

ance can make it impossible for the ball to move freely with regurgitation as a result, or can cause it to stick in the cage in the closed position. However, many causes of late valve dysfunction are not related to the design of the valve. Ozkokeli and colleagues [4] reported a case in which a 37-year implanted Starr-Edwards valve (Edwards Lifesciences) (model 1000-9A) developed acute prosthetic valve endocarditis, a complication unrelated to the implantation time. Also, indiscriminate to years of implantation, is the formation of tissue overgrowth. An article by Butany and colleagues [5] describes pannus growth in a DeBakey Surgitool (Travenol Laboratories Inc, Morton Grove, IL) mechanical aortic valve prosthesis implanted for 32 years. The valve itself did not show any signs of wear, but it became dysfunctional due to the excessive tissue. Schmitto and colleagues [6] reported a suboptimal but satisfactory working Starr-Edwards ball-caged valve at 39 years after initial implantation. However, a post-valvular ascending aortic aneurysm of 6.0×6.5 cm made it necessary to perform a Bentall procedure [6].

A few cases have been reported of patients with a mechanical aortic or mitral valve in place for more than 30 years in which the nonprosthetic valve in the systemic circulation was regurgitating, not the prosthesis [7]. In these cases, the prostheses were working satisfactory, but in many cases the decision was made to prophylactically replace the valve.

Reports of prolonged ball-caged valve durability are mostly Starr-Edwards valves, with survival of greater than 43 years in a number of cases (Table 1). In the literature, it is reported that Smeloff-Cutter valves have been explanted after as long as 37 years [7]. Until further results have been published, we believe that this case reports the longest implanted Smeloff-Cutter mechanical valve of 43.3 years.

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Successful On-Pump Coronary Artery Bypass Without Using Protamine

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A 48-year-old woman presented with a history of angina and breathlessness on exertion. She was diagnosed to have critical left main stem coronary artery disease along with a blocked right coronary artery. She was also allergic to protamine. After multidisciplinary consultation, it was decided to use heparin without protamine for reversal. She underwent successful on-pump coronary artery bypass grafting (CABG) without excessive blood loss. The disadvantages were a longer total operating time and the use of blood products to achieve normal coagulation. This case report describes the successful management of this complex problem.

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Cardiac operations using cardiopulmonary bypass (CPB) were greatly facilitated by the discovery of heparin by Jay McLean in 1915. Unfractionated heparin (UFH) has been the drug of choice for achieving anticoagulation for CPB because of the low cost, ease of administration and monitoring, and the easy reversibility by protamine. However, protamine is contraindicated in patients with known allergy or hypersensitivity to protamine. We present a patient with protamine allergy requiring urgent coronary artery bypass grafting using CPB who was successfully managed without using protamine.

A 48-year-old woman presented with angina and breathlessness. She had a history of stenting of the right coronary artery after an inferior wall myocardial infarction 4 years earlier. Comorbidities included hypertension, emphysema, and asthma. A coronary angiogram revealed critical left main coronary artery stenosis and a blocked right coronary artery, with good left ventricular function. She had a history of allergy to different species of fish that precipitated urticaria and angioedema. Fish allergy has been reported to increase the risk of protamine allergy [1], and she underwent an intradermal skin test, which was positive for protamine sensitivity. (Further immunologic tests were not performed at this point because of the urgent nature of the operation.) After multidisciplinary consultation, we decided to proceed

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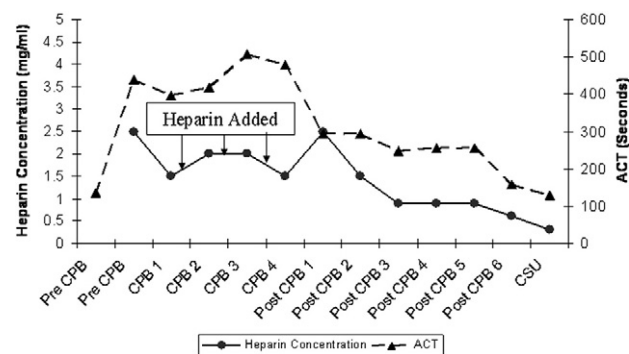


Fig 1. The temporal relation of the activated clotting time (ACT, triangles) and heparin concentration (circles) is shown as measured using the Medtronic Hepcon system at various perioperative intervals. Heparin was added as indicated during cardiopulmonary bypass (CPB) to maintain the ACT above 400 seconds. The ACT and heparin concentration continued to reduce with time after CPB was stopped. (CSU = cardiac surgical intensive care unit.)

with on-pump coronary artery bypass grafting using heparin, but without using protamine. We decided to titrate the dose of the heparin with the use of the heparin-dose-response (HDR) test.

Before commencing the case, the HDR test (Medtronic Hepcon HMS system, Medtronic, Minneapolis, MN) was used to estimate that 120 mg of heparin was the precise amount required for a target activated clotting time of 400. This level of heparinization was maintained by intermittent measurement of heparin concentration using the HDR test. Additional heparin was administered where indicated (Fig 1).

The coronary artery bypass grafting was accomplished as in a routine procedure. After CPB was terminated, the HDR test was used to measure heparin levels intermittently to predict the time for heparin to wear off. Figure 1 illustrates the temporal relationship of the activated clotting time and the heparin concentration. Surgical hemostasis was achieved, and a cell-saving device was used to salvage blood, which was retransfused. The patient received 4 units of platelets and 2 units of fresh frozen plasma to correct the clotting abnormalities measured after discontinuation of CPB. Once a minimal level of heparin was measured, coinciding with formation of clots in the surgical field, the aortic cannula was removed and the chest was closed. Total CPB time was 101 minutes, and the total operating time was 380 minutes.

A cell-saving device was set up in the intensive care unit to salvage any blood from the drains. Postoperative bleeding was within acceptable limits, and subsequent management was as according to usual protocols. The patient made a good recovery and was discharged home on day 6.

Comment

Anaphylaxis to protamine is uncommon and is usually diagnosed when a reaction occurs during the administration of protamine. Protamine allergy is suspected in

patients with known allergy to fish. Various options have been described for the management of CPB in such patients [2, 3].

Heparin substitutes that do not require protamine for reversal include bivalirudin, lepirudin, argatroban, and danaparoid [2]. Of these, bivalirudin is most researched. The management of anticoagulation with these agents during CPB is complex and requires special monitoring of the ecarin clotting time [4]. Except for bivalirudin, these agents have a prolonged half-life and are known to be associated with increased bleeding because of the unavailability of any agent for reversal of anticoagulation. Although bivalirudin is short acting, special bypass circuits are recommended to avoid stasis of blood, which results in its degradation.

Heparin-coated circuits [5] have been successfully used but have limited availability. Other options include heparin removal devices, which have been shown to be effective only in experimental settings [6], and the use of heparinase I, which has not been proven to be safe [7]. Heparin-coated circuits and heparin removal devices were not available for use in our center, and heparinase did not appear to be a safe option.

Protamine has been used in protamine allergic patients with antihistamine and steroid cover [8], but we did not choose this because of the possible risks in the event of anaphylaxis. Although the off-pump option uses a lower dose, heparin would still not be entirely excluded. These factors led us to revisit the use of heparin. The Hepcon system made it possible to monitor heparin concentration and wait for spontaneous degradation of heparin to safe levels. Supplemented by the use of blood products (fresh frozen plasma and platelets), adequate hemostasis was achieved within a reasonable time. The use of a cell-saving device to process blood lost during and after CPB is routine practice in our hospital and was continued in the intensive care unit to minimize the risk of transfusion. The patient did not experience excessive blood loss and had an uncomplicated recovery.

The disadvantages were a longer total operating time and the need for transfusion of blood products. However, we recommend this technique when protamine cannot be used safely in an urgent situation, especially when bivalirudin or ecarin clotting time monitoring are not available.

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Mixed-Type Total Anomalous Pulmonary Venous Connection in an Adult

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Cardiac plus infracardiac mixed-type total anomalous pulmonary venous connection is an extremely rare congenital heart disease. We describe a case in which the pulmonary veins made a confluence and connected to a vertical vein running into the inferior vena cava by the way of the hepatic vein. Surgical correction was successfully obtained by deroofting the coronary sinus and using the pericardial patch to reconstruct the interatrial septum. The patient showed no signs of any complication at her 5-month follow-up.

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Mixed-type total anomalous pulmonary venous connection (TAPVC) is a rare congenital heart disease. Cardiac plus infracardiac mixed-type TAPVC is more unusual. More importantly, patients who survive to adulthood without surgical correction are extremely rare in the literature. Herein, we describe a case as follows.

A 27-year-old woman was admitted to our hospital due to 10 years of cardiac murmur. At her physical examination, mild cyanosis was found on her oral lips, the heart rate was 74 beats/min, the cardiac border enlarged on the right side on percussion, and a blast systolic murmur (grade 3/6) could be detected at the second and third ribs on the left side of the sternum. No tremor was noted. Routine blood tests and biochemical tests were within

normal limits. Her arterial blood gas analysis showed pH of 7.364, PO₂ of 85.6 mm Hg, PCO₂ of 38.2 mm Hg, base excess of –3.2 mmol/L, and HCO₃ of 21.8 mmol/L. An electrocardiogram revealed sinus rhythm and incomplete right bundle-branch block.

Echocardiography revealed that the right atrium and right ventricle were enlarged. The ventricular wall was not thick. The coronary sinus was also found to be enlarged. Behind the left atrium, the pulmonary venous of the left and right inferior lobes drained into the vena coronary that followed the right atrium. The site that the pulmonary venous of the left and right superior lobes connected to could not be identified after many times of echocardiography. There was a 10-mm defect in the interatrial septum and a bi-directional shunt was seen through the defect. Cardiac acoustic contrast showed ordinal visualization of the right and left atriums, whereas no visualization showed in the coronary sinus. There was no defect in the interventricular septum, and no shunt in the ventricle. All valves were fine in appearance. The function of the left ventricular contractile was normal.

A 64-slice helical contrast computed tomographic scan and three-dimensional reconstruction revealed that the left and right superior and inferior pulmonary veins made a confluence, connected to a vertical vein running into the inferior vena cava (Fig 1). The sagittal view of the contrast computed tomographic scan clearly showed that the vertical vein drained into the liver and followed the inferior vena cava (Fig 2). The computed tomographic section of the liver also showed the hepatic inflow.



Fig 1. Helical contrast computed tomographic scan and three-dimensional reconstruction showed the four pulmonary veins made a confluence, which connected to a vertical vein, and the vertical vein drained to the inferior vena cava.

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