1995, when post mortem study of a 72-year-old patient who died after surgical repair using GRF glue showed microscopic particles of polymerized glue in afferent vessel of ischemic cerebral and meningeal regions [4]. Recently, Bioglue® embolism to right and left coronary arteries has been reported as the cause for fatal right ventricular infarction, also as a post mortem finding [5].

We present two cases of type A aortic dissection that were repaired using biological glue (Bioglue®) as a surgical adjunct, which were followed by acute limb ischemia due to embolism of glue.

2. Case reports

2.1. Patient 1

A 30-year-old man was referred to our institution with the diagnosis of acute type A aortic dissection. He had consulted in his community hospital with chest pain, right eye anopsia, dizziness, and alternating sinus and nodal rhythm in the electrocardiogram. Further explorations, including transesophageal echocardiography (TEE) and thoracoabdominal computerized tomography (CT), showed an aortic dissection from left coronary sinus of Valsalva to right subclavian artery ostium, with maximal diameter of 90 mm in the ascending aorta distal to sinotubular junction. Distal aortic arch and descending thoracic aorta seemed to be uninvolved, and they had normal diameters. TEE confirmed the diagnosis and detected mild aortic insufficiency with a central regurgitant jet. He was transferred to our hospital, and was operated upon emergent basis. After right femoral...
artery cannulation, median sternotomy was performed and cardiopulmonary bypass began with right atrial cannulation. Exploration of the aortic arch and distal anastomosis was performed under deep hypothermic circulatory arrest (DHCA). Distal aortic anastomotic site was reconstructed with injection of Bioglu\(^{\text{e}}\) between dissected layers and inversion of external layer into the true lumen followed by a 5/0 polypropylene running suture over the whole sandwich. The end-to-end anastomosis between the Dacron graft to the reconstructed aortic wall was sutured in a running fashion with 4-0 polypropylene, without Teflon felt stripes reinforcement. Care was taken not to spill adhesive in the true lumen, and a dry surgical field was prepared before using it. During rewarming, a David-IV valve sparing inclusion technique was done using a 32-mm straight Dacron graft (Intervascular\(^{\text{e}}\), Montvale, NJ), as previously described [6]. In-hospital postoperative complications included paroxysmal atrial fibrillation and right phrenic nerve palsy with transient acute ventilatory failure following extubation. On postoperative day 14, being at home, he suddenly developed short distance left lower limb intermittent claudication, with absence of left popliteal and posterior tibial and pedal pulses. He was transferred again to our hospital, where urgent digital angiogram showed a contrast defect in the femoro-popliteal region suggesting embolism (Fig. 1A). Surgical embolectomy using a Fogarty catheter was then performed via combined femoral and popliteal approach due to large amount of debris to be removed from the popliteal artery. Histopathologic examination of the embolic material confirmed it to be bioadhesive. After 40 months of follow-up, he has returned to his previously active life. Phrenic nerve palsy has completely recovered. Aortic regurgitation, rediscension, or intermittent claudication, have not been documented during this period.

2.2. Patient 2

A 76-year-old woman was referred to our institution with the diagnosis of acute type A aortic dissection. She complained about chest pain in the context of hypertensive crisis. The TEE described a dissected 46 mm ascending aorta with mild aortic regurgitation. Thoraco-abdominal CT scan showed a type A dissection beginning in the aortic root and ending proximal to the celiac trunk. She was operated under cardiopulmonary bypass and DHCA by femoral artery and right atrium cannulation. The ascending aorta was replaced with a 28 mm straight Dacron tube (Intervascular\(^{\text{e}}\)), with resuspension of aortic valve and reinforcement of proximal and distal anastomosis with Bioglu\(^{\text{e}}\) between the diseased layers as in patient 1. After discontinuation of cardiopulmonary bypass, absence of previously patent radial pulse was detected. Thromboembolectomy from the humeral artery with Fogarty catheter recovered radial pulse. Embolic material was confirmed to be biological glue after pathological analysis. In-hospital postoperative complications included left pleural effusion, and transient temporal and spatial disorientation. On postoperative day 14, she was transferred back to referring hospital in good condition.

3. Comment

Dealing with a fragile aortic wall is the most common scenario in the acute aortic dissection. Suboptimal reconstruction may lead to postoperative bleeding or secondary anastomosis dehiscence with disastrous consequences. Several techniques have been described to reinforce the aortic anastomotic sites. These include the use of Teflon felt stripes or the use of biological glue to seal the dissected layers. Both of them try to increase the consistence in the anastomotic site, while avoiding direct blood flow through false lumen.

However, there has been some concern in recent years regarding the use of biological adhesives in the repair of aortic dissection. It has been described in an increased incidence of aortic wall necrosis and rediscension [2,3]. Moreover, a post mortem case of glue microembolism to central nervous system has been described [4]. Recently, a fatal right ventricular infarction caused by Bioglu coronary embolism has been reported [5].

The cause of aortic wall rediscension remains controversial and some authors have reported that it might be related to use of GRF glue. It has been argued that high formaldehyde concentration in GRF (37%) compared to lower glutaraldehyde concentration in Bioglu\(^{\text{e}}\) (10%) may partially explain differences in rediscension incidence after the use of these adhesives [2,7]. Histopathologic examination of the removed GRF-reinforced anastomotic site showed extensive wall necrosis, with disappearance of the intima and media [2,3].

Distal embolism is another concern following use of biosealants as a surgical adjunct. It was first described as a necropsy finding in a case report where microparticles were found in cerebral and meningeal regions [4]. The authors proposed three possible mechanisms that may have led to peripheral embolization of glue particles: (1) direct glue escape in the true lumen during application of the adherent agent; (2) escape of glue through re-entries distal to site of use; and (3) secondary mobilization of glue particles through stitch channels in the diseased aortic wall.
It seems unlikely that mechanism 3 explains the embolisms we describe, since the specimens obtained are too large to mobilize through stitch channels. Although there was no evidence of direct deployment of glue in the aortic true lumen in both patients, mechanism 1 cannot be excluded completely. Lack of viscosity of the glue and a colour similar to the endothelium could have led to an accidental introduction of the glue in the true lumen. Nevertheless, the large size of the specimens lets us think they would have been detected intraoperatively. We believe mechanism 2 was the most probable cause of embolism in our patients. Due to fluidity and translucent properties of Bioglue®, adhesive could have travelled from the false lumen to the true one through distal re-entry sites. After being fixed to the aortic endothelium, the embolic material could have been set free by aortic pulsatile flow.

Some precautions must be taken when planning to use biological glue. Surgical field must be kept as dry as possible. When using GRF glue, pressure must be applied between layers to help binding process. Bioglue®, which is less sticky than GRF, needs to be handled cautiously. Any inappropriate applied pressure may end in spillage of this uncolored substance. To avoid accidental insertion of glue in the true lumen we have used a small gauze inserted in the aortic lumen at the moment of glue deployment. This is more important in the aortic arch, where accidental true lumen glue would be very difficult to recover. In other patients, an inflated Foley balloon catheter in the true lumen 2 cm from the anastomotic margin has created the same effect. Additionally, the pressure by the balloon intends to apply the inner to the outer layer, closing the false lumen and preventing glue in the false lumen to leak in to the true lumen through a distal re-entry site. Coronary artery perfusion cannulae placed in situ may provide additional protection to coronary ostia when applying glue in the aortic root. To avoid glue from coming back through the anastomosis, adventitial inversion into aortic lumen has been described. The use of DHCA and open technique of anastomosis in type A aortic dissection has been pointed as a security mechanism to allow direct visual control of glue distribution, allowing detection of distal intimal leaks [2,7–9].

Despite these embolic events, our group has a positive experience after introducing the use of biological glue, with a lower incidence of postoperative bleeding. We should not despise what these new weapons contribute to our armamentarium, as we deal with such a dangerous enemy as the type A aortic dissection.

References