The use of an autologous fibrin sealant during a complex cardiac surgical procedure

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Kardiochirurgia i Torakochirurgia Polska 2018; 15 (1): 62-64

Due to substantial perioperative injuries and changes in coagulation, cardiac surgery procedures using extracorporeal circulation often necessitate the transfusion of blood products [1]. This pertains especially to patients in whom the procedures involve prolonged periods of extracorporeal circulation and aortic clamping [2]. Although allogenic blood products have been used in the treatment of hemorrhages or significant anemia for many years, it has been proven that their transfusion is associated with the risk of numerous complications [3, 4]. The methods for limiting or eliminating perioperative bleeding include the use of absorbable sponges soaked with blood products (e.g., thrombin) and the use of tissue glue. One special type of such glue is fibrin sealant derived from the patient’s autologous blood acquired intraoperatively [5]. We present a report of one of the first uses of the fibrin sealant Vivostat in Poland; it was used in a patient undergoing a complex procedure involving the implantation of an aortic valve prosthesis and an ascending aortic prosthetic.

The 57-year-old male patient was admitted to our center in order to undergo surgical treatment of aortic valve stenosis and ascending aortic dilatation. When interviewed, the patient reported significant impairment of exercise tolerance (classified as NYHA III based on the reported symptoms), which had been increasing for approximately 6 months, and single episodes of syncope. His medical history included coronary artery disease, treated with the implantation of a drug-eluting stent into the anterior descending branch of the left coronary artery 5 years prior, and the associated monotherapy with acetylsalicylic acid. Control coronary angiography revealed no signs of restenosis or new significant stenoses in the coronary arteries. Echocardiographic examination showed severe stenosis of the bicuspid aortic valve (mean gradient: 42 mm Hg; indexed effective orifice area: 0.5 cm²/m²; 2nd degree regurgitation). Other findings included: left ventricular (LV) diameter – 50 mm, end-diastolic LV volume – 214 ml, interventricular septal (IVS) thickness – 17 mm, posterior LV wall – 13 mm, IVS dyskinesia, hypokinesia of the lateral wall, left ventricular ejection fraction reduced to 50% and supracoronary dilatation of the ascending aorta to approx. 50 mm. Electrocardiography showed normal sinus rhythm.

During a detailed conversation, the patient was presented with the advantages and drawbacks of the individual valve prostheses and the possibly increased risk associated with combining oral anticoagulation with antiplatelet therapy; the patient made an informed choice to be implanted with a mechanical aortic valve prosthesis.

Using median sternotomy, the ascending aortic dilatation was visualized above the coronary ostia, ending before the aortic arch. An arterial cannula was placed in the initial segment of the aortic arch, and a venous cannula was placed in the right atrium. The heart was stopped with cold crystalloid cardioplegia (Custodiol), used routinely in our center; the cardioplegia was initially administered through a needle introduced into the ascending aorta and later – directly into the coronary ostia. The bicuspid aortic valve with massive calcifications was removed, and a 25-mm Sorin Bicarbon mechanical aortic valve prosthesis was implanted using single sutures, which were reinforced with teflon pledges from the side of the left ventricle. After the excision of the dilated segment of the ascending aorta and positive assessment of aortic wall thickness, a 30-mm Gelweave prosthesis was implanted. Distal and proximal anastomoses were reinforced with single felt strips and sewn with monofilament 4-0 sutures. Before unclamping the aorta, its anastomoses with the prosthesis were covered with 3 ml of the Vivostat fibrin sealant (Vivostat A/S, Alleroed, Denmark) (Fig. 1). The sealant was prepared while the anastomoses were being made, from 120 ml of heparinized blood acquired from the patient’s extracorporeal circulation set. The set for producing fibrin sealant is a completely automated system consisting of a module that delivers the sealant into a replaceable attachment in the form of a spray (Fig. 2). The larger module controls the biochemical process of synthesizing the fibrin sealant without the use of cryoprecipitation, aprotinin, or animal-derived substances. This module can remain outside the operating room. The prepared glue is placed in the smaller...
application module, which must be placed in the vicinity of the patient. During one work cycle (approx. 20 minutes), the set produces 5 ml of glue which can be used repeatedly during the surgery. In the described case, the remaining 2 ml of glue were used to seal the cannulation sites in the atrium and aorta.

The heart was deaired, the aorta was unclamped (after 97 minutes), and electric defibrillation was performed, resulting in the restoration of sinus rhythm. After the administration of protamine, the tightness of the anastomoses between the prosthesis and the aorta was confirmed, except for a single hemorrhage from the anterior part of the distal anastomosis, which was stopped with a monofilament suture with a teflon patch. The patient required support with a small dose of catecholamines; he was transferred in good condition to the postoperative ward.

He woke up normally, and was discharged from the intensive postoperative care ward on the 1st day. Due to the increased volume of drainage that did not suggest bleeding (700 ml in total) and the associated increased risk of cardiac tamponade, the drains were kept in place until the 3rd day. On the 8th day, the patient was discharged to a cardiac rehabilitation hospital in good general condition. Throughout the treatment at the cardiac surgery ward, the patient did not receive any transfusions of packed red blood cells or other allogenic blood products, including prothrombin complex concentrates.

Procedures for aortic aneurysms are associated with the risk of increased peri- and postoperative blood loss due to the relatively long duration of aortic cross-clamping and the length of vascular anastomoses, among other factors. There is also a higher risk of bleeding requiring surgical revision of the mediastinum [2]. Repeat procedures due to bleeding and transfusions of blood products have a negative impact on the outcomes of cardiac surgical treatment [3, 4]; therefore, the use of various techniques for limiting the blood loss (and thus the number of complications associated with transfusions of allogenic blood products) is fully justified.

There are many products for sealing sites where bleeding may occur; for the discussed procedure, we used the fibrin sealant Vivostat for the first time in our practice. This sealant is produced from the patient’s own blood and contains no derivatives of allogenic human or animal blood. Although Vivostat has been available on the medical market for almost 20 years, based on a review of literature and information acquired from the manufacturer, we can surmise that this was one of the first cases in Poland in which an autologous fibrin sealant was used during a cardiac surgery procedure. The usefulness of the Vivostat sealant, both in cardiac surgery and other procedures, has been widely described by foreign authors [5–7]. Among the benefits of the fibrin glue, researchers noted the reduced number of transfused packed red blood cell units and the smaller number of surgical revisions after coronary artery bypass grafting [8]. Belcher et al. and Hanks et al. made a number of interesting comparisons between fibrin sealant, oxidized cellulose (Surgicel), and BioGlue with regard to their effectiveness in ensuring hemostasis [9, 10].

During the described procedure, we found that the sealant’s mode of application (in the form of a spray) allows it to reach locations that are difficult to access; the sealant forms an elastic layer that does not pose problems if surgical sutures need to be used. The volume of 5 ml...
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sprayed from the applicator is sufficient to cover the vascular anastomoses repeatedly during the various stages of the procedure. Notwithstanding, some drawbacks of its use should be noted. These include the relatively large size of the equipment and the longer time required to prepare the sealant (approx. 20 minutes), which limits its application in cases in which the use of this hemostatic was not planned beforehand.

In the case of ascending aortic aneurysm repair, various surgical techniques can be employed. Due to the normal thickness of the aortic wall and the lack of dilatation in the aortic bulb we were able to use a technique that was less burdensome than the Bentall procedure. The lack of signs of a connective tissue disease was an important argument for replacing the aortic valve and the ascending aorta.

One other drawback that should be mentioned is the product’s cost, which was twice as high as that of a matrix containing human thrombin and fibrinogen. However, this cost may depend on the yearly number of sets used and the proprietorship of the module. We cannot rule out that the financial aspect contributes to the sporadic use of the described system in Poland.

In our view, the Vivostat fibrin sealant is an easy-to-use, promising product for supporting intraoperative hemostasis. In the described case, the hospitalization of the patient in whom it was used was uneventful, and no blood products were transfused. This outcome encourages further reliable observations in subsequent patients and comparative analyses in larger groups of patients.

Disclosure
Authors report no conflict of interest.

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