
CASE REPORT

Use of the Cell Saver as a Rapid Infusion Device

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Abstract

A Bio-Medicus pump with a model BP 80, flow probe, model DP 38, and Gott TDMAC Shunt tubing, primed with Plasma Lyte A, pH 7.4, was used during a repair of a descending aortic aneurysm. The Haemonetic Cell Saver Plus with 1/4" tubing, List #243, and Gish Cardiotomy ATR-2900F was used to process shed blood.

The patient was heparinized with 31,000 units of beef lung heparin (400 units/Kg) to maintain the activated clotting time above 480 seconds. The aneurysm was opened. Collateral bleeding caused the patient to bleed out excessively into the cell saver, rendering the Bio-Pump ineffective due to severe hypovolemia. As the bleeding was controlled, the cell saver was connected to the Gott TDMAC shunt tubing with a 1/4" X 3/8" connector to autotransfuse shed blood from the cardiotomy back to the patient, bypassing the cell saver centrifuge.

The aortic cross clamp time was 22 minutes. The patient suffered no complications and at the 12 month follow up, she continues to do well. In summary, we feel that the surgical team should be equipped to provide ancillary support as the situation requires.

Introduction

Various methods are available to aid in the repair of descending thoracic aortic aneurysms. These assorted modalities include 1) The use of the heart-lung machine for partial cardiopulmonary bypass, 2) Inserting Gott TDMAC shunts above and below the aneurysm site to provide perfusion distal to the clamp, 3) Attaching a centrifugal pump to the Gott shunts to actively regulate distal perfusion, and 4) Cross clamping the aorta with pharmacological control of proximal hypertension.

On May 19, 1988, a patient presented to the operating room for surgical repair of a descending thoracic aortic aneurysm. A Bio-Medicus Pump^a with Gott TDMAC shunts^b were used in an attempt to control the proximal pressures, as well as to provide distal perfusion. Collateral blood loss prevented such use, and the cell saver was adapted such that shed blood was directly

transfused into the descending aorta proximal to the clamp, acting as a rapid infusion device. It was concluded that not one particular method available may provide adequate support in all cases, and that the surgical team must be prepared to modify their game plan as needed.

Methods and Materials

The circuit consisted of a Bio-Medicus Cone model BP 80, with two (2) Gott TDMAC Shunts (9.0 mm) connected together with a 3/8" connector going to the inlet of the cone, while the outlet of the cone comprised of two (2) Gott TDMAC shunts connected together with a disposable flow probe, model DP 38. The cell saving circuit consisted of 30,000 units of beef lung heparin added to 1,000 cc of Plasma Lyte A, pH 7.4. A Gish Cardiotomy ATR-2900F was used to collect shed blood, while the circuit on the Haemonetic Cell Saver Plus^c consisted of 1/4" tubing, List # 243.

Priming the Bio-Medicus circuit was performed on a sterile table. The inlet tubing was submerged in a basin filled with Plasma Lyte A, pH 7.4, while gentle vacuum was applied to the outlet tubing, allowing the fluid to displace the air within the circuit. After the gross air was removed, the shunts were clamped, and the cone was passed off the sterile field and mounted on the Bio-Pump. The fluid within the Bio-Pump circuit was then recirculated to remove any remaining air while the shunts remained submerged in the basin. The cell saver was set up with the tubing placed within their respective color coding clamps (see Figure 1), and the cardiotomy primed with 200 cc of heparinized Plasma-Lyte.

Case Report

The patient, a forty-year-old non-hypertensive, nondiabetic, black female developed pain in the region of the left neck, left shoulder, left breast, and between the shoulder blades. She was admitted in the Emergency Department and given narcotics with some improvement. A CT Scan was done with findings suggestive of a descending thoracic aortic aneurysm.

The patient was scheduled for elective repair of the aortic

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a Bio-Medicus, Eden Prairie, MN
b Argyle, St. Louis, MO
c Haemonetic Corporation, Braintree, MA

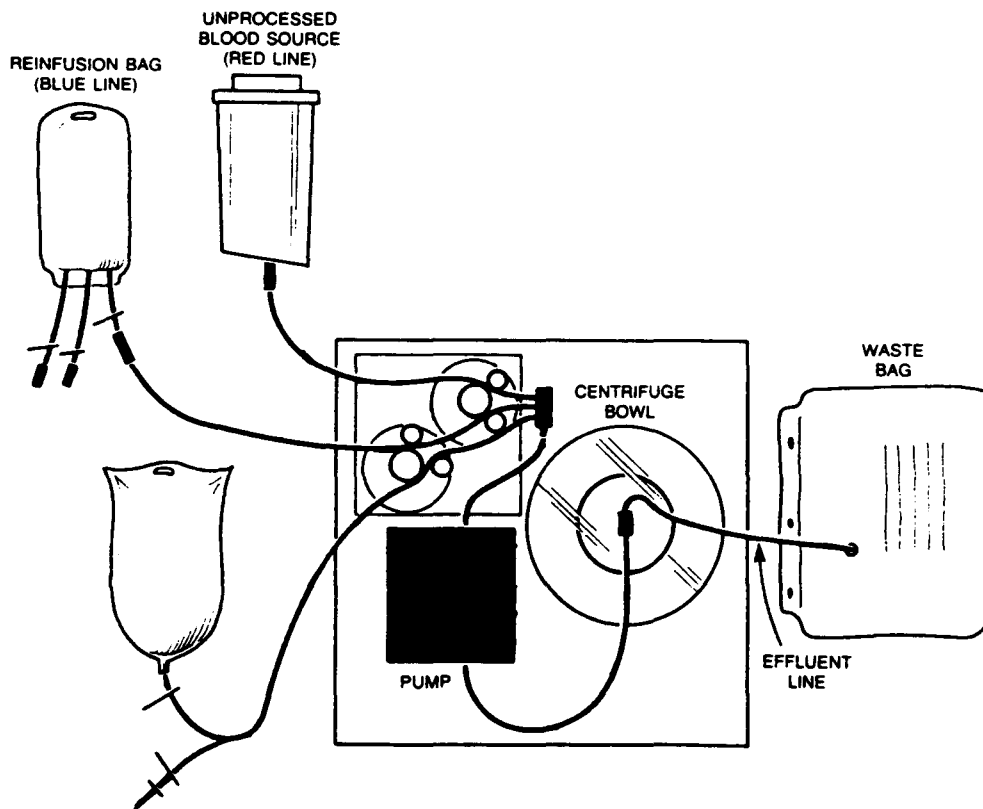


Figure 1 - Haemonetic Cell Saver Plus Circuit

aneurysm for the following day. Upon arrival to the operating suite, electrocardiographic monitoring leads were positioned to monitor cardiac activity, the left radial artery was cannulated for systemic arterial blood pressure monitoring, and a pulmonary artery catheter was inserted to monitor pulmonary artery pressures. Following general endotracheal anesthesia, a foley catheter was inserted to measure urine output and bladder temperature, and esophageal temperature probe was also inserted.

The patient was prepped and draped, the left femoral artery was isolated, and the left thoracotomy was made through the 7th intercostal space. The patient was heparinized with 31,000 units of beef-lung heparin (400 units/Kg). The descending aorta was cannulated with the Gott Shunt leading to the inlet of the Bio-Cone just proximal to the aneurysm. The left femoral artery was cannulated with the Gott Shunt for blood return from the Bio-Cone back into the patient.

Once all the air was removed from the cannulation sites, and the activated clotting time (ACT) was in excess of 300 seconds as measured with by the Hemochron 400^d, partial bypass was initiated. Maximum flow rate achieved was 4.0 liters/minute. Normothermia was maintained with the use of the Blanketrol^e warming blanket during bypass. Clamps were placed above and below the aneurysm, and the aneurysm was then opened. Severe bleeding from collaterals within the aneurysm resulted in severe hypovolemia preventing adequate blood flow into the Bio-

Cone, requiring partial bypass to be abandoned while an attempt to control the collaterals were being made. During this time, blood loss was excessive into the cell saver, resulting in hemodynamic instability.

In order to transfuse the shed blood in a timely manner back into the patient, four steps were employed. Step 1) The bypass was discontinued and clamps were placed on the Gott Shunt tubing as close to the inlet and outlet segments of the Bio-Cone as possible. Step 2) The Gott Shunt cannula that was in the descending aorta was disconnected at the point where it connected onto the inlet of the Bio-Cone. Step 3) The cell saver tubing segment that leads from the cardiotomy through the roller pump, and onto the centrifugal bowl was removed from the inlet connection of the bowl. Step 4) The Gott Shunt cannula positioned proximal to the aneurysm (from step 2) was connected to the cell saver tubing (from step 3) with a 1/4" x 3/8" connector (see Figure 2). All air was removed at the connection site by turning the cell saver roller pump to the on position as the connection was being made. At this point, all shed blood from the cell saver cardiotomy was transfused directly into the descending aorta, proximal to the clamp. Maximum flow rate achieved was 1000 cc/minute.

Once the collaterals were under control, and all shed blood had been returned to the patient, the operation continued with the placement of an intraluminal graft. Total cross clamp time was 22 minutes. The patient suffered no complications, and at the 12 month check up, the patient continues to do well.

^d International Technidyne Corp, Edison, NJ
^e Cincinnati Sub-Zero Prod, INC, Cincinnati, OH

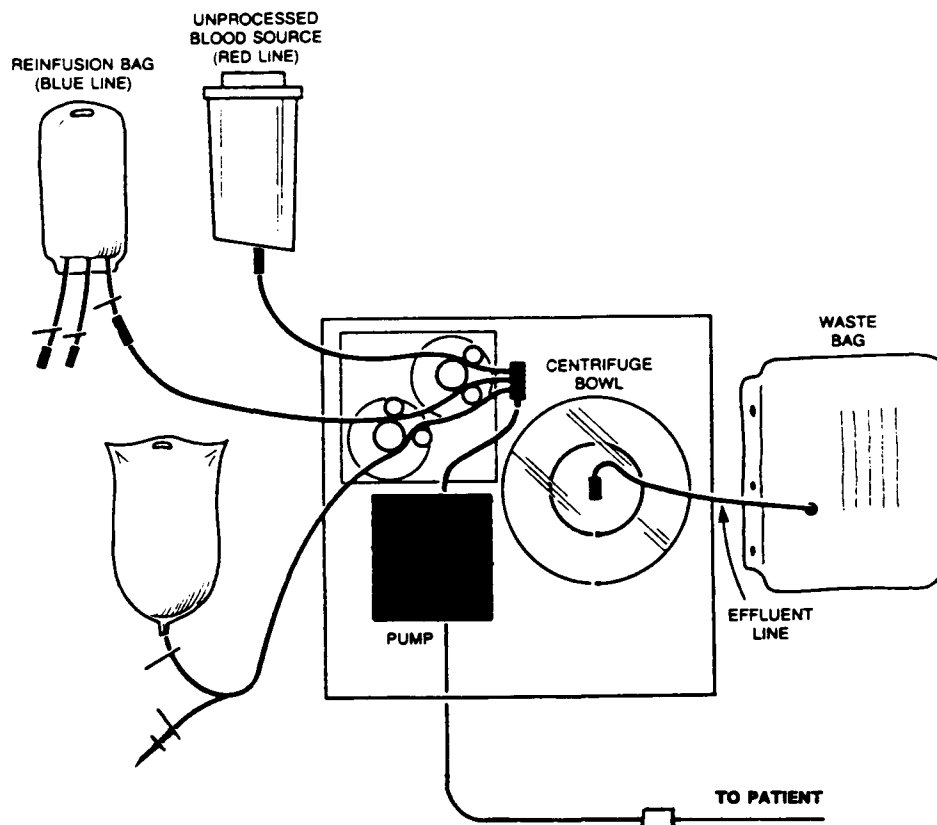


Figure 2 - Haemonetic Cell Saver Plus Modification: Rapid Infusion Device

Discussion

Several methods are available to the surgeon for repair of a descending thoracic aortic aneurysm. The debate over which technique reduces the risk of paraplegia seems to be a never ending dilemma.

Excellent results in avoiding spinal cord injuries with the use of Gott Shunts or bypass have been reported.^{3, 4, 9} DeBakey reported with a greater population of patients, the incidence of paraparesis did not vary significantly between the bypass/shunt technique, and simple cross clamping. However, the operative mortality did drop significantly when bypass techniques were abandoned.⁶ Crawford also reported good results with simple cross clamping with no mechanical adjuncts.⁵

The effects of cross clamping the aorta without a shunt or bypass can have profound hemodynamic effects. The systemic and pulmonary pressures increases, while the cardiac index decreases.⁸ This may be why of all the causes of mortality, cardiac related deaths remains high upon the list.^{1, 5}

Crawford reported that bypass methods were not always available or adequate, and that somatosensory evoked potential (SEP) did not provide 100% reliability.⁷ Despite this, in this institution, partial bypass is frequently employed with the aid of the heart-lung machine and systemic heparinization for repair of descending aortic aneurysms. Advantages and disadvantages of this technique have been listed elsewhere.²

For this case, however, we elected to use the Bio-Medicus pump. The patient was heparinized per our normal protocol (400 units/Kg). Bleeding from the collaterals was so extensive that a major portion of the patient's blood volume went directly

into the cell saver. This made the Bio-Medicus pump ineffective due to severe hypovolemia. By adapting the cell saver into a modified rapid infusion device, we were able to return all shed blood back into the Gott TDMAC Shunt line placed in the descending aorta, proximal to the clamp. This allowed us to regain control of the patients mean arterial pressure proximal to the cross clamp.

While this technique is not an ideal method of providing partial bypass, it proved to be beneficial in this situation. Some disadvantages of this modified system may include the following: 1) No arterial line filter, however, in this institution, a 25 micron filtered cardiotomy is routinely incorporated for all cell savers 2) No low level or bubble detector and 3) No system to monitor the line pressure distal to the roller pump.

Had the patient not been systemically heparinized, we feel that the blood would have most likely began to gel within the cell saver cardiotomy, and the outcome may not have been quite as promising.

There are several options that the surgeon may choose from for treating a descending aortic aneurysm. Each method has, available at times, been able to provide various institutions with good results. However, as of yet, no optimal treatment has been described.

In conclusion, because of the experience that we had with this case, we feel that not all methods will provide excellent results in all cases, and that the surgical team should be prepared to adjust to the situation to provide ancillary support for the patient as needed.

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