[NM-278] Acute left ventricular dysfunction following protamine reversal of heparin after the arterial switch operation

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This is a case of an unusual manifestation of a protamine reaction. A 4 -day old, 3.3 kg term female with d-Transposition of the Great Arteries/ intact ventricular septum, status post balloon atrial septostomy (BAS) presented for arterial switch operation (ASO). Echocardiogram (echo) post BAS showed a 6 x 7 mm intra-atrial communication with left to right flow, patent ductus arteriosus, typical coronary artery distribution, and good biventricular function.

After placement of standard American Society of Anesthesiologists monitors as well as a right radial arterial line and near infrared spectroscopy, the patient was uneventfully induced and intubated. Anesthesia was maintained with fentanyl, midazolam and isoflurane. Cardiopulmonary bypass (CPB) was initiated and ASO, consisting of the reconstruction of the neoaorta, coronary transfer, the creation of the neo-pulmonary artery (PA) with the Lecompte maneuver, and closure of the atrial septal defect, was performed. Right and left atrial lines were surgically inserted, followed by uneventful separation from CPB, with the patient in normal sinus rhythm at 120s-130s, BP 80s/60s, on dopamine 10 mcg/kg/min, no signs of ischemia on electrocardiogram, left and right atrial pressures (LAP and RAP) of 6-9 mmHg, SpO2 99% on FiO2 100%, and satisfactory anatomical repair with good biventricular function on epicardial echo.
Protamine administration was initiated, with almost immediate bulging of the reconstructed PA, dramatic deterioration in ventricular contraction, acute rise in LAP (peak 45 mmHg), purple discoloration of the lungs and difficulty ventilating. The patient was immediately reheparinized, CPB was resumed, and endotracheal tube was suctioned for copious amounts of blood. Surgical inspection of coronary anastomoses revealed no obstruction. Echo showed anterograde flow through both reimplanted coronary arteries, markedly depressed left ventricular (LV) function and new, significant mitral regurgitation, with only mild right ventricular dysfunction. After a further 90 mins of CPB to allow for recovery of function, she was successfully weaned, paced up to HR 160/min, BP 60s/40s, peak LAP of 11 mmHg, on dopamine 10 mcg/kg/min plus epinephrine 0.15 mcg/kg/min. Repeat echo demonstrated good biventricular function, no MR, no regional wall motion abnormalities and good flow in both coronaries. Total CPB, aortic cross-clamp and circulatory arrest time were 238, 93 and 11 minutes, respectively. The decision was made not to reverse heparin with protamine. Platelets and cryoprecipitate were given to achieve hemostasis.
In the ASO, the Lecompte maneuver results in the reimplanted coronary arteries being positioned behind the reconstructed main PA (See figure). Protamine can cause catastrophic pulmonary vasoconstriction and acute PA distension, which can compress these coronaries, leading to ischemia, increased LAP and pulmonary artery pressure, further worsening coronary compression; manifesting as LV dysfunction.

References

1. Park KW: Protamine and protamine reactions. International Anesthesiology Clinics 42: 135-45, 2004

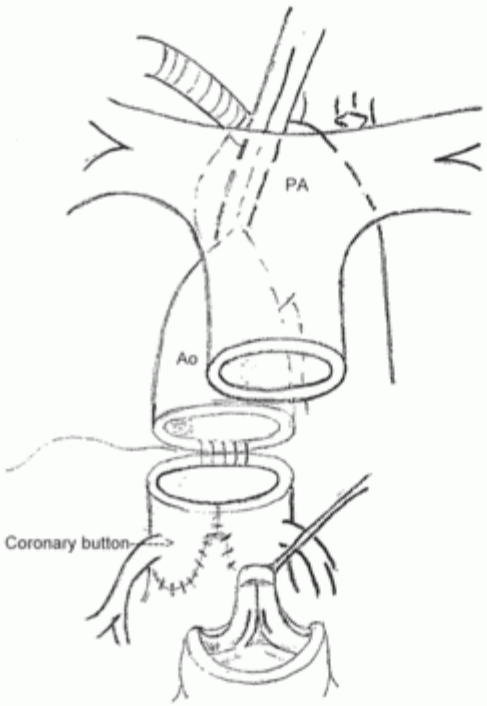

Figure: Schematic drawing of the Arterial Switch Operation showing the LeCompte Maneuver with the translocation of aortic and pulmonary arteries. Note sites of coronary artery button removal and subsequent reimplantation into neo-aortic root. PA: pulmonary artery Ao: aorta