

Asanguinous Del Nido Cardioplegia for an Aortic Valve Replacement Patient with Cold Agglutinins

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Abstract: A patient with known cold agglutinins requiring an aortic valve replacement was referred for surgery. Asanguinous, Del Nido cardioplegia was used for myocardial protection. Warm induction followed by cold infusion prevented any agglutination and eliminated the need for subsequent cardioplegia doses. Following the cross-clamp period, the heart returned to normal

sinus rhythm without need for defibrillation. Postoperative ejection fraction and systolic function were normal. **Keywords:** aortic valve replacement, cardiopulmonary bypass, CPB, inflammatory response, CPB pathophysiology, CPB complications, myocardial protection, Del Nido, cardioplegia, cold agglutinins. *J Extra Corpor Technol. 2018;50:187–8*

Cold agglutinins are serum autoantibodies activated during hypothermic conditions that react with antigens on the red blood cell surface to cause agglutination. This antibody reaction is rarely clinically significant in most operative scenarios; however, it does have important implications in cardiac surgery (1). The use of cardiopulmonary bypass in most cardiac surgical operations usually uses the practice of systemic cooling of the patient's circulation and profound hypothermic blood cardioplegia administration, both of which carry the risk of precipitating the agglutination reaction. Agglutination can cause microvascular thrombosis, hemolysis, and may compromise flow through the heart–lung machine. Patients can undergo screening for cold agglutinin reactivity during pre-admission testing. A positive reaction at 4°C requires further testing to determine the thermal amplitude, which is the temperature at which the antibodies are activated. The thermal amplitude will dictate the plan for anesthesia,

surgical technique, and the conduct of cardiopulmonary bypass throughout the case. Clinically significant cold agglutinin titers are said to be greater than 1:64 at 4°C. The patient's blood temperature must remain higher than the thermal amplitude to avoid agglutination, which presents a challenge in preparing a myocardial protection strategy (1,2). Typically, a hyperkalemic cardioplegia solution in a 4:1 blood to crystalloid ratio is administered at around 4°C every 15–20 minutes during the cross-clamp period. In the presence of cold agglutinins, hypothermic blood cardioplegia is not an option for these cases.

There are a few methods for myocardial protection in the patient with cold agglutinins. One option is to use a standard hypothermic crystalloid solution with no blood component to avoid intracoronary mixing of blood with hypothermic solution (3,5). Another option is to use continuous warm blood cardioplegia greater than the thermal amplitude to avoid activating the antibodies (4). Both come with disadvantages, most notably the need for redosing the cardioplegia.

Del Nido cardioplegia solution has been our preferred agent for myocardial protection. Del Nido consists of a hyperkalemic, hypocalcemic Plegisol solution with lidocaine and magnesium additives (Plegisol; Abbott Laboratories, Chicago, IL) (Table 1). This solution limits the intracellular buildup of calcium leading to a prolonged electromechanical arrest. Redosing of cardioplegia is not

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Table 1. Comparing our “Del Nido” solution to our standard 4:1 blood plegia mixture.

Ingredients	Del Nido	4:1 Blood Plegisol
Solution	Plasmalyte-A 1,000 mL	Plegisol 1,000 mL
Potassium	26 mEq	76 mEq (Hi)/36 mEq (low)
Bicarbonate	13 mEq	20 mEq
Lidocaine	130 mg (not given at XC removal)	None (200 mg given at XC removal)
Magnesium	4 g	4 g
Mannitol 20%	16 cc	None

typically needed until after 60–90 minutes of aortic cross-clamping (6,7).

CASE REPORT

A 77-year-old female with symptomatic aortic stenosis was referred for aortic valve replacement. She was noted to have an ejection fraction of 65% and normal coronary arteries. She had previously been noted to have cold agglutinin antibodies. Further testing revealed titers of 1:128 at 4°C with a thermal amplitude of 30°C. Given this, we chose to use asanguinous, Del Nido cardioplegia while systemically drifting no lower than 35°C. Initially, a warm induction dose was given to wash out any intracoronary blood and then switched to cold to gain the benefits of hypothermia. This strategy obviated the need for cardioplegia redosing and eliminated the risk of hemoagglutination.

Minimally invasive aortic valve replacement was performed via a right anterior thoracotomy. Following systemic heparinization, central cannulation was performed. Routine cardiopulmonary bypass was established and the patient maintained at a temperature greater than 35°C. The aortic cross-clamp was then applied and a warm antegrade infusion of asanguinous Del Nido cardioplegia was administered at 36°C flowing approximately 400 mL/min. Electromechanical arrest was witnessed directly by ECG after 200 mL of cardioplegia was infused, at which time, we lowered the temperature of the infusate to 4°C. The venous cannula was observed for agglutination while switching to cold cardioplegia. Agglutination did not occur. One liter of Del Nido cardioplegia was administered.

The procedure was uneventful and the aortic cross-clamp was removed after 52 minutes. Normal sinus rhythm returned within two minutes without the need for defibrillation. Successful valve replacement and preserved cardiac function were confirmed by transesophageal echocardiogram (TEE) and separation from cardiopulmonary bypass proceeded without

difficulty. Postprocedure TEE demonstrated a preserved ejection fraction of 65% and there was no need for inotropes or vasopressors in the immediate postoperative setting.

DISCUSSION

The use of asanguinous Del Nido cardioplegia being used in cardiac surgery for a patient with cold agglutinins has not previously been described. The technique described, enabled us to provide the heart with the benefits of hypothermic cardioplegic arrest. By using the Del Nido solution, we eliminated the need to give additional cardioplegia doses and had the added benefit of diminishing the amount of hemodilution caused by straight intermittent crystalloid administration. The technique of beginning with a warm induction of cardioplegia eliminated the risk of agglutination.

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