

**Case Report**

***Cardiopulmonary Bypass on a 1.0 Kilogram Infant for Removal of a Trans-Atrial Mycetoma***

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**ABSTRACT**

A premature, 1.0 kilogram infant developed an umbilical venous catheter thrombus which extended through the patent foramen ovale and into the left side of the heart. After consultation with the physicians, the perfusion team was asked to adapt the bypass pump as needed to perfuse the tiny baby. The preparation also included evaluation of a 14 and 16 gauge angiocatheter to be used in the event that the standard 8 Fr. cannula was not sufficient. The mycetoma was excised during circulation arrest. The hematocrit of 20% during bypass was increased to 29% during rewarming of the patient via hemoconcentration. The patient was hemodynamically stable post-operatively and was transferred back to the referring hospital several days later. The patient died six weeks later of sepsis.

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## INTRODUCTION

This case report describes a unique situation in which a 1.0 kilogram infant was placed on cardiopulmonary bypass (CPB) because of an unusual anomaly. A premature infant developed an umbilical venous catheter thrombus which became dislodged. Cardiac echocardiogram revealed that the thrombus lay in both atria across a patent foramen ovale. This patient was transferred to our institution from a military hospital and was in acute distress. Because the infant was rapidly deteriorating, it was decided that emergent surgical removal of the thrombus utilizing CPB with circulatory arrest was the patient's only chance of survival.

To date, this type of case has not been reported in literature.

## CASE REPORT

A baby boy was born at 26 weeks gestation and weighed 797 grams. The birth occurred in a U.S. military hospital in Germany and the patient was eventually transferred to the U.S. for more intensive medical care. The patient was intubated at birth and placed on a mechanical ventilator. He was given surfactant and steroids for lung maturation. He also received an umbilical venous catheter for blood sampling and drug administration.

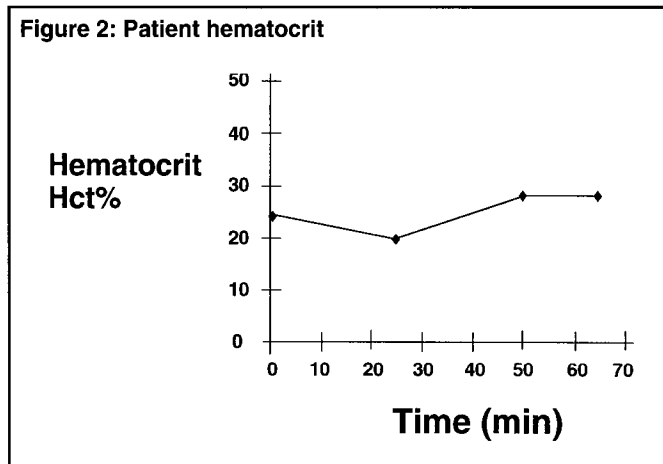
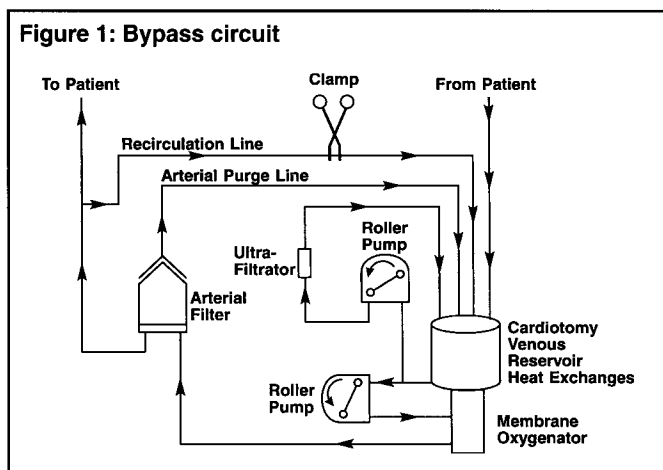
This patient was diagnosed with a patent ductus arteriosus (PDA) and was treated with three courses of indomethacin. Closure of the PDA was confirmed by echocardiogram.

On the 35th day of life, the patient was reintubated secondary to apnea and poor perfusion, which was thought to be related to sepsis. Blood cultures were positive for candida albicans and the patient was started on amphotericin B. A repeat echocardiogram was done to rule out a thrombus. The echocardiogram revealed an enlarging mycetoma extending from the inferior vena cava and hepatic veins up through the right atrium, across the patent foramen ovale and through the left atrium, extending down to the mitral valve. It was considered too large and too mobile to be treated medically.

The surgical risk was considered significant because of the child's small size. However, after consultation among the physicians, it was decided to excise the thrombus while under hypothermia and circulatory arrest. The cardiothoracic surgeons also consulted with the perfusion team because, after reviewing the echocardiogram, the aorta was suspected to be too small for an 8 Fr. cannula, which is the smallest cannula kept in stock.

## MATERIALS AND METHODS

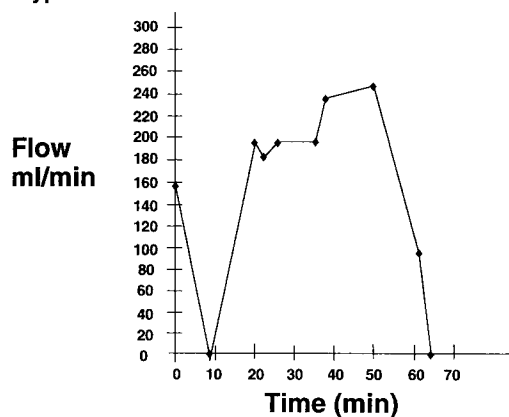
The bypass circuit consisted of a Cobe VPCML membrane oxygenator and hardshell reservoir<sup>a</sup>; Gish custom tubing pack (1/4" lines throughout)<sup>b</sup>; a Quest Medical K-37 pediatric arterial line filter<sup>c</sup>; and an Amicon minifilter plus hemoconcentrator<sup>c</sup>. A roller pump was used as the arterial pump with 1/4" line in the raceway



(Figure 1). The length of the lines was reduced as much as possible by moving the pump closer to the table while allowing sufficient length for emergency change out. This permitted a circuit line reduction of approximately 12 inches on both the arterial and venous sides, which decreased the priming volume by about 20 ml. The oxygenator was raised up on the pump mast about 3 or 4 inches, which reduced the priming volume another 10 ml. The circuit was primed with heparinized (300 mg/kg) Normosol-R and debubbled.

The pre-bypass hematocrit was only 24%. After estimating that hemodilution would reduce the hematocrit to around 3%, approximately 100-125 ml of packed red blood cells (PRBCs) was added to the system. Approximately 70 ml of crystalloid was removed at the time that the blood was added to further decrease hemodilution. Despite the fact that we were trying to reduce the priming volume, we decided to leave the arterial line filter in the circuit because it is standard operating procedure in our institu-

- a Cobe Cardiovascular, Inc., Aurora, CO 80004-3599
- b GISH Biomedical, Inc., Santa Ana, CA 92705
- c Quest Medical, Allen, TX 75002
- d Amicon, Beverly, MA 01915-1065

**Figure 3: Bypass flows**

atrial septum. After 11 minutes of circulatory arrest, CPB was reinstated. Rewarming was initiated using a 10°C temperature gradient. The blood was hemoconcentrated. The hematocrit had been diluted to 20% for circulatory arrest (2) (Figure 2). We were able to remove 110 ml of fluid, which raised the hematocrit to 29% (3). When the patient reached 37°C, bypass was terminated. The cannulas were removed and the sites secured. When the patient was hemodynamically stable, the chest was closed and the patient was transferred to the Pediatric Intensive Care Unit. On post operative day 14, the patient was transferred back to the U.S. military hospital in fair condition. Approximately six weeks after surgery, the patient died of septic complications.

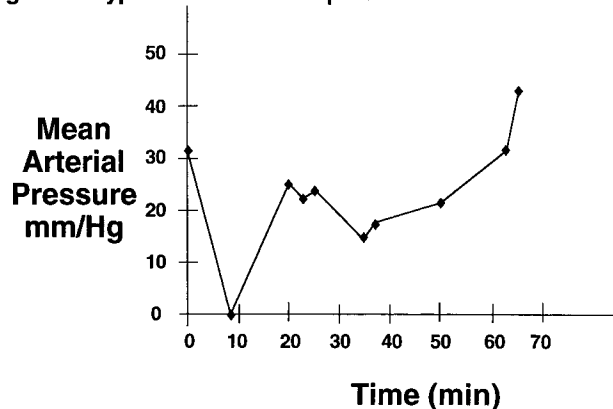
## DISCUSSION

In preparation for this case, there was a concern that the aorta would be too small for a standard pediatric cannula. The evening before the day of surgery, the surgeon asked if we could perfuse through an angiocatheter. After further consultation with him, we began testing a 14 gauge and a 16 gauge angiocatheter to be used as alternatives. After water testing these catheters for flow and pressure gradients, we presented our findings. The surgeon determined that the 16 gauge catheter, particularly due to its external diameter, would be sufficient for the requirements of this baby. However, on the day of surgery, the 8 Fr. cannula was used (Figures 3 & 4).

Ideally, an infant that is placed on bypass should be of sufficient size to tolerate cannulation and the circuit small enough to avoid excessive hemodilution. However, in cardiac surgery, one must often deal with less than ideal circumstances and little preparation time in order to save a patient's life. This 1.0 kg infant is the smallest child we have ever attempted to place on bypass. Fortunately, we learned that by using only what we had in stock at the moment, and by following basic methods of prime reduction (i.e. raising the oxygenator, shortening the lines), and utilizing a hemoconcentrator, we could successfully conduct perfusion on a 1.0 kilogram infant.

## REFERENCES

1. Kurusz M, Buter BD. Embolic Events and Cardiopulmonary Bypass. In: Gravlee, GP, Davis RF, Utley JR. *Cardiopulmonary Bypass: Principles and Practice*. Baltimore: Williams & Wilkins; 1993: 279-280.
2. Lake CL, Schwartz AJ, Campbell FW. Extracorporeal Circulation. In Lake CL. *Pediatric Cardiac Anesthesia*. Norwalk: Appleton & Lange. 1988: 168.
3. Han YQ, Zhu DM, Su ZK, Ding WX. Ultrafiltration in pediatric cardiac surgical procedures. *J Extra-Corpor Technol*. 1992; 23:63-65.

**Figure 4: Bypass mean arterial pressures**

tion (1). Total circuit prime was 550 ml. Ten mEq of sodium bicarbonate was then added to the prime to buffer the PRBCs and a sample of the pump prime was sent to the laboratory for pH measurement.

The A-V circuit was handed to the surgeon using sterile technique. The lines were clamped and cut, and the priming volume in the lines was returned to the cardiotomy.

## SURGICAL PROCEDURE

The patient was induced and intubated. The skin was prepped and draped. A longitudinal mid-sternal incision was made and the chest retracted. The patient was heparinized and cannulated using an 8 Fr. arterial cannula in the mid-ascending aorta (this site had the largest diameter) and a 14 Fr. venous cannula in the right atrial appendage.

Bypass was initiated and after 9 minutes of cooling, the rectal temperature registered 22°C, and the pump was turned off. The aorta was cross clamped and 10 ml of cardioplegia was given. After the patient was exsanguinated, the venous cannula was removed.

The mycetoma was located and excised with a portion of