Autologous Blood Transfusion in a Patient with Pericardial Tamponade During Atrial Fibrillation Ablation

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ABSTRACT. Atrial fibrillation has become a common clinical challenge facing physicians. As the overall population ages, the incidence of atrial fibrillation continues to expand. Previous therapeutic strategies have had minimal success in controlling symptoms associated with atrial fibrillation. The development of radiofrequency ablation holds promise and continues to evolve. Significant risks are associated with the ablation procedure and must be handled expeditiously. We describe a patient undergoing pulmonary vein isolation for the treatment of paroxysmal atrial fibrillation that was complicated by perforation and pericardial tamponade. Autologous transfusion was completed without incident. The patient remained hemodynamically stable and the pigtail pericardial catheter was removed the following day. Direct autologous transfusion of blood from the pericardial space was not associated with any apparent adverse effects and can serve as an immediate strategy for the treatment of tamponade.

KEYWORDS. atrial fibrillation, autologous blood transfusion, pericardiocentesis, radiofrequency ablation, tamponade.

Introduction

The number of patients suffering from atrial fibrillation has steadily increased over the years, with estimates of affected Americans exceeding 2 million. As the overall population ages, the predicted prevalence of patients suffering from atrial fibrillation is expected to increase by 2.5-fold. The direct and indirect costs associated with their care have equally expanded, further straining the health-care system. Atrial fibrillation significantly increases the risks of a variety of adverse outcomes, including stroke, all-cause mortality, and heart failure. For many years, medical therapy with rate or rhythm control strategies has been the hallmark of therapy. In addition to the poor success rates in maintaining sinus rhythm with medical therapy, patients remain attracted to reducing pharmaceuticals and freedom from their many potential side effects. As radiofrequency ablation techniques have continued to improve, greater promise hangs on their ability to effectively treat patients with atrial fibrillation.

Pulmonary vein isolation is well established as the initial therapeutic strategy for symptomatic, drug refractory treatment of atrial fibrillation. Independence from atrial fibrillation via radiofrequency ablation comes at a cost, with procedure-related risks including pericardial effusion with or without tamponade, stroke, pulmonary vein stenosis, vascular access complications, and, although rare, even death. Tamponade is the leading complication resulting in death, but can be effectively treated and avoided if promptly recognized. We report a patient undergoing pulmonary vein isolation via radiofrequency ablation for paroxysmal atrial fibrillation complicated with cardiac tamponade. Complication management consisted of intraoperative autologous blood salvage and transfusion with completion of pulmonary vein isolation.

The subject was a 70-year-old female Jehovah’s Witness with a history of paroxysmal atrial fibrillation diagnosed many years ago who was initially minimally symptomatic; however, episodes progressively increased...
in frequency and the patient reported palpitations and generalized fatigue. She was started on antiarrhythmic therapy, which was unhelpful in reducing her symptoms or frequency of paroxysmal atrial fibrillation. Radiofrequency ablation with isolation of the pulmonary veins was offered as treatment. She was brought to the electrophysiology laboratory and placed under general anesthesia. Two transseptal punctures were completed with the assistance of intracardiac echocardiography, fluoroscopy, and hemodynamics without incidence. The left pulmonary veins were isolated together with bidirectional block confirmed. Ablation on the right pulmonary veins was initiated when the patient was noted to have a progressive increase in heart rate and decrease in blood pressure. Using intracardiac echocardiography, a moderate to large pericardial effusion was identified. Percardiocentesis was immediately completed with a pigtail catheter being inserted and removal of the pericardial blood. Hemodynamics improved to early procedural levels. The removed blood was re-injected into a venous sheath, returning the salvaged blood back to the circulation. Activated clotting times (ACT) were maintained above 350 s with intravenous heparin. Isolation of the right pulmonary veins was completed with successful bidirectional block. A total of 800 ml of blood was intraoperatively salvaged and transfused. Protamine was given at completion of the procedure. The pigtail drain was left in place overnight, with no significant drainage, and subsequently removed the following day. The patient was discharged home and has remained free from atrial fibrillation.

The reported major complication rate in complex atrial fibrillation procedures is 4.5% with the incidence of cardiac tamponade being 1.31%. Newer catheter designs to reduce mechanical trauma and a reduction in the power of radiofrequency ablation further reduce the risk of perforation and subsequent tamponade. In addition, consideration of the anatomy of the left atrium and the surrounding thoracic structures will significantly reduce serious complication rates. Careful catheter movement is essential when navigating around three main areas of the left atrium: left atrial appendage, vestibular component surrounding the mitral valve, and posterior left atrial roof. These areas are most susceptible to perforation because of the thinness of the tissue.

The left atrial appendage constitutes the only rough surface area within the left atrium. It contains pectinate muscles, forming thickened areas within the wall of the appendage. Paper-thin areas between these ridges are areas that can be perforated easily. The vestibular component of the left atrium surrounds the orifice of the mitral valve. Myocardial tissue in this area can be very thin and may contain pits and crevices that may complicate radiofrequency ablation of the mitral isthmus line. In one retrospective series of patients, the lateral mitral isthmus was the most common area of cardiac perforation and tamponade during ablation of atrial fibrillation. Reduction in radiofrequency energy may reduce perforation in this area. Overall, the left atrial tissue is approximately 4 mm, but becomes significantly thinner as each venoatrial junction is approached. In addition, the posterior wall and roof are relatively thin, an estimated 2.3 ± 0.9 mm, creating potential complications by easy perforation and unintended excessive energy transmission to the esophagus and surrounding structures. Minimal pressure to these areas during catheter manipulation is crucial to prevent complication. Finally, the thin pulmonary veins, ranging from 1 to 2 mm, require careful catheter manipulation while delineating structures during electrical anatomical mapping or trauma that may occur while using the cryoballoon.

Iatrogenic acute cardiac tamponade often involves hemodynamic instability and is a medical emergency. Cardiopulmonary resuscitation may be required in 20% of patients and blood transfusion in at least 25%. Intraoperative blood salvage has been an implemented surgical technique for decades. Various accounts claim Union Army Physicians completed blood transfusions during the Civil War. However, the first documented case in American literature came in 1917, describing autotransfusion during a splenectomy. Gross filtration of blood prior to reinfusion was extensively studied in the 1960s. The “Cell-Saver” was instituted in the 1970s, implementing centrifugation and washing of harvested blood before returning to the patient. Cell salvage systems have been successfully used in electrophysiologic procedures, and in some cases enabling completion of the radiofrequency ablation. Unprocessed blood contains thrombolytic substances and other coagulation system components that may lead to coagulation abnormalities and disseminated intravascular coagulation. However, with systemically anticoagulated patients this risk seems to be minimal. Blood that comes into contact with the pericardium by an unknown mechanism is defibrinogenated, possibly by mechanical disruption from the beating heart, and usually does not clot. This property enables direct infusion of extracted blood from the pericardium back to the venous circulation, as was done in our patient. Furthermore, the level of anticoagulation maintained during left atrial electrophysiologic procedures also reduces the likelihood of thrombosis. At least three case reports have reported this strategy. One patient received 3 liters of blood evacuated from the pericardial sac over a 2-h period while in transit to surgery.

The refusal of Jehovah’s Witnesses to accept blood products stems from the interpretation of several biblical passages. While adherence to these practices vary by individual, the need for open communication prior to any cardiac procedure is essential. Many Jehovah’s Witnesses will agree to undergo cardiopulmonary bypass with continuous circulation. Thus, even open-heart surgery can be safely completed with a moderately increased risk. In conclusion, autologous blood transfusion from a pericardial drain can be completed. Ideally, processing the blood with at least filtration is optimal, but, when needed, direct transfusion can be completed. Strategies to reduce complications may include keeping the ACT above 350 s and low force withdrawal and injection to avoid thrombosis and hemolysis, respectively, as utilized in our case.
References